Chapter 2

Literature Review

2.1 INTRODUCTION

Brain signals identification has remained a difficult as computers are not effective. It is difficult to find the fine variations in the signal because the signals are too lengthy. Today, efficient brain signal recognition is limited to find different brain diseases such as epilepsy, tumour, encephalitis, and sleep disorders; using hardware like Electroencephalogram (EEG) where the strokes are openly identified then the brain signals remain recognized. But then again if you need to transform a brain signal text keen on a digital text, then it must to mine the EEG signals and before identify the brain syndromes by means of brain signals. However the problem through this method is that nearby are not numerous algorithms that might efficiently mine signals from a brain. Consequently, brain signals recognition by means of software is quiet not as able as it might be. Entirely automatic systems is to overwhelmed the above difficulties remain proposed. Herein work, the work proposes the design of software which might do this work of decoding brain signals toward digital text documents. This research work suggest a new method using which the difficult of identifying brain signals can remain resolved. We similarly provide the execution particulars of this software. For the execution of described knowledge, we suggest a novel Neural Network Architecture, which is an improved form of the predictable Back Propagation Network. The system approved through the Back Propagation Network (BPN) used in neural network directed and inspired us to scheme this research work. Particulars concerning the involuntary preprocessing then the shortcomings remain similarly comprised in this research work. This research effort will be in categorizing EEG with a neural network centred intelligent classifications.

The consequence in some emerging nation is practically the similar currently. The western nations through their greater organization are creating the maximum ready of the expertise whereas in countries comparable India, knowledge has been imperfect towards the residents where the infrastructure has remained advanced. Then
if the nation remains to equivalent the advanced countries in manipulating this knowledge, the country want to enlarge the arrangement keen on the rest of the nation as well as towns. On the other hand to this, we must first contrivance an absolutely electronic method of doing everything. Trail of everything i.e., after electricity, rations, grocery, headed for taxes must be set aside harmless through computers. This would severely decrease the quickness of treating to discover brain diseases then manpower necessary. This needs to ensue at about fact of period, if not directly, if the country remains to contest with the advanced nations in somewhat means. For instance it is obvious, founding such an arrangement in a nation as enormous such as the country would need massive funds.

The essential quantity of computers, networks etc. would be enormous. This remains one of the leading ranges of research in which the Indian department of information technology is complicated. Abdulhamit Subasi et al., (2005) reported that it is continuously operational on creating inexpensive EEG devices, components, computers then software. Then even uncertainty the country do create such a substructure through the year 2020 for instance remains predictable, it would yield an enormous volume of physical effort to do the transferring or switch to, such a classification where everything remains computerized. This stands accordingly, because in place of over half a century, it has to stayed recording each feature physically, then if we remain to change to a digital earnings, all these essential to be transformed keen on the digital media also. This means extra effort. By hand nourishing entirely these particulars keen on a digital media would precede enormous manpower and period which cannot be almost expert. Therefore to overcome this difficulty it should be automate and renovation too, through developing software that would identify brain signals and transform it keen on digital records.

2.2 LITERATURE REVIEW

2.2.1 History

Carlo Matteucci (1811-1868) and Emil Du Bois-Reymond (1818-1896) remained the first individuals to record the electrical signals produced from muscle nerves by means of a galvanometer then create the thought of neurophysiology. But, the idea of action current announced by Hermann Von Helmholz and Niedermeyer
(1999) reported formerly clarified then established the negative differences that occur in the course of muscle contraction. Richard Caton (1842-1926) a expert from Liverpool, England used a galvanometer then located two electrodes above the scalp of a human substance then in this manner first documented brain movement in the practice of electrical signals in 1875. Meanwhile then, the models of electro (referring to recording of brain electrical happenings) encephalo (mentioning to producing the signals after the head) then gram (or graphy), which means writing or drawing were collective, so that the period EEG was hereafter used to signify electrical neural movement of the brain.

Fritsch (1838-1927) and Hitzig (1838-1907) revealed that the human cerebral can remain electrically inspired. Danilevsky (1852-1939) tracked Caton's work then completed PhD theory in the examination of the physiology of the brain in 1877 described by Jasper (1958). Herein effort, he examined the movement of the brain subsequent electrical stimulus as well as impulsive electrical movement in the brain of natures. Brazier (1961) reported that the brainy electrical activity experiential above the visual cortex of dissimilar species of animals remained reported through Ernst Fleischl von Marxow (1845-1891). Napoleon Cybulski (1854-1919) delivered EEG indication of an epileptic seizure in a dog produced through electrical motivation. Motokawa (1949) described that the knowledge of the suggestion of epileptic rounds with irregular electrical releases was articulated by Kaufman. Pravidch-Neminsky (1879-1952) a Russian physiologist, verified the EEG after the brain, called the dura, then the intact brain of a pup in 1912. He experiential a 12-14 cycle/s measure below usual circumstances, which reduced below asphyxia then well ahead named it *electrocerebrogram*.

The innovator of the being of human EEG signals remained Hans Berger (1873-1941). He initiated the training of human EEGs in 1920 described by Niedermeyer (1973). Berger is well recognized by nearly all electroencephalographers. He in progress operational through a string galvanometer in 1910 then drifted to a lesser Edelmann model, then afterwards 1924, to a superior Edelmann model. In 1926, Berger started to practice the additional influential Siemens double coil galvanometer (attaining a sensitivity of 130V/cm) described by Aserinsky and Kleitman (1953). The work states the initial statement of human EEG footages of one
to three minutes period on photographic paper was in 1929. In this footage he only used a one channel bipolar technique through fronto-occipital leads. Record of the EEG became common in 1924. The formerly statement by Berger 1929 involved the alpha rhythm as the main constituent of the EEG signals, as labelled advanced in this chapter, and the alpha delaying reaction.

Speckmann and Elger (1999) reported that through the 1930s the formerly EEG recording of sleep supports was assumed by Berger. He formerly described the consequence of hypoxia scheduled the human brain, the nature of numerous diffuse then contained brain complaints, and provided an inkling of epileptic discharges. Shepherd (1974) described that through this time additional collection recognized in Berlin-Buch and controlled by Kornmuller delivered additional detailed recording of the EEG. Berger was similarly attracted in cerebral localization then above all in the localization of brain tumors. He similarly originates some association among mental doings then the variations in the EEG signals.

Toennies (1902-1970) after the collection in Berlin constructed the first biological amp for the recording of brain capacities. A variance amplifier for recording EEGs was later manufactured by the Rockefeller foundation in 1932. Attwood and MacKay (1989) reported that the significance of multi-channel recordings then by means of an enormous amount of electrodes to shield a wider brain area remained documented through Kornmuller. The formerly EEG exertion converging on epileptic appearance then the first demonstration of epileptic points were obtainable through Fischer and Lowenbach. In England, W. Gray Walter converted the innovator of clinical electroencephalography. He revealed the foci of slow brain movement (delta waves) which introduced enormous clinical attention in the diagnosis of brain irregularities.

In Brussels, Fredric Bremer (1892-1982) revealed the influence of dissimilar signals on the state of vigilance. Research doings associated to EEGs ongoing in North America in about 1934. In this year, Hallowell Davis demonstrated a respectable alpha rhythm for himself. A cathode ray oscilloscope remain used about this date through the collection in St.Louis University in Washington, in the revision of peripheral nerve potentials. The effort on human EEGs started at
Harvard in Boston and the University of Iowa in the 1930s. Caspers et al (1987) reported that the training of epileptic seizure advanced by Fredric Gibbs was the foremost effort on EEGs during these years, as the realm of epileptic seizure syndromes was the realm of their highest efficiency. Epileptology may be separated historically into two epochs, before and after the advent of EEG.

Gibbs and Lennox smeared the impression of Fischer created on the educations about picrotox in and its effect on the cortical EEG in creatures to human epileptology. Berger presented a limited example of paroxysmal EEG discharges in a case of reputed petit mal assaults and throughout a focal motor seizure in a persistent through overall paresis. By way of the additional excessive creators of electroencephalography in North America, Hallowell and Pauline Davis remained the initial detectives of the nature of EEG throughout human sleep. A. L. Loomis E. N. Harvey and G. A. Hobart remained the first who scientifically deliberate the human sleep EEG designs then the phases of sleep. At McGill University, H. Jasper deliberates the connected social syndrome before he originates the niche in basic then clinical epileptology. The American EEG Humanity was originated in 1947 and the First International EEG Congress was held in London, U.K, about this period. Whereas the EEG trainings in Germany remained quiet limited to Berlin and Japan increased devotion through the work of Motokawa (1949), an investigator of EEG rhythms. In the course of these years the neurophysiologists established the thalamocortical association through anatomical systems. This led to the growth of the theory of centrencephalic epilepsy.

During the 1950s the work on EEG’s expanded in several different places. Throughout this period surgical process for eliminating the epileptic foci developed general then the manuscript entitled Epilepsy and the Functional Anatomy of the Human Brain (Penfiled and Jasper) remained available. Through this period microelectrodes were conceived. They remained complete of metals such as tungsten or else glass, filled with electrolytes such as potassium chloride, through diameters of less than 3mm. Depth electroencephalography of a human was first attained with enclosed intracerebral electrodes by Mayer and Hayne (1948). Creation of intracellular microelectrode knowledge transformed this technique and was used in the spinal cord by Brock et al. in 1952 than in the cortex by Phillips
in 1961. Investigation of EEG signals ongoing in the course of the early days of EEG dimension. Berger supported by Dietch (1932) practical Fourier analysis to EEG orders, which was quickly advanced for the period of the 1950s. Study of sleep complaints with EEGs started its growth in the 1950’s over the work of Kleitman at the University of Chicago. In the 1960’s study of the EEGs of full term then premature new borns initiated its growth. Study of evoked potentials (EPs), particularly visual EPs, as usually used for watching mental illnesses, advanced during the 1970s.

The history of EEG, conversely needs been an incessant process, which started after the early 1300’s and has transported daily growth of experimental, clinical and computational trainings for recognition, discovery, diagnosis, then treatment of a massive amount of neurological and physiological irregularities of the brain then the relaxation of the central nervous system (CNS) of human beings. Currently EEGs are verified indiscreetly and noninvasively by means of completely electronic schemes. The EEG technologies are prepared with numerous signal processing tools, delicate and exact dimension electrodes, and sufficient memory for actual long term recordings of numerous hours. EEG or MEG (magnetoencephalogram) machineries might be combined with additional neuroimaging schemes such as functional magnetic resonance imaging (fMRI). Kandel and Schwartz (1997) reported that the very faint needle type electrodes can similarly be used for recording the EEGs from above the cortex (electrocardiogram), and in this means evade the weakening and nonlinearity belongings induced by the skull. The landscape of neural doings within the human brain will be defined afterward.

2.2.2 Artificial Neural Network

Artificial neural network frequently just named a ‘neural network’ (NN) is a mathematical model or computational model founded on networks. Sriram and Eswaran (2008) reported that in most cases an ANN is an adaptive system that changes its structure created on outside or inner data that streams over the network throughout the knowledge stage in additional useful terms neural networks are non-linear statistical data modeling tools. They can be used to model multifaceted
relations among inputs then outputs before near catch designs in information. Artificial neural networks remain completed of interrelating artificial neurons.

Artificial neural networks might also be castoff to gain an empathetic of biological neural networks, before for explaining artificial intelligence difficulties deprived of unavoidably making a model of an actual biological system. Artificial Neural Network (ANN) likewise named a Simulated Neural Network (SNN) or generally just Neural Network (NN) is an organized collection of artificial neurons that practices a mathematical or computational model for data processing created on a connectionist method to computation.

Figure 2.1 The Synapse
Figure 2.2 Artificial neural network

One traditional kind of artificial neural network is the Hopfield net. In a neural network prototypical simple nodes, which can be named variously “neurodes”, “neurons”, and “Processing Elements” (PE) or “units” are associated together to form a network of nodes later the period “neural network”. Although a neural network does not have to be adaptive per se, its applied use derives with algorithms intended to change the strength (weights) of the influences in the network to create a preferred signal flow. In some of these schemes neural networks, or else portions of neural networks (such as artificial neurons) are used as mechanisms in larger schemes that association together adaptive and non-adaptive fundamentals. The idea of a neural network appears to have first been planned by Alan Turing in 1948 paper “Intelligent Machinery”.

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2.2.3 Neural Network Software

Neural network software is used to simulate, research, develop and apply artificial neural networks, biological neural networks then in more or less cases a broader array of schemes.

**Learning paradigms:** There are three main learning paradigms, respectively consistent to a specific abstract knowledge task. These are administered learning, unsupervised learning then reinforcement learning. Typically slightly given type of network architecture can be working in any of individual’s responsibilities.

**Reinforcement learning:** Now reinforcement learning, documents x is typically not assumed, but produced through an agent’s connections with the location. ANN’s are regularly castoff in reinforcement learning as part of the general algorithm. Responsibilities that decrease inside the example of reinforcement learning remain device problems, games then additional sequential decision making responsibilities.

**Learning algorithms:** Here are numerous algorithms for exercise neural networks; maximum of them can be observed as a straight forward claim of optimization theory and estimation. Evolutionary methods simulated annealing, expectation maximization and non-parametric methods are among other generally castoff approaches aimed at exercise neural network.
Neural networks and neuroscience: Theoretic in addition to computational neuroscience is the arena worried through the hypothetical examination besides computational modeling of biological neural schemes. Meanwhile neural systems are familiarly connected to cognitive procedures then behavior, the field is strictly connected to reasoning then behavioral modeling. The purpose of the arena is to make reproductions of biological neural schemes in order to comprehend how biological systems grind. To increase this accepting, neuroscientists struggle to brand a link among experiential biological procedures (data), biologically plausible devices for neural dispensation and knowledge (biological neural network models) then model (statistical learning theory in addition to information theory).

2.2.4 Current Research

Study remains continuing in appreciative the computational algorithms castoff in the brain, with roughly current biological proof for radial basis networks then neural back propagation as tools for handling data. The situation in any emerging country is nearly the similar today. The western nations with their greater infrastructure are creating the maximum out of the technology whereas in countries like India, knowledge has been restricted to the metropolitans where the organization has been established. On the other hand if the country are to equal the advanced countries in manipulating these technologies, we need to enlarge Indian organization into the rest of the nation together with villages. But to this we must first implement a completely computerized way of undertaking everything from electricity, grocery; rations to taxes must be kept track of through computers. This would severely decrease the speed of handling to find brain diseases then manpower required. This needs to happen at some point of time, if not instantaneously, if India is to contest with the advanced nations in somewhat means. By means of it is understandable, creating such a structure in a nation as enormous as country would need massive funds.

The essential number of networks, computers etc. would be enormous. This is one of the foremost ranges of study in which the Indian department of information technology is involved. It is continuously operational on creating cheaper EEG components, computers, devices and software. However even if India do create such
an organization by the year 2020 as is estimated, it would take an enormous amount of manual effort to do the changing or evolution to such a system where the whole thing is computerized. This is so for the reason that for over half an era, country have been recording each detail by hand, and if the nation remain to switch to a digital means, all these essential to be improved addicted to the digital media also. This means extra work. Physically feeding all these particulars keen on a digital media would take enormous manpower and time which cannot be practically consummate. Therefore a clarification aimed at this difficult would be to automate this renovation also, by emerging software that would identify brain signals then renovate it into digital files or records.

2.3 SYSTEM ARCHITECTURE

Jakob et al (2003) reported that the simple design of system architecture comprises a buffer which is of equivalent size as the contribution EEG signal file. The entire of the file is first look over into this buffer. Altogether the handling involved in the recognition procedure is completed on the data extant in this buffer. The modernization or the alteration in the recognition procedure is the way these signals remain controlled. Such as clarified before in the previously existing software, first a raster scan is executed on the signals then for each signal is recognized creating them not appropriate for recognizing extended signals. To elude this work is not to segment the lengthy signals in advance recognizing them.

This research work comprehends the recognition procedure as then when the scanning is through. This work use two concurrent scans, a vertical and horizontal one; feed them to two dissimilar neural networks. The important in this is that once a horizontal scan is completed, the signals are nourished into a neural network which is qualified to classify the bases of numerous brain signals.

Wong and Abdulla (2006) reported that when the base of a brain signals is recognized, the lengthy signal, in the order in which they seem in the EEG, are transported to a second buffer where the brain signals remain located. This is wherever the vertical scan approaches into play. Figure 2.5: Illustration of the planned structure the brain signal buffer stays scanned vertically then they are nourished into the second neural network which classifies the brain signal created on the EEG
design. So once each of the signals is delivered, it is nourished into the neural network which knows it at physical period. Then the output of this is not resolute till the brain signals are definite for assured.

Figure 2.5 System Architecture of the proposed system

2.4 AIM

Haas et al (2003) reported that the clarifications that the work have proposed is motivated by the Electroencephalograms (EEGs) remain suitable progressively significant measurements of brain action then they have countless possible for the analysis and action of mental and brain diseases and irregularities. Through suitable clarification approaches they are developing as a key practice to fulfil the increasing global mandate for more reasonable and real clinical and healthcare facilities.

Jakob et al (2003) and Subasi et al (2005) reported that Emerging and accepting advanced signal processing techniques for the study of EEG signals is critical in the part of biomedical research. The future work centres on these techniques, as long as expansive reporting of algorithms and tools after the field of digital signal processing. It deliberates their applications to medical records, using graphs and topographic pictures to show reproduction results that assess the efficiency of the approaches.

Srinivasan et al (2007) reported that the EEG classically scans each signal of the brain and based on current input brain signal, the digital signal processing is prepared. The changeover remains till a pre-defined EEG brain signal is touched. The
final EEG signal that is reached decides what the brain disease is. This is exactly that the works do with the digital signal data file containing the EEG brain signals. We scan separately signal stake then created on the design so far scanned and the existing brain signal stake. The equal proportion is planned for the numerous pre-processed lengthy brain signals. Uncertainty an equal is found to be worthy enough, and then the recognition is prepared.

2.5 OBJECTIVE

Shepherd (1974) reported that the difficult here is that through such a real time process, signals like brain and muscles; eye might be documented as similar before the complete EEG signal might be skimmed. Hence here is a necessity for an additional restraint which would make sure that this kind of real time processing fixes not ends up in incorrect outcomes.

Motokawa (1949) reported that the restraint is carried in to the network such that the appreciation of the EEG brain signals is created on the signals documented till the preceding EEG signal of brain then the existing signal. That is if a brain signal has been recognized till the previous signal of EEG and if the next few brain signals of EEG do not proceeds it nearby to somewhat additional signals in terms of the lengthy signals, then the corresponding EEG brain signals is recognized.

If the next few EEG signals see to precedes it earlier to more or less additional signals formerly, the EEG till which the signal (s1) was documented is reserved path of, and now if it jumps to depart after that EEG signal formerly it is quiet documented as s1, and the next signals starts from the electrode next to s1. Going on the conflicting, if it precedes the recognition enormously nearby to about additional signals (s2), then the brain signal is recognized as s2 and not s1. For example, ‘Electrode 1’ could be s1 and ‘Electrode 2’ could be s2.

In that case, s2 is recognized. If some other brain signals like were in the following signals, it might take the signal closer to ‘Electrodes’ then jumps to differ nearby next before it is documented as Electrode 1 and some other signals. Therefore the recognition might be achieved at actual time. So, the recognition might be stretched to digital signal processing method.
2.6 SYSTEM IMPLEMENTATION

2.6.1. Using back propagation network

The knowledge that the work planned can be effortlessly applied by means of a conventional back propagation network. Caton, R. (1875) reported that the network as normal can require one or two hidden layers. The quantity of output elements is equivalent to the number of digital signals existing in the brain that is being predictable.

![Diagram of back propagation network]

Figure 2.6 Architecture of back propagation network

The amount of signals in the input layer is equivalent to the amount of the quantity of signals in the output layer and the maximum EEG signal of the brain. The input to the brain consists of different sets of electrodes. One set represents the pattern of the signal of brain that is currently being analysed. The extra set is essentially the output that is existence nourished back into the input layer. The output of the EEG brain signals would signify the measurement equal of the arrangement, so far perused with the numerous brain signals. So once this data is fed back as a portion of the input and the extra amount being the data on the pattern, and then the output be influenced by on both the previously recognized arrangements and the present design.
Figure 2.7 EEG Signal Recognition using electrodes

Built on this it is obvious whether the design matches additional through the brain signals or not. Therefore once the percentage equal exceeds EEG signal information, then the brain signal is documented. But the problem with this operation is that the work would must to generate a way to link the standards demonstrating the measurement equal with the EEG signals then the brain signals that they stand for. As an alternative of this, we polished the neural network so as to contribute a novel architecture that would flawlessly ensemble the problem in hand.

2.6.2 The pre-processing

The pre-processing essential for the recognition is pretty meek; the entire of the EEG signals is replicated by enlarging the brain signal as it is essential. This is complete so that the EEG signals to be documented are in normal size. If only this is the case, the amount of brain syndromes per EEG signals would be the similar as the ones known through carrying out stage.

Figure 2.8 Electrodes associated with Head to Read EEG Signals
2.7. SUMMARY

Here remain limited experiments in this technique that the work are so far to overcome which this work hope to do in the following couple of years. The main one is background the thresholds for enhanced brain signals recognition. These signal handling comprise the number of brain signals that essential to be observed gaining earlier the electrode might bring the amount produced. Additional factor of concern through algorithm, when the future neural network is castoff, is the time limitation. Then with earlier pre-processors coming up, this must not be ample of disquiet, at least not the main apprehension. Providing these experiments are taken care of, this research work have confidence in that the algorithm might prove to be an extremely effective means of recognizing brain signals with an extraordinary amount of accuracy.