SURVEY PAPER

Fall Detection System for the Elderly

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ABSTRACT

According with the World Health Organization, Falls are the second leading cause of accidental or unintentional injury deaths worldwide. Adults older than 65 suffer the greatest number of fatal falls. Therefore, the quality of life of older people can be improved by using automatic fall detection systems. This paper presents a fall detection system that monitors in real-time an older adult. The system defines two major components: a wearable device and a cell phone. The wearable has the capability of communicating with a cell phone can be located in a 100ft radius. Once, the wearable device detects a fall, it sends an alert to the cell phone; then the cell phone alerts to the emergency contacts defined by the user. The main idea is to avoid the need of carrying the cell phone every time. In addition, our system has a panic button that can be used in order to alert the emergency contacts in the event that the user feels that a fall may happen..

INTRODUCTION

A fall is defined as an event which results in a person coming to rest inadvertently on the ground or floor or other lower level. Fall-related injuries may be fatal or non-fatal though most are non-fatal. Over 80% of fall-related fatalities occur in low- and middle-income countries, with regions of the Western Pacific and South East Asia accounting for 60% of these deaths. In all regions of the world, death rates are highest among adults over the age of 60 years.

This paper presents a fall detection system for the elderly. The system defines two major components: a wearable device that detects, using an accelerometer and a gyroscope, if the user has suffered a fall, and a mobile application that automatically calls a predetermined number in case of emergency. The main advantage of the proposed system is that it does not require the person carry the cell phone everywhere since the fall detection is carry out in the wearable device.Therefore, the mobile phone can be located in any place in a house.

The wearable device has the capability of detecting a fall sensing an accelerometer and a gyroscope. The available literature states that measuring a person acceleration and orientation allows a electronic device to detect a fall .Therefore, this project measures the acceleration in 3-axis as well as the angular position of the pendant. If the acceleration achieves a defined threshold, the angular position is measured. Then, if a position threshold is achieved, a fall has been detected and the emergency protocol is activated. The emergency protocol includes a phone call contacts that have been selected by the user previously.

A functional prototype was implemented and tested for this project. This prototype includes the wearable device acting as a pendant, and an Android application to activate the emergency protocol which includes an alerting call and a text message. In addition, our system allows the user to activate the emergency protocol when required, pressing a panic button as well as to cancel a call using a button in order to avoid false alerts

LITARATURE SURVEY

There are so many studies conducted by persons and organisations about problems of fall like fear of falling as a mental disorder ,and characteristics of fall patterns like gender age etc. From the different surveys conducted worldwide different persons in different regions ,following are some of the interesting findings

According study conducted by WHO[1]ear, making it the second leading cause of unintentional injury death, after road traffic injuries. Over 80% of fall-related fatalities occur in low- and middle-income countries, with regions of the Western Pacific and South East Asia accounting for 60% of these deaths. In all regions of the world, death rates are highest among adults over the age of 60 years. Though not fatal, approximately 37.3 million falls severe enough to require medical attention occur each year. Such falls are responsible for over 17 million DALYs (disability-adjusted life years) lost *(2)*. The largest morbidity occurs in people aged 65 years or older, young adults aged 15–29 years and children aged 15 years or younger.

A. Smith ,in his paper "Older adults and technology use"[2], even though citizens above 65 are late adopters of mobile phones, In April 2012 the Pew Research Center found for the first time that more than half of older adults (defined as those ages 65 or older) were internet users. Today, 59% of seniors report they go online—a six-percentage point increase in the course of a year—and 47% say they have a high-speed broadband connection at home. In addition, 77% of older adults have a cell phone, up from 69% in April 2012.

A. Bourke and G. Lyons studies with a gyroscope in their paper , "A threshold-based fall-detection algorithm using a bi-axial gyroscope sensor"[3] shows how activities of daily life(ADL) and a fall can be distinguished. A threshold-based algorithm, to distinguish between Activities of Daily Living (ADL) and falls is described. A gyroscope based fall detection sensor array is used. Using simulated-falls performed by young volunteers under supervised conditions onto crash mats and ADL performed by elderly subjects, the ability to discriminate between falls and ADL was achieved using a bi-axial gyroscope sensor mounted on the trunk, measuring pitch and roll angular velocities, and a threshold-based algorithm. Data analysis was performed using Matlab® to determine the angular accelerations, angular velocities and changes in trunk angle recorded, during eight different fall and ADL types. Three thresholds were identified so that a fall could be distinguished from an ADL: if the resultant angular velocity is greater than 3.1 rads/s (Fall Threshold 1), the resultant angular acceleration is greater than 0.05 rads/s2 (Fall Threshold 2), and the resultant change in trunk-angle is greater than 0.59 rad (Fall Threshold 3), a fall is detected. Results show that falls can be distinguished from ADL with 100% accuracy, for a total data set of 480 movements.

Y. S. Delahoz and M. A. Labrador, "Survey on fall detection and fall prevention using wearable and external sensors[4]" describe about the various ways of fall detection systems such as wearable device ,externl devices ,camera based motion evaluation, machine learning techniques etc.are discussing in which wearable devices having accelerometers or gyroscope in them have sufficient importance.He found that wearable device are very effective and lower cost.

Threshold-based methods are one the most popular techniques for fall detection using wearable sensors. Here, a fall is reported when the acceleration goes beyond a pre-defined thresholds. A typical problem with this approach is the difficulty of generalizing results for diverse populations (e.g., height and weight). Thereby, these methods need a set of predefine parameters that should be adjusted according to the target population. Research on this category include the work of De La Hoz et al. [5].

Kangas et al. [6] used specific locations in the user's body to compute different thresholds with data collected from a three-axes accelerometer, and gyroscope. Sensor locations with the greatest fall recognition accuracy included places such as the users waist and head. In addition, the study found

that the features with significant contribution for fall recognition were the sum vector, dynamic sum vector, vertical acceleration, and maximum and minimum values.

CONCLUSION

The fall detection system for the elderly has been developed to the point where the system can detect backward falls with an accuracy of 92%,Sideway falls with 92% accuracy for the left side and 83% for the right side. Future work considers detection of frontal falls. The application has been made to allow the user to call two different numbers but if the cellphone has an error it can make more than two calls on the last phone number. However, the entire application works properly. The Bluetooth service can connect the application if needed.

REFERENCE

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