DOCUMENT IMAGE BINARIZATION BASED ON ADAPTIVE CONTRAST METHOD FOR DEGRADED DOCUMENT IMAGES

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ABSTRACT

Segmentation of text from badly degraded document images is a very challenging task due to the high inter/intra variation between the document background and the foreground text of different document images. Here, we propose a novel document image binarization technique that addresses these issues by using adaptive image contrast. The adaptive image contrast is a combination of the local image contrast and the local image gradient that is tolerant to text and background variation caused by different types of document degradations.In the proposed technique, an adaptive contrast map is first constructed for an input degraded document image. The contrast map is then binarized and combined with Canny's edge map to identify the text stroke edge pixels. The document text is further segmented by a local threshold that is estimated based on the intensities of detected text stroke edge pixels within a local window. The proposed method is simple, robust, and involves minimum parameter tuning

Keywords*: *Adaptive image contrast, document analysis, document image processing, degraded document image binarization,

I. INTRODUCTION

In document image processing, the paper documents are initially scanned and stored in the hard disk or any other required location. It is easy to define document image processing as scanning-storing-retrieving-managing. The final outcome of document image processing will be in compatible electronic format, which makes documents easier and quicker to access. Document image processing comprises of a set of simple techniques and procedures, which are used to work upon the images of documents and convert them from pixel information into a format that can be read by a computer. Document image binarization is usually performed in the pre-processing stage of different document image processing related applications such as optical character recognition (OCR) and document image retrieval. Basically, document image processing using OCR is divided into two steps. The first step captures the text, based on the information from the document. It identifies the reorientations, tables, words and their colours, font sizes and other textual matter in the file. The second step involves graphical processing which works on drawings, dividing lines between paragraphs and sections, logos and other pictorial representations. As the images are one of the most important components in the documents, it is very important to process the images rather than just locating them in the document.

Document image binarization aims to segment the foreground text from the document background. But the segmentation of text from badly degraded document images is a very challenging task due to the high inter and intra variation between the document background and the foreground text of different document images. Document image binarization converts the acquired image to binary format, the objective of binarization is to automatically choose a threshold that separates the foreground and background information. Document image binarization has been studied for many years[1]-[3], the thresholding of degraded document images is still an unsolved problem due to the high inter and intra variation between the text stroke and the document background across different document images

Fig. 1. Five degraded document image examples (a)–(d) are taken from DIBCO series datasets and (e) is taken from Bickley diary dataset

II. RELATED WORKS

A new document image binarization technique that segments the text from badly degraded historical document images. Here makes use of the image contrast that is defined by the local image maximum and minimum. Compared with the image gradient, the image contrast evaluated by the local maximum and minimum has a nice property that it is more tolerant to the uneven illumination and other types of document degradation such as smear. Given a historical document image, the technique first constructs a contrast image and then detects the high contrast image pixels which usually lie around the text stroke boundary. The document text is then segmented by using local thresholds that are estimated from the detected high contrast pixels within a local neighbourhood window.They divide this section into three subsections, which deal with the contrast image construction, the high contrast pixel detection, and the local threshold estimation, respectively

2.1Contrast Image Construction

The image gradient has been widely used in the literature for edge detection. However, the image gradient is often obtained by the absolute image difference within a local neighbourhood window, which does not incorporate the image intensity itself and is so sensitive to the image contrast/brightness variation. Take an unevenly illuminated historical document image as an example, the gradient of an image pixel (around the text

stroke boundary) within bright document regions may be much higher than that within dark document regions. To detect the high contrast image pixels around the text stroke boundary properly, the image gradient needs to be normalized to compensate for the effect of the image contrast or brightness variation. At the same time, the normalization suppresses the variation within the document background as well. In the proposed technique, we suppress the background variation by using an image contrast that is calculated based on the local image maximum and minimum as follows:

$$D(x,y) = \frac{f_{max}(x,y) - f_{min}(x,y)}{f_{max}(x,y) + f_{min}(x,y) + \epsilon}$$

where fmax(x, y) and fmin(x, y) refer to the maximum and the minimum image intensities within a local neighbourhood window. In the implemented system, the local neighbourhood window is a 3 × 3 square window. The term e is a positive but infinitely small number, which is added in case the local maximum is equal to 0.The image contrast in above equation, lowers the image background and brightness variation properly. In particular, the numerator (i.e. the difference between the local maximum and the local minimum) captures the local image difference that is similar to the traditional image gradient. The denominator acts as a normalization factor that lowers the effect of the image contrast and brightness variation. For image pixels within bright regions around the text stroke boundary, the denominator is large, which neutralizes the large numerator and accordingly results in a relatively low image contrast. But for image pixels within dark regions around the text stroke boundary, the denominator is small, which compensates the small numerator and accordingly results in a relatively high image contrast. As a result, the contrasts of image pixels (lying around the text stroke boundary) within both bright and dark document regions converge close to each other and this facilitates the detection of high contrast image pixels lying around the text stroke boundary(to be described in the next subsection).

2.2 High Contrast Pixel Detection

The purpose of the contrast image construction is to detect the desired high contrast image pixels lying around the text stroke boundary. As described in the last subsection, the constructed contrast image has a clear bimodal pattern where the image contrast around the text stroke boundary varies within a small range but is obviously much larger compared with the image contrast within the document background. We therefore detect the desired high contrast image pixels (lying around the text stroke boundary) by using Otsu's global thresholding method.

2.3 Historical Document Thresholding

The text pixels can be classified from the document background pixels once the high contrast image pixels around the text stroke boundary are detected properly. The document thresholding from the detected high contrast image pixels is based on two observations. First, the text pixels should be close to the detected high contrast image pixels because most detected high contrast image pixels lie around the text stroke boundary. Second, the intensity of most text pixels should be close or lower than the average intensity of the detected high contrast image pixels within a local neighbourhood window[4]-[6]. This can be similarly explained by the fact that most detected high contrast image pixels lie around the text stroke boundary.

For each document image pixel, the number of the detected high contrast image pixels is first determined within a local neighbourhood window. The document image pixel will be considered a text pixel candidate if the

number of high contrast image pixels within the neighbourhood window is larger than a threshold. The document image pixel can thus be classified based on its intensity relative to that of its neighboring high contrast image pixels as

$$R(x,y) = \begin{cases} 1 & N_e \geq N_{min} \quad \&\& \\ & I(x,y) \leq E_{mean} + E_{std}/2 \\ 0 & \text{otherwise} \end{cases}$$

where Emean and Estd are the mean and the standard deviation of the image intensity of the detected high contrast image pixels(within the original document image) within the neighbourhood window that can be evaluated as

$$E_{mean} = \frac{\sum_{neighbor} I(x,y) * (1 - E(x,y))}{N_e}$$

$$E_{std} = \sqrt{\frac{\sum_{neighbor} ((I(x,y) - E_{mean}) * (1 - E(x,y)))^2}{2}}$$

where I refers to the input document image and (x, y) denotes the position of the document image pixel under study. E refers to the binary high contrast pixel image where E(x, y) is equal to 0 if the document image pixel is detected as a high contrast pixel. Ne refers to the number of high contrast image pixels that lie within the local neighbourhood window. So if Ne is larger than Nmin and I(i, j) is smaller than Emean+ Estd/2, R(i, j) is set at 1. Otherwise(i, j) is set at 0.

Disadvantages:

- It can't handle document images with bright text properly. This is because a weak contrast will be calculated for stroke edges of the bright text where the denominator in Equation(image contrast, is calculated based on the local image maximum and minimum)will be large but the numerator will be small.
- Time consuming.

III. PROPOSED METHOD

In the proposed document image binarization techniques, given a degraded document image, an adaptive contrast map is first constructed and the text stroke edges are then detected through the combination of the binarized adaptive contrast map and the canny edge map. The text is then segmented based on the local threshold that is estimated from the detected text stroke edge pixels. Some post-processing is further applied to improve the document binarization quality

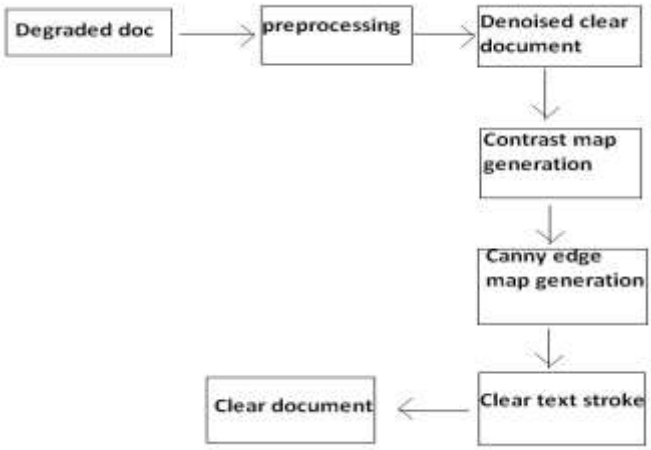

Fig2:System design of document image binarization technique

3.1 Contrast Image Construction

The image gradient has been widely used for edge detection and it can be used to detect the text stroke edges of the document images effectively that have a uniform document background. On the other hand, it often detects many non-stroke edges from the background of degraded document that often contains certain image variations due to noise, uneven lighting, bleed-through, etc. To extract only the stroke edges properly, the image gradient needs to be normalized to compensate the image variation within the document background.

In earlier method , The local contrast evaluated by the local image maximum and minimum is used to suppress the background variation as described in Equation (image contrast, is calculated based on the local image maximum and minimum). In particular, the numerator (i.e. the difference between the local maximum and the local minimum) captures the local image difference that is similar to the traditional image gradient. The denominator is a normalization factor that suppresses the image variation within the document background. For image pixels within bright regions, it will produce a large normalization factor to neutralize the numerator and accordingly result in a relatively low image contrast. For the image pixels within dark regions, it will produce a small denominator and accordingly result in a relatively high image contrast.However, the image contrast in the earlier method has one typical limitation that it may not handle document images with the bright text properly. This is because a weak contrast will be calculated for stroke edges of the bright text where the denominator in Equation(image contrast, is calculated based on the local image maximum and minimum)will be large but the numerator will be small. To overcome this over-normalization problem,we combine the local image contrast with the local image gradient and derive an adaptive local image contrast as

$$C_\alpha(i,j) = \alpha C(i,j) + (1-\alpha)(I_{\max}(i,j) - I_{\min}(i,j))$$

where $C(i, j)$ denotes the local contrast in the previous equation and$(I\max(i, j) - I\min(i, j))$ refers to the local image gradient that is normalized to [0, 1]. The local windows size is set to 3 empirically. α is the weight between local contrast and local gradient that is controlled based on the document image statistical information. Ideally, the image contrast will be assigned with a high weight (i.e. large α) when the document image has significant intensity variation. So that the proposed binarization technique depends more on the local image contrast that can capture the intensity variation well and hence produce good results. Otherwise, the local image gradient will be assigned with a high weight. The proposed binarization technique relies more on image gradient

and avoid the over normalization problem of our previous method.We model the mapping from document image intensity variation to α by a power function as

$$\alpha = \left(\frac{Std}{128}\right)^{\gamma}.$$

where *Std* denotes the document image intensity standard deviation, and γ is a pre-defined parameter. The power function has a nice property in that it monotonically and smoothly increases from 0 to 1 and its shape can be easily controlled by different γ .γ can be selected from $[0,\infty]$, where the power function becomes a linear function when $\gamma = 1$. Therefore, the local image gradient will play the major role in *Ca(i, j)*when γ is large and the local image contrast will play the major role when γ is small.

3.2 Text Stroke Edge Pixel Detection

The purpose of the contrast image construction is to detect the stroke edge pixels of the document text properly. The constructed contrast image has a clear bi-modal pattern [7],where the adaptive image contrast computed at text stroke edges is obviously larger than that computed within the document background. We therefore detect the text stroke edge pixel candidate by using Otsu's global thresholding method.

As the local image contrast and the local image gradient are evaluated by the difference between the maximum and minimum intensity in a local window, the pixels at both sides of the text stroke will be selected as the high contrast pixels. The binary map can be further improved through the combination with the edges by Canny's edge detector, because Canny's edge detector [8]-[13] has a good localization property that it can mark the edges close to real edge locations in the detecting image. In addition, canny edge detector uses two adaptive thresholds and is more tolerant to different imaging artifacts such as shading.

3.3 Local Threshold Estimation

The text can then be extracted from the document background pixels once the high contrast stroke edge pixels are detected properly. Two characteristics can be observed from different kinds of document images: First, the text pixels are close to the detected text stroke edge pixels. Second, there is a distinct intensity difference between the high contrast stroke edge pixels and the surrounding background pixels. The document image text can thus be extracted based on the detected text stroke edge pixels as

$$R(x,y) = \begin{cases} 1 & I(x,y) \le E_{mean} + \frac{E_{std}}{2} \\ 0 & \text{otherwise} \end{cases}$$

where *E*mean and *E*std are the mean and standard deviation of the intensity of the detected text stroke edge pixels within a neighbourhood window *W*, respectively. The neighbourhood window should be at least larger than the stroke width in order to contain stroke edge pixels.

3.4 Post-Processing

The binarization result can be further improved by incorporating certain domain knowledge as described in post processing algorithm. First, the isolated foreground pixels that do not connect with other foreground pixels are filtered out to make the edge pixel set precisely. Second, the neighbourhood pixel pair that lies on symmetric sides of a text stroke edge pixel should belong to different classes (i.e., either the document background or the

foreground text). One pixel of the pixel pair is therefore labelled to the other category if both of the two pixels belong to the same class. Finally, some single-pixel artifacts along the text stroke boundaries are filtered out by using several logical operators.

Advantages:

The main advantages of the system are as follows:

- It relies more on image gradient and avoid the over normalization problem
- The proposed method simple, robust and capable of handling different types of degraded document images with minimum parameter tuning

IV. CONCLUSION

Segmentation of text from badly degraded document images is a very challenging task due to the high inter/intravariation between the document background and the foreground text of different document images. Here, propose a novel document image binarization technique that addresses these issues by using adaptive image contrast. The adaptive image contrast is a combination of the local image contrast and the local image gradient that is tolerant to text and background variation caused by different types of document degradations. In the proposed technique, an adaptive contrast map is first constructed for an input degraded document image. The contrast map is then binarized and combined with Canny's edge map to identify the text stroke edge pixels. The document text is further segmented by a local threshold that is estimated based on the intensities of detected text stroke edge pixels within a local window. This is an adaptive image contrast based document image binarization technique that is tolerant to different types of document degradation such as uneven illumination and document smear. Moreover, it works for different kinds of degraded document images. The proposed technique makes use of the local image contrast that is evaluated based on the local maximum and minimum. The proposed method is simple, robust, and involves minimum parameter tuning

V. ACKNOWLEDGEMENT

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EFFECTIVENESS OF MOBILE LEARNING USING VIDEO LESSONS AND ANALYZING THE PERFORMANCE OF UNDERGRADUATE ENGINEERING STUDENTS

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ABSTRACT

Research study used quasi experimental design to measure student's performance using video lessons in engineering education using mobile learning, questionnaire is used to evaluate the effectiveness of mobile learning and learning outcome is the results of engineering students. In this paper main study reveals results of 506 learners(male students 299 and female students 207) affiliated colleges and deemed universities of second year undergraduate engineering students of Electronics and Communication (ECE), Electrical and Electronics (EEE) and Bio-Medical Engineering (BME) at Chennai, Tamil Nadu, India about their usage of mobile communication technology, mobile learning using video lesson. The video lesson used for this study is Electrocardiography is common for ECE and BME and Electromagnetism is common for EEE and ECE, the duration of the video lesson is 30 minutes. The smart phones, mobile phones and wireless devices tablet pc, personal digital assistants are used for this study. The video lesson can be transferred via Bluetooth technology within classroom, library and corridors in their free hours.

I.INTRODUCTION

This research paper describes the interdisciplinary research project (PhD) in progress. The main aim of this study is to give awareness of the mobile learning in India and improve the self study or individualized learning style in an adaptive mobile learning environment. The recent trends to focus on mobile learning as an additional source to many universities and colleges to provide a unique approach in personalized learning experience. Nowadays smart phones and tablet pc are popularly increasing with the students. Mobile learning system with dynamically adapted video content is an effective medium for individualized learning.,,Mobile learning is a method in which wireless and mobile technologies is used for education by extending access to a desktop based on-line environment to handheld devices such as mobile phones or wireless devices used as part of a mobile community [Farooq 2002].

Mobile learning uses the latest mobile phones and wireless network technology to achieve the effectiveness of traditional learning process. It offers more interactivity, greater flexibility, more functionality, reusability, interoperability, accessibility and educational experience with a single device. This project is focused on the usage on video lesson in education using mobile learning system which paves way to the improvement of learner‟s knowledge, performance, achievements and individual learning system and also to develop their

problem solving skills. The main motivation of the research is to attract student"s attention and motivate them to learn difficult subjects and also to find alternative methods to practice in the field of mobile learning.

According to Mlearn 2002 to Mlearn 2009 and WMTE"02 conference proceedings, the characteristics of physical, psychological of the learners environment in which the study of mobile learning features as follows:

- Mobile or wireless device are attractive, availability and accessibility of wireless network is 24/7 method
- Mobile learning is greater flexibility and functionality in a single device
- Mobile learning with students interactive and interoperability
- Mobile learning is improving of communicative and collaborative learning in education system
- Mobile learning supports adaptability and affordability of learning environment
- Theory of mobile learning is mobility and memory ability for learners
- Mobile devices use reusability and reliability

II.REVIEW OF LITERATURE

Mohamed Osman M.El-Hussein and Johannes C.Cronje (2010) has explained the meaning of mobile learning by applying its key concepts to learning experiences in education. Disassemble the basic components and provide an interpretation of the model in the context of higher education. The author further states comprehensive understand and define mobile learning. The key concepts can be arranged under three different concepts. The first concept relates to the mobility of technology. The second concept hinges on increased learner mobility. And the third concept examines the mobility and dynamism of the learning processes and the flow of information. The authors define mobile learning as "any type of learning that takes place in learning environments and spaces that take account of the mobility of technology, mobility of learners and mobility of learning". The article concludes that knowledge in the modern world is transformed by the development of revolutionary technologies in society.

Edward J. Cherian and Paul Williams (2008) Mobile learning has evolved from electronic learning, which evolved from distance learning. The barriers previously available for mobile learning have now all but disappeared and the number of adult learners available for mobile learning represents a sizeable student population. The study indicates that no significant difference between most forms of distant learning and tradition face-to-face learning, which may represent the last barriers to fall in the march toward the adoption of widespread mobile learning. Mobile Learning as a viable learning platform in and of itself as opposed to a mere extension of face to face learning principles and the traditional learner therein.

GoncaTelli Yamamoto, OzlemOzan and UgurDemiray considers the learning activity from past to the present and evaluates the opportunities and changes that are expected to arise in the future. This study argues the extent of orientation towards discussing the necessity of tending concrete m- and t-learning, moreover u-learning technology in Distance Education practices. Distance learning on the first hand is mostly for the distant scaled and influenced very much from the classical learning. Some technological advancement confronts e-learning and m-learning and up-t-learning are more interactive. Since there cannot be a single application of

technology, only multi education system would survive. Some of them would replace their status to the other or merge. The u-learning could be evaluated as the prepared systems only teach conscious or unconscious situations.

John Traxler (2005) defines the preliminary attempt to address the issues of definition and conceptualization and draws on recent research examining case studies from the UK and elsewhere. Learning from learners‟ and users‟ perspective, a definition of mobile learning becomes clearer. People use a variety of words to describe the nature of learning when it is mobile. Many of these characteristics are the core of separates from mobile learning (m-learning) from („tethered‟) e-learning. This paper attempts to summarize the factors that will influence our understanding of mobile learning in the coming years. This understanding will itself influence the progress and direction of mobile learning and its perception and acceptance by the wider educational community. The definition and depiction of mobile learning as „merely‟ portable e-learning is a gradualist position which will ease its diffusion but weaken its contribution whereas the definition and depiction of mobile learning as something wholly new and distinct is a radical position that will make diffusion and acceptance more problematic but maintain its identity and coherence.

III.METHODOLOGY

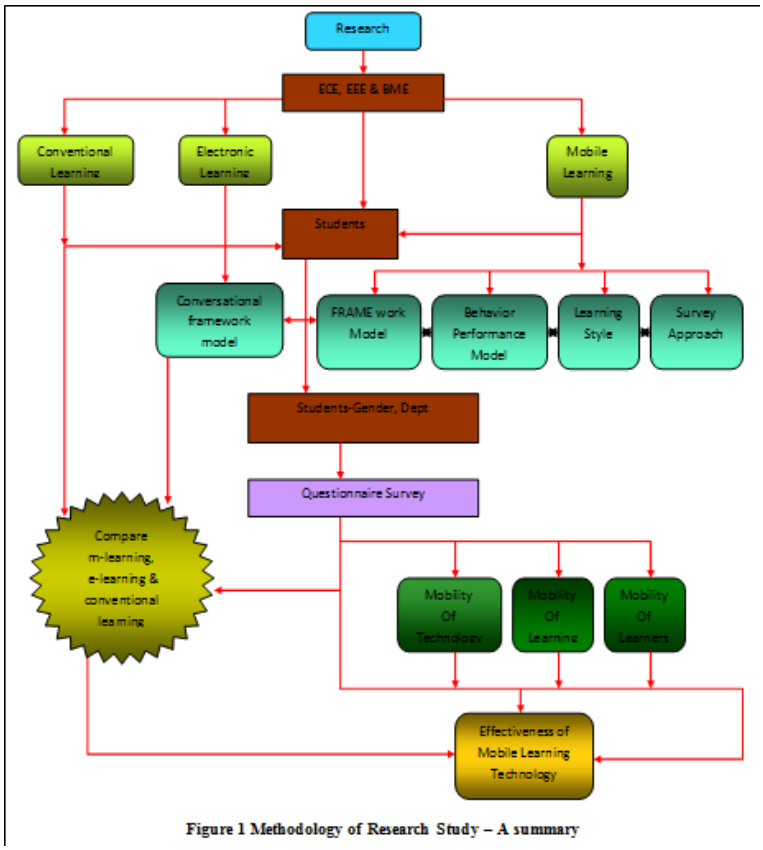


Figure 1 Methodology of Research Study – A summary

The survey was conducted with 301 students of electronics and communication, electrical and electronics and bi-medical engineering students to collect the following data. The mobile learning concept can be divided into three areas: mobility of technology, mobility of learning and mobility of learners. Wireless devices usage in learning, motivates the students to learn, convenient to access the network anytime, any network, anywhere, any

data on any wireless device. The result of the survey showed that more than 90% of students reveal that it is useful for their self study and supports as an additional source of learning. At the same time, two main objectives were identified which have effectiveness of mobile learning and usage of wireless devices for learners.

The mobile learning was evaluated through quasi experimental design, the design involve three groups which are control group and experimental group1 (e-learning), and experimental group2 (m-learning). The control group attended the treatment of using conventional learning method, experimental group1 used for desktop and laptop for electronic learning and experimental group2 use for mobile and wireless devices for mobile learning.

The 22 parameters were analyzed from questionnaire survey results, the students have assessed the effectiveness in the range of undecided (Mean 3) to agree (Mean 4) almost for all the areas; these parameters were used with students to collect their personal opinion about the video lesson using in the wireless devices. From the survey results strongly agree is combined a grouped with agree. Similarly, strongly disagree with disagree. Accordingly three attributes Agree, Undecided, and Disagree is reflected in the graph.

IV.RESULT AND DISCUSSION

The data collected into three phases, first phase pre-test for Control group (CG), experimental group1(EG1) (e-learning) and experimental group2 (EG2) (m-learning) before attending the classroom lecture and watching the video lesson. Second phase conducted by attending the classroom lecture for same topic of control group and delivered the video lesson for experimental group1 in the form of DVD or memory stick and transferred the video lesson for experimental group2 through Bluetooth technology in their free hours.In the third phase the students from control group and experimental groups go for the post-test to evaluate their performance. Finally, the effectiveness of mobile learning technology data were examined and questionnaires given to the experimental groups about usage of mobile device and usage of technology in the field of learning. The concept of mobility of technology, mobility of learning and mobility of learners"questionnaire included 22 indicators.

The Table I shows the sample frequency of the control group and experimental group on pre-test and post-test. And 506 students from each of the following discipline, ECE, EEE and BME students of second year undergraduate engineering (engineering) participated in the study. The contents of the video lesson is consists of Function of Stethoscope, function of Sphygmomanometer, working of Electrocardiography, heart functioning, Diagnosis and prevention of heart disease and public awareness. Hence these topics were used to evaluate the effectiveness of the video lesson using mobile learning technology, with the pre-test and post-test correspondingly.

The quantitative data were collected through pre-test, post-test and questionnaire. Pre-test was used to obtain a baseline performance of students and compare with their post-test result. Finally, questionnaires were used to measure the impact on video in providing assistance to the learners. Meanwhile, the qualitative data were collected using subjective questionnaires and also comments either written or orally which cannot be represented numerically. Qualitative data is used for decision making process. The comparison of the pre-test and post-test will indicate the effectiveness of the mobile learning technology in education system in terms of improving performance.

To analyze the quantitative data both effectiveness of mobile learning and mobility concept of mobile learning analysis were used. The following section will discuss the two analyses of elements.

1. Effectiveness of mobile learning using video lesson in education system
2. Is the mobile learning is effective than electronic and conventional learning
3. Is performance results improved using mobile learning

Effectiveness is used to determine the efficiency of the video lesson through enhancing students" understanding and conducted pre-test and post-tests to measure its efficiency. The maximum mark of test is 15. The analysis was done by comparing the control and experimental groups.

The first objective of this survey is effectiveness of mobile learning using video lessons was measured using twenty two indicators, Table 1 shows the mean value of the effectiveness of mobile learning. Responses to each of the indicators on effectiveness of mobile learning were measured on a Likert scale of 1 to 5 ranging from "Strongly agree to Strongly disagree" scores greater than 3.0 indicate relative importance, below 2.0 indicate relative unimportance; a score of 2 to 3 shows it to be neither important nor unimportant.

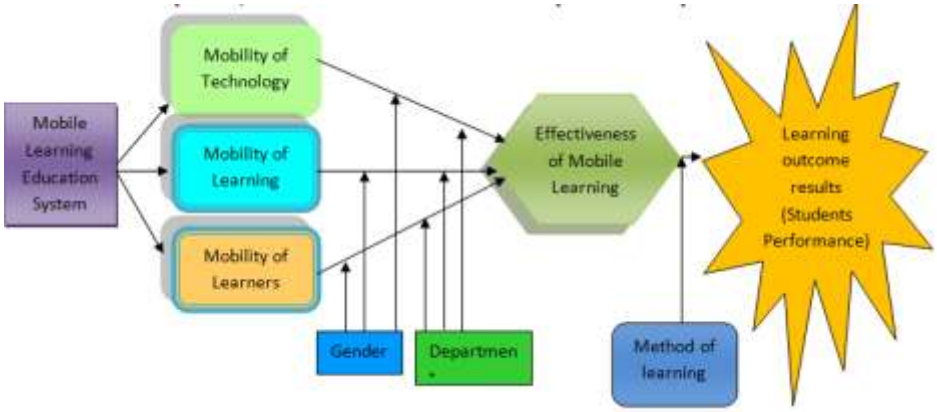


Figure 2 Research Model - Effectiveness and Performance of students in Mobile Learning Education

Figure 2 Snap Shots of video lesson & video lesson in mobile phone

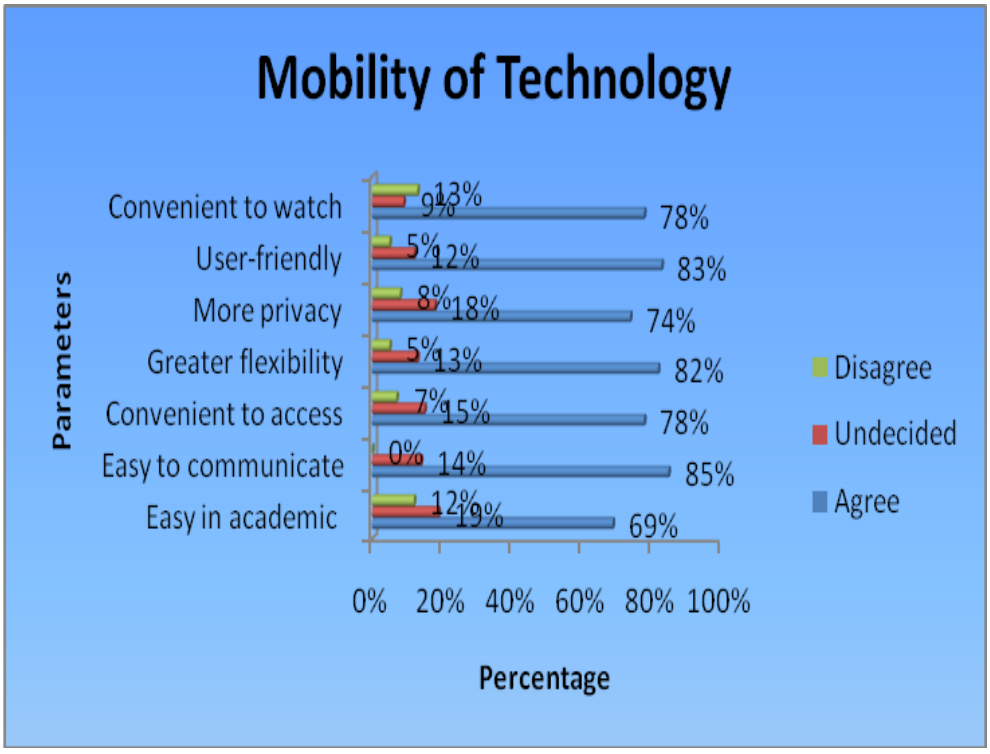
Table 1 Mobility Concepts

Sl.No.	*Parameters*	*Mean*	*SD*	*Mean Ranks*	*Chi-square value*	*P value (sig)*
	Mobility of Technology				87.644	0.000
1.	Use of mobile phones or wireless devices is **easy in academic** environment	3.73	1.016	3.41		
2.	Mobile phones or a wireless devices is **easy to communicate** with students and other teachers	4.18	0.659	4.28		
3.	Mobile learning technology is **convenient for accessing** information anywhere, at any time, any network, any data on any wireless devices	3.92	0.924	3.75		
4.	Mobile phones offers greater **privacy** than other learning devices	4.09	0.870	4.17		
5.	Mobile learning technology has**greater flexibility** where and when learning needs are present	3.97	1.004	3.99		
6.	Mobile learning is **user-friendly**	4.14	0.904	4.23		
7.	Watching video lessons in mobile phones is more **convenient**when compared to television	4.00	1.074	4.16		
	Mobility of Learning				62.331	0.000
8.	Mobile learning a good **alternate or supplemental** source to traditional learning	4.12	0.931	6.01		
9.	Mobile learning can bring **newopportunities** of learning.	3.96	1.018	5.55		
10.	Mobile phones or wireless devices can increase students **interest in learning**	4.00	0.963	5.66		
11.	Mobile learning helps in providing an **adaptive learning** environment	3.78	1.055	4.99		
12.	Mobile learning a good use in**self studyor individualized learning**.	4.10	0.894	5.92		
13.	Mobile learning as a **paperless** method of learning & teaching.	4.02	0.769	5.52		
14.	Using of mobile phones or wireless devices is **easy learning.**	3.93	0.895	5.32		
15.	**Positive impact** on the technology enabled learning system	3.94	0.918	5.22		
16.	Mobile learning technology is **affordable** for any one.	3.90	0.952	5.28		
17.	Mobile learning will help to adopt their **learning**	3.95	1.028	5.53		

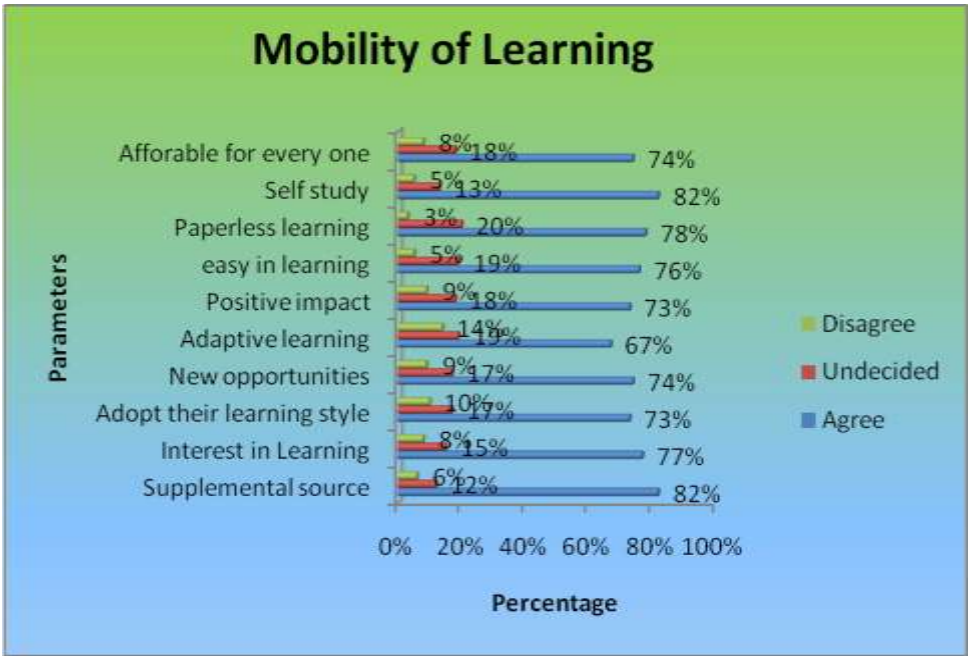
	style					
	Mobility of Learners				59.319	0.000
18.	Mobile phones or wireless devices are simple and **easy to get feedback** from learners and teachers	4.10	0.660	3.08		
19.	With usage of video in mobile learning **motivates** the students to learn	3.90	1.083	2.86		
20.	Mobile Learning is **easy to use**while travelling by bus/car/van/train.	4.19	0.858	3.36		
21.	Learners feel **convenient to carry** their data with them to almost all the places.	3.91	0.952	2.86		
22.	Learners can revise their lessons in an easy method through mobile learning system with **unlimited time and location.**	3.91	0.910	2.84		

In the above Table 1 seven parameters under mobility of technology, the students have assessed the effectiveness and the highest value of mean is mobile phones or a wireless devices is easy to communicate with teachers and other students mean is 4.18 and graph 1 represents 85% of students agree, 14% were undecided and use of mobile phones or wireless devices is easy in academic environment is the lowest mean value parameters mean is 3.73 and 69% of students were agree, 19% undecided and 12% disagree.

Graph 1 Mobility of Technology

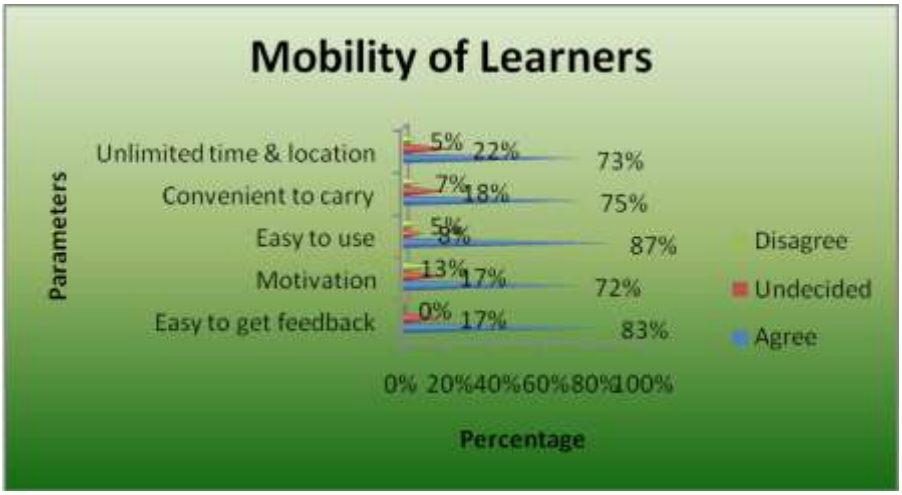


Graphy 2 Mobility of Learning



In the above graph 2 and table 1 shows that ten parameters under mobility of learning, the students have assessed the effectiveness and the highest value of mean 4.12 and graph 2 represents mobile learning is an alternate or supplemental source of learning and also agreed for 82% of students, undecided for 12% and 6% of students disagree and mobile learning can provide an adaptive learning environment mean value 3.78 is the lowest mean value and 67% of students are agree, 19% undecided and 14% disagree.

Graph 3 Mobility of Learners



In table 1 and graph 3 five parameters under mobility of learners, highest value of mean 4.19 mobile learning is easy to use while travelling by bus/car/van/train and87% of students agree, 8% of students are undecided and remain 5% disagree. The lowest mean value 3.90 for usage of video lesson in classroom motivates the students to learn 72% of students agree, 17% undecided and 13% disagree. It is concluded that under mobility of learners above 70% of students are agree all the parameters.

Table 2 Marks obtained by the students from control group, experimental group1 (e-learning) and experimental group2 (m-learning)

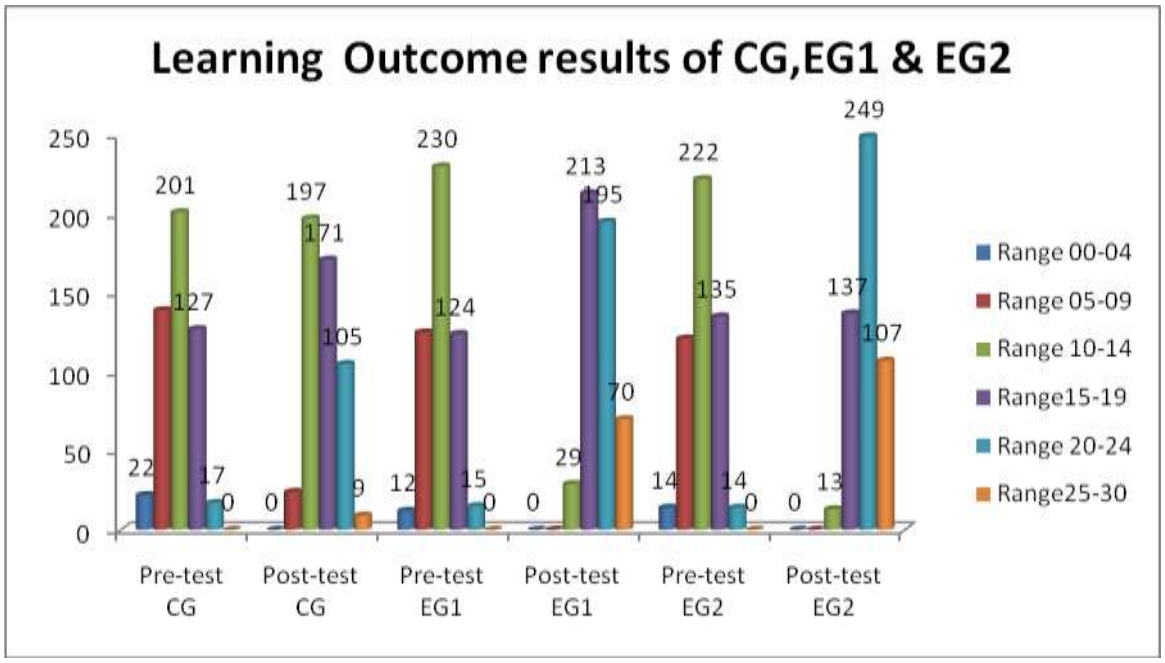
Scores	Pre-Test			Post-Test		
	CG frequency	EG1 frequency	EG2 frequency	CG frequency	EG1 frequency	EG2 frequency
00-04	22	12	14	0	0	0
05-09	139	125	121	24	0	0
10-14	201	230	222	197	29	13
15-19	127	124	135	171	213	137
20-24	17	15	14	105	195	249
25-30	0	0	0	9	70	107
Mean	11.71	11.94	12.03	16.07	19.77	21.55
SD	**3.563**	**3.431**	**3.513**	**3.77**	**3.956**	3.465

The results in table 2 is analyzed using t-test to measure the difference between groups using different learning methods and Cohen"s d to determine effect size. The Cohen"s d is used to measure the strength of the relationship between two variables. The effect size is more than 0.8 has the large effect size of Cohen"s d for interpretation [Kotrlik& Williams, 2003]

Table 3 Paired t-test & Cohen's d value and significance for CG, EG1 & EG2

		Mean Diff.	„t"value	Cohens" d value	Correlation	Effect size	Sig 2-tailed	Comments
Pair1	CG EG1	3.70	43.898	3.907	0.880	0.890	0.000	The results are significant, the use of mobile learning in education system is improved the students performance.
Pair 2	CG EG2	5.48	75.870	6.75	0.903	0.959	0.000	
Pair 3	EG1 EG2	1.78	29.748	2.648	0.943	0.798	0.000	

Graph 4 Students performance results of conventional learning, e-learning and m-learning



In this study, there are five hypotheses which are analyzed as follows:

1. Hypothesis 1: Pre-test scores between the three groups: Null Hypothesis (H01) – There is no significant difference in the pre-test scores between the Control group and experimental group. Table 1 indicates the test mean scores of control group 11.71; experimental group1 was 11.94 while the experimental group2 was 12.03. However, the significant (2tailed) value of p=0.542which is greaterthan (Alpha) $\alpha = 0.05$. The result failed to reject the null hypothesis H01 and there is no significant difference in the pre-test scores of all three groups. Hence the null hypothesis 1 (H01) is accepted.
2. Hypothesis 2: Post-test scores between the two groups Null Hypothesis (H02) – There is no significant difference in the post test scores between the control group and experimental group1 and experimental group2. Table 1 indicates the test mean scores of control group were 16.07, experimental group1 (e-learning) mean score was 19.77 and the experimental group2 (m-learning) was 21.55. The mean score comparison shows that the experimental group1 and group2 achieved significantly more in the post-test compared to control group. However, the significant (2-tailed) value, p=0.000, is less than (Alpha) $\alpha = 0.05$ which implies that H02 should be rejected. This means that there is a significant difference in the post test scores between the three groups; thus mobile learning is effective.
3. Hypothesis 3: The mobile learning of concept under Mobility of Technology: Null Hypothesis (H03): There is no significant difference between the mean ranks of parameters under mobility of technology assessed by the students. Friedman test for significant difference between the mean ranks of parameters is presented in Table 2, it can be arrived that in mobility of technology, since F value is 87.644 and P= 0.000 value is less than 0.01, the null hypothesis is rejected at 1% level of significance. Hence it is concluded that there is significant difference between mean ranks of parameters in mobility of technology with respect to the effectiveness of mobile learning technology. Based on mean ranks, it is inferred that, mobile devices and mobile communication technology is easy to communicate with teachers and other students 4.28 is the most

effective parameter on analysis of mobility of technology, followed by use of mobile phones is easy in academic environment 3.41 is the least effective parameter.

4. Hypothesis 4: The mobile learning concept of mobility of learning: Null Hypothesis (H04) – There is no significant difference between the mean ranks of parameters in mobility of learning assessed by the students. Friedman test for significant difference between the mean ranks of parameters in mobility of learning is presented in Table 2, it is arrived that the analysis of mobility of learning, since F value is 62.331 P=0.000 value is less than 0.01, the null hypothesis is rejected at 1% level of significance. Hence it is concluded that there is significant difference between mean ranks of parameters in mobility of learning with respect to the effectiveness of mobile learning technology. Based on mean ranks, it is concluded that mobile learning is the alternate or additional or supplemental source of learning mean ranks is 6.01 is the most effective parameter and mobile learning to provide adaptive learning environment is the least effective parameter under mobility of learning.
5. Hypothesis 4: The mobile learning concept of mobility of learners: Null Hypothesis (H05) – There is no significant difference between the mean ranks of parameters in mobility of learners assessed by the students. Friedman test for significant difference between the mean ranks of parameters in mobility of learners is presented in Table 2, it is arrived that the analysis of mobility of learning, since F value is 59.319 P=0.000 value is less than 0.01, the null hypothesis is rejected at 1% level of significance. Hence it is concluded that there is significant difference between mean ranks of parameters in mobility of learners with respect to the effectiveness of mobile learning technology. Based on mean ranks, it is concluded that mobile learning is easy to use at the time of travelling by bus/car/van/train mean ranks is 3.36 is the most effective parameter and the learners can revise their lessons in an easy method through mobile learning system with the unlimited time & location mean rank 2.84 is the least effective parameter under mobility of learners..

Reliability of effectiveness of mobile learning derived with three categories, identifying and to form Communalities by extraction method under Principal Component Analysis (PCA) by following this method all the parameters were analyzed with students, the data reduction can be done with the extraction method under principal component analysis results were collected from each parameter and analyzed. Another statistical analysis instrument is reliability coefficient. Cronhach"salpha (Cronbach.1951) to estimate the scale of consistency among items in the group (Hair, Anderson, Tatham& Black, 1998). The Cronbach"s alpha is generally acceded upon the level of 0.70, albeit it is acceptable at 0.60 in exploratory research (Hair et al., 1998). A reliability analysis using Cronbach"s Alpha was conducted to estimate the reliability of the parameters under each category. Cronbach"s alpha coefficients were calculated for each multi-parameter variable.In the cluster validation via Exploratory factor analysis (EFA) was performed, Principal Component Analysis (PCA) with Varimax Rotation (Kaiser Normalization) was employed. To ensure that factor loadings were accounting for at least 10% of the variance in the overall model, the criteria of Eigen values greater than > 1 and factor loadings of [.3] and greater were employed. The results are presented in table 4.Although it was anticipated a priori that the 22 parameters would load onto the 3 variables identified, only three areas. The parameters that loaded onto each area and determined and represented by: 1) Mobility of Technology 2) Mobility of Learning and 3) Mobility of Learners. The results of this study can be explained in Table 4 gives the results of extracted

communalities of all the variables. It shows the proportion of the variance of a variable explained by the common factors

Mobility of Technology: In the mobility of technology components were characterized by seven parameters with factor loadings ranging from 0.494 – 0.653. The parameters commonalities are described in the table 4 ,

Technology: User-friendly, easy to communicate, watching video lesson is convenient in mobile phones and convenient to access information anywhere, anytime, on any device.

- "Mobile phones offers more privacy than other learning devices" has the least percentage (49.4%) of variance
- "Mobilephonesare convenient to access information anywhere, at anytime on any network" has the highest variation (65.3%)
- The internal consistency represented by coefficient alpha, of all items is as much as 0.674.
- Mobile learning result provides confidence statistical results extracted only one component.

Mobility of Learning: In the mobility of learning components were characterized by fifteen parameters with factor loadings ranging from 0.461 - 0.745. The parameters commonalities are described in the table 4

Learning: Mobile learning will bring new opportunities in learning, mobile learning is paperless method of learning, it is also additional or supplemental source of learning and it can be used for self study.

- "Mobile learning technology will bring new opportunities of learning" has the least percentage (46.1%) of variance that can be predicted
- "Mobile learning to provide adaptive learning environment" has the highest variation (74.5%)
- Cronbach"s alpha from reliability analysis of the data,the internal consistency, represented by coefficient alpha, of all items is as much as 0.702
- Factor analysis loaded ten questionnaire statements into three components. . The alpha value of first factor is 0.718, second factor is 0.579 and the third component of alpha value of third factor 0.553

Mobility of Learners: In the mobility of learners components were characterized by twelve parameters with factor loadings ranging from 0.512 – 0.782. The parameters commonalities are described in the table 4

Learners: Using video lessons in mobile phones motivates the students to learn, usage of video unlimited time and location, user"s convenient to carry their data, and easy to use in education system.

- "mobile phones / wireless devices are simple and easy to get feedback from the learners and teachers" has the least percentage (51.2%) of variance that can be predicted
- "With usage of video lesson in classroom motivates the students to learn" has the highest variation (78.2%)
- Cronbach"s alpha from reliability analysis of the data, represented by coefficient alpha, of all items is as much as 0.638.

- Factor analysis loaded five questionnaire statements into two components. The alpha value of the first factor is 0.689 and the second factor is 0.603.

The overall reliability of the mobile learning student‟s instrument is Cronbach‟s Alpha value is 0.857 it has high internal consistency of the system.

Table 4 Communalities (Extraction Method: Principal Component Analysis), Rotated Component Matrix and Cronbach's Alpha of Mobile Learning

	Communalities Principal Component Analysis		***Rotated Component Matrix and Cronbach's Alpha of Mobile Learning Technology***			
	Initial	***Extraction***		***Component***		
				1	*2*	*3*
			Mobility of Technology	***0.674***		
Q18	1.000	0.544	Easy in academic	0.494		
Q40	1.000	0.623	Easy to Communicate	0.725		
Q13	1.000	0.653	Convenient to access	0.568		
Q23	1.000	0.494	More privacy	0.703		
Q10	1.000	0.523	Greater Flexibility	0.723		
Q32	1.000	0.633	User-Friendly	0.603		
Q22	1.000	0.526	Convenient to watch	0.725		
			Cronbach's Alpha	***0.674***		
			Mobility of Learning	***0.702***		
Q4	1.000	0.603	Self study	0.775		
Q3	1.000	0.598	Additional source of learning	0.767		
Q24	1.000	0.461	New opportunities	0.674		
Q9	1.000	0.463	Interest in learning	0.616		
Q17	1.000	0.379	Affordable	0.446		0.419
Q37	1.000	0.650	Paperless method		0.741	
Q27	1.000	0.561	Positive impact		0.730	
Q34	1.000	0.471	Easy in learning		0.594	
Q38	1.000	0.745	Adaptive learning			0.863
Q19	1.000	0.611	Adopt their learning style			0.596
			Cronbach's Alpha	***0.718***	***0.579***	***0.553***
			Mobility of Learners	***0.638***		
Q28	1.000	0.686	Unlimited time & Location	0.807		
Q21	1.000	0.545	Convenient to carry	0.729		
Q39	1.000	0.512	Easy to get feedback	0.670		

Q29	1.000	0.649	Easy to use	0.609	0.528	
Q31	1.000	0.782	Motivation		0.884	
			Cronbach's Alpha	***0.689***	***0.603***	
			Overall Reliability (Cronbach's Alpha)	***0.857***		

V.CONCLUSION

This paper presented the research study survey from 506 undergraduate engineering students of ECE, EEE and BME on the effectiveness of mobile learning. From the above results it is concluded that there is a significant difference between the mobile learning, electronic learning and conventional learning. From the parameters or indicators to the concept of mobility in mobile learning using video lessons in education system is easy to understand the concept of the subject. For future research, to develop the mobile learning management system and evaluate the system with students using the video lesson implemented into the wireless devices.

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APPENDIX –I

Part-I

ELECTRO CARDIO GRAPHY

(Pre-Test)

Multiple Choice

Choose the correct answer, write in the provided box or fill in the blanks

1. Which instrument is used to record the electrical activity of the heart?

a. EMG b) EEG c. ECG d. PCG [ ]

2. Electro retina graph is used for recording the change in potential when light falls on the -------

a. Chest b. Eye c. Hear d. Nose [ ]

3. Sphygmomanometer is used to measure the blood pressure

a. True b. False [ ]

4. The normal person"s blood pressure is----------

a. 120/80 b. 110/70 c. 100/60 d.140/100 [ ]

5. From the blood pressure meter „when hear the sound" is called

a. Diastolic B.P b. Systolic B.P c. Congenital B.P d. Acquired B.P [ ]

6. What are the parts of the stethoscope?

a. Auricles & Ventricles b. Systolic & Diastolic

c. Ischemia & Angina d. Chest piece & Ear Piece [ ]

7. ---------- is the acoustic medical device

a. SMM b. Blood pressure meter c. Stethoscope d. ECG [ ]

8. Stethoscope is used to listen heart sounds and lungs sounds

a. True b. False [ ]

9. Major component of ECG machine ----------
a. Sensors & recorders b. Pen motor & recorders
c. Sensors & Pen motor d. Pen motor & Chart transport motor [ ]

10. ---------- is to record the electrical activity of the heart in the ECG paper
a. Sensor b. Electrode c. Recorder d. None of these [ ]

11. In ECG, the current"s measurement is divided into different parts
a. QRS & T b. P & T c. P, QRS d. P, QRS & T [ ]

12. Recovery wave is represented by ----------
a. P wave b. T wave c. R wave d. S wave [ ]

13. Heart is made up of pure ----------
a. Blood b. muscles c. water d. none [ ]

14. The top chambers represented by ----------
a. Ventricles b. atria c. Auricles d. septum [ ]

15. Where the purification of the blood will taking place?
a. Lungs b. Muscles c. Septum c. None [ ]

16. Which functional block in the ECG machine gets the signal?
a. Preamplifier b. Power amplifier c. Lead Selector switch d. all the above [ ]

17. The output of the power amplifier is fed to the --------- motor
a. bridge b. Chart c. Pen d. Frequency selector [ ]

18. How many stages of differential amplifier are used in the preamplifier?
a. 2or 3 b. 3 or 4 c. 2 or 4 none [ ]

19. Which block the stabilizing effect will occur?
a. Power amplifier b. pre amplifier c. Pen motor d. none [ ]

20. Which type of power amplifier is used in the ECG machine?
a. Push pull b. pull/push c. Class A d. None [ ]

21. Which affects the heart disease to the human?
a. High cholesterol b. High Blood Pressure c. Diabetes d. all the above [ ]

22. The heart disease affecting the human is called
a. Congenital b. Acquired c. myocardial infarction d. all the above [ ]

23. What are the symptoms of the heart diseases for the human?
a. Stomach pain b. Chest pain c. vomiting d. Giddiness [ ]

24. How to identify the acquired heart disease
a. Congenital b. myocardial infarction c. rheumatic fever d. angina [ ]

25. Which type of disease will affect the carrying mother?
a. Infarction b. Epilepsy c. Fever d. Heart attack [ ]

26. When the supply of the blood flow is completely cut off it creates
a. Minor attack b. Ischemia c. Infarction d. Chest pain [ ]

27. CPR stands for
a. Percutaneous coronary intervention b. Phonocardiograph
c. Cardiopulmonary resuscitation d. Cardiovascular disease [ ]

28. How to prevent the heart disease

a. Good food habit b. Good exercising habit

c. Change healthy life habit d. All the above [ ]

29. To prevent the acquired heart disease take the

a. High green foods b. High fiber diet

c. High oil foods d. High rice foods [ ]

30. „Basic Life Support" program is conducted all over the world to prevent the heart attack

a. True b. False [ ]

ELECTRO CARDIO GRAPHY

(Post-Test)

Multiple Choice

Choose the correct answer, write in the provided box or fill in the blanks

1. Which instrument is used for recording the electrical activity of the brain?

a. EMG b. EEG c. ECG d. PCG [ ]

2. Electrocardiography is to find the ---------- diseases

a. Brain b. Kidney c. Heart d. Chest [ ]

3. Sphygmomanometer is used in conjunction with a stethoscope

a. True b. False [ ]

4. Disappearance of the sound in the SMM is called as --------

a. Systolic B.P b. Diastolic B.P. c. Congenital B.P d. Acquired B.P [ ]

5. SMM consists of an ---------- and ---------

a. Sensors and Electrodes b. Inflatable cuff and mercury manometer

c. recorder and sensor d. None of these [ ]

6. The Stethoscope is used to listen / hear the

a. Heart sounds b. Brain sounds

c. Muscles sound d. Each beat of heart cycle [ ]

7. ----------instrument is used to listen the intestines and blood flow in arteries and veins

a. SMM b. Stethoscope c. Blood pressure meter d. None of these [ ]

8. Stethoscope is used to listen the animal heart sounds

a. True b. False [ ]

9. Which component is pickup the electrical potentials from the patient"s body

a. Electrodes b. Wires c. Lead selector switch d. Clips [ ]

10. How to fix the electrodes in the patient"s body

a. Clips b. paste c. Gel d. None [ ]

11. The P wave represents activation of the ----------

a. Ventricles b. Auricles c. Atria d. Septum [ ]

12. ---------- represents the electrical current moving through the heart during heart beat.
a. ECG b. EEG c. EMG d. ERG [ ]

13. Heart consists of ---------- chambers
a. 2 b. 3 c. 4 d. 5 [ ]

14. The bottom chambers represented by ----------
a. Ventricles b. Atria c. Auricles d. Septum [ ]

15. Organs are separated by a thick valve is called:
a. Muscles b. Chambers c. Septum d. Auricles [ ]

16. ------- is Frequency selective network which provides necessary damping of the pen motor.
a. L network b. C network c. R network d. RC network [ ]

17. The auxiliary circuit includes a ---------- for the chart drive motor
a. Pen motor b. Preamplifier c. Speed control circuit d. Power amplifier [ ]

18. Which block has the large negative current feedback effect?
a. Preamplifier b. Power amplifier c. Lead selective network d.none [ ]

19. Which block is the writing device on the ECG paper?
a. Power amplifier b. Pen motor c. Auxiliary circuit d.none [ ]

20. Auxiliary circuit provides a -------- volt calibration signal
a. 1mv b. 2mv c.3mv d. 4mv [ ]

21. Which block has speed control drive motor?
a. Auxiliary circuit b. Chart transport motor c. Pen motor d. none [ ]

22. Which affects the heart disease to the human?
a. High cholesterol b. High Blood Pressure c. Diabetes d. all the above [ ]

23. The heart disease which affects the human is called
a. Congenital b. Acquired c. myocardial infarction d. all the above [ ]

24. What are the symptoms for the heart diseases to the human?
a. Stomach pain b. Chest pain c. vomiting d. Giddiness [ ]

25. How to identify the acquired heart disease
a. Congenital b. myocardial infarction c. rheumatic fever d. angina [ ]

26. Which type of disease will affect the carrying mother?
a. Infarction b. Epilepsy c. Fever d. Heart attack [ ]

27. When the supply of the blood flow is completely cut off it creates
a. Minor attack b. Ischemia c. Infarction d. Chest pain [ ]

28. How to prevent the heart disease
a. Good food habit b. Good exercising habit
c. Change healthy life habit d. All the above [ ]

29. To prevent the acquired heart disease takes
a. High green foods b. High fiber diet c. High oil foods d. High rice foods [ ]

30. „Basic Life Support" program is conducting the all over the world to prevent the heart attack
a. True b. False [ ]

ARTIFICIAL NEURAL NETWORKS FOR PREDICTABILITY OF ALL INDIA RAINFALL USING HISTORICAL TIME SERIES

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ABSTRACT

Accurate forecasting of All India Rainfall (AIR) is not only scientifically challenging problem but is also important for planning agricultural and other financial and social strategies. Rainfall being chaotic time series, its prediction involves complex dynamics of several parameters. However, rainfall time series contains self describing features which can be used for the prediction of future points much in advance than it is normally anticipated. Hence it may be interesting to explore the possibility of AIR prediction by improvising the time series of AIR itself thus simplifying the system which is usually complex when large number of parameters is considered. In order to answer this question in all its entirety several aspects of time series of the AIR is required to be investigated statistically. However, as a modest first step to explore this possibility, we have used the Artificial Neural Network (ANN) technique with back-propagation algorithm for the predictability of AIR one year in advance by analysing the historical time series of 140 years of AIR data. The ANN model used is described in detail and the forecast is validated using the correlation coefficient and Root Mean Square Error(RMSE). It is found that the AIR time series can be exploited in conjunction with the ANN model for satisfactorily predicting the points one year in advance. Future scope of this study is discussed.

Keywords : Artificial Neural Network (ANN), Backpropogation (BPN) , Root Mean Square Error (RMSE), Standard Deviation(SD)

I. INTRODUCTION

Weather forecasting is one of the most demanding & challenging requirement of all over the world .Prediction of monsoon rainfall is one of the challenging and demanding requirement of the metrology department. As per analysis ,In India the total population dependency on the agriculture is around 70%, so the prediction of rainfall plays a very important role. The prediction of rainfall is a one of the demanding problem to Indian atmospheric scientists. All decisions are to be taken in the visage of uncertainty in the field of meteorology ,so the task is very complicated .The rainfall in highly unpredictable phenomena . Linear regression ,principal component analysis , spectral analysis and other approaches are used to understand the trends of the rainfall. ANNs is one of the approach being used for nonlinear regression and classification problems in metrology .In this study we are predicting the AIR using the one of the soft computing approach i.e Artificial Neural Network (ANN) based on the time series analysis. The ANNs have been found sufficiently suitable to predict chaotic behaviour of

rainfall .Since the mechanisms of rainfall are still not understood well, By using the ANNs the relationships of rainfall parameters are very well analyzed .The use of ANN for rainfall prediction will provide the satisfactory results and it is found that there is no scientific controversy. In general, it is found that ANN is an appropriate technique for forecasting various weather phenomena by the observation of various forecasting techniques such as statistical and numerical modelling over the meteorological data.By the literature review from 1923 to 2012 for rainfall forecasting ,it is observed that ANN is an efficient approach to forecast chaotic behaviour and enough to forecast the weather parameters [4] . The ANN approach with back propagation algorithm is one of the best approach for temperature forecasting. BPN is capable for good results of temperature forecasting. The performance can be tested by the root mean square error.[13,15] The prediction model for rainfall is designed by Artificial neural network and multi regression technique. By the analysis of monthly rainfall data ,it has been found that ANN is better approach than MLR model .The results analysis is done by RMSE (root mean square error), Mean absolute error (MAE), (CC) and BIAS parameters The ANN gives the good result because the AAN is a nonlinear mapping tool ,which is more suitable for rainfall forecasting [1]. There are different statistical methods for meteorology and oceanography like, Linear regression ,principal component analysis, canonical correlation analysis ,neural network. The obstacles of the ANN for meteorology-oceanography, i.e nonlinear instability, especially with a short data record, overwhelmingly large spatial data fields , difficulties in interpreting the nonlinear NN can be removed [14].The multi layer perceptron (MLP) is one of the approach for short term forecasting .The results shows that MLP network has minimum forecasting error and a good network for one day ahead temperature forecast.[8]. For prediction of Indian rainfall Autoregressive Integrated moving average model using ANN can be used .The analysis of results with Absolute Average percentage error parameter is done with Multi Layer Perceptron (MLP), Functional-link Artificial Neural Network (FLANN) and Legendre Polynomial Equation (LPE) .It is observed that Functional-link Artificial Neural Network (FLANN) gives better prediction results as compared to other models with less Absolute Average Percentage Error (AAPE) for the measured rainfall data. [12] . It is analysed that the ANN model is good capable for the sea surface temperature (SST) anomalies over the whole tropical Pacific region [7] . One hidden-layer neural network is an efficient forecasting tool for short range prediction of some meteorological parameters during the pre-monsoon season . The estimation of maximum surface temperature and maximum relative humidity can be done by this approach [2]. The predictability of Sea surface temperature anomalies of small area of Indian ocean region by using artificial neural network can be done .The comparision of linear regression and ANN shows that ANN performs better than regression where regression fails [5].The prediction of intraseasonal variability of sea ice area can be performed by ANN .The ANN is a good approach for Antractic sea ice anomalies prediction with good accuracy[6] .It is analysed that the ANN and support Vector Regression are better approaches than linear regression for Tropical Pacific Sea Surface temperature [10] .For the seasonal forecast skill of the Indian Summer Monsoon Rainfall Index (ISMRI) by using multiple linear regression and Artificial Neural Networks (ANNs) models are tested and observed ,and analysed that the ANN model has better predictive skills than all the linear regression models[9] .For predicting severe thunderstorms the ANN approach can also be used with different parameters .The capabilities of six learning algorithms, namely, Step, Momentum, Conjugate Gradient, Quick Propagation, Levenberg-Marquardt, and Delta-Bar-Delta in predicting thunderstorms is tested . Levenberg-Marquardt Algorithm well predicted thunderstorm affected surface parameters. [11].

In the present study , Artificial Neural Network with multi layer feed forward is used. The structure of a multilayer feed forward network is defined with interconnected set of processing units called the neurons. Three layers are defined in the network ,the Input layer ,hidden layer and output layer. Different no of neurons are defined in each layer .The no of hidden layers plays an important role in the analysis. The decision of the number of hidden layers in a network depends on the training and validation data.

II. DATA COLLECTION

To achieve the objective of the any study ,the selection of Dataset is an important factor. The integrity of the research is maintained by the accuracy of data collection . Monthly data set of (1871-2010) of ALL-INDIA RAINFALL of 30 meteorological subdivisions of 2,880,324 SQ. KM. with a resolution of up to 0.1 mm/month is considered for this research .The dataset is taken from Indian Institute of Tropical Meteorology website [3] .

III.DATA PREPROCESSING

The raw data is transformed into an understandable format by using the data mining techniques. The following normalization scheme has been used. The data to be normalized before inputting, otherwise the network will be ill-conditioned. The purpose of normalization is to have stable convergence of weight and biases . We normalize the collected data using Formulae in range [0.2, 0.8] .

$$Xn = [(X - Xmin) / (Xmax - Xmin)] * 0.6 + 0.2 \quad \ldots (1)$$

Where X is the rainfall anomaly and Xmin is the minimum value and Xmax is the maximum value . Xn is the normalized value .

The network using Back-propagation Algorithm is used to train network with normalized data .The proposed ANN model is basically a three layered ANN with different no of neurons in hidden and output layer .Total samples are 1680 data points .Out of total samples (130 yr data) are used for training and validation & rest (10 yr data) are used for kept for testing.

(i) Training and validation : (130 yr data)

(ii) Testing: (10 yr data)

IV. METHODOLOGY

The steps followed for the development of the model are as follows:

1. Designing of the ANN model.
2. Training of network with 130 years .
3. Testing of data by trained network.
4. Comparing the results of different networks .

4.1 Network Model

With different output analysis , it is observed that one hidden layer and an output layer can provide the valuable results. One neuron for input and one for the output is considered for this study. The network is trained with different no of neurons in hidden layer and find out that five neurons for the hidden layer with a learning rate of 0.2 are given some valuable results . Figure 1 shows the architecture of artificial neural network.

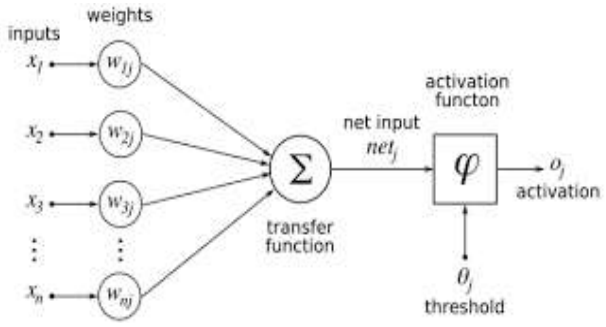

Fig.1. Architecture of ANN

The training is performed for 1000 epochs. The training data is divided into 70% for training ,15% for validation & 15% for testing purpose. Gradient descent backpropagation is used for training purpose. The momentum .75 is used for this purpose.

The Hyperbolic tangent sigmoid transfer function

$$f(n) = 2/(1+\exp(-2*n))-1 \quad \ldots \quad (2)$$

With bias has been used as the activation function for the neurons in hidden layer for prediction .For the neurons in the output layer the identity function has been used as the activation function

$$f(n) = n \quad \ldots \quad (3)$$

4.2 Back Propagation

The backpropagation algorithm is used to trains a given feed-forward multilayer neural network for a given set of input patterns . Each sample set is presented to the network, the network examines its output. The output is then compared to the known and desired output and the error is calculated. The weights are adjusted to reduce the error . The process is repeated until the error is minimum .

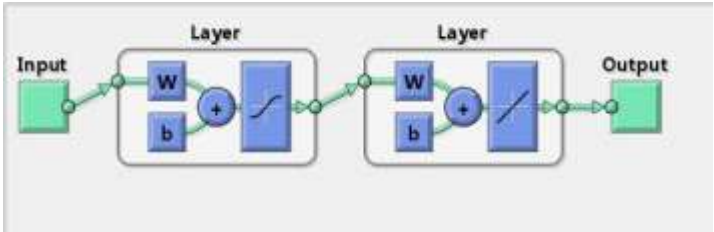

Fig.2 Architecture of neural network

Figure 2 shows the activation functions of the layers.

Table 1- Parameters of Ann

1. Epochs	1000
2. Learning rate	.2
3. No of hidden layers	1
4. Activation (hidden layer)	Hyperbolic tangent sigmoid transfer function
5. Activation function (outer layer)	Identity function
6. Training algorithm	Backpropagation

V. EXPERIMENTAL RESULTS

In this experiment, ANN using backpropagation is implemented to investigate the Indian Rainfall (140 years) dataset .The parameters like RMSE , correlation coefficient, Standard deviation are used for study . The performance is measured with these parameters .The correlation and RMSE is calculated and compared . The comparison shows that the ANN is successful approach for prediction . Initially an ANN model is designed with 4 neuron in hidden layer .The learning rate .2 is taken for this analysis .

Table 2 – Experimental Results

S.N	No of neurons	Training Results				Testing Results		
		CC	CC B/W output &	RMS	SD	CC B/W target & output	RMSE	SD
1	4	.7487	.7453	.1101	.1680	.7190	.1177	.1640
2	**5**	**.7487**	**.7711**	**.1078**	**.1680**	**.7228**	**.1152**	**.1640**
3	6	.7487	.7730	.1091	.1680	.7124	.1157	.1640
4	7	.7487	.7562	.1103	.1680	.7235	.1161	.1640

SD- standard deviation, CC- correlation coefficient, RMSE- root mean square error

The RMSE and standard deviation are calculated for training and testing data .The results are compared and it is found that RMSE is less than SD . Different networks are designed by using the different no of neurons in hidden layers .In the present study the networks with 4,5,6,7 neurons in hidden layer are designed and tested .The network that has least RMSE (< SD) & more correlation b/w target & output is considered best & used for testing purpose.

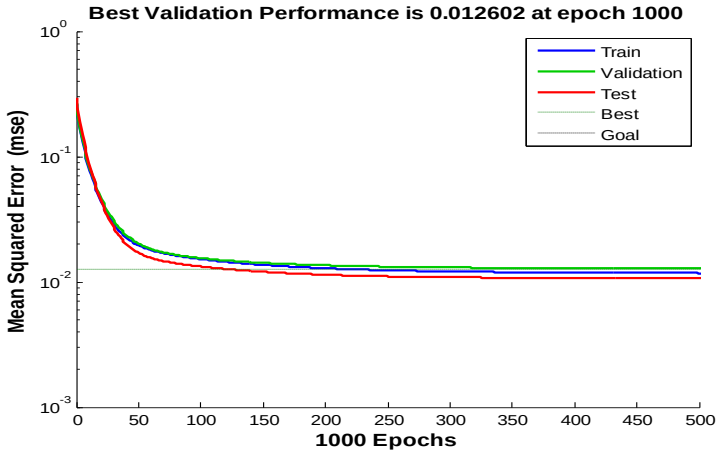

Fig. 3 Error graph with 5 neuron in hidden layer

The RMSE and standard deviation for training and testing data are calculated and compared . The network with minimum error is used for testing .By the analysis ,it is observed that the ANN model with 5 neuron in

hidden layer is best . It is considered for testing .By the analysis of results ,it can be concluded that ANN capable approach for prediction.

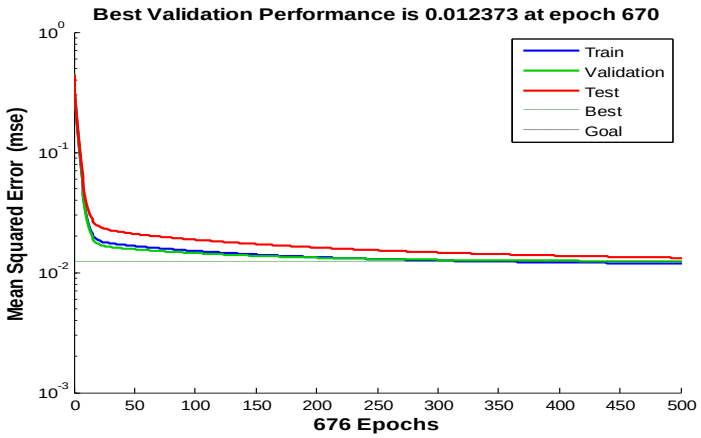

Fig. 4 Error graph with 6 neuron in hidden layer

VI.CONCLUSION

ANN model was used for the predictability of AIR. It was our conjecture that the AIR time series contains vital information which can be statistically utilised for more advance prediction of the points than is normally anticipated using the complex dynamical systems with several parameters. It is found that the ANN models can satisfactorily predict the time series one year in advance. Although the importance of the dynamical models cannot be done away with for the correct understanding of the dynamical system of the All India Rainfall, ANN models can be used for more advance prediction in practice. It remains to be investigated how the predictions fare in case of more interesting regions of prediction- the Indian Summer Monsoon Rainfall and the active and break spells of the same. Correct forecasting in these regions will help in better planning and catastrophic announcements. Further, it is proposed for future to investigate the time series for better prediction using other statistical models including other variants of the ANN.

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DESIGN OF CURRENT MODE R-2R LADDER DIGITAL TO ANALOG CONVERTER USING SWITCHABLE MOS DEVICES

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ABSTRACT

This paper present a design of Current mode MOS only R-2R ladder Digital to Analog converter using an innovative technique for dividing currents accurately. The resistances in conventional R-2R ladder Digital to Analog Converter are replaced by NMOS as switch which has lower power & area. The design of R-2R ladder is supported by current mode architecture which results efficient reduction in power dissipation. The design is supported by implementation of 4 bit R-2R ladder network using NMOS transistors only. Four bit D to A converters use an LSB current of 10uA and implemented using 180nm CMOS process.

Keywords: Digital To Analog Converters, NMOS, R-2R Ladder.

I. INTRODUCTION

The 4 bit digital to analog converter is implemented by current mode R-2R ladder architecture. This Design is elaborated by the concept of division of current or voltages very accurately & linearly in various signals processing application like A/D, D/A conversion. A common technique is to use resistors or capacitors for the linear & accurate division of current or voltage while using NMOS as switches. In this paper, 4 bit current mode R-2R ladder D/A is proposed based on the NMOS as switch for linear current division technique.When we design 8 bit D/A converter directly the requirement of total reference current will be 256 times the 1LSB current. Hence this current is too large for MOS device to handle. Instead of handling large current we have design 4 bit R-2R ladder Digital to Analog converter and each stages are handling total reference current of160uA. Section II presents the basic MOS current division principal. Section III reviews the design of linear current mode 4-bit R-2R ladder DACs. In Section IV discuss the power dissipation analysis. Section V gives results of Current mode R-2R ladder DAC. Section VI gives the conclusion of the design.[1]

II. THE MOS CURRENT DIVISION PRINCIPAL

The basic principal of current division technique is shown in fig 2. Both NMOS transistor have the same gate voltage Vg. The two terminal voltages Vx & Vy can be select such that the transistors are in the on state. A

current I_{in} flowing into or out of the circuit will be divided into two parts, in which I_1 flow into Vx, & I_2 flow to Vy. The current division principal state that the fraction of this input current flowing to one side is:

1) Constant & independent of I_{in}
2) Independent of the values of Vx &Vy.
3) Independent of whether one or both device operates in linear or in saturation region.

That is why the basic current division technique independent of process variations and thus well suited for large scale integration.Note that Vx and Vy may be any value applied, there may be a dc current flowing through the transistor. Also assume that Vx and Vy are ideal voltage source, i...e, having zero output impedance. Current division ratio is independent of voltages Vx, Vy, Vg and I_{in}, the operation of two MOS devices is only depends on the aspect ratio of the devices [1].

$$\frac{\Delta I_1}{\Delta I_2} = \frac{\frac{W_1}{L_1}}{\frac{W_2}{L_2}} \quad (1)$$

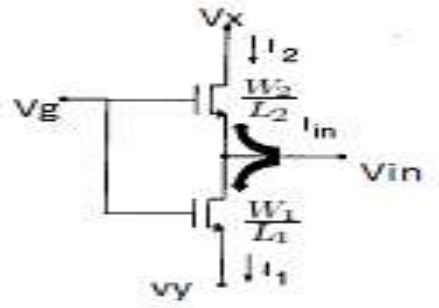

Fig. 1: The principle of current division

All transistors in R-2R ladder D/A converter are biased in linear region and having large aspect ratio. Because the current division mechanism is based on the symmetry of a MOS device and it is valid for both NMOS & PMOS [2].

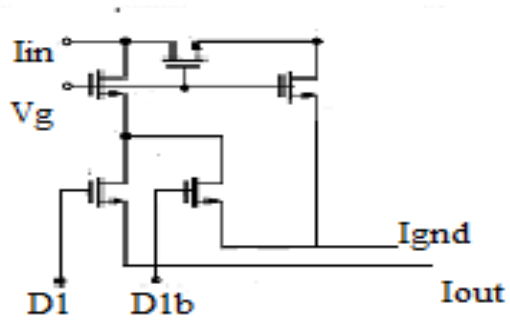

Fig.2: The unit cell of R-2R ladder using NMOS

III. DESIGN OF R-2R LADDER D/A CONVERTER

The design of current mode 4 bit R-2R ladder D/A converter is shown in fig 3. The resistances in R-2R ladder D/A converter are replaced by NMOS as switch, and are biased in strong inversion region to reduce the power dissipation. All transistors are having same gate voltage and aspect ratio (W/L) to avoid the transistor mismatch. The conventional resistive R-2R ladder is shown in Fig 4. The 4 bit R-2R ladder D/A converter consist of 17 NMOS transistors as shown in Fig. 4. All NMOS transistors have same aspect ratio given in table I.

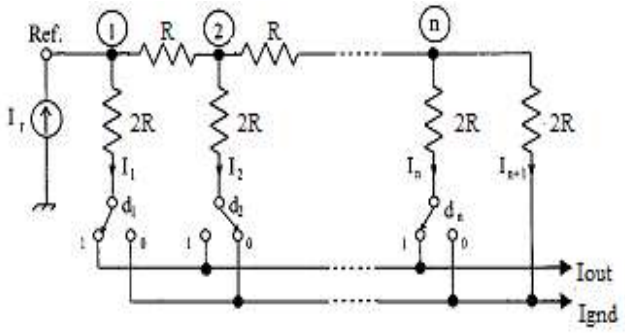

Fig.3: n-bit Resistive R-2R ladder

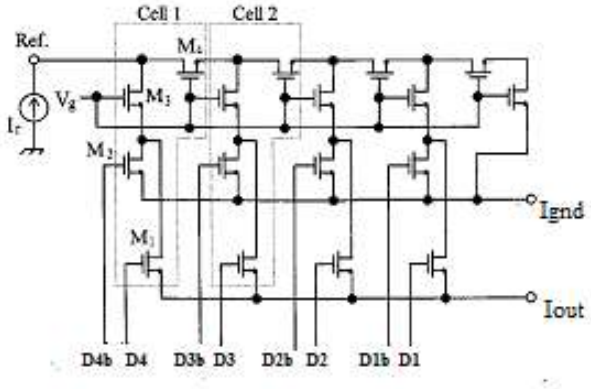

Fig.4: The 4 bit R-2R ladder D/A Converter.

In this design, 1LSB current is chosen to be 10uA. Hence for 4 bit the total reference current will be 2^4 times the 1LSB current i...e, $I_{ref}=I_{in}$= 160uA. The fig. 4. shows the schematic of 4 bit LSB R-2R ladder D/A converter. All NMOS transistors in the design have same gate voltage and aspect ratio given in Table I.

Table I

Process Parameters	Specifications
CMOS Process	180nm
V_T	0.37 V
un * Cox	246.90uA/V^2
W	60um
L	1um

Assume that four NMOS transistors as shown in fig. 4 are matched and operate in linear region .The drain current of NMOStransistors M1 and M2 operating in the linear region is given by [4]

$$I1 = \frac{\mu_n C_{ox}}{2}\left(\frac{W}{L}\right)_1 (V_g - V_s - V_T)(V(1) - V_s) \quad (2)$$

$$I2 = \frac{\mu_n C_{ox}}{2}\left(\frac{W}{L}\right)_2 (V_g - V(2) - V_T)(V(1) - V(2)) \quad (3)$$

Where I1 and I2 are the current through the transistors M1 and M2 respectively, μ_n is the mobility of the electron, Cox, (W/L) and V_T are the oxide capacitance aspect ratio and threshold voltage of the transistors respectively [3,4].

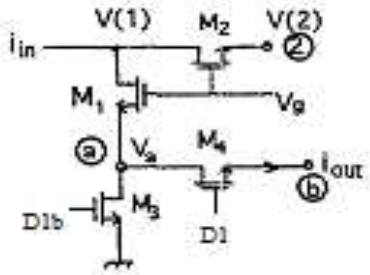

Fig. 5: The unit cell of 4 bit R-2R ladder D to A converter.

The aspect ratio of the transistor should be large in order to achieve small on channel resistance of MOS Device which reduces the power dissipation & harmonic distortion [4].

The output current equation is given by

$$Iout = (D4\ 2^{-1} + D3\ 2^{-2} + D2\ 2^{-3} + D1\ 2^{-4}) \times Iref(4)$$

WhereIout = output current

Iref (total reference current) =160uA.

D4, D3, D2 & D1 are digital inputs.

D4 is MSB bit and D1 is LSB bit.

Table II. Shows the relationship between digital inputs and analog output.

Table II

Digital Input				Analog output
D4	D3	D2	D1	Iout (µA)
0	0	0	0	0
0	0	0	1	10
0	0	1	0	20
0	0	1	1	30
0	1	0	0	40
0	1	0	1	50
0	1	1	0	60
0	1	1	1	70
1	0	0	0	80
1	0	0	1	90
1	0	1	0	100
1	0	1	1	110
1	1	0	0	120
1	1	0	1	130
1	1	1	0	140
1	1	1	1	150

From the table II we conclude that Output current is increasing in the step of 10µA and is always less than 1 LSB current. The total output current swing will be upto 150µA. Table III shows the simulation conditions.

Table III

Parameter	Conditions
Reference Current	Iref = 160uA
Transistor dimensions	W = 60um, L = 1um
Gate bias Voltage	Vg = 0.8 V
Logic levels	0.8 V when Di = 1 and 0 V when Di = 0

IV. RESULTS

Fig. 6 & Fig. 7 show the output current waveform of current mode 4 bit R-2R ladder digital to analog converter.This shows that the Resistances in conventional R-2R Ladder can be replaced by NMOS as switch which can be used in digital to analog converter.It improves linearity, INL & DNL values for this digital to analog converter.

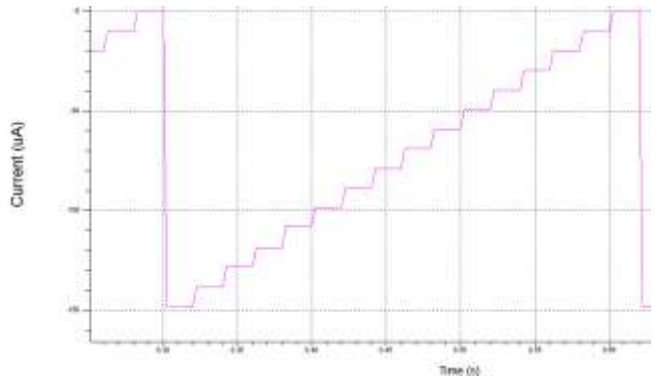

Fig.6: Output waveform of current 4 bit R-2R ladder D/A converter.

Fig.7: Output waveforms of voltage 4 bit R-2R ladder D/A converter.

V. CONCLUSION

The Design of 4 bit current mode R-2R Ladder Digital to Analog converter using switchable MOS Devices has been proposed and implemented successfully. This Design is independent of threshold voltage, terminal voltages and process parameter but it depends on W/L ratio of all transistors in the current mode R-2R ladder Digital to Analog converter. But it depends on W/L ratio of all transistors in the current mode R-2R ladder D/A converter. Power dissipation reduces significantly in this current mode digital to analog converter.

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A COMPARATIVE STUDY OF TECHNIQUES FOR LEUKAEMIA DETECTION

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ABSTRACT

Leukaemia is a cancer of blood that causes more deaths than any other cancer. Presently, the diagnosis of blood samples is done through visual examination by doctors. For proper and efficient treatment of leukaemia it is essential to detect it in early stage and proceed with the monitoring and evaluation. Till date many research have been done to design an automated system for detection of leukaemia either through study of microscopic images of blood samples or bone marrow biopsy.

In this paper, a literature review has been done to classify the types of leukaemia and the various methodologies being followed by the researchers to detect it. Also, we have discussed some of the issues faced by the researchers. This paper also describes the various changes on texture, geometry, color and statistical analysis of microscopic images.

Keywords: ALL, AML, Microscopic Imaging, MLP, SFAM.

I INTRODUCTION

Over the past few decades there has been huge growth in the application of image processing techniques in the bio-medical area. Researches are being carried out to develop efficient and cost effective system for solving medical problems. Presently the diagnosis of the blood samples is done through visual examination by the haematologist. However these morphological or biochemical analysis are subjected to various short comings like operators experience, tiredness, fatigue and slowness and these cell images are prone to have errors due to lack of efficiency, difficulties in cell nature and problems related to preparation of staining of blood cell slides [1][2][3]. Also, it has been found that the manual recognition method has an error rate between 30% and 40%. [4].This situation is further gearing up the demand of developing an automated system to provide more accuracy and precision.

One of the most feared disease by the human is cancer. Leukaemia is the cancer of blood, and if not detected in the early stage can even lead to death. Automated systems based on artificial vision can speed up this operation [5].

Most of the symptoms and conditions of a disease are reflected in the blood. Studies have shown that all the techniques developed for medical imaging uses all the information about blood for classifying various diseases like leukaemia, anaemia, cancer, thalassaemia etc. These parameters may be RBC count, haemoglobin level or

other parameters such as color, shape, size etc [11].

In general leukaemia detection is done by performing the complete blood count [6]. If the count is found to be abnormal, study of morphological bone marrow smear is done to confirm the leukaemia [4]. From decades basically two main analyses are performed: cell classification and counting. The morphological analysis do not require a blood sample and hence is suitable for low cost accurate and remote screening system, as it just needs an image [5].

Alteration in WBC can be neoplastic and non-neoplastic. Leukaemia is the neoplastic proliferations of hemopoietic cells. It is quite complicated to practically classify leukaemia and it can be categorised on the basis of genetic abnormalities, cell of origin, clinical characteristics and morphologic findings [2].

When there is an abnormal production of white blood cell by the bone marrow, leukaemia is said to occur. Due to increase in WBC count there will be misbalance in the blood system. These blast cells can be either myeloid or lymphoid. Leukaemia can be broadly classified as acute or chronic on the basis of severity of the situation. Further, we can classify acute leukaemia as either Acute Lymphoblastic Leukaemia (ALL) or Acute Myelogenous Leukaemia (AML). During the observation, three types of WBC need to be considered, that are Lymphoblast, Myeloblast and normal WBC [7].

The acute Lymphoblastic leukaemia disease is concerned with lymphocyte formation in bone marrow and into the peripheral blood. In preparation of blood, colorant are used which tend to concentrate only in WBC, particularly at the nuclei centre. Mostly size of white cells is bigger than red cells. One of the most common methods for leukaemia classification is FAB method [8]. Further advanced method is immunologic classification which requires more sophisticated setup for testing [9].

Toure and Basu applied the MLP network by an algorithm called Back Propogation (BP). It predicted the type of leukaemia whether it is ALL or AML, and they succeeded with 58% accuracy on test data [10].

II BACKGROUND

The three principle cells present in the blood are red blood cells, white blood cells and platelets. A microscopic image of a WBC is shown in Fig. 1.

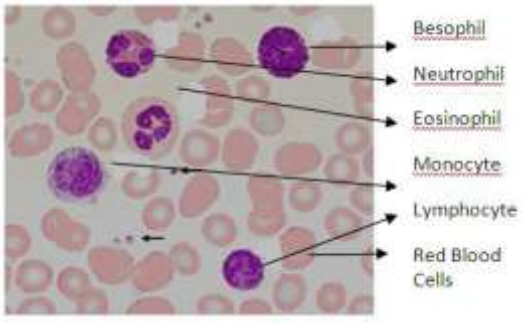

Figure 1: White blood cell [3]

Granules are contained in Leucocyte cells called granulocytes (collected by neutrophil, basophil, eosinophil). Rest of the cells which are without granules are called a granulocytes (composed of monocyte and lymphocyte). The percentage of range of leucocytes in human blood has following values: Eosinophils 1- 5%, neutrophils 50-70%.Basophils 0-1%. monocytes 2-10%, lymphocytes 20.45% [3].

Changes in health and development of specific diseases can be retraced from the information provided from the

blood. Variation in the number or appearance of elements that formed will guide health condition of an individual [11].

2.1 Leukaemia

Bone marrow is a soft material found in middle of each bone. Cells in the bone marrow produces blood cells, most of which are called stem cells. On maturing, stem cells become some kind of blood cell. Blood consist of four main components, namely:

a) Red Blood Cell (erythrocytes)

b) White Blood Cell (leukocytes)

c) Platelets

d) Plasma

Old or damaged cells die and are replaced by the new cells [11].

Fig. 2 shows that how stem cells became mature and evolve into several components of blood.

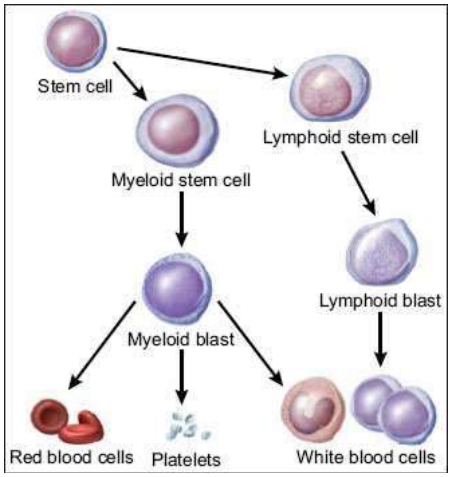

Figure 2: Production of Blood Cell [11]

The stem cell on maturity evolves either into myeloid stem cell or lymphoid stem cells. Lymphoid stem cells eventually become lymphoid blast which will further form several types of WBC. On the other hand, the myeloid cells on maturity become myeloid blast and form RBC, platelet and several type of WBC. The WBC from lymphoid blast and myeloid blast differ.

For a person suffering from leukaemia, the bone marrow will produce abnormal WBC. These abnormal WBC don't die when they should and become numerous. Thus, they interfere with the duties of the normal WBC. This causes imbalance of blood system in human body. In other words, certain abnormalities cause the rapid growth and division of cell which seem to live longer than the normal cells.

One of the basic ways of classifying leukaemia is on the basis of severity and progress of the disease. They are:

a) **ACUTE:** In this type of leukaemia the abnormal cells are the immature blasts which are not capable of carrying out normal work and multiply rapidly. This condition needs to be treated quickly and on time.

b) **CHRONIC:** This type of leukaemia has more mature cells which replicate and accumulate. They can work like normal cells for some period of time. In this case accumulation of abnormal cell is slow and the leukaemia can go undiagnosed for years.

On the basis of type of WBC affected, leukaemia can be classified as:

a) **LYMPHOCYTIC:** In this case lymphoid cells are affected. Lymphoid cells develop lymphatic tissues which makes our immune system.

b) **MYELOGENOUS LEUKEMIA:** This type of leukaemia affects the myeloid cells. Myeloid cells give rise to red blood cells, white blood cells and platelet-producing cells.

2.2 Types of Leukaemia

- **Acute lymphocytic leukaemia (ALL).** This is the most common type of leukaemia in young children. ALL can also occur in adults.

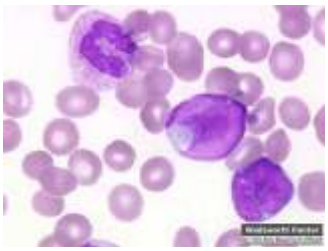

Figure 3: Acute Lymphocytic Leukaemia (ALL) [12]

- **Acute myelogenous leukaemia (AML).** AML is a common type of leukaemia. It occurs in children and adults. AML is the most common type of acute leukaemia in adults.

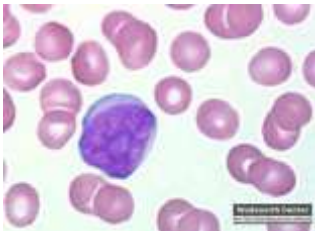

Figure 4: Acute Myeloid Leukaemia (AML) [12]

- **Chronic lymphocytic leukaemia (CLL).** With CLL, the most common chronic adult leukaemia, you may feel well for years without needing treatment.

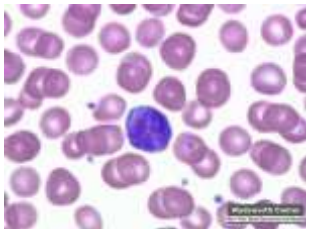

Figure 5: Chronic Lymphocytic Leukaemia (CLL) [12]

- **Chronic myelogenous leukaemia (CML).** This type of leukaemia mainly affects adults. A person with CML may have few or no symptoms for months or years before entering a phase in which the leukaemia cells grow more quickly.

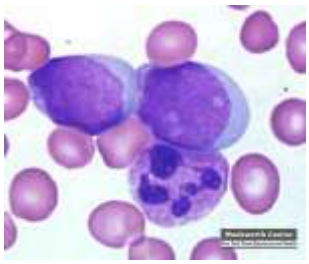

Figure 6: Chronic Myeloid Leukaemia (CML) [12]

III RELATED RESEARCH

For detection of leukaemia disease firstly blood samples are gathered and further studied. The samples are then segmented by using various techniques. The methodologies so used may vary and researches are being carried out to find the most efficient segmentation technique. Researchers have given various methods for image segmentation. When there is good contrast between foreground and background, edge detection can prove to be a meaningful segmentation technique [13]. Automatic thresholding method was used by cseke in 1979. However it does not always produce precise results as during the selection of the segmentation threshold no spatial information is used [14]. Another method that can be used is fuzzy C-mean clustering in which single cell image of WBC in bone marrow is segmented into two regions (nucleus and non-nucleus). However it has been reported in [15] that if the number of clusters is greater than two then the computational time may increase.

From years researches has been done to present an automated leukaemia detection technique which can assist the haematologist to obtain accurate results for mapping the disease. The main objective of these techniques is to allow automatic image segmentation, feature extraction and classification. The various schemes applied may differ in the methodologies employed to study WBC. The segmentation technique may vary, or the parameters used for classifying abnormal blood cells may differ.

Minal D. Joshi et. al. in. [1] represents blood side image segmentation and classification for automatic detection of leukaemia. In this paper, lymphocytes are detected and using feature extraction module, their features such as perimeter, circularity, area etc are calculated. The author emphasizes on the correct segmentation technique used as the subsequent accuracy of feature will depend on it. Pattern recognition is also considered a powerful tool for the differentiation of normal cells and blast cells. The paper mainly concentrates on calculation of features such as area, perimeter, circularity etc and the features were classified using kNN classifier. The technique developed was applied on 108 images and gave an accuracy of 93%.

Subrajeet Mohapatra et. al. in. [2], a comparative approach for the detection of Acute Lymphoblastic Leukaemia (ALL) based on WBC nucleus image segmentation and morphological analysis is introduced. The author suggests that the leukaemia detection process depends on proper WBC nuclear segmentation, feature extraction and classification. The segmentation is done using color based clustering followed by feature characterisation and assessment of lymphoblast. The clustering algorithm used were k-means, k-medoid, FCM, GK and FPCM for microscopic image segmentation. First K-means color based clustering was used to obtain WBC nucleus of the image. Then the image was cropped around each nucleus to obtain the sub-image. Noise detection process

employed included incorporation of adaptive threshold to get more reliable detection of noise.

The author suggested that nucleus is sufficient for leukaemia feature extraction and classification. However, cytoplasm obtained in clustering scheme can also be used as an indicator of leukemic conditions. Further, Hausdorff dimension (HD) was measured. The analysis was conducted on 50 samples and it was found that none of the lymphocytes had a HD larger than 1.22. on the other hand, larger percentage of lymphoblast had HD more than this value. Therefore, this was considered to be most suitable method for leukaemia detection [2].

Another parameter used in the paper is contour signature. First, centroid of the nucleus contour is determined and then Euclidean distance between the centre and the boundary was depicted. Then the variance of the distances of the lymphocytes and lymphoblast is measured and is chosen as a hard limiter to identify whether the nucleus is healthy or leukemic. The limit for the feature was fixed as 0.02 .Also shape color and texture were extracted and fed to the SVM classifier for detection of leukaemia. Accuracy of 92% was obtained [2].

Ruggero Donida Labati et. al. in. [5], the authors have proposed a data set of blood samples that provides evaluation and comparison of the performance algorithm of segmentation and image classification. They have also proposed a metric to evaluate the performance of algorithm employed for the detection of ALL in the automatic systems. They have illustrated a need for a system that can work with different structures of module and can identify the presence of blast cells in the input image. They have also proposed a bench mark approach to measure and compare the identification accuracy of different structures of module.

Aimi Salihah. A. N. et. al. in. [16] the author proposed a technique to detect Acute Myelogenous Leukaemia. Employing this technique, any abnormalities in WBC can be detected by the combination between contrast enhancement and segmentation. The contrast enhancement technique includes partial contrast and bright stretching. Here authors have used HSI color space technique instead of RGB as it is observed to yield better results. The results showed that the enhancement technique used reduces the interference of background images to a great extent and allow efficient extraction of morphological images from the blood samples.

Aimi Salihah. A. N. et. al. in. [17] considered contrast enhancement technique at the pre-processing stage to be very useful in diagnosing Acute Myelogenous leukaemia in blood. In this paper the authors suggested two phase methodologies: first was contrast enhancement technique and second was segmentation using HSI technique. Contrast enhancement technique includes bright stretching, dark stretching and partial contrast which enhanced the area of acute leukaemia. After using HSI color space if results so obtained are satisfying then these images are filtered using NxN (N=7) median filter to obtain better results.

Abdul Nasir et. al. in. [18], the authors discussed various problems that haematologist encounter when they try to observe the samples due to its uneven texture and irregularity. Thus in this paper threshold technique is suggested to overcome the problems. In this technique the original blood cell images are firstly converted to greyscale image and then the WBC and RBC threshold count are observed manually. Then the image is converted into binary images. These images may sometimes contain small spots which are considered to be

noise. These spots can be eliminated by using two techniques: removing pixels technique and Gaussian filter. They studied 91 microscopic images and found that the ratio range is 0.2 to 2.5 for ALL and 0 to 14 for AML. Therefore, these counts were sufficient for the detection of leukaemia.

N. H. Harun et. al. in. [19], the authors classified the blasts in acute leukaemia samples using artificial neural network. From the blood images a total of six morphological features were extracted and for the classification purpose these were used as neural network inputs. To perform the task of classification Hybrid Multilayer Perceptron (HMLP) neural network was used. The HMLP is trained using RPE (MRPE) training algorithm for 1474 samples. It was observed that HMLP produces an performance accuracy of 97.04%. The results indicated that the HMLP neural network was capable of differentiating the blast cells from acute leukaemia blood samples. HMLP network is said to have high accuracy even in testing of cervical cancer and breast lesions successfully with accurate results. After input being fed to HMLP network, images are captured and finally to ensure the correctness of the results so obtained haematologist or technologists revise those images.

Aimi Abdul Nasir et. al. in. [20], the author have presented the classification of white blood cells inside the acute lymphoblastic leukaemia (ALL) and acute myelogeneous leukaemia (AML) blood samples by using multi-layer perceptron and simplified fuzzy ARTMAP (SFAM) neural networks. The limitation of the ability of computer to perform certain task was overcome by ANN. The segmentation process employed used morphological pre-processing followed by bythe snake –balloon algorithm.In the paper, the author has used several types of features based on intensity, color, shape and texture. It has been evaluated that SBM produce 91.03% accuracy as compared to multi-layer perceptron network using conjugate gradient descent, linear vector quantization and K-nearest neighbour classifier which produce 89.74%, 83.33% and 80.76% of accuracy respectively. This paper utilised the potential use of MLP and SFAM networks for categorising WBC as lymphoblast, myeloblast and normal cell. The methodology used includes image acquisition, image segmentation, feature extraction and classification using ANN. Here identification of blood cell is based on color and features were derived from red, green, blue and intensity components. Total of 12 color features were extracted from cytoplasm of WBC.

Using both MLP and SFAM network have given promising result with testing accuracy of more than 80% for the three categories of features (shape, size and color) [20].
For MLP it was observed that the color based testing accuracy is highest followed by size and shape. For SFAM the size based testing accuracy was found to be highest followed by color and shape based feature. The results provided in the paper using MLP_LM, MLP_BR and SFAM networks with testing accuracy of 95.55%, 95.70% and 92.43% respectively [20].

IV INFERENCES DRAWN AND DISCUSSIONS

From all the literature studies above, it is clear that the detection of Leukaemia involves some basic steps. These are as follows:

- Image Acquisition

- Image Preprocessing
- Image Segmentation
- Feature Extraction

4.1 Classification on the basis of features

The overall efficiency and effectiveness of the technique depends upon the methodology being followed. Image segmentation is a very crucial stage and hence many researches have been made to obtain the proper segmentation technique. This is because the preciseness of the extracted feature will majorly depend on the quality of the segmented image.

a) **Acquisition of Image**: Firstly, all the blood images are gathered. These images can be obtained from the public dataset available.

b) **Preprocessing**: During image acquisition, there are chances of image staining or we could say image gets distorted by noise. These noises may appear as illumination or shadow which blurs the image. To enhance the quality of image contrast enhancement techniques are used.

c) **Segmentation**: After preprocessing, various segmentation techniques are employed such as threshold otsu method, automated histogram thresholding, data clustering such as K-means, fuzzy C- means, etc., snake balloon algorithm, Fluorescence in-situ hybridization (FISH) method, immunophenotyping, cytogenetic analysis and cytochemistry. Fig. 7 shows the flow chart representation of various segmentation techniques used.

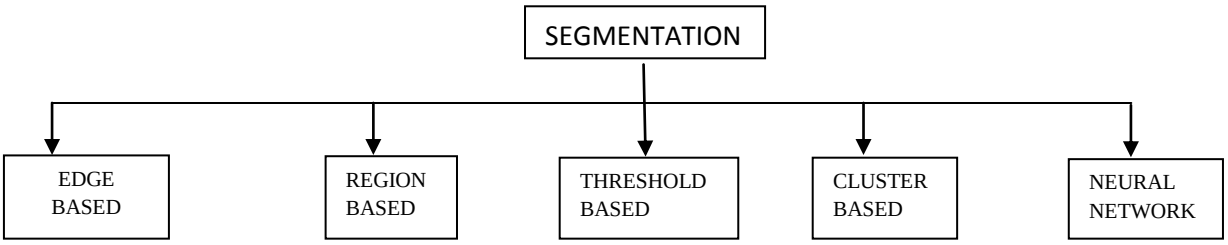

Figure 7: Flow Chart Representation of Segmentation Techniques

d) **Feature extraction**: In this technique, input data is transferred into set of features. Various features of the cells are studied to identify Leukaemia. Some of these features are: geometry, texture, color, contour signature, statistical features, etc.

e) **Classification**: Once the features are extracted from the segmented image, then classification of Leukaemia type is done. This classification can be done by employing one of the mentioned techniques, which are kNN rule, Reinforcement learning algorithm. By classification, Leukaemia can be categorized as AML, ALL, CML, CLL.

From all the literature studies, it was observed that all the authors emphasize on designing a system that can be employed for digital pathology, and at the same time follow the methodology to obtain a robust system. Accuracy and precision is still a problem and more research need to be done in this field.

V CONCLUSION

From the complete literature survey, it can be concluded that no matter whatever methodology is being

employed by the author, the main focus is to use a precise and correct segmentation technique. Many techniques have been developed to detect leukaemia namely study of microscopic images using image processing techniques, MLP, SFAM and bone marrow biopsy. Some of the authors have suggested shape and size to be the sufficient parameter to detect Leukaemia, however others have suggested to take into account the features such as Contour signature and HD for more accurate results.

Even after so many techniques, problems are still faced when it comes to staining of the cells, noise detection and segmentation. Researchers are still looking for technique which can help to develop a robust, fully automated detection system which can be efficiently used for medical image mapping.

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A STUDY OF RF-MEMS SWITCH

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ABSTRACT

Radio frequency Micro-Electro-Mechanical-System switch (MEMS) technology is converging the sub areas of MEMS technology that is changing the RF and microwave applications. The MEMS technology is continuously developing the RF/microwave applications with new reliability and lifetime estimation. This paper, gives an overview of the RF MEMS switches and its application. RF MEMS switches offer lower insertion loss, high isolation, low power consumption, small size etc.

Keywords: Cantilever, Micro-Electro Mechanical Systems (MEMS), Radio Frequency (RF), Series Switch, Shunt Switch.

1. INTRODUCTION

Range of Radio Frequency (RF) is around 3 KHz to 300 GHz. RF systems design antennas with characteristics such as frequency band, radiation pattern, polarization and gain. Applications of radio frequency (RF) system are cognitive radio systems and satellite communications with reconfigurable antenna [1,2]. Radio frequency Micro-Electro-Mechanical-System (MEMS) is a process technology which is used to produce integrated devices or systems that combine mechanical and electrical components. RF MEMS switches play a vital role in modern communication systems. The capability of RF MEMS is to merge the technologies of electro-mechanical and semiconductor switches. In particular, RF MEMS devices have the potential to enhance many telecommunication and military applications due to wide bandwidth and low loss signal. MEMS switches are found to have many applications in switching networks, TIR modules, phase shifters, reconfigurable antennas, tunable and switch bank filters etc. [4]. RF MEMS switches can be classified in different configurations such as signal path (series or shunt), actuation mechanism (electrostatic, magneto static, thermal), type of contact (ohmic and capacitive) and type of structure (cantilever or bridge). RF MEMS switches would be actuated using different actuation mechanism (electrostatic, piezoelectric, magneto static, thermal etc.). RF MEMS switches give better performance in comparison with other traditional switches i.e. transistor, pin diode, and coaxial cable due to high linearity, low power consumption, low insertion loss and high isolation. Depending on the design, RF MEMS switch can operate at 0.1 GHz to 40 GHz. The size of RF MEMS switches is 1μ to 1mm [4].

II BACKGROUND

The first micro machined membrane was demonstrated in 1979. Many contact type RF MEMS switch have been developed using different types of actuation mechanisms. These types of switches are categorized into metal contacting and capacitive coupling switches. Metal contacting switches produce an ohmic contact between the

electrodes, whereas, capacitive coupling switches have a thin dielectric film and an air gap between the contact surfaces [7, 8].

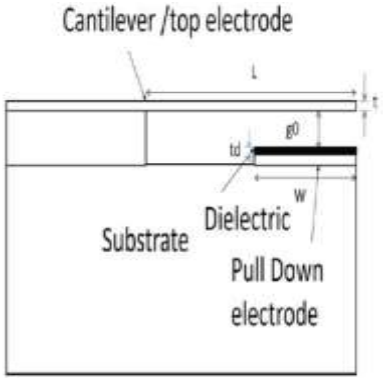
In 1996, the first practical capacitive shunt switch was presented by Raytheon which was based on a fixed-fixed metal beam [9]. In recent year, the developments in MEMS switches have promoted exciting growth in the field of microwave switching. The growth rate of RF MEMS technology is increasing day by day. The performance of the RF MEMS is providing sharp filter, stable frequency, reduced loss, higher isolation (reduced cross talk), low signal distortion and wide bandwidth. At present, RF MEMS switch is being used in different applications such as defence, satellite communication systems, wireless communication systems, and in instrumentation systems. RF MEMS based circuit is also being used in handset application due to their small size and good electrical performance [6].

III RF MEMS SWITCHES

To millimetre-wave circuit designs there are generally two basic switches that are used: the series switch and the shunt switch.

3.1 RF MEMS Series Switch

MEMS switch are device which operation is based on the mechanical movement to achieve a short circuit or an open circuit in the RF transmission line. Fig 1 shows cross-sectional view of the RF MEMS switch. These switches use metal to metal contact for ohmic contact between signal line and contact beam [4].



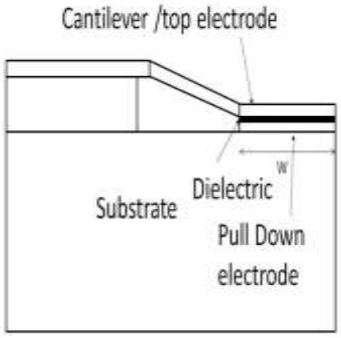


Fig. 1: Cross sectional view of RF MEMS series Switch [12].

Fig. 2: Cross sectional view of actuatedRF MEMS series Switch [12].

When a dc bias is applied between the bottom electrode and cantilever, an electrostatic force pull down the cantilever from anchor as shown in fig 2 and it will complete the RF signal path at downstate and get transmitted. When the voltage is removed, cantilever is back to original position by restoring force.

3.2 RF Mems Shunt Switch

These switches use metal-insulator-metal type contact. RF MEMS shunt switch consist of copalaner waveguide fixed-fixed metal bridge and a dielectric layer fabricated on the si substrate fig 3.

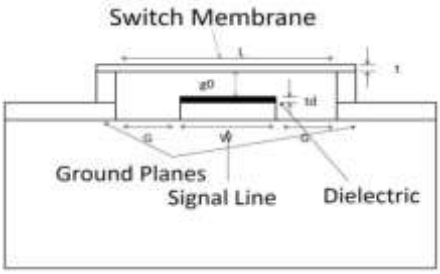


Fig. 3: Cross sectional view of RF MEMS shunt Switch [12].

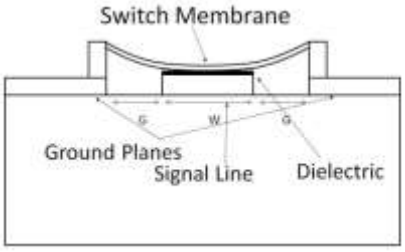


Fig. 4: Cross sectional view of actuatedRF MEMS shunt Switch [12].

Generally RF signal is passed through the switch and transmit the signals. When a dc bias is applied, electrostatic force produced, this force pull down the switch membrane over dielectric layer on the signal line fig 4. When the switch is in upstate it provides low capacitance to the ground and it does not affect the signal on the transmission line. When the switch is actuated in the downstate, the capacitances to the ground become high [10, 11].

IV COMPARISON

Comparing RF MEMS with traditional switches, MEMS switch provides better isolation, low losses and low power consumption.

TABLE 1: Comparison of various parameters [3].

PARAMETER	RF MEMS	PIN	FET
Voltages (V)	20-80	±3-5	3-5
Power consumption(mW)	0.05-0.1	5-100	0.05-0.1
Cutoff frequency(THz)	20-80	1-4	0.5-2
Isolation(1-10GHz)	Very high	High	Medium
Isolation(10-40GHz)	Very high	Medium	Low
Isolation(60-100GHz)	High	Medium	None
Loss(1-100GHz)dB	0.05-0.2	0.3-1.2	0.4-2.5

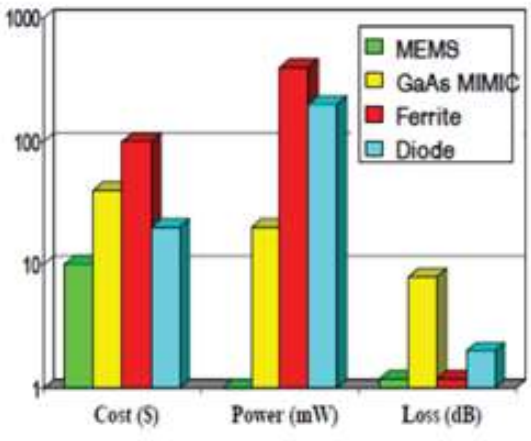


Fig. 5: Comparison of cost, power, consumption and loss in switches [10].

V APPLICATIONS

Reconfigurable antennas, filter, tuners, high-Q passives and resonators, low loss planer, radar system for defence applications, automotive radar, satellite and wireless communication systems, low loss phase shifter having low loss and high isolation are few application of RF MEMS switches.

VI CONCLUSION AND FUTURE SCOPE

An overview of RF MEMS switches and its applications is presented in this paper. MEMS switches development has been progressing very rapidly and RF performance is excellent when compared to PIN diode or FET switches. Further, it is also explained how the RF MEMS switches is better than conventional semiconductor switches in comparison with size, power consumption, isolation, insertion loss etc. These switches are suitable in applications where high isolation and low losses are required.

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TALK AND CHARGE

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ABSTRACT

By the extend use of mobile phones for communication, GPRS, entertainment, etc a worn out battery or a lost charge are the two difficulties every mobile user goes through. To overcome this we have to look for a new technology that can be adopted to charge the mobile phones. Use of non-conventional sources to recharge portable devices is the need of the hour. On the other hand we see that in this modern world there is lot of noise pollution in roads, airports, industries....which involves mainly sound energy. As sound has enormous amount of energy with it, which could be used, it can be treated as an alternative source of energy. Sound is a mechanical form of energy which travels in the form of wave, mechanical wave that is an oscillation of pressure this pressure created by the sound could be used to convert it into electric energy or other form of energy. Random sound energy around us can be treated as a source of electric power after efficient conversion using suitable transducer. An effective way of producing usable electric power from available random sound energy is presented here. Piezoelectric transducers are used for conversion of sounds into electric energy. Piezoelectric transducer converts mechanical strain into electric energy this property of Piezo material could be used to make a device which would be able to sustainably convert the sound energy to electric energy. So suppose your mobile phone get discharge you could shout at it and then it will again get charged or it could also get charge by using sound pollution around us.

Keywords : Charging, Conversion, Mobile Phone, Piezoelectric, Sound

I. INTRODUCTION

In the present scenario a Mobile phone is the basic necessity for everyone. A recent survey shows that the telecommunication market in the India is projected to have 1.159 billion mobiles subscribers by 2013 [1]. An incredibly huge amount of electric energy is being expended for the charging of mobile phones. Various researches are being conducted all over the world to find alternative means for charging mobile phones. Using conventional sources like body temperature, body vibrations and human activities have been proved to provide a considerable amount of electrical energy. [2]

But have we ever imagined that the sound that always exists in our everyday life and environments can be considered as a source of energy. This is was a stone which was left unturned by the researchers up till now but this hidden source is now emerging as the a new era in the world of renewable sources of energy.

Sound is type of energy which travels in the form of wave, mechanical wave that is an oscillation of pressure which needs a medium to travel. The medium can be air, water, wood, or any other material, but the only place in which sound cannot travel is a vacuum. Through liquid and gas state sound is transmitted as longitudinal wave whereas through solid it could be transmitted as both longitudinal wave and transverse wave. Longitudinal waves are of alternating pressure deviation from the equilibrium pressure, causing local region of compression and rarefaction, while transverse wave are waves of alternating shear and stress at right angle to the direction of propagation. Sound that is perceptible by humans has frequencies from about 20 Hz-20,000 Hz. In air at standard temperature and pressure, the corresponding wavelengths of sound waves range from 17 m-17 mm. [3]

But how can we use this sound to solve our electric energy problems? This could be easily understood by the third "law of thermodynamics" which states that the mechanical energy can be converted to electrical energy. [4] Sound energy could be easily converted into heat energy which could then converted into electricity but it is not highly efficient as the loss in conversion will be more, whereas the other method is converting sound energy to electricity by Piezoelectricity. Piezoelectricity is the conversion of mechanical strain to electric energy. So it could be seen that theoretically sound energy could be converted into electricity.

1.1.Piezoelectric Technology

Piezoelectric materials have found applications as gas igniters, displacement transducer/accelerometers, actuators, delay lines, wave filters, and as generators of ultrasonic energy. Arrays of piezoelectric elements have been used to produce ultra-sonic imaging equipment. [3] This link between electricity and mechanism forms the basis of the method for evolving conversion technique. The Piezoelectric materials have established a platform for mechanical energy to be utilized in novel ways such as generation of high voltages, electronic frequency generation and many other major applications. Now next, we have mentioned a number of sources of vibration which are already being used for piezoelectric energy harvesting.

Japan has already started experimenting use of piezoelectric effect for energy generation by installing special flooring tiles at its capitals' two busiest stations. Tiles are installed in front of ticket turnstiles. Thus every time a passenger steps on mats, they trigger a small vibration that can be stored as energy.

Energy thus generated by single passenger multiplied by many times over by the 400,000 people who use Tokyo station on an average day, according to East Japan Railway, generates sufficient energy to light up electronic signboards, run automatic ticket gates and electronic displays. [5]

In United States, Defence Advance Research Project Agency (DARPA) initiated an innovative project on Energy harvesting which attempts use piezoelectric generators embedded in soldiers' boots. DARPA's effort to harness 1-2 watts from continuous shoe impact while walking was abandoned due to the discomfort and its impact on body. [6]

Constructing special types of roads that generates electricity just by driving over them is next step towards use of piezoelectric crystals. Though small charge is generated by single car but 1 km stretch of such road could generate around 400kW-enough to run eight small cars. Such experimenting have already started in Israel. According to the Environmental Transport Association (ETA), if such system was installed on every stretch of British motorway it would generate enough energy to run 34,500 small cars. Certain vehicles could thus be powered entirely by road on which they drive and the street lights too. [5]

In Netherlands, Rotterdam's new club WATT has a floor that harnesses the energy created by dancer's steps. Designed by Dutch company called the Sustainable Dance club, the floor is based on the piezoelectric effect. As club goers dance on floor, the floor is compressed by less than half an inch. It makes contact with the piezoelectric material under it and generates around 2-20 watts of electricity, depending on the impact of the dancers' feet. At present, it's just enough to power LED light present in the floor. In London, Surya, another new eco-nightclub, uses the same principle. A similar idea was used in some night clubs of Europe where crystals were laid underneath the dance floor to generate electricity by which they could power their strobes and stereos.

1.2 Other energy harvesting ideas through piezoelectric materials include:

i) To lay down piezoelectric crystals under the keys of a mobile unit and keyboards. For the press of every key, the created vibrations and pressures can be used for charging purpose. [7]

ii) Harvesting the energy from human movements in train stations or other public places by laying piezoelectric materials under floor mats, carpets and tiles in those places. [7]

iii) At workplaces, while sitting on the chair, energy can be stored in the batteries by laying piezoelectric crystals in the chair. [6]

iv) Also, the studies are being carried out to utilize the vibrations in a vehicle, like at clutches, gears, seats, shock-ups, foot rests.[6]

v) Vibrations from industrial machinery or from the machines in the gym can also be harvested by piezoelectric materials to charge batteries for backup supplies or for low power microprocessors and wireless radios. [7]

All these researches show the potential of piezoelectric materials in producing usable electrical power. It is also noted that, all these possible applications utilize the sensitivity of piezoelectric materials to any kind of pressure or vibration. Now let us look into the phenomenon of Piezoelectricity.

II.MECHANISM FOR PIEZOELECTRICITY

The word piezoelectricity means electricity resulting from pressure. Piezoelectricity is the charge that accumulates in certain solid materials in response to applied mechanical stress. The piezoelectric effect exists in two domains, the first is direct piezoelectric effect that describes the material's ability to transform mechanical strain into electrical charge, the second form is the inverse effect, which is the ability to convert an applied electrical potential into mechanical strain energy.

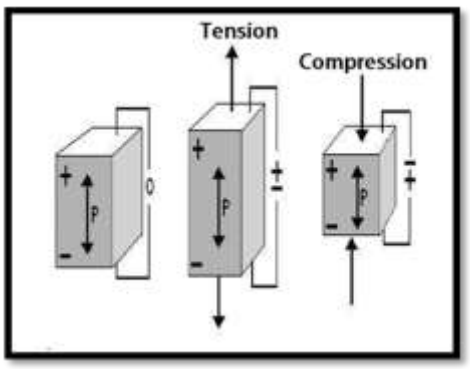

Fig.1 the direct piezoelectric effect.

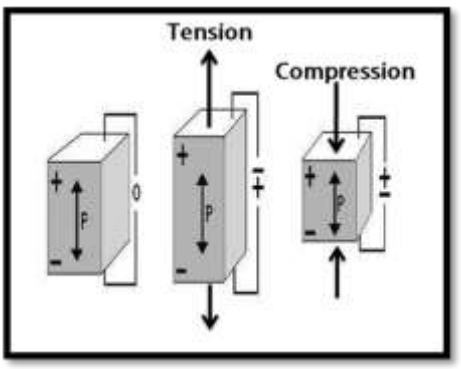

Fig.2 the inverse piezoelectric effect.

The direct piezoelectric effect is responsible for the materials to function as a sensor and the reverse piezoelectric effect is accountable for its ability to function as an actuator. A material is deemed piezoelectric when it has this ability to transform electrical energy into mechanical energy, and vice versa. The piezoelectric materials are transducers and exist naturally as quartz, possess properties for the production of electricity in very small quantity, however, compare to quartz, an artificial piezoelectric materials such as PZT (Lead Zirconate Titanate) presents advantageous characteristics of generating more electricity. [5]

Piezoelectric materials belong to the class called ferroelectrics. One of the defining traits of a ferroelectric material is that the molecular structure is oriented such that the material exhibits a local charge separation, known as an electric dipole. Throughout the artificial piezoelectric material composition the electric dipoles are oriented randomly, but when a very strong electric field is applied, the electric dipoles reorient themselves relative to the electric field, this phenomena occurs in case of reverse piezoelectric effect. When the material is deformed or stressed an electric voltage can be recovered along surface of the material (via electrodes).

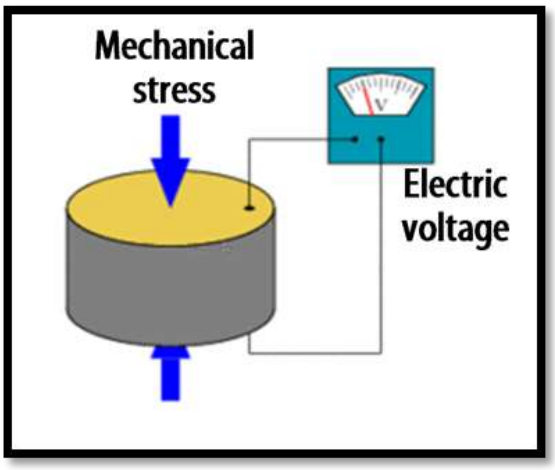

Fig.3 piezoelectric material

The process whereby the piezoelectric effect takes place is based on the fundamental structure of a crystal lattice. Crystals generally have a charge balance where negative and positive charges precisely nullify each other out along the rigid planes of the crystal lattice. When this charge balance is disrupted by an external force, such as, applying physical stress to a crystal, the energy is transferred by electric charge carriers, creating a surface charge density, which can be collected via electrodes.

As sound is nothing but the vibrations in air and piezoelectric transducer is sensitive to any kind of vibrations, piezoelectric material is found to have useful application in the detection of pressure variations in sound. This inspired us to bring this application to use and hence we have proposed an effective method for charging of mobile phones using sound energy.

III.PROPOSED METHOD

An effective way of producing usable electric power from available random sound energy is presented here. Piezoelectric transducers are used for conversion of sounds into electric energy.

The produced electric energy from multiple piezoelectric transducers is stored in multiple super-capacitors which are then summed up and amplified through adder and voltage multiplier circuits. The resultant electric power was used to charge a rechargeable mobile battery using sound as source through the proposed conversion circuit.

In this way, random sound energy from numerous sources around us can be stored as electric energy which can be used later to deliver electric power to drive compatible small loads.

The overall conversion process can be summarized in the block diagram as shown:

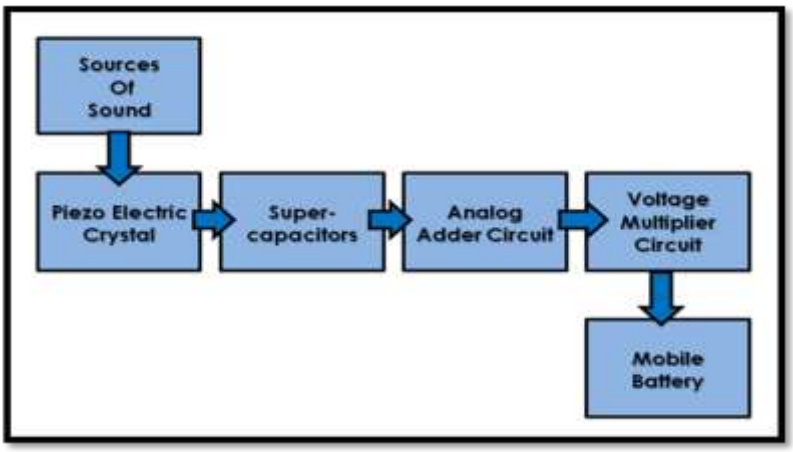

Fig. 4 block diagram

In this proposed method, at first, sound energy generated was used to produce small electric energy at the terminal of piezoelectric transducer As the generated voltage will be noisy in nature, so a super-capacitor is used in parallel to the piezoelectric transducers for both filtering and storing the produced electric energy. The super-capacitor also known as Electrical Double-Layer Capacitor (EDLC) is a relatively new technology. Super-capacitors have the highest capacitance values per unit volume and have the greatest energy density compared with other capacitors.

Due to its quick charging characteristics, super-capacitor can effectively store momentarily produced electrical energy through piezoelectric material from available sound energy. Due to its slow discharging characteristics, it can hold this stored electric energy for a longer time than usual capacitors, hence output from multiple super-

capacitors can be added easily. A number of this transducer-super-capacitor parallel set up can be constructed as shown in Fig.5 and their output voltages are added using a LM 324 Op Amp adder circuit. More transducers-super-capacitors parallel set up could be used but in that case the added output will exceed the highest saturation voltage of LM 324 Op Amp.

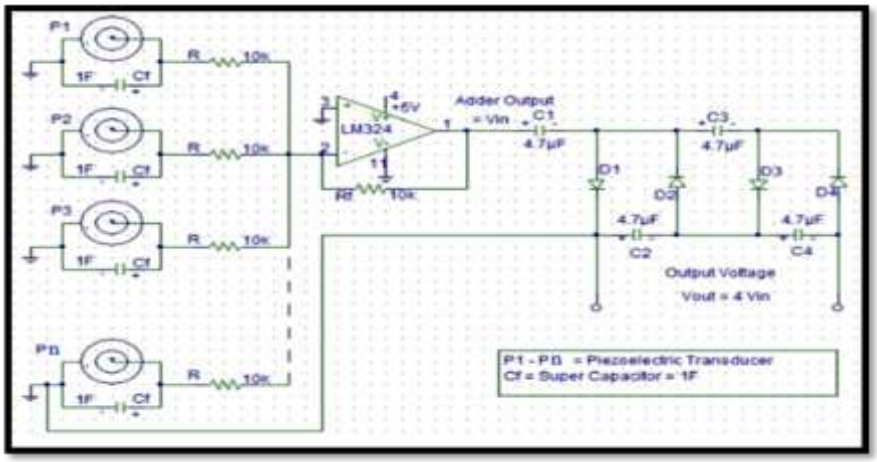

Fig. 5 circuit diagram

The output of the adder circuit was then fed to the input of a voltage multiplier (here, Quadrupler) circuit in order to increase the produced voltage level. The resultant voltage at the output of the Quadrupler circuit can now be used to charge a suitable rechargeable mobile battery.

Higher output voltage can be achieved at the output of adder by increasing the number of transducers-super-capacitors parallel stages before adder circuit if the biasing voltage of LM 324 Op Amp is increased accordingly. The purpose of using a diode in the direction of Quadrupler to rechargeable battery in the circuit is to prevent the discharging of the battery when there is not enough sound. In the absence of no sound or low level sound, output of the Quadrupler circuit will be below the required voltage and the battery will try to discharge by flowing current in reverse direction assuming the Quadrupler circuit as a load. The diode is placed to stop this reverse flow of current from battery so that it only take charge from the Quadrupler circuit and cannot get discharged in the absence of sufficient sound.

If sound is converted to electricity and then used to charge mobiles then there is a very wide scope of application for it. It can be utilized for military purpose (war field, border and hilly regions). When travelling in a long journey, during a trek or beach when switch boards are not available. While continuously talking on the phone with a low battery especially in android and smart phones where battery gets quickly discharged due to running applications. During lectures, long hour seminars or when a person has to talk for a long time. In outdoors with various sources like train whistle in railway station, noise in traffic, industries and public places. Sound produced from a running hydraulic pump and construction piling.

IV.CONCLUSION

An effective way of producing usable electric power from available sound energy is presented. Piezoelectric transducers can be used for conversion of sounds into electric energy. The produced electric energy from

multiple piezoelectric transducers is stored in multiple super-capacitors which is then summed up and amplified through adder and voltage multiplier circuits. The resultant electric power can be used to charge a rechargeable mobile battery. The proposed method opens the door of a relatively less explored source of energy i.e. Sound energy and can contribute in global search for renewable energy.

If we will be able to convert sound energy to electric energy efficiently it could help us to reduce the scarcity of electrical energy globally and help in the development of mankind and reduction of CO2 as electric energy is one of the cleanest energy. The noise pollution on roads and runways due to traffic could be converted into electric energy and power the street lightning, signals and various other electrical appliances.[4] Future work of the proposed idea encompasses further amplification of the crystal output to a greater extent. Future lies in the inclusion of advanced material used to design the piezoelectric crystal which further amplifies the crystal output in terms of voltage as well as current.[6] With considerable research and sophistication to this technology, we can expect a world with no external chargers for mobile phones in the future.

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EDM PARAMETER INVESTIGATION ON MACHINING OF INCONEL 718MATERIAL UTILIZING COPPER ANODE

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ABSTRACT

In electrical release machining methodology (EDM), the procedure parameters, for example, beat on time, heartbeat off time, crest present, flushing weight alongside device geometry are of awesome significance in light of the fact that they unfavorably influence the precision of machined gimmicks. This paper displays the impact of each one data parameters for examining the impact of individual parameters on MRR, TWR and SR on inconel718. The exploratory results demonstrates that the beat on time and crest current are the impacting parameters straightforwardly corresponding to MRR and contrarily relative to TWR,SR.

Keywords: Electrical Discharge Machining (EDM), Material Removal Rate (MRR), Tool Wear Rate(TWR), Surface Roughness(R_a)

I INTRODUCTION

Electrical release machining (EDM) methodology is the procedure of machining hard metals which are can't be machined utilizing traditional machining methodology. This technique was created in the late 1940s,has been acknowledged worldwide as a standard process in assembling of structuring devices. In EDM the primary components that impact the machining methodology is crest current and heartbeat on time, which demonstrates more prominent impact in improving alternate parameters like Surface Roughness(SR), Tool Wear Rate(TWR), Material Removal Rate (MRR) however it is hard to clarify the impact of top current and heartbeat on time on those parameters**.**

The inconel718 is a high nickel substance combination. This combination is advanced for the methodology by thorough control of piece, melt practice and moving conditions. Inconel718 was produced to address the requirement for a nickel-base composite suitable for assembling into complex molded parts subject to a mix of high temperature, high push, high temperature erosion. The inconel718 material is for the most part utilized as a part of aviation commercial enterprises.

The EDM discover a wide application in the machining of hard metals. EDM is principally utilized as a part of commercial ventures like model generation, coinage pass on making and in little opening penetrating. Here the copper apparatus is made into roundabout, square, rectangle and circle shape which are machined by wire cut

EDM. The wire cut EDM is utilized primarily for exact measurements. Copper is the most regularly utilized EDM instrument.

II.MATERIALS AND METHODS

The inconel718 material is made into sheets of obliged measurements utilizing wire cut EDM process. At that point the boring procedure i.e) through gap operation is carried out on inconel718 material utilizing copper anode of distinctive shapes circle, triangle, rectangle and square. The machining is carried out on EDM machine of evaluation EMS 5050 by utilizing lamp oil as a dielectric liquid. The info parameters top current(4,9,12,17A), beat on time(10,25,40,60µs), with heartbeat off time (3,5,7,9µs) and flushing pressure(23,20,29,18kgf/ cm2) with the instrument states of circle, triangle, square and rectangle , different parameters as kept steady. After the machining procedure both device and work piece ought to be cleaned utilizing compressed air firearm to uproot dust particles and dielectric liquid then both the apparatus and work piece ought to be measured utilizing exact measuring machine. The parameters are organized orthogonally and the machining methodology is carried out. The fundamental reason of utilizing orthogonal show is to lessen the quantity of tests yet gives the result more precise than any system, here the orthogonal L16 cluster is utilized. The last results were upgraded

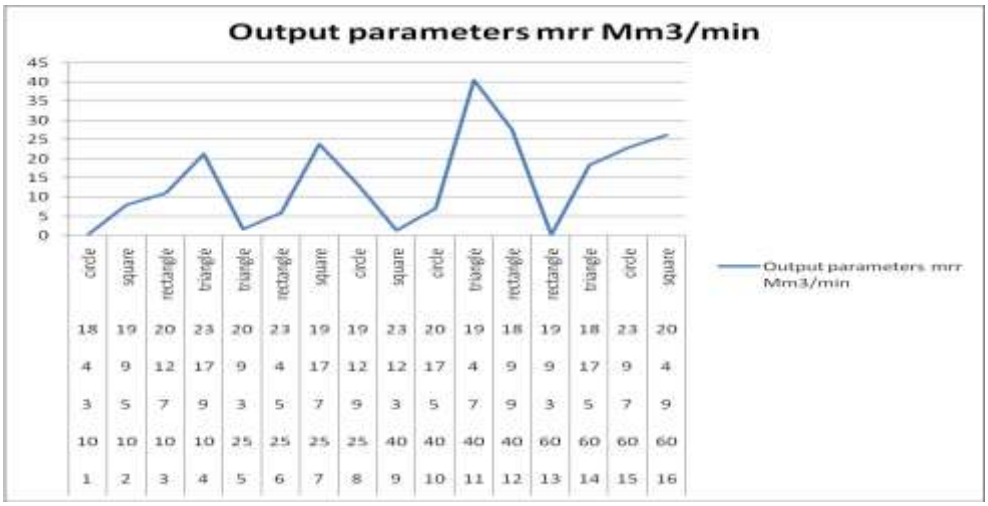
TABLE 1:INPUT AND OUTPUT PARAMETERS OF EDM USING COPPER ELECTRODE

Exp .no	pulse on time	pulse off time	current	flushing pressure	tool geometry	Output parameters			
	T_{ON}	T_{OFF}	A	P	geometry	mrr	twr	r_a	Machining time
	µS	µS	Ampere	Kgf/cm^2	Geo	Mm3/min	Mm3/min	µm	minute
1	10	3	4	18	circle	0.299	0.025	2.601	842
2	10	5	9	19	square	8.042	0.819	3.634	32.8
3	10	7	12	20	rectangle	11.07	0.702	3.405	22.61
4	10	9	17	23	triangle	21.37	3.008	3.437	11.77
5	25	3	9	20	triangle	1.697	0.017	3.256	147.5
6	25	5	4	23	rectangle	6.069	0	4.748	41.44
7	25	7	17	19	square	23.824	0.243	6.437	10.05
8	25	9	12	19	circle	13.201	0.128	4.993	19.05
9	40	3	12	23	square	1.479	0.014	2.708	170.1
10	40	5	17	20	circle	7.184	0	4.679	17.85
11	40	7	4	19	triangle	40.547	0.394	5.771	6.2

12	40	9	9	18	rectangle	27.694	0.135	4.146	9.04
13	60	3	9	19	rectangle	0.213	0.008	3.01	1173.55
14	60	5	17	18	triangle	18.416	0.089	4.154	13.66
15	60	7	9	23	circle	22.971	0.112	3.844	10.9
16	60	9	4	20	square	26.334	0.128	3.845	9.51

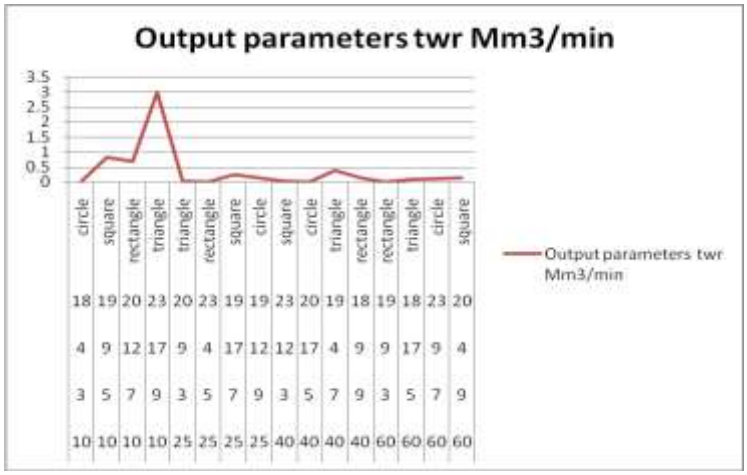
III. RESULTS

FIG.1 OUTPUT PARAMETERS OF MRR



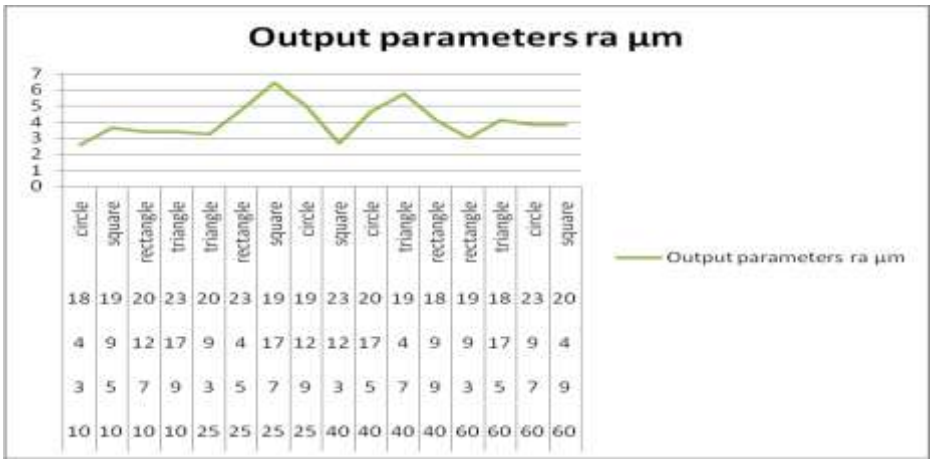
The above table obviously demonstrates that the material evacuation rate is high when the top current is at 17A,TON is at 40µs,TOFF is at 5µs with roundabout molded anode having flushing weight 0of 20 kgf/cm2. Consequently the ideal parameters are noted.

FIG.2 OUTPUT PARAMETERS OF TWR



When we consider TWR it is least when TON is 10µs,TOFF IS 9µs, top current is at 4A with flushing weight 18 kgf/cm2,with the circle as best shape.

FIG.3 OUTPUT PARAMETERS OF SR



In the event that we consider surface harshness it is discovered to be least when TON is 10µs, TOFF 3µs which is having a crest current of 4A with flushing weight 18kgf/cm2,having best shape as circle.

IV.CONCLUSION

At the point when EDM procedure is viewed as the MRR is to be at most extreme, where TWR, Ra is to be least. At long last for an ideal machining TON is to be 40µs , TOFF is to be 3µs, with the flushing weight is at 23 kgf/cm2, having crest current of 12A.

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EEG SIGNAL CLASSIFICATION USING PRINCIPAL FEATURE ANALYSIS AND ARTIFICIAL NEURAL NETWORK FOR BRAIN DISEASE DIAGNOSIS

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ABSTRACT

The paper proposes an automated system for classification of brain signals using EEG signals by adopting concepts such as artificial neural networks and principle feature analysis or principle component analysis(PCA). The artificial neural network, an artificial illustration of the human brain that tries to imitate its learning process that will be used to classify the brain EEG signal that is tumor case or epilepsy case or normal. The manual analysis of the signal is time consuming, inaccurate and requires highly qualified professionals to avoid diagnostic errors. The detection of the brain tumor is a challenging problem, due to the nature of the tumor cells. PCA is a way of identifying patterns in input data, and expressing the data in such a way as to highlight their similarities and differences. The back propagation network is used finally for classifying the pattern of tumor and normal EEG. The probability of correct classification has been increased by using soft computing techniques like Principal Component Analysis with neural network.

Keywords- Artificial Neural Network, Back Propagation Network, EEG Signals, Epilepsy, Principle Component Analysis / Principle Feature Analysis.

I. INTRODUCTION

This system of automated EEG classification of various signals from EEG sensor is always needed in medical environment to get accurate results on the brain activity conditions. Since EEG brain disease diagnosis system has A major impact on valuable human life, it is very much necessary to maintain the system accurately and there must be no possibility for risking human life. Existing method of brain disease diagnosis uses a EEG monitor to receive and record the signal in which the doctor or a lab technician detects and collects the features of brain signal and finally decides on the result of whether the person has a normal or epileptic brain signal .This technique is practically impossible to do because of the large number of patients ,lack of time and in emergency situations where the professionals are pressurized to provide results as soon as possible .Brain–computer interfaces (BCI) is a direct communication pathway between human and brain.bci is often used for assisting, augmenting, directing humans about the sensory motor functions of brain. BCI is a part of the neuroprosthetics which connects the neural system to a device. The electroencephalogram (EEG) is defined as the electrical activity, recorded from the scalp surface after being picked up by metal electrodes and conductive media. It measures the voltage fluctuations resulting from ionic current flows within neurons of the brain .The EEG is a

non-invasive technique and practically does not harm the patient under test. When brain cells (neurons) are activated, local current flows are produced in brain. EEG measures mostly the currents that flow during synaptic excitations of the dendrites of many pyramidal neurons in the cerebral cortex of the brain. Differences of electrical potentials are caused by summed postsynaptic graded potentials from pyramidal cells that create electrical dipoles between body of neuron(soma) and neural branches (apical dendrites).The electrical current of brain consists mostly of Na+, Ca++, K+ and Cl- ions which are pumped through channels in neuron membranes in the direction shown by membrane potential. The microscopic picture is more sophisticated, including various types of synapses involving variety of neurotransmitters. The large populations of active neurons can generate electrical activity recordable on the head surface. There lies a layer between electrode and neuronal layers in which current penetrates through skin, skull and several other layers. Only weak electrical signals detected by the scalp electrodes are massively amplified, and then displayed on paper or stored in PC. Due to capability to reflect both the normal and abnormal electrical activity of the brain, it has been found to be a very powerful tool in the field of diagnosis in neurology and clinical neurophysiology.

II. RELATED WORKS

Principal component analysis (PCA), first described by Karl Pearson in 1901, is a statistical and analytical procedure that uses an orthogonal transformation to convert a large set of observations includes possibly correlated(inter-related) variables into a set of values of linearly uncorrelated variables (principal components).The number of principal components is less than or equal to the number of original variables. In this transformation, the first principal component has the largest possible variance ie., maximal amount of variability in the input data, and each succeeding component in turn has the highest variance possible under the constraint that it is orthogonal to (i.e., uncorrelated with) the preceding components. The principal components are usually orthogonal because they are the eigenvectors of the covariance matrix, which is symmetric. Retaining maximal amount of variation makes it easier to operate the data and make predictions. Depending on the area of application, it is also named the discrete Karhunen–Loève transform (KLT) in signal processing, the Hotelling transform in multivariate quality control, proper orthogonal decomposition (POD) in mechanical engineering, singular value decomposition(SVD) of X (Golub and Van Loan, 1983), eigen value decomposition (EVD) of X^TX in linear algebra, factor analysis , and empirical modal analysis in structural dynamics. A BCI based on MI translates the subject‟s motor intention into a control signal through classifying EEG. Multichannel EEG are usually needed for spatial pattern identification and therefore MI based BCI is still in form of lab demonstration. Or as Yijun Wang and Shangkai Gao (2005)[1] put it, “A classification algorithm can be developed by combining LDA and RP . They are independent in frequency domain and can lead to significant performance gain.”According to Aleˇs Procha´zka, Jarom´ır Kukal and Oldˇrich Vyˇsata (2008)[2] in their article, they denote that “ DWT can be used for signal processing and feature extraction as an alternative to the DFT. This signal classification assumed the knowledge of the range of the number of classes to apply a self-creating classification method to find their optimal value and to exclude the possibility of dead neurons.”L.M.Patnaik and Ohil K. Manyam (2008)[3] specify that “Automated detection process can be developed by using WT for feature extraction and ANN for classification. This provides many advantages among them are low cost, non-stop monitoring and faster diagnosis.” A new EEG classification was developed by Min Han and Leilei Sun(2010)[4] . They put it as “A new EEG classification can be based on RVM and AR

model. Good performance of RVM employing AR coefficients increase interest in the prediction of epilepsy."EEG signal classification as stated by Abdul hamit Subasi and M.Ismail Gursoy(2010)[5], is by using PCA , ICA, LDA and SVM. It acts as a promising tool for intelligent diagnosis. According to Indu Sekhar Samant, Guru Kalyan Kanungo, Santosh Kumar Mishra(2012)[7] in their paper propose "To use Least Mean Square algorithm to remove the artifact in the EEG signal. This proposed method can facilitate the doctor to detect the breast cancer in the early stage of diagnosis as well as classify the total cancer affected area." Epileptic EEG and its classification as given by Nilima Mohite , Rajveer Shastri , Arnab Das(2014)[8], is "To extract features by combining DWT , EMD & bispectrum analysis. Results of all four methods shows that the EMD has better variance and thus the potential of classifying normal and Seizure EEGs is more using EMD than other methods."

2.1 Artificial Neural Network (ANN)

Artificial neural network (ANN) is a machine learning approach that models human brain and consists of a number of artificial neurons It is a computational model for information processing. Neurons in ANNs tend to have fewer connections than biological neurons, each receiving a number of inputs.

An activation function is applied to these inputs which results in activation level of neurons, which is nothing but the output value of the neuron. Knowledge about the brain's learning task is given in the form of examples called training examples.

A Neural Network is clearly specified by:

(i) Neuron model: the information processing unit of the NN, Fig 1.2 gives the artificial neuron model.

(ii) A architecture: a set of neurons and links connecting all neurons. Each link has a specified weight.

A learning algorithm is mainly used for training the NN by modifying the weights in order to model a particular learning task correctly on the training examples. The aim is to obtain a NN that is trained and generalizes well. It should behave correctly on new instances of the learning task .The neuron of brain is the basic information processing unit of a NN.

It consists of:

(i) A set of links, with weight, describes the neuron inputs, with weights of $W_1, W_2, \ldots, W_m$

(ii) An adder function (linear combiner) for computing the weighted sum of the inputs:

in real numbers $\mathrm{u}=\sum_{j=1}^{m} \mathrm{w_j x_j}$

(iii) Activation function φ for limiting the amplitude of the neuron output. Here „b" denotes bias.

$$\mathrm{y}=\varphi(\mathrm{u}+b)$$

A neural net is an artificial illustration of the human brain that tries to imitate its learning process. ANN is an interrelated group of artificial neurons. Most systems have three layers. The first layer of input neurons used to send data through synapses to the second layer of neurons, and then send through more synapses to the third layer of output neurons.

More complex systems have more layers of neurons with some having increased layers of input neurons and output neurons. The synapses store parameters called "weights" for manipulating data in the calculations.

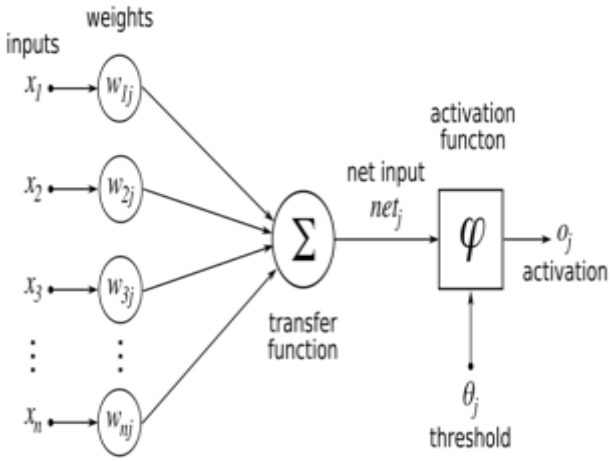
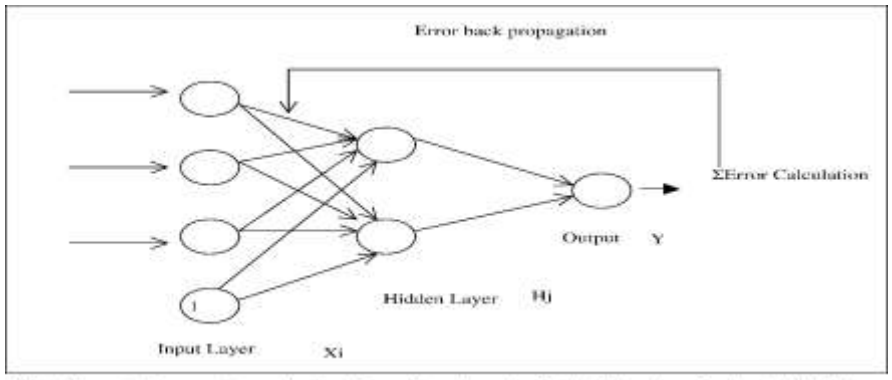


Fig.1.1 shows the basic diagram of Artificial Neural Network

ANN is a neural network of simple processing elements to demonstrate complex overall performance of brain, based on the connections between the processing elements and their parameters.ANN is an adaptive system that changes its structure based on external or internal information when flowing through the network. Neural computing approach to information processing mainly involves a learning process with an ANN architecture that adaptively responds to inputs according to a learning rule of the network. After the NN has learned, the trained network can be used to execute certain tasks depending on the exact purpose for the variation . The ability to learn with the help of example and simplify are the main characteristics of ANN. Classification of signals is performed using ANN to obtain the correct classification percentage. ANN is learned using the back propagation algorithm where the errors for the units of the hidden layer are determined by back propagating the errors of the units of the output layer. It is a systematic way of training multi-layer ANNs. It contains an input layer, at least one intermediate or hidden layer and an output layer in its network. Some ANN learning parameters are Threshold, Goal, Epoch, Sigmoid function, Training type and Number of Hidden layers.

2.2 Back Propagation Network

The Back propagation algorithm mainly searches for weight values of the data that minimize the total error of the network over the large set of training examples (training set).



Notes: The weight connecting node *i* in the input layer to node *j* in the hidden layer is denoted by *Wji*, and the weight connecting node *j* to the output node is represented by *Vj*

Fig: 1.2 Back Propagation Training Algorithm

Back propagation network consists of the repeated application of the following two passes:

(i) Forward pass: In this pass, the network is activated on one example and the error of (each neuron of) the output layer is computed.

(ii) Backward pass: In this pass, the network error is used for changing by updating the weights. The error is propagated backwards from the output layer through the network layer after layer.

This is done by repeatedly computing the local gradient of all neuron individually

Back propagation adjusts the weights of the Neural Network in order to minimize the network total mean squared error.

Consider a network of three layers. We use i to represent nodes in input layer, j to represent nodes in hidden layer and k represent nodes in output layer.w_{ij} refers to weight of individual connection between a node in input layer and node in hidden layer.

The following equation is used for deriving the output value Yj of node j

$$Yj = \frac{1}{1+e^{-X_j}}$$

where, $X_j = \sum x_i \cdot w_{ij} - \theta_j$, $1 \leq i \leq n$; n is the number of inputs to node j, and θ_j is threshold for node j.

The back propagation algorithm is used to compute the necessary corrections, after choosing the weights of the network randomly.

The algorithm can be decomposed into the following four steps.

- Feed-forward computation
- Back propagation - output layer
- Back propagation - hidden layer
- Weight updates

The algorithm continues until the value of the error function has become sufficiently small. The fig.2 shows the notation for three layered network. Consider the connection between neuron A (a hidden layer neuron) and neuron B (an output neuron) and has the weight of WAB. The diagram specifies another connection, between neuron A and C.

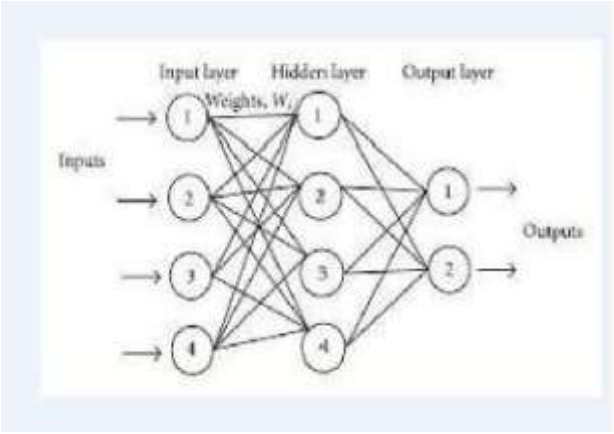


Fig 2: Basic Diagram of Artificial NN

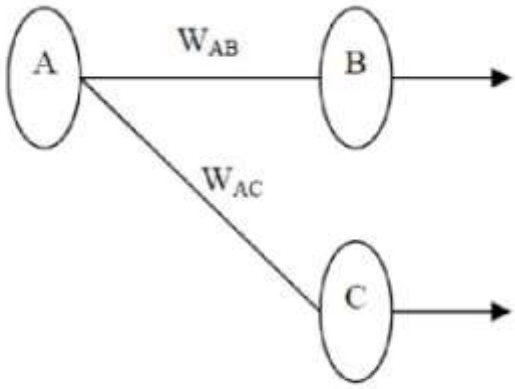


Fig 3: Single Connection learning in BPN

The algorithm works like this:

1) *First apply the inputs to the network and find the output:*

Note that this Initial output could be anything, since the initial weights were random numbers.

2) *Next find the error for individual neuron B. The error is what you want and What you actually get, in formula:*

Error B = Output B (1-OutputB) (Target B – Output B)

The "Output (1-Output)" term is necessary in the equation because of the Sigmoid Function – if we were only using a threshold neuron it would just be (Target –Output).

3) *Change the weight. Let W+AB be the new (trained) weight and WAB be the initial weight.*

W+AB = WAB + (Error B x Output A)

Notice that it is the output of the connecting neuron (neuron A) we use (not B). We update all the weights in the output layer in this way.

4) *Calculate the Errors for each of the hidden layer neurons. But in output layer we can't calculate these directly (because we don't have a specified Target), so we Back Propagate them from the output layer (hence it is named so).*

This is done by taking the Errors from the output neurons and running them back through the weights to get error in the hidden layer. For example if neuron A is connected as shown to B and C then we take the errors from B and C to generate an error for A.

Error A = Output A (1 - Output A) (Error B WAB + Error C WAC)

Again, the factor "Output (1 - Output)" is present because of the sigmoid squashing function.

5) *After obtaining the Error for the hidden layer neurons now proceed as in stage 3*

To change the hidden layer weights of nodes. By repeating this method we can train a network with any number of layers.

The back propagation algorithm is used to compute the necessary corrections, after choosing the weights of the network randomly. The algorithm can be decomposed in the following four steps: Feed-forward computation, Back propagation to the output layer, Back propagation to the hidden layer and Weight updates. Fuzzy logic is a form of many valued logic, it deals with reasoning that is approximate rather than fixed and exact.

This may well have left some doubt in your mind about the operation, so let"s clear that up by explicitly showing all the calculations for a full sized network with 2 inputs, 3 hidden layer neurons and 2 output neurons as shown in figure 3. W + represents the new, recalculated, weight, whereas W (without the superscript) represents the old weight.

III PROPOSED WORK

3.1 Block Diagram

The block diagram of the entire project is shown in fig 4.1. It is composed of four major techniques

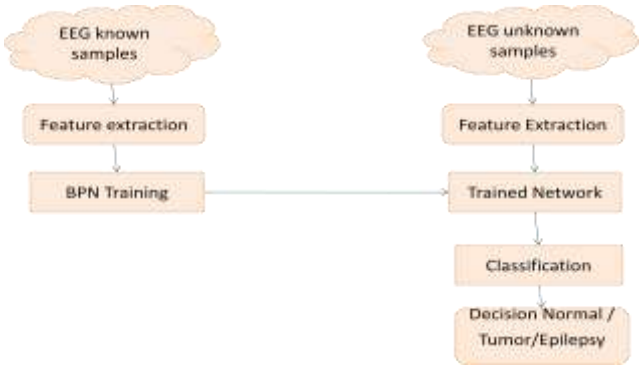


Fig 3.1: Proposed system Block diagram

3.1.1 Input acquisition

The analysis of brain signals plays an important role in classification and diagnosis of different brain diseases. MATLAB provides a user friendly and interactive graphic user interface (GUI) allowing users to flexibly and interactively process their high-density EEG dataset. EEGLAB is a MATLAB toolbox distributed under the free GNU GPL license for processing data from electroencephalography (EEG) and other electrophysiological signals. EEGLAB also implements independent component analysis (ICA) and several techniques. EEGLAB allows users to access their electrophysiological data by importing it into about 20 binary file formats, processing the data, performing single trials, and then ICA. Repeated ICA components may be subtracted from the data. Sometimes, ICA components representing brain activity may be further processed and analyzed. EEGLAB allows users to group data from several areas, and cluster their unique components. The input retrieval is through EEGLAB software installed in the personal computer which is used to convert the .eeg file generated by the EEG monitor to .txt file which in turn can be easily exported to the excel sheet that can then be used as input. Block diagram is in Figure 4.2)

3.1.2 Feature Extraction (PCA)

The electrodes generate the signals from patient's brain and give them to the Principal Component Analysis for dimensionality reduction for removing the redundant variables in the data by converting the multiband signal to a single-band signal and these are classified using Neural Network classifier with back propagation.

In PCA the better classification of signals is obtained for the learning variables like epochs as 1000, number of hidden layers as 3, goal of it as 0.01, and sigmoid function as a threshold of 0.5,tensing and training type.

A data reduction method will be applied to each signal for converting multi band to single band data using PCA. PCA is used to reduce the large dimensionality of the data and multi spectral band reduction through extracting features like covariance, Eigen values and vectors. It is useful for discriminating the pattern of different signals with limited features. The signal reduction is used to explain the majority of its variability compared to multiband features. It is also named as Karhunen-Loève transform or proper orthogonal decomposition.

The algorithm of PCA:

Step-1: Input the Samples

Step-2: Compute Mean value as

$M=sum(I_{ij})./N$

Step-3: Find the Difference Matrix,

D= I-M

Step-4: Calculate Covariance, C=D*D‟

Step-5: Compute the Eigen Vectors

[V D]= eig(C)

Step-6: Obtain Features

The brain signals are trained using Neural Network. During the classification of the mental tasks using Neural Network classifier, the data is misclassified at the output that is, the percentage of correct classification is low. Similarly during the classification of the mental tasks using Principal Component Analysis with Neural Network classifier, the data is correctly and accurately classified at the output . The percentage of accurate classification is high because of reduction of the redundant variables in the dataset. The comparison of the results of Neural Network classifier and Principal Component Analysis with Neural Network classifier is tabulated to show the variation of mean square error during training, mean square error during testing, computation time and the percentage of correctly classified data for both types of classification.

3.1.3 Fuzzy Logic (FL)

Fuzzy logic is an approach to computing based on "degrees of truth" rather than the usual "true or false" (1 or 0) Boolean logic on which most of the modern computers are running. The idea of fuzzy logic was first introduced by Dr. Lotfi Zadeh from the University of California at Berkeley in the 1960s. Dr. Zadeh was dealing with the problem of computer understanding of natural language. Natural language (like most other activities in life and indeed the universe) is not easily translated into the absolute terms i.e., binary form 0 and 1. (Whether is it possible to describe everything in binary terms is a shocking question, but in reality much data we might want to feed a computer are in states between 0 and 1).

3.1.4 Experimental Results

Mean of entire db:

We can calculate the mean of the sample. The mean of a sample is given by the formula:

$$\bar{X} = \frac{\sum_{i=1}^{n} X_i}{n}$$

Notice the symbol $\bar{X}$ (said "X bar") to indicate the mean of the set. All this formula says is "Add up all the numbers and then divide by how many there are".

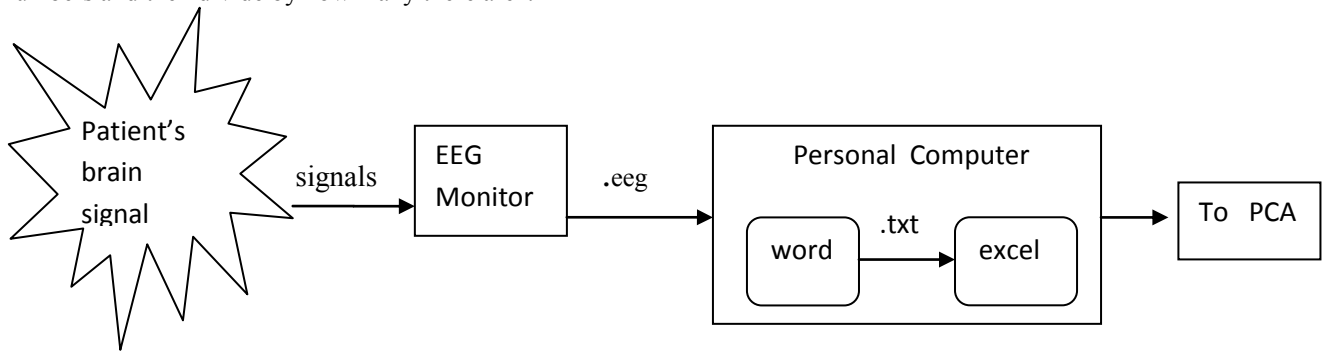


Fig 4.2: Input acquisition

3.2. Classification (BPN)

The classification of EEG signals is done here by using back propagation method. The back propagation algorithm plays a key role in computing the necessary corrections, after choosing the weights of the network in random. The algorithm can be categorized into the following four steps:

i) Feed-forward computation

ii) Back propagation - output layer

iii) Back propagation - hidden layer

iv) Weight updates

The algorithm continues until the value of the error function has become sufficiently small.

3.2.1Forward path

i. Initialize weights.
ii. Choose activation function
iii. Apply i/p. Calculate o/p of hidden layer which is the input to output layer.
iv. Then calculate o/p of output layer.
v. Calculate error.

3.2.2Reverse path

i. Adjust the weight of the o/p layer based on the error using delta learning rule.
ii. Adjust the weight of the hidden layer based on the weight of the output layer.
iii. This is continued until error is minimized.

3.3Performance metrics

The performance metrics of BPN classifier can be calculated using the following variables,

Sensitivity: It is the one that is used to measures the proportion of positives which are correctly identified .

Sensitivity = Tp./(Tp + Fn)

Where,

Tp = True Positive: Abnormality correctly classified as abnormal

Fn = False negative: Abnormality incorrectly classified as normal

Specificity: It is the one that measures the proportion of actual negatives which are correctly identified.

Specificity = Tn./(Fp + Tn)

Where,

Fp = False Positive: Normal incorrectly classified as abnormal

Tn = True negative: Normal correctly classified as normal

Total accuracy: (Tp+Tn)./(Tp+Tn+Fp+Fn)

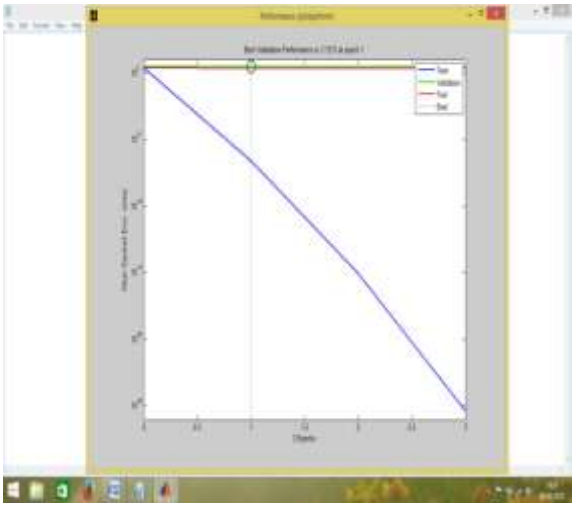


Fig 5: Performance Plot

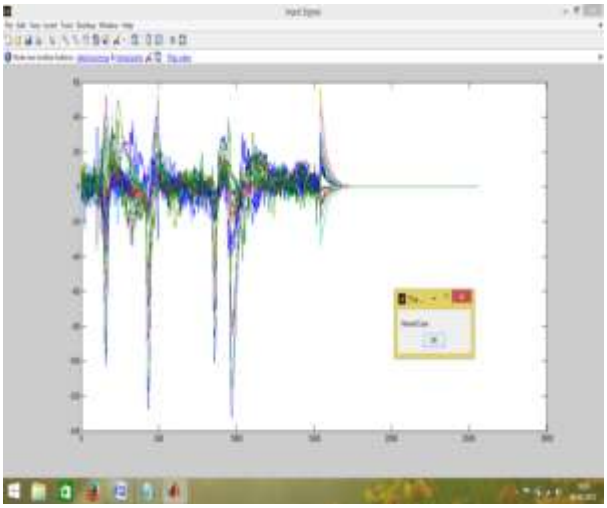


Fig 6: EEG of Normal patient

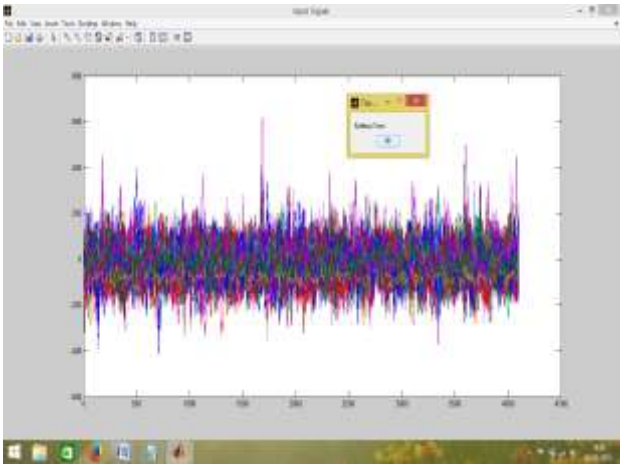


Fig 7: EEG of Epileptic Patient

IV CONCLUSION

Human brain is judgmental ,neural networks has become the solution for the BCI problem .The task are based on brain signals classification is improved by several methods of pre-processing techniques, to generate the input data for the classification of signal with the help of neural networking concept. The soft computing techniques are used for the classification of the EEG signals as they are used to model and make accurate and possible solutions to real world circumstances. The probability of accurate classification has been increased by using soft computing techniques like Principal Component Analysis with artificial neural network and Fuzzy Logic techniques.

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HYBRID VEHICLES – THE AUTOMOBILE FUTURE

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ABSTRACT

A Hybrid Vehicle is a vehicle that uses two or more distinct power sources to move the vehicle. Today the whole world is running out of power. Again the environment is also polluted to a great extent. To eliminate both the problems we can use the Hybrid Vehicles. This paper is all about the Hybrid Vehicles and its recent advances. A Hybrid Vehicle can reduce the pollution to a great extent. It can also reduce the power consumption. The main aim of this paper is to make everybody aware of the Hybrid Vehicles. Another aim of this presentation is to see the recent trends in the Hybrid Vehicles. The world is on the cusp of a major transition to hybrid power vehicles, which use highly efficient electric motors to boost the fuel efficiency of vehicles powered by internal combustion engines. This is a game-changing technology that promises to increase energy efficiency substantially, make a broad range of fuels available for powering vehicles, and meaningfully reduce demand for oil from the transportation sector.

Keywords: Distinct Power Sources, Environment Friendly, Game Changer, Hybrid Vehicles, Oil Demand Reduction.

I. INTRODUCTION

The hybrid car has been developed during the past decade as a combination of the traditional automobile, which uses a gasoline engine, and the electric car, which derives its power solely from a charged electric battery/electric motor system. Many consumers are finding that hybrid cars strike an ideal balance between the two alternatives; it is more environmentally friendly and fuel efficient than a traditional vehicle and does not require the inconvenience of battery charging via a wall plug, as electric cars do. My objective in this report is to form a technical definition of hybrid car technology, in particular the mechanical and electrical workings of the hybrid automobile.

Given that rising petroleum/diesel gasoline prices, the demand for alternative fuel vehicles, or vehicles that use other methods to obtain power, has increased dramatically in the past decade. These alternative fuel vehicles include electric cars, biodiesel cars, and of course, hybrid cars. The hybrid car is unique because the system contains both a rechargeable car battery and a small gasoline engine; the car battery is recharged while the car is running on the gasoline engine. Below you will see the Toyota Prius dashboard energy monitor, which contains a diagram of the Toyota Prius energy sources and consumption. This monitor diagram depicts the flow of the power from the battery to electric motor to the wheels; the other route is directly from the small gasoline engine. Using this monitor, the driver knows where the power for the car is coming from, the amount of battery power left, and when the battery is recharging.

II. HISTORY

Honda unveiled its Insight hybrid car at the 1999 North American International Auto Show in Detroit. But the Insight wasn't the first hybrid car on the road. See more pictures of hybrid car models.

Generally speaking, a hybrid car is any car that uses more than one fuel source. Nowadays, however, we mainly use the term to describe cars that combine a gas-fueled internal combustion engine with a battery-driven electric motor. Until recently such hybrid electric vehicles (or HEVs) were relatively rare, but the success of the Toyota Prius has raised public awareness of these gas-saving vehicles and spawned a number of similar cars from manufacturers such as Honda (the Honda Insight) and Ford (the Ford Fusion Hybrid). In fact, these fuel efficient vehicles are one of the most rapidly growing segments within the auto industry. They help us achieve the ideal of green driving.

In the late 19th and very early 20th centuries, back when the idea that cars must run on gasoline wasn't yet set in stone, inventors tinkered with a number of ways in which automobiles could be powered -- including electricity, fossil fuels, steam and combinations of these things. The history of hybrid electric vehicles, however, began shortly after the dawn of the 20th century. Here are some of the highlights of that history:

1900: The Lohner-Porsche Elektromobil makes its debut at the Paris Exposition. Although initially a purely electric vehicle, designer Ferdinand Porsche soon added an internal combustion engine to recharge the batteries, making it the first hybrid electric vehicle.

1917: Woods Motor Company introduces the Woods Dual Power, a hybrid electric vehicle with a 4-cylinder internal combustion engine. The Dual Power had a top speed of around 35 miles per hour (56.3 kilometers per hour). It was not a success.

1960s and 1970s: Electrical engineer Victor Wouk builds a prototype HEV based on the Buick Skylark. When the U.S. government decided not to invest in the vehicle's further development, Wouk ran out of money and abandoned the project.

1968: GM develops the GM 512, an experimental vehicle that runs on electricity at low speeds and gasoline at high speeds.

1989: Audi demonstrates the experimental Audi Duo. It combines a 12-horsepower electric motor with a 139-horsepower internal combustion engine. Audi develops further generations of the Duo over much of the following decade.

1997: In response to a challenge from Executive Vice President Akihiro Wadi to develop more fuel-efficient vehicles, Toyota introduces the Prius and begins marketing it in Japan.

1999: Honda introduces the Insight.

2000: Toyota begins marketing the Prius (as a 2001 model) in the United States.

2002: Hybrids start to become fairly common in the marketplace. Honda introduces the Accord Hybrid. Many more hybrid cars follow over the next few years.

2004: Ford introduces first hybrid SUV, the 2005 Ford Escape.

III. TYPES

There are two types of hybrid cars, parallel hybrids and series hybrids. These classifications are based on the arrangement of the parts previously described.

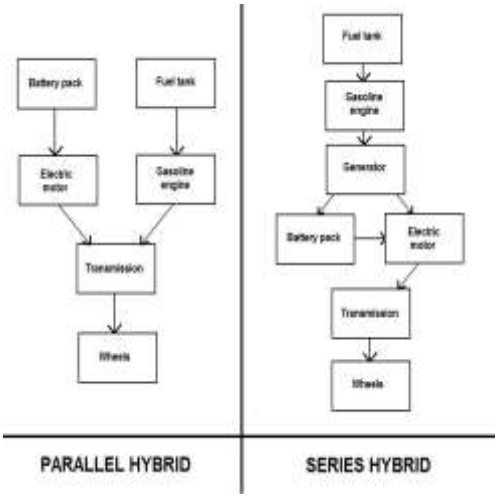

Figure 1. Comparative Block Diagram of Parallel and Series Hybrid

3.1 Parallel Hybrids

These hybrid cars have two different circuits from which their power is derived. One pathway originates from the fuel tank, which activates the engine, which powers the transmission; the other originates from the electric battery pack to the electric motor, which also powers the transmission. These two pathways do not intersect in a parallel hybrid. The transmission then transfers power to the wheels. Most hybrid cars today are powered with a parallel system. Examples of parallel hybrids include the Honda Insight and Toyota Prius.

3.2 Series Hybrids

Series hybrid cars generally have a generator act as the mediator between the engine and the batteries/electric motor. Therefore, the gasoline engine is not connected directly to the transmission. In this scenario, the flow chart begins with the fuel tank, which activates the engine, which transfers energy to the generator. The generator then is connected to the battery pack and the electric motor, and the electric motor provides power to the transmission and ultimately the wheels. Examples of series hybrids include the Saturn Vue, Green Line, and Honda Civic Hybrid.

The serial type has a downsized engine on board that drives a generator that supplements the batteries and can charge them when they run low. In the parallel type the ICE and the electric motor can both deliver propulsion power to the wheels [1].

Special attention is given to series hybrid drivelines, because they benefit much more directly than parallel hybrid drive lines from the recent large improvements in the specific weight and volume of electric drive motors/electronics. The results of the present study indicate that series hybrid vehicles with an electric range of 90-100 km and good acceleration performance (0-88 km/h acceleration times of less than 12 seconds) can be designed with a powertrain weight and volume comparable to that of a parallel hybrid of the same performance [2].

In order to understand the functioning of a hybrid vehicle, one must first know the mechanical components and their functions.

IV. WORKING OF HYBRID CARS

To know the working of a hybrid car, we must understand the basics of Mild Hybrid cars and Full Hybrid cars.In mild hybrid cars, the electrical motor is used only when additional power is needed. The conventional engine is used to provide most of the power. The electrical motor alone cannot operate the vehicle. Whenever power is needed the electric motor acts as a side-kick to the conventional engine. Some vehicles that carry this concept is the Honda Civic and Insight.

In a full hybrid car, the electrical energy is used while the car needs less power. The gasoline energy is used when the car needs less power. Thus at lower speeds the battery drives the vehicle and at higher speed the gasoline drives the vehicle. This technology has been used in cars like Toyota Prius and Ford Escape.

Both of them though have a little different mode of operation provide the same amount of efficiency.

Since both electric motor and an engine are used simultaneously, the size of the engine will be considerably smaller than the usual ones. But they will be a lot more advanced than the usual ones. The motor, on the other hand is also used to give power for the air conditioner, power windows, water pump and also power steering.

Take a look at the diagram given below. It shows the actual working of the hybrid car Toyota Prius. During the starting position, none of the system is working. After the car starts to move, it is in the normal driving mode. Thus the car will automatically change to the use of electric motor. Later when the car is accelerated and gains speed, it switches from the use f motor to the use of engine. Thus the gasoline engine supplies the required power. This switching is carried out automatically, with the help of an on-board computer. Since the battery has lost some of its charge, it needs to be immediately recharged. This is also done automatically. When the car starts to go in a uniform speed or when it is descending a road, the generator starts charging the battery.

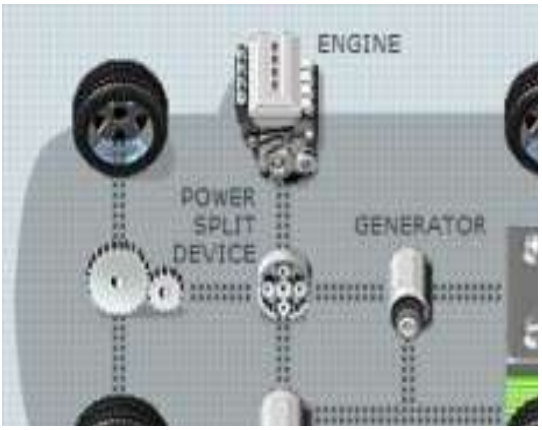

Figure 2. Working of a Toyota-Prius

V. ADVANTAGES OF HYBRID CARS

- Very less pollution.
- Better mileage.
- More reliable and comfortable.
- Very clean cars due to less emission.
- Batteries need not be charged by an external source.
- Warranties available for batteries as well as motors.
- Less dependence on fuels.

VI. LIMITATIONS OF HYBRID CARS

- The initial cost will be very high – higher than other cars.
- Since a lot of batteries will be needed, the car will be very heavy.
- As there are electrical components, there is risk of shock during an accident.
- The vehicle can be repaired only by professionals.
- Spare parts will be very costly and rare.

VII. TIPS TO IMPROVE FUEL EFFICIENCY

Most people buy tires that provide good traction for all weather conditions. Little do they look out for efficiency. If stiffer tires with higher pressure are used they reduce the friction by two times than the usual.

For any car, as the weight and size of the car increases, the efficiency decreases. So remove the unwanted weight and thus increase efficiency. Make the body using lighter metals like aluminium and magnesium.

Aerodynamics plays an important role in the fuel consumption of your car. For this you have to reduce the frontal area of the car, thereby reducing the air drag.

The energy wasted from your hybrid car includes the energy wasted as heat. If you could recycle that energy and reuse it, you can surely get more fuel efficiency. When you apply brakes, you are throwing out energy from the car. This energy can be stored in the battery through a process called regenerative braking. Instead of applying the brakes, the electric motor drives the hybrid to reduce the speed of the car. This way, the electric motor acts as a generator and charges the batteries while the car is slowing down.

VIII. BATTERIES OF HYBRID CARS

Figure 3. Rechargeable Batteries are Used In Hybrid Cars

A hybrid car battery is like any other battery—except that it is rechargeable and has enough juice to move a large heavy vehicle down the road for a few feet or a few miles.

8.1 Today's Hybrid Car Battery: Nickel Metal Hydride

Toyota Prius Hybrid Battery The battery pack of the second generation Toyota Prius consists of 28 Panasonic prismatic nickel metal hydride modules—each containing six 1.2 volt cells—connected in series to produce a nominal voltage of 201.6 volts. The total number of cells is 168, compared with 228 cells packaged in 38 modules in the first generation Prius. The pack is positioned behind the back seat.

The weight of the complete battery pack is 53.3 kg. The discharge power capability of the Prius pack is about 20 kW at 50 percent state-of-charge. The power capability increases with higher temperatures and decreases at lower temperatures. The Prius has a computer that's solely dedicated to keeping the Prius battery at the optimum temperature and optimum charge level. The Prius supplies conditioned air from the cabin as thermal management for cooling the batteries. The air is drawn by a 12-volt blower installed above the driver's side rear tire well.

8.2 Lithium Ion Battery – For Next Generation Hybrids and Electric Cars

Lithium ion (or Li-ion) batteries are important because they have a higher energy density—the amount of energy they hold by weight, or by volume—than any other type. The rule of thumb is that Li-ion cells hold roughly twice as much energy per pound as do the previous generation of advanced batteries, nickel-metal-hydride (NiMH)—which are used in all current hybrids including the Toyota Prius. NiMH, in turn, holds about twice the energy per pound of the conventional lead-acid (PbA) 12-Volt battery that powers your car's starter motor. It's Li-ion's ability to carry so much energy that makes electric cars possible.

Compare the batteries from GM's legendary EV1 to those for its upcoming Volt extended-range EV. The 1997 EV1 pack used lead-acid cells; it was almost 8 feet long and weighed 1200 pounds. But today's Volt pack, using lithium-ion cells, stores the same amount of energy (16 kilowatt-hours) in a 5-foot-long container weighing just 400 pounds.

IX. FUTURE SCOPE OF HYBRID SYSTEM

Speculations are on about the future of hybrid cars. With relatively new technology, some believe that hybrid cars are fast turning into the cars of future. Consumers are ready to take chance with the advance technology which hybrid cars have on offer. Today, Honda and Toyota are the two prominent companies producing hybrid cars.

While Honda launched its Honda Civic Hybrid, Toyota is ready with its Prius. With brands such as Nissan, Mazda, Ford, Fiat, Peugeot, Audi, Mercury and even Porsche, all these vehicles are licensed to use Toyota's Hybrid technology in future. In spite of this much hyped show, hybrid cars are somehow falling flat on consumer market.

Hybrid cars lack in mileage which is a great setback for all the hybrid car owners. Currently a hybrid car gets up to a mileage of 31 mpg on city and 45 mpg on highway. Unless manufacturers seriously look into this aspect, the car may fail to sustain the on-going hybrid mania for long.

The hybrid car designs of the future are including sports car models that have been all-time favorites with the world in the past and are now being revived with the brand new hybrid engine in mind.

With a mindset of grasping and expanding the propulsion features that are somewhat limited in today's hybrid car designs, there are retro styling efforts that are focusing on providing hybrid cars with optional V8 engine capacities.

There are considerations in place to use solar cells in the framework of hybrid automobiles. The future hybrid car will need to focus more on greenhouse gases that negatively affect the environment as well as a hybrid car that will be even more fuel efficient.

X. PLUG-IN HYBRIDS

Plug-in hybrids, sometimes called Plug-in Hybrid-Electric Vehicles (PHEVs), are hybrids with high-capacity batteries that can be charged by plugging them into an electrical outlet or charging station. They can store enough electricity from the power grid to significantly reduce their petroleum consumption under typical driving conditions.

Plug-in hybrid electric vehicle (PHEV) drive trains are predominantly dependant on the energy storage system (ESS), compared to those of regular HEV. One of the major current issues in the auto-industry related to PHEVs is the type of battery system which favours the technology the most [3].

Plug-in hybrid electric vehicles (PHEVs) are hybrid electric vehicles that can draw and store energy from an electric grid to supply propulsive energy for the vehicle. This simple functional change to the conventional hybrid electric vehicle allows a plug-in hybrid to displace petroleum energy with multi-source electrical energy. This has important and generally beneficial impacts on transportation energy sector petroleum consumption, criteria emissions output, and carbon dioxide emissions, as well as on the performance and makeup of the electrical grid. PHEVs are seen as one of the most promising means to improve the near-term sustainability of the transportation and stationary energy sectors [4].

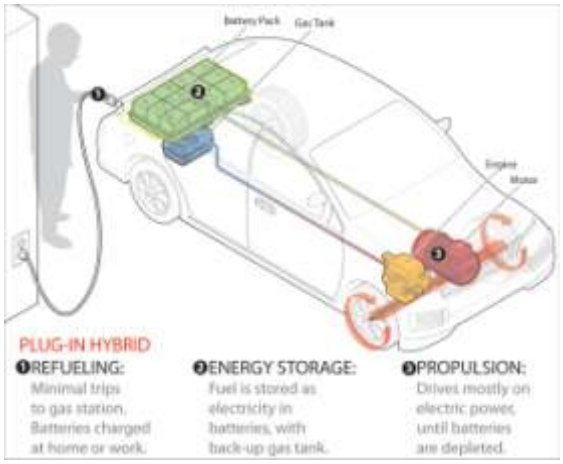

Figure 4. Basics of A Plug-In Hybrid

10.1 Different Kinds of Plug-in Hybrids

There are two basic plug-in hybrid configurations:

- Series plug-in hybrids, also called Extended Range Electric Vehicles (EREVs). Only the electric motor turns the wheels; the gasoline engine is only used to generate electricity. Series plug-ins can run solely on electricity until the battery needs to be recharged. The gasoline engine then generates electricity to power the electric motor. For shorter trips, these vehicles might use no gasoline at all.
- Parallel or Blended Plug-in Hybrids. Both the engine and electric motor are mechanically connected to the wheels, and both propel the vehicle under most driving conditions. Electric-only operation usually occurs only at low speeds.

Plug-in hybrids also have different battery capacities, allowing some to travel farther on electricity than others. Their fuel economy, like that of electric vehicles and regular hybrids, can be sensitive to driving style, driving conditions, and accessory use.

10.2 Benefits and Challenges

Less petroleum use. Plug-in hybrids are expected to use about 40% to 60% less petroleum than conventional vehicles. Since electricity is produced mostly from domestic resources, plug-in hybrids reduce oil dependence.

Less greenhouse gas emissions. Plug-in hybrids typically emit less greenhouse gas than conventional vehicles, but the amount generated depends partly on the fuel used at electrical power plants—nuclear and hydroelectric plants are cleaner than coal-fired power plants.

Higher Vehicle Costs, Lower Fuel Costs. A plug-in hybrid can cost roughly $4 to $8 thousand more than a comparable non-plug-in hybrid. Using electricity is much cheaper than using gasoline, but whether fuel savings will offset the higher vehicle cost depends on the vehicle purchased, the percentage of miles operating on electricity, fuel costs, and ownership length. Federal tax incentives up to $7,500 are currently available for qualifying plug-ins.

Re-charging Takes Time. Re-charging the battery using a 120-volt household outlet can take several hours; re-charging using a 240-volt home or public charger can take roughly 1 to 4 hours; while a "quick charge" to 80% capacity may take as little as 30 minutes. However, these vehicles don't have to be plugged in. They can be fueled solely with gasoline but will not achieve maximum range or fuel economy without charging.

Estimating fuel economy. Since a plug-in can operate on electricity alone, gasoline alone, or a mixture of the two, EPA provides a fuel economy estimate for gasoline-only operation and an estimate for electric-only or gas-and-electric operation—both for combined city-highway driving.

Assuming that current low-end battery cost projections can be met in the future, a plug-in should be able to recover its incremental cost through fuel savings in well under the life of the vehicle. Plug-ins with more than modest electric-only range will have difficulty passing the often-cited “three-year payback” test, however, even under such a favorable battery cost scenario and with $3 per gallon gasoline. A further increase in fuel prices or a shift in consumer priorities could nonetheless create a sizable market for plug-ins [5].

TABLE 1. COST COMPARISION BETWEEN DIFFERENT PHEV

Cost comparison between a PHEV-10 and a PHEV-40 (prices for 2010)

Plug-in type by EV range	Similar production model	Type of drivetrain	Manufacturer additional cost compared to conventional non-hybrid mid-size	Cost of battery pack	Cost of electric system upgrade at home	Expected gasoline savings compared to a HEV	Annual gasoline savings compared to a HEV(2)
PHEV-10	Prius Plug-in(1)	Parallel	US$6,300	US$3,300	More than US$1,000	20%	70 gallons
PHEV-40	Chevy Volt	Series	US$18,100	US$14,000	More than US$1,000	55%	200 gallons

Notes: (1) Considers the HEV technology used in the Toyota Prius with a larger battery pack. The Prius Plug-in estimated all-electric range is 14.5miles (23km)

(2) Assuming 15,000 miles per year.

10.3 Fuel Efficiency

The actual fuel economy for PHEVs depends on their powertrain operating modes, their all-electric range, and the amount of driving between charges. If no gasoline is used the miles per gallon gasoline equivalent (MPG-e) depends only on the efficiency of the electric system. The first mass production PHEV available in the U.S. market, the 2011 Chevrolet Volt, with an EPA rated all-electric range of 35 miles (56 km), and an additional gasoline-only extended range of 344 miles (554 km) has an EPA combined city/highway fuel economy of 93 MPG-e in all-electric mode, and 37 mpg-US (6.4 L/100 km; 44 mpg-imp) in gasoline-only mode, for an overall combined gas-electric fuel economy rating of 60 mpg-US (3.9 L/100 km; 72 mpg-imp) equivalent (MPG-e). The EPA also included in the Volt's fuel economy label a table showing fuel economy and electricity consumed for five different scenarios: 30, 45, 60 and 75 miles (121 km) driven between a full charge, and a never charge scenario. According to this table the fuel economy goes up to 168 mpg-US (1.40 L/100 km; 202 mpg-imp) equivalent (MPG-e) with 45 miles (72 km) driven between full charges.

Trade-offs between fuel economy improvement, and thus petroleum savings, and economic factors, such as vehicle cost differential and break-even gasoline price, are studied for mild (15% of total driveline power electric) and full (engine and electric power are about equal) hybrid vehicles. The study considered compact and mid-size passenger cars and mid-size SUVs. The same weights and road loads were used for the conventional ICE and hybrid vehicles. It was found that the fractional fuel savings are greater for the full hybrids (40-50%) than for the mild hybrids (30-40%). However, the break-even gasoline prices for the mild hybrids are significantly lower than that for the full hybrids. In the cases of the mild hybrids using conventional PFI gasoline engines, the break-even gasoline prices were found to be $1.25-1.50/gal for a vehicle use of 100,000 miles over 8 years and a discount rate of 4%. For the full hybrids, the corresponding break-even gasoline prices were $2.00-2.30/gal [6].

For the more comprehensive fuel economy and environment label that will be mandatory in the U.S. beginning in model year 2013, the National Highway Traffic Safety Administration (NHTSA) and Environmental Protection Agency (EPA) issued two separate fuel economy labels for plug-in hybrids because of their design complexity, as PHEVS can operate in two or three operating modes: all-electric, blended, and gasoline-only. One label is for series hybrid or extended range electric vehicle (like the Chevy Volt), with all-electric and gasoline-only modes; and a second label for blended mode or series-parallel hybrid, that includes a combination of both gasoline and plug-in electric operation; and gasoline only, like a conventional hybrid vehicle.

10.4 Disadvantages

10.4.1 Cost of Batteries

Disadvantages of plug-in hybrids include the additional cost, weight, and size of a larger battery pack. According to a 2010 study by the National Research Council, the cost of a lithium-ion battery pack is about US$1,700/kW·h of usable energy, and considering that a PHEV-10 requires about 2.0 kW·h and a PHEV-40 about 8 kW·h, the manufacturer cost of the battery pack for a PHEV-10 is around US$3,000 and it goes up to US$14,000 for a PHEV-40. According to the same study, even though costs are expected to decline by 35% by 2020, market penetration is expected to be slow and therefore PHEVs are not expected to significantly impact oil consumption or carbon emissions before 2030, unless a fundamental breakthrough in battery technologies occurs.

10.5 Charging Systems

Batteries are DC devices while grid power is AC. In order to charge the batteries, a DC charger must be utilized. The charger can be located in several locations:

On-board chargers are mounted inside the vehicle. Since the charger takes up space and adds weight, its power capacity is generally limited by practical considerations, avoiding carrying a more powerful charger that can only be fully utilized at certain locations. However, carrying the charger along with the vehicle ensures that power will be available anywhere a power connection can be found.

Off-board chargers can be as large as needed and mounted at fixed locations, like the garage or dedicated charging stations. Built with dedicated wiring, these chargers can handle much more power and charge the batteries more quickly. However, as the output of these chargers is DC, each battery system requires the output to be changed for that car. Modern charging stations have a system for identifying the voltage of the battery pack and adjusting accordingly.

Using electric motor's inverter allows the motor windings to act as the transformer coils, and the existing high-power inverter as the AC-to-DC charger. As these components are already required on the car, and are designed to handle any practical power capability, they can be used to create a very powerful form of on-board charger with zero additional weight or size. AC Propulsion uses this charging method, referred to as "reductive charging".

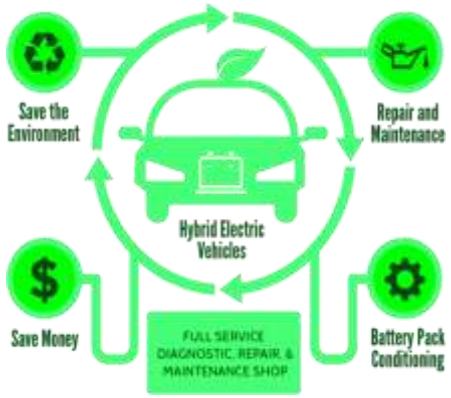

Figure 5. All About Hybrids

XI. CONCLUSION

Hybrid Vehicles is truly a revolutionary concept. If widely used, it would help in reducing many serious problems like Global Warming, Environmental Pollution, etc. It would also help in conservation of the nearly extinct Fossil Fuels.

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