USING SMART WEARABLES TO IDENTIFY PATIENTS AT RISK OF FALLS

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SUMMARY

Falls are a major burden on society, with approximately one third of people aged over 65 falling each year. They cause minor injuries, fractures, and increase mortality. One of the causes of falls is orthostatic hypotension, which is an overly large drop in blood pressure (BP) occurring shortly after standing up. This is particularly common in the elderly, whose automatic reflexes for maintaining a constant BP during changes in posture are impaired. The aim of this project is to develop a technique for use with smart wearables to identify substantial drops in BP, which are indicative of OH. If successful, this technique could be implemented in fitness bands and smart watches, and used to identify individuals exhibiting signs of OH, and therefore at increased risk of falls. In the community, individuals could then take steps to reduce their risk of falls, such as drinking more water. In the healthcare setting, this could prompt healthcare providers to monitor those at increased risk more closely.

1. INTRODUCTION

People aged over 65 are at an increased risk of falls, which result in increased morbidity, mortality and healthcare costs [1]. One of the possible causes of falls is orthostatic hypotension (OH), which is the reduction in blood pressure (BP) due to gravity causing blood to pool in the lower body when standing up. In health the body’s reflexes compensate for the effect of gravity by increasing heart rate and cardiac contractility when a person stands up, thus restoring the BP to normal values. OH is defined as a drop in systolic (or diastolic) blood pressure (BP) of at least 20 (or 10) mmHg within the three minutes after standing up [2]. It has been found to be a risk factor for falls [3]. It can be accompanied by symptoms such as lightheadedness and vision problems [3], and is more common in the elderly whose autonomic reflexes are impaired. There are several strategies for alleviating the risk of falls due to OH, including increasing BP through drinking water or muscle contraction [4]. However, currently it is difficult to identify when individuals may be at increased risk of falls due to OH as it requires continuous BP measurement.

The proliferation of smart wearables provides a new opportunity to identify people who suffer from OH, and may therefore be at increased risk of falls. Wearables such as fitness bands and smart watches currently measure the arterial pulse wave to monitor heart rate. The shape of the pulse wave is influenced by BP. Consequently, it may be possible to derive indicators of rapid drops in BP indicative of OH from smart wearables. If successful, this approach could be used to notify individuals at increased risk of falls, and prompt them to reduce their risk accordingly. It may also be useful to healthcare providers who could ensure that patients identified as being at increased risk of falls are monitored more closely.

The aim of this project is to determine whether there are changes in the pulse wave which are indicative of a large drop in BP after standing up, which could be used to identify occurrences of OH. This will be performed using a database containing peripheral pulse waves and reference BP values acquired during slow and fast postural changes.

2. METHODS

The Physiologic Response to Changes in Posture dataset will be used for this project [5, 6]. It contains BP signals recorded from 10 healthy subjects. The signals were recorded whilst subjects performed a series of tilt-tests in which they moved from lying down to standing in a controlled manner. The BP signals will be used for two purposes. Firstly, the shape of the individual pulse waves will be analysed using in-house Matlab code to extract possible indicators of drops in BP. Secondly, reference BP values will be extracted from the BP signals with which to assess the performance of the extracted indicators of BP drops. The performance of the indicators will be assessed using statistical techniques.

3. OUTCOMES

In addition to the core outcomes of the Summer Research Module, it is hoped that the student will submit a paper on their work to the 6th International Conference on Sensors and Applications. This will provide the student with valuable experience in disseminating their work to the wider scientific community.

4. RECOMMENDED READING

The following publications are recommended reading, and should form the basis of the literature review:

- The clinical importance and physiology of orthostatic hypotension: [7, 4, 8, 9]
- The association between orthostatic hypotension and falls: [10, 3]
• Analysing arterial pulse waves:
• Haemodynamic effects of changes in posture: [11]
• Detecting changes in posture from the pulse wave: [12, 13]
• The role of wearable sensors: [14, 15]

5. REFERENCES


