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**Mobile Phone based Fall Detection and Monitoring**

**Introduction**

Approximately 30 percent of people over 65 years of age and living in the community fall each year and 20 percent of these incidents require medical attention [1]. With the advent of smartphones and other mobile technologies more methods for remote healthcare have become apparent. The ease of access to technology that can assist the person in the event of a fall or other accident or alert caregivers has increased exponentially. Independent living for the disabled is no longer a large concern for families with unattended disabled persons. Our group is researching an effective way to develop a mobile android application that can monitor disabled persons and send that data to a central database. Since smartphone ownership has greatly increased, this app can be easily installed and maintained. Our ultimate goal is to develop an efficient mobile app that can detect possible falling incidents and accurately monitor the users’ status.

**Motivation**

With the recent surge of easily accessible mobile computing, the ability to care for disabled persons living on their own is becoming easier and cheaper. This application will use the efficient method to measure the walk speed and detect the fall. If something happens, the application will send the message to let the hospital and their family know. Also, this application will allow these elder to be home safely and continue their daily activities without using more money to hire the healthcare professional to stay with.

**Related Work**

One approach to fall detection used a small device that had two axes of acceleration, one detecting vertical speed and the other detecting in an anterior-posterior axis (front to back). This device was worn on the hip and its position was kept constant. Test falls showed that acceleration values fluctuated at a constant pace while walking but experienced a heavy drop into negative levels at the moment of a fall. The system recalibrates regularly to check for false positives and gather the most accurate data. [2]

Another approach used a Galaxy SII android device and a fall detection app that utilized the phone’s gyroscope, accelerometer, and magnetometer. The application implemented an –-algorithm that made use of the acceleration sum vector. If the sum vector is greater than a certain value, and impact is detected. If the sensor detects that the orientation of the phone is vertical before the impact and horizontal after impact. After a possible fall is detected the device emits an alarm which waits for user input. If the alarm is not stopped they are assumed to be unconscious and an alert is sent to the designated caregivers of the user. The application features two main features, a stop alarm screen that displays on fall detection, and a settings screen to toggle the various features such as sensor usage, the ability to run in the background, and an area to input the caregiver’s number. [3]

**Proposed Approach**

We will be using our mobile devices, Android phones and tablets using java, to acquire a person’s current moving speed, whether or not they fall, and if they are in need of assistance through long term monitoring. To determine speeds and a user’s change of direction, we will use the phones built in gyroscope and accelerometer. With these pieces of hardware it will be easy to obtain the data necessary for our cause. To do this we will use equations found in some of our articles to determine whether or not a sudden change of speed can be recognized as a fall. Euclidean vectors are a great way to determine this and whether or not the fall has occurred. However, in one of the former team’s projects the fact of recalibrating the mobile devices accelerometer and gyroscope was brought up and is a very important issue. The easiest way to make sure you are correctly calibrated is to make sure the acceleration of the phone is the same as gravity when the person is not moving in any direction. Another piece of potentially useful hardware is the GPS. Though the GPS is known to be heavy on the battery, we believe that with our approach of turning the GPS on and off we can help to alleviate some of this battery drain. The GPS will be used to determine the location of the person if an accident occurs and how fast they are currently moving. Being able to recognize when someone is not moving is a very important step for our application. When this occurs the persons GPS location will be saved, a check for fall or issue will happen, and finally hardware will be recalibrated. If the GPS proves to be too much on the battery life of the mobile device then a far more complex approach must be taken. We must measure the person's gait through the movement of the phone while in their pocket. From there we must find a way to determine the speed judging by length of stride and the movement of the speed of the phone. A lot of this type of monitoring was done in the earlier projects and will be closely related and drawn from the ideas there. This is not our go to method of determining moving speed due to the fact that a person does not always have their phone in their pocket due to the fact that a phones primary use is to text or make calls while on the go. [2]

**Evaluation**

We will begin by testing the user’s health conditions by using a treadmill to measure their gait while walking and running. We will also simulate falling by detecting the gravitational forces that occur by dropping android devices to see the actions that occur while falling. This will help us test all the different ways of falling, like tripping forward, falling backwards and falling to the sides. We will then test the differences between a user falling, bending over, or lying down.  We will also test the user’s movement by using a GPS device for an extended period of time to compare their usual movements with unusual movements. While doing these tests, we will try to get accurate results to predict when falling or health issues may occur and send data to the server to request assistance before fatal health conditions occur.

**References**

1. World Health Organization. Global report on falls prevention in older age. [<http://www.who.int/ageing/publications/Falls_prevention7March.pdf>]
2. J. Boyle and M. Karunanithi, *Simulated Fall Detection via Accelerometers,* l IEEE EMBS Conference, Vancouver Canada, August 2008
3. Chiari, Lorenzo, “Smartphone-based slutions for fall detection and prevention: the FARSEEING approach.” *Academia.edu,* Web. 12 February 2014. http://www.academia.edu/2207551/Smartphone-based\_solutions\_for\_fall\_detection\_and\_prevention\_the\_FARSEEING\_approach