WiP Abstract: Accurately Measuring Heartrate using Smart Watch

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I. INTRODUCTION

According to American Heart Association, cardiovascular disease is the leading cause of death in the United States, accounting for 17.3 million deaths per year [1]. It is mandatory that cardiovascular disease patients live a healthy lifestyle but it is also important that they pay close attention to their heartrate since monitoring their heartrate can help predict incoming cardiovascular events. For example, continuous elevation of his or her heartrate may lead to critical conditions such as endothelial dysfunction, atherosclerotic plaque development, and arrhythmia [2], [3].

Many efforts are made to help monitor heartrate by using smart wearable devices. However, these devices project inaccurate readings due to motion artifacts. Therefore, we evaluate existing smart watches and develop an algorithm that adjusts heartrate readings to match up with clinical standards. It is important to note that we plan to make this algorithm as a module or component to use in various applications. In this paper, we survey existing techniques for monitoring heartrate, present how far we have progressed with this study, and discuss our future research directions.

II. EXISTING TECHNIQUES

Heart rate monitoring devices and techniques have been innovated through many years. A number of existing devices utilizes well-known heartrate monitoring approaches such as Electrocardiogram (ECG) and Photoplethysmography (PPG) based sensing techniques. The ECG techniques is commonly used for chest strap sensors such as QardioCore. This technique captures sino atrial node electrical impulse to measure heartrate. The PPG technique has been commonly utilized in recently commercialized smart watches, which are now equipped with heartrate sensors. This method uses a combination of green, red, or infrared (IR) LED emitters and optical sensor to measure heartbeat. When the emitters emit light to the skin, blood under the skin absorbs the light and the optical sensor measures the changes in light absorption. With a given heartrate monitoring capable hardware, users can observe daily heartrate on smart phone or smart watch applications.

III. IMPLEMENTATION AND FUTURE WORK

We specifically choose to use the Apple Watch and the Galaxy Gear to compare their accuracy to existing clinical heartrate monitoring systems. As our first step in running this evaluation, we develop a measurement logging application with the Apple Watch. Our implementation uses the Swift language for iOS. With the help of the Health Kit library, we access the heart rate sensor and collect heartbeats per minute (BPM) information. With this, we display the BPM data on the surface of the Apple Watch as shown on Figure 1. This application utilizes the green LED to detect heartbeats and stores information to the memory.

As part of our future work, we plan to also collect BPM information on the Galaxy Gear and compare the logged BPM information from both watches to ground truth clinical devices. In order to provide accurate heartrate monitoring approach, we plan to design our own filtering algorithm. The algorithm will be validated with real hospital, clinical-scale devices to improve the quality of disease detection on wearable devices.

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