Real-World Neuroimaging Technologies

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***Abstract*— In this paper, we discuss our findings undeleting eye blink artifacts in brain activity using EEG. A test subject participated in a car driving simulation and his brain activity was captured during the experiment. While driving, stressful emotions were triggered in the participant, through steep curves and attention seeking billboards. Our research shows that detecting eye blinks is possible using a low cost EEG solution. We use the longitudinal differences of two prefrontal cortex sensors in combination with amplitude maps to classify eye blinks. We correlate eye blink frequency with experienced stress, observing higher frequency of eye blinks in stressful situations. Furthermore, we show that brain activity is significantly more active when doing mental calculation with eyes open as opposed to doing them with eyes closed. Results of this research could in combination with other stress detectors lead to applications to improve transport safety and support other areas where stress levels need to be monitored.**

***Index Terms*— EEG, Image Processing, Matlab**

I. Introduction

The human brain is considered a black box by many scientists. Although we are able to model and explain some phenomena, the majority of the brain's workings are still a mystery. The brain's activity can be measured using detection of electrochemical signals, blood flow and possibly others. When looking at the electrochemical signals, a large problem is linking these signals with a specific activity, such as activating motor functions or solving math equations using mental calculations. It is even harder to generalize the interpretation of these associations, since brain activity can differ between different persons. In this paper we discuss our findings on detecting eye blinks of one test subject and correlate eye blink frequency with the experienced level of stress.

II. Theoretical Background

Neuroimaging includes the use of various techniques to either directly or indirectly image the structure, function/pharmacology of the nervous system.

Neuroimaging falls into two broad categories:

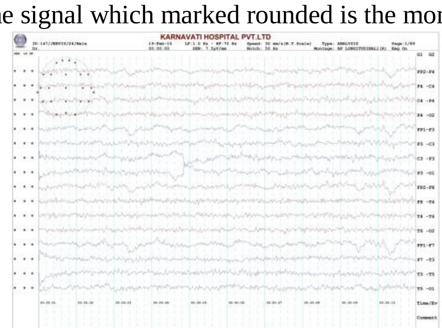
- Structural imaging (X-ray, City Scan, MRI)
- Functional imaging (EEG, ECG, Solography)

An electroencephalograph (EEG) is the recorded electrical activity generated by the brain. In general, EEG is obtained using electrodes placed on the scalp with a conductive gel. In the brain, there are millions of neurons, each of which generates small electric voltage fields. The aggregate of these electric voltage fields create an electrical reading which electrodes on the scalp are able detect and record. Therefore, EEG is the superposition of many simpler signals. The amplitude of an EEG signal typically ranges from about 1 uV to 100 uV in a normal adult, and it is approximately 10 to 20 mV when measured with subdural electrodes such as needle electrodes.

- 24 Electrodes used 23 for measurement and 1 for reference
- Worked on 70 Hz (may be changed according to width of the brain scalp)
- Detect the brain signal with the help of two potential differences between two electrodes.

III. EEG Graph

This is the EEG graph of a normal patient in normal condition at VS Hospital, September, 2014. When the fluctuation of the signal is increased is the moment when the eyes of the patient is opened and these fluctuations shows the effects of that eyes moments and thought came when the eyes became open. The below EEG Graph is we took for special purpose and that is for the eyes blink. The signal which marked rounded is the moment when eyes blink.



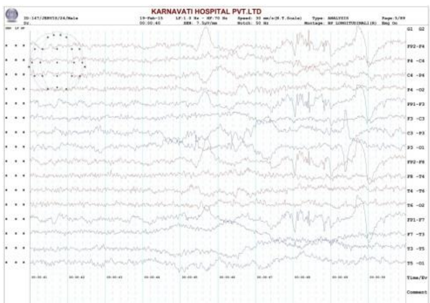


Figure 2.5 EEG Graph from Karnavati Hospital, February

IV. SURF (Speeded Up Robust Features)

SURF (Speeded Up Robust Features) is a robust local feature detector, first presented by Herbert Bay et al. ECCV 9th in International Conference on Computer Vision held in Austria in May 2006, that can be used in computer vision tasks like object recognition or 3D reconstruction. It is partly inspired by the SIFT descriptor. The standard version of SURF is several times faster than SIFT and claimed by its authors to be more robust against different image transformations than SIFT. SURF is based on sums of 2D Haar wavelet responses and makes an efficient use of integral images.

It uses an integer approximation to the determinant of Hessian blob detector, which can be computed extremely quickly with an integral image (3 integer operations). For features, it uses the sum of the Haar wavelet response around the point of interest. Again, these can be computed with the aid of the integral image. This information is treated to perform operations such as locate and recognition of certain objects, people or faces, make 3D scenes, object tracking and extraction of points of interest. This algorithm is part of that artificial intelligence, able to train a system to interpret images and determine the content.

SURF is a detector and a high-performance descriptor points of interest in an image where the image is transformed into coordinates, using a technique called multi-resolution. Is to make a copy of the original image with Pyramidal Gaussian or Laplacian Pyramid shape and obtain image with the same size but with reduced bandwidth. Thus a special blurring effect on the original image, called Scale-Space is achieved. This technique ensures that the points of interest are scale invariant. The SURF algorithm is based on the SIFT predecessor.

Implementation of the Method

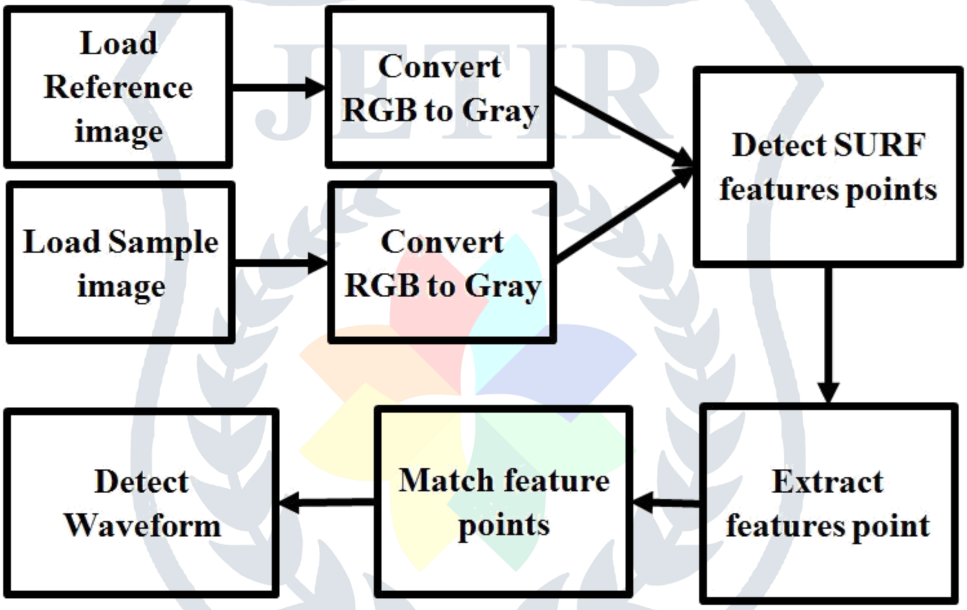


Figure 5.1 Implementation of Method

This section details the step back in search of characteristic points that provides the detector. This way it is possible to compare between descriptors and look for matching pairs of images between them. There are two ways to do it:

- Get the characteristic points of the first image and its descriptor and do the same with the second image . So you will be able to compare the two images descriptor correspondences between points and establish some kind of measure.
- Get the characteristic points of the first image with the descriptor. Then compare this descriptor with the points of the second image which is believed to be the partner concerned.

Result of the Implementation

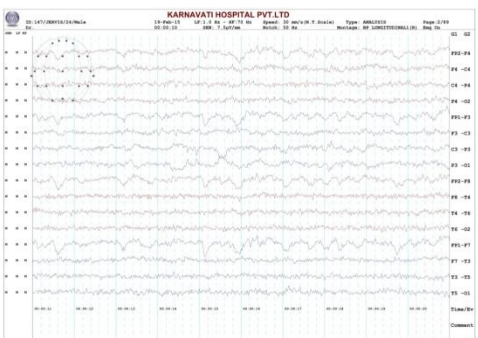


Figure of Reference Image

Figure of Sample Image

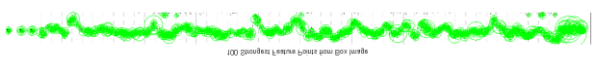


Figure of Feature point in Sample Image

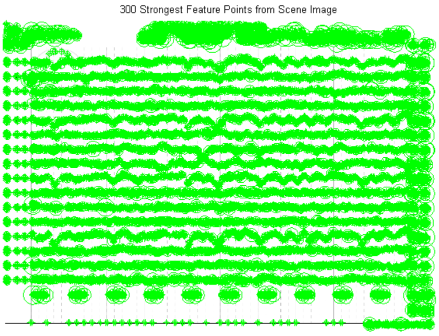


Figure of Feature points in Reference Image

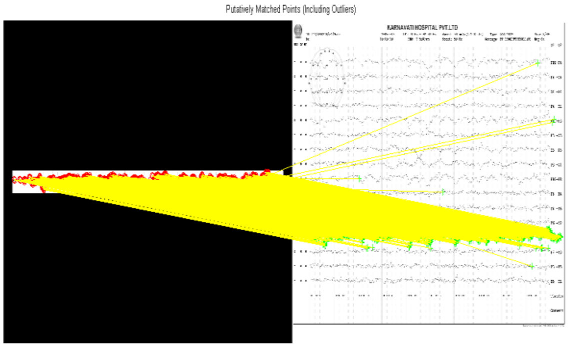


Figure of Feature Point Matching

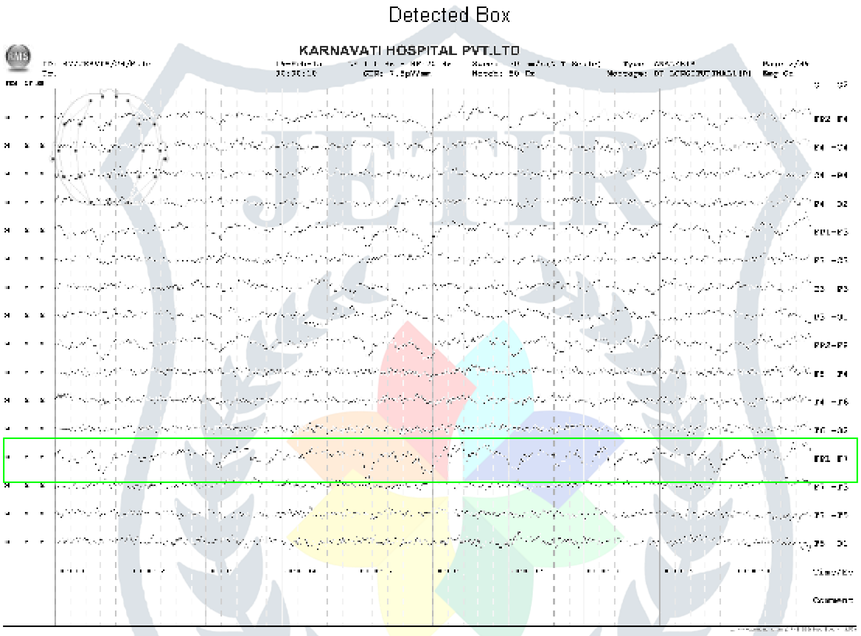


Figure of Matched EEG Signal detected

Conclusion

In this research paper we can see that by using SURF feature detection technique we can detect and matched normal waveforms from the EEG graph and separate the normal EEG graph and also detect the abnormal EEG waveforms from the EEG graph so this research paper also present a simulation based on this EEG graph which can provide a guideline for EEG interpretation.

References

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