Texas A&M University at Qatar

Electrical and Computer Engineering Program

ECEN 403 –901

Fall 2016

Senior design proposal

ESD

Efficient Epileptic Seizure Onset detection

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TEXAS A&M
UNIVERSITY at QATAR

Content

I. Abstract

Epilepsy is a neurological disorder of brain that manifests through sudden and random seizures. Epileptic seizures are in general associated with the loss of consciousness for many epileptic patients. Seizures according to manifestation intensity range from unnoticeable to extremely violent that threatens patients' lives. Therefore, many elliptic patients are exposed to risks of injuries and mental distress. Epilepsy is the third most common neurological disorder worldwide that is estimated to affect 65 million people around the world. In Qatar, 1% of the population are affected by epilepsy and about 2000 patients are medically treated in Hamad Medical Corporation (HMC). This project seeks to enhance the quality of life of epileptic patients in Qatar through developing an efficient seizure onset detection system that uses the electroencephalogram signals (EEG) to detect the onset of seizures.

II. Problem statement

Epilepsy is a condition of a neurological disorder that causes repeated seizures of brain activity and deterioration of mental and physical abilities. Epilepsy affects twenty thousand people in Qatar (out of which 3000 children) and about two thousand patients are receiving treatments in HMC annually. Epileptic patients suffering from severe syndromes cannot lead their lives normally. For example, certain types of seizures may lead to lack of muscle control and loss of consciousness that result in physical injuries such as fractures and breathing problems. The objective of this project is to improve the life quality of epileptic patients via developing an efficient seizure onset detector that can be used in a feedback medical system which triggers medical precautions once the seizure starts.

III. Project description

Early onset seizure detection devices help neurologists in the process of aborting seizures either by medicine or targeted therapy. Detection devices can also help to enhance the quality of patients' lives as once a seizure is detected it can notify epileptic patients to take precautions that may avoid or ease the intensity of the seizure. The onset detector will consist of two stages shown in Figure 1.

The first stage is the feature extraction stage where EEG signal features will be extracted using various biomedical signal processing techniques in order to detect the seizure onset event. In such a stage, wavelet transform technique is used in order to decompose the incoming EEG signal into four frequency sub-bands (alpha, beta, gamma, and theta) and measure each sub-band's energy separately. Features can also be extracted using linear time domain tools to find the magnitude and variance in the EEG signal. Also, other tools can be used such as neural synchrony.

The second stage is the classification where the extracted signal is observed in order to classify the occurring events into seizure and non-seizure events. The classification stage is carried out by a trained artificial intelligence device using neural networks or support victor machine. The classifier will be trained using recorded EEG signals of epilepsy patients. All needed algorithms for both the feature extraction and classification stages will be developed on Matlab.

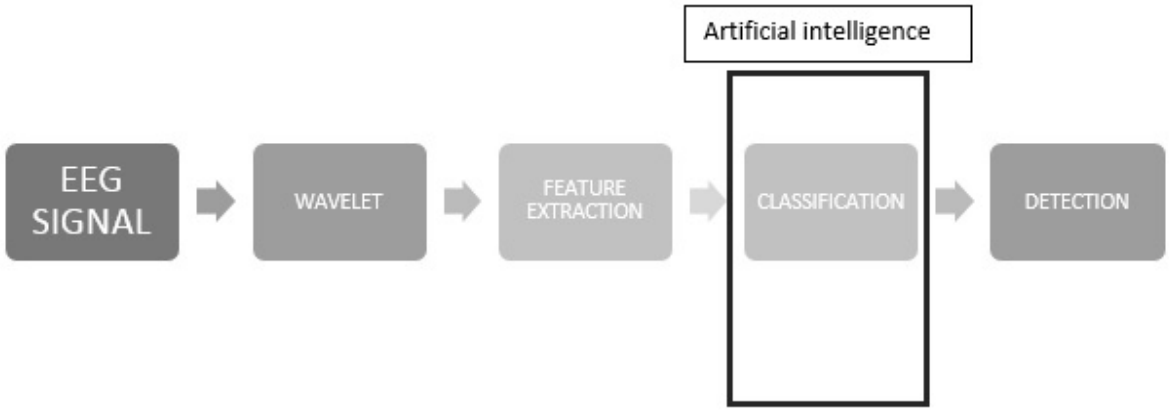

Figure 1: Illustration of a seizure onset detector

Efficiency is the main pillar in this project, as with no efficiency the device will lose the ability to successfully detect seizure events. In order to develop an efficient detector, the device sensitivity level must be as high as 100% while the latency and the false alarm rate should be as low as possible.

IV. Budget

Three main equipment's are to be used in this project, a desktop computer, software (Matlab), and the EEG signal detection kit. All the students in the group have laptops, and an access to the Matlab software around campus as well as in computer labs. The EGG kit was previously purchased by TAMUQ and our group have been granted access to use it. Therefore, there will be no need for an estimated budget for this project as all needed equipment's are available for the student

V. Timeline

PROJECT PHASE I FALL 2016	STARTING	ENDING
PROJECT PROPOSAL, INITIAL WEBSITE, TEAM AGREEMENT	28 - 8 - 2016	8 - 9 - 2016
PROPOSAL PRESENTAION	17 - 9 - 2016	29 - 9 - 2016
CUSTOMER NEEDS STUDY	2 - 10 - 2016	6 - 10 - 2016
BENCHMARKING	9 - 10 - 2016	13 - 10 - 2016
FUNCTIONAL MODELING + PROJECT STUDY VIDEO UPLOADED TO WEBSITE	16 - 10 - 2016	20 - 10 - 2016
PROGRESS PRESENTATION	23 - 10 - 2016	3 - 11 - 2016
CONCEPT SELECTION	6 - 11 - 2016	17 - 11 - 2016
INTELLECTUAL PROPERTY	20 - 11 - 2016	-
INITIAL PROJECT DESIGNING	20 - 11 - 2016	5 - 12 - 2016
FINAL PROGRESS PRESENTATION	22 - 11 - 2016	4 - 12 - 2016

PROJECT PHASE FALL 2016	STARTING	ENDING
PEER EVALUATION	-	4 - 12 - 2016
FINAL PROGRESS REPORT	-	5 - 12 - 2016
SEMINAR I	TBA	

PROJECT PHASE II SPRING 2017 (UPCOMING)	STARTING	ENDING
THEORITICAL BACKGROUND	TBA	TBA
FEATURE EXTRACTION STAGE	TBA	TBA
CLASSIFICATION STAGE	TBA	TBA
TRAINING AND TESTING	TBA	TBA
ABSTRACT SUBMISSION TO QATAR ANNUAL RESEARCH CONFERENCE (ARC)	TBA	TBA

SEPTEMBER

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VI. References

[1] M. Qaraqe, M. Ismail, and E. Serpedin, “Epileptic seizure onset detection via energy an neural synchronization decision fusion,” XIII International Conference on Bioinformatics, Computational Biology and Biomedical Engineering (World Academy of Science, Engineering and Technology, International Science Index, Bioengineering and Life Sciences, 1(7), 785), July 2015.

[2] M. Qaraqe, M. Ismail, Q. Abbasi, and E. Serpedin, “Channel selection and feature enhancement for improved epileptic seizure onset detection,” MobiHealth 2014, pp. 258-262, Nov. 2014.

[3] M. Qaraqe, M. Ismail, and E. Serpedin, “Band-sensitive seizure onset detection via CSP enhanced EEG features,” Epilepsy and Behavior, Elsevier, vol. 50, pp. 77-87, Sept. 2015.

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[6] M. Qaraqe, M. Ismail, E. Serpedin, and Haneef Zulfi, “Epileptic seizure onset detection based on EEG and ECG data fusion,” Epilepsy and Behavior, Elsevier, accepted for publication, Febr. 2016.