

# Smart Fall Detection and Protection for Elderly People

T. Padma<sup>\*1</sup>, Ch. Usha Kumari, M. Bhargav<sup>3</sup>

<sup>1-3</sup>. T. Padma is with the Embedded System Department, Gokaraju Rangaraju Institute of Engineering and Technology, Pincode-500090, India; e-mail: tatipartipadma@gmail.com, ushakumari.c@gmail.com, bhargavy93@gmail.com

## ABSTRACT

The elderly people require attention because of their health conditions and in many cases falls lead to many critical consequences. When an elderly person falls results in physical injury and is not possible for them to request for help at that condition. The main intention of this project is to prepare a fall detection and protection system for the elderly people at an affordable cost. In that process a wearable airbag is developed which inflates when the fall occurs. MEMS Accelerometer is used for the fall detection. The processing of data is done by the Microcontroller based on the input given by accelerometer sensor. When the fall is detected Microcontroller triggers the air pump which inflates the airbag. The Microcontroller (NODE MCU) consists of a built in Wi-Fi module by which the entire data were presented to cloud platform.

**Keywords:** MEMS Accelerometer, Wi-Fi, Microcontroller, Cloud, Air Bag.

*SAMRIDDHI : A Journal of Physical Sciences, Engineering and Technology, (2020); DOI : 10.18090/samriddhi.v12iS3.12*

## INTRODUCTION

When an elderly person accidentally falls which leads to serious health problems like fractures which may cause sudden death.

Even a fall that does not resulted in the injury but the worry of falling in the person which leads to the lack of confidence and causes mental stress.

Accidentally an elderly person who was living alone had a fall then the information to the health centers or the family may not reach in the required time which would results in undesired consequences. There are different technologies developed to detect the person fall using the smartphone sensors but the elderly has to carry the mobile phone with them without fail and this is not possible, by using Accelerometer sensor and GPS modules the location of the elderly person who had taken the fall is shared to the concerned care taker and another technology is by placing RFID tags under the mat using Neural Networks it was studied the user behavior for the fall and another method is by using 2 modules in which one module is connected to the chest and the other to the thigh each module consists of Protoboard, Arduino, XBee radio and MPU6050 sensor is a Motion-Tracking

---

**Corresponding Author :** T. Padma is with the Embedded System Department, Gokaraju Rangaraju Institute of Engineering and Technology, Pincode-500090, India; e-mail: tatipartipadma@gmail.com

**How to cite this article :** Padma, T., Kumari, Ch.U., Bhargav, M.(2020). Smart Fall Detection and Protection for Elderly People

*SAMRIDDHI : A Journal of Physical Sciences, Engineering and Technology, Volume 12, Special Issue (3), 53-56.*

**Source of support :** Nil

**Conflict of interest :** None

---

devices and an extra Pulse Sensor is added to the module which is attached to the chest to obtain heart rate values some predefined values are assigned to the sensors which define the position of the body when the sensing equipment's are above the certain value then the fall is detected all the above techniques had no result in decreasing the injury of the fall [1-5]. So in our project fall detection as well as prevention are two important issues and in human body head is the most creative and sensitive part this project is designed to prevent the head from injuries based on threshold technique The sensor continuously observes the value and if these readings are more than the

threshold then fall is detected, and the airbag also inflates automatically [6-10].

**EXISTING SYSTEM**

In the below figure shows the existing system in which mems accelerometer is used combined with GSM and GPS modules. MEMS accelerometer sensor will obtain the accelerometer value continuously by studying the values a certain threshold is prescribed when the values are above the threshold then it is considered as a fall then with the assistance of a GSM module the location is sent as a message to the registered number.

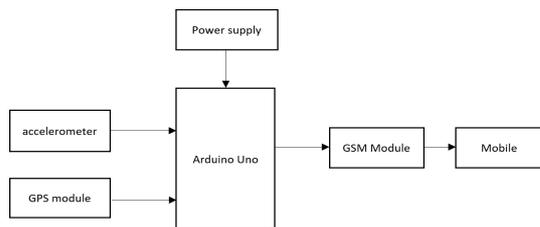


Figure 1: Existing System

**POPOSED SYSTEM**

The figure 2 shown below represents the proposed system in this it is by using a Node MCU Microcontroller which has an inbuilt Wi-Fi, for which the input is given through the MEMS accelerometer. Whenever the readings of Mems are above the prescribed threshold values then it is considered as a fall then air pump is triggered with which the air bag inflates.

The Microcontroller consists of an inbuilt Wi-Fi it acts as the server by which the data can be guided to platform of cloud and can be obtain to anywhere through webpage.

In this project a solenoid is connected to another end of the air bag by which after the fall air is removed automatically, and the same air bag can be used again and again.

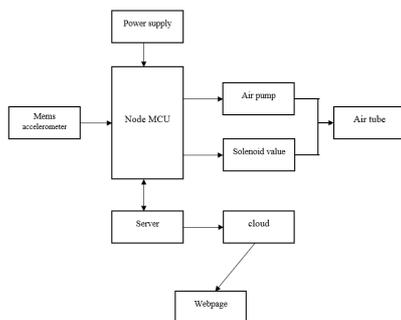


Figure 2: Proposed System

**HARDWARE INVOLVED IN THE PRESENT WORK**

A Node MCU(ESP8266) is a Microcontroller self-contained with wi-fi networking with built in USB connector, it can be directly interfaced with laptop similar to Arduino boards.

The mems Accelerometer is Electromechanical system measures acceleration force by static, gravity pulling or dynamic method by vibrating/moving sensing part of accelerometer. The sensors as a provision with automatic airbag system, it also has multiple sensors for multi axis sensing with more accurate sensing data.

The air motor depends on relation as pressure applied at the inlet produce linear output. The entire setup is more economical with user friendly operation.

**FLOWCHART**

Initially it starts with the collection of the data through accelerometer sensor and in the next step the data is directed towards Microcontroller. Here processing of the data takes place, that is the values of the accelerometer are compared with threshold. Suppose acceleration sensor values are less than threshold then the process again moves back to the step 2 if not i.e., acceleration values are greater than the threshold value then it is considered that the fall is detected. Further moves to next step an air pump is triggered which deploys the air bag and at the same time the message that the fall had occurred will be forwarded via cloud which is easily noticed through webpage is accessed from anywhere.

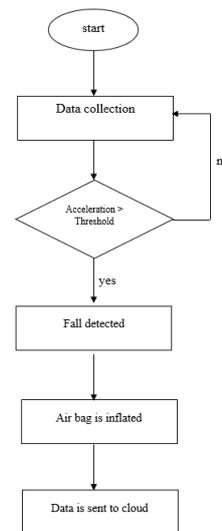


Figure 3: Proposed System Block Diagram

**Steps involved for working of Proposed Fall detection System**

1. Initialize Motor for Solenoid
2. Initialize Motor for Air Pump
3. Check connected to Wi-Fi for the notified delay time
4. IP address is identified
5. Acquiring the Data
6. Check for the predetermined Threshold value with respect to X-Axis
7. Solenoid and Air pump is activated if the value is above Threshold
8. Information of the fall message is given to identified IP address location
9. Display of Web Page
10. The above steps are continuous with a delay.

**RESULT**

Initially it starts with the collection of data in the below figure 4a shown the image of the complete kit before inflation. The entire setup has shown a quick response with minimal delay which can be ignored. The software's used in the proposed work is readily available through open source.

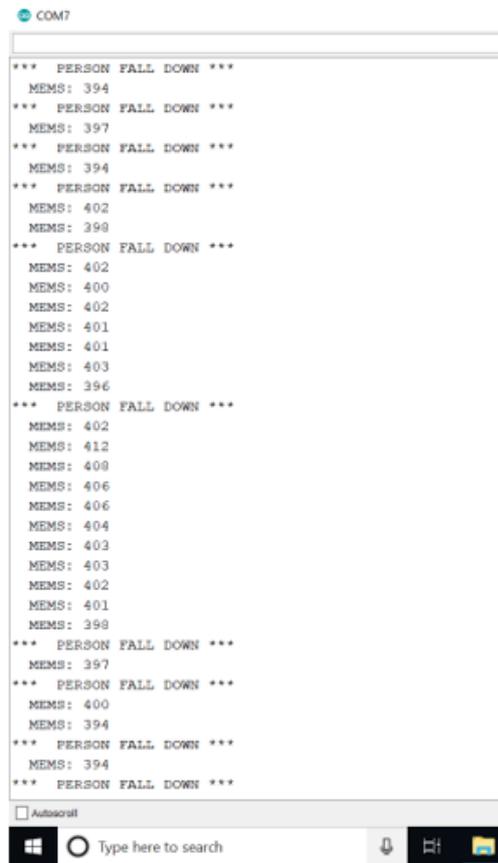


Figure: 5a. Values displayed on Serial monitor



Figure: 4a. Complete Kit before inflation



Figure: 4b. Air bag after inflation

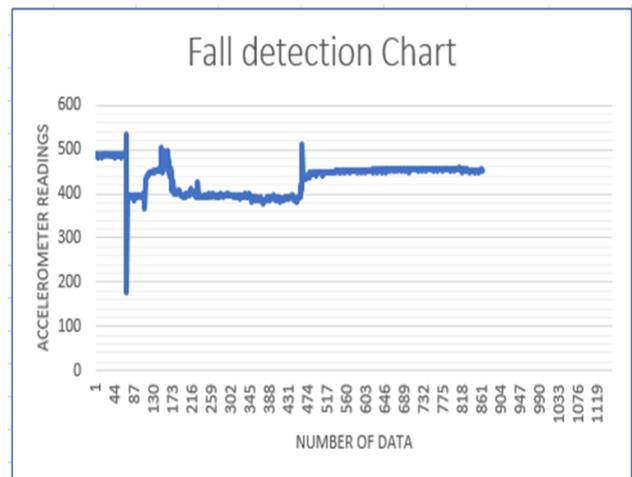


Figure: 5b. Fall Detection Chart

In the second step when the accelerometer sensor detects the fall then the air pump is triggered by the microcontroller and the airbag is inflated is represented in figure 4b. The figure 5a shows values displayed on the serial monitor of the PC and the graphical representation during the fall detection in figure 5b it is observed that along with the fall the ideal situation also displayed.

At the same time the microcontroller consists of an inbuilt Wi-Fi, the data is observed at cloud platform and it is easily available anywhere any time through web page as shown in figure 6 below.

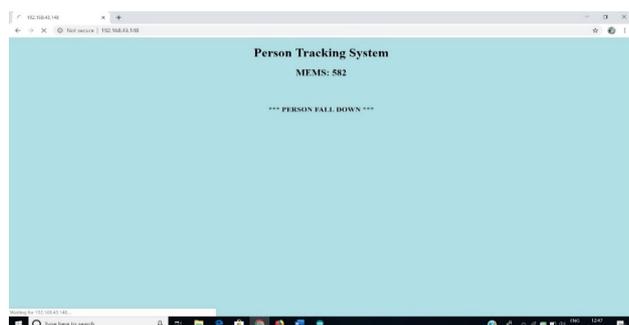


Figure: 6 Web page on cloud

## CONCLUSION

This Project is developed with a reusable wearable airbag to protect the head from fall injuries. The code was developed by using Arduino IDE which is flexible and easy to access. The information to the family members is also possible via webpage through the inbuilt Wi-Fi module. Practically observed if the battery is replaced with the higher capacity the inflation time can be reduced further

## REFERENCES

- [1] "Arduino based human air bag system for the elderly"- Hita Prem, Ashika NA, Shilpa N, MVJ College of Engineering-International Journal of Current Engineering and Research (IJCER)- VOL-5, ISSUE-5,2018.
- [2] "A Privacy Protected Fall Detection IoT Systemfor Elderly Persons Using Depth Camera"- Xiangbo Kong, Zelin Meng, Lin Meng and Hiroyuki Tomiyama - Proceedings of the 2018 International Conference on Advanced Mechatronic Systems, Zhengzhou, China, Aug. 30-Sep. 2, 2018
- [3] Bo Wang, Xie Ni, Guoru Zhao, Yingnan Ma, Xing Gao, Huiqi Li, Cuiju Xiong, Lei Wang, Shengyun Liang, "A wearable action recognition system based on acceleration and attitude angles using real-time detection algorithm", Engineering in Medicine and Biology Society (EMBC) 2017 39th Annual International Conference of the IEEE, pp. 2385-2389, 2017
- [4] "Arduino Based Fall Detection and Tracking of Elderly"-Dr. G.R. Patil, Subham Kumar Sharma, Vikas Kumar Lathar & Vipul Tiwari - Imperial Journal of Interdisciplinary Research (IJIR) Vol-2, Issue-7, 2016.
- [5] "Smart Unit Care for Pre-Fall Detection and Prevention"- Ashok Kumar Thella, Vinay Kumar Suryadevara, Maher Rizkalla, and Gahangir Hossain-2016 IEEE National Aerospace and Electronics Conference (NAECON) and Ohio Innovation Summit (OIS)
- [6] Guangyi Shi, Tianqiao Zhang, Yufeng Jin, Jack Wang, Zhenyu Wang, "Algorithm of the fall prediction based on the double foot pressure and Micro Inertial sensors", Cyber Technology in Automation Control and Intelligent Systems (CYBER) 2016 IEEE International Conference on, pp. 354-359, 2016
- [7] "A Wearable Pre-impact Fall Early Warning and Protection System Based on MEMS Inertial Sensor and GPRS Communication"-Mian Yao, Qi Zhang, Menghua Li, Huiqi Li1, Yunkun Ning, Gaosheng Xie, Guoru Zhao, Yingnan Ma, Xing Gao, Zongzhen Jin-2015 IEEE 12th International Conference on Wearable and Implantable Body Sensor Networks (BSN).
- [8] Fadi Aloul, Imran Zuлкernan, Ruba Abu-Salma, Humaid Al-Ali, May Al-Merri, "iBump: Smartphone application to detect car accidents", Industrial Automation Information and Communications Technology (IAICT) 2014 International Conference on, pp. 52-56, 2014.
- [9] Mitchell Yuwono, Steven W. Su, Bruce Moulton, "Fall detection using a Gaussian distribution of clustered knowledge augmented radial basis neural-network and multilayer perceptron", Broadband and Biomedical Communications (IB2Com) 2011 6th International Conference on, pp. 145-150, 2011.
- [10] "A Wearable Airbag to Prevent Fall Injuries"- Toshiyo Tamura, Senior Member, IEEE, Takumi Yoshimura, Masaki Sekine, Member, IEEE, Mitsuo Uchida, and Osamu Tanaka - IEEE TRANSACTIONS ON INFORMATION TECHNOLOGY IN BIOMEDICINE, VOL. 13, NO. 6, NOVEMBER 2009.