International Innovative Research Journal of Engineering and Technology

ISSN NO: 2456-1983

International Conference on Emerging Innovation in Engineering and Technology
ICEIET-2017

ACCELEROMETRIC MOTION ANALYSIS FOR ELDER PEOPLE FALL DETECTION USING GSM

C.Oorvasi[1] ,S. Krishna Priya[2],Blinda priyadharsini[3] Akshayai[4]
[1,2] Assistant Professor,[3,4] II yr ,Department of BioMedical Engineering,
Rajiv Gandhi College of Engineering and technology ,Pondicherry

Abstract

We present a wrist worn fall detector for elderly people.The detector is easy to wear and offers the full functionality of a small transportable wireless alarm system. It implements a fall detection algorithm which will alert a call center after a heavy fall. This occurs even if the wearer is unconscious or too agitated to press the alarm button himself. The algorithm is designed to work with the fall detector attached to the wrist. This is probably the most difficult place for detecting a fall. The algorithm can therefore be expected to function at other locations on the body. The system combines complex data analysis and wireless communication capabilities in a truly wearable watch-like form .This paper summarizes the functionality, architecture and implementation of the system.

Introduction

Falls in the elderly are a major problem for society. A serious consequence of falling remaining on the ground or floor for more than an hour after a fall [2]. The long-lie is a marker of weakness, illness and social isolation and is associated with high mortality rates among the elderly. A fall detection system and algorithm, incorporated into a custom designed garment has been developed which will automatically detect falls and potentially reduce the incidence. A fall detection system consisting of a tri-axial accelerometer, micro controller, battery and GSM module. This sensor is attached to a custom designed vest, designed to be worn by the elderly person under clothing. Health monitoring is among the most attractive application fields for wearable electronics and has been studied by many research groups [1, 2]. A variety of wearable devices for monitoring physiological parameters are commercially available today, with many others in the research and development stage. Most monitoring devices target people needing special care young and activepeople.We developed Speedy, a first prototype of a fall detector built into a wrist watch. Small, ubiquitous and very easy to handle, it is aimed at elderly people living alone at home or in social housing. If they press the incorporated alarm button, or if they are unconscious after a fall, Speedy will alert relatives or a call center via a wireless link to a local telephone central.

About GSM

GSM has been the backbone of the phenomenal success in mobile telecom over the last decade. Now, at the dawn of the era of true broadband services, GSM continues to evolve to meet new demands. One of its great strengths is the international roaming capability. This gives consumers seamless and same standardized same number contact ability in more than 212 countries. In the Americas, today's 7 million subscribers are set to grow rapidly, with market potential of 500 million in population, due to the introduction of GSM 800, which allows operators using the 800 MHz band to have access to GSM technology too. GSM satellite roaming has extended service access to areas where terrestrial coverage is not available. The cell size determination is usually based on the local traffic distribution and demand. The more the concentration of traffic demand in the area, the smaller the cell has to be sized in order to avail the frequency set to a smaller number of roaming subscribers and thus limit the call blocking probability within the cell. On the other hand, the smaller the cell is sized, the more equipment will be needed in the system as each cell requires the necessary transceiver and switching equipment, known as the base station subsystem (BSS), through which the mobile users access the network over radio links. The degree to which the allocated frequency spectrum is reused over the cellular service area, however, determines the spectrum efficiency in cellular systems. That means the smaller the cell size, and the smaller the number of cells in the reuse geometry, the higher will be the spectrum usage efficiency.

GSM Advantages

- Better voice quality
- Low-cost alternatives to making calls, such as the Short message service
- Ease of deploying equipment from any vendors that implement the standard
- Offer roaming services so that subscribers can use their phones on GSM networks all over the world

Project Description

The embedded microcontroller used here is LPC2148 microcontroller. It is a 32-bit RISC microcontroller based on ARM7TDMI architecture. It has 512KB of non-volatile Flash memory and 40KB of data memory. Since, the microcontroller has inbuilt peripherals it is called as embedded microcontroller.

Accelerometer is used to measure the position of the patient. If the patient fell down for long time, then the message will be sent to the doctor or required person through the wireless communication namely GSM. Here Accelerometer places the vital role in this project. This accelerometer is connected to the embedded input and output unit. Then the data will be processed using the ARM lpc2148. The fell down information is transferred Controller to embedded serial port. Besides this ARM microcontroller will send the message to the corresponding persons. The embedded microcontroller is programmed to report the status of the patient to the required number through SMS.This system offers better solution for the safety system and also it will help you to patient fell down information.

GSM Modem provides full functional capability to Serial devices to send SMS and Data over GSM Network. The GSM Modem supports popular "AT" command set so that users can develop applications quickly. The product has SIM Card holder to which activated SIM card is inserted for normal use.The firmware for this project is written in embedded 'C' language and the machine codes for the program is stored in the non-volatile Flash memory of the microcontroller.

Specifications:

Embedded Controller:

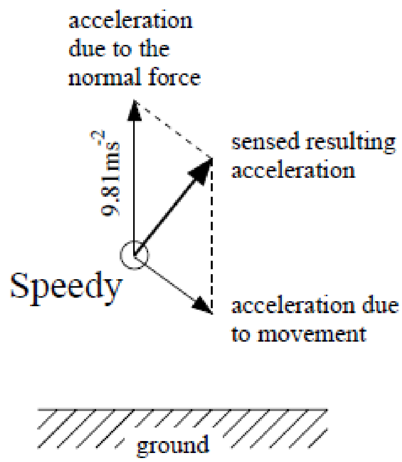
Device Name : P89C51RD2
Operating Voltage : 4.5 – 5.5 V
ROM : 64KB
RAM : 1KB
Crystal Frequency : 11.0592 MHz
Time taken for execution: 1.085μs

GSM Module:

Device Name : Q240xA
ROM (Flash) : 16Mb
RAM : 2Mb
Operating Voltage: 3.1 – 4.5 V
Receiving Frequency : 925 – 960 MHz
Transmitting Frequency: 880 – 915 MHz

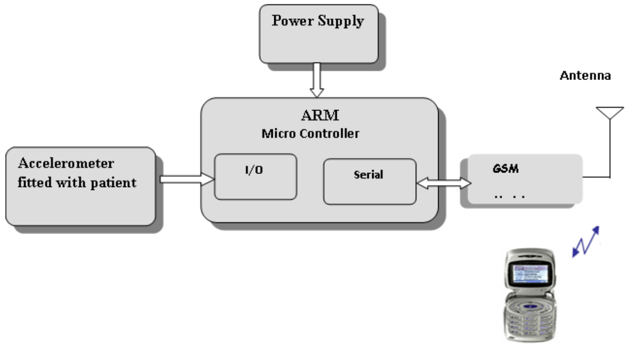
Principle of Detection

Our approach is to integrate the norm of the three axes acceleration vector. Due to the static acceleration the norm can only be smaller than $9.81 ms^{-2}$ during a fall.



The approximation is best for vertical movements and worst for nearly horizontal movements. More problematic is that fast accelerated movements towards the ground (acceleration $\geq 9.81 ms^{-2}$) result in an incorrectly estimated velocity. Nevertheless, this approximation has some beneficial properties. It is independent of the orientation and even rotation of Speedy. During a vertical movement, the approximation results in an underestimated velocity. This point helps reduce the sensitivity to horizontal movements. Only during a fall are negative values integrated. Because we are not interested in other movements, the implemented algorithm integrates negative values and damps the integral during positive values. Speedy targets elderly people and has a minimal user interface. Only one button is provided to either generate an alarm by pressing for more than 10 seconds, or to cancel an alarm triggered by the fall detection algorithm. All other settings, like threshold values or telephone numbers, are programmed by the call center.

Block diagram:



Result and conclusion

The main components of Speedy are two accelerometers The noise level measured is 5mg rms on each of the three axes. The power consumption is 2.6mA in monitoring mode and 11 mA during the wireless transmission of an alarm. The workload of the processor is only about 25%. With the employed batteries (1000mAh/ 3.6V) the device works constantly for approximately 2 weeks in the monitoring mode. The next figure depicts the values of the three axes measured by Speedy during a typical fall. The three phases detected by the algorithm are also put in evidence. We can see that not all fall situations are detected with the same certitude. One problem was sideways falls on the side the device is worn because the distance to ground can be very short. The second difficult fall to detect was the fall backwards because the arms are often first moving in the opposite direction of the fall. In some cases phase 2 was not detected. This is mainly because of the soft mattress. After these test series the device was worn for 48 hours.

The wearer was walking, cycling, washing dishes and doing all kinds of day-to-day activities. No false alarm was given. Yet the device worked fine in a subsequent fall test. We are able to detect a potentially harmful fall with a small and light fall detector which is easily integrated into a wrist watch. This is a new approach where the fall detector is integrated into a truly ubiquitous device. There was no false alarm during a two-day trial. All this is important for the acceptance of such a device especially for elderly people. In our tests not all fall situations were detected. But we believe the algorithm can be improved by optimizing the thresholds based on long-term tests. This could be done in social housing with medical staff and an in-house telephone central.

Reference

[1] A. Belardinelii, G. Palagi, R. Bedini, A. Ripoli, V. Macellari,
and D. Franchi. Advanced technology for personal biomedical signal logging and monitoring. Digest of Papers. Fourth International Symposium on Wearable Computres. IEEE Comput. Soc., 2000.

[2] E. Jovanoc, T. Martin, and D. Raskovic. Issues in wearable computing for medical monitoring applications: A case study
of a wearable ecg monitoring device. Proc. of the 20th Annual International Conference of the IEEE Engineering in Medicine and Biology Society, 3:1295–1298, 1998.

[3] E. E. Sabelman, D. Schwandt, and D. L. Jaffe. The wamas (wearable accelerometric motion analysis system: combining technology development and research in human mobility. Conf. Intellectual Property in the VA: Changes, Challenges &
Collaborations, Arlington, VA, 2001.

[4] Y. Schutz, S. Weinsier, P. Terrier, and D. Durrer. A new accelerometric
method to assess the daily walking practice. International Journal of Obesity, 26:111–118, 2002.

[5]. N. Noury, A. Fleury, P. Rumeau, A. K. Bourke, G. O. Laighin, V. Rialle, J. E. Lundy: Fall detection Principles and methods. In: Proceedings of the 29th International Conference of the EMBS, IEEE (2007), 1663{1666

[6]. J. Chen, K. Kwong, D. Chang, J. Luk, R. Bajcsy: Wearable sensors for reliable fall detection. In: Proceedings of the 27th Engineering in Medicine and BiologyConference, IEEE (2005) 3551{3554

[7]. B. Jansen, R. Deklerck: Home monitoring of elderly people with 3d camera technology. In: Proceedings of BENELUX biomedical engineering symposium, Brussels, Belgium (2006)

[8]. http://www.netcarity.org

[9]. N. Ravi, N. Dandekar, P. Mysore, M. L. Littman: Activity recognition from accelerometer data. In: Proceedings of the 17th Innovative Applications of Artificial Intelligence Conference AAAI, IEEE (2005) 1541{1546