Development Biosignal Monitoring For Insomnia Using ECG Prediction

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Keywords: ECG; Insomnia; PSQI

ABSTRACT – Insomnia is the most common medical disorder found at young people and elderly. Prolonged sleep disorders will result in the biological sleep cycle changes, decreased body resistance and work performance, irritability, depression, lack of concentration, fatigue, which can ultimately affect the safety of self or others. The level of sleep disturbance is determined, commonly by using Pittburth Sleep Quality Index (PSQI) questionnaire on psychological and also Polysomnography for physiological measurement, which is a combination of EEG, EOG, EKG and so on. For that purpose, an electrocardiogram (ECG) instrument is used to record cardiac activity at any given time. In this research, we studied the relationship between PSQI questionnaire with the prototype ECG in sleep insomnia patients. The ECG measurements that show the electrical signal activity of the heart are used to diagnose and treat heart disease.

1. INTRODUCTION

1.1. Insomnia

The word "Insomnia" comes from Latin, "in" (not) and "somnus" (sleep), meaning is a disorder characterized by an inability to sleep or lack of sleep. It is described as the psychosomatic disorder by Johann Heinroth in 1818 which is clinically subjective perception of dissatisfaction with quantity and/or sleep quality [1]. Another definition says that Insomnia is dissatisfaction with the quantity or quality of sleep with one of the sleep difficulties, difficulty sleeping and waking up in the morning [2].

1.2. Insomnia Assesment

The Pittsburgh Sleep Quality Index (PSQI) is a self-rated questionnaire that assesses sleep quality and disturbances over a 1-month time interval. The PSQI aims to provide reliable, valid, and standardized sleep quality measures that distinguish between "good" and "bad" sleep, and aims to provide an easy-to-use index by subjects and clinicians and researchers to interpret and grade short clinical benefit to various sleep disorders that may affect sleep quality [3].

1.3. Electrocardiograph

The electrocardiograph at the beginning of its discovery in 1902 by Willem Einthoven was a major advance in the methods available to diagnose heart disease. [4]. Einthoven labeled P, Q, R, S, and T on electrical deflection images by concluding that each contraction has a different electrical deflection [5]. Therefore currently the ECG signal is divided into 5 recurrent electrical deflections, this signal which will provide information whether the heart is normal or has abnormalities.

2. METHODOLOGY

In this study, we designed the prototype of AT Mega microcontroller signal-biopotential monitoring system as a receiver of biopotential signals with the help of AD8232 Electrocardiographic module device with full integration of single-lead ECG with common-mode 80 dB rejection ratio using three electrode configurations.

The analysis of relationship between PSQI and biosignal from the heart is done on the subject by filling out the PSQI questionnaire to determine the severity of insomnia sleeping sickness. This questionnaire filling is done before the subject ECG measurement is done.

The subject's biopotential signals is recorded in several short RR periods. The biopotential signals will be compared with the PSQI results for the sought-after blindness of cardiac behavior with insomnia sleep abnormalities using features derived from RR intervals such as median, mean, inter quartile range (IQR) and standard deviation from RR interval changes based on some studies that have done before [6-9].

3. RESULT AND DISCUSSION

3.1. Data Reading on PSQI questionnaires

The PSQI questionnaire has seven assessment components related to sleep quality of the study subjects. The meaning of PSQI assessment per research subject is the higher the value the worse the quality per subject assessment that ranges from the value 0 to 3. The first component about the subject of sleep quality is worth 2 which means the subject of the study rate that the quality of sleep he felt was bad. Furthermore, the assessment component on sleep latency gets a value of 3 which means the sleep latency is very bad. The third component

is a sleep duration of 2 that indicates that the duration of sleep is bad. The fourth component of the efficacy of sleep habits, the subject gets a very bad value that is 3. Component fifth, step disorder, the subject got a value of 2 which means bad. The sixth component of the use of sleeping pills, the subjects use it almost every day then get a value of 3. The last component about daytime dysfunction gets a value of 2 because it gets into trouble when the activity that the subject is doing during the daytime. Overall the subjects scored 17 out of 21 points. Based on this assessment the subject had bad sleep quality.

3.2. Reviewing biopotential signals of the heart

The biopotential heart has been collected from the subject by using the ecg prototype . The prototype has detected the interval from the R peaks or the interval from R to R (RR interval). This RR interval can be used to determine for the number of heartbeats per minute. Then the statistical calculation of the RR interval also serves to obtain the characteristics of cardiac activity.

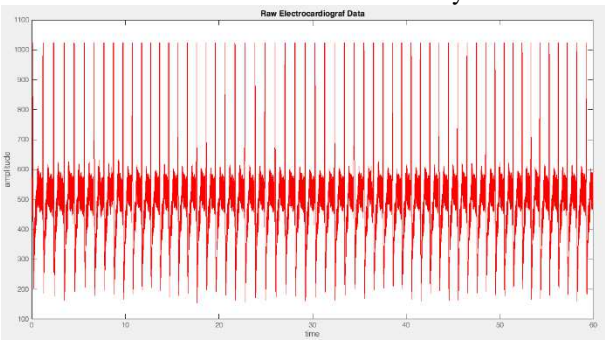

Figure 1 Raw ECG data from Heart biopotential

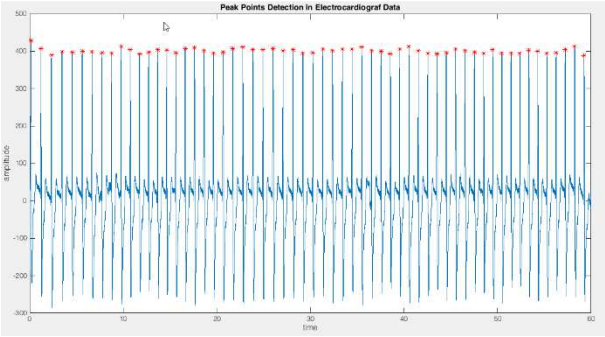

Figure 2 Interval RR peak detection

Based on the calculation of statistics on ECG data obtained, the average value of heart rate variability is 58.9741, then the standard deviation value in the whole RR interval is 0.04289, we can know that the value of Root Mean Square of the Successive Differences is 0.020088 with value NN50 is 1.

4. CONCLUSION

In this study, we studied the PSQI questionnaire with the prototype ECG that has been made to see the relationship between the two tests in sleep insomnia patients. We performed RR-based interval testing and then extraction from statistical calculations of ECG signals.

For further work, we plan to optimize performance and automation with the help of artificial intelligence to study the relationships between the two assessments.

ACKNOWLEDGEMENT

Authors are grateful to Kemenristekdikti for Grant Desentralised Skim 2018.

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