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ORIGINAL CONTRIBUTION

Role of a Teacher as a Manager & more than

Subtheme - Management based fields

*Bhabesh Pramanik and Niranjan Maity

Institute of Education, Haldia, Purba Medinipur, WB, India

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ABSTRACT

Teachers are responsible for maintaining a positive learning environment in the classroom. Teachers at all levels are also managers; they are expected to manage the most difficult and arguably the most demanding of professions – teaching. The styles of managing learning situations largely determine the effectiveness of teachers as managers. It is the teacher who plays the main role in planning, organizing procedures and resources, arranging the environment to maximize efficiency, monitoring students' progress, anticipating potential problems etc. This study investigates the competencies of secondary school teachers in classroom management and finds strength and weaknesses and the role of a teacher in this modern era.

KEY NOTES: positive learning environment, student interaction, styles of managing learning situations, more realistic approach, competencies of secondary school teachers

1. INTRODUCTION

Teachers are responsible for maintaining a positive learning environment in the classroom. Managing a classroom is not an easy task. A classroom that is out of control yields lower achievement for students and high burnout rates for teachers. Teachers must implement structure, develop positive student interaction and take immediate action when problems arise. Maintaining control from the beginning provides a foundation for effective classroom management.

Teachers are responsible for maintaining a positive learning environment in the classroom. A classroom that is out of control yields lower achievement for students and high burnout rates for teachers. Teachers must implement structure, develop positive student interaction and take immediate action when problems arise. Maintaining control from the beginning provides a foundation for effective classroom management. Teachers at all levels are also managers, they are expected to manage the most difficult and arguably the most demanding of professions – teaching. The styles of managing learning situations largely determine the effectiveness of teachers as managers.

Argues that the recently established teaching and learning development units in universities should adopt a more realistic approach towards promoting high teaching standards, since teaching constitutes only one aspect of the teachers′, lecturers′ and trainers′ daily activities as they go about managing learning situations and all that they entail. Draws parallels from the nature of managerial work and explores their implications for effective management of learning situation. Proper classroom management and discipline ensure the success of learning process. It is the teacher who plays the main role in planning, organizing procedures and resources, arranging the environment to maximize efficiency, monitoring students' progress, anticipating potential problems etc. In order to maintain the effective management in the classroom, teacher has to be

*Corresponding Address: bp.anish2012@gmail.com

precise and clear in directions to the students, as well he communicates well.

Teacher and Manager-

The purpose of this study is to compare the hues tasks of a teacher with a manager. Modern educationists compare the role of a teacher with the manager of any organization. Even they quote that, "Teacher is a manager." So, it is the perfect time to analyze the role of a teacher as a manager-

1. Self-Directed Manager-This paper presents a model dealing with the teacher as a manager of self-directed and interactive learning programs and discusses the value of this model for educators working within continuing and professional education contexts. It provides a framework for the planning, implementation and evaluation of learning programs which promote self-directed and interactive learning and comprises an outline of phases of learning programs and the roles of teachers (and learners) in these programs.

2. Manager of a Class--Proper classroom management and discipline ensure the success of learning process. Classroom management is the linchpin that makes teaching and learning achievable in the teaching learning process. It is the teacher who plays the main role in planning, organizing procedures and resources, arranging the environment to maximize efficiency, monitoring students' progress, anticipating potential problems. In order to maintain the effective management in the classroom, teacher has to be precise and clear in directions to the students, as well he communicates well.

3. Manager of Wisdom--Every good manager must also be a teacher—in both senses of the term. A teacher is someone who has expertise and knowledge, and a teacher is someone who knows how to instruct others. A manager must be good at her/his job, act professional, and possess technical competence. Formal authority must be preceded and accompanied by expertise.

4. Manager of Inspiration--Of course, "inspiration" is often dramatized in those cheesy teacher movies that are all the rage on channels like Lifetime, and that sort of melodramatic inspiration is not what s/he is talking. Inspiration, for both teachers and managers basically boils down to becoming a motivator. They are inspirational when they can inspire her/his workers to really and truly want to work hard and excel at their jobs.

5. Manager of Abilities--Although "schooling" may stop after one finishes their university education, learning never stops. In fact, learning basically anything new is one of the most basic sources of human happiness. Our brains essentially crave learning in any capacity. While most jobs can be pretty tedious, good managers will encourage their workers to continue learning in whatever way they can. Good managers will present their employees with new challenges that stretch their learning abilities.

6. Manager of Goals — It seems that micro-managing has no place in effective management. Good managers understand that there are millions of ways to complete any given task. If an employee feels comfortable doing certain things her /his way, and the result is the same as if s/he had done it one's way, then his/her ability to do things on his/her own should be applauded and not punished. If one can teach an employee to think on her/his own, then half your work is done.

7. Manager of Challenges-- Of course, teachers and managers do each have a whole set of unique challenges. But the comparison can be a constructive one. It helped all to understand that managing can be just as difficult—and just as rewarding—as teaching. Good luck!

8. Manager of Diverse Audience-Teachers have to be able to explain complex topics to diverse audiences, as no two students come to the classroom with exactly the same skills and experience. Managers have a similar responsibility. No two employees are exactly alike -- they often come to the job with different levels of experience, different ways of interacting with clients and customers, and a variety of professional development needs. Learning to read what employees need is not

much different from learning to read students. One have to be cognizant of social cues, looks of confusion or comprehension, and s/he has to be able to ask the right questions in order to determine what has been mastered, what requires more explanation, and what opportunities exist for them to learn on their own.

9. Manager of Mentorship-It's critical that teachers -- and managers -- learn to be mentors. The school doesn't have "academic advisors." They have "mentors," who specialize not just in what a person should study, but why they should study it. There's more to managing than simply saying, "Do this." The people who work for you want to understand why. That is how they grow, both professionally and personally, and in turn that is how you grow as a leader.

10. Manager of Tolerance --Both teachers and managers have to play the role of epitome of tolerance. Teachers get feedback from students (say, on course evaluations) that her/his teaching style needs work. It's tempting to brush this off, especially when there are other evaluations that say s/he doing fine. But the opportunity exists to absorb that information for real growth. A manager has to understand that s/he will not please everyone, but s/he should still strive to do so. Take criticism as a fact of life. And further, take it as a sign that there is always something more that s/he can learn. Continually improve. Grow. Expand your mind, your world, and your perceptions.

11. Manager of Seeking Good--"Good management," like "good teaching," can sound like catchphrases. But at the end of the day, both are collections of practices and processes that shape how humans interact and make progress. Staker's playbook breaks these practices and processes down. It offers actionable moves for any teacher looking to embolden his students to new heights.

12. Manager of an Organization-The teacher in a shared space of responsibility within an educational community and relationship with other social agents. The levels of responsibility of the teaching staff within the Organization of a Center, can locate it, in different organs or four structures: Organ of teacher preparation Organs of management Coordinating bodies Study and advisory bodies. Any manager also has to do the same.

13. Manager with Big Eyes - But two major institutions buck this trend: our schools and our bank. In both, newly minted young professionals are asked to take on management roles from the very start. And surpassing even the number of direct reports young bank officers oversee, teachers must manage upwards of 30 people the moment they set foot in school: their students.

14. Manager off our Realms-Both teacher and managers have to manage four realms of management: materials, events, time and people. These are grouped in order of management difficulty from easiest to most difficult. Regardless of grade level, teachers are faced with management tasks. How well the teacher deals with these tasks often determines how effective the teacher will be.

15. Manager of Leading Indicator-In many ways, this was a task in translation: students are not employees, and how schools define success and productivity can vary widely from corporations' goals. But teaching and management share the same task of shepherding diverse groups of humans to improve and succeed along leading indicators, like satisfaction and engagement, and lagging indicators, like productivity and academic outcomes. In the end, taken together, the pilots revealed seven discrete classroom moves that can help teachers leverage effective management to inspire and support their students.

Principles	Moves for teachers to create happier, higher performing classrooms
Empower the team and do not micromanage	**1. Teach mindsets.** Develop the mindsets of agency, creativity, growth mindset, and passion for learning. **2. Release control.** Provide content and resources that students are free to access without your direct instruction. This control gives them ownership, develops their agency, and frees up your time. **3. Encourage teaming.** Foster peer-to-peer learning and dynamic, team-based collaboration.
Be a good coach	**4. Give feedback.** Create a culture of feedback so that students receive personal, frequent, and actionable feedback in the moment, in small groups, and in one-on-ones. **5. Build relationships of trust.** Show interest and concern in students as individuals and trust in their ability to drive their own learning, given the right structures are in place.
Emphasize accountability	**6. Help students hold themselves accountable.** Give them tools to set goals, track their progress, and follow through. **7. Hold yourself accountable.** Use reflection time, peers, student surveys, and self-assessments to make sure that you are on track personally.

2. ACTIVITIES OF THE TEACHER/MANAGER

A manager is basically at the helm of any organization/institution. S/he has to take decisions, control the situation, be spontaneous and resourceful to change decisions for better functioning of the organization if situation so demands, etc. We all are familiar with managers of a company, of a school or a college, etc. Let us see how a teacher performs the role of a manager.

Teachers, like the executives in other organization, are expected to provide leadership to students and to coordinate a variety of activities as they and students work interdependently to accomplish academic and social goals of schooling. According to IGNOU material, the role of a teacher as a manager is concerned with all the three phases of teaching namely, pre-teaching, teaching and post-teaching. Now, it is the time to see teacher's role in different phases separately.

3.ROLE OF THE TEACHER IN THE PRE-TEACHING PHASE

Pre-teaching phase essentially comprises the activity of planning teaching-learning process. Planning is actually a simplification of a complex process. The following are the specific activities involved in the pre-teaching phase:

i) Analysing the content.

ii) Deciding on the portion of the content to be selected for instruction.

iii) Deciding on instructional objectives for the chosen content on the basis of the knowledge about:

a) level of students

b) their socio-cultural context

c) Time available.

iv) Studying different learning experiences that are suitable for achieving the set objectives.

v) Deciding on the best alternative from a repertoire of learning experiences and deciding the best sequencing of these, to bring about pre-specified learning.

vi) Deciding the method of evaluating learning, (a written test, oral test, a performance test etc.) and the specific item of evaluation (question in case of oral and written tests, aspects to be observed and assessed in case of performance test).

The teacher is not participating in the instructional process. S/he is an outsider and a decision maker, and a designer of the way. The process of instruction has to be organized. In all these situations, the teacher's role is strictly speaking that of manager and not of an input although management is an important input in effective implementation of following situations:

4. ROLE OF THE TEACHER IN THE TEACHING PHASE

Now we have to see how a teacher plays the role of a manager during the instructional/teaching-learning process. Examine the following situations:

i) Sensing that students are becoming bored,

a teacher decides to stop teaching.

ii) Realizing that a student has not understood a point fully, a teacher decides to simplify the explanation with more examples.

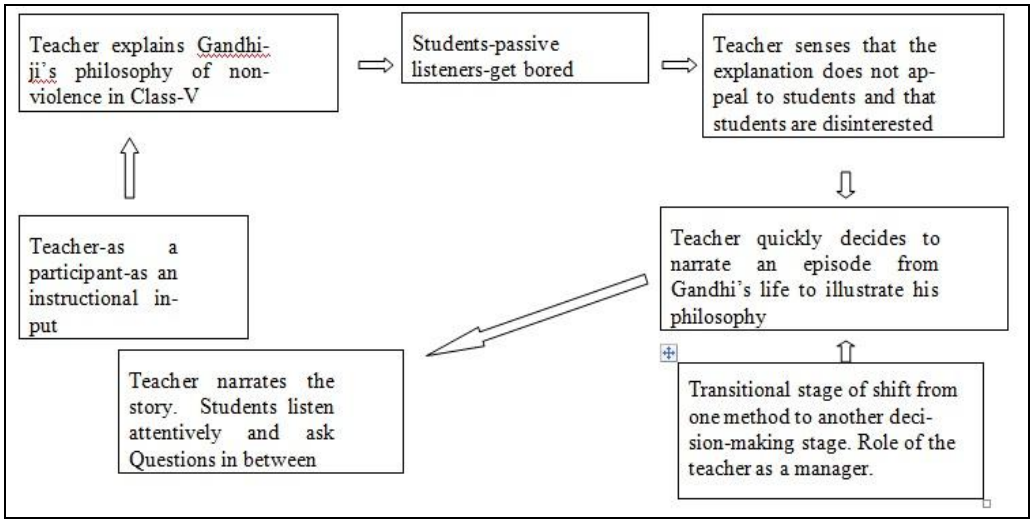
iii) In order to make a lesson more interesting, a teacher decides to narrate a related story.

iv) As students start making too much noise and could not be managed by a teacher,

S/he decides to let them go out and play.

iv) As the prepared plan does not prove effective to make students understand the point, a teacher decides to deviate from the plan and tries out another sequencing of learning experiences.

In all these situations, a teacher is part of the instructional system, but is not participating or is not an instructional input. S/he is, however, making quick decisions in between the process with the objective of being effective. In other words, in order to bring about meaningful learning, a teacher with her/his resourcefulness and spontaneity is deciding to change the mode of operation to suit to the needs of learners. In this situation, a teacher is functioning as a designer/manager/decision maker. In fact s/he is at a transitional stage or shifting from the role of a participant/as instructional input to a different mode as a decision maker. This shift can be shown as-



We all must be familiar with such comments that people make: "He can manage the class very well" or "students are well disciplined in his class". In such situations it is obvious that a teacher is effectively managing students with alternative solutions to problems as and when they emerge in the class. These alternative solutions depends on many factors like, age group of students, physical fitness of the group (if they are not interested in a class after a physically tiring PT period), general climate of the school (if annual day is approaching, or fun fair is due, and students are in a fun-making mode) etc. An effective teacher would succeed in maintaining discipline and managing students well without losing his/her cool and at the same time the confidence of students. A lot of knowledge of the psychology of child/adolescent is required by teacher for being an effective manager in such situations. A teacher has to be empathetic, tactful, patient and tolerant.

5. ROLE OF THE TEACHER IN THE POST-TEACHING PHASE

Post-teaching phase is the one that involves teacher's activities such as analysing evaluation results to determine students'

learning, especially their problems in understanding specific areas, to reflect on the teaching by self, and to decide on the necessary changes to be brought in the system in the next instructional period. Examine the following activities of a teacher:

i) Teacher analyses the written performance of students (of class HI) and realizes that 80% (Class III) have not been able to do single digit multiplication correctly.

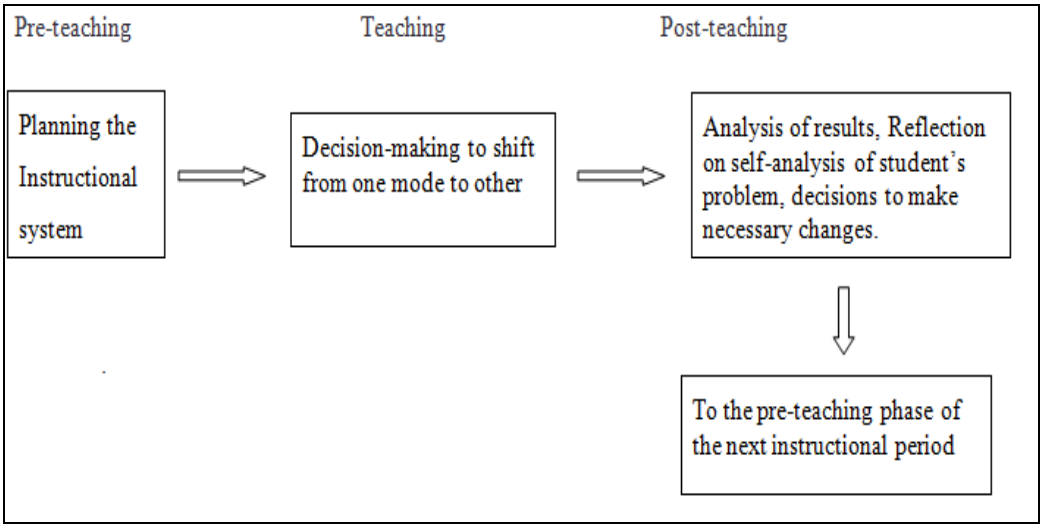
ii) Teacher goes through the plan of the lesson on multiplication and realizes that student's knowledge of addition was presumed, but not revised.

iii) Realizing that multiplication is based on thorough mastery of addition the teacher decides to start all over again with addition.

In these three situations, the teacher is a designer in the post-teaching phase-designer of the next instructional system.

We can summarize by saying that in the post-teaching phase, a teacher analyses results, reflects on self and modifies the teaching-learning process -all with purpose of being an effective as a teacher.

In order to see the roles of a teacher as a manager at different stages the flow diagram (Fig. 6.3) would help us:



6. CONCLUSION

To conclude, it is said that, there are other hundred activities of a teacher where the manager is not comparable. Teachers (especially teachers of younger students) come into the job with their authority already endowed. A teacher, after all, is an adult, and children must heed the instructions of adults, whether or not they like it. Of course, some managers do believe they come endowed automatically with authority. S/he is not managing children; s/he is managing her/his peers. An effective manager understands that their authority must be earned once their employees respect them. S/he earns respect by doing her/his job well and respecting and appreciating others' unique talents, abilities, and opinions. In this e-era a teacher is not only a teacher s/he is also the role of manager, instructor, facilitator, and supervisor.

References

[1] Bansal N. K.(2005) Bridging the Gaps between School Curriculum and Teacher Edu. Curriculum Quality concern in Teacher Education, the M.S. University of Baroda,PP 105-187

[2] Ranjan K. M.(1997): Teachers role in Three Operational Models New Frontiers in Education, Vol XXVII, No.1,Jan-March 1997,PP.63-68

[3] Curriculum Framework for Teacher Education, draft 2006, NCTE, New Delhi.

[4] Desai, Ashok. J(2012).Problems Of Teacher Education In India,IJRE, Vol.1, Issue: 1.

[5] Labaree, D.F. (1995), A Disabling Vision: Rhetoric and Reality in Tommorrow's Schools of Education, Teachers College Record, 97, PP. 166-205

[6] Mehrotra, R.N. (1979), Teacher Education: A Trend Report in Buch, M.B.(Ed), Second Survey of Research in Education, SERD, Baroda.

[7] IGNOU study material.ES-335.Teacher and School.Page-19-22.

[8] National Knowledge Commission Report, 2007 Government of India, New Delhi.

[9] https://www.thedailymba.com/2012/06/25/how-managing-is-like-teaching-and-how-its-not/

[10] https://www.linkedin.com/pulse/why-good-teachers-make-managers-rob-kadel

[11] http://www.naacindia.organ.col.org.;www.thejournal.com/magazine.;

[12] https://blogs.worldbank.org/education/six-s-quality-education

[13] HTTPS://WWW.BLENDEDLEARNING.ORG/TEACHERS_ARE_MANAGERS_SO_LETS_GIVE_THEM_THE_TOOLS_TO_MANAGE/

[14] HTTPS://EDUCATION.SEATTLEPI.COM/DUTIES_TEACHER_CLASSROOM_MANAGEMENT_4012.HTML

[15] HTTPS://WWW.HEALIO.COM/NURSING/JOURNALS/JNE/1981-5-20-5/%7B74219412

[16] https://www.tandfonline.com/doi/pdf/10.1080/0022062740060205

[17] https://www.emeraldinsight.com/doi/abs/10.1108/09513549510095077

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ORIGINAL CONTRIBUTION

Modeling and Simulation of Multi walled carbon nanotubes on the Mechanical Properties of HDPE-P5300 Epoxy Using Molecular Dynamics

*Sakshi Tyagi

Department of Mechanical Engineering, Haldia Institute of Technology, Haldia, West Bengal, India

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ABSTRACT

In this investigation, Molecular Dynamics (MD) is used for mechanical characterization of High Density Polyethylene grade P5300 epoxy nanocomposite reinforced with multi-walled carbon nanotubes (MWCNTs). Modeling of six different samples with MWCNT percentages of 0, 1.0, 2.0, 3.0, 4.0 and 5.0 has been done by using MD. This study investigates the effect of MWCNT wt. % on the tensile strength, flexural modulus, tensile, bulk and shear modulus of HDPE-P5300 epoxy nanocomposites. Considerable increment of 10.5% and 12.4% with respect to pristine has been observed for 5.0 wt.% sample in tensile and flexural modulus respectively. Artificial Neural Network and Fuzzy logic based non-linear regression models are also developed to predict the values of tensile and flexural modulus for epoxy nanocomposites. It has been observed that ANN modeling produced best results for 5.0 wt.% sample as compared to lower wt.% samples. This study will assist in the modeling, simulation and design of advanced nanotube reinforced epoxy composites for potential real life applications, particularly in high pressure pipes applications.

KEYWORDS: Epoxy, Nanocomposite, Molecular Dynamics, Artificial Neural Network, Fuzzy logic

1. INTRODUCTION

The discovery of Carbon Nanotubes has brought about a revolution in the field of nanotechnology. An exceptionally high stiffness, strength and resilience, is possessed by the CNTs, also superior electrical and thermal properties can be observed in it, making it the supreme reinforcing material for the nanocomposites [1,2,3]. After Iijima has discovered the CNTs (1991), carbon nanotubes have been used in multiple areas of applications such as medical, aerospace & defense. Many experiments have been done to demonstrate the mechanical load carrying capacities of CNTs in nanocomposites [4]. Reinforcements made by carbon fiber have high strength, light weight, high-performance and possess excellent load-bearing capacity in composites [5]. However due to excellent mechanical, thermal and electrical properties, CNTs has developed a lot of interest in composite community.

The matrix additives are represented by the nanotubes, which provide the composite with the multifunctional properties [7]. It is difficult to achieve a large volume fraction (>5%) due to increased viscosity and difficulties in subsequent processing. At least there are three general experimental methods for polymer nano composites production: mixing in the liquid state, solution mediated processes and in situ polymerization techniques [8]. Meanwhile, these nanocomposite materials have been characterized experimentally [8, 9, 10, 11].But experimental characterization proves to be an expensive task so in order to curb this problem,

*Corresponding Address: tyagi.sakshi615.hcst@gmail.com

computational methods are being used in the development of nanotube composite materials. Empirical potentials are used by Molecular dynamics simulations which makes it an important tool in understanding of polymer-carbon nanotube composites properties.

In the current work, Molecular Dynamics (MD) is used for mechanical characterization of High Density Polyethylene grade P5300 epoxy nanocomposite reinforced with multi-walled carbon nanotubes (MWCNTs). Modeling of six different samples with MWCNT percentages of 0, 1.0, 2.0, 3.0, 4.0 and 5.0 has been done by using MD. This study investigates the effect of MWCNT wt. % on the tensile strength, flexural modulus, tensile, bulk and shear modulus of HDPE-P5300 epoxy nanocomposites. The remainder of this paper is organized as follows: In section 2 we discuss the experimental work that we use in our study of polymer-carbon nanotube composites. In section 2.1, we give the details of the material system. In section 2.2, we discuss about the composite preparation. In section 2.3, we describe a tensile specimen preparation. Section 2.4 gives details of the mechanical characterization. 2.5 shows tensile test of the specimen.

2. EXPERIMENTAL

2.1. Material system

In this study the epoxy matrix used is High Density Polyethylene grade P5300 (epoxy resin) which has density of 0.948 g/cc at 27^0C and procured from HALDIA PETROCHEMICALS LIMITED, HALDIA, WEST BENGAL, INDIA. The melt flow index of this grade is 0.25 for each 5kg of resin sample at 190^0C . Hardener HY951 is used as a curing agent which has density of 0.97 at 25°C. A crosslinker is formed between epoxy resin and curing agent after the curing process. Now MWCNTs are reinforced with the HDPE grade P5300.MWCNTs are procured from Sigma Aldrich (New Delhi). Aspect ratio is in the range of 4 – 10. Different amounts MWCNT percentages of 0, 1.0, 2.0, 3.0, 4.0 and 5.0 were dispersed in epoxy matrix using an advanced ultrasonic probe sonication method to fabricate the composites. For the formation of the chemical network in the In-situ polymerization technique the solvent used is Acetone.

A. 2.2. Composite Preparation

For the synthesis of MWCNTs reinforced HDPE grade P5300 epoxy composite, In-situ polymerization technique is used. In the In-situ polymerization technique proper dispersion of reinforcing material in the composite matrix is done by using a solvent such that there are no solvent traces left in the composite material. In-situ polymerization stands for within the polymerization mixture. The required amount of MWCNTs to be reinforced are preheated for 4 hours and then mixed with acetone. Acetone is a solvent used for the formation of chemical network between MWCNTs and epoxy resin and no traces of acetone are included in the core material because it is further removed from the mixture. To sonicate the mixture Ultrasonicator (140W, 40 kHz) was used for one hour and required amount of epoxy resin (HDPE P5300) is mixed in the sonicated mixture and collectively they are again sonicated for an hour. Acetone is completely removed from the sonicated mixture by the partial distillation process. After the removal of acetone, the next step is to remove the entrapped air from the mixture, which is done by keeping it in vacuum (20mm Hg) for about half an hour. By avoiding the formation of the bubbles, 15% hardener is added to the mixture very carefully. Now an acrylic mould is used to pour the mixture which is kept in vertical direction. To prevent the agglomeration of the nanoparticles precautions should be taken while pouring the mixture and the mould has to be rotated in order to prevent settling of the MWCNTs at the bottom. After two hours, it is cured at room temperature for 24 hours and then the prepared composite can be taken out of the mould very carefully. Post cure was done for four hours at 100 °C in an oven. Prepared samples are MWCNT percentages of 0, 1.0, 2.0, 3.0, 4.0 and 5.0 reinforced in HDPE epoxy resin.

B. 2.3. Tensile Specimen Preparation

In an injection molding machine the MWCNT reinforced HDPE pallets were used as a raw material at the plasticized unit of the injection

moulding machine, HDPE is melted, also in order to induce sufficient softening of polymer to mix with CNTs temperature was set upto 200^0C and this mixture is further injected into a tensile specimen. The test samples were obtained for different weight percentages of MWCNT in the composites: 0, 1.0, 2.0, 3.0, 4.0, 5.0.

2.4. Characterization

The mechanical properties of MWCNTs reinforced epoxy composite are examined by Izod test, Melt flow index test, Flexural modulus testing using Universal Testing Machine, stress tested by Rheo stress meter, X-Ray diffractometer, Viscosity measured by viscometer. In details the Izod impact test is an ASTM standard method of determining the impact resistance of materials. The sample is hit by the arm. Either the weight rests on the specimen or it breaks. The impact energy is determined from the energy absorbed by the sample. The application of impact test is in studying the toughness of material. In the Izod impact test, the test piece is a cantilever, clamped upright in an anvil, with a V- notch at the level of the top of the clamp. Striker carried on the pendulum hits the test piece, it is allowed to fall freely from a fixed height, to give a blow of 120 ft lb energy. After the test piece is fractured, the absorbed energy amount is read by the height to which the pendulum rises. This rise is recorded by a slave friction pointer mounted on the dial.

2.5. Tensile test of the samples

The specimen undergoes tensile testing with the help of Universal Testing Machine model AG-50kNG. The tensile modulus, ultimate strength, flexural modulus, shear modulus and their percentage of increment with an addition of MWCNT were obtained. The tests were carried out at room temperature with a cross head speed of 30 mm/min. The structure of the composite appears to be the one as shown in figure 2.5.1 and figure 2.5.2 represents di-block structure of the composite.

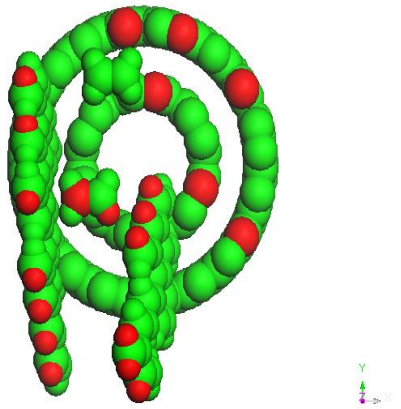

Figure 2.5.1: Molecular structure of the HDPE P5300 resin reinforced with 5.0 wt.% of MWCNT, obtained from MATERIAL STUDIO 6.0

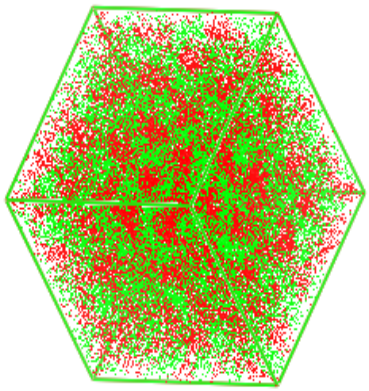

Figure 2.5.2: Di-block structure of the composite where green represents HDPE and red represents MWCNT with six different weight percentages

3. RESULTS AND DISCUSSIONS

In order to find that at which weight percent reinforcement of MWCNTs in epoxy polymer, mechanical strength and tensile modulus of polymer is increasing, figure 3.1 and 3.2 represents the plots of energy distribution and free energy density for composites of 0, 1.0, 2.0, 3.0, 4.0 and 5.0 MWCNTs weight percentages reinforced epoxy. Considerable increment of 10.5% and 12.4% with respect to pristine has been observed for 5.0 wt. % sample in tensile and flexural modulus respectively. On increasing wt. % of MWCNTs in the composite material, flexural modulus and shear modulus also

increases. Artificial Neural Network and Fuzzy logic based non-linear regression models are also developed to predict the values of tensile and flexural modulus for epoxy nanocomposites. It has been observed that ANN modeling produced best results for 5.0 wt.% sample as compared to lower wt.% samples. This study will assist in the modeling, simulation and design of advanced nanotube reinforced epoxy composites for potential real life applications, particularly in high pressure pipes applications.

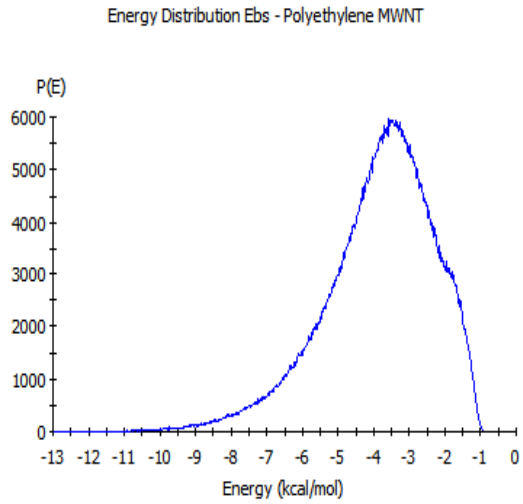

Figure 3.1: Shows energy distribution of the composite for various MWCNTs weight percentages. With the increase in value of MWCNTs, energy increases

TABLE 1: Mechanical properties of MWCNTs -HDPE composites

Wt.% of MWCNTs	**Tensile modulus(GPa)**	**Flexural modulus(GPa)**	**Ultimate stress(MPa)**
0%	1.125	894.163	103.561
1.0%	1.538	946.454	109.923
2.0%	2.103	1062.918	126.891
3.0%	2.743	1122.325	143.438
4.0%	3.042	1298.412	161.235
5.0%	3.521	1401.265	185.734

Table 1: Shows the mechanical properties of the MWCNTs and HDPE composite

In each case, of different percentages of MWCNTs, a minimum of two samples were tested and the tabulated values are the average of these results. It can also be observed that with an increase of CNT concentration there is good enhancement in the mechanical properties, which is believed to be due to good interface between polymer and CNT thus transferring load from polymer to CNT. Also with an increase of CNT concentration in HDPE, stiffness of the composites is increased. Figure 4 shows free energy density with respect to the time steps. It can be clearly observed from the curve that for the first ten steps the free density declines sharply for the next sixty steps free energy density decreases hyperbolically and for the last ten steps there is again a steep decline in the graph.

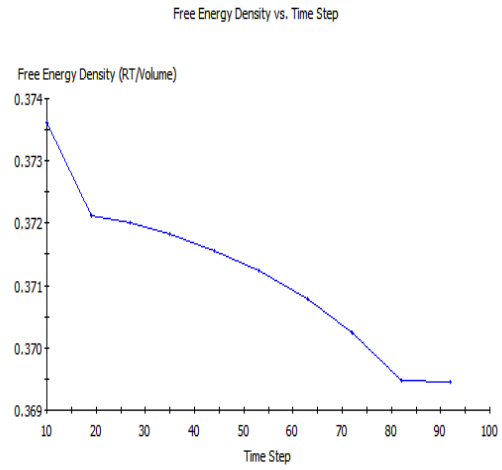

Figure 3.2: Free energy density versus time step curve

4. CONCLUSION

The conclusions drawn from the above reported work states that:

1. With an increase of MWCNT weight concentration MWCNT–HDPE composites show a good enhancement of mechanical properties.

2. Artificial Neural Network and Fuzzy logic based non-linear regression models are also developed to predict the values of tensile and flexural modulus for epoxy nanocomposites. It has been observed that ANN modeling produced best results for 5.0 wt.% sample as compared to lower wt.% samples.

3. With an increase of MWCNT, the measure of reinforcement increases that is because of good load transfer effect and interface link between CNT and polymer.

4. Melting point and oxidation temperature of HDPE composites are not affected with an addition of CNT but crystallinity of composites increases.

5. ACKNOWLEDGEMENT

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References

[1] Iijima S., "Helical microtubules of graphitic carbon" in Nature 354 (1991), 56–8

[2] D. K. Shukla and R. K. Srivastava, "Effect of Alumina Platelet Reinforcement on Dynamic Mechanical Properties of Epoxy" in Proceedings of the World Congress on Engineering (2011)

[3] G. Bao and S. Suo, "remarks on crack-bridging concepts" in Appl. Mech. Rev (1992)

[4] K. Sharma and M. Shukla, "Three-Phase Carbon Fiber Amine Functionalized Carbon Nanotubes Epoxy Composite: Processing, Characterisation, and Multiscale Modeling" in Journal of Nanomaterials (2014) 1- 10

[5] B. C. Kim, S. W. Park and D. G. Lee, "Fracture toughness of the nano-particle reinforced epoxy composite" in Composite Structures 86 (2008) 69–77

[6] M. Omidi, H. Rokni, A. S. Milani, R. J. Seethaler and R. Arasteh, "prediction of the mechanical characteristics of multiwalled carbon nanotube/ epoxy composites using a new form of rule of mixtures" in carbon 48 (2010), 3218-3228

[7] A. J. Kinloch, M. L. Yuen and S. D. Jenkins, "Thermoplastic Toughened Epoxy Polymers" in Journal of material science 29(1994), 3781-3790

[8] B. Francis, S. Thomas, J. Jose, R. Ramaswamy and V. L. Rao, "Hydroxyl terminated poly (ether ether ketone) with pendent methyl group toughened epoxy resin: miscibility, morphology and mechanical properties" in Polymer 46 (2005), 12371-12385

[9] K. Sharma and M. Shukla, "Molecular modeling of mechanical behavior of carbon fiber/ amine functionalized multiwalled carbon nanotube/ epoxy composites." In New carbon materials 29 (2014)

[10] D. K. Shukla, P. Sonia and V. Verma, "Characterization of fracture properties of epoxy-alumina polymer nanocomposite" in Applied mechanics and materials 390 (2013), 557-561

[11] D. Puglia, L. Valentini, I. Armentano and J. M .Kenny, "Effects of single-walled carbon nanotube incorporation on the cure reaction of epoxy resin and its detection by Raman spectroscopy" in Diamond and Related Materials 12 (2003), 827–832

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ORIGINAL CONTRIBUTION

Production of Biodiesel from Jatropha Oil

[#]Sandeep Kumar, [#]Vishnupriya and [*]Dilip Dey

[#]Student 4th year, Department of Electrical Engineering, Haldia Institute of Technology, Haldia, West Bengal, India

[*]*Department of Electrical Engineering, Haldia Institute of Technology, Haldia, West Bengal, India*

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ABSTRACT

There is a continuous search for renewable sources of fuels due to the rate of depletion of fossils. The term biofuel is used to define fuels that are obtainable from plants or animals. Being a renewable source, it is gaining attention all over the world today. Biofuel is defined as fuel comprising of mono-alkyl esters of long fatty acids derived from vegetable oils or animal fats. These fuels could be either in the form of vegetable oils or animal fats that have been transformed by chemical or natural processes for use in powering various engines. Biofuels are obtained from renewable energy sources such as biological materials from living organisms and can also be obtained from biodegrade waste. Here we implement the production of biodiesel from jatropha oil. Other oils can also be used for the production, but jatropha was chosen because it is not edible therefore, it will not pose a problem to humans in terms of food competition serving all the necessary needs of biodiesel production.

KEYWORDS: Biodiesel, Jatropha Oil, biofuel

1. INTRODUCTION

The production of biodiesel is a viable alternative solution to the rapid depletion of the finite sources of energy. The energy demand of the world is increasing day by day and that too not gradually but exponentially and very soon we will run out of the conventional sources of energy and hence, use of biodiesel as an alternative which needs to be clutched by mankind in order to survive. The term biofuel is not the same with fuels from fossils, the major difference between biofuels and fossil fuel is in their carbon content. Biofuels are very similar to diesel fuel in composition; therefore, there is no need for engine modification to run on biofuels. This is a liquid fuel that is created by chemically processing vegetable oil and altering its properties to make it perform like petroleum diesel. The commercialization of biodiesel is intended to be achieved in the near future in order to sustain the challenges regarding the environmental issues.

2. LITERATURE REFERENCES

The references can be stated as follows:

- "The conventional sources of energy drying up at faster rate, so, the alternate sources have to be explored, examined and implemented in no time. Bio-diesel production is in rise day-by-day basis in India as well as foreign countries." **Journal of Fundamentals of Renewable Energy and Applications. Swain, 2014.**
- "Biofuels are very similar to diesel fuel in composition; therefore, there is no need for engine modification to run on biofuels." **Journal of Petroleum Engineering, Volume 2013, Article ID 956479. Folaranmi, 2012.**
- "In India, there is a vast potential for the production of biodiesel from Jatropha curcas (called Jangli arandi in Hindi

*Corresponding Address: dilip_de@rediffmail.com

and Kattukkotai in Tamil) and Pongamia pinnata (The Indian Beech called Karanj in Hindi and Pungai in Tamil) as they occur in plenty in forests and wastelands." **Biodiesel in India: The Jatropha fiasco. Lahiry, 2018.**

- "You are all aware that Jatropha plantation provides not only biodiesel but other products such as manure for the crops, methane for power generation and glycerol for industrial use besides, enormous advantage of carbon trading." **Speech during visit to jatropha plantation at sunderkera, chhattisgarh. Kalam, 2006.**

3. PERSPECTIVE

The aim of any start up for any individual or a group of people is to earn huge profit and live a life of which they have dreaming since the dawn of their lives. This aim has been achieved by many, but the sad part is it has disturbed the aim of Mother Nature and created an unbalanced ecological system. The energy demand of the country is increasing day by day as the lifestyle of people is changing now-a-days. The requirement to fulfill the ever increasing demands of the human population has put the ecosystem balance into a strained procedure. The major sources of energy provided are the fossil fuels which have evolved in a very long duration and their consumption is at much higher rate than the formation rate. This is a very simple mathematics and it can be said that in this situation, these resources will no longer be available for use in the very near future. The world is collectively trying to fight these problems and a few solutions have come up, one of them being biodiesel production of jatropha oil. This is the oil of the seeds of a species of jatropha oil - jatropha curcas. This crop can be grown on wasteland unlike other cash crops and hence, it utilizes the portion of land that has been unusable till now. Once, the plant has been grown, their life is around twenty five years and produce the required product with minimal cost requirement. Their seeds are crushed to extract oil and this oil can be directly used, without refining, making it easy to use and most importantly, it serves as an excellent replenishment to the non-renewable sources of energy. Apart from the environmental advantages, the demand is going to increase drastically due to depletion of the present energy sources and hence, it serves as a wonderful platform for transacting business.

4. TECHNOLOGY USED

The technology that has been used here is conversion of the jatropha oil into diesel which is suitable for replacing the conventional sources of energy which are non-renewable and will be depleted soon.

The conversion process involves the following steps:-

Dosing Chamber

The raw materials are mixed in the dosing chamber. The raw materials used are:

- Jatropha oil
- Pure methanol
- Sodium hydroxide (catalyst)

These raw materials are weighed in the dosing chamber and then mixed thoroughly.

Reactor chamber

The mixture present in the dosing chamber is pumped to the reactor. The mixture reacts with the methanol in the chamber and biodiesel is produced in it. The biodiesel produced such is not purified and demands purification of the product.

Separation chamber

The biodiesel produced in the reaction chamber is pumped to the separation chamber. This mainly consists of glycerol and biodiesel. There are two sensors in the chamber, one is situated at the top and other is at bottom. The glycerol being heavier settles down in the separation chamber and the biodiesel segregated lies at the top and is extracted from there.

5. ECONOMIC ASPECT

Initial investment

The machineries that will be required by us at the initial stage of the setup are Machine for biodiesel extraction and Diesel Generator which cost an approximate of 1 lac rupees.

Source of initial investment

This amount of initial investment will be taken as an interest free loan from the family by each member. This amount will be returned to the families from the profit earned by the company.

Monthly expenses

TOTAL MONTHLY EXPENSES come to a sum total of the amount required for raw materials, transportation, electricity, labour, land rent and miscellaneous costs come around two lakhs

Monthly income:

The sale of biodiesel and it's byproduct glycerol will lead to an income of approximate two and half lakhs.

Profit

The monthly profit will come around half lakhs.

6. MARKETING STRATEGY

The products manufactured need to be sold with a proper plan. The product will become a hit once people are aware of the benefits of the process and the product meets their requirement. The marketing strategy depends on awareness of the perspective of this business. The following methods can be applied for promotion of our products:

- Social media platform
- YouTube advertisement
- Use of poster in various places
- News Paper advertisement
- Radio advertisement
- Development of an application with all the details of products ranging from method used to price.

The advertisement needs to be carried out efficiently. The very nature of the production of biodiesel is environment friendly which is a very important aspect of the supplying energy sources to fulfill the demands of the population. In addition to being environment friendly, the product is a renewable source of energy and it will not get depleted in the near future unlike other resources and with less competition from the existing sources, the business is going to expand at an unmeasurable rate.

6. WASTE MANAGEMENT

The product in this case is biodiesel and a substantial amount of glycerol is produced as by product. These products are sold over which serves as our profit. The waste management is a very important aspect of any business running now-a-days. The government has imposed very strict laws for proper disposal of the waste produced at any business. Hence, we will also follow the required protocols of waste management in our business.

Biodiesel production does not result in a lot of waste. However, it can produce some wastewater, minerals, resins, solids strained out of used oil and glycerin. Byproducts become waste when no one else wants them.

We will try our level best to use the byproducts properly and minimize the waste production. However, the following procedures can be followed in order to manage the waste at our site:

- The wastewater will be directed to the municipality for treatment of the water to be reused.
- The solid wastes available may have chemical composition which may be harmful for the environment and hence, they will be provided to the municipality in order to dispose these wastes properly.

7. SOCIAL ASPECTS

This business, like any other, has some visions for the betterment of the society in which we are residing. It works on the principle of making this society a better place to live in along with development in a sustainable manner. The farmers are the backbone of the society. It is practically impossible for us to imagine our life without the farmers. They produce food and, any person, no matter how rich, requires food which comes from the farmers of our society. The raw material purchased from the farmers will give them a support, though small, it will prove to be helpful to them. The increasing energy demands have led to an enrgy crisis as the demand is much more than supply. In order to meet the demand and wield it for profit, the exploitation of conventional sources has increased at an alarming rate and very soon it will be depleted.

Hence, an alternative resource needs to be adapted. The change from one option to another will require a large amount of time, but, someone has to start, and this business is an initiative in this step. The balanced environment depleting sources has increased so much that in the near future, there will be nothing left for the future generation, we need to do something about it. The sustainable program of this business highlights these aspects. The factor of overpopulation in this country has increased the rates of unemployment. There will be tremendous opportunities of employment for people, with no discrimination between the male and female category of society, giving people a chance to survive comfortably.

8. CONCLUSION

This business works on the principle of conversion of jatropha oil into biodiesel. This has many benefits and the most important of them being the welfare of the environment. The statics of the data analysis shows that the business is a profit oriented business which serves the purpose of business. This is an opportunity for the world to switch from a non-environment friendly mechanism to an environment friendly mechanism. The business is an employment generator, reducing the major problems up to some extent. This idea needs to be worked with the goal of making the world a better place to live in for us as well as our future generation, whole heartedly.

References

[1] G. Knothe, G. Jon Van, and K. Jurgen, The Biodiesel Handbook, Champaign, Ill, USA, 2005

[2] Q. Junfeng, S. Haixlan, and Y. Zhi, Preparation of Biodiesel From Jatropha Circas Oil Produced By Two-Phase Solvent Extraction, Pergamon Press, 2010

[3] Silveira and D. Foster, “Availability of Biomass Across the Globe,” 2008

[4] Satyendra Nath Mishra. 2014, Design of Resource Use: case of jatropha based biodisel in India, Journal of Rural Development

[5] Barta, Patrick (24 August 2007), "Jatropha Plant Gains Steam in Global Race for Biofuels

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ORIGINAL CONTRIBUTION

Good Employees Leave Bad Job/ Bad Manager(s)

*Madhuri Sanap

Sasmira's Institute of Management Studies & Research, Worli, Mumbai, India

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ABSTRACT

Employees generally refer to their manager's conduct as the essential explanation behind stopping their occupations. We tried to broaden turnover inquire about by exploring whether two generally utilized impact strategies by supervisors influence their workers' intentional turnover and whether employee's passionate commitment and employment fulfillment intercede this relationship.

Key words: Present Employees, Turnover, Commitment

1. INTRODUCTION

Starting with this topic, here I would like to focus upon many things about management, rules and regulation, organizational culture. In most of the organization, senior managers plays very vital role in terms of influencing others, devoting their quality time in quality wok, delegating work to others. They can set up good example(S) for their junior employees by doing good work without doing any unethical work in the organization.

But In most of the organization, top management retain bad senior manager's on higher position without knowing past background of his/her work. This leads problem in nearer and future for other employee those who work honestly, and with dignified manner. Result, good employees prefer to walk away from toxicities cultural organization. Sometimes, motivational factor is also plays equal role in quitting bad organization. Most of the time, organization fail to recognize good employee's talent and hard work. According to me, money is not only the factor to attract good employees. Verbal appreciation is also matters when it comes to motivational part. A thank you from the board goes far. It very well may be as straightforward as a private discussion or email message."

Unfair compensation [relates to this reason too]. It is essential to recognize the value of a good employee and supply him with a fair salary, bonuses and extra benefits. Those that feel underpaid will also feel underappreciated and will start looking for the compensation elsewhere."

2. OBJECTIVE OF STUDY

- To understand the main reason behind employees quit organization/bad bosses.
- To understand the relationship between employee engagement and motivation factor.
- To know about Gallup study and it's implication in communication skills.

-PiotrSosnowski Co-Founder and VP at Zety

"Employees will often leave companies when they no longer feel they are valued. Employee engagement is extremely important in today's workplace, but it should go further than bringing pizza to work or a company outing. Managers need to get to know their employees' experience and what knowledge the employee could bring to the table. Start including employees in business decisions when able. It tends to go further than a slap on the back thanking them for their hard work."

-Jill Thornell, HR Manager at Tennessee Tool Works

*Corresponding Address:madhuri.simsr10@gmail.com

"One of the top things most candidates are searching for is future development or limited time capacities at another organization. In the event that you are a piece of a huge association, you can most likely address the advancements past occupants of the position have gotten. Vocation pathing might be somewhat trickier for littler associations who have just observed stable employment development throughout the years. That being stated, any estimated association can even now make an arrangement for places that incorporate preparing openings, affirmation openings, administrative chances, and so forth. Demonstrating an applicant that the organization is put resources into their development will permit him/her to see a potential future with the association and give a feeling of future professional stability. Without these endeavors, organizations will keep on losing great employee's to contenders."

No relationship can thrive without good communication #

In a progression of ongoing examinations, inquire about association Gallup finished up:

- Employee's whose supervisors hold customary gatherings with them are just about multiple times as liable to be locked in.
- Chiefs who utilize a mix of eye to eye, telephone, and electronic correspondence are the best in drawing in employees.
- Connected with representative's report that when endeavoring to contact their chief, the individual returns their calls or messages inside 24 hours.
- Also, Gallup's exploration discovered employees esteem correspondence from their administrators about "what occurs in their lives outside of work."

At the end of the day, treat your kin like individuals, not assets you're attempting to suck dry.

America's Point of View #

50% of Americans have left a job to "get away from their manager at some point in their career."

So half of all Americans have had the #1 reason for leaving a job be their boss.

But given the career trends in America, most people have had multiple jobs. What about all those other jobs they've had along the way?

And what about the half that haven't felt the need to ever, "get away from their manager"?

Less Motivation #

- **Stagnancy:** Workers will make an endeavor to remain on in such a circumstance; however it isn't astonishing that after a point of time, they become worn out on the absence of development and difficulties and choose to search out new pursuits. A colossal piece of thankfulness is remunerating skilled and persevering people with open doors for development. When somebody feels they have quit developing, they will advance somewhere else.
- **Over-burdening:** In addition to the fact that this means the employee being referred to is stalled by a huge measure of work, yet in addition that different representatives who may be able to possibly develop don't get an opportunity. The whole circumstance turns out to be much similar to our school days, when a gathering venture was totally done by one individual and not, indeed, a gathering.
- Lack of clarity: At the point when an employee's occupation job and future are indistinct, they become frustrated with their present circumstance, and find employment elsewhere. This is frequently ordinary at the beginning and is even comprehended by most workers, however on the off chance that this turns into an example long into the employee's residency, at that point people who are performing admirably may begin expecting that their future in the organization is misty, or isn't going toward the path that they plan it to.
- Under-appreciation: Diligent work, truthfulness, responsibility and

proprietorship, all profit by support, affirmation and some degree of approval. At the point when their sincere endeavors or starts of splendor go unnoticed, employee's will undoubtedly feels let somewhere near their associates and seniors. Compensation assumes a gigantic job in this and pay that goes connected at the hip with employee's yields is urgent in telling them that they are esteemed and expected to climb significantly higher on the stepping stool of achievement. Nonetheless, compensation isn't the main key.

A. Toxic Work Culture

As much as we'd like to state "harmful workplaces aren't close to home," by and large, they truly are. In some cases a chief may have it out for you, or simply need to make you an advantageous substitute for their very own ineptitude. Possibly it's another partner who needs to support their vocation by currying support with administrators, and you're the present objective. Whatever it will be, it very well may be extremely close to home—possibly you're new to the organization, or that individual has it out for you as a result of the manner in which you look, dress, or the profession risk you conceivably posture to them. Whatever it is, recall that it might be close to home, yet it's not your flaw. Try not to give yourself a chance to become involved with the whirl of pessimism that possible encompasses the entire issue. Whatever you do, make a point to keep your choices open. At times poisonous workplaces just appear that way since we're delicate to a particular trigger. There are approaches to support your barriers in the event that you believe that may be the situation. Be that as it may, if nature is genuinely lethal—and mind you, now and then everything necessary is a staggeringly terrible bosses —and it is highly unlikely you can spare it yourself, it might be an ideal opportunity to search for something new.

B. Less Employee Engagement

Deficient Education: Some representative commitment issues emerge because of the absence of training in the field most firmly identified with the activity. On the off chance that your field is a profoundly particular one, and laborers don't have the ability to prevail in it, they may not be locked in. To counteract this issue, guarantee that you enlist laborers with the fundamental preparing and take care to give preparing when new improvements emerge inside your field.

Powerlessness to Affect Change: Laborers should feel that they can make change inside their work environments. On the off chance that your laborers don't feel as though their proposals matter, they might be less anxious to endeavor to execute change and improve their work environments. To guarantee that this issue doesn't emerge in your working environment, tune in to all representative concerns or recommendations and execute changes because of them at whatever point conceivable.

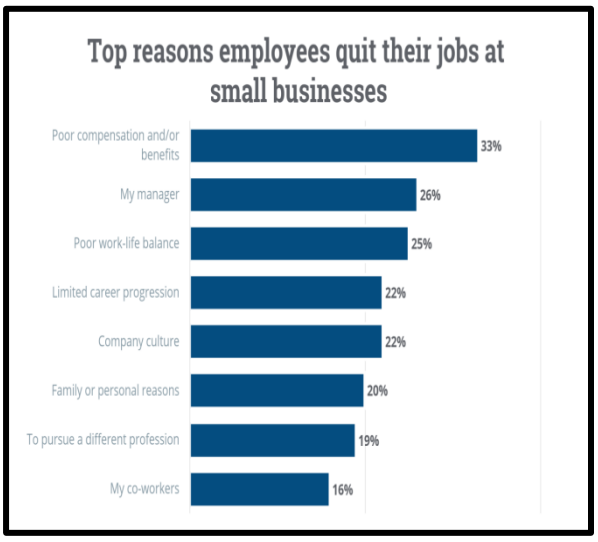
C. Hire & Promote Wrong People

Great, dedicated employee's need to work with similar experts. At the point when chiefs don't do the diligent work of procuring great individuals, it's a noteworthy de-motivate for those stuck working close by them. Advancing an inappropriate people is much more terrible. When you work your tail off just to get disregarded for an advancement that is given to somebody who happy gave their way to the top, it's a monstrous affront. No big surprise it makes great individuals leave.

3. METHODOLOGY OF STUDY

I have chosen secondary source for my study. For that, I have referred various journals, and HBR articles and Linkd-in, and most of them are practical based on my topic.

A. Overall Statistics About Employee's Quit Their Jobs In Small Business:



Source: blog.capterra.com

LIMITATION OF STUDY:

- Time Constraint
- Vast Scope
- No time for primary data collection

4. CONCLUSION

In day to day life, we do face several problems related to our profession. Most of them occurred because of bad managers or organizations. It varies from sector to sector or department to department. Most of the organization(S) hire wrong person for higher positions which leads problem in future. Results, many good employees' starts to walk out from organization. Turnover ratio starts to goes up and many organization(s) do get fail to recognize good employee's talent. Unnecessary harassment, unfavorable atmosphere, toxic and lots of negativity, dirty politics and unethical practice, which leads big hustle for both employee's and organization. De-motivation will not going to help out to boost employee's morale. Change is necessary for organization's betterment. Organization need to improvise retention policies so good employee's will not think about to quit organization/ managers.

REFERENCES

[1] Ahmad, N. (1987), Problems and Management of Small Scale and Cottage Industries. Deep and Deep Publications: New Delhi

[2] Anjum, D. (2011), An Analysis of Khadi and Village Industry Sector in Jammu and Kashmir, Zenith International Journal of Multidisciplinary Research. 1(8): 213-220

[3] Chand, R. and Srivastava, S. K. (2014).Changes in the rural labour market and their implications for agriculture.Economic and Political Weekly. XLIX (10): 47-54

[4] Gandhi, M. K. (1934),VillageIndustries, Harijan, November 23: 324

[5] Ghosh, A. (2012), Triggering innovation and creativity in traditional handicraft sectors: An Indian perspective, Management Insight, VIII (1): 2-5. ISSN 0973-936X

[6] Ghouse, S. M. (2010). Indian Handicraft Industry: Problems and Strategies. International Journal of Management Research and Review.2 (7):4-7. ISSN 2249-7196

[7] Goyal, M.; et al.(2014). Production, Sale and Employment Trends in village industries: A Study of Punjab, Pacific Business Review International. 6(12):17-22

[8] Hashmi, S. K. (2012). Market for Indian Handicrafts, Excel Journal of Engineering Technology and Management Science I (1): 6, 7. ISSN 2249-9032

[9] Jadhav, S. (2014). Indian Handicrafts: Growing or Depleting? IOSR Journal of Business and Management (IOSR-JBM).pp: 07-13.e-ISSN: 2278-487X

[10] Jena, P. K. (2010). Indian Handicrafts in Globalization Times: An Analysis of Global - Local Dynamics, INDECS, 8 (2): 119-137. ISSN 1334-4676

[11] Baumeister, R.F.; Vohs, K.D. (2004), Handbook of self-regulation: Research, theory, and applications, New York: Guilford Press, p. 574, ISBN 978-1-57230-991-3

[12] Carver, C.S.; Scheier, M.F. (2001), On the self-regulation of behavior, New York: Cambridge University Press, p. 460, ISBN 978-0-521-00099-4

[13] Cervone, D.; Shadel, W.G.; Smith, Ronald E.; Fiori, Marina (2006), "Self-Regulation: Reminders and Suggestions from Personality Science", Applied Psychology: An International Review, 55 (3): 333–385, doi:10.1111/j.1464-0597.2006.00261.x, archived from the original on 2013-01-05

[14] Cofer, Charles N; Appley, Mortimer H (1967), Motivation: Theory and Research, New York, London, Sydney: John Wiley & Sons

[15] Harter, James K.; Schmidt, Frank L.; Hayes, Theodore L. (2002). Business-unit-level relationship between employee satisfaction, employee engagement, and business outcomes: A meta-analysis. Journal of Applied Psychology.Vol 87(2), Apr 2002, 268-279

[16] Kahn, William A (1990). "Psychological Conditions of Personal Engagement and Disengagement at Work"(PDF), Academy of Management Journal, 33 (4): 692–724. doi:10.2307/256287. JSTOR 256287.Retrieved 2016-04-14

[17] Macey, Schneider (2008).The meaning of employee engagement.Industrial Organizational Psychology.

[18] McKay, Avery, Morris (2008). "Mean racial and ethnic differences in sales performance: The moderating role of diversity climate". Personnel Psychology, 61 (2): 349–374. doi:10.1111/j.1744-6570.2008.00116.x.

[19] Colvin, Fred H. (1919). Labor turnover, loyalty and output: a consideration of the trend of the times as shown by the results of war activities in the machine shops and elsewhere. New York City: McGraw-Hill. LCCN 19006158.OCLC 512539

[20] https://www.gallup.com/workplace/.../five-ways-improve-employee-engagement.aspx

[21] https://smallbusiness.chron.com › Managing Employees › Employees

[22] https://inc42.com/.../why-do-employees-quit-organisations-when-they-are-

[23] https://hbr.org/2018/01/why-people-really-quit-their-jobs

[24] https://medium.com/.../do-you-struggle-to-feel-motivated-in-certain-aspect.

[25] https://www.cio.com/.../9-reasons-good-employees-leave-and-how-you-ca..

[26] https://b2b.kununu.com/blog/why-do-good-employees-quit-leave-their-job

[27] https://blog.betterworks.com/employees-dont-quit-their-jobs-they-quit-thei..

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ORIGINAL CONTRIBUTION

Digital Microfluidic Biochip: A New Droplet Based Fault Detection Technique

Aman Raj[*], Bidyut Das[+], Manasija Bhattacharya[+], Pranab Goswami[+] and Moumita Mantri[+]

[*]*Student, Department of IT, Haldia Institute of Technology, Haldia, India*

[+]*Department of Information Technology, Haldia Institute of Technology, Haldia, India*

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ABSTRACT

Digital microfluidic biochips are used for biomedical operation like massive parallel DNA analysis, clinical diagnostics, automated drug discovery and other laboratory works. Exactness and reliability are important requirement to use biochips. Therefore, these devices must be tested after manufacturing. In this paper, we have proposed a droplet based fault detection technique for digital microfluidic biochips. The key idea is to manipulate droplet using a matrix search testing through the microarray. The traversal of microarray is carried out by scanning the intermediate cells and edges by a special type of anti-clockwise movement called Modified Depth First Search (MDFS). The experimental results suggest that the proposed technique considerably enhanced the result of fault detection over existing methods.

KEYWORDS: Microfluidic technology, Biochip, Droplet, Lab-on-chip, bio-MEMS

1. INTRODUCTION

Microfluidic Biochips (DMFB) has become very popular in the present day for biochemical analysis or bioassay operations. This biochip is also called lab-on-a-chip or bio-MEMS as it replaces highly repetitive laboratory tasks by replacing traditional large lab equipments with composite micro-system. It offers the advantages of design flexibility, higher sensitivity, smaller size and lower cost [1-5]. In last few years biochips and bio-MEMS grab the attraction of a huge number of researchers.

In earlier days microfluidic biochip was manipulated by continuous fluid flow carried out by using micro-valves, micro-pumps, and micro-channels [7,8,11]. An alternate approach is to manipulate liquid using discrete droplet [2,21]. The droplet based chip is referred as "Digital Microfluidic Biochip" [8-9, 11-12, 14-18]. The digital microfluidic system is advantageous over the continuous flow system [7, 8, 12]. Exactness and reliability are the important attributes for DMFB that are used as medical micro-systems, for biomedical operation or safety critical applications like point-of-care health assessment, DNA analysis, drug discovery, air-quality monitoring, food safety testing, etc. Therefore, these devices must be tested after manufacturing. Since these biochips are being targeted for a highly competitive and low-cost market segment, test and diagnosis methods must be inexpensive, quick and effective.

In this paper, we are proposing an efficient cost-effective technique that can detect single fault and locate these fault within the biochip. It can also calculate the time to traverse a fault-free biochip using single droplet. The paper is organized as Sec. 2 discusses the basic of DMFB. Section 3 discusses the related previous works. Section 4 represents the proposed technique. Section 5 presents the result of the proposed technique. Finally conclusion is found at Sec. 6.

*Corresponding Address: *aman25722@gmail.com*

2. DIGITAL MICROFLUIDIC BIOCHIPS

The basic idea of microfluidic biochips is to integrate all necessary functions for biochemical analysis onto one chip using micro-fluidics technology. Integrated functions include microfluidic assay operations and detection, as well as sample pre-treatment and preparation. There are two different classes of microfluidic biochips, namely continuous-flow biochips and droplet-based microfluidic biochips. Alternatives to closed-channel continuous-flow systems include novel open structures, where the liquid is divided into discrete, independently controllable droplets, and these droplets can be manipulated to move on a substrate. A number of methods for manipulating microfluidic droplets have been proposed in the literature [27-29]. Among the proposed techniques, electrowetting-on-dielectric (EWOD) also referred to as digital microfluidic biochips, has received considerable attention in recent years.

2.1 Structure of the Digital microfluidic biochip

The basic cell of a microarray includes a pair of electrodes that acts as two parallel plates. The bottom plate contains an array of individually controllable electrodes; the top plate is coated with a continuous ground electrode. Hydrophobic dielectric insulator is added to the plates to decrease wettability of the surfaces and to increase capacitance between a droplet and a plate. A biochemical droplet rests on a hydrophobic surface over an electrode, and is sandwiched between two parallel glass plates [18–11]. The basic cell structure of a digital microfluidic-based biochip is shown in Fig. 1.

2.2 Type of Faults in a Biochip

The Fault of a DMFB can be categorized as either Catastrophic or Parametric [12, 18, 23]. The Catastrophic or hard fault cannot be recoverable. It causes complete breakdown of the system and the test droplet is stuck during its movement at the fault position. On the other hand Parametric or the soft fault does not causes system failure but it decreases system performance immensely by reducing droplet motion. In a fault-free system, all the test droplets can be seen to reach at the droplet sink in specified time by the capacitive detection circuit [7]. To find a fault, we have to traverse the entire biochip by moving the droplet to every cell and edge from source to sink. Source is the point where the droplet enters into the biochip and sink is the point where it leaves the biochip.

3. RELATED WORK

Testing of microfluidic device or MEMS is a new topic in the area of researches, as the microfluidic technology itself is a new one. A well described previous work on the testing of microfluidic devices can be found in [6]. Methods on fault modeling and fault simulation for continuous flow microfluidic biochips have been presented by Kerkhoff et al. in [4,16]. For classifying defects and test application procedures for digital biochip have been discussed by Su et al. in [15]; faults in biochip have been categorized as catastrophic and parametric. For detecting catastrophic faults in digital microfluidic arrays, some effective techniques have been found in [2,10]. A concurrent testing methodology for detection of catastrophic faults in digital microfluidic systems has been presented and the problems of test planning and resource optimization have been discussed by Chakraborty et al. in [6]. In [18], Davids et al. has discussed a technique for faults detection and their diagnosis in biochip. The technique has three basic steps. In the first step, the outer loop of the microfluidic array has been tested using one single droplet. In the second step, all the columns of the microarray have been tested using multiple droplets in parallel. And in the third step the rows have been tested using the same technique used for column testing. Fault detections in microfluidic biochips with multiple droplets in parallel have also being discussed in [17-19]. In [17-19], the proposed techniques first select some start electrodes (pseudo sources) or base nodes, then the traversal of the microarray is done by moving the droplets from these pseudo sources or base nodes. So the appropriate selections of base nodes or pseudo sources are very much important. Though these techniques have used

pseudo source or base node the issues of exiting fault in pseudo source or base node have not been taken care. In [20], a technique has been proposed to use a Hamiltonian path to detect catastrophic faults in microfluidic arrays. One problem with this approach is that although finding Hamiltonian paths in grid structures is well known, but checking the existence of Hamiltonian path in a given graph is NP-complete problem. So it would be very expensive to determine such paths in the microfluidic array. An alternative method for testing digital microfluidic biochip based on Euler paths is found in [21]. This method maps a DMFB to an undirected graph and an Euler path is determined for testing the biochip. A technique of multiple faults detection and identification of their locations has been proposed by Davids et al. in their paper [12]. In [14] Xu and Chakrabarty has he presented different fundamental operations of biochip like droplet dispensing, droplet transportation, mixing, splitting and capacitive sensing.

4. PROPOSED METHOD

We are proposing a new advanced technique for detecting a single fault within a microfluidic array in this paper. The proposed technique is based on the graph theoretic approach. Here the key idea is to manipulate single droplets with single source and single sink. We applied here a modified Depth First Search (DFS) approach MDFS to test the microfluidic biochip. In this technique the entire biochip is traversed by the droplets in single steps.

DFS is an algorithm for traversing or searching tree or graph data structures. One starts at the root (selecting some arbitrary node as the root in the case of a graph) and explores as far as possible along each branch before backtracking. A version of depth first search was investigated in the 19th century by French mathematician Charles Pierre Trémaux [24] as a strategy for solving mazes [26-27]. MDFS is similar technique of traversing with one difference; outer node is visited first than the inner node at the time of traversing. If both nodes are same depth then; then any one node is chosen as a next node for traversing. The movement of the technique we consider anti-clockwise. The Figures 1.(a) & 1.(b) shows the traversing technique. We are started at node (1,1). Then move to anti-clockwise (2,1), (3,1), (4,1). After that traverse node (4,2), (4,3), (4,4). Then move up (3,4), (2,4) and so on according to the arrow. If any node visited twice then we perform backtrack and come back to the previous node.

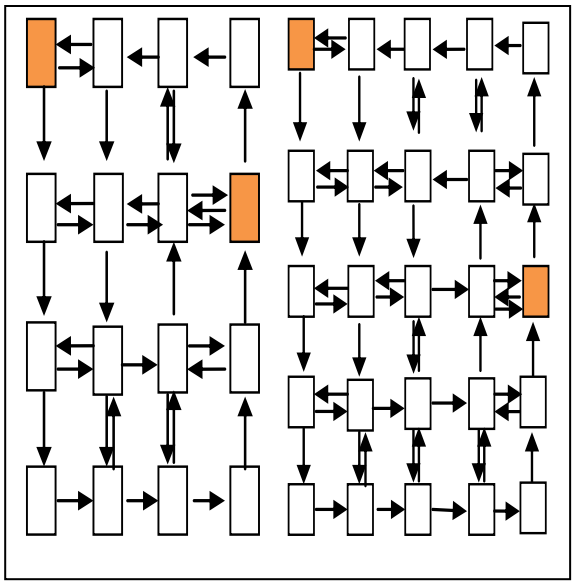

Figure 1: a) 4 x 4 Microarray b) 5 x 5 Microarrays

Source Cell= First (1, 1) = First row first column

Destination Cell = If ODD like 3x3 or 5x5 then (right middle) that is (2x3) or (3x5) respectively. If ODD like 4x4 or 6x6 then (right middle) that is (2x4) or (3x6) respectively.

5. RESULT & ANALYSIS

The proposed technique can detect single fault within bio-chip. After corrected the faulty node it is applied again to detect the next fault. The simulation is done in Turbo C environment by considering the structure of microarray chip as 2D matrices. Table 1 shows some experimental calculated times to traverse a vast number of microarrays starting from 4 x 4. Table 2 presented a comparative study of the proposed technique with a technique in [24].

Table 1: Time taken to traverse a fault-free biochip

Size of biochip	Time Taken	Total Path	Backtrack
4 x 4	34	32	2
5 x 5	56	50	6
6 x 6	86	72	14
7 x 7	120	98	22
8 x 8	164	128	36
9 x 9	210	164	44
10 x 10	264	200	64

Table 2: Time taken to traverse a fault-free biochip.

Size of biochip	Existing	Proposed	Improvement
4 x 4	48	34	29.16
5 x 5	66	56	15.15
6 x 6	140	86	38.57
7 x 7	204	120	41.18
8 x 8	280	164	41.43
9 x 9	364	210	42.31
10 x 10	441	264	40.14

6. CONCLUSION

In this paper we have proposed a modified DFS approach (MDFS) for detecting and locating the single fault in a digital microfluidic biochip. This technique uses single source and single sink. It reduces the manufacturing cost of a bio-chip. It has also been shown that the proposed technique is able to calculate the traversal time for a fault-free biochip.

REFERENCES

[1] H. G. Kerkhoff, H. P. A. Hendriks, “Fault modeling and fault simulation in mixed microfluidic microelectronic systems”, J. Electron. Testing Theory Appl. 17, 427–437 (2001)

[2] M. Pollack, A. Shenderov, R. B. Fair, “Electrowetting-based actuation of droplets for integrated microfluidics”, Lab Chip 2, 96–101 (2002)

[3] T. H. Schulte, R. L. Bardell, B. H. Weigl, “Microfluidic technologies in clinical diagnostics”, Clin. Chim. Acta 321, 1–10 (2002)

[4] H. G. Kerkhoff, M. Acar, “Testable design and testing of micro-electro-fluidic arrays," Proc. IEEE VLSI Test Symp. pp. 403–409 (2003)

[5] R. B. Fair et al., “Electrowetting-based on-chip sample processing for integrated microfluidics”, Proc. IEDM, pp. 32.5.1–32.5.4 (2003)

[6] F. Su, S. Ozev, K. Chakraborty, “Testing of droplet based microfluidic systems”, Proc. IEEE Int. Test Conf. pp. 1192–1200 (2003)

[7] F. S. S. Ozev, K. Chakraborty, “Concurrent testing of droplet-based microfluidic systems for multiplexed biomedical assays”, ITC International Test Conf. pp. 883–892 (2004).

[8] 4. F. Su et al., “Architectural-level synthesis of digital microfluidic based biochips”, Proc. IEEE Int. Conf. on CAD, pp. 223–228 (2004).

[9] V. Srinivasan, V. Pamula, R. Fair, “An integrated digital microfluidic lab-on-a-chip for clinical diagnostics on human physiological fluids," Lab Chip 310–315 (2004)

[10] F. Su, K. Chakrabarty, R. B. Fair, “Microfluidic based biochips: Technology issues, implementation platforms, and design-automation challenges”, IEEE Trans. Comput.-Aided Des. Integrated Circ. Syst. 25(2), 211–223 (2005)

[11] S. Fei et al., “Defect-oriented testing and diagnosis of digital microfluidics based biochips", Proc. IEEE Int. Test Conf. pp. 1–10 (2005)

[12] D. Davids et al., “Multiple fault diagnosis in digital microfluidic biochips”, ACM J. Emerg. Technol. Comput. Syst. 2(4), 1–15 (2006)

[13] F. Su, S. Ozev, K. Chakraborty, “Test planning and test resource optimization for droplet-based microfluidic systems”, J. Electron. Test. Theory Appl. 22, 199–210 (2006)

[14] T. Xu and K. Chakraborty, “Parallel scan-like testing and fault diagnosis techniques for digital microfluidic biochips”, IEEE Trans. Biomed. Circuits Syst. 1(2), 148–158 (2007)

[15] F. Su et al., “Testing and diagnosis of realistic defects in digital microfluidic biochip”, J. Electron. Test. Theory Appl. 23, 219–233 (2007)

[16] H. G. Kerkhoff, “Testing of microelectronic-biofluidic systems”, IEEE Design Test Comput. 24, 72–82 (2007)

[17] T. Xu, K. Chakrabarty, “Functional testing of digital microfluidic biochips”, Test Conf. ITC. IEEE Int. pp. 1–10 (2007)

[18] D. Davids, B. Joshi, A. Mukherjee, A. Ravindran, “A fault detection and diagnosis technique for digital microfluidic biochips”, IMS3TW '08 Proc. IEEE 14th International Mixed-Signals, Sensors, and Systems Test Workshop, pp. 1–4 (2008)

[19] S. Saha, A. Chakraborty, S. Roy, “An efficient single fault detection technique for microfluidic based biochip”, Int. Conf. Advances in Computer Engineering, pp. 10–14 (2010)

[20] M. Majumder, K. Hansda, S. Roy, “A novel single fault detection technique of digital microfluidic biochip”, Int. J. Comput. Sci. Appl. 1, 92–95 (2011)

[21] M. Majumder, S. Ray, S. Roy, “A multi droplets detection technique for single-fault in digital microfluidic biochip”, CIIT 2011, CCIS Vol. 250, pp. 337–342, Springer-Verlag Berlin Heidelberg (2011)

[22] B. Hadwen, G. R. Broder, D. Morganti, A. Jacobs, C. Brown, J. R. Hector, Y. Kubota, H. Morgan, “Programmable large area digital microfluidic array with integrated droplet sensing for bioassays”, Lab Chip 12(18), 3305–3313 (2012).

[23] H. Kai, B.-N. Hsu, A. Madison, K. Chakrabarty, R. Fair, “Fault detection, real-time error recovery, and experimental demonstration for digital microfluidic biochips”, Proc. Conf. Design, Automation and Test in Europe, pp. 559–564, EDA Consortium (2013).

[24] Charles Pierre Trémaux (1859–1882) École polytechnique of Paris (X:1876), French engineer of the telegraph in Public conference, December 2, 2010 – by professor Jean Pelletier-Thibert in Académie de Macon (Burgundy – France) – (Abstract published in the Annals academic, March 2011 –ISSN 0980-6032)

[25] Jump up^ Even, Shimon (2011), Graph Algorithms (2nd ed.), Cambridge University Press, pp. 46–48, ISBN 978-0-521-73653-4.

[26] Jump up^ Sedgewick, Robert (2002), Algorithms in C++: Graph Algorithms (3rd ed.), Pearson Education, ISBN 978-0-201-36118-6.

[27] Gallardo, B. S., Gupta, V. K., Eagerton, F. D., Jong, L. I., Craig, V. S., Shah, R. R., and Abbott, N. L. 1999. Electrochemical principles for active control of liquids on submillimeter scales. Science 283, 57--60

[28] Ichimura, K., Oh, S., and Nakagawa, M. 2000. Light-driven motion of liquids on a photoresponsive surface. Science 288, 1624--1626

[29] Washizu, M. 1998. Electrostatic actuation of liquid droplets for microreactor applications. IEEE Trans. Indus. Appl. 34, 732--737

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ORIGINAL CONTRIBUTION

Natural Gas Hydrates and their Potentiality for Future Energy Supply: A Survey of Literature

*Biswajit Mandal

Department of Chemical Engineering, , Haldia Institute of Technology, Haldia, West Bengal, India

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ABSTRACT

The discovery of large gas hydrate accumulations in terrestrial permafrost regions of the Arctic and beneath the sea along the outer continental margins of the world's oceans has heightened interest in gas hydrates as a possible energy resource. However, significant to potentially insurmountable technical issues must be resolved before gas hydrates can be considered as a viable option for affordable supplies of natural gas. The combined information from Arctic gas hydrate studies shows that, in permafrost regions, gas hydrates may exist at subsurface depths ranging from about 130 to 2000 m. The presence of gas hydrates in offshore continental margins has been inferred mainly from anomalous seismic reflectors, known as bottom-simulating reflectors, that have been mapped at depths below the sea floor ranging from about 100 to 1100 m. Current estimates of the amount of gas in the world's marine and permafrost gas hydrate accumulations are in rough accord at about 20,000 trillion m^3. Disagreements over fundamental issues such as the volume of gas stored within delineated gas hydrate accumulations and the concentration of gas hydrates within hydrate-bearing strata have demonstrated that we know little about gas hydrates. Recently, however, several countries, including Japan, India, and the United States, have launched ambitious national projects to further examine the resource potential of gas hydrates. These projects may help answer key questions dealing with the properties of gas hydrate reservoirs, the design of production systems, and, most important, the costs and economics of gas hydrate production.

KEYWORDS: Natural Gas Hydrates, Future Energy Supply, Methane Hydrate

1. INTRODUCTION

Gas hydrates are crystalline substances composed of water and gas in which a solid water-lattice accommodates gas molecules in a cagelike structure, or clathrate. The estimated amount of gas in the hydrate accumulations of the world greatly exceeds the volume of known conventional gas resources (reviewed by Kvenvolden [1988]). However, whether gas hydrates will be a factor in contributing to the world's energy requirements depends ultimately on the availability of producible gas hydrate resources and the cost to extract them. Considerable uncertainty and disagreement prevail concerning the world's gas hydrate resource potential. Gas hydrate as an energy commodity is commonly grouped with other unconventional hydrocarbon resources that are either expensive to extract or require specialized technology for extraction. Except for gas hydrates, most unconventional natural gas resources are being commercially produced somewhere in the world. In most cases, the evolution of a nonproducible unconventional gas resource to a producible energy resource has relied on significant capital investment and technology development. To evaluate the energy resource potential of gas hydrates also will require sustained research and development programs. I propose that the evolution of gas hydrates as a viable source of natural gas, like any other unconventional energy resource (e.g., deep gas, shale gas, tight gas sands, and coal bed methane), will follow a predictable path from research and discovery to implementation (Figure 1). Today, most of the gas hydrate research community is focused on three

*Corresponding Address: mondal.biswajit@gmail.com

fundamental issues: Where do gas hydrates occur, how do gas hydrates occur in nature, and why do gas hydrates occur in a particular setting? Relatively little has been done to integrate these distinct research topics or to evaluate how they collectively affect the ultimate resource potential of gas hydrates. Only after understanding the fundamental aspects of where-how-why gas hydrates occur in nature will be able to make accurate estimates of how much gas is trapped within the gas hydrate accumulations of the world. Even with the confirmation that gas hydrates may exist in considerable volumes, significant technical, economic, and political issues need to be resolved before gas hydrates can be considered a viable energy resource. In this article, I have attempted to review the status of gas hydrates as a future energy resource. The technical and nontechnical factors controlling the ultimate resource potential of gas hydrates are identified and assessed. The fundamental questions of where do gas hydrates occur, how do gas hydrates occur in nature, and why do gas hydrates occur in a particular setting are individually reviewed and discussed. In addition, published gas hydrate volume assessments are summarized, and the production technology needed to extract the world's gas hydrate resources is assessed. This article concludes with a discussion of the economic and political motivations that may eventually lead to gas hydrate production.

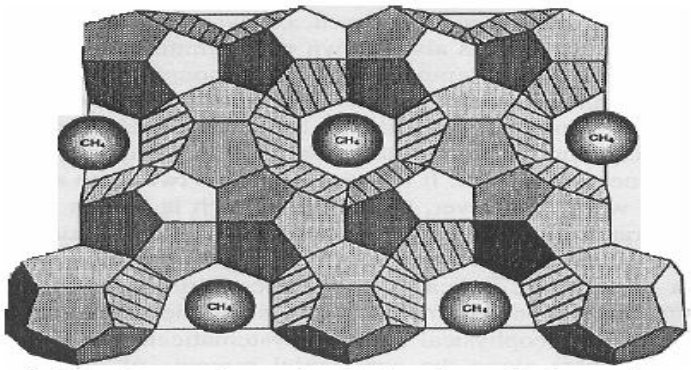

Fig. 1 Structure of gas-hydrates in which methane molecules are caged in hydrogen bonded water molecules (Kvenvolden, 1998). Cages are both exposed and covered.

In recent years the topics of naturally occurring gas hydrates have attracted major interest worldwide due to the fact that they may play a dominant role as possible energy resources in the future. Prior to this natural gas hydrates were mainly viewed at as a source of operational problems in gas processing and transportation equipment. The historical background and development of gas hydrates and natural gas hydrates is reviewed as well as the necessary fundamental information about the structures of gas hydrates. One prerequisite of stable operation of gas processing plants as well as the allocation of gas deposit is the exact knowledge of the hydrate stability (equilibrium) data. Whereas a lot of data have already been measured and based on this reliable computation methods have been developed, there is still the necessity to measure equilibrium data to further improve the accuracy of the models. The organization of own measurements carried out with natural gases as well as key binary systems with water-electrolyte systems and also inhibitors are presented together with some representative results. Some review of the currently vast growing investigations on detection of natural gas hydrate locations, exploratory and first production efforts as well as some issues on possible hazards identified today in connection with naturally occurring gas hydrate deposits are highlighted.

Background to and development of Gas Hydrates

It is about 200 years ago that gas hydrates were discovered. Most of the literature gives the tribute of this discovery to Davy in 1811. When investigating the system chlorine – water he noticed that a crystalline substance was stable also above the melting temperature of water, 0 °C. This was chlorine hydrate. In his book Makogon indicates that the retrieval of gas hydrates actually should be assigned to Joseph

Priestley (best known for the discovery of oxygen), who in the late 1770ies, about thirty years prior to the experiments of Davy, came across gas hydrates when investigating sulphur dioxide in its water solution as well as the gaseous phase and ice. However, the temperatures then (-10 °C) were well below the freezing point of water. It was soon realized that gas hydrates differ significantly from what are commonly known as "hydrates". Gas hydrates do not develop covalent bonds between the water and the gas molecule. Water molecules due to their capability of forming hydrogen bonds form cages which encapsulate the "guest" gas molecule of suitable size. The interaction between the guest and the water molecules are restricted to physical dispersion or van der Waals forces. Therefore these combinations of solid water-guest molecules are also called inclusion or clathrate hydrates. Due to the fact that not all the cages formed have to be filled by a guest molecule to stabilize the crystalline structure, clathrate hydrates are non stochiometric compounds. During more than a century gas hydrates remained a mere niche curiosity. This did not change when by the end of the 19th century Villard showed that also hydrocarbons like methane, ethane, ethylene or propane can form hydrates. First tabulated results date back to de Foucard, a collaborator of Villard. Only in the late 20ies and early 30ies of the last century when in the United States transport of natural gas in pipelines started operation on a larger scale and at higher pressures natural gas hydrates began to play its since then ongoing role as a source of severe operational problems including operational breakdowns due for instance to plugging the lines. The first to show that blockages of pipes did not trace back to ice but to gas hydrates was Hammerschmidt in 1934. Hammerschmidt in 1939 also presented the first algorithm to calculate the amount of methanol necessary to inhibit the formation of stable natural gas hydrates. Now having been recognized as a possible source of highly undesirably costs due to the operational problems caused in technical applications gas hydrates from a mere curiosity immediately turned into a real troublemaker in natural gas industry. It was recognized that there was urgent need to enter systematic research activities for getting to know the conditions – pressure, temperature, gas composition under which natural gas hydrates will form. The American Gas Association initiated a large research project in which Deaton and Frost pioneered these systematic investigations, Katz and co-workers developed the first method for estimating the conditions under which natural gas hydrates will form. This method as well as the Hammerschmidt algorithm for hydrate inhibition still widely continue to be used in practical work today, for instance in Germany in recommendations of DVGW Technical Report G 285. However, revealing the structures of gas hydrates took yet more than another decade. By applying X-ray diffraction methods von Stackelberg in the middle of last century was able to present the information of the detailed structure of these compounds. Stackelberg and his coworkers then described two different structures. Based on this knowledge and applying statistical thermodynamics, van der Waals and Platteeuw laid the basis for calculating gas hydrate phase equilibria. Parrish and Prausnitz in the early 70ies of last century were the first to extend it with additional assumptions on the occupation of the cages to gas mixtures including natural gases and to present a first computer applicable algorithm. With several modifications which are being carried out until today this method is nowadays state of the art to predict gas hydrate formation conditions and has widely replaced the method of Katz. Sloan gives a more complete overview over milestones in the early years of gas hydrate history as well as the recent developments in his book "Clathrate Hydrates of Natural Gases" in its second edition 1998. This book since the appearance of its first edition in 1990 has become a standard work covering information on nearly all aspects of natural gas hydrate related topics. It also includes a computer program (Release 1996) for predicting formation conditions for natural gas hydrates as well as the possible hydrate prevention by taking into account the inhibition properties of methanol and salt (NaCl). About forty years ago for the first time natural occurring gas hydrates in form of the first natural gas hydrate deposits were confirmed to exist in Siberia. This laid the ground for possible prospects of fossil fuel reserves in the form of natural gas hydrates. Makogon gives the background on the up to date sole continuous gas production from natural gas hydrates in the Messoyaka field, Siberia.

Research on natural gas hydrates has entered a new stage since then that still accelerates pace till today. In the meantime potential natural gas hydrate deposits in suitable pressure and temperature regions are being reported virtually all over the world with the majority of occurrence in offshore regions. Since the first discovery research also is focussing on kinetics of formation and dissociation of natural gas hydrates as only a thorough understanding of these phenomena including the interaction with the ambient like sediments or electrolytes will present the key to open the door to a stable and safe handling and production possibility of natural gas hydrates. With the advent of the first international conference on natural gas hydrates in New York in 1993 new developments in this field of interest are documented, discussed in a wide international forum and potential areas of application of gas hydrates suggested in a regular triennial conference schedule with the latest (4^{th} Intl. Conference on Gas Hydrates) having been held in Yokohama in 2002 (2nd 1996 in Toulouse, 3rd 1999 in Salt Lake City, the coming 5th in 2005 in Trondheim, Norway). The recent increase of contributions clearly shows the vivacious and vast expanding activities in the field of natural gas hydrates: in 1999 there were a total of 143 papers (including posters), in 2002 204 papers. In total eight topics were covered in 2002 ranging from exploration, resources and environment over fundamentals (thermodynamic aspects, kinetics, structural studies, physical properties, multiphase mechanics and heat/mass transfer) to hydrate formation and prevention in pipelines and to hydrate-based technologies. The currently dominant role of the US and Japan in natural gas hydrate research is documented by the fact that out of a total of 204 papers alone 115 were presented from representatives of these two countries. In addition numerous national as well as international symposia, workshops and conferences give evidence of the ever increasing world wide interest in natural gas hydrates as a potential alternative source of fossil energy. This is also documented by the fact that large research projects have been launched during the last few years: In the USA, the "Methane Hydrate Research and Development Act" became Law in May 2000 covering a period of five years (2001-2005) and bringing together different governmental authorities such as the Secretary of Energy, the Secretaries of Commerce, of Defence and the Interior as well as the Director of the National Science Foundation (NSF). Also Japan, Russia, India, Norway, Germany and Canada have established active natural gas hydrate programs with a 5 year program for the Japanese which is considered to be the most advanced. In Germany the Deutsche Forschungsgemeinschaft (DFG) in 1999 defined Gas Hydrate Research as one out of thirteen large projects for the next 10 to 15 years, in 2000 the Ministry for Education and Research (BMBF) set up a ""Gas Hydrates in the Geosystem R&D Center" encompassing three multi-research centre projects. In India the Indian Government charged an expert group in March 1999 which defined four phases totalling 47.1 Mio US $ (exchange 6.8.2000) as follows: Phase I to examine existing geological, geophysical data (2.2 Mio $), Phase II the acquisition and processing of seismic data (8.4 Mio $), Phase III stratigraphic drilling, 3-5 wells (3.3 Mio $) and Phase IV drilling and completion 3 to 5 wells ($ 33.2 Mio $). Two areas have been shortlisted: on the west in the Arabian Sea off Mumbai coast, to the east off Calcutta, south of Bengal Delta. Also in 1999 the first US patent for hydrate recovery and conversion to liquid onboard a vessel was granted. What is most promising and may show the coming into maturity for the natural gas hydrate development is that oil and gas producers begin to break with the attitude of looking at the scenery as being mainly of academic interest and start also to engage in the field of exploration and production. Hopefully, this will continue also when research funds no longer will be granted to make natural gas hydrates on the long run a real viable and reliable energy source alternative.

2. GAS HYDRATE RESOURCE ASSESSMENT

As noted in the introduction, this article deals with the assessment of the geologic, engineering, economic, and political factors that control the ultimate resource potential of gas hydrates. This assessment is conducted mainly though the examination of several relatively well-characterized gas hydrate accumulations.

Where Do Gas Hydrates Occur?

Gas hydrates have been inferred to occur at about 50 areas throughout the world (Figure 2). However, only a limited number of gas hydrate accumulations have been examined in any detail. Described in the following sections are five of the best-known marine and on shore permafrost-associated gas hydrate accumulations in the world. They are located on the Blake Ridge along the southeastern continental margin of the United States, along the Cascadia continental margin off the Pacific coast of Canada, near the Nankai Trough off the eastern coast of Japan, on the North Slope of Alaska, and in the Mackenzie River delta of northern Canada. Discussions pertaining to the volume of gas within each of the gas hydrate accumulations described in the following sections are included in the energy resource assessment section of this article.

Methane Hydrate

What do you get when you combine water and swamp gas under low temperatures and high pressures? You get a frozen lattice like substance called methane hydrate, huge amounts of which underlie our oceans and polar permafrost. This crystalline combination of a natural gas and water (known technically as a clathrate) looks remarkably like ice but burns if it meets a lit match. Methane hydrate was discovered only a few decades ago, and little research has been done on it until recently. By some estimates, the energy locked up in methane hydrate deposits is more than twice the global reserves of all conventional gas, oil, and coal deposits combined. But no one has yet figured out how to pull out the gas inexpensively, and no one knows how much is actually recoverable. Because methane is also a greenhouse gas, release of even a small percentage of total deposits could have a serious effect on Earth's atmosphere. Research on methane hydrate has increased in the last few years, particularly in countries such as Japan that have few native energy resources. As scientists around the world learn more about this material, new concerns surface. For example, ocean-based oil-drilling operations sometimes encounter methane hydrate deposits. As a drill spins through the hydrate, the process can cause it to dissociate. The freed gas may explode, causing the drilling crew to lose control of the well. Another concern is that unstable hydrate layers could give way beneath oil platforms or, on a larger scale, even cause tsunamis. Lawrence LivermoreÕs William Durham, a geophysicist, began studying methane hydrate several years ago with Laura Stern and Stephen Kirby of the U.S. Geological Survey in Menlo Park, California. With initial funding from NASA, they looked at the ices on the frigid moons of Saturn and other planets in the outer reaches of our solar system. One of these ices is methane hydrate. Their work on the physical properties of this plentiful but poorly understood material has put the team in the forefront of methane hydrate research in the U.S. While they continue to study icy moons, Laboratory Directed Research and Development funding allows them to focus on applications that their research might have closer to home. In the process, they have run across a few surprises.

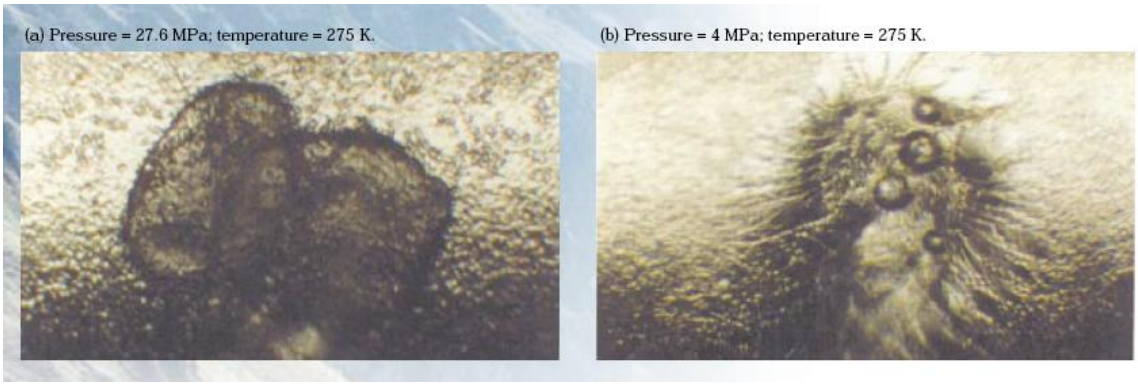

Figure 2. Partially reacted grains of methane hydrate that still contain cores of solid water ice and the same grains after the ice has begun to melt. In (a), the reaction proceeds rapidly as the hydrate mantle thickens and consumes the ice core. In (b), the rate of hydrate formation slows

to almost zero. Melting of the superheated ice cores, apparently suppressed in (a) by rapid hydrate formation, is allowed to proceed. The grains become misshapen as liquid pools inside, causing distortion and partial collapse of the outer hydrate mantle within 10 minutes. Liquid water is radially expelled along fissures and crystallized as fine crystalline hydrate to surround the original grains.

Ice That Doesn't Melt

For their research, Durham, Stern, and Kirby needed goodquality samples of methane hydrate. But samples of the real thing are tough to acquire, requiring expensive drilling and elaborate schemes for core recovery and preservation. Previously developed methods for synthesizing the stuff in the laboratory generally resulted in an impure material still containing some water that had not reacted with the methane. The LivermoreÐUSGS team attempted an entirely new procedure. They mixed sieved granular water ice and cold, pressurized methane gas in a constant-volume reaction vessel and slowly heated it. Warming started at a temperature of 250 kelvin (K) (-10°F) with a pressure of about 25 megapascals (MPa).* The reaction between methane and ice started near the normal melting point of ice at this pressure (271 K, or 29°F) and continued until virtually all of the water ice had reacted with methane, forming methane hydrate. The team studied the resulting material by x-ray diffraction and found pure methane hydrate with no more than trace amounts of water. This simple method produced precisely what they needed: low-porosity, cohesive samples with a uniformly fine grain size and random crystallographic grain orientation. Says Durham, "In a way, we got lucky. We used the same technique we use for producing uniform water ice samples from 'seed' ice. We tried adding pressurized methane gas and heating it. And it worked." It worked, but some unexpected things happened along the way. The ice did not liquefy as it should have when its melting temperature was reached and surpassed. In fact, methane hydrate was formed over a period of 7 or 8 hours, with the temperatures inside the reaction vessel reaching 290 K (50°F) before the last of the ice was consumed. Repeated experiments produced the same result: ice that did not melt (Figure 1). A control experiment replaced the methane with neon, which does not form the cagelike latticework of gas and water molecules that is a gas hydrate. Under otherwise identical experimental conditions, the ice melted as it should. Other experiments replaced the methane with both gaseous and liquid carbon dioxide, which does form a hydrate. Here the superheating phenomenon reappeared, indicating that it is not unique to methane hydrate. Durham and his team believe the superheating phenomenon is related to active hydrate formation. The reaction at the free ice surface somehow suppresses the formation of a runaway melt. Figure 1 shows that when the reaction ceases, melting happens immediately. The American Chemical Society was impressed enough with these rather bizarre results to give the team a cash prize and award in late 1997.

Another Surprise

Once the team had large, pure samples they could work with, they began studying the material's physical properties and the way it forms and dissociates. This is research at its most basic. But its applications are clear when one considers that dissociation of seabed methane hydrate deposits could cost the lives of workers on an oil drilling platform. Methane hydrate's stability curve (Figure 2) has been established for some time. If conditions fall outside that curve, the material will dissociate into its components, methane and water. Durham, Stern, and Kirby looked at how the dissociation occurs under a variety of temperature and pressure conditions outside the curve. After the samples were created, the pressure was reduced to 0.1 MPa, the pressure at sea level. They did this in two ways: by slow cooling and depressurization and by rapid depressurization at a range of temperatures. The compound decomposed to ice and gas as expected in all experiments except those that involved rapid depressurization at temperatures from 240 to 270 K (Figure 3). In these experiments, the team found yet another surprise. Even after the pressure drop, the methane hydrate was "preserved" as a compound for as long as 25 hours before it decomposed. This behavior may have implications for future exploitation of the material. Preserving the mixed hydrates may be possible at an easily accessible temperature, just a few degrees below ice's melting temperature. In another series of

experiments, the team is looking at the strength of gas hydrate samples in various temperature and pressure scenarios. Results of these experiments may indicate the possible effects that stresses from gravity, tectonic activity, or human disturbance might have on gas hydrate deposits. Thus far, the team has found that water ice and methane hydrate have about the same strength at very low temperatures of 180 K and below. But the hydrate is much stronger than ice at temperatures of 240 K and above. The most recent data indicate that methane hydrate is several times stronger than ice (Figure 5). Although methane hydrate is not as strong as rock, the data may be good news for the stability of the deposits.

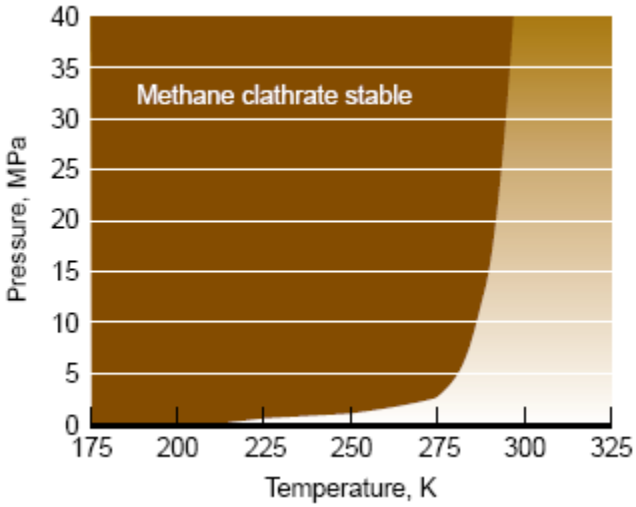

Figure 3: The stability curve shows that methane hydrate is stable at 0.1 MPa if temperatures are low enough and that it is stable far above the melting point of water ice if pressures are high enough

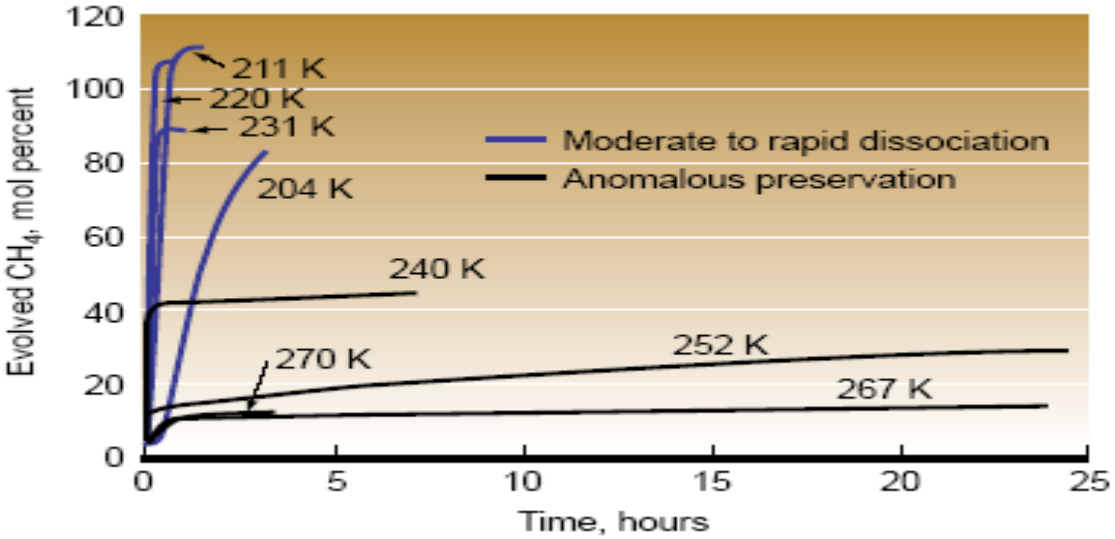

Figure 4: At lower temperatures (the blue lines), methane hydrate dissociates rapidly after rapid depressurization. At warmer temperatures (the red lines), dissociation is complete only after periods as long as 25 hours

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Figure 5: Used to compare the strengths of water ice and methane hydrate, a sample containing both was subjected to axial stress from a piston inside a cryogenic container about 25 millimeters in diameter. Inside this vessel, the weaker water ice (toward left of photo) deforms, causing a bulge, while the stronger methane hydrate under the same stress does not bulge

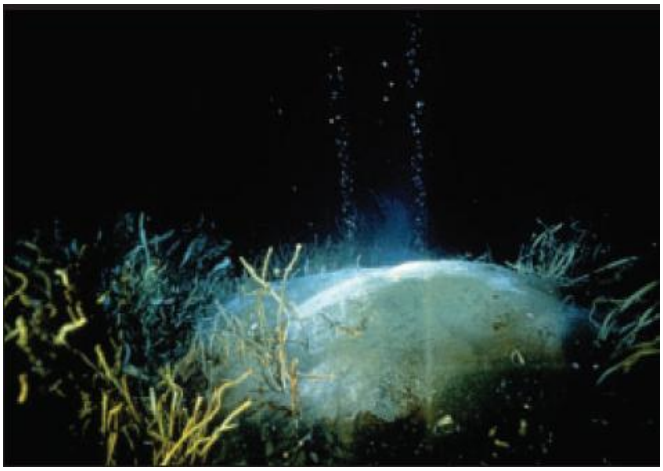

Figure 6: Methane is actively dissociating from a hydrate mound on the Gulf of Mexico deep sea floor

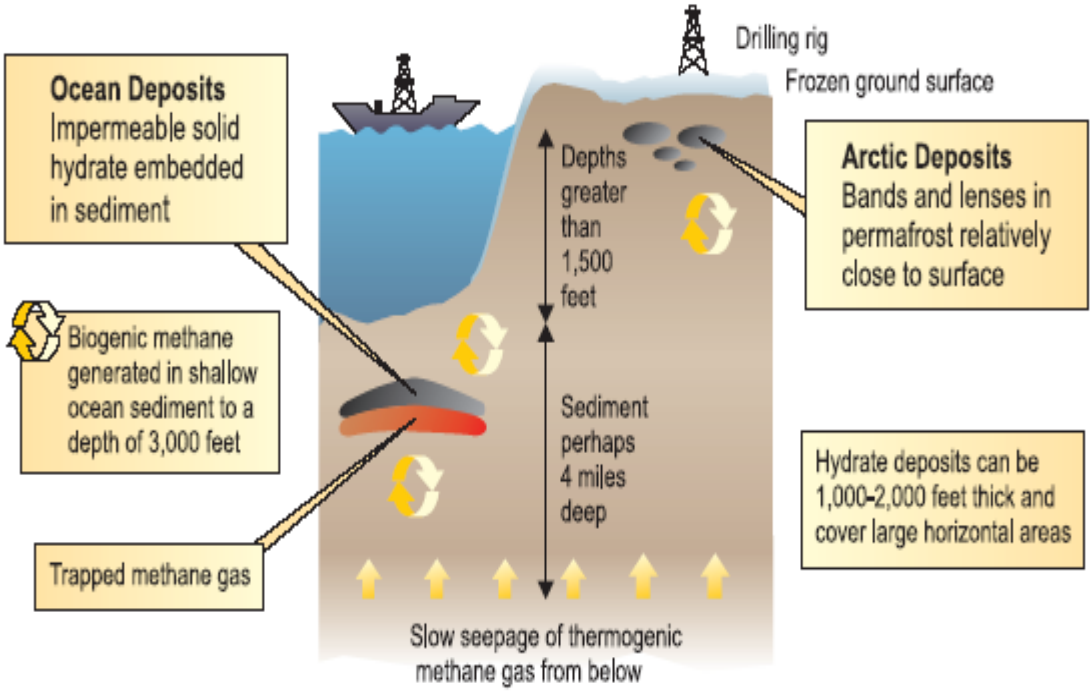

Figure 7: Types of Methane Hydrates Deposits

Figure 8: Discrete samples of gas hydrates (above) are collected from Gulf of Mexico seeps using a mini-drill and a gas hydrate recovery chamber deployed from the submersible Johnson Sea Link.

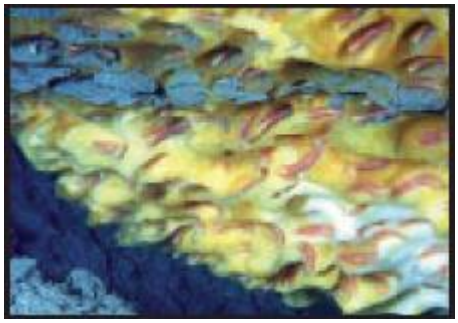

Figure 9: The so-called ice worm, Hesiocaeca methanicola, lives in the sediment that cover gas hydrate deposits and digs burrows that extend into the hydrate mass. They are thought to live by browsing bacteria, which are in turn supported by the abundant methane

Occurrence of natural Gas in hydrate deposits

The assumptions of naturally occurring gas hydrates were initiated by unusual observations made during exploratory drillings in the 1950ies (Malone in).However, it was not until in the mid-1960's that Russian scientists (Makogon in) succeeded in providing practical proof of this theory when hydrate saturated cores were extracted in exploratory drilling. Since then a large number of deposits in onshore areas (permafrost areas) and particularly in the offshore areas of the continental shelves have been and still are being discovered. The proof of such deposits/occurrences can be obtained by the analysis of drilling cores from deep sea drillings. Seismic procedures in which special reflections of acoustic signals which are interpreted as indicating the location of possible hydrate deposits are also used. Such reflections are known as "Bottom Simulating Reflections" or BSR because they indicate the base of the hydrate layer parallel to the ocean floor. Hydrates are to be found where the required high pressures and low temperatures occur together with suitable sediment and hydrate formers. In permafrost regions, hydrate deposits have been discovered in depths between about 130 and 2000 m. It is also known that in part conventional free gas deposits are to be found below these deposits. This is also the case in the Messoyaka field (West Siberia) which to date is the only field where successful production of natural gas from hydrates has been performed. Up to date, 14 bill. m^3 of natural gas have been produced from this deposit, approximately one third of which comes from the hydrate layer. In greater depths no hydrate deposits are expected to be found, since due to the geothermal gradient the temperatures exceed the stability limits. The onshore deposits known today are primarily located in Russia and the northern part of Alaska, all exclusively in permafrost regions. In offshore regions, hydrate deposits have been found at depths anywhere from a few meters to about 1000 m below the ocean floor. There is evidence of such deposits existing on the coasts of North, Central and South America, the Bering Sea, Japan, Norway, Africa, India as well as in the Caspian and Black Seas.

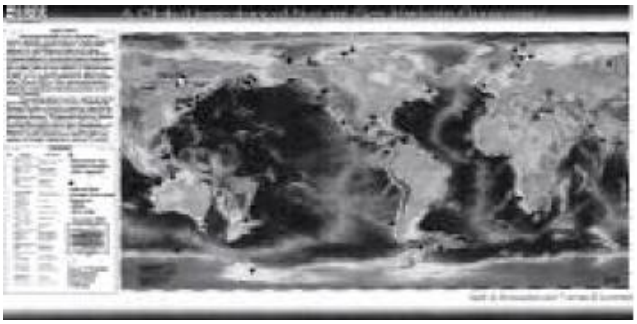

Fig. 7: Status of worldwide Hydrate Deposits according to Kvenvolden and Lorenson, 2000 [32]

In figure 7 the currently known and presumed continental and ocean deposits are shown on a map of the world. This global inventory has been updated by Kvenvolden and coworkers over the decades and its development gives some insight in the boosting activities of natural gas hydrate deposit research. In 1980 it showed 14 areas of hydrate bearings, in 1988 this was increased to 36 and in 2000 now over 80 locations are included. An exact quantification of the amount

of natural gas existing in hydrate form, however, is not yet possible. Sloan in 1999 summarizes the results of the estimates for the occurrence of natural gas hydrate deposits of several researchers:

Onshore (permafrost) 1.4 x 1013 - 3.4 x 1016 m^3

Offshore 3.1 x 1015 - 7.6 x 1018 m^3

In order to give a feeling for the magnitude of these figures one can take Kvenvolden's 1988 estimate of 1.8x1016 m^3 for the offshore reserves. He stated that this figure would be more than double the methane equivalent of all fossil fuel depots worldwide. Of course only a portion of the hydrate figures can be expected to be economically recoverable if the pending technical problems can be solved. However, even if only a small portion (10%) of the conservatively estimated amount could be produced under (still to be proven) technically feasible and profitable conditions, the statistic range of the current worldwide natural gas reserves and resources (3.98x1014 m^3) would already be doubled (from 160 years to 320 years). These statistics show clearly what large potential these deposits constitute. In order to be able to exploit natural gas from a hydrate deposit, first the gas must be occluded from the solid phase. There are various ways of achieving this:

- by decreasing the pressure;
- by increasing the temperature (by means of supplying steam or in-situ combustion)
- by adding inhibitors.

Holder et al, in a comparison in terms of profitability for a study of a gas hydrate field offshore California and producing from a conventional field in Alaska comes to the conclusion that pressure reduction is the most profitable procedure. End of first quarter 1998 a first drilling was finished by a Japanese – Canadian consortium at Beaufort- Mackenzie Basin's Mallik Anticline (Mallik 2L-38) finding a hydrate zone predominantly containing fine methane (said to be of thermogenic origin) grains in sediment with underlying five foot free gas. It has been reported that lately a consortium enlarged by US Geological Society, US DOE and GFZ Potsdam, Germany has performed successfully the first intentional sustained production of methane in March 2002 at 3825 foot/1166 m Mallik 5L-38, a well drilled by a multi research consortium, Dallimore et al. Pressure draw down experiments were carried out, however, with only small gas flow. A longer duration flow testing was effected over a 13 m interval which was thermally stimulated via circulation of about 400 l/min of 60 °C warm water resulting in dissocated gas hydrate as well as free gas. It is reported that their energy content has exceeded the energy required down hole to stimulate hydrate dissociation. Due to confidentiality agreements with energy companies that have in part funded the project detailed results on these findings, however, will only be issued in 2004. Detailed information of the Mallik drilling experiments as well as those at the Nankai trough near Japan's Honshu Omae Zaki peninsula can be found in. Economical production on a large scale, however, is not to be expected during the next 10 or 20 years, which even might turn out to be a too optimistic prognosis. There still is too little knowledge of and technology for producing natural gas from hydrate deposits, especially for offshore locations. Economically acceptable solutions still have not been found for a number of technical problems. These problems do not only pertain to controlled dissociation of hydrates, but also to the possibility of maintaining a stable resist coating, the prevention of gas outflow.

Potential Hazards originating form natural gas hydrates

When investigating the possibility of producing natural gas from the offshore reservoirs one must also take into consideration possible hazards that can evolve from their recovery a well as from their mere existence and also natural dissociation. Natural occurring gas hydrates often are distributed very differently in the ocean sediments, as solid hydrate inclusions or finely dispersed in the sediments. In this case hydrates act as a cementing agent giving the necessary stability to the sediment itself. Small changes in local temperature profile can lead to dissociation and possibly to unstable conditions. There are hypotheses that huge slides of sub-sea sediments having occurred in the past are associated with the decomposition of hydrates also with possible impact on the world's climate (e.g., GEOMAR, Paull et al). Also it has been discussed that (uncontrolled) hydrate dissociation may be a

potential hazard to the foundations of production platforms and pipelines [40] and drilling activities have reported instabilities of hydrates. A detailed analysis about drilling and production hazards caused by gas hydrates has been presented recently by Collett and Dallimore showing that gas hydrates can and have create severe problems in oil and gas drilling such as well bore casing damage, uncontrolled gas leakage outside the bore casing due to dissociation, uncontrolled gas flow during drilling .They stress the utmost importance of understanding the geological formation and occurrence of natural gas hydrates and the need for detailed information of gas hydrate distribution, reservoir temperatures and pressures as well porosities and permeabilities to ensure safe handling. So there is still a long way to go until natural gas hydrate deposits will be developed as the same safe production fields as conventional natural gas fields are today. The recently established and very much tied up international efforts in research consortiums and technological developments represent a promising development in this direction.

3. CONCLUSION

Gas hydrates are the potential source for alternative fuel for world. To explore the gas hydrate as reliable source of alternate energy extensive research and developments are required. Affordability of the simple technique, reliable use and compatible cost are the main limitations for gas hydrates. All these limitations are subject to proper research and awareness in this area.

References

[1] H. Davy, Phil.Trans.Roy.Soc. London 101, 1, 1811

[2] Y.F. Makogon, Hydrates of Hydrocarbons, Pennwell Publ. Comp. Tulsa, Oklahoma, 1997

[3] P. Villard, Compt. Rend. Vol. 106, 1602-1603, 1888

[4] P. Villard, Compt. Rend. Vol. 111, 302, 1890

[5] R. De Forcrand, Compt. Rend. 135, 959, 1902

[6] E.G. Hammerschmidt, Formation of Gas Hydrates in Natural Gas Transmission Lines, Ind.Eng.Chem. Vol.26,No. 8, 851-855, 1934

[7] E.G. Hammerschmidt, The Oil and Gas Journal, May 11, 66-72, 1939

[8] W.M. Deaton, E.M. Frost, The Hydrates of Natural Gas, Pure Gas and Synthetic Gas Mixtures, Gas Vol. 16, No. 6, 1940

[9] D.L. Katz, D.B. Carson, W.I. Wilcox, Natural Gas Hydrates, Ind.Eng.Chem. Vol. 33,No. 5,1941

[10] Technische Mitteilung G 285, DVGW, Hinweise für die Hydratinhibierung mit Methanol, Sept. 1974

[11] M. von Stackelberg, Feste Gashydrate, Naturwissenschaften 36, No. 11, 327-359, 1949

[12] M. von Stackelberg, H.R. Müller, Feste Gashydrate II, Zeitschrift für Elektrochemie 58, Nr. 1, 104, 1954

[13] J.H. van der Waals, J.C. Platteeuw, Clathrate Solutions, in: I. Prigogine, ed., Adv. In Chem. Phys., Vol. II, Intersciene Publ. Inc. New York, 1-57, 12959

[14] W.R. Parrish, J.M. Prausnitz, Dissociation Pressures of Gas Hydrates Formed by Gas Mixtures, Ind. Eng. Chem.Proc.Des.Dev., Vol. 11 no. 1, 26-35, 1972

[15] E.D. Sloan jr. Clathrate Hydrates of Nartural Gases, Marcel Dekker Inc. New York, 1st ed. 1990 and 2nd ed. 1998

[16] Proceedings of the 1st Intnl. Conference on Natural Gas Hydrates, New Paltz, The New York Academy of Sciences, New York, 1994

[17] Proceedings of the 4th Intnl. Conference on Gas Hydrates, Yokohama, Japan, on CD, 2002

[18] D. F. Morehouse, Natural Gas Hydrate Update 1998-2000, Energy Inform. Adm.

[19] David F. Morehouse, Natural Gas Hydrate Update 2001-2002,Energy Information Administration Also to appear in Potential Supply of Natural Gas in the United States, Report of the Potential Gas Committee, Dec. 31, 2002, Potential Gas Agency, Colorado School of Mines, Golden, CO, April 2003

[20] J.A. Ripmeester, J.A. Tse, C.I. Ratcliffe, B.M. Powell, A new clathrate hydrate structure, Nature 325, 135-136, 1987

[21] K. A. Udachin, J.A. Ripmeester, A Complex Clathrate Hydrate Structure showing bimodal guest hydration, Nature 397, 420-421, 1999

[22] J. Nixdorf, Experimentelle und theoretische Untersuchung der Hydratbildung von Erdgasen unter Betriebsbedingungen, Dissertation, Universität Karlsruhe (TH), 1996

[23] O.Y. Zatsepina, B.A. Buffet, Thermodynamic Conditions for the Stability of Gas Hydrate in the Seafloor, J. Geophys. Res. 103, Vol. B10, 24127-24139, 1998

[24] J. Nixdorf, L.R. Oellrich, Experimental determination of hydrate equilibrium conditions for pure gases, binary and ternary mixtures and natural gases, Fluid Phase Equilibria, 139, 325-333, 1997

[25] A. Rock, L.R. Oellrich, Hydrate Equilibria in Aqueous Solutions Containing Inhibitors, to be published in Wiley VCH within DFG Schwerpunktprogramm Komplexe Gemische", end 2003

[26] R.L. Christiansen, E.D. Sloan, Mechanisms and kinetics of hydrate formation, 283-305, 1994, in [16]

[27] F. Franks, The Hydrophobic Interaction, in F. Franks, ed., Water: A Comprehensive Treatise, Vol. 4, Plenum Press, New York, 1975

[28] M. Clarke, P.R. Bishnoi, Determination of the Intrinsic Rate of Gas Hydrate Decomposition Using Particle Size Analysis, 556-563, 2000, in Proc. of the 3rd Intern. Conf. On Gas Hydrates, Salt Lake City, 1999

[29] 29. L.R. Oellrich, J. Nixdorf, Equilibrium Conditions for Natural Gas Hydrates to high Pressures and Influence of some Inhibitors in Proceedings ISAAE '97, Johor Bahru, Malaysia, paper 5A.7, 381-387, 1997

[30] D.B. Robinson, H.-J. Ng, J. Can. Petrol. Techn. 26, 1986 quoted in [15]

[31] A. Rock, Experimentelle und theoretische Untersuchung zur Hydratbildung aus Gasgemischen in inhibitorhaltigen wässrigen Lösungen, Dissertation, Universität Karlsruhe (TH), 2002

[32] K. A. Kvenvolden, T. D.Lorenson, http://walrus.wr.usgs.gov/globalhydrate/ browse.pdf 33. J. Nixdorf, L.R. Oellrich, Natural Gas Hydrates – from Bane to Boon?, Natural Resources and Development, Vol. 47, 83-98, 1998

[34] G.D. Holder, V.A. Kamath, S.P. Godbole, The Potential of Natural Gas as and Energy Resource, Annu.Rev.Energ. 427, 1984

[35] The National Energy Technology Laboratory Methane Hydrate Newsletter, p. 2, Summer 2003,in http://www.netl.doe.gov/scng/hydrate/newsletter/HMNewsSummer03.pdf

[36] GEOMAR, in http://www.gashydrate.de/

[37] S.R. Dallimore, T. S. Collett, T. Uccida, M. Weber, H. Takahashi, Overview of the 2002 Mallik Gas Hydrate Production Research Well Program, 36-39, 2002 in [17]

[38] The National Energy Technology Laboratory Methane Hydrate Newsletter, Spring 2003 in http://www.netl.doe.gov/scng/hydrate/newsletter/HMNewsSpring03.pdf

[39] C.K. Paull, P.G. Brewer, W. Ussler III, E.T. Peltzer, G. Rehder, D. Clague,Evaluation of Marine Slumping as a Mechanism to Transfer Methane from Seafloor Gas Hydrate Deposits into the upper Ocean and Atmosphere, 31-35, 2002 in [17]

[40] K.J. Campbell, Offshore, 46, 1991

[41] T.S. Collett, S.R. Dallimore, Detailed Analysis of Gas Hydrate Induced Drilling and Production Hazards, Proceedings of the 4th Intnl. Conference on Gas Hydrates, Yokohama, Japan, 47-52, 2002

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ORIGINAL CONTRIBUTION

A Novel Design of an Automated Adaptive Detection Analyzer System using Digital Microfluidic Biochips

[*]Tamosa Chakraborty and [#]Mriganka Chakraborty

[*]*Department of Information Technology, Haldia Institute of Technology, WB, India*

[#]*Department of Computer Science, Syamaprasad College, WB, India*

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ABSTRACT

In recent times a new generation of droplet based lab-on-chip device termed as Digital Microfluidic Biochip has found wide applications in the field of clinical diagnostics, DNA sequencing, drug design and environmental toxicity monitoring applications. Optical detection in DMFB is of major significance as it involves detection accuracy of the final results that determines the decision for clinical diagnostic solutions. In this work we propose the design of an adaptive detection system comprising of an automated digital detection analyzer. The system performs analysis of the detection results and predicts the trend of the detection results based on adaptive manipulation of ranges to provide better detection accuracy. The design is simulated in FPGA platform and the detection results displays accuracy in line with conventional laboratory methods.

Key notes: Digital Microfluidics, Detection and analysis, Photodiode, Droplet detection analyzer , Decision-based execution , Integration, Bioassay Protocols

1. INTRODUCTION

The requirement for regular and instantaneous health monitoring specifically for emergency situations as well as point of care diagnosis has initiated the development of a new generation of droplet based portable lab-on-chip devices. They perform high precision clinical screening within a very short time for determination of the levels of multiple parameters in multiple human physiological samples. These devices termed as Digital Microfluidic Biochip are capable of fluid handling which can be identified as discrete microfluidic operations namely dispensing, merging, mixing, splitting, transportation and detection. In DMFBs the sample droplets in nanolitre volume are manipulated individually as digital entities on a planar surface allowing for the scope of developing a highly scalable and reconfigurable system. Electro Wetting on Dielectric (EWOD) is considered as one of the best actuation methods for droplet manipulation in digital microfluidic systems [1]. Electrowetting is the phenomenon whereby an applied electric field modifies the wetting behavior of a polarizable or conductive liquid droplet in contact with a hydrophobic, insulated electrode. The actuation is based on the principle of modulating the interfacial tension between a liquid and an electrode coated with a dielectric layer [2].Droplets are usually sandwiched between two parallel plates; the bottom plate is the chip surface usually a glass substrate, which houses the addressable electrode array, and the top is either a continuous ground plate or a passive top plate.(figure 1) Electrodes are addressed individually through control pins for prescheduled actuation. By varying the patterns of control voltage activation, in a time multiplexed manner all microfluidic operations are implemented at any desired location.

*Corresponding Address: ctamo.net@gmail.com

For a given bioassay after completion of the entire protocol involving sample preparation followed by merging and mixing - the resultant droplet is transported to a prespecified detection site. The detection site is comprised of a cell dedicated for optical sensing using the integrated optical detection mechanism. Detectors such as photodiodes and LEDs are either integrated or aligned in conjunction (for earlier designs) with the biochips to perform the task of optical detection [3].

In this paper we propose a automated detection and analysis system using adaptive detection to provide further accuracy and determination of the trends for the obtained results. A majority based detection technique for homogeneous samples is used for the proposed automated adaptive detection system. The major contribution of this work is to perform detection on multiple copies of the samples obtained from a single patient or patients from a specific class or family. The detection system attempts to determine detection results based on majority based detection and predicts the detection trends using adaptive variation on the reference range.

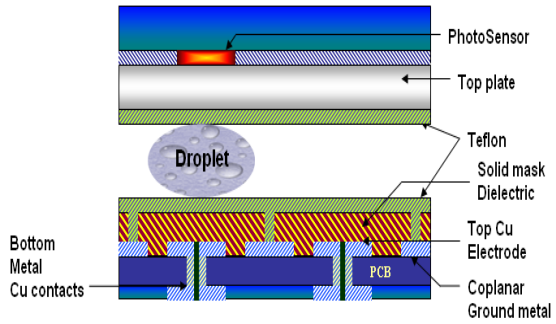

Figure 1: Schematic diagram of coplanar DMFB with integrated photosensor

2. PRIOR CONTRIBUTION

In recent years numerous research on integration of detection operations with analytical applications in EWOD based DMFBs has been reported. The work in [3] demonstrates a colorimetric enzyme-kinetic method based on the Trinder's SZ reaction used for the determination of glucose concentration.[4,5] uses an integrated optical sensor based upon the heterogeneous integration of an InGaAs based thin film photodetector with a digital microfluidic system. A point of care testing (POCT) device has been proposed in [6] for PCR manipulation. The system is comprised of a miniature fluorimeter, consisting of an LED and a photodiode aligned to specific areas on the chip to enable real-time detection for the PCR reaction Automated droplet detection analyzer using integrated photo sensors and LEDs has been reported in the works of [7]. Integration of multiple Bioassays based automated detection analyzers to form integrated detection system that can perform sequential diagnostic procedure using multiple DMFBs is reported in [8].

3. MOTIVATION

As the complexities of survival increases, various health monitoring systems are being developed for easy detection of one's current health conditions. Keeping in mind that the conditions and surroundings which are variable in nature, a test result is most effective when the results are adaptive to its test values and hence an iterative method is devised to precise the result. A set of samples which needs to be analyzed, is first classified according to its first set of references, and then when the result is obtained, a new set of thresholds are calculated from the results, which is solely responsible for classifying it further. The more the number of iteration, the more is the accuracy. But to optimize an increased complexity of the circuit, the number of iteration in this design is kept to be two. The system thus, predicts the result based on majority detection and sets its threshold values according to its test sample ranges.

4. PROPOSED DESIGN

As the name suggests, adaptive detection analyzer is based on the principle that instead of using fixed reference for detection analyzers, the reference values can be made to be varied according to the sample values.Optical detection in Lab on Chips is performed through a photodiode integrated in the upper glass plate along a plane perpendicular to the 2D grid. Depending on the intensity of light based on droplet luminescence incident on the photodiode or absorbance - a measure the absorption of radiation, as a function of frequency or

wavelength, due to its interaction with a sample an output current is measured. The sequence of operations is as follows:

1. Droplets for homogeneous samples together with scheduled reagents as defined for pre-sequenced Bioassay protocols are placed on the bioassay as per pre-synthesized schedule.

2. On completion of necessary protocols optical detection using at detection sites are completed. The detection result for each droplet from the respective detection site is stored in a separate Register stack.(biochip output register stack)

3. The average of the results are determined using a divider circuit. The reference values are stored in High and Low reference registers.

4. The results are compared with references the majority detection results are obtained using technique followed in [7].

5. Based on the average value the new adaptive range is computed using offset increment on low and high reference values.

6. Select all samples within the newly specified range.

7. The average of the results for the selected samples is determined.

8. Repeat from step 5 until iteration ends for the second time.

9. Finally using the average value comparison predicts the final range which determines the trend on the basis of initial reference offset.

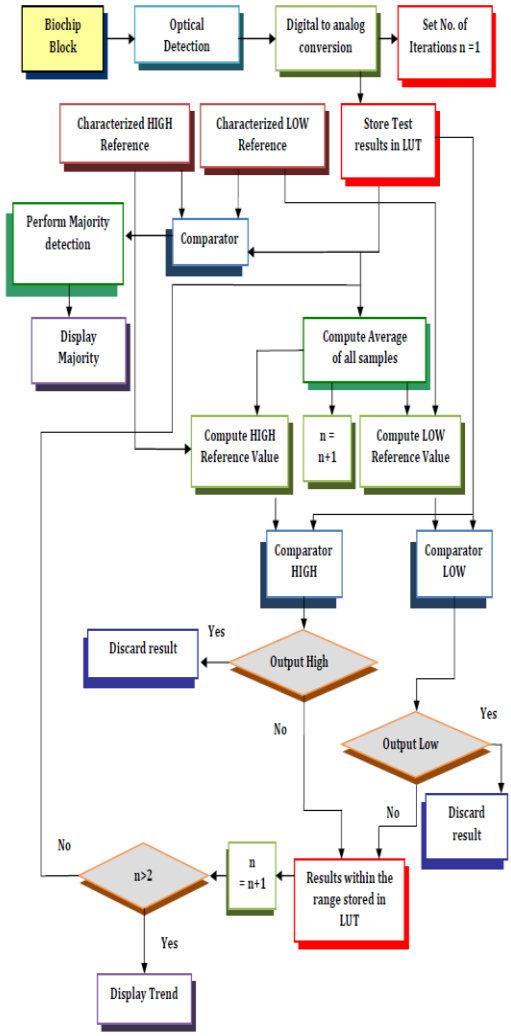

Figure 2: Flowchart for the adaptive detection system operation sequence

The circuit diagram for the adaptive detection analyzer system is shown in figure 3.the major components are

1) The Biochip blocks comprising of the ADC and TI amplifier.

2) Output register stack for storage of the results and reference register stack for storage of different levels of references.

3) Adder, comparator and intermediate threshold register for majority detection operation.

4) A 2D Register array to store 4 level comparison results.

5). A decision block for determining frequency of occurrence for different levels of detection.

6) The Adder, divider, Average value register for average computation and

7) Adder-subtractor component for adaptive reference computation.

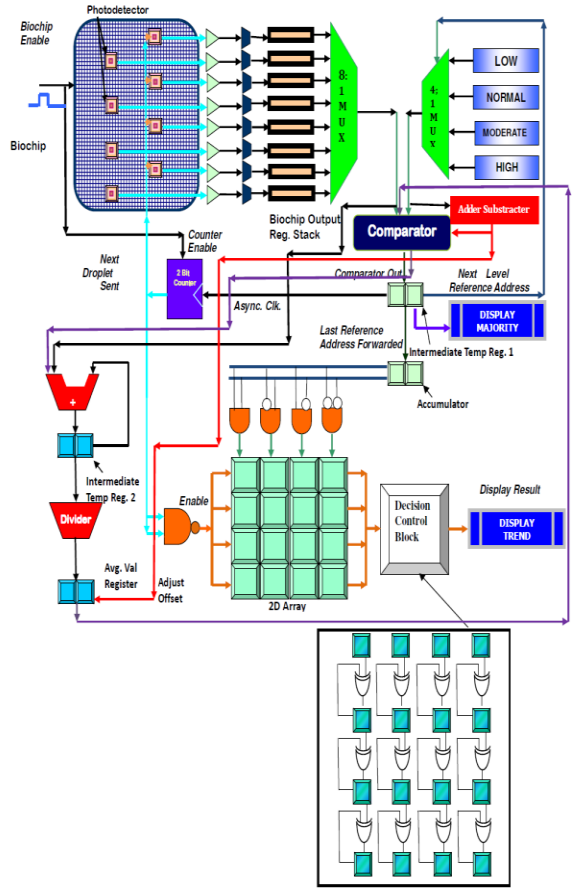

Figure 3: The block level circuit diagram for adaptive detection system

5. EXPERIMENTAL RESULT

Here we have performed two bioassays for Glucose and Urea detection using four levels of references namely Low, Moderate, Normal and High. The setup is comprised of a light emitting diode (LED) and a photodiode (TSL257). A 12-bit analog data acquisition board (PCI-DAS08) is used for ADC conversion. The analog data acquisition board has a measurable range of −5 to 5V and an analog-to-digital (A/D) resolution of 2.44mV. The prototype for the proposed circuit is implemented on FPGA platform. FPGA Spartan 3E architecture (target device – xc3s500e-pq208-5).the simulation result is given in figure 4 and Table 1 gives the final detection results.

Table 1: Final detection results for two bioassays for glucose and urea

Reference	Values	Sample Values	Average Of Sample	Trend Of Droplet	Avg. Offset	Samples Within Avg. Offset	Average of 2nd Iteration	Avg. Offset Of 2nd Iteration	Samples Within 2nd Avg. Offset (Majority)	Trend
TEST FOR GLUCOSE										
HIGH	11001	01000	01110	NORMAL	10011 TO 01001	XXXXX	01100	10001 TO 00111	XXXXX	NORMAL
		01001				01001			01001	
MODERATE	10100	01010				01010			01010	
		01100				01100			01100	
NORMAL	01111	01110				01110			01110	
		10001				10001			10001	
LOW	01010	10100				XXXXX			XXXXX	
		11010				XXXXX			XXXXX	
TEST FOR UREA										
HIGH	11001	01100	10100	MODERATE	11001 TO 01111	XXXXX	10011	11000 TO 01110	XXXXX	MODERATE
		01110				XXXXX			XXXXX	
MODERATE	10100	10001				10001			10001	
		10010				10010			10010	
NORMAL	01111	10110				10110			10110	
		11010				XXXXX			XXXXX	
LOW	01010	11011				XXXXX			XXXXX	
		11101				XXXXX			XXXXX	

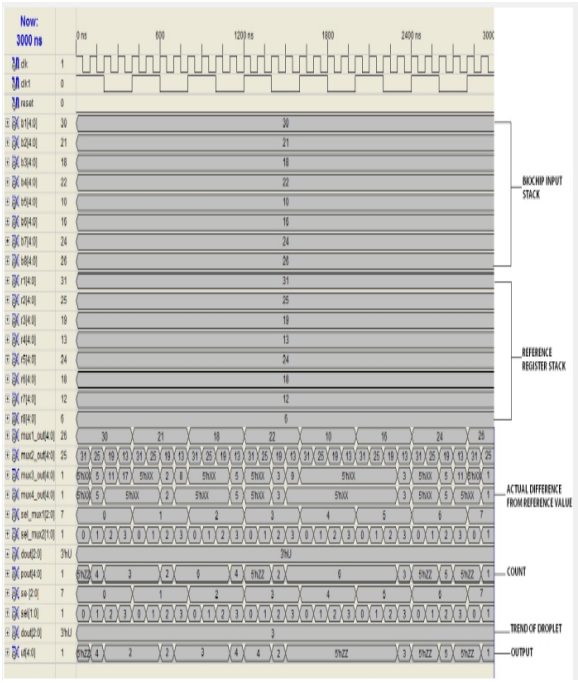

Figure 4: Simulation results for the proposed design in Xilinx 13.1

6. CONCLUSION

In this paper we proposed a design of detection based analyzer for homogeneous samples .As compared with earlier designs we have used multiple levels and developed a new circuit that employs a adaptive system based detection logic to determine the intensity of occurrence of the targeted parameter in the given set of samples and compiled the count for occurrence of each level type – to provide a clear idea for final diagnosis. A mere majority based detection strategy as proposed in earlier works is ignored. Instead a adaptive system based detection to determine the trend of existence of the specific parameter is carried out. The work can be extended to develop a neural network that may integrate other test methodology to combine results from different bioassays executed in different biochips for development of patient specific disease pattern that can be utilized for customized drug design for enhanced medical diagnostic and therapeutic operation.

REFERENCES

[1] Alborz Arzpeyma, Shan Bhaseen, Ali Dolatabadi, Paula Wood Adams, "A coupled electro-hydrodynamic numerical modeling of droplet actuation by electrowetting," Colloids and Surfaces A: Physicochem. Eng. Aspects, vol.323, pp. 28-35, 2008

[2] F Su, Jun Zeng,“ Computer aided design and test for digital microfluidics” ,IEEE Design and test for computers, pp. 60-70. Feb, 2007.

[3] V. Srinivasan et al., “An integrated digital microfluidic lab-on-a-chip for clinical diagnostics on human physiological fluids”, Lab on a Chip, vol. 4, pp. 310-315, 2004.

[4] Randall Evans, Lin Luan, Nan Marie Jokerst, Richard B. Fair, “Optical Detection Heterogeneously Integrated With a Coplanar Digital Microfluidic Lab-on-a-Chip Platform” proceedings of IEEE SENSORS 2007 Conference,pp 423 -426.

[5] L. Luan, R.D. Evans, D. Schwinn, R.B. Fair, and N.M. Jokerst, “Chip Scale Integration of Optical Microresonator Sensors with Digital Microfluidics Systems,” LEOS-2008, Newport Beach, CA, Nov. 2008.

[6] Ramakrishna Sista , Zhishan Hua, Prasanna Thwar Arjun Sudarsan, Vijay Srinivasan, Allen Eckhardt ,Michael Pollack and Vamsee Pamula,“ Development of a digital microfluidic platform for point of care testing”Lab on Chip Journals 2008, 8, pg. 2091–2104.

[7] Pranab Roy, Mahua Raha Patra, Hafizur Rahaman, Parthasarathi Dasgupta: “Digital microfluidic system: A new design for heterogeneous sample based integration of multiple DMFBs.” IEEE ISCAS 2013: pp.1905-1909

[8] P. Roy, M. Raha Patra, H. Rahaman and P. S. Dasgupta, “An intelligent Biochip System for Diagnostic Process Flow based Integration of Combined Detection Analyzer”, Proc. of IEEE International Symposium on Electronic System Design, 2013, Singapore

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ORIGINAL CONTRIBUTION

An Approach to Face and Head Pose Detection using Machine Learning Algorithms

Supriya Singh[*,+], Nitu Kumari[+], [*], Solanki Pattyanayak[$], Banani Ghosh[#] and Sabyasachi Samanta[#]

[+]*Student, 4th year, Department of Information Technology, Haldia Institute of Technology, Haldia, WB, INDIA*

[$]*Haldia Institute of Management, Haldia, WB, INDIA*

[#]*Department of Information Technology, Haldia Institute of Technology, Haldia, WB, INDIA*

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ABSTRACT

Face recognition or detection is one of the most promising applications in the field of image analysis. In this paper, we have attempt to improve the accuracy of face detection algorithm in case of low light in images by making a dynamic image brightness increasing function so that if the image is not properly visible, then the brightness function will increase the brightness of the picture and then faces will be detected. Also we have focused the head pose detection using supervised learning technique in which facial landmark detection and then we have trained the model whether the person is looking left, right, front or there are more than one person in the frame.

KEYWORD: Machine Learning, Face Detection, Head Pose Detection, Image Clustering, K-Means Clustering

1. INTRODUCTION

Face recognition appreciated as one of the most promising applications in the field of image analysis. Face detection has considered as a significant branch of face recognition also[2] [3].

Face Detection: To build our face recognition system, we have first performed face detection, extract face embeddings from each face using deep learning, train a face recognition model on the embeddings, and then finally recognize faces in images. We may apply deep learning and Open CV together (with no other libraries other than scikit-learn) to detect faces, train a machine learning model and recognize faces in images. In order to build our Open CV face recognition pipeline, we'll be applying deep learning in the following way:

- To apply face detection, this detects the presence and location of a face in an image, but does not identify it.
- After face detection and increasing the brightness of all the images to increase the accuracy of face detection, we have to do head pose estimation on all the images to observe whether the person in the image is looking left or right. All this, we have to do using supervised learning.
- And in the last portion, we have to do the image clustering by extracting features of the images using keras's pre trained model and then applying k-means clustering algorithm on the dataset to see whether the person is looking left or right or front or there are multiple persons in the picture.

*Corresponding Address: *supriyasinghs122@gmail.com*

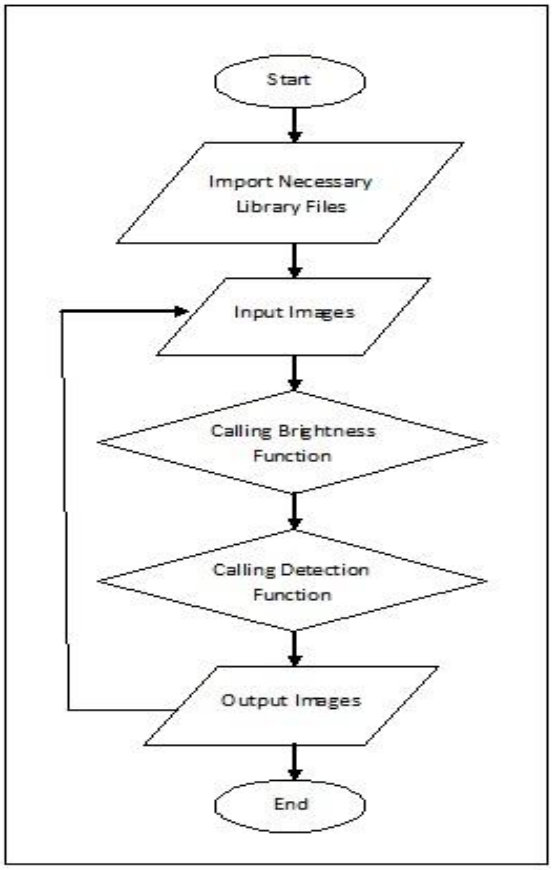


Figure 1: Flow chart for face detection and brightness

The major objectives of the project are to find out that the exam given by a person is valid or invalid. For that we are using video proctoring, where pictures of the person giving exam are clicked every minute and after that we have to perform several functions to detect whether the exam is valid or not. Those functions are listed as follows:

- Detecting faces in the images using face detection api.
- Increasing brightness and then increasing the accuracy of face detection.
- Detecting whether the person is looking left or right or front using supervised learning.
- Clustering using K-means algorithm to detect whether the person is looking left, right, front or there are multiple persons.

After performing all the functions on the image dataset, we have to see whether the person is looking at the screen or not and if there are multiple persons in the screen window and accordingly mark the exam as valid or invalid.

Our intend of this development to improve the accuracy of face detection algorithm in case of low light in images by making a dynamic image brightness increasing function so that if the image is not properly visible, then the brightness function will increase the brightness of the picture and then faces will be detected.

After that, the second thing we have done the head pose detection using supervised learning technique in which to do facial landmark detection and then we have to train the model whether the person is looking left, right, front or there is more than one person in the frame.

At last, we have done the head pose detection and multiple person detection using unsupervised learning technique. So for that first, we have used a pre-trained keras model top extract the features of the images and then applying k-means clustering algorithm to find out whether the person is looking left, right, front or there are multiple persons.

Face recognition from image or video is a popular topic in biometrics research.

The goal of this project is to evaluate various face detection and recognition methods, provide complete solution for image based face detection and recognition with higher accuracy, better response rate as an initial step for video surveillance. Solution is proposed based on performed tests on various face rich databases in terms of subjects, pose and light.

2. WORKS RELATED TO FACE RECOGNITION

Shireesha Chintalapati et al. [1] proposed an automated attendance management system based on face recognition algorithm. This system automatically detects the student when they enters the class room and marks the attendance. With compare to traditional attendance marking it saves time and also helps to monitor the students. Shivam Bachhety et al. [2] projected a crime detection procedure using text and face recognition. These are also very effective at toll

tax collection, parking system, airports, and Border crossings. Text Recognition can be used to identify number plate and face recognition can be used for criminal identification. Faizan Ahmad et al. [3] proposed an image-based face detection and recognition. This method was proposed based on performed tests on various face rich databases in terms of subjects, pose, emotions, race and light. Savath Saypadith et al. [4] proposed a real-time multiple face recognition using deep learning on embedded GPU system. The framework contains face detection based on convolution neural network with face tracking and state of the art deep CNN face recognition algorithm. Rajeev Ranjan et al. [5] proposed a fast and accurate system for face detection and identification. They depict the details of a deep learning pipeline for unconstrained face identification and verification which achieves state-of-the-art performance on several benchmark datasets. Robert Laltanpuia et al. [6] proposed a method on face recognition. They treat face recognition as a two-dimensional recognition problem by converting the colours image into gray scale image. The Eigen face approach uses the PCA for recognition of the images. Experiment result for 145 face images of 29 persons of varying illumination and posture show 80 percent of successful recognition of test images.

Suthagar S. et al. [7] proposed a smart surveillance camera using RASPBERRY PI 2 and OPENCV. They proposed an enhanced recent model- RASPBERRY PI 2 which has operating speed 900MHz. Also they used a PI camera. So the image is captured via the pi camera and it is send to the RASPBERRY PI 2 for processing for face and human detection with the help of OPENCV. Kaipeng Zhang et al. [9] proposed a joint face detection and alignment using multi-task cascaded convolution networks. Their method achieves superior accuracy over the state-of-the-art techniques on the challenging FDDB and WIDER FACE benchmarks for face detection, and AFLW benchmark for face alignment, while keeps real time performance. Nalini Nagendran et al. [9] proposed an security and safety model with facial recognition feature for next generation automobiles. The acknowledged pictures are put away in the picture database amid confront acknowledgment by utilizing Support Vector Machine (SVM) classifier. Sunita Roy et al. [10] also proposed a method on face detection and its applications. Xudong Sun et al. [11] proposed a method on face detection using deep learning by using an improved faster RCNN approach. Piyush Kakkar et al. [12] proposed a criminal identification system using face detection and recognition using known Haar feature-based cascade classifier. Sapna Rathor et al. [13] proposed an image based face detection and recognition by Gabor SVM.

3. IMPLEMENTATION OF THE PROCESS

A. FACE DETECTION AND BRIGHTNESS

To increase the accuracy of the already implemented API in JavaScript for face detection:

2.1: Tools Used:

1. OpenCV: OpenCV-Python is a library of Python bindings designed to solve computer vision problems. OpenCV-Python makes use of Numpy, which is a highly optimized library for numerical operations with MATLAB-style syntax. All the OpenCV array structures are converted to and from Numpy arrays. This also makes it easier to integrate with other libraries that use Numpy such as SciPy and Matplotlib. Mainly we have used the OpenCV library for reading images(cv2.imread(image_path)) , to covert BGR TO RGB format since the input of OpenCV is BGR and we needed the output in RGB.

2. Pillow: Python Imaging Library (abbreviated as PIL) (in newer versions known as Pillow) is a free library for the Python programming language that adds support for opening, manipulating, and saving many different image file formats. It is available for Windows, Mac OS X and Linux. Pillow offers several standard procedures for image manipulation. These include:

- Per-pixel manipulations
- Masking and transparency handling

- Image filtering, such as blurring, contouring, smoothing, or edge finding
- Image enhancing, such as sharpening, adjusting brightness, contrast or colour
- Adding text to images and much more

We mainly have used the image enhance module present inside the PIL library for increasing the brightness and increasing accuracy of our face detection algorithm. We also have used the image stat module present inside PIL for calculate statistics of the image(R, G, B) pixel values of the images and finally calculated the average pixel brightness of the images.

3. Matplotlib: Matplotlib is a python library used to create 2D graphs and plots by using python scripts. It has a module named pyplot which makes things easy for plotting by providing feature to control line styles, font properties, formatting axes etc. It supports a very wide variety of graphs and plots namely - histogram, bar charts, power spectra, error charts etc. It is used along with NumPy to provide an environment that is an effective open source alternative for MatLab. We mainly have made use of this library to view images in the jupyter notebook (plt.imshow(image)).

4. Os: The OS module in python provides functions for interacting with the operating system. OS, comes under Python's standard utility modules. This module provides a portable way of using operating system dependent functionality. The *os* and *os.path* modules include many functions to interact with the file system.

We mainly used the method listdir() returns a list containing the names of the entries in the directory given by path. We mainly used the method to access the directory in which images were present.

B. HEAD POSE ESTIMATION (LOOKING

LEFT AND RIGHT)

Tools Used:

1. Keras : Keras is a high-level neural networks API, written in Python and capable of running on top of TensorFlow, CNTK, or Theano. It was developed with a focus on enabling fast experimentation. We built a Sequential model and feed into it cropped images of left, right and front images and find tried to predict the class of an image.

2. Sklearn :

Skikit-learn is the library used for data analysis. It contains simple and efficient tools for data mining and data analysis. It is built on Numpy, Scipy and Matplotlib.

The second method was landmark detection and extracting 68 points from the original image using the build in face-alignment library present in python and finally made a dataset of 68 features and built a K-[Nearest Neighbors model to classify images into Left, Right and Front.

3. Tensorflow:

TensorFlow is an open source software library released in 2015 by Google to make it easier for developers to design, build, and train deep learning models. TensorFlow originated as an internal library that Google developers used to build models in-house, and we expect additional functionality to be added to the open source version as they are tested and vetted in the internal flavor. Keras is built on top of tensor flow.

CALCULATING THE FACIAL LANDMARKS AND CLASSIFICATION USING MACHINE LEARNING

1. Preparing the dataset

Using the built-in library in python for face landmark prediction we extracted landmarks from 50000 images and prepared the dataset with 68*68 coordinates, image_id,direction and stored it into the csv file landmarks.csv

2. Loading and splitting the dataset

We first loaded the data in X and y and since y was categorical so we encoded it for our machine learning model to understand.

```
from sklearn.model_selection import train_test_split
x=data.drop(['136','137'],axis=1)
y=data['136']
y=pd.get_dummies(y)
'''Dividing it into train and test '''
```

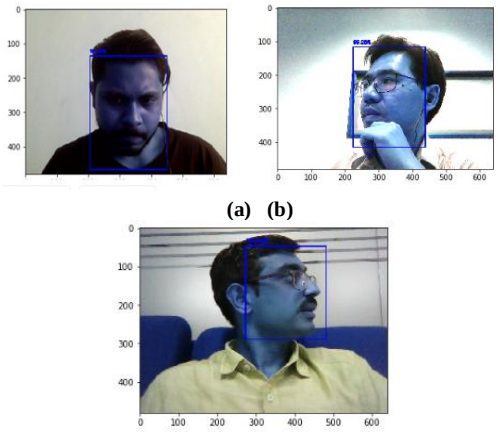
x_train,x_test,y_train,y_test=train_test_split(x,y,test_size=0.2,random_state=12)

Finally we tested several model like DecisionTree Classifier,Random Forest Classifier and KNearest Neighbors and got an accuracy of 92% on both training and testing in KNearest Neighbors so we used it to detect classes on the dataset provided.

3. Function: get_landmark_point():

Take Input of frame (cropped image of the face) and return list of the 68 landmark points. Finally ran the detection for the whole folder. After testing for about 1100 images we have got an accuracy of about 94% approx.

Finally after checking we have decided that the second model is much better than the Keras model and if implemented will give good results.



(a) (b)

(c)

Figure 2: (a) Front, (b) Right and (c) Left Positions detection

C. K-MEANS CLUSTERING

K-means is a simple algorithm that has been adapted to many problem domains. Sklearn.cluster.Kmeans *class* sklearn.cluster.**KMeans**(*n_clusters=8, init='k-means++', n_init=10, max_iter=300, tol=0.0001, precompute_distances='auto', verbose=0, random_state=None, copy_x=True, n_jobs=None, algorithm='auto'*)

Parameters: n_clusters : ***int, optional, default: 8***

The number of clusters to form as well as the number of centroids to generate.

init : ***{'k-means++', 'random' or an ndarray}***

Method for initialization defaults to 'k-means++':

'k-means++' : selects initial cluster centers for k-mean clustering in a smart way to speed up convergence. See section Notes in k_init for more details.

'random': choose k observations (rows) at random from data for the initial centroids.

If an nd array is passed, it should be of shape (n_clusters, n_features) and gives the initial centers. **n_init :** ***int, default: 10***

Number of time the k-means algorithm will be run with different centroid seeds. The final results will be the best output of n_init consecutive runs in terms of inertia.

max_iter : ***int, default: 300,*** Maximum number of iterations of the k-means algorithm for a single run.

tol : ***float, default: 1e-4,*** Relative tolerance with regards to inertia to declare convergence

precompute_distances : ***{'auto', True, False}***

Precompute distances (faster but takes more memory).

'auto' : do not precompute distances if n_samples * n_clusters > 12 million. This corresponds to about 100MB overhead per job using double precision.

True : always precompute distances

False : never precompute distances

verbose : ***int, default 0,*** Verbosity mode.

random_state : ***int, RandomState instance or None (default),*** Determines random number generation for centroid initialization. Use an int to make the randomness deterministic.

copy_x : ***boolean, optional***

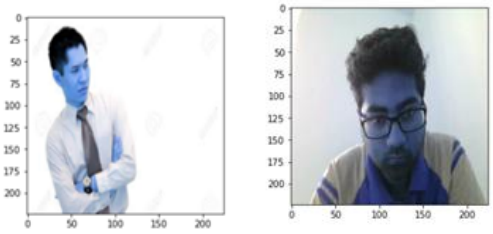
When pre-computing distances it is more numerically accurate to center the data first. If copy_x is True (default), then the original data is not modified, ensuring X is C-contiguous. If False, the original data is modified, and put back before the function returns, but small numerical differences may be introduced by subtracting and then adding the data mean, in this case it will also not ensure that data is C-contiguous which may cause a significant slowdown.

n_jobs : ***int or None, optional (default=None)***

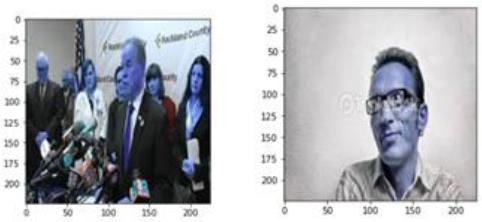
The number of jobs to use for the computation. This works by computing each of the n_init runs in parallel.

None means 1 unless in a **joblib.parallel_backend** context -1 means using all processors.

algorithm : *"auto", "full" or "elkan", default="auto"*
K-means algorithm to use. The classical EM-style algorithm is "full". The "elkan" variation is more efficient by using the triangle inequality, but currently doesn't support sparse data. "auto" chooses "elkan" for dense data and "full" for sparse data.
Attributes: cluster_centers_ : *array, [n_clusters, n_features]*
Coordinates of cluster centers. If the algorithm stops before fully converging (see tol and max_iter), these will not be consistent with labels_.
labels_ : Labels of each point
inertia_ : *float,* Sum of squared distances of samples to their closest cluster center.
n_iter_ : *int* Number of iterations run.
MAKING THE K-MEANS MODEL:
from sklearn.cluster import KMeans
cluster_model
=Means(n_clusters=4,random_state=42)
cluster_model.fit(x)
Here, x is the dataframe in which all the features of all the images to be classified is stored which is returned by the vgg16 model.
np.unique(Cluster_model.labels_)
It returns the unique labels which are given to the images array([0, 1, 2, 3])
So our images are classified in four different clusters of people looking left, right, front and multiple people:



(a) (b)



(c) (d)

Figure 3: (a), (b), (c) and (d) few snapshots of clusters

4. CONCLUSION

Nowadays, technologies are able to automatically identity information for secure transactions, surveillance and security tasks, and access control to buildings etc. To achieve these goal computers must be able to reliably identify nearby people in a manner that fits naturally within the pattern of normal human interactions. These goals now appear in reach -- however, substantial research remains to be done in making person recognition technology work reliably, in widely varying conditions using information from single or multiple modalities. This technology can be further developed to be used in other avenues such as ATMs, accessing confidential files or other sensitive materials. This can make other security measures such as passwords and keys obsolete. Another way that innovators are looking to implement facial recognition is within subways and other transportation outlets. They are looking to leverage this technology to use faces as credit cards to pay for your transportation fee. Instead of having to go to a booth to buy a ticket for a fare, the face recognition would take your face, run it through a system, and charge the account that you've previously created. This could potentially streamline the process and optimize the flow of traffic drastically. But all the faces in some images are not properly detected. Facial landmarks points are properly drawn in case of some images where people are looking left or right. In case of unsupervised learning, clusters are built randomly on its own and all the clusters are not properly made; some random images are also there.

REFERENCES

[1] Shireesha Chintalapati and M.V. Raghunadh, "Automated Attendance Management System Based On Face Recognition Algorithms", IEEE International Conference on Computational Intelligence and Computing Research, 26-28 Dec. 2013, Enathi, India

[2] Shivam Bachhety, Ramneek Singhal, Kshitiz Rawat, Kunal Joshi and Rachna Jain, "Crime Detection Using Text Recognition and Face Recognition", International Journal of Pure and Applied Mathematics, Volume 119, No. 15, 2018,pp. 2797-2807

[3] Faizan Ahmad, Aaima Najam and Zeeshan Ahmed, " Image-based Face Detection and Recognition: State of the Art",https://arxiv.org/pdf/1302.6379

[4] Savath Saypadith and Supavadee Aramvith, "Real-Time Multiple Face Recognition using Deep Learning on Embedded GPU System", Proceedings, APSIPA Annual Summit and Conference 2018 12-15 November 2018, Hawaii, pp. 1318- 1324

[5] Rajeev Ranjan, Ankan Bansal, Jingxiao Zheng, Hongyu Xu, Joshua Gleason, Boyu Lu, Anirudh Nanduri, Jun-Cheng Chen, Carlos D. Castillo and Rama Chellappa, "A Fast and Accurate System for Face Detection, Identification and Verification", Journal of Latex Class Files, Vol. 14, No. 8, August 2015, pp. 1-16

[6] Robert Laltanpuia, Vanlalhruaia and R.Chawngsangpuii, "Face Recognition Using Pca", International Journal of Engineering Science Invention (IJESI) ISSN (Online): 2319 – 6734, ISSN (Print): 2319 – 6726, Volume 7 Issue 4 Ver. V, April 2018, PP 17-28

[7] Suthagar S, Augustina Shaglin Ponmalar,3Benita,Banupriya and Beulah, "Smart Surveillance Camera Using Raspberry PI 2 and OPENCV", International Journal of Advanced Research Trends in Engineering and Technology (IJARTET), Vol. 3, Special Issue 19, April 2016

[8] Kaipeng Zhang, Zhanpeng Zhang and Zhifeng Li, "Joint Face Detection and Alignment using Multi-task Cascaded Convolutional Networks", EEE Signal Processing Letters, April 2016, pp. 1-5

[9] Nalini Nagendran and Ashwini Kolhe, "Security and Safety With Facial Recognition Feature for Next Generation Automobiles", International Journal of Recent Technology and Engineering (IJRTE) ISSN: 2277-3878, Volume-7 Issue-4S, November 2018, pp. 289- 294

[10] Sunita Roy and Susanta Podder, " Face detection and its applications", IJREAT International Journal of Research in Engineering & Advanced Technology, Volume 1, Issue 2, April-May, 2013 ISSN: 2320 – 8791, pp. 1-10

[11] Xudong Sun, Pengcheng Wu and Steven C.H. Hoi, "Face detection using deep learning: An improved faster RCNN approach", Neurocomputing, 2017 July, Volume 299, Pages 42-50

[12] Piyush Kakkar and Vibhor Sharma, "Criminal Identification System Using Face Detection and Recognition", International Journal of Advanced Research in Computer and Communication Engineering, Vol. 7, Issue 3, March 2018

[13] Sapna Rathor, Harsh Gupta and Dev Karan Singh, "Image Based Face Detection and Recognition by Gabor SVM", International Journal of Scientific & Engineering Research, Volume 6, Issue 7, July-2015 434 ISSN 2229-5518, pp. 434-437

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ORIGINAL CONTRIBUTION

A study on – Analysis of success of application of IPR in India

*Indranil Bandyopadhyay

Dept. of Management and Social Science, Haldia Institute of Technology Haldia, Purba Medinipur, WB, India

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ABSTRACT

IPR provides a secure environment for investors, scientists, artists, designers, traders etc. to foster innovation and scientific temper. This innovation often has potential to yield astronomical returns and rewards to creators and users. Obviously, original inventors shall have rights to such profits. However it is imperative that society at large should also be benefited by such outcomes. Thus, IPR regime aims to strike balance between public and private rights.

There were various treaties at the world level like Paris Convention for Industrial Property, 1883, Bern convention for literary and artistic works, 1886, Madrid Agreement, 1881, Patent co-operation treaty, 1970, Budapest Treaty of 1980, Trademark Law Treaty, 1994,The Hague agreement concerning the International Deposit of 'Industrial Design' 1925, International Union for protection of new varieties of plants, 1961, Agreement on Trade Related Aspects of Intellectual Property etc. which almost all the countries of the world follows keeping in tune to their own domestic laws. Same is done by India. Few IPR acts which India follows are:

Copyrights Act 1957, amended in 2012, Patents Act, 1970, amended in 2006, Trademark Act 1999, Designs Act, 2000, Geographical Indications of Goods Act, 1999, Protection of Plant varieties and farmers' right Act, 2001, Semi-conductors and integrated Layout design Act, 2000, Traditional Knowledge Digital Library-A collaboration between the Council of Scientific and Industrial Research (CSIR) and the Department of Ayurveda, Yoga and Naturopathy, Unani, Siddha and Homoeopathy (Dept. of AYUSH), Ministry of Health & Family Welfare, Government of India.

In this work we have tried to find out whether in India the IPR Acts are followed properly or whether Government of India is amending the IPR Acts as per the demand of modern times. Key words : Intellectual Property Rights, treaty, copyright, trademark, patent, design, geographical indications

Declaration : This paper has not been published anywhere else earlier.

Key notes: Intellectual property Right,

1. INTRODUCTION

Intellectual property Right (IPR) is a term used for various legal entitlements which attach to certain types of information, ideas, or other intangibles in their expressed form. The holder of this legal entitlement is generally entitled to exercise various exclusive rights in relation to the subject matter of the Intellectual Property. The term intellectual property reflects the idea that this subject matter is the product of the mind or the intellect, and that Intellectual Property rights may be protected at law in the same way as any other form of property. Intellectual property laws vary from jurisdiction to jurisdiction, such that the acquisition, registration or enforcement of IP rights must be pursued or obtained separately in each territory of interest.

Intellectual property rights (IPR) can be defined as the rights given to people over the creation of their minds. They usually give the creator an exclusive right over the use of his/her creations for a certain period of time.

What is Intellectual Property?

*Corresponding Address: indranil_bandyopadhyay2000@yahoo.com

Intellectual property is an intangible creation of the human mind, usually expressed or translated into a tangible form that is assigned certain rights of property. Examples of intellectual property include an author's copyright on a book or article, a distinctive logo design representing a soft drink company and its products, unique design elements of a web site, or a patent on the process to manufacture chewing gum.

What is Intellectual Property Rights?

Intellectual property rights (IPR) can be defined as the rights given to people over the creation of their minds. They usually give the creator an exclusive right over the use of his/her creations for a certain period of time.

Intellectual property (IP) refers to creations of the mind: inventions, literary and artistic works, and symbols, names, images, and designs used in commerce.

Categories of Intellectual Property

One can broadly classify the various forms of IPRs into two categories:

- IPRs that stimulate inventive and creative activities (patents, utility models, industrial designs, copyright, plant breeders' rights and layout designs for integrated circuits) and
- IPRs that offer information to consumers (trademarks and geographical indications).

IPRs in both categories seek to address certain failures of private markets to provide for an efficient allocation of resources

IP is divided into two categories for ease of understanding:

1. **Industrial Property**
2. **Copyright**

Industrial property, which includes inventions (patents), trademarks, industrial designs, and geographic indications of source; and

Copyright, which includes literary and artistic works such as novels, poems and plays, films, musical works, artistic works such as drawings, paintings, photographs and sculptures, and architectural designs. Rights related to copyright include those of performing artists in their performances, producers of phonograms in their recordings, and those of broadcasters in their radio and television programs

Intellectual property shall include the right relating to:

i. Literary, artistic and scientific works;

ii. Performance of performing artists;

iii. Inventions in all fields of human endeavour;

iv. Scientific discoveries;

v. Industrial designs;

vi. Trademarks, service marks and etc;

vii. Protection against unfair competition.

What is a property?

Property designates those things that are commonly recognized as being the possessions of an individual or a group. A right of ownership is associated with property that establishes the good as being "one's own thing" in relation to other individuals or groups, assuring the owner the right to dispense with the property in a manner he or she deems fit, whether to use or not use, exclude others from using, or to transfer ownership.

Properties are of two types - tangible property and intangible property i.e. one that is physically present and the other which is not in any physical form. Building, land, house, cash, jewellery are few examples of tangible properties which can be seen and felt physically. On the other hand there is a kind of valuable property that cannot be felt physically as it does not have a physical form. Intellectual property is one of the forms of intangible property which commands a material value which can also be higher than the value of a tangible asset or property.

3. RIGHTS PROTECTED UNDER INTELLECTUAL PROPERTY

The different types of Intellectual Property Rights are:

i. Patents
ii. Copyrights
iii. Trademarks
iv. Industrial designs
v. Protection of Integrated Circuits layout design
vi. Geographical indications of goods
vii. Biological diversity
viii. Plant varieties and farmers rights
ix. Undisclosed information

IPR as Instruments of Development

a. Key drivers of economic performance in R&D based growth models

b. Intellectual property policies do affect the extent and nature of investments undertaken by multinational enterprises. At the same time, relative to other factors determining foreign investment decisions, IPRs seem to be of relatively minor importance.

Duration of Intellectual Property Rights in a nutshell

1) Term of every patent will be 20 years from the date of filing of patent application, irrespective of whether it is filed with provisional or complete specification. Date of patent is the date on which the application for patent is filed.
2) Term of every trademark registration is 10 years from the date of making of the application which is deemed to be the date of registration.
3) Copyright generally lasts for a period of sixty years.
4) The registration of a geographical indication is valid for a period of 10 years**.**
5) The duration of registration of Chip Layout Design is for a period of 10 years counted from the date of filing an application for registration or from the date of first commercial exploitation anywhere in India or in any convention country or country specified by Government of India whichever is earlier.
6) The duration of protection of registered varieties is different for different crops namely 18 years for trees and vines, 15 years for other crops and extant varieties.

Intellectual Property Trends – India

- During 2009-10, 34,287 patent applications were filed, 6069 examined and 6168 patents granted. The number of applications filed by the Indian applicants was 7044. Out of the applications filed by the Indian applicants, Maharashtra accounted for the maximum number followed by Delhi, Tamil Nadu, Karnataka, Andhra Pradesh, West Bengal etc.
- During 2009-10, 6092 design applications were filed, 6266 examined and 6025 registered. The number of applications filed by the Indian applicants was 4267. The number of registered designs in force at the end of 2009-10 was 39008.
- During 2009-10, 1,41,943 trademark applications were filed, 25875 examined and 67,490 registered. The number of applications filed by the Indian applicants was 1,34,403. The total number of registered trademarks as of 31st March, 2010 is 8,22,825.
- During 2009-10, 40 Geographical indications applications were filed and 14 were registered. A total of 120 Geographical Indications have been registered till 31st March, 2010.
- During 2009-10, 142 applications were received for access of bio-resources for research/commercial use, transfer of research results, intellectual property rights and third party transfer. Totally, 13 agreements have been signed. So far,

11 patents have been granted on the applications cleared by NBA. The NBA has also received a royalty.

- In 2010-11, a total of 642 applications representing 28 crops were received by the Authority for seeking plant variety protection under the Act. The applications belong to new (395), extant (216), farmers' varieties (30) and essentially derived variety (1) categories.

Initiatives of Government of India towards protection of IPR

1. The Government has brought out A Handbook of Copyright Law to create awareness of copyright laws amongst the stakeholders, enforcement agencies, professional users like the scientific and academic communities and members of the public.
2. National Police Academy, Hyderabad and National Academy of Customs, Excise and Narcotics conducted several training programs on copyright laws for the police and customs officers.
3. The Department of Education, Ministry of Human Resource Development, Government of India has initiated several measures in the past for strengthening the enforcement of copyrights that include constitution of a Copyright Enforcement Advisory Council (CEAC), creation of separate cells in state police headquarters, encouraging setting up of collective administration societies and organization of seminars and workshops to create greater awareness of copyright laws among the enforcement personnel and the general public.
4. Special cells for copyright enforcement have so far been set up in 23 States and Union Territories, i.e. Andhra Pradesh, Assam, Andaman & Nicobar Islands, Chandigarh, Dadra & Nagar Haveli, Daman & Diu, Delhi, Goa, Gujarat, Haryana, Himachal Pradesh, Jammu & Kashmir, Karnataka, Kerala, Madhya Pradesh, Meghalaya, Orissa, Pondicherry, Punjab, Sikkim, Tamil Nadu, Tripura and West Bengal.
5. The Government also initiates a number of seminars/workshops on copyright issues. The participants in these seminars include enforcement personnel as well as representatives of industry organizations.

4. OVERVIEW OF LAWS RELATED TO INTELLECTUAL PROPERTY RIGHTS IN INDIA

The Rules and Laws governing Intellectual Property Rights in India are as follows:

1. The Copyright Act, 1957, The Copyright Rules, 1958 and International Copyright Order, 1999.
2. The Patents Act, 1970 The Patents Rules, 2003, The Intellectual Property Appellate Board (Patents Procedure) Rules, 2010 and The Patents (Appeals and Applications to the Intellectual Property Appellate Board) Rules, 2011.
3. The Trade Marks Act, 1999, The Trade Marks Rules, 2002, The Trade Marks (Applications and Appeals to the Intellectual Property Appellate Board) Rules, 2003 and The Intellectual Property Appellate Board (Procedure) Rules, 2003.
4. The Geographical Indications of Goods (Registration and Protection) Act, 1999 and the Geographical Indications of Goods (Registration and Protection) Rules, 2002.
5. The Designs Act, 2000 and The Designs Rules, 2001.
6. The Semiconductors Integrated Circuits Layout-Design Act, 2000 and The Semiconductors Integrated Circuits Layout-Design Rules, 2001.
7. The Protection of Plant varieties and Farmers' Rights Act, 2001 and The Protection of Plant varieties and Farmers Rights' Rules, 2003.
8. The Biological Diversity Act, 2002 and The Biological Diversity Rules, 2004.

9. Intellectual Property Rights (Imported Goods) Rules, 2007.

5. CONCLUSION

India's IPR regime stands fully complaint to Agreement on TRIPS i.e. Agreement on Trade Related Aspects of Intellectual Property which is a landmark and most comprehensive treaty on Intellectual property. However, implementation of various laws should be more strictly and stringently done. Patent or copyright infringement and piracy in India is not uncommon. It is also the fact that India has poor performance in R&D, where it accounts for meager 2.7% of global expenditure. Poor

IPR protection regime plays some part in this. Government is about to launch a New IPR policy. It is expected that it will reassert its commitment to TRIPS and promise that measures like compulsory license will be resorted to in rarest of rare cases. It will also consider need and measures to ramp up implementation by building infrastructural and human resource capacities. It is like to give a significant impetus to expansion of copyright and patent offices all over India.

As we have seen that various subject matters in IPR are dealt by different departments and ministries, there needs to be some integration among these arms. This integration is prerequisite for formulating an integral IPR policy and taking stand at various international forums. Having said this, legal setup in India nicely tries to balance Public rights with Private rights. This system provides adequate incentives for entrepreneurs to innovate. We just need strict implementation. This way we will able to make innovation a change agent of Indian economy.

REFERENCES

[1] Sinha.A, n.d,' Intellectual Property Rights in India' (ISBN 978-81-928510-1-3) retrieved from Legal Service India.com

[2] Adukia..R.S,n.d, 'Handbook of Intellectual Property Rights in India'-Caaa.in (www.caaa.in> Image> 34-hb-on-IPR)

[3] Rao.S,' IPR,2nd Edition, ch-1'retrieved from www. bspublications.net

[4] Prabu L.S, Suryaprakash.T.N.K, Dinesh Kumar. C (2012),'Intellectual Property Rights and Its Development in India' retrieved from Pharma Times-vol 44-No. 07-July 2012

[5] www.ipindia.nic.in- Intellectual Property Office India

[6] www.mit.gov.in- Department of Information Technology India

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ORIGINAL CONTRIBUTION

An Approach to Automated Human Less Secure Billing and Dispensing System

Amisha Sinha[+], Suman Kumar[+,*], Solanki Pattyanayak[$], Moumita Mantri[#] and Sabyasachi Samanta[#]

[*]*Student(4th year), Department of Information Technology, Haldia Institute of Technology, Haldia, WB, INDIA*

[$]*Haldia Institute of Management, Haldia, WB, INDIA*

[#]*Department of Information Technology, Haldia Institute of Technology, Haldia, WB, INDIA*

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ABSTRACT

Detection of objects from any particular reflection is enormously conflicting. Changes in enlightenment and of camera position generate important dissimilarity in image appearance, even in a motionless picture. For example, people have different nature of walking, eating, swimming etc. and wear a variety of clothes from day to day. The handwritten character, digits differs from one to others only for the practice of different slants, stroke widths, etc. by different persons. Development of detection algorithms are invariant with respect to these variations and are computationally efficient. In this work, we have developed a scheme that detect the dispensed items and also tally it with the billed items. If there is any discrepancy between the two then it will generate the error to the main system, inform the supervisor about it.

Keywords: Human Less Secure Billing System, Automated Dispensing System, Deep Learning, Neural Network, Object Detection

1. INTRODUCTION

In the world of today, it's the trust and loyalty that the constraint while planning any business and discussing about it, the widely spread and easy to set up any business is installing a shop. So when you install a shop, you need a good management of inventories and staff as well who are honest enough share and generate revenues. That's why there came the payroll system of billing each entity to track record of every item sold. Just imagine at a stall, which sells beverages, the cost of tea is Rs. 10 and that of coffee is 20. Now the vendor can do mischief by selling coffee at 15 and billing for tea against it. So for each cup sold, the loss to the entrepreneur is Rs. 05 which is shared by selling staff and customer in the ratio 50:50 percent each.

The violation arises due to dishonesty of staff member. And our goal is to remove this all, making a secure billing and dispensing counter. By putting back our trust in machine's intelligence to be designed artificially, rather than risking it for some human whose honesty is subject to question. The architecture of our model builds a system that takes the order from the user via billing counter and the same is matched with the item description provided at the dispensing window by our object recognition module, which further generates alert if there is any mismatch in two [1] [2]. To achieve our goal, we have used a lot of features from the world of Artificial Intelligence and Machine Learning like Deep Learning, CNN etc.

*Corresponding Address: *suman3961@gmail.com*

Machine learning is an application of Artificial Intelligence that gives the capability to automatically learn and improve from experience without being explicitly programmed. The primary aim is to allow be trained without human intervention. Deep Learning (DL) and Neural Network (NN) are currently driving some of the most ingenious inventions in today's century. Deep Learning and Neural Network lie in the heart of products such as self-driving cars, image recognition software, recommender systems etc. Neural networks are the building blocks of Deep Learning Algorithm. It is nothing but analogous to our neurons. Neural Networks (NN), also called as Artificial Neural Network is named after its artificial representation of working of a human being's nervous system.

Here, the object identification and visual tracking has been done through the use of ordinary camera. Here the background subtraction technique has been implemented. This technique is applicable only, where there is no movement of camera. For robotic application or automated vehicle assistance system, due to the movement of camera, backgrounds are continuously changing leading to implementation of some different segmentation techniques like single Gaussian mixture or multiple Gaussian mixture models. Object identification task with motion estimation needs to be fast enough to be implemented for the real time system. Still there is a scope for developing faster algorithms for object identification [9] [10].

Section 2 is about the related works. Section 3 represents the scheme followed by process diagram and implementation of the process. Section 4 represents the limitation of the process. Section 5 draws a conclusion.

2. PREVIOUS WORK

MD. Saddam Hussain et al. [1] proposed deadlock avoidance and re-routing of automated guided vehicles (AGVS) in flexible manufacturing systems (FMS). They developed an algorithm and code it in a software language which generates a safe sequence to be followed to avoid deadlock.

Lakshmi K et al. [2] recommend a GPS based automatic toll collection system. That was designed for the automation in toll tax payment using GPS and GSM Technology. Automation of toll plaza has been experimented using combination of Microcontroller, RFID, Global positioning system, Global system for Mobile. Implementation of automation in toll plaza enhances the monitoring of vehicles that are travelling in predestined routes. It may bypass the information to avoid the traffic congestion at toll plazas and helps in consuming less amount of fuel.

Farshid Sahb et al. [3] planned a museum automation system with RFID. In this system visitors have to monitored, as well as visitors need to be guided and getting information in the environment. By utilizing RFID technology and short-distance network tools, technical solutions for more efficient management and more effective retention in museums may be implement by this technique.

Chahat Varshney et al. [4] proposed a smart vending machine with security features for automatic car parking system. They have implemented an improved and secured vending machine for automatic car parking applications. It's included with the security features and the coin management systems. Likewise, entry and exit module with the slot management has been intelligently designed. Thus, the cash management and the parking slot management have been presented here. Also, the power consumption of the overall system has been optimized by the PSO Algorithm (Particle Swarm Optimization).

Ankita Nagrale et al. [5] recommend an automatic toll collection and data monitoring scheme. They explained the implantation of automation in toll plaza which is a step towards improving the monitoring of vehicles, travelling in predetermine routes. If the vehicle belongs to the authorized person, it automatically opens the toll gate and a predetermined amount is automatically deducted from its account. This translates to reduced traffic congestion at toll plazas and helps in lower fuel consumption. Vishnupriya. R et al. [6] also proposed an

automatic toll collection system using RFID & GSM technology. This identifies an approaching vehicles and records vehicles number and time. Whenever the vehicle passes the toll booth, the amount will be deducted from his prepaid balance and new balance will be updated. In case if one has insufficient balance, his updated balance will be negative one. Satyasrikanth P. et al. [10] projected an automatic toll collection system using RFID The need for manual toll based systems is completely reduced in this methods and the tolling system works through RFID.

Priyanka Sutrave et al. [7] proposed an authenticated and automated museum using RFID and IOT. The proposed system is based on RFID tag per visitor which has ability to identify visitors & generates an OTP and at the same time counts the number of visitors entering in the museum. Apart from this, the visitors can consequently get the multimedia information of each sculpture by scanning the respective QR-code (Quick Response-code) near each artwork, will also opt the information based on their preferred languages.

Neelima Mishra et al. [8] planned automation in restaurants by ordering to robots via smart ordering system. It's a web based application that a customer can open on their smart phone. This system will help restaurants and hotels to increase their star rating and reduce the human error at the time of taking orders.

S. Baby et al. [9] proposed a systematic role check with human less auto meter reading using LIFI. To propose a technique of LIFI, where in EB meter when transmit the electricity consumption reading details to server. Reading details transmit to server through LIFI. Server calculates the cost of remaining units and send EB bill to user mobile phone via SMS. User may view SMS and pay their EB bills through remotely. Android Application is deployed to the customer for Payment System.

3. ACTIVITY DIAGRAM

Activity diagrams are loosely defined diagram technique for showing work flows of stepwise activities and actions. Activity diagrams can be used to describe the business and operational step-by-step workflows of components in a system. An activity diagram shows the overall flow of control. Here the activity diagram has been extended to indicate flows among steps that convey physical element. Activity diagrams are typically used for business process modelling. They consist of initial node, activity final node, activities. The starting point of the diagram is the initial node, and the activity final node is the ending.

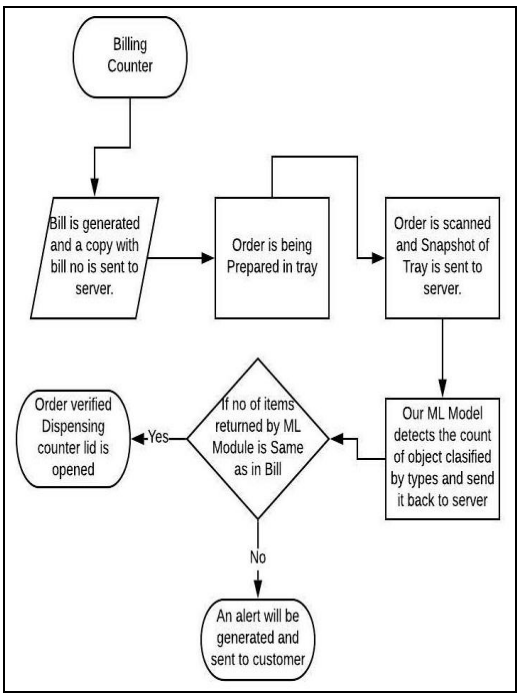

Figure 1: Flow chart for activity diagram

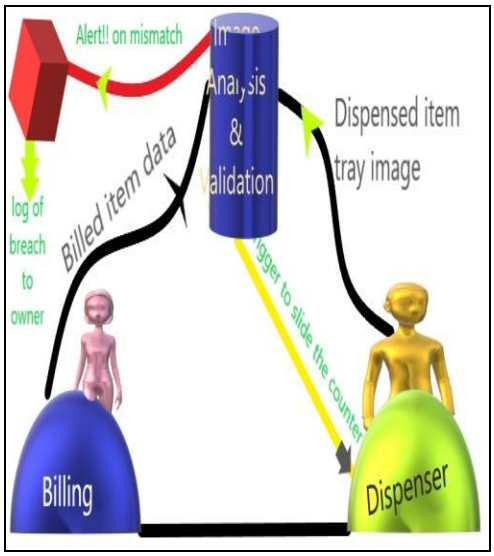

Figure 2: Overview of entire process

A. IMPLEMENTATION OF THE WORK

MODULE 1: GUI (Graphical User Interface)

GUI provides an efficient way through which user can interact with the system and works accordingly to fulfil the task. Through GUI user can select the file that is to be encrypted or decrypted. User can generate keys randomly or enter manually. At every window a "back" button is provide that lets the user to go back to the previous window. Thus, it provides a user-friendly environment.

MODULE 2: Image detection

This module takes the snapshot of image and process it under model trained.

It detects the class of image as per pre trained model and forwards the information to python module.

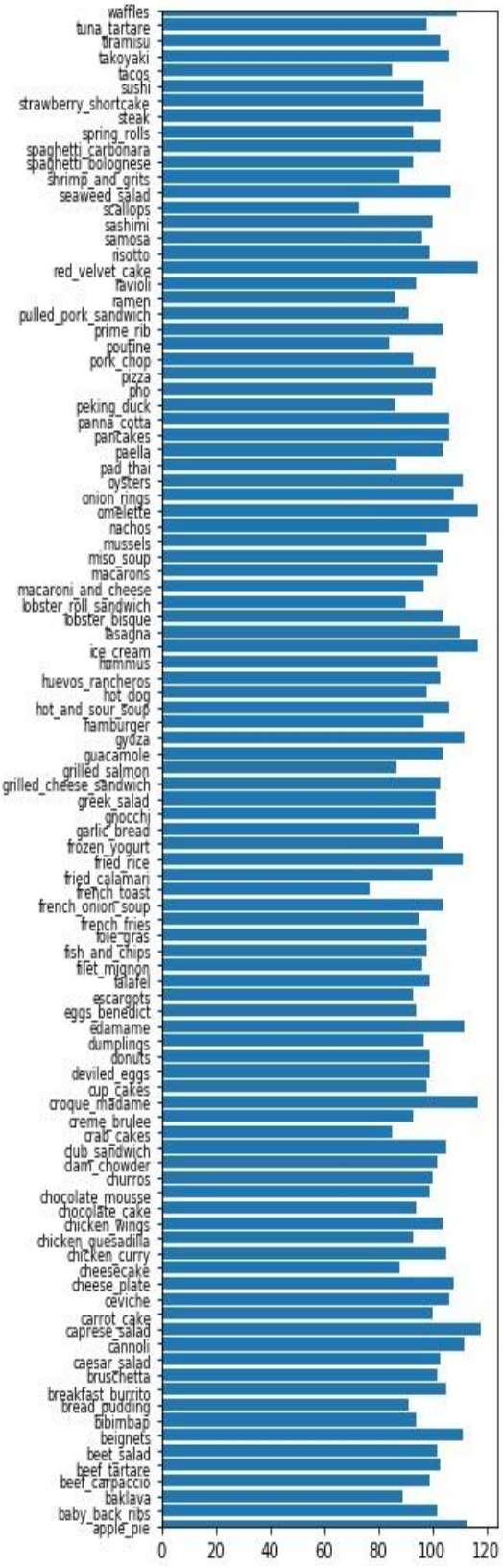

Figure 3: Result and Accuracy on 1000 samples

MODULE 3: Object count and classification

In this module, we count the objects in the image. And forward it to the next module where it will be matched against the bill.

MODULE 4: Object matching count with generated bill

In this module, the matching is done with the bill generated and an alert is generated on mismatch.

MODULE 5: Generate the alert

It alerts the user about breach.

B. USER INTERFACE DESIGN

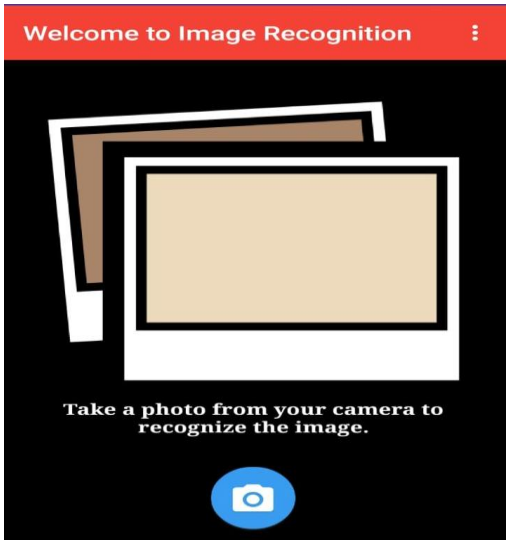

Figure 4: Object Scanner application

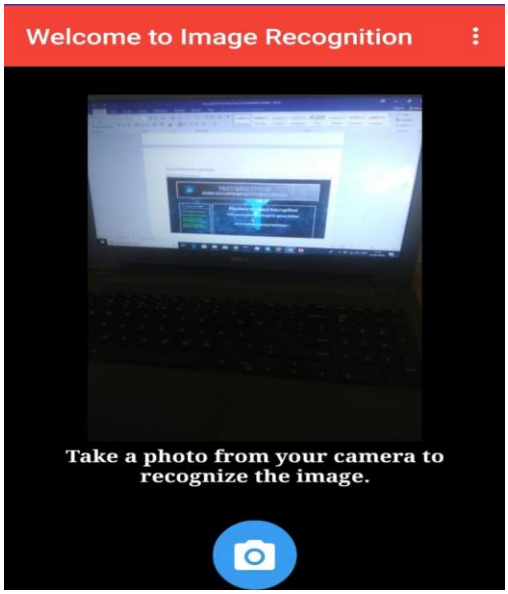

Figure 5: Predicting image

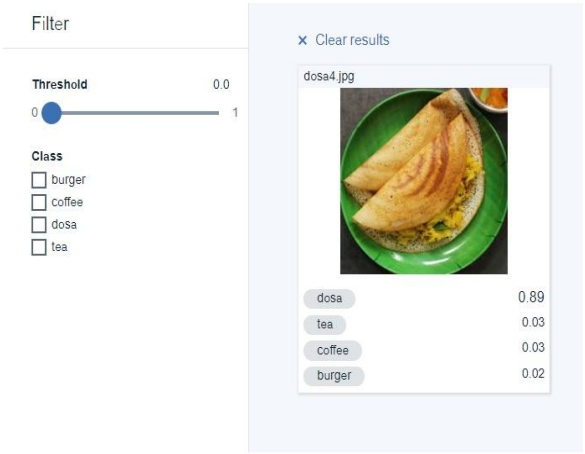

Figure 6: Object detection

4. LIMITATIONS OF THE SYSTEM

In the single visual tracking, the size of the template remains fixed for tracking. If the size of the object reduces with the time, the background becomes more dominant than the object being tracked. In this case the object may not be tracked. Fully occluded object cannot be tracked and considered as a new object in the next frame.

- Foreground object extraction depends on the binary segmentation which is carried out by applying threshold techniques.
- So spot extraction and tracking depends on the threshold value.

- Splitting and merging cannot be handled very well in all conditions using the single camera due to the loss of information of a 3D object projection in 2D images.

To make the system fully automatic and also to overcome the above limitations, in future, multi-view tracking can be implemented using multiple cameras. Multi view tracking has the obvious advantage over single view tracking because of wide coverage range with different viewing angles for the objects to be tracked. In this work, an effort has been made to develop an algorithm to provide the base for future applications such as listed below. Here we have used following validation checks.

- Evaluate the count of the objects given by last module to the count received from the billing end.
- Use python script for this purpose.
- If there is mismatch, an alert will be generated along with the description log.

5. CONCLUSION

Here we have proposed a model for object identification and to achieve the estimation of motion analysis of the entity. Because of the fact that there is not yet an outperforming algorithm, even though the literature on object tracking is very rich, various approaches are merged together for achieving better results. Different approaches have been tried for different tasks during the development of the new proposed algorithms implemented and discussed in the previous chapters. An accurate and efficient object detection system has been developed which achieves comparable metrics with the existing state-of-the-art system. This method uses recent techniques in the field of computer vision and deep learning. Custom dataset was created using labelling and the evaluation was consistent. This can be used in real-time applications which require object detection for pre-processing in their pipeline. An important scope would be to train the system on a video sequence for usage in tracking applications. Addition of a temporally consistent network would enable smooth detection and more optimal than per-frame detection.

REFERENCES

[1] MD. Saddam Hussain, B. Satish Kumar and G. Janardhana Raju, "Deadlock Avoidance And Re-Routing Of Automated Guided Vehicles (AGVS) in Flexible Manufacturing Systems (FMS)", International Journal of Advances in Production and Mechanical Engineering (IJAPME), ISSN(print):2394-6202,(online):2394-6210,Volume-1,Issue-4,2015, pp. 5-9

[2] Lakshmi K. , Megha R., Abhilasha B. K., Kruthi P. and Harshitha K. S., "GPS Based Automatic Toll Collection System", International Journal of Innovative Research in Computer and Communication Engineering, ISSN(Online): 2320-9801, ISSN (Print): 2320-9798, Vol. 5, Special Issue 6, July 2017, pp. 105-109

[3] Farshid Sahb and Maryam Nazaridoust, "Museum Automation with RFID", https:// arxiv.org/ pdf/1410.0519

[4] Chahat Varshney, Kamal Prakash Pandey and Naresh Chandra Agrawal," Design and Implementation of Smart Vending Machine with security Features for Automatic car Parking System", International Journal of Advanced Engineering Research and Technology (IJAERT), Volume 5, Issue 8, August 2017, ISSN No.: 2348 – 8190, pp. 643-647

[5] Ankita Nagrale, Nikita Shinde, Pranita Golekar, Vinayak Godhale and Urvashi Bhat, " Automatic Toll Collection and Data Monitoring", International Journal of Advance Research in Science and Engineering, Vol. 6, Issue 4, April 2017, pp. 271-275

[6] Vishnupriya. R and N. P. Ananthamoorthy, "Automatic Toll Collection System Using RFID & GSM Technology", International Journal of Advanced Research in Computer and Communication Engineering, Vol. 6, Issue 10, October 2017, pp. 285-290

[7] Priyanka Sutrave and Rekha S., "Authenticated and Automated Museum Using RFID AND IOT", International Journal of Computer Engineering & Technology (IJCET) Volume 9, Issue 3, May-June 2018, pp. 69–75,

[8] Neelima Mishra, Dinesh Goyal and Ashish Dutt Sharma, "Automation in Restaurants: Ordering to Robots in Restaurant via Smart Ordering System", International Journal of Converging Technologies and Management (IJCTM), Volume 4, Issue 1, 2018 ISSN: 2455 - 7528

[9] S. Baby, S. Hemamalini, N. Pavithra, V. Suganya and T. Karthikeyan, "EB check: systematic role check with humanless auto meter reading using LIFI", International Research Journal in Advanced Engineering and Technology, E - ISSN: 2454-4752 P - ISSN : 2454-4744, Volume 3, Issue 2 (2017), pp. 1753 – 1757

[10] Satyasrikanth P., Mahaveer Penna and Dileep Reddy Bolla, "Automatic Toll Collection System Using RFID", International Journal of Computer Science and Mobile Computing, ISSN 2320–088X, Vol. 5, Issue. 8, August 2016, pg.247 – 253

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ORIGINAL CONTRIBUTION

Application of Cu Impregnated TiO_2 Nanomaterial for Photocatalytic Degradation of Organic Dye in the Presence of Sunlight

Siddhartha Sankar Boxi*, Avinash Kumar, Soumya Chatterjee, Amal Kumar and Rittik Kumar Jana

Dept. of Chemical Engineering, Haldia Institute of Technology, Haldia, West Bengal, India

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ABSTRACT

Cu impregnated TiO_2 nanoparticles were synthesized by wet impregnation method. Photodegradation of methylene blue dye (MBD) was conducted in the presence of TiO_2 and Cu impregnated TiO_2 nanoparticles under sunlight. Experiment was performed in aqueous media at normal pH condition. The degradation was investigated under different TiO_2 concentration (0.05 to 0.5 mg/l). Initial concentration of MBD solution was maintained at 0.2 g/l. For pure TiO_2 the maximum dye degradation efficiency was obtained 92.61% at 0.25 mg/l TiO_2. Dye removal efficiency increased to 98.06% in the presence of 1% Cu impregnation. Reason of increase in degradation efficiency in the presence of Cu impregnation was also explained in detail.

KEYWORDS: TiO_2, Cu, Impregnation, Dye, Photocatalysis, Oxidation

1. INTRODUCTION

Environmental pollution because of organic dyes is one major problem that world is facing today. Contamination of dyes in water is mainly due to the disposal of dye pollutants from textile, dye, leather, food and paper industries. It was reported that about 15% of world production of dyes is released through the effluent of textile industries during dyeing [1–3].These organic wastes are harmful for microorganisms, aquatic life and human life. Synthetic dyes also hindered the penetration of sunlight through water and are responsible for eutrophication and death of the aquatic life [4]. So, removal of dyes from environment is very important. As the synthetic dyes contain complex aromatic compound it is not easily biodegradable. Different methods have been developed to remove the organic pollutants from the environment, such as adsorption [5], biodegradation [6], chlorination [7], etc.Over the last few years research has been focused on the heterogeneous based catalyst for the oxidation of polluting compounds such as dyes.

Titanium dioxide (TiO_2), a semiconductor material, has long been studied for its wide range of applications in photocatalysis, solar cell, hydrogen gas production, bio applications, and so on. For the catalytic point of view TiO_2 has been regarded as an excellent semiconductor photocatalyst for its high performance, low toxicity, low cost, availability, and outstanding chemical stability[8–10]. But, because of its wide band gap (3.2 eV for anatase and 3.06 eV for rutile) [11] TiO_2 acts efficiently as a catalyst under UV light irradiation. Since only a small fraction (3–5%) of solar light

*Corresponding Address: ssboxich@gmail.com

corresponds to UV region, so, it is expected that merely 3–5% of whole radiant solar energy is use full for the photocatalysis application. It is also well known that there is a high rate of recombination between the excited electron and positive hole in case of pure TiO_2. Research interest came to the scenario on the development of efficient TiO_2 photocatalyst that can efficiently utilize the solar or indoor visible light for catalytic degradation. Several steps have been taken for improving the catalytic response of TiO_2 nanomaterials to visible light. Modification of TiO_2in the presence of other metals can produce high Schottky barrier that facilitates electron capture[12], that may produce longer electron-hole pair separation life time and reduce the recombination of electron-hole pair separation. Several studies has been done in order to get the visible light response of TiO_2 photocatalyst, such as transition metal doping[13–17], deposition of noble metal [18–21], dye photosensitization on the TiO_2 surfaces[22, 23], etc.

Deposition of transition metal like Copper on TiO_2 can reduce recombination of charge carriers and enhances photocatalytic activity [24]. It was also reported that copper is an effective candidate for H_2 evaluation from water under visible irradiation [25]. Impregnation of Cu on TiO_2 was tested to be a good active catalyst in the hydrogenation of 1,3-cyclooctadiene and in the CO–NO reaction between Cu/TiO_2 samples [26]. Impregnation of Cu and Zn on TiO_2 was applied as photocatalyst for the conversion of CO_2 to methane. It was suggested that synergy of copper and zinc on the surface of titania support has enhanced the conversion of CO_2 [27]. Catalytic activity of TiO_2 nanorod was investigated for the production of hydrogen under solar light and it was found that incorporation of copper substantially increased the hydrogen generation activity of nanorod [28]. One experiment was conducted on CuO_x-TiO_2 for the production of hydrogen from Ethanol and Glycerol solutions and the results revealed that the production rate was more for impregnated systems [29]. Cu–Mn supported Al_2O_3, TiO_2 and ZrO_2 were studied as the catalyst for combustion of volatile organic compounds and was seen that redox properties were mainly responsible for the better activity of the TiO_2 and ZrO_2 based catalysts [30].

In this work, pure TiO_2 and Cuimpregnated TiO_2 nanoparticles were applied as the photocatalyst for the degradation of methylene blue dye. Degradation of methylene blue dye (MBD) was conducted in natural sun light using these nanoparticles to see its visible light active photocatalysis. The experiments were conducted with low catalyst dose and the high initial MBD concentration compared to the studies reported till now. Optimum impregnation quantity of Cu for maximum dye removal was also identified.

2. MATERIALS AND METHODS

2.1 Materials

Titanium dioxide (TiO_2) was obtained from Loba Chemie, Mumbai, India. Cupric sulphate ($CuSO_4.5H_2O$) was taken from S. D. Fine-Chem Limited, Mumbai, India, and was used as the source of copper. Methylene blue dye was collected from Merck and was used for photodegradation purposes. All the chemicals were used as it was received without any further purification. Double distilled water was used for all the experiments.

2.2 Synthesis of Cu impregnated TiO_2 Nanomaterial

The Cu impregnated TiO_2 nanoparticles were synthesized by wet impregnation method. Initially TiO_2 nanoparticles were

suspended in distilled water. Aqueous solution of cupric sulphate (according to the desired concentration) was then added to the slurry. Then it was stirred for 30 minutes. The resultant slurry was kept in an oven at 60°C for overnight. The dried powder was calcined at 450°C for 2 hours. A series of Cu impregnated TiO_2 nanoparticles were synthesized with varying copper concentrations of 0.5, 1.0, 2.0 and 3.0% of TiO_2. According to the copper concentration the sample were named as 0.5-Cu-TiO_2, 1.0-Cu-TiO_2, 2.0-Cu-TiO_2 and 3.0-Cu-TiO_2.

2.3 Photocatalytic degradation

The photocatalytic activities of the synthesized nanoparticles were studied by the degradation of methylene blue dye (MBD) under irradiation of natural sun light in sunny days from 10.00 AM to 3.00 PM. Experiments were conducted in aqueous solution and normal pH with the initial concentration of the MBD solution of0.2 g/l and the catalyst concentration was varied. The samples were magnetically stirred for 20 min in dark to allow physical adsorption equilibrium of MBD on catalyst particles. Then the solution was exposed to sun light irradiation under constant stirring condition. Degradation experiment was continued for 4 hours. The sample was then centrifuged to remove the nanoparticles. Then the concentration of the MBD solution was analyzed using a UV-Vis-NIR Spectrophotometer (Shimadzu, Japan) at its maximum absorbance wavelength of λ=661 nm.

3. RESULTS AND DISCUSSION

3.1 Photocatalytic activities of pure TiO_2 nanoparticles

Initially the photodegradation was studied in the presence of pure TiO_2 nanoparticles. TiO_2 concentration was taken 0.05, 0.1, 0.15, 0.2, 0.25, 0.3 and 0.5 mg/l. Accordingly, the samples were named as 0.05-TiO_2, 0.1-TiO_2, 0.15-TiO_2, 0.2-TiO_2, 0.25-TiO_2, 0.3-TiO_2, 0.5-TiO_2. Photodegradation was continued for 4 hours. Obtained results are presented in Figure 1.

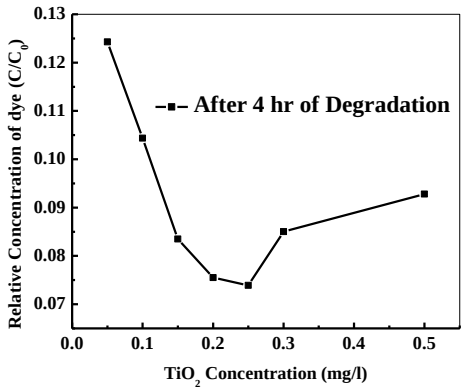

Figure 1: Plot of relative concentration of methylene blue dye with concentration of TiO_2 after 4 hours photodegradation

The Figure indicates the relative concentration (C/C_0) of methylene blue dye with different TiO_2 concentrations. Here C_0 is the initial concentration of MBD and C is the concentration after 4 hour of degradation for different catalyst concentrations. The results clearly indicate that there is decrease in C/C_0 with increasing concentration of TiO_2 till 0.25 mg/l, and then there is decrease of C/C_0 with further increase in TiO_2 concentration. The dye removal efficiency was 87.57, 89.56, 91.65, 92.45, 92.61, 91.5 and 90.72% for 0.05-TiO_2, 0.1-TiO_2, 0.15-TiO_2, 0.2-TiO_2, 0.25-TiO_2, 0.3-TiO_2, 0.5-TiO_2. So, maximum dye degradation efficiency was obtained at 0.25 mg/l TiO_2.

Physical appearances of the dye solutions before and after degradation in presence of different TiO_2 concentrations are shown in Figure 2.The images showed that there is gradual disappearance of the colour of methylene blue dye solution at higher degradation.It further supports the results

obtained in degradation efficiencies at various TiO_2 concentrations.

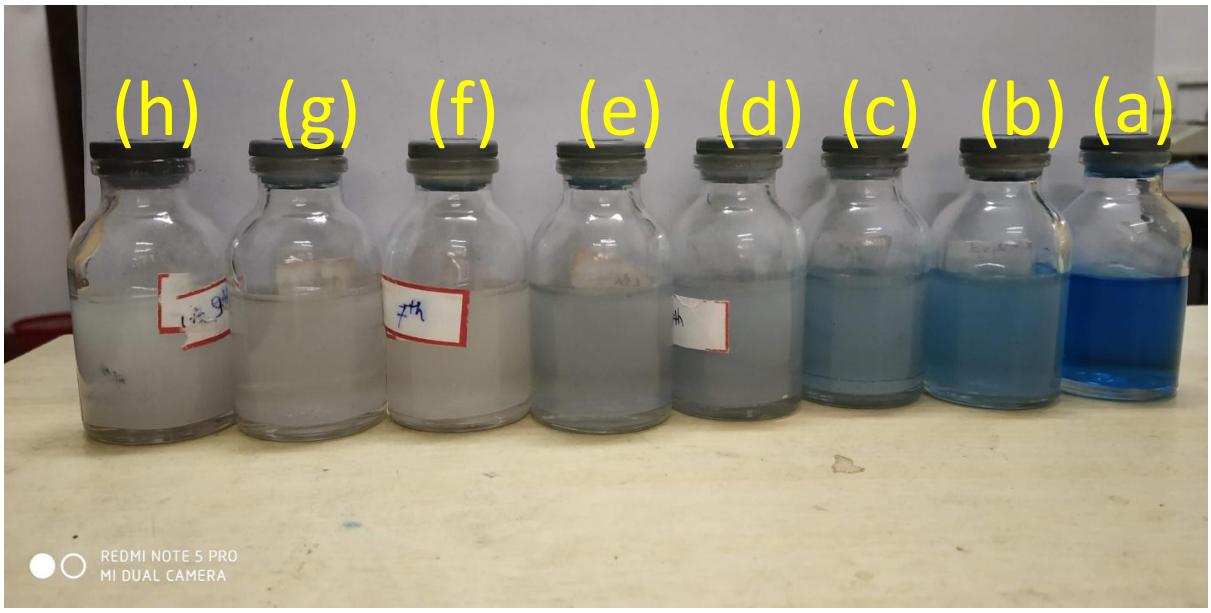

Figure 2: The images of methylene blue solution for (a) no catalyst, (b) 0.05 mg/l TiO_2, (c) 0.1 mg/l TiO_2, (d) 0.15 mg/l TiO_2, (e) 0.2 mg/l TiO_2, (f) 0.25 mg/l TiO_2 (g) 0.3 mg/l TiO_2 (h) 0.5 mg/l TiO_2

For each degradation study, two sets of reference studies were also conducted: (i) MBD solution + catalyst in dark and (ii) only MBD solution under sunlight irradiation. The obtained results showed that there was no significant change in the concentration of MBD, which indicates the concentration change in MBD in the presence of light and catalyst is mainly because of degradation of MBD.

3.2 Photocatalytic activities of Cu impregnated TiO_2 nanoparticles

Photocatalytic degradation of MBD was also carried out in the presence of Cu impregnated TiO_2 nanoparticles. Concentration of TiO_2 was taken 0.25 mg/l for all the Cu impregnated TiO_2 samples. Degradation results are shown in Figure 3. With increasing the Cu % there is decreasing in relative concentration of dye up to 1.0% then there is increase in relative concentration of the dye. After 4 hours of photodegradation the dye degradation efficiency was obtained 97.27, 98.06, 90.42 and 88.42% for 0.5-Cu-TiO_2, 1.0-Cu-TiO_2, 2.0-Cu-TiO_2 and 3.0-Cu-TiO_2. Maximum degradation efficiency was obtained 98.06% at 1.0% Cu concentration. From the results it has been found that the degradation efficiency increased significantly in presence of Cu impregnation.

Figure 4 represents the images of methylene blue solutions before and after photodegradation in presence of 0.5-Cu-TiO_2, 1.0-Cu-TiO_2, 2.0-Cu-TiO_2 and 3.0-Cu-TiO_2. Figure 4b and 4c clearly indicate that the dye is almost removed; whereas Figure 4d and 4e indicate the less degradation of MBD. This also supports the degradation results obtained by concentration measurement.

The higher degradation efficiency in presence of Cu is because of more $^{\bullet}OH$ radical formation. This $^{\bullet}OH$ radicals subsequently participate in the dye oxidation. During the photodegradation

process using Cu, the Cu accepts photoinduced electrons and holes, which in turn act as electron/hole traps.In general, electron or hole traps prevent the recombination of the charge carriers by increasing the separation efficiency of the electron-hole pairs efficiently, and eventually the degradation efficiency increases.

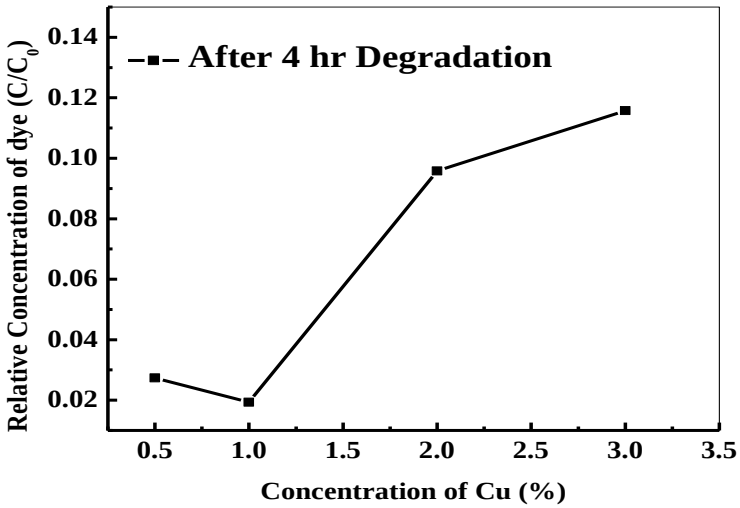

Figure 3: Plot of relative concentration of MBD with concentration of Cu impregnation after 4 hours photodegradation

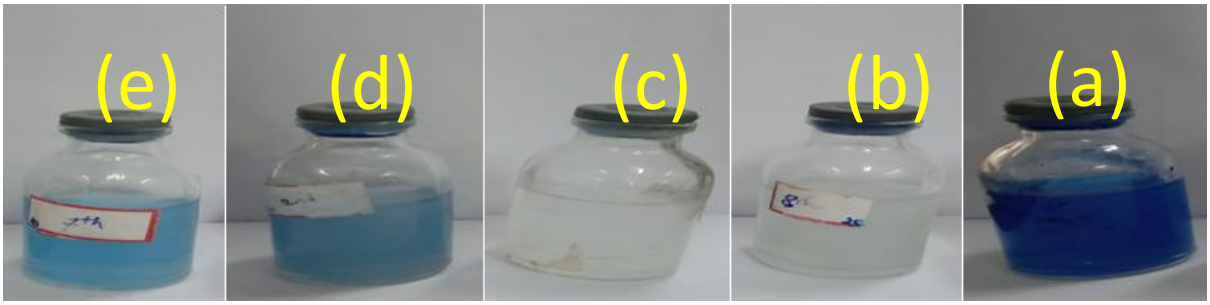

Figure 4:Images of methylene blue solution for (a) no catalyst, (b) 0.5-Cu-TiO_2, (c) 1.0-Cu-TiO_2, (d) 2.0-Cu-TiO_2, (e) 3.0-Cu-TiO_2

With increasing the Cu concentration after a particular limit there is a possibility of destroying the lattice structure of TiO_2 because of serious lattice mismatching and the loss of stoichiometry; which in turn leads to quantum tunnelling and structural instability of the material. Additionally, at higher Cu concentration the electron-hole pairs will try to recombine again through quantum tunnelling because of higher trapping of charge carriers, which finally leads to reduction in the photocatalytic activity [31].

4. CONCLUSION

TiO_2 and Cu impregnated TiO_2 nanoparticles were applied as the photocatalyst for degradation of methylene bule dye. Photodegradation was conducted under sunlight. Maximum dye removal was

obtained at 0.25 mg/l TiO_2. Impregnation of Cu improved the photocatalytic efficiency of TiO_2. Concentration of Cu is also a crucial parameter for getting maximum degradation efficiency of TiO_2. Maximum dye degradation efficiency was obtained 98.06% under 1.0% Cu impregnation. The obtained Cu impregnated TiO_2 is expected to be useful as catalyst for water treatment in organic compound degradation.

REFERENCES

[1] Ehrampoush MH, Moussavi GR, Ghanian MT, Rahimi S, Ahmadian M. Removal of methylene blue dye from textile simulated sample using tubular reactor and TiO_2/UV-C photocatalytic process. Iran J Environ Health Sci Eng 2011; 8: 35–40

[2] Natarajan TS, Thomas M, Natarajan K, Bajaj HC, Tayade RJ. Study on UV-LED/TiO_2 process for degradation of Rhodamine B dye, Chem Eng J 2011; 169: 126–134

[3] Zollinger H. (Ed.). Color Chemistry. Synthesis, Properties and Applications of Organic Dyes and Pigments, 2nd revised Edition, VCH, 1991

[4] Buvaneswari N, Kannan C. Plant toxic and non-toxic nature of organic dyes through adsorption mechanism on cellulose surface. J Hazard Mater 2011; 189: 294–300

[5] Dejohn PB, Hutchins RA. Tex Chem Color 1976; 8: 69

[6] More AT, Vira A, Fogel S. Biodegradation of trans-1,2-dichloroethylene by methane- utilizing bacteria in an aquifer simulator. Environ Sci Technol 1989; 23: 403–406

[7] Slokar YM, Le Marechal AM. Methods of decoloration of textile wastewaters. Dyes Pigments 1998; 37: 335–356

[8] Cao S, Lun Yeung K, Yue P-L. An investigation of trichloroethylene photocatalytic oxidation on mesoporous titania-silica aerogel catalysts. Appl Catal B: Environmental 2007; 76: 64–72.

[9] Hoffmann M R, Martin S T, Choi W, Bahnemann D W. Environmental Applications of Semiconductor Photocatalysis. Chem Rev 1995; 95: 69–96

[10] Zaleska A. Doped-TiO_2: A Review. Recent Patents Eng 2008; 2: 157–164

[11] Zhang WF, Zhang MS, Yin Z, Chen Q. Photoluminescence in anatase titanium dioxide nanocrystals. Appl Phys B 2000; 70: 261–265

[12] Vorontsov AV, Stoyanova IV, Kozlov DV, Simagina VI, Savinov EN. Kinetics of the photocatalytic oxidation of gaseous acetone over platinized titanium dioxide. J Catal 2000; 189: 360–369

[13] Iwasaki M, Hara M, Kawada H, Taday H, Ito S. Cobalt ion-doped TiO_2 photocatalyst response to visible light. J Colloid Interface Sci 2000; 224: 202–204

[14] Jaimy KB, Ghosh S, Sankar S, Warrier KGK. An aqueous sol–gel synthesis of chromium(III) doped mesoporous titanium dioxide for visible light photocatalysis. Mater Res Bull 2011; 46: 914–921

[15] Liqiang J, Honggang F, Baiqi W, Dejun W, Baifu X, Shudan L, Jiazhong S. Effects of Sn dopant on the photoinduced charge property and photocatalytic activity of TiO_2 nanoparticles. Appl Catal B: Environmental 2006; 62: 282–291

[16] Mohamed RM, Aazam ES. Preparation and characterization of platinum doped porous titania nanoparticles for photocatalytic oxidation of carbon monoxide. J Alloys Compounds 2011; 509: 10132–10138

[17] Zhu J, Chen F, Zhang J, Chen H, Anpo M. Fe^{3+}-TiO_2 photocatalysts prepared by combining sol–gel method with hydrothermal treatment and their characterization. J Photochem Photobiol A: Chemistry 2006; 180: 196–204

[18] Binitha NN, Yaakob Z, Sugunan MRR, Ambili VK, Zetty AA. Preparation and characterization of nano silver-doped mesoporous titania photocatalysts for dye degradation. Catal Today 2009; 147S: S76–S80

[19] Herrmanna J-M, Tahiria H, Ait-Ichoub Y, Lassalettac G, Gonzilez-Elipe AR, Fernbdez A. Characterization and photocatalytic activity in aqueous medium of $Ti0_2$ and Ag-$Ti0_2$ coatings on quartz. Appl Catal B: Environmental 1997; 13: 219–228

[20] Li Y, Ma M, Chen W, Li L, Zen M. Preparation of Ag-doped TiO_2 nanoparticles by a miniemulsion method and their photoactivity in visible light illuminations. Mater Chem Phys 2011; 129: 501–505

[21] Liu Y, Wang X, Yang F, Yang X. Excellent antimicrobial properties of mesoporous anatase TiO_2 and Ag/TiO_2 composite films. Micropor Mesopor Mater 2008; 114: 431–439

[22] Pang H, Yang H, Guo CX, Lu J, Li CM. Nanoparticle self-assembled hollow TiO_2 spheres with well matching visible light scattering for high performance dye-sensitized solar cells. Chem Commun 2012; 48: 8832–8834.

[24] Wu T, Liu G, Zhao J, Hidaka H, Serpone N. Photoassisted degradation of dye pollutants. V. self-photosensitized oxidative transformation of rhodamine B under visible light irradiation in aqueous TiO_2 dispersions. J Phys Chem B 1998; 102: 5845–5851

[25] Butler EC, Davis AP. Photocatalytic oxidation in aqueous titanium dioxide suspensions: the influence of dissolved transition metals. J Photochem Photobiol A 1993; 70: 273–283

[26] Xu S, Du AJ, Liu J, Ng J, Sun DD. Highly efficient CuO incorporated TiO_2 nanotube photocata lyst for hydrogen production from water. Int J Hydrogen Energy 2011; 36: 6560–6568

[27] Boccuzzi F, Chiorino A, Martra G, Gargano M, Ravasio yN, Carrozzini yB. Preparation, characterization, and activity of Cu/TiO_2 catalysts. J Catalysis 1997; 165: 129–139

[28] Rana AG, Ahmad W, Al-Matar A, Shawabkeh R, Aslam Z. Synthesis and characterization of Cu-Zn/TiO_2 for the photocatalytic conversion of CO_2 to methane. Env Technol; DOI: 10.1080/09593330.2016.1217940

[29] Khemthong P, Photai P, Grisdanurak N. Structural properties of CuO/TiO_2 nanorod in relation to their catalytic activity for simultaneous hydrogen production under solar light. Inter J hydrogen energy 2013; 38: 15992 –16001

[30] Gombac V, Sordelli L, Montini T, Delgado JJ, Adamski A, Adami G, Cargnello M, Bernal S, Fornasiero P. CuO_x-TiO_2 Photocatalysts for H_2 Production from Ethanol and Glycerol Solutions. J Phys Chem A 2010; 114: 3916–3925

[31] Doggali P, Teraoka Y, Mungse P, Shah IK, Rayalu S, Labhsetwar N. Combustion of volatile organic compounds over Cu–Mn based mixed oxide type catalysts supported on mesoporous Al_2O_3,TiO_2 and ZrO_2. J Molecular Catal A: Chemical 2012; 358: 23–30

[31] Boxi SS, Paria S. Effect of silver doping on TiO_2, CdS, and ZnS nanoparticles for the photocatalytic degradation of metronidazole under visible light. RSC Adv 2014; 4: 37752–37760

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ORIGINAL CONTRIBUTION

Holonic Diffusion in Multi Criteria Decision Making

[1,*]Bikash Bepari, [2]Saurav Mishra, [3]Aman Gupta and [4]Sumit Anand

[1]*Department of Production Engineering, Haldia Institute of Technology, Haldia, Purba Medinipur, West Bengal*

[2,4]*UG student, Dept. of Electronics and Communication Engineering, Haldia Institute of Technology, Haldia, Purba Medinipur, West Bengal*

[3]*UG student, Dept. of Production Engineering, Haldia Institute of Technology, Haldia, Purba Medinipur, West Bengal*

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ABSTRACT

In this paper, the authors proposed a novel MCDM technique which includes pair-wise Euclidean Deviation Quotient (DQ) between criteria-holons to determine the relative suitability of the alternatives. Problems in which the interactions of criteria-holons are predominant, this method obtains the disagreement measure for all the pairs and forms the Disagreement Matrix (DM). Then the disagreement indices (DI) were determined for each criteria-holons by aggregating the deviation quotients and the criteria-holon having minimum sum was considered as nodal-holon. After determining the nodal-holon, the relative importance of the criteria-holons was determined. Then the composite scores for all the alternatives were calculated using the above determined weights and initial decision matrix. Higher the composite score implies higher the suitability of the competing alternative. An illustrative example was solved by the proposed method and results were compared with the results of the existing methodologies and legitimate degree of correlation was found.

KEYWORDS:

1. INTRODUCTION

In today's dynamic business scenario, in order to sustain the unprecedented global economical turmoil there should be a tremendous coalition between market pull and technological push. Owing to the extirpation of monopoly, the business and sustenance has eventually become mutually dependent on the utility of goods and choice of the customer. Therefore, to exist in this milieu, proper decision, foresightedness and business trend analysis play a significant role. To substantiate these components, researchers and scientists are extending their untiring endeavour to develop different expert systems. Decision science being one of the inevitable components for business prosecution, prediction and prevention has already established itself as an emergent avenue to envisage the business spectrum.

Biologically, decision is an internal desire encapsulated by the cognitive aspects to judge good over bad, best over better and which is a time and instinct variant hierarchical phenomena substrated with cognitive layers of mind namely sensing, generation and interpretation. Contrastingly, the external decision making refers to formulating a decision under abundance of alternatives based on number of adjudging parameters known as 'criteria'. Therefore, Multi Criteria Decision Making (MCDM) explicitly evaluates the relative suitability of the alternatives based on a set of criteria (Hwang &Yoon, 1981). . Over and above, one should be chary in defining the criteria and their conflicts because MCDM reveals the decision as a whole subjected to a set of criteria which are in non-commensuration by virtue of their considerations.

*Corresponding Address: bikashbepari@gmail.com

The concept of "holon" was first coined by Koestler (Koestler, 1967).Holons are self deployed entities with distinct characteristics within a biological and/or social hierarchy to emulatefunctionality of a larger whole. Nevertheless, the interaction between the holons dictates the performance of the whole and the mode of interaction forms a structured architecture which is known as holarchy. Now, if a MCDM problem is analyzed with the eyes of holonomy, unequivocally they are analogous with respect to criteria-holons poised up with unique characteristics which when interacts in a synergistic manner within the decision making holarchy determines the relative suitability of the alternatives. Moreover, criteria-holons are adroit enough to evaluate the goodness or badness of each alternative but it leads to mono-criteria decision making. Therefore, MCDM is assemblage of decisions laid by different criteria-holons whose consensus ascertains unanimous decision as shown in Figure 1.

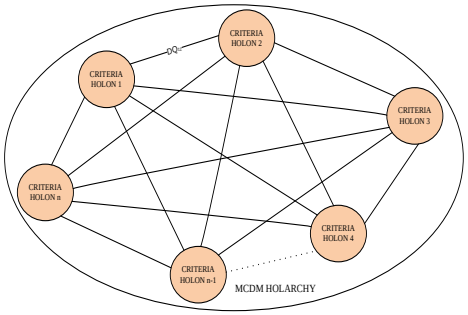

Figure 1: The Holonomic MCDM Architecture

Literature survey reveals several MCDM techniques to rank or quantify alternatives based upon Pareto optimal selection which can be categorized into two distinct types, Multi-Attribute (MA) methods and Outranking methods (Hodgett, 2016). MA methods follow a standalone mathematical protocol in the form of a mathematical function which results into assignment of a numerical score to each alternative. Whereas, outranking methods adjudges pair wise preferential assessments of the alternatives to determine the rank order (Malczewski, 1999). Evidence of conflicts between objectives and criteria was sought which seldom requires trade-off amongst decisive factors i.e. criteria (Chatterjee&Chakraborty, 2012).

Over the past few decades, certain MCDM methods like analytic hierarchy process (Dweiri&Al-Oqla,2006), multi-attributeutility theory (Roth, Field&Clark,1993), technique of order preference by similarityto ideal solution method (Jee& Kang,2000; Edwards, 2011), graph theory andmatrix approach (Rao, 2006), elimination and choice expressingthe reality method (Shanian&Savadogo, 2006; Shanian&Savadogo, 2006), (VlseKriterijumskaOptimizacijaKompromisnoResenje) method (Rao, 2008), evaluation of mixed data method (Chatterjee et al, 2011), complex proportional assessmentmethod (Chatterjee et al, 2011), gray relational analysis (Chan, 2006;Chan & Tong,2007), preferenceselection index method (Maniya& Bhatt, 2010). and linear assignmentmethod (Jahanet al, 2010),were extensivelydeployed to solve MCDM problems arising in wide range of engineering applications. Although, there exists methods which are unique with their respective mathematical foundations substantiated with tremendous logical background, but they lack with dexterity to prop up the characteristics that defines MA and outranking methods simultaneously. Hence, the objective of the present investigation includes a holonomic approach to entail the agreements of the criteria-holons through a pair-wise consensus map to ascertain the weights of the criteria which is dynamic and case variant also rational in formative protocol. The proposed methodology therefore, integrates both the MA and Outranking fraternities in an authentic manner to emanate an alternate avenue to solve MCDM problems diffused with Holonomy.

2. MATHEMATICAL FORMULATIONS

This section circumscribes the explanation of the projected methodology bit by bit. The sequential propositions are as follows:

Step 1: MCDM Problem Formulation:

For MCDM problem, let $\boldsymbol{A} = A_1, A_2, \ldots\ldots A_k \ (k \geq 2)$ be a discrete set of ***'k'*** feasible Alternatives, and $\boldsymbol{C} = \{C_1, C_2 \ldots\ldots C_n\}$ be a finite set of ***'n'***Criteria-holons. Let, $i \in k$, $j \in n$. If ***'k'*** alternatives are evaluated with respect to the ***'n'*** Criteria, the values constitute a decision matrix shown in equation 1.

$$\text{DM}= \begin{array}{c|ccccc} & C_1 & \ldots & C_j & \ldots & C_n \\ \hline A_1 & x_{11} & \ldots & x_{1j} & \ldots & x_{1n} \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots \\ A_i & x_{i1} & \ldots & x_{ij} & \ldots & x_{in} \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots \\ A_k & x_{k1} & \ldots & x_{kj} & \ldots & x_{kn} \end{array} \quad (1)$$

Step 2: Data Pre Processing:

When the target value of the original sequence is infinite, then it has a characteristic of the "higher is better". The original sequence is normalized through:

$$r_{ij} = \frac{x_{ij} - min\, x_{ij}}{max\, x_{ij} - min\, x_{ij}} \quad (2)$$

When the "lower the better" is the feature of the original sequence, then this is normalized as follows:

$$r_{ij} = \frac{max\, x_{ij} - x_{ij}}{max\, x_{ij} - min\, x_{ij}} \quad (3)$$

Where, $i = 1, \ldots\ldots, k;\ j = 1, \ldots\ldots, n.$ m is the number of experimental data set, n is the number of responses. x_{ij} denotes the original sequence, r_{ij} is known as comparability sequence which is had after pre-processing, $max\, x_{ij}$ and $min\, x_{ij}$ are the largest and smallest value of x_{ij} respectively.After pre-processing or normalization, the dimensionless sequences were compensated to obtain the compensated normalized decision matrix. The grey relational coefficient for j^{th}criteria fori^{th}alternative is expressed by:

$$\varepsilon_{ij} = \frac{\Delta_{min} + \zeta . \Delta_{max}}{(1 - r_{ij}) + \zeta . \Delta_{max}} \quad (4)$$

$$\Delta_{max} = 1.00,\ \Delta_{min} = 0.00,$$

$'\zeta'$ is the distinguishing or identification coefficient whose value is confined within the range of $0 \leq \zeta \leq 1$ and the value may be tweak based on the practical requirements of the system(Abhang&Hameedullah, 2012).Here this value has been taken as 0.5.

Step 3: Calculation of Deviation Quotient

For calculating the deviation measure, the grey coefficients down by any two criteria holons$\boldsymbol{C_i, C_j}$, are taken and mathematicallyEuclidean distance can be determined equation (5).

$$DQ_{j,j'} = \sqrt{\sum_{i=0}^{i=k}(\varepsilon_{ij} - \varepsilon_{ij'})^2} \text{Where,} j \neq j' \quad (5)$$

In a very similar way the deviation quotients for all the pairs were derived and tabulate in the form of a Disagreement Matrix (DM) which has been shown in (6).

$$[RDM]_{n\times n} = \begin{array}{ccccc|c} C_1 & \dots & C_j & \dots & C_n & \\ \hline 0 & \dots & DQ_{j,1} & \dots & DQ_{n,1} & C_1 \\ \dots & 0 & \dots & \dots & \dots & \dots \\ DQ_{1,j'} & \dots & DQ_{j,j'} & \dots & DQ_{n,j'} & C_{j'} \\ \dots & \dots & \dots & 0 & \dots & \dots \\ DQ_{j,n} & \dots & DQ_{j,n} & \dots & 0 & C_n \end{array} \quad (6)$$

Step 4: Determination of Disagreement Index (DI)

Herein the Disagreement Index (DI) for j^{th}criteria-holon has been expressed as the summation of deviation-quotient with the remaining criteria-holons and it is mathematically expressed by(7).

$$DI_j = \sum_{j=1}^{n} DQ_{j',j}\,; \forall j, j' \in n \quad (7)$$

Step 5: Determination of Nodal Criteria-Holon

Nodal criteria-holon seems to have the least value of Disagreement Index (*DI*). Logically, the same has been expressed by the following logic statement.

$$j \rightarrow nodal, if\ min\{DI_j\} = DI_j; j \in n \quad (8)$$

Step 6: Determination of Weights of Criteria-Holons

Once the nodal criteria-holon is determined, the deviation from the same in terms of disagreement indices with the other criteria-holons can be processed to generate the relative weights of importance amongst them.

$$l_j = \frac{DI_{jmin}}{DI_j}; where\ j \in n \quad (9)$$

Weight of j^{th}criteria-holon is then calculated as

$$w_j = \frac{l_j}{\sum_{j=1}^{n} l_j} \quad (10)$$

Step 7: Determination of Composite Score

Composite Score of each Alternative's is calculated as

$$CS_i = \sum_{j=1}^{n} w_j \times r_{ij} \quad (11)$$

Alternatives are then ranked according to the descending order of the composite score.

3. ILLUSTRATIVE EXAMPLE

To reveal the usefulness and effectiveness of the proposed method, the authors took up a material selection problem of mass-produced non-heat-treatable cylindrical cover has been shown in Table 1. (Shanian&Savadogo, 2006). Eight number of different materials were taken into consideration based on thirteen selection criteria, namely Density (C_1), Compressive stress (C_2), Ultimate tensile stress (C_3), Spring back index (C_4), Bend force index (C_5), Static load index (C_6), Hardness (C_7), Yield stress (C_8), Elastic modulus (C_9), Thermal diffusivity(C_{10}), Thermal conductivity (C_{11}),Thickness (C_{12}) and Cost of base material(C_{13}).

Table 1 : Decision matrix for selection problem

Material	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
Mat1	8.25	560	940	0.78	15183	2916	380	560	138	465	105	5.207	18.64
Mat2	8.65	460	600	0.71	12472	2395	220	460	125	465	205	5.207	13.99
Mat3	8.94	50	210	0.08	1355	260	45	50	122	460	398	5.207	3
Mat4	8.95	340	380	0.48	9218	1770	115	340	135	460	390	5.207	3.46
Mat5	2.67	190	295	0.25	20317	1966	87	191	73.59	741	152	10.238	2.81
Mat6	8.06	690	1030	1.55	5909	2174	350	800	190	189	17	2.7178	5.99
Mat7	8.63	95	270	0.17	2711	520	63	100	116	174	185	5.207	3.32
Mat8	7.08	267	355	0.49	1957	720	110	265	205	329	50	2.7178	1.04

The decision matrix is then normalized to make dimensionless and comparable through equation (1) and equation (3) depending upon their orientation and the compensation normalization decision matrix as shown in Table 2.

Table 2 : Compensation normalized decision matrix

Material	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13
Mat1	0.360	0.711	0.820	0.512	0.407	0.333	1.000	0.610	0.495	0.507	0.394	0.602	0.333
Mat2	0.344	0.582	0.488	0.538	0.460	0.383	0.511	0.524	0.451	0.507	0.497	0.602	0.405
Mat3	0.334	0.333	0.333	1.000	1.000	1.000	0.333	0.333	0.442	0.502	1.000	0.602	0.818
Mat4	0.333	0.478	0.387	0.648	0.547	0.468	0.387	0.449	0.484	0.502	0.960	0.602	0.784
Mat5	1.000	0.390	0.358	0.812	0.333	0.438	0.364	0.381	0.333	1.000	0.436	0.333	0.833
Mat6	0.368	1.000	1.000	0.333	0.676	0.410	0.848	1.000	0.814	0.339	0.333	1.000	0.640
Mat7	0.345	0.350	0.350	0.891	0.875	0.836	0.346	0.349	0.425	0.333	0.472	0.602	0.794
Mat8	0.416	0.431	0.378	0.642	0.940	0.743	0.383	0.412	1.000	0.408	0.354	1.000	1.000

Employing equation (5) pair-wise deviation Quotients were calculated and the disagreement indices were calculated through equation (7). It may be observed that 8th criteria-holon (C_8) is having least DI values which indicate C_8 in the nodal-holon having highest weights as shown in Table 3.

Table 3 : Disagreement Matrix, Disagreement Index and weights of criteria-holons

	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13	*DI*	l_j	w_j
C1		0.99	1.02	0.99	1.26	1.06	1.04	0.94	1.03	0.33	1.10	1.23	1.04	12.04	0.80	0.069
C2	0.99		0.18	1.21	1.10	1.15	0.35	0.12	0.67	0.94	1.12	0.70	1.16	9.68	1.00	0.086
C3	1.02	0.18		1.27	1.16	1.19	0.24	0.23	0.75	1.00	1.19	0.79	1.26	10.27	0.94	0.081
C4	0.99	1.21	1.27		0.68	0.50	1.26	1.21	1.07	0.82	0.72	1.03	0.58	11.35	0.85	0.074
C5	1.26	1.10	1.16	0.68		0.37	1.20	1.08	0.74	1.18	0.90	0.63	0.60	10.91	0.89	0.077
C6	1.06	1.15	1.19	0.50	0.37		1.22	1.11	0.87	0.99	0.74	0.88	0.64	10.72	0.90	0.078
C7	1.04	0.35	0.24	1.26	1.20	1.22		0.42	0.82	0.97	1.19	0.87	1.30	10.88	0.89	0.077
C8	0.94	0.12	0.23	1.21	1.08	1.11	0.42		0.65	0.93	1.10	0.72	1.15	9.66 *	1.00	0.086
C9	1.03	0.67	0.75	1.07	0.74	0.87	0.82	0.65		1.02	1.10	0.37	0.82	9.90	0.98	0.084

C10	0.33	0.94	1.00	0.82	1.18	0.99	0.97	0.93	1.02		1.09	1.52	1.34	12.13	0.80	0.069
C11	1.10	1.12	1.19	0.72	0.90	0.74	1.19	1.10	1.10	1.09		1.11	0.92	12.28	0.79	0.068
C12	1.23	0.70	0.79	1.03	0.63	0.88	0.87	0.72	0.37	1.52	1.11		0.78	10.64	0.91	0.078
C13	1.04	1.16	1.26	0.58	0.60	0.64	1.30	1.15	0.82	1.34	0.92	0.78		11.58	0.83	0.072

**Minimum DI*

Once the criteria weights are determined by the present methodology, the composite score is evaluated in accordance with equation (11). The result reveals the priority of the alternatives as M6 ≻ M8 ≻ M4 ≻ M1 ≻ M3 ≻ M2 ≻ M7 ≻ M5.

Table 4 : Composite Score and Ranks

Weights	0.069	0.086	0.081	0.074	0.077	0.078	0.077	0.086	0.084	0.069	0.068	0.078	0.072	Score	Rank
Material	C1	C2	C3	C4	C5	C6	C7	C8	C9	C10	C11	C12	C13		
M1	0.111	0.797	0.890	0.524	0.271	0.000	1.000	0.680	0.490	0.513	0.231	0.669	0.000	0.489	4
M2	0.048	0.641	0.476	0.571	0.414	0.196	0.522	0.547	0.391	0.513	0.493	0.669	0.264	0.447	6
M3	0.002	0.000	0.000	1.000	1.000	1.000	0.000	0.000	0.368	0.504	1.000	0.669	0.889	0.479	5
M4	0.000	0.453	0.207	0.728	0.585	0.431	0.209	0.387	0.467	0.504	0.979	0.669	0.863	0.493	3
M5	1.000	0.219	0.104	0.884	0.000	0.358	0.125	0.188	0.000	1.000	0.354	0.000	0.899	0.373	8
M6	0.142	1.000	1.000	0.000	0.760	0.279	0.910	1.000	0.886	0.026	0.000	1.000	0.719	0.620	1
M7	0.051	0.070	0.073	0.939	0.928	0.902	0.054	0.067	0.323	0.000	0.441	0.669	0.870	0.408	7
M8	0.298	0.339	0.177	0.721	0.968	0.827	0.194	0.287	1.000	0.273	0.087	1.000	1.000	0.555	2

4. RESULTS AND DISCUSSION

Table 5reveals the rank orders of the competing materials as per existing methods like Block-TOPSIS, VIKOR, MOORA, COPRAS and SAW by(Shanian&Savadogo, 2006) alongwith the rank order revealed by the proposed methodology. It is noteworthy to observe that the rank orders laid down by the different methodologies are having mostly the same extremities i.e. the most desired and less desired materials are the same which indicates the alignment of the rank band width of the proposed methodology over the existing methodologies. Moreover, the rank order laid by the proposed methodology has 88% compliance in terms of spearman's correlation coefficient with methodologies like B-TOPSIS, MOORA and SAW and also the compliance of the proposed methodology is sufficiently high with methods like VIKOR and COPRAS as shown in Table 6.

Table 5 : Rank orders by different methods

Material	Block-TOPSIS	VIKOR	MOORA	COPRAS	SAW	Proposed Methodology
M1	5	7	5	3	5	4
M2	6	5	6	6	6	6
M3	3	3	3	1	3	5
M4	2	1	2	5	2	3
M5	8	8	8	8	8	8
M6	1	2	1	2	1	1
M7	7	6	7	7	7	7
M8	4	4	4	4	4	2

Table 6 : Composite Score and Ranks

	Block-TOPSIS	VIKOR	MOORA	COPRAS	SAW
PM	0.88	0.71	0.88	0.69	0.88

5. CONCLUSION

Since the objective of the present investigation was to diffuse holonomic approach in MCDM by combining MA and outrank preferences. To establish the same a novel technique namely HMCDM (Holonomic Multi Criteria decision making) was proposed, implemented and validated through a materials selection problem. The preferences of criteria-holons were mutually adjudged by forming a complete graph based on Euclidean Deviation Quotients and the consensus fetched the weights of criteria-holon which later on yielded the scores of the alternatives. Thus the operational attitude of the proposed method encapsulated both the essence of MA and outranks preferences. Moreover, the upshot of the proposed method was validated with those of the existing methods and higher levels of correlations were found. Over and above, the proposed method shows an alternative way to determine criteria weights which is of significant importance in the field of MCDM.

REFERENCES

[1] Abhang, L. B., &Hameedullah, M., (2012). Determination of optimum parameters for multi-performance characteristics in turning by using grey relational analysis.The International Journal of Advanced Manufacturing Technology.63(1-4), 13-24,https://doi.org/10.1007/s00170-011-3857-6

[2] Chan, J. W. K., (2006). Application of grey relational analysis for ranking material options.International Journal of Computer Applications in Technology, 26(4), 210–217.doi: 10.1504/IJCAT.2006.010766

[3] Chan, J. W. K., & Tong, T. K. L., (2007). Multi-criteria material selections and end-of-life product strategy: grey relational analysis approach. Materials & Design, 28(5), 1539–1546.doi: https://doi.org/10.1016/j.matdes.2006.02.016

[4] Chatterjee, P., Athawale, V. M., &Chakraborty, S., (2011). Materials selection using complex proportional assessment and evaluation of mixed data methods.Materials & Design, 32, 851-860. doi: https://doi.org/10.1016/j.matdes.2010.07.010Get

[5] Chatterjee, P., &Chakraborty, S. (2012). Material selection using preferential ranking methods.Materials and Design, 35, 384–393, doi:10.1016/j.matdes.2011.09.027

[6] Dweiri, F., & Al-Oqla, F. M. (2006).Material selection using analytical hierarchy process.International Journal of Computer Applications in Technology, 26(4), 182-189. doi:10.1504/IJCAT.2006.010763

[7] Edwards, K. L. (2011). Materials influence on design: a decade of development. Materials and Design, 32, 1073–1080.

[8] Hodgett, R.E., (2016). Comparison of multi-criteria decision-making methods for equipment selection.The International Journal of Advanced Manufacturing Technology.85(5-8), 1145-1157, https://doi.org/10.1007/s00170-015-7993-2

[9] Hwang, C.L. Yoon, K. (1981). Multiple Attribute Decision Making: Methods and Applications. New York: Springer-Verlag.

[10] Jahan, A., Ismail, M.Y., Mustapha, F., &Sapuan, S. M. (2010). Material selection based on ordinal data. Materials and Design, 31(7), 3180–3187.doi: https://doi.org/ 10.1016/ j.matdes.2010.02.024

[11] Jee, D-H., & Kang, K-J. (2000). A method for optimal material selection aided with decision making theory.Materials & Design, 21, 199–206. doi: https://doi.org/10.1016/S0261-3069(99)00066-7

[12] Koestler, A. (1967). The Ghost in the Machine. London: Arkana.

[13] Malczewski, J. (1999). GIS and multi-criteria decision analysis. New York: Wiley.

[14] Maniya, K., & Bhatt, M. G., (2010). A selection of material using a novel type decision making method: preference selection index method. Materials & Design, 31(4), 1785–1789. doi: https://doi.org/10.1016/j.matdes.2009.11.020

[15] Rao, R.V. (2006). A material selection model using graph theory and matrix approach. Material Science and Engineering A, 431, 248–255. doi: https://doi.org/10.1016/j .msea.2006.06.006

[16] Rao, RV. (2008). A decision making methodology for material selection using an improved compromise ranking method. Materials & Design, 29, 1949–1954. doi: https://doi.org/ 10.1016/j.matdes.2008.04.019

[17] Roth, R., Field, F., & Clark, J. (1993).Materials selection and multi-attribute utility analysis.Journal of Computer Aided Materials Design, 1(3), 325–342. doi: https://doi.org /10.1007/BF00712855

[18] Shanian, A., &Savadogo, O. (2006). TOPSIS multiple-criteria decision support analysis for material selection of metallic bipolar plates for polymer electrolyte fuel cell. Journal of Power Sources, 159, 1095–1104. doi: https://doi.org/10.1016/j.jpowsour.2005.12.092

[19] Shanian, A., &Savadogo, O. (2006).A material selection model based on the concept of multiple attribute decision making.Materials & Design, 27, 329–337. doi: https://doi.org /10.1016/j.matdes.2004.10.027

[20] Shanian, A., &Savadogo, O. (2006).A non-compensatory compromised solution for material selection of bipolar plates for polymer electrolyte membrane fuel cell (PEMFC) using ELECTRE IV.ElectrochimicaActa, 51(25), 5307–5315. doi: https://doi.org/10.1016/j.electacta.2006.01.055

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ORIGINAL CONTRIBUTION

Big Data and its Contribution towards Business: A Review

*Sourabh Bhattacharya

Department of Management & Social Science, Haldia Institute of Technology, Haldia, Purba Medinipur, West Bengal

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ABSTRACT

Big Data is changing rules of the game of business. Both market leaders, challengers and niche players are adopting big data to have more insights regarding the different metrics of business. But still a good percentage of organizations till now haven't adopted big data as they haven't understood the value of big data. This paper tries to understand the role of big data in the business world.

KEYWORDS – Big Data, Data Mining, Cloud Computing

1. INTRODUCTION

The term 'big data' means data in huge, enormous form which cannot be stored by conventional database systems. The purpose of big data is to store, mine and to utilize huge amount of data for efficient business decisions.

Big Data is characterized by 3 vs i.e. variety, velocity and volume. Variety means different forms of data as structures, unstructured and semi structured. Velocity is related to the social media posts like Facebook, Twitter, LinkedIn, Instagram which are being posted at a rate of million posts per second. The discipline of big data which analyzes social media posts is called social media analytics. Volume means data in large quantities. Daily 2.5 quintillion bytes of data are created in the world. 90% of the current global data were created in the last couple of years. The global data has been growing at a very fast rate and experts are in confusion regarding how to analyze this gigantic form of data. Though a lot of models have been conceptualized but still the right model needs to be identified.

Basically, big data presents three challenges to organizations. Firstly, this huge enormous form of data needs to be arranged. Secondly, the opportunities provided by big data need to be tapped. Thirdly it needs to be seen that the technology used for big data has low cost.

This paper will try to evaluate the role of big data in the business world.

2. BIG DATA AND BUSINESS

Organizations are in confusion regarding what is big data, how it affects their organization, how they can harness its enormous potential. According to the Big Data Survey Research Brief, 2017 only 12 percent of the MNCs have started implementing dedicated teams and processes to harness big data,71 percent are in their planning stage and the remaining 17 percent are still to think on big data. In this age of dog eat dog competition, companies need big data very badly to understand customers in a better manner. This understanding is very necessary as the insights will help them to fight effectively with competitors. Companies are analyzing transactional information in order to get new insights. But recently companies have also started concentrating on another unstructured but very effective form of data, i.e. that data which is emanating from social media, blogs, emails. One of the companies working on big data is Oracle. The big data product of Oracle organizes and analyzes big data and then

*Corresponding Address: sourabhb82@gmail.com

take decisions based on the data. Oracle names its big data analysis as Predictive Analytics. Intel with the help of big data team has sped up its innovation process. Unlike others companies like Facebook, Google, LinkedIn, Whatsapp, Amazon, eBay have been utilizing big data right from their inception.

3. OBJECTIVES OF BIG DATA

The different objectives of big data are:

a. Reduction of cost: With regard to cost cutting the most effective framework which will come in mind is Hadoop. With the help of Hadoop enormous amount of data can be stored in distributed clusters. The cost of storing one terabyte data for a year in Hadoop is US$ 2000. In traditional data bases that cost will be around US$ 1600000.

b. Reduction of time: With the help of big data applications, data sets can be calculated in seconds or minutes instead of hours.

c. Great customer insights:Electronic retailers like Amazon, eBay, Flipkart are using big data in a way. For example, the e-retailers can analyze apparel purchase of customers in terms of price, colour, design, style, brand, size etc.

d. Developing products based on big data: Using big data, companies are producing new products. For example the app based companies like Ola, Uber, Zomato, Food Panda, Swiggy, Practo are all using big data to provide services. LinkedIn has added several new features in its core product so as to attract new members.

4. DATA MINING AND BIG DATA

In the world of production the importance of big data cannot be ignored. An effective big data analytics platform must have features like robustness, high development speed, smoothness and capability to analyze huge amount of data. In the past few years size of data has increased enormously. That's why even the e-commerce companies have increased the team size of analysts by thousands. The most effective form of data analysis is live data streaming. Extracting and analyzing data from live streaming have been very effective as the analysis provides insights on happenings on spot.Stream data requires very strong algorithm for analysis. Social media, blogs and online news provide huge amount of data in the hands of analysts. One of the tools of analyzing streams is Samoa. It can be used in different stream processing engines like storm for data mining in a cloud based environment. In the future Samoa will become open source software. Hence, another data oriented model aggregates data from multiple sources and analyzes the data with regard to data mining.

By utilizing big data, Intel has improved its business intelligence division in a big manner. Previously 90% of Intel's data used to be unstructured. Now with the use of big data a lot of advantages have been derived in the form of better decisions, increased business velocity, catching new markets. Intel now intends to convert descriptive data into predictive data in order to get greater and more powerful business insights.

5. APPLICATIONS OF BIG DATA

The primary goal of big data is to help companies in taking more and more informed business decisions through the analysis of large volume of data. Companies from different sectors are investing huge amount of money in big data applications in order to examine enormous data sets to discover unknown correlations, hidden patterns, customer taste and preference, market trends etc. Some of the applications of big data analytics in different fields are as per below:

a. In the field of healthcare big data analytics have helped in a great way in terms of providing prescriptive analytics and personalized medicine. Data miners are getting indepth insights from data to know what type of treatments are required in certain conditions, identify drug side effect patterns and trend analysis of major diseases.

b. In manufacturing, some of the benefits generated through big data are tracking

of product quality and defects, planning of supply, identification of defects in manufacturing process, enhancement of efficiency, output; forecasting, new manufacturing process simulation, testing and mass customization.

c. In the world of media, big data looks after requirements like audience requirement prediction, schedule optimization to increase footfalls, proper targeting of ads, and development of new products.

d. With regard to Internet of Things(IOT),big data is being applied by several companies to map device connectivity. Such mappings are used by companies to enhance efficiency.IOT is also used for collecting sensitive data.

e. Governments are also using big data in such areas such as cyber security, crime records, pharma, drug evaluation, scientific research, weather forecasting, tax collections, traffic management.

6. CHALLENGES OF BIG DATA

The challenges faced by big data are:

a. Privacy and Security: Experts have found that with regard to cloud computing and big data applications there are a number of security loopholes which need to be plugged. If data needs to be stored then it has to be secured. Several issues related to data security are data backup, data availability, data integrity and data breaches.

b. Dynamic Provisioning: It's an additional service of cloud computing. Through it, computation resources are provided on demand. The frameworks currently present in the market do not have the property of dynamic provisioning. More resources will be required for dynamic provisioning.

c. Algorithms: Selecting the right alogorithm is a challenge for big data experts. The algorithms can vary from one another. The variations can impact the reliability of the final result.

d. Data misuse: As information is power so people with vested interest can misuse the data in hand. Internal processes and systems have to be improved in order to prevent data misuse.

7. CONCLUSION

Even after getting massive scale or a critical mass big data must be integrated into the final business goals of an enterprise. Not only companies but even governments have also started working on big data. Organizations which have built their business models are Facebook, Google, Amazon, LinkedIn, eBay, Uber. Big companies are joining the bandwagon of big data and they are integrating big data with their traditional data analytics. This big step is bring a revolution in the technology, skills, performance, efficiency of the companies. Almost two-third of companies have already agreed that big data is bringing a sea change in their business operations. Challenges which have emerged from this field are building of prediction models and design of big data sampling from online streams of data. The challenges also include are potential misuse of data. Lastly there is also an uncertainty with regard to nature of data to be produced in the future.

REFERENCES

[1] Chen, H., Chiang, R. H., &Storey, V. C. (2012). Business intelligence and analytics: From big data to big impact. *MIS quarterly*, *36*(4).

[2] Chen, M., Mao, S., & Liu, Y. (2014). Big data: A survey. *Mobile networks and applications*, *19*(2), 171-209

[3] Labrinidis, A., &Jagadish, H. V. (2012). Challenges and opportunities with big data. *Proceedings of the VLDB Endowment*, *5*(12), 2032-2033

[4] LaValle, S., Lesser, E., Shockley, R., Hopkins, M. S., &Kruschwitz, N. (2011). Big data, analytics and the path from insights to value. *MIT sloan management review*, *52*(2), 21-32.

[5] Lohr, S. (2012). The age of big data. *New York Times*, *11*(2012).

[6] Jagadish, H. V., Gehrke, J., Labrinidis, A., Papakonstantinou, Y., Patel, J. M., Ramakrishnan, R., &Shahabi, C. (2014). Big data and its technical challenges. *Communications of the ACM*, *57*(7), 86-94.

[7] Kambatla, K., Kollias, G., Kumar, V., &Grama, A. (2014). Trends in big data analytics. *Journal of Parallel and Distributed Computing*, *74*(7), 2561-2573.

[8] Katal, A., Wazid, M., &Goudar, R. H. (2013, August). Big data: issues, challenges, tools and good practices. In *2013 Sixth international conference on contemporary computing (IC3)* (pp. 404-409). IEEE.

[9] McAfee, A., Brynjolfsson, E., Davenport, T. H., Patil, D. J., & Barton, D. (2012). Big data: the management revolution. *Harvard business review*, *90*(10), 60-68.

[10] Russom, P. (2011). Big data analytics. *TDWI best practices report, fourth quarter*, *19*(4), 1-34.

[11] Sagiroglu, S., &Sinanc, D. (2013, May). Big data: A review. In *2013 International Conference on Collaboration Technologies and Systems (CTS)* (pp. 42-47). IEEE.

[12] Xiaofeng, M., & Xiang, C. (2013). Big data management: concepts, techniques and challenges [J]. *Journal of computer research and development*, *1*(98), 146-169.