The University of Manchester

Development of medical bracelet measuring heart rate and producing an ECG

Third Year Individual Project – Final Report

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1. Introduction

Portable medical devices are becoming more popular these days due to the revolutionization of this industry. Sensors that can measure the heart rate or produce an electrocardiograph (ECG) have not only become more accurate but also smaller. These are incorporated in wearable devices enabling people to track their own vital measurements in real-time. As a result, regular meetings in the doctor are avoided and heart abnormalities can be detected instantly leading to prompt treatment.

Undoubtedly, the advancement in medical devices should be accessible to all people regardless of age, technological literacy or financial background. That is because the data acquired by these devices are critical for everyone to stay healthy and diminish the possibility of a fatal incident. However, the latest portable medical devices, in the form of a bracelet mostly, discourage a wide range of people from using them due to increased complexity and cost or due to limited functionality of communicating data to a doctor in real time.

More specifically, some devices require connection to a nearby smart device, such as a smartphone or a tablet. These gadgets are the only way to collect the recorded data and display them for analysis and detection of potential flaws. This feature already restricts many categories of people to have their vital data measured due to limited abilities using technological equipment. There is a high possibility that the ones affected the most are old people who most of the times do not possess one of the smart devices. Ironically, they are the ones who need these devices the most, as the measurements of heart rate and ECG need to be monitored constantly so that dangerous situations can be dealt with immediately.

As it is understood taking real time and continuous measurements is the most essential feature that these devices need to incorporate. Also, the communication of these data to a specialist, such as a cardiologist, is critical so that the correct interpretation of the results can be guaranteed and prevention of undesired incidents is ensured. All of these characteristics are partially or not at all included in the medical bracelets in the market, as they pose challenges in battery life and most of all cost.

The increasing cost of development of such devices is reflected on the high selling price. It is a fact that a lot of people are not able to afford prices that start from £80

and can reach the level of £500. Hence, it is understood that there are numerous challenges to be overcome in the development of medical bracelets.

The aim of this project is to develop a low-cost medical bracelet which measures the heart rate and the electrical activity of the heart continuously, in real time and can be used without requiring a connected smart device. The communication of data will be implemented through direct Wi-Fi to a cloud and the results will be displayed in a webpage and an app. These two streams of displaying information will be used by doctors to track the condition of their patients and detect abnormal activity. As a result, they will be able to contact them directly and instruct them on which steps to follow.

The main objectives of the project are directly related to the features that the medical bracelet will incorporate. These include:

- Measurement of heart rate in BPM using a low-power heart rate sensor
- Measurement of the heart's electrical activity using a low-power ECG sensor
- Communication of the above data to a cloud through direct Wi-Fi
- Display of the data on a webpage and an app in real time
- Development of app interface for doctors and patients

In order for the above to be achieved, a series of methods is followed. As a first step, testing of different sensors for heart rate and ECG is performed in order to select the ones which provide the best trade-off between cost, accuracy and size. Furthermore, the available options in Wi-Fi modules are assessed in terms of cost, speed and power consumption. A design of the overall circuit on a prototyping board follows which integrates the mentioned components with the rest of the elements such as the microcontroller and the battery. After that step is completed, the PCB is designed to maximise the performance of the circuit and improve the communication of data between the individual components.

The successful implementation of the PCB progresses the project to the software development part. During this phase, the cloud is optimized to receive the data from the Wi-Fi module. Following this, the webpage and the app are designed to collect the information and display them in a user-friendly way. Finally, an early completion of the above would allow for the 3D-printed design of the bracelet to be used with the

system, otherwise an available one in the market will be used.

This report concludes the Final Year Project and summarizes the work undertaken on planning, designing and implementing the low-cost medical bracelet. First, some statistical figures related to fatal incidents from heart attacks or strokes prove the need for this device. After that, the advantages and disadvantages of state-of-the-art are thoroughly examined and the novel features of the proposed technology are pointed out. Finally, the technical details of the project are presented and a discussion of the results is included, assessing whether the project has been successful in accomplishing the main aim.