Stress analysis of ECG signal by using PSD

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Abstract - This paper presents a method for analyzing Electrocardiogram to determine a driver's relative stress levels during real-world driving tasks. Electrocardiogram were recorded continuously during driving. The ECG signals under rest, highway and city condition are analyzed. Rest condition is considered as normal and city and highway condition is considered as high stress and medium stress respectively. The physionet database for ECG signal of drivers in different driving conditions. The PSD (power spectral density) for each signal normal, medium stress, high stress is obtained and considered for the present work and the parameters of the PSD are computed. It is shown that PSD of the ECG signal is able to provide good classification in normal and stressed condition of driver.

Keywords- real world driving task, electrocardiogram, stress, PSD**.**

I.   INTRODUCTION

Today use of electronics in cars is increasing, so that work for the drivers is increasing, we can say that frustration of drivers is increasing. To find out that frustration of driver during driving is very essential for intelligent driving system. To understand the frustration of drivers is the main area of intelligent driving system by the both government and industry [1]. Methods for calculating the work load of a driver is eye glance and on road matrix, but these technique is very costly and very difficult to obtain, and a another technique 15-s rule do not provide flexibility to account for changes in the driver's environment [3].In this study we show how the physiological signal (electrocardiogram) is used for analysis the internal state of the driver in natural driving condition. The experiment was designed for record the ECG signal in real driving condition. Performing the experiment in real driving situation indicate that results is more likely useful in these conditions. Historically stress is define as a reaction from a relax state to excited state. There are so many type of stress such as intellectual, emotional, and perceptual. Some researcher gives the classification of stress as another way first one is good stress and second one is bad stress, good stress can be define as a joy, we can say that such type stress which is benefit for our body, But in this paper we can use bad stress, stress with negative meaning, frustration of driver due to workload. This paper gives the stress estimation of driver by analyzing the physiological signal (electrocardiogram). Electrocardiogram gives the information about internal state of the driver because it is the electrical representation of movement of heart and they recorded during the driving without interfering the driver's work. So we can easily find out the movement of heart over complete period and by analysis the movement of heart over period of time we can easily find out the effect of stress. This information is used for various way to help the drivers. In high-stress situations, phone calls could be diverted so that it cannot increase the stress level and by using music we can reduce .In this paper we take PSD (power spectral density) for each signal and calculate the parameters of PSD graph for each signal and by analysis the variation of the parameters value we can easily take.

II.   METHODS AND MATERIALS

2.1. Driving Protocol

Stress cannot be created in open road so the route is planned in such a way that driver goes to different situations so that different type of stress is created. Driver take rest first after that go to city and after that highway, that different situations create stress of different levels normal medium stress high stress respectively. Route is set such a way that it shows the daily routine. In daily life person goes to office by moving through main city and highway. By this way we can easily understand the stress of normal person in daily life. For experiment driver should have a valid license. A map of route is given to driver and given some instructions such as keep the driving consistent and follow the speed limits and not listen the radio because listening the radio affect the value of stress, music can relax the person An observer sat in car for giving answer of any query of driver so that recoding of signal done in a proper way for quality recoding. Two 15 min rest periods is given .These rest period are used for normal data. In rest period driver sit on the chair with closed eye. After rest period driver goes to city where traffic is high so stress is high, we can say that it is the condition of the high stress after crossing the city driver goes on highway traffic on highway is less as compared to city so this situation is considered as a medium stress. Actually two rest periods is given first at starting and other at last.

III. DATA PROCESSING

3.1 Electrocardiogram.
Electrocardiogram is one of the physiological signal but use of electrocardiogram in analysis of stress is very limited. HRV (heart rate variability) is dominant parameters for analysis of stress .ECG is electrical representation of movement of heart over a period of time when electrodes placed on the chest .By analysis of ECG we can find out condition of heart and function of heart and we can easily find out the effect on heart such as heart beat and so on.

3.2 Feature Extraction
We used physionet database 'stress recognition in automobile drivers'. Total duration of complete signal is 81 min. First 15 min rest period is considered as a normal. After rest period driver goes to city where traffic is more so more stress on the driver so signal recoding of city is considered as high stress database. After the city driver come on highway where traffic is smooth as compare to city traffic so that amount of stress is low as compared to city stress, highway stress is considered as a med stress. We extracted the normal, med, high stress signal from the main database signal. We have three signal normal, med, high .We take PSD (power spectral density) of each signal such as normal, low stress, medium stress, high Stress. We calculate FFT of normal, medium, high signal and find out the frequency component of each signal with respect to amplitude. We calculate the parameters of a FFT of normal, medium, high stress signal.

IV. RESULT & DISCUSSION

PSD (power spectral density) for normal low stress, medium stress and high stress is show in fig 1. From the figure it is clear that all the frequency spectrum is centered at (0-1 Hz) frequency and amplitude in increasing order. The parameters (RMS, mean, median, min, kurtosis, Variance) are also extracted to differentiate for normal, med, high stress respectively.
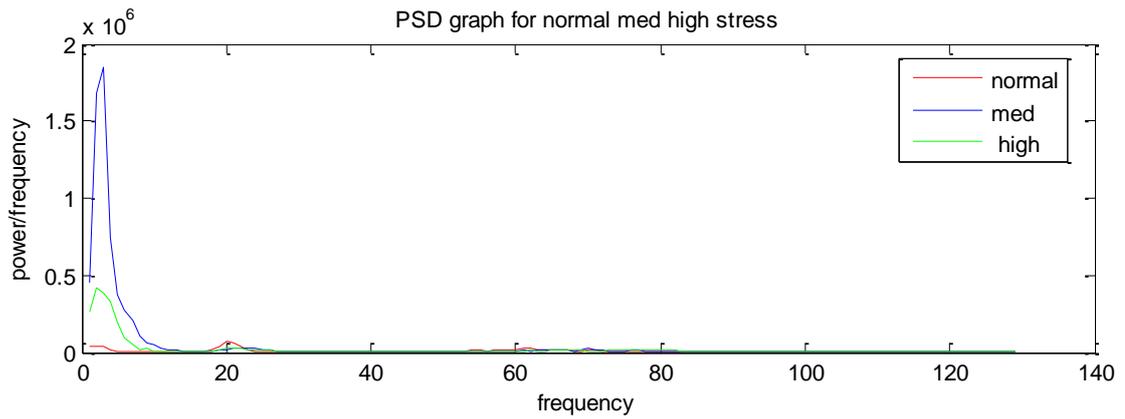
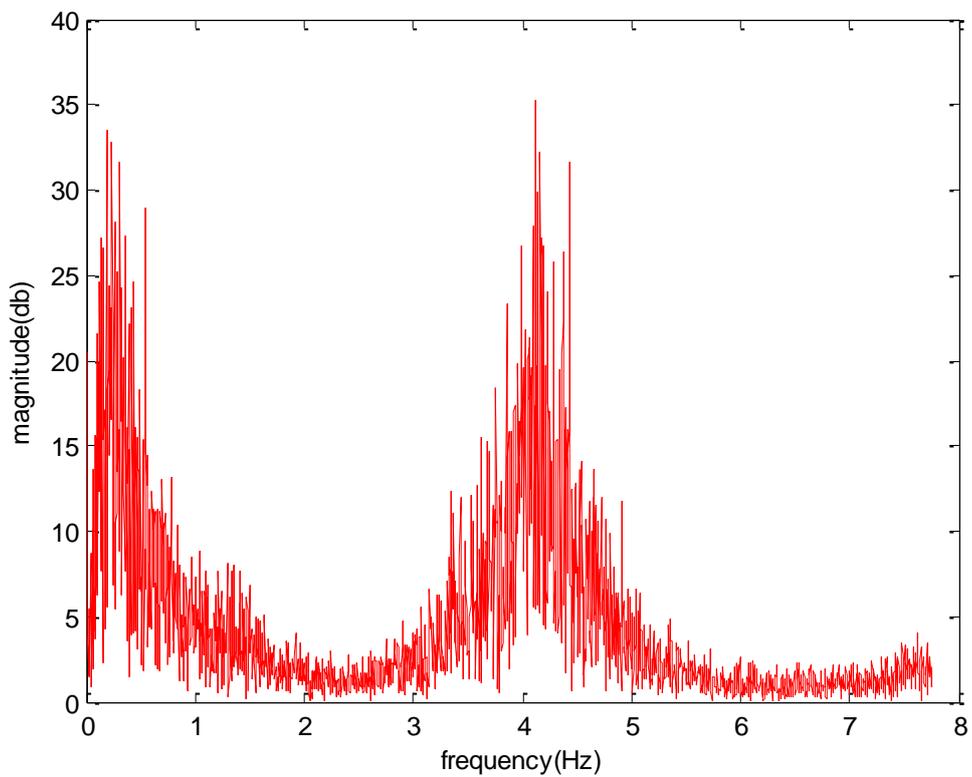***Figure1. PSD for Normal, medium stress, high stress subject***

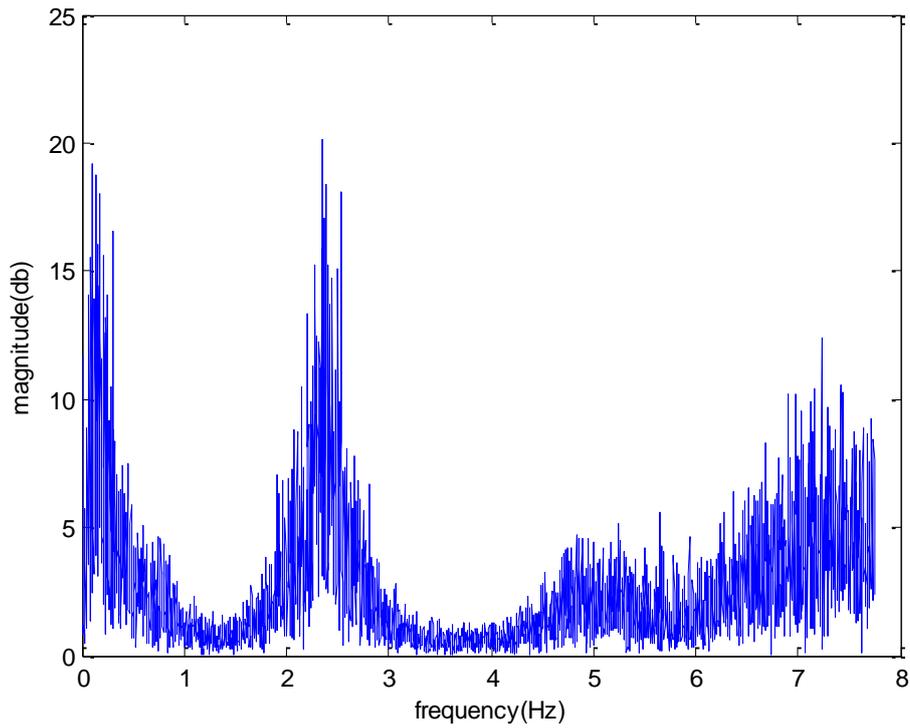***Figure2. FFT for Normal Subject***

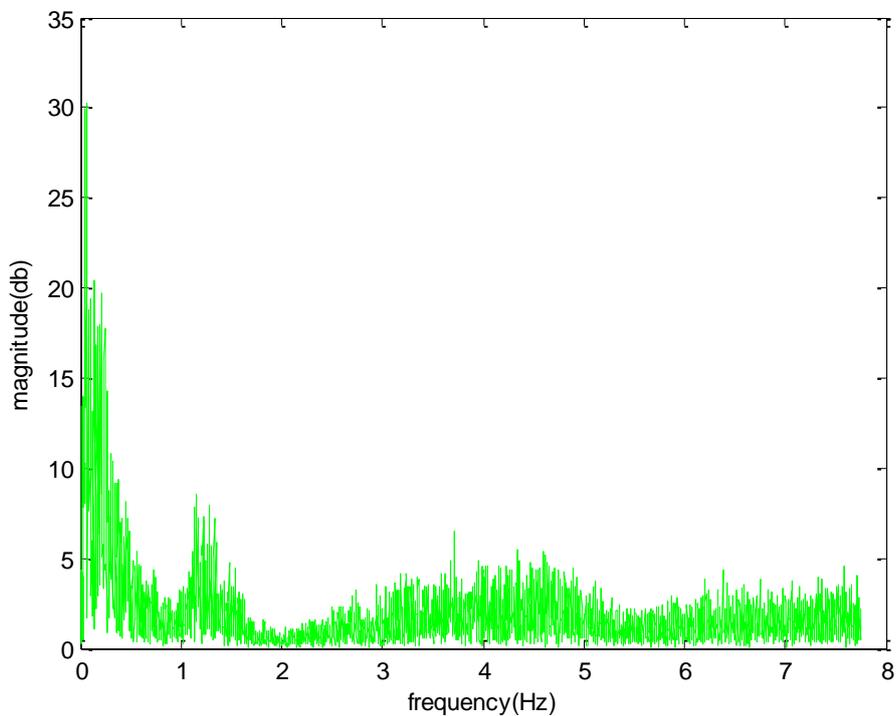*Figure3. FFT for the subject under medium stress (highway driving)*

Figure4. FFT for the highly stressed subject (city driving)

TABLE1. *Parameters of PSD graph for Normal, medium stress, high stressed*

Parameters	Normal	Medium Stress	High stress
RMS	6.83	3.68	2.86
Mean	4.39	2.62	1.89
Median	2.24	1.72	1.38
Min	0.04	0.02	0.010
Kurtosis	9.12	9.69	40.39
Variance	27.43	6.65	4.59

V.CONCLUSION

In this study we show the analysis of physiological signal (Electrocardiogram) for stress measurement of automobile driver. We used physionet database for ECG data of automobile drivers in real traffic situations and different stressed condition. 15 min rest periods is considered as a normal and signal of driving in city and highway considered as a high stress and medium stress respectively. We find out each signal for normal, medium stress, high stress from the complete database .We take PSD (power spectral density) for normal, med stress, high stress signals after that we take parameters for each signal. By analysis the parameters of each PSD graph we can easily find out that you are in stress on not and in which level of stress such as medium, high.

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