Scientific Journal of Impact Factor (SJIF): 4.72

e-ISSN (O): 2348-4470
p-ISSN (P): 2348-6406

International Journal of Advance Engineering and Research Development

Volume 4, Issue 12, December -2017

RELIABLE HUMAN FALL DETECTION USING AUTOMATED MOBILE SYSTEM

A . HEMANTHA KUMAR[1], K. APARNA[2]

[1] DEPARTMENT OF ECE, JNTUACE, PULIVENDULA, AP, INDIA
[2] DEPARTMENT OF ECE, JNTUACE, PULIVENDULA, AP, INDIA

ABSTRACT---*An unintentional fall may injure elderly people. This paper aims to develop a portable and efficient device, which monitors the fall in the elderly people, by integrating a microcontroller, a tri – axial accelerometer, a GPS/GSM modem. The human activities can be sensed by the low-cost and low power tri - axial accelerometer. The system is composed of data acquisition, fall detection and database for analysis. Triaxial accelerometer is used for human position tracking and fall detection. The system is capable of monitoring patients in real time and on the basis of results another important parameters of patient can be deducted: the quality of therapy, the time spent on different activities, the joint movement, etc. The system, including calibration of accelerometers and measurement is explained in detail.*

Keywords: *accelerometers, fall detection, GPS, GSM, LCD.*

1. INTRODUCTION

One of the main medical issues in the elderly group is oblivious. Falls are one of the leading health problems in that community. They can occur in home as well as in hospitals or in the long-term care institutions. Falls increase risk for serious injuries, long-term disability, chronic pain,, and loss of independence ,psychological and social limitations due to institutionalization. Nearly fifty percent of older adults hospitalized for fall-related injuries are discharged to long-term care facilities or nursing homes. A fall can cause psychological damage even if the person did not suffer a physical injury. Those who fall often experience decrease activities of self care and daily living due to fear of falling again. This behaviour decrease their mobility, balance and fitness and leads to reduced social interactions and increased depression. The mortality rate for fall increases progressively with age. Falls caused 57% of deaths due to injuries among females and 36%of deaths among males .age 65 and above.

Majority of falls result from an interaction between multiple long-term and short-term factors in person's environment. Common risk factors include problems with balance and stability, arthritis, muscle weakness, multiple medications, therapy, cardiac disorders, stroke. Detection of a fall possibly leading to injury in timely manner is crucial for providing adequate medical response and care. Present fall detection systems can be categorized under one of the following groups:

- User activated alarm systems (wireless tags).
- Floor vibration-based fall detection,
- Wearable sensors (contact sensors and switches, sensors for heart rate and temperature, accelerometers, gyroscopes),

- Acoustic fall detection,
- Visual fall detection.

The most common method for fall detection is using a tri axial accelerometers or bi-axial gyroscopes. Accelerometer is a device for measuring acceleration, but is also used to detect free fall and shock, movement, speed and vibration. Using the threshold algorithms while measuring changes in acceleration in each direction, it is possible do detect falls with very high accuracy. Using two or more tri-axial accelerometers and combining them with gyroscopes at different body locations it is possible to recognize several kinds of postures (sitting, standing, etc.) and movements, thereby detecting falls with much better accuracy

An easy and simple method to detect fall detection of patients is using accelerometer together with ZigBee transceiver to communicate with Monitoring System through wireless network, and in this paper a system for monitoring and fall detection of patients using mobile MEMS accelerometers will be presented.

2. RELATED WORK

The system consists of a mobile station and a base station. The mobile station uses a 2-axis accelerometer sensor for acceleration measurement and a 2.4 GHz wireless radio chip for data transmission. Because obstacles affect the wireless communication between the mobile station and the base station, a wireless sensor network with multiple relay nodes had to be implemented, adding cost and complexity to the system. Moreover, the system is only suitable for indoor use and monitoring. Four kinds of activities were simulated and the reported fall detection rate for the system was 93.2%. J. Dai et al. [6] used a mobile phone as a fall detection system, with a fall detection algorithm implemented in Java. As the proposed fall detection algorithm is based on measured acceleration data, the mobile phone must have an integrated tri-axial accelerometer in order to be used for fall detection. Different performances were obtained from the experiments conducted, with the best results (2.67% false positive and 8.7% false negative) achieved with the mobile phone placed at the waist level. Although power consumption was considered in the design of the fall detection application, the battery life is limited by the mobile phone overall energy consumption, which can vary depending on the phone specifications and the owner's usage patterns. proposed a mobile fall detection system with three main modules: a tri-axial accelerometer for data acquisition, a microcontroller for fall detection and a GSM module for alarm signal transmission. However, the system has not been implemented and no results are presented. L. Ren, Q. Zhang and W. Shi [8] designed and implemented a mobile fall detection prototype with an emphasis on energy efficiency. The authors state that the system can function for approximately one month using two AA batteries (1500 mAh). The proposed mobile system consists of a tri-axial accelerometer, a microcontroller and a ZigBee radio module. Because the wireless communication is based on the ZigBee protocol, the communication range is limited and a local base station is needed in order to send the alarm signal to a remote monitoring center. The accuracy rate for the fall detection algorithm used was 96.25%.

MEMS

- **Accelerometer**

The MMA7260QT low cost capacitive micro machined accelerometer features signal conditioning, a one pole low pass filter temperature compensation and g-select which allows for the selection among four sensitivities.

- **Features**

1. Selectable Sensitivity (1.5g/2g/4g/6g)
2. Low Current Consumption: 500 μA
3. Sleep Mode: 3 μA
4. Low Voltage Operation: 2.2 V – 3.6 V
5. Fast Turn On Time

The Free scale accelerometer is a surface-micro machined integrated-circuit accelerometer .The device consists of two surface micro machined capacitive sensing cells (g-cell) and a signal conditioning ASIC contained in a single integrated circuit package. The sensing elements are sealed hermetically at the wafer level using a bulk micro machined cap wafer. The g-cell is a mechanical structure formed from semiconductor materials (poly silicon) using semiconductor processes (masking and etching). It can be modelled as a set of beams attached to a movable central mass that move between fixed beams. The movable beams can be deflected from their rest position by subjecting the system to an acceleration .As the beams attached to the central mass move, the distance from them to the fixed beams on one side will increase by the same amount that the distance to the fixed beams on the other side decreases. The change in distance is a measure of acceleration. The g-cell beams form two back-to-back capacitors. As the center beam moves with acceleration, the distance between the beams changes and each capacitor's value will change, ($C = AE/D$). Where A is the area of the beam, **E** is the dielectric constant, and D is the distance between the beams. The ASIC uses switched capacitor techniques to measure the g-cell capacitors and extract the acceleration data from the difference between the two capacitors. The ASIC also signal conditions and filters (switched capacitor) the signal, providing a high level output voltage that is ratio metric and proportional to acceleration.

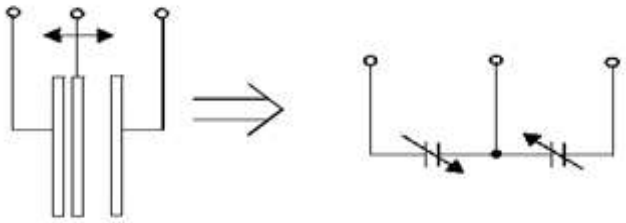


Fig.2.1: simplified transducer physical model

A. **Global Positioning System(GPS)**

The Global Positioning System (GPS) is a U.S. space-based radio navigation system that provides reliable positioning, navigation, and timing services to civilian users on a continuous worldwide basis freely available to all. For anyone with a GPS receiver, the system will provide location and time. GPS provides accurate location and time information for an unlimited number of people in all weather, day and night, anywhere in the world.

B. **GSM**

A GSM modem is a wireless modem that works with a GSM wireless network. A wireless modem behaves like a dial-up modem. The main difference between them is that a dial-up modem sends and receives data through a fixed telephone line while a wireless modem sends and receives data through radio waves.

Fig 2.2: Global System for Mobile communications

3. SOFTWARE REQUIRED

A. Kiel software
B. Embedded ‘C’
C. Flash magic

We use Kiel software to write the program and execute it, program is written in the embedded ‘c’ language, after completion of executing the program hex file program is dumped into the controller using flash magic.

A. ADC Function

```
int read_adc(char chnl)
        {
          unsigned long result=0;
          AD0CR =  AD0CR_setup | (1<<chnl);
      AD0CR |= START_NOW; //Start new Conversion
      while(!(AD0GDR & 0x80000000));
      AD0CR &= ~0x01000000;    //Stops the A/D Conversion
      result = (AD0GDR>>6) & 0x3ff;
      result=3.3*result;
          return (result);
    }
```

4. FUNCTIONAL DESCRIPTION

The purpose of this project is to design and produce a system to monitor the fall of patients and track the position of fall using global positioning system (GPS) and global system for mobile communication (GSM) Technology effectively. This project is also used for measuring and calibration of the joint movement, this paper describes system for monitoring and fall detection of patients using tri axial accelerometer along with ZigBee transceiver to detect fall of patient’s .The system is composed of data acquisition, fall detection and data base for analysis

Tri axial accelerometer is used to track the position of human and it is also used for fall detection.. The system is capable of monitoring patients in real time and on the basis of results another important parameters of patients can be predicted. Those parameters includes the quality of therapy, the time spent on different activities, the joint movement etc. Falls increase risk for serious injuries, long-term disability, chronic pain, and loss of independence, psychological and social limitations due to institutionalization .Nearly 50% of older adults hospitalized for fall-related injuries are discharged to long term care facilities or nursing homes.

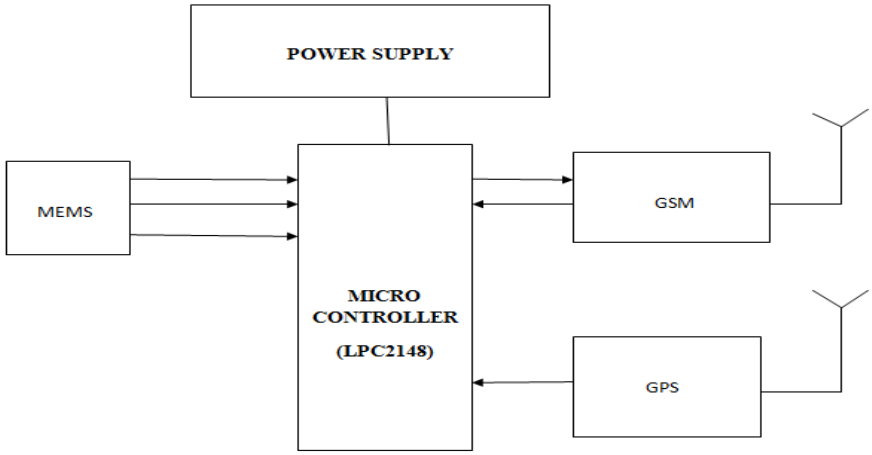


Fig 4.1: SYSTEM OVERALL BLOCK IAGRAM

A fall can cause psychological damage even if the person did not suffer a physical injury. Those who fall often experience decrease activities of daily living and self-care due to fear of falling
again. This behaviour decrease their mobility, fitness and balance and leads to reduced social interactions and increased depression.

Detection of a fall possibly leading to injury in timely manner is crucial for providing adequate medical response and care.

Present fall detection systems are categorized as follows

- Wearable sensors (contact sensors and switches)
- Sensors for heart rate and temperature
- User activated alarm systems (wireless tags)
- Floor vibration-based fall detection,
- Acoustic fall detection,
- Visual fall detection

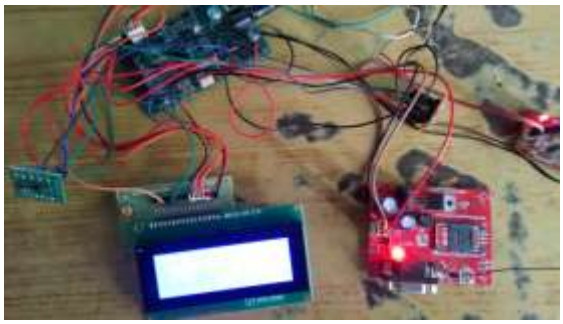
The most common method for fall detection is using gyroscopes or tri-axial accelerometer. Accelerometer is a device for measuring acceleration it is also used to detect free fall and shock, speed and vibration, movement. Using the threshold algorithms while measuring changes in acceleration in each direction, it is possible to detect falls with very high accuracy. Using two or more tri-axial accelerometers and combining them with gyroscopes at different body locations it is possible to recognize several kinds of positions like sitting, standing etc. there by detecting falls with much better accuracy. A simple method to detect fall detection of patients is using accelerometer along with ZigBee transceiver to communicate with monitoring system through wireless network.

A. SYSTEM FOR MONITORING AND FALL DETECTION

The system consists of a set of sensors (2 or more sensors on patient, usually MEMS sensors which the patient wears on himself, local units to collect data that are placed in patient vicinity and systems for collecting, processing and storage of data on each patient.

Accelerometer identifies whether person suddenly fall or normally sit using three axis voltages(X, Y, Z). When the person felt down suddenly, then the voltage difference between previous state (before fall) and present state values will change. Any one of the difference of the voltages(X, Y, Z) is more than preset values then the microcontroller understands that the person fall down suddenly due to fits or some other diseases.

Once the microcontroller identifies the person is fell then it reads both latitude and longitude of particular place by using GPS where person fall down then these values are sent to the authorized person.

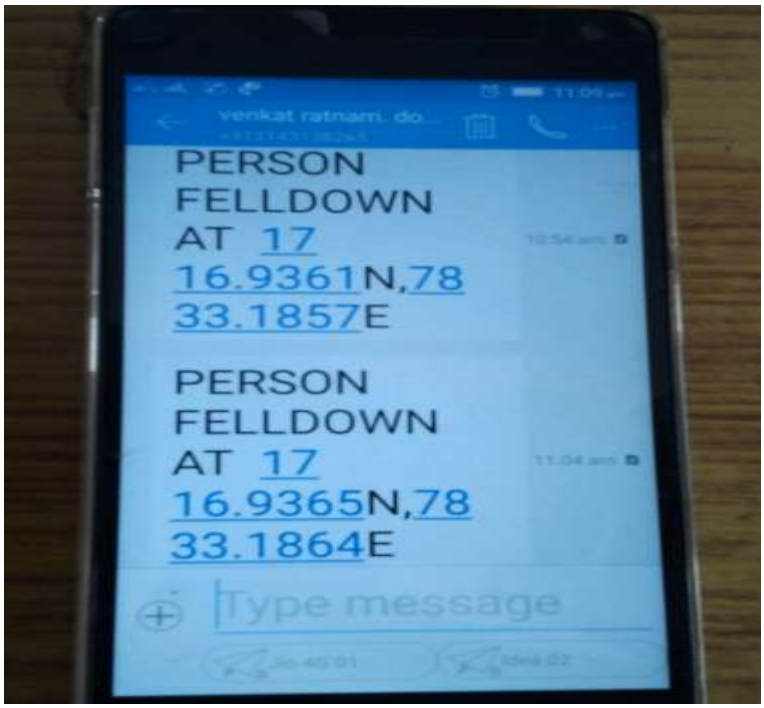


FALL DETECTION CIRCUITARY

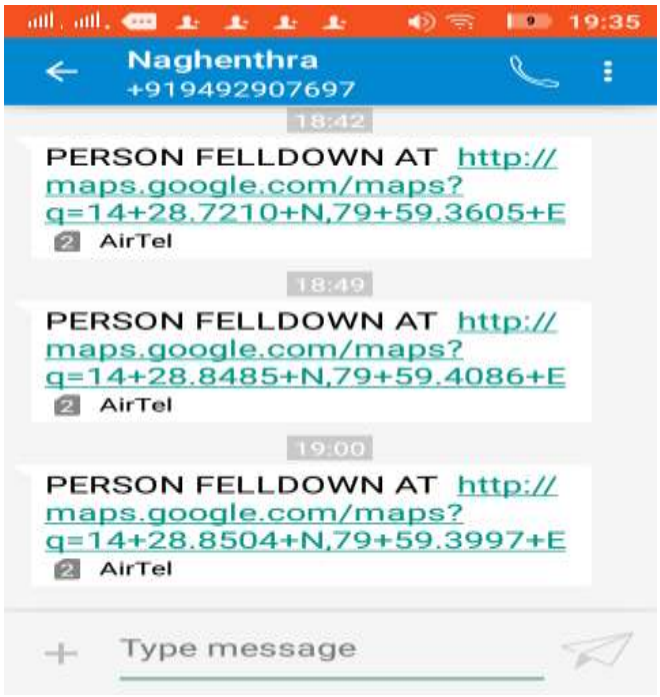
5. RESULT

This project implementation provides information on patient's fall and sends the latitude and longitude information to the preferred persons, By using a personal computer it is possible to trace the patients location by using latitude and longitude information received on mobile.

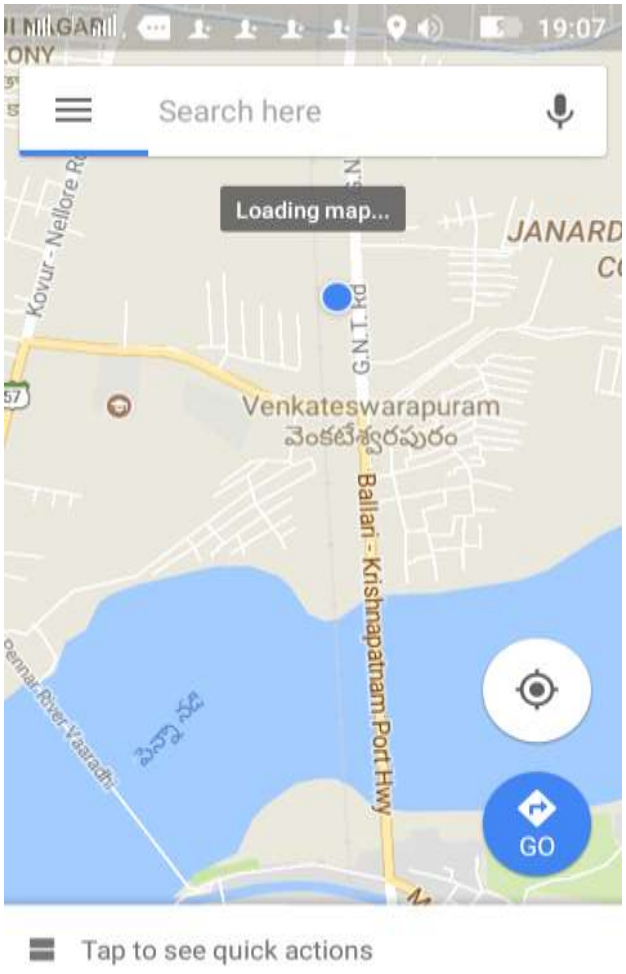
LCD DISPLAY



MESSAGE ON MOBILE DISPLAY



MESSAGE ON MOBILE DISPLAY



GPS TRACED LOCATION

6. CONCLUSION

The proposed system is implementation for monitoring or observing patients in real time. Human position tracking and fall detection of patient's is recognized quickly and get alerts in the form messages to android mobile phone and nearest hospital. After getting the alerts of message to their family or hospital then take certain treatment for the situation of patient. The system implementation provides information about the patient's exact location, who is suffering with some serious illness. The system is designed by integrating features of all the hardware components used and fabricated and developed it as industry standard prototype. In this system, proposed to provide complete solution for fall detection of patient using the GPS and GSM technology. The system is proposed as a reasonable cost i.e., less expensive optimized solution by using GPS, GSM modem and MEM technology. Based on this approaching system, the health monitoring system can be implemented by using Internet of Things (IoT). In future this work may be extended in Voice based navigation would be add charm in the functionality of system. Application based appointment system will be another enhancement, with the help of single click User/Patient can book an appointment with concern doctor.

REFERENCES

1. J. Tomkun and B. Nguyen, ―Design of a Fall Detection and Prevention System for the Elderly‖, In EE 4BI6 Electrical Engineering Biomedical Capstones, Department of Electrical and Computer Engineering, McMaster University, Hamilton, Ontario, Canada, April 23, 2016..
2. Li, Q., Zhou, G. and Stankovic, J. A. (2016): „Accurate, Fast Fall Detection Using Posture and Context Information" in ACM SenSys 2016, Raleigh, NC, USA, pp. 55562
3. Fu, Z., et al (2015):An Address-Event Fall Detector for Assisted Living Applications" in IEEE Transactions on Biomedical Circuits and Systems, June 2015, vol. 2 no 2, pp. 8896
4. C.-F. Lai, Y.-M. Huang, J.H. Park, and H.-C. Chao, ―Adaptive Body Posture Analysis for Elderly-Falling Detection with Multi sensors‖, IEEE Intelligent Systems, vol. 25, no. 2, 2014, pp. 20-30
5. http://robotix.in/tutorials/category/mechanical/rockerbogie
6. http://electrical4u.com/working-or-operating-principle-of-dc-moto.

