An Investigation of the ECG and PPG Signal Acquisition Analysis System

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Abstract—**The study is focus in investigation of the ECG and PPG signal acquisition analysis system. This is based on ECG signal and PPG signal as input. It records the blood flow produced by the subject. Heart rate variability compared to the same posture. It attempts to find out the correlation between the PPG signal and the ECG signal and analyze it.**

I. INTRODUCTION

Home health care medical equipment will show a high rate of demand and growth. It is again showing the future of people on the simple, functional and user-friendly medical equipment craving [1-3]. Current ECG (electrocardiogram) is one of the best indicators to assess physical health and cardiac function. Its biggest advantage is non-intrusive. Its waveform integrity is available to clinicians for clinical reference. So widely known and used by the public [4-7]. However, measuring ECG requires the use of conductive adhesive as a medium. It will be conductive electrodes attached to the chest, there must be no clothing barrier, and the measurement location is limited to the chest and hands. It is quite inconvenient for home care. In contrast, the light volume descriptor (PPG) is a signal sensed by light-sensing changes in blood pressure. It is less susceptible to power supply noise and electromagnetic interference. It can measure the location more convenient to wear. The same technique can be used to detect oxygen concentration. It is the greatest strength of PPG convenience for the growing home medical care.

II. ECG AND PPG SIGNAL

ECG measured heart rate is retained a considerable degree of heart rate variability. It is called heart rate variability (HRV). Heart rate variability is affected by respiratory, blood pressure, exercise, sleep, disease, drugs and other factors. Among them, blood pressure is an important regulator of heart rate variability. Basically, heart rate variability can reflect autonomic neural activity in vivo. It is a popular study in nearly four decades. Scholars have also found that many areas and closely related heart rate variability. For example, patients with myocardial infarction. If the heart rate variability becomes smaller, the prognosis is usually worse. The signal of PPG comes from the change of peripheral blood flow of fingertip. Therefore, the measured changes and heart rate variability are closely related.

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III. EXPERIMENT

The whole system is to use PPG to assist with ECG. It is more convenient to achieve the measurement results. Therefore, this study is based on ECG signal and PPG signal as input. It records the blood flow produced by the subject. Heart rate variability compared to the same posture. It attempts to find out the correlation between the PPG signal and the ECG signal and analyze it. System investigated whether PPG signals can replace ECG. It is looking forward to the future to measure the end of the finger advantage. It will replace the inconvenience of ECG measurement. The arduino leonardo microcontroller module pin design is shown in Fig 1.

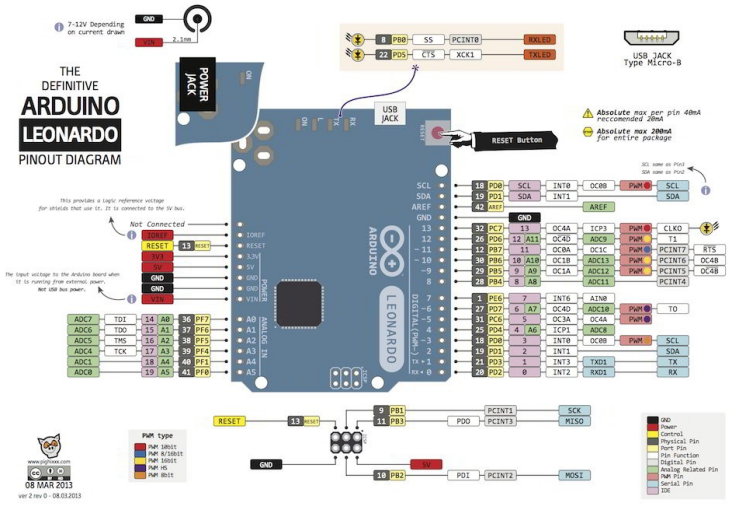

Fig. 1 Arduino leonardo microcontroller module pin

IV. RESULTS

This detection system is a transmission sensor. Infrared emitted by the LED will pass through the finger tissue. It is received by the receiver below. When the infrared light is projected onto the skin, it shows the degree to which the white and red blood cells in the blood absorb light to a different degree. This study is a microprocessor system that integrates medical sensing patches for instant bluetooth wireless transmission to smartphone systems as shown in Fig.2 and Fig.3. It is the real imitation of limb control man-machine interface system. This system is a disable for the benefit of people with different disabilities and designs special handicapped aids for their needs.

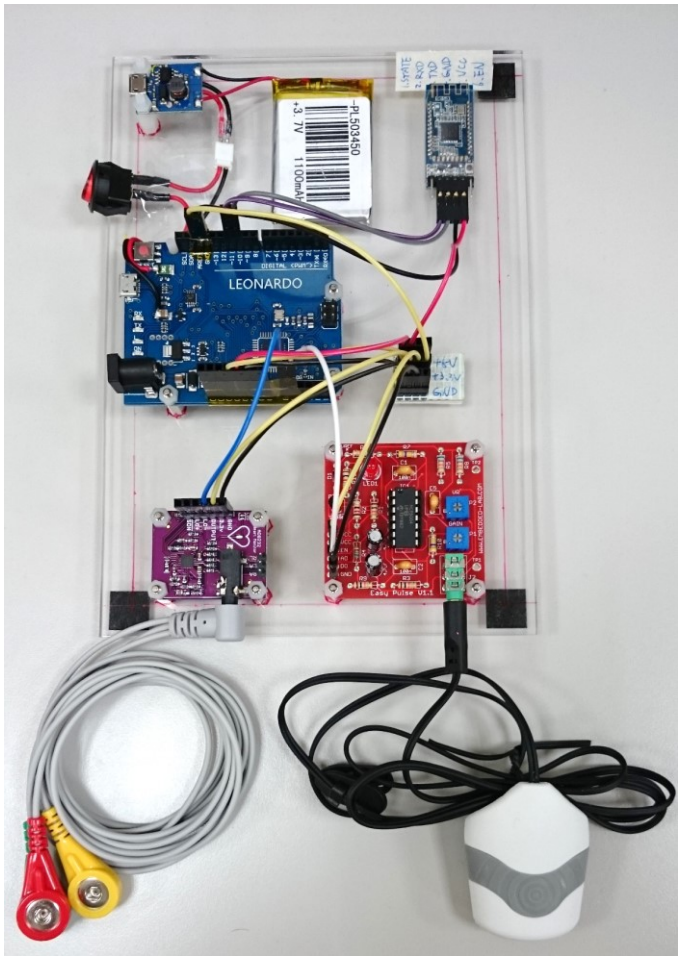

Fig. 2 ECG & PPG signal acquisition device

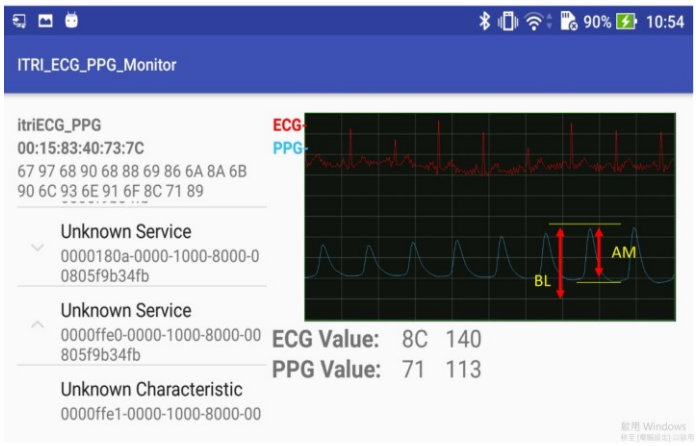

Fig. 3 ECG & PPG signal

PPG signal is the use of optical sensors to measure changes in the diameter of the human distal microvascular. It has the advantage of being non-intrusive and easy to measure. The disadvantage is that it is susceptible to external noise disturbing its waveform. In addition, body temperature can affect the state of the surrounding blood vessels. If the body temperature changes too much, PPG accuracy will be reduced. For patients with vascular sclerosis, it although the changes in the diameter of blood vessels less obvious. However, the PPG waveform can still be measured as a reference. The maximum amplitude of AM appears due to the increased blood volume of the tissue as a result of systolic blood flow; whereas BL is related to the volume of arterial blood but inversely related to the blood volume of the tissue, the maximum amplitude of BL appears at the end-diastolic volume.

V. Conclusion

This research has been completed ECG and PPG Signal Acquisition Analysis System. It attempts to find out the correlation between the PPG signal and the ECG signal and analyze it. System investigated PPG signals can replace ECG. It is looking forward to the future to measure the end of the finger advantage.

5.Acknowledgment

The authors acknowledge financial supports of MOST 106-2221-E-151 -051.

Examples of Reference Styles

[1] Drew A. Birrenkott; Marco A. F. Pimentel; Peter J. Watkinson; David A. Clifton,“Robust estimation of respiratory rate via ECG- and PPG-derived respiratory quality indices”,2016 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBC),Pages: 676 – 679(2016).

[2] Vidhya V; Deepa Unnikrishnan,”Synthetic ECG and PPG signal generation using pulse shaping technique”,2015 Annual IEEE India Conference (INDICON),Pages: 1 – 6(2015).

[3] S. Sree Niranjanaa Bose; C. Santhosh Kumar,”Improving the performance of continuous non-invasive estimation of blood pressure using ECG and PPG”,2015 Annual IEEE India Conference (INDICON),Pages: 1 – 5(2015)

[4] D. Narayana Dutt; S. Shruthi,”Digital processing of ECG and PPG signals for study of arterial parameters for cardiovascular risk assessment”,2015 International Conference on Communications and Signal Processing (ICCSP),Pages: 1506 – 1510(2015).

[5] Ajay Verma; Sergio Cabrera; Allan Mayorga; Homer Nazeran,”A Robust Algorithm for Derivation of Heart Rate Variability Spectra from ECG and PPG Signals”,2013 29th Southern Biomedical Engineering Conference,Pages: 35 – 36(2013).

[6] K. Venu Madhav; M. Raghuram; E. Hari Krishna; Nagarjuna Reddy Komalla; K. Ashoka Reddy,”Extraction of respiratory activity from ECG and PPG signals using vector autoregressive model”,2012 IEEE International Symposium on Medical Measurements and Applications Proceedings,Pages: 1 – 4(2012).

[7] P. Manimegalai; Delpha Jacob; K. Thanushkodi,”Estimation of cardiovascular parameters from ECG and PPG signals”,2012 38th Annual Northeast Bioengineering Conference (NEBEC),Pages: 237 – 238(2012).