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Fall Detection with Live Tracking Mechanism for the Elderly

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Abstract: According to the World Health Organization, Falls are the second leading cause for accidental, unintentional injury of deaths worldwide. Fall-related injuries can thus be prevented or reduced with the help of a fall reduction system. Hence, the quality of life of elderly people can be monitored and improved with the help of automatic fall detection systems. The detection of the fall is also an interesting scientific problem as it is an ill-defined process which one can approach to using various methods. The system consist of two major components namely a wearable device and an android cell phone. The wearable device detects a fall, it then sends an alert to the cell phone, and then the cell phone alerts the emergency contacts provided by the user. Along with this, our system has a panic button that can be used by the user in case he/she is unable to take care of themselves and needs immediate help. There is an interrupt button too which can be used by the user if he/she is alright and doesn't want an alert to be sent to the emergency contacts.
Keyword: Fall detection, wearable device, Android Cell phones, panic button, interrupt button

I. INTRODUCTION

Falls are famous among the external causes of unintentional injury. In the World Health Organization that include a variety of falls along with those on the same level, upper level, and other unspecified falls. Falls are usually defined as "accidentally coming to rest on the ground, floor or other lower level, excluding intentional change in the position to rest on the furniture, wall or a variety of objects"

.Falls are the second leading cause of death by accidental or unintentional injuries. Worldwide around 424,000 people die due to fatal fall related injuries. Out of this number, the ones who suffer fatal falls more often are the elderly people over 65 years . But how can we know if an older adult has fallen down? This would be an unanswered question then, but now this question has a fine solution. Nowadays, most elderly people have a cell phone in case of emergency. Therefore, how can we design a solution involving technology when most elderly people have problems adapting to such technologies? This paper presents a fall detection system for the elderly which can be used without much difficulties. A wearable device that detects, using an accelerometer, if the user has suffered a fall and a mobile application that automatically alters the predetermined number in case of emergency. The main advantage of the proposed system is that it does not require the person to carry the cell phone everywhere since the fall detection is carried out with the help of a wearable device. Therefore, the mobile phone can be located in any place in the house. Therefore, this project measures the acceleration in 2-axis (x and y axis which is divided into x-p, x-m, y-p, y-m) as well as the angular position of the wearable device. If a position threshold is achieved, a fall has been detected and the emergency protocol is activated. Our paper consists of six sections, with each section explaining about various aspects of our paper, starting from the introduction to the references.

II. RELATED WORK

The main objective of a fall detection system is to differentiate between fall, events and activities of daily living (ADL). This is never an easy task as certain ADL, like sitting down or bending down to pick up something from the floor or even lying down from standing position can resemble a fall. The following contains various studies and works on the fall detection system. In the year 2011, Lai et al made a study on several acceleration sensors for joint sensing fall events. It was based on TBM, to differentiate dynamic/static states using the acceleration of the three axis. The fall types were: Forward, backward, rightward or leftward falls. It was tested on 16 subjects. The accuracy rate was 92.92%. It could be worn on the neck, hand, waist, foot. In 2013, Ching et al made a study on Daily activity monitoring and fall detection. It was based on TBM using a decision tree:

A. A decision tree is applied to the angles of all the body postures to recognize posture transition

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B. the impact magnitude is thresholded to detect the fall. It includes four types of falls: from standing to face-up lying, face-down lying, left-side lying, and right-side lying Dynamic gait activities are also identified using Hidden Markov Models.

And now, in 2018, along with the fall detection using the accelerometer, we have also included a voice playback kit which will help the user with his/ her tablet timings and whenever the user has pressed the panic button the voice playback kit will inform the user that an alert has been sent to the guardian and suppose the person doesn't know which button to press if he/ she is alright after a fall, the voice playback kit will play a voice informing the user regarding the button.

III. PROPOSED WORK

A. Block diagram

The block diagram consist of a Bluetooth module in order to communicate with the application. It also consists of a battery, an accelerometer sensor which is connected to the comparator for the axial movement measurements, a panic button that is used for normal emergencies, an interrupt button for stopping the application to send any sort of text message to the guardian or the emergency unit in case of a false alarm or if he/she is alright and a voice playback kit that guides the user with his/her medicinal habits and also helps him/her know what button to press according to his/her needs. Whenever the application is started in the cell phone, the wearable device connects to it.

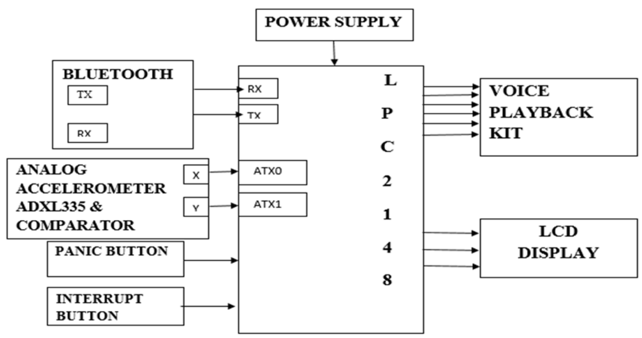
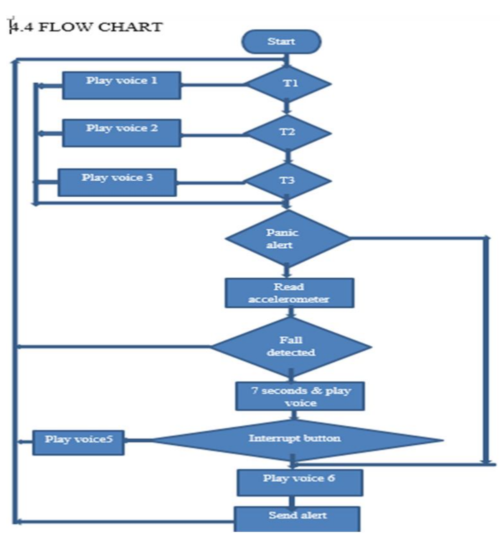


Fig 4.1 Block diagram

Fig.1 Block Diagram

The moment the mobile application receives a request for sending an alert from the wearable device indicating a fall detected. It then alerts to the guardian or the emergency unit indicating that the person has fallen or he/she is asking for help. In case the person wants to cancel the alert being sent, he/she can press the interrupt button. If this is the case then the mobile application will return to it listening state .The voice playback kit is connected to the Port 1 of the arm controller, it is also provided with 8V power supply, which will later be converted to 5V. It is the same with the case of accelerometer.

B. Flowchart



When the device is started, it goes through several loops. If time=T1 is true then, the voice playback kit will play the respective voice that has been already stored in it. If time =T1 is false then, the device will then do its next job, ie.,, it checks if the time=T2, if it is true then the voice playback kit will play the respective voice informing the user his/her tablet timings and suppose it is not true, then the device will check if it is time=T, if it is true then the voice playback kit will play the necessary voice informing the user his/her medicinal habit.

Suppose it is not true, then the device will then check if the panic button is pressed, if the panic button is pressed, then ,The voice play back kit will play voice 6 which informs the user that an alert will be sent to the guardian or the emergency unit. If the panic button is not pressed, then the device will read the accelerometer to find out if a fall has occurred. If the fall is detected, then the device will wait for 7seconds to play voice 4 which informs the user to press the interrupt button if he/she is alright, If the interrupt button is pressed within 7seconds of the given time then the device will play voice 6 which informs the user that an alert will be sent to the guardian or the emergency unit in the form of a text message. After sending the alert, the device will repeat this cycle infinite amount of time. This can be achieved in the code by using the while (1) loop. In the meanwhile, the various medicinal habits of the user that is stored in the device and recorded in the voice play back kit will also take place during the respective time slots.

IV. SOFTWARE REQUIREMENTS

A. Programming necessity manages all the product or portable application utilized as a part of the project, and programming plays an important part.
B. An assembler is used to assemble the arm controller’s assembly language to the .hex file.
C. The compiler that we are using is Keil micro vision 4. The programming language is Embedded-C.
D. The size of the code is about 6Khz.
E. The programming tool being used is LPC2000 Flash Utility V.2.2.3For the app we used Android Studio 2.3.
F. Front end design is done using XML and the back end operation is done using java.
G. To have a database to store the GPS in the cloud server, we use my SQL.
H. The script to access the database from the cloud server is PHP(Hypertext pre-processor)

V. EXPERIMENTAL RESULTS

Whenever the user will fall, the wearable device will detect the fall and then after certain period of time say about 7 seconds, send an alert to the guardian. The guardian will then check his app to find out and track the location of the elderly person. The Voice play back kit will also play certain voices at certain periods of time to indicate the medicinal habits of the elderly person through the speaker that is provided in the wearable device. This is indicated in the Fig 3

Fig.2 Wearable Device

This section presents the experimental setup and the results of this project. Once the mobile application i.e.., the user app receives a request for message from the wearable device indicating a fall, it dials or messages to the emergency contacts indicating that the person has fallen, he or she is in need of help . But in case the elderly person is able to manage the situation , and he doesn’t want an alert to be sent, then the elderly person can press the blue button on the wearable device. Then an alert will not be sent to the guardian.

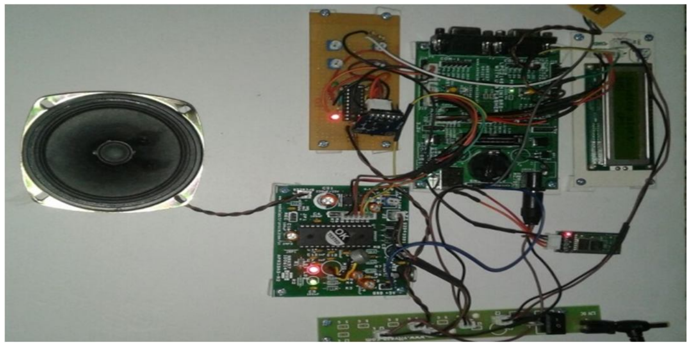
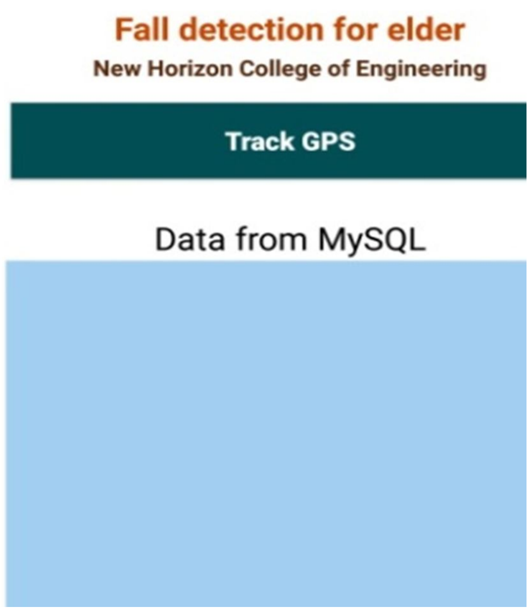
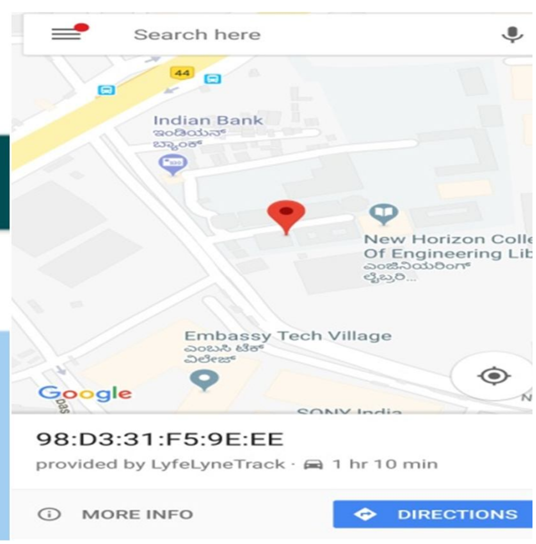


Fig.3. Experimental Results



This is the guardian app which will be installed in the guardian's android phone. Once the guardian will receive an alert from the user stating he / she has fallen or he/she is not feeling alright and wants to be monitored, then the guardian can check this app on his/her phone and track the location of the older person instantly by just clicking on thr address present on the guardian app because of live tracking mechanism that is installed in this device and app.The user app can also be used to just check the messages that have been delivered because it will be saved in the user app.



VI. CONCLUSION AND FUTURE SCOPE

The fall detection system for the older people was developed to detect sideway falls, backward and forward falls with a great accuracy. It is of a great help to those older people who are not monitored throughout. Future scope involves including airbags in the device which will inflate whenever a fall is detected and this will easily prevent any sort of injuries, but care should be taken such that the wearable device doesn't get bulky. If at all the older person is not able to press the panic button, the device should sense that the older person is not in a healthy condition and automatically alert the guardian. The wearable device should automatically play music or any video on the user's phone whenever it is requested of the device, it should also make calls to anybody from the user's phone as requested by the user. The accuracy should also be increased to about 100%.

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