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An Innovative Portable Device for Detecting and Sending the Occurrence of the Seizure

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Abstract

Background: Epilepsy is the most common neurological disease. Tonic-clonic seizures (Grand Mal) are a type of generalized seizures with fast spiactivity, gradually decreasing in frequency and increasing in amplitude (tonic phase), interrupted by slow waves (clonic phase), and followed by post-ictal EEG depression. The unpredictable nature of seizures poses risks for the patient like falling down as well as other dangerous situations.

Objectives: We are going to present an innovative "portable, wireless EEG monitoring with the ability of real time detection of grand-mal seizures in the starting point. In addition, an alarm will be sent to the patient's family and doctor notifying them, as well as the emergency unity asking them for an ambulance by sending the GPS data to them." It can facilitate timely intervention and hence minimize risks. The system can analyze recorded EEG waves from the 4 main brain areas and then extract rapid increase spikes of EEG rhythms as feature of seizure-occurrence-time. The task of the software is to the analyze EEG waves, extracting features, and commanding the hardware unit to call and report an emergency situation to increase the patients' safety. The doctor can view the patient's EEG information at any time.

Methods: The proposed system is a wireless and portable EEG, including 2 innovative hardware and software parts. The main part is the hardware, processing, and controlling unit using the ARM chip as well as the telecommunication unit. The first stage of the process is capturing raw EEG signals by placing 2 bipolar electrodes in each mentioned areas. Then, the EEG goes to the processing unit for extracting epileptic seizure features, which includes by rapid polyspike activity with increase in EEG rhythms using the fast fourier transform (FFT) as software unit. These features were considered as occurrence time of seizure. Using this features control unit commands telecommunication to call defined contacts.

Results: This methodology was applied on EEG data sets that belong to 3 subject groups (healthy subjects, epileptic subjects during seizure-free interval, and epileptic subjects during a seizure). An overall classification accuracy of 99% was achieved and the device could have an emergency call to the selected contacts for patient's emergency condition

Conclusion: The results confirmed that the proposed algorithm and device has a potential in classification of EEG signals and detection of Epileptic seizures that could help the doctors and the patients, even the patients' families, for better detection, protection, and care.

Keywords: Epilepsy; EEG; Telemedicine; Real Time Detection; Grand Mal Seizure