Coma Brain Activity Classification Using Ml

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Abstract- *A coma is a prolonged state of unconsciousness in which the affected is totally unresponsive. This can be a very strenuous situation both for the near and dear ones of the affected as well as the doctors' duty bound to diagnose and treat the patient. In this regard, the proposed idea aims to introduce a way of using EEG based brain-computer interface system to detect an elicited response from a patientand give an idea of the emotional state of the person*

Keywords- Coma, emotion detection, EEG scan

I. INTRODUCTION

A coma is a state of prolonged unconsciousness that can be caused by a variety of problems including traumatic head injury, stroke, brain tumor, drug or alcohol intoxication, or even an underlying illness. During this period the person shows no response to stimuli, even pain. To date there is no real way to accurately judge the condition and mental state of the affected person to an accurate degree.Previously, detection was based on visual inspection of the averaged readings by a skilled clinician, a process which is expensive and not always feasible in practice. In this paper we propose a practical machine learning (ML) based approach for detection of the patients brain activity, thus improving the accuracy of prediction of mood . Further, the method can operate on an automatic and continuous basis, thus alleviating the need for clinician involvement.

REVIEW OF EXISTING TECHNOLOGIES AND RESEARCH

The following sections review the currently used technologies in the field of medicine to take care of patients affected by coma.

II. DIAGNOSIS BY A QUALIFIED DOCTOR

People in a coma can't express themselves, doctors must rely on physical clues and information provided by families and friends. This includes details such as events leading upto the coma, whether the onset on coma was immediate or it happened over time, the person's prior medical history, any anomaly in the persons behaviour, their medical history including drugs used , both prescribed as well as other illegal recreational drugs.

a) Physical Exam

In a physical exam, doctors will check the affected person's movements and reflexes, response to painful stimuli, and pupil size. Doctors will observe breathing patterns to help diagnose the cause of the coma. Doctors also may check the skin for signs of any bruises due to trauma. To determine the affected person's level of consciousness, doctors may speak loudly or press on the angle of the jaw or nail bed. Doctors will watch for signs of arousal, such as vocal noises, eyes opening or movement. Doctors will test reflexive eye movements. These tests can help determine the cause of the coma and the location of brain damage. Doctors also may squirt ice-cold or warm water into the affected person's ear canals and observe eye reactions.

b) Laboratory Tests

Blood samples will be taken to check for the complete blood count, electrolytes, glucose, thyroid, kidney and liver function, carbon monoxide poisoning, drug or alcohol overdose. A spinal tap (lumbar puncture) can check for signs of infections in the nervous system. During a spinal tap, a doctor or specialist inserts a needle into the spinal canal(mid-section of the spinal cord) and collects a small amount of fluid for analysis.

c) Brain Scans

These can be of a few different types depending on the instructions prescribed by the doctor after the preliminary aforementioned tests are conducted. These help to understand the affected areas of the brain and can help decide the cause of damage and how to go about treating it in the required way.

MRI:

Magnetic resonance imaging (MRI) is a medical imaging technique that uses a magnetic field and computer-generated radio waves to create detailed images of the organs and tissues in your body. When you lie inside

an MRI machine, the magnetic field temporarily realigns water molecules in your body. Radio waves cause these aligned atoms to produce faint signals, which are used to create cross-sectional MRI images

Figure 1. MRI Scanner

CT Scan:

A computerized tomography (CT) scan combines a series of X-ray images taken from different angles around your body and uses computer processing to create cross-sectional images (slices) of the bones, blood vessels and soft tissues inside your body. CT scan images provide more-detailed information than plain X-rays do. it's particularly well-suited to quickly examine people who may have internal injuries from car accidents or other types of trauma. A CT scan can be used to visualize nearly all parts of the body and is used to diagnose disease or injury as well as to plan medical, surgical or radiation treatment.

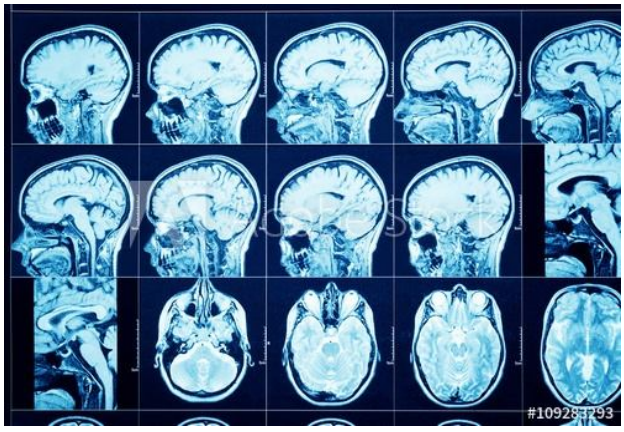

Figure 2. CT Scan Imaging of the brain

Electrocorticography:

Also known as ECoG, it is a type ofelectrophysiological monitoring of the brain using electrodes that are placed directly on the surface of the brain to detect electrical activity in the cerebral cortex. It is an intrusive procedure as openings need to be made in the skull for the insertion of the electrodes. This requires the use of anesthesia and hence a qualified professional for the same. It is mainly used to find the cause of epilepsy and though a commonly adopted procedure for the same

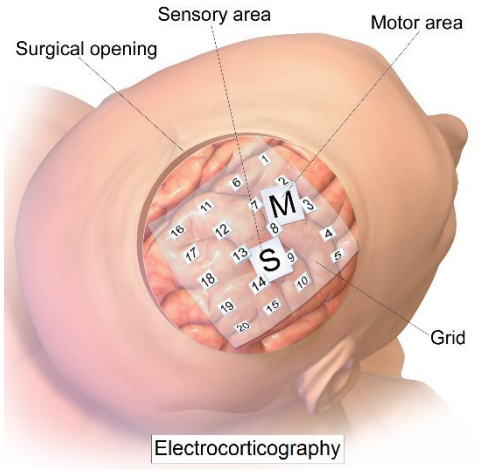

Figure 3. ECoG implant insertion illustration

EEG:

An electroencephalogram (EEG) is a test used to evaluate the electrical activity in the brain. Brain cells communicate with each other through electrical impulses. An EEG can be used to help detect potential problems associated with this activity.An EEG tracks and records brain wave patterns. Small flat metal discs called electrodes are attached to the scalp with wires. The electrodes analyze the electrical impulses in the brain and send signals to a computer that records the results.The electrical impulses in an EEG recording look like wavy lines with peaks and valleys. These lines allow doctors who have studied these patterns and their meanings to quickly assess whether there are any abnormal patterns. Any irregularities may be a sign of seizures or other medical conditions. This is a non-intrusive procedure that can be performed either in a hospital or any place with the associated EEG kit and is hence much more common and preferred than an ECoG which is used only in serious cases that need the explicit use of the procedure

Figure 4. EEG Imaging

III. PROPOSED IDEA OVERVIEW

The proposed system aims to unite the use of aforementioned technologies to bring about a conducive and more effective method to communicate with victims of such medical conditions.The EEG machine can be used to record the brain activity of a patient and the resultant activity can be processed to give valuable insights into the mind of the patient. There exist two states of such patients.

One where the patient exhibits relatively high level of brain function and is only inhibited in his motor capacities due to some reason such as nervous failure or muscle degradation etc. Another is where the patient exhibits only MMN (Mismatch negativity) signals which show minimal brain activity and hence is a sign of emergence from coma like brain conditions but not enough to elicit reactions based on stimulus from the patient.

In case of the former, an EEG machine, set up with a computer system can act as a brain-computer interconnect (BCI) which can then be programmed with machine learning techniques to accurately predict the emotional state of the subject

IV. ARCHITECTURE

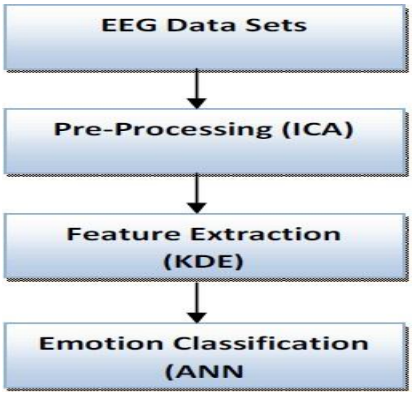

Figure 5. System architecture

Here the data sets comprise of the various brain activity readings from the patients, be it from a single patient multiple times or a variety of patients

In the Pre-processing stage, the data is filtered using Individual Component Analysis (ICA) to separate the valid data from noise

KDE or kernel Density Extraction is used to ascertain the data and finally ANN (Artificial Neural Network) is used for emotion classification to ascertain the emotional response from the patient to a degree of accuracy nearing 82.7%. The ANN has input and hidden neurons based on the feature types used whereas the output neurons are the four emotional states that the data can be finally classified to.

V. DISCUSSIONS AND CONCLUSION

The proposed system can bring about a big change in the way such niche conditions are treated where not much can be done to help a patient, with the innovative use of modern technology in conjugation with advancements in Machine Learning and Artificial Intelligence.

That being said there are a number of factors to consider such as the initial cost of EEG machines which is pretty high.

Cases with a higher brain activity state are rarer and initially the system would find it harder to classify the state of the patient in such cases. A more efficient algorithm or method will have to be found to entertain even such minimal activity cases

A fully functioning system could take a long time to be taught, given enough data and cases to fine tune it to be accurate even with differing factors and specifications

Once completed though, the proposed system has the potential to treat a variety of case not limited to coma alone, but any case where the patient is not able to respond physically due to any reason

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