

## International Journal of Innovative Research in Science, Engineering and Technology

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# A Geriatric Care System Using Electronically Controlled Air Jacket

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**ABSTRACT:**An event of fall is one of the common problems faced by the older adults that can cause injuries and lead to hospitalization. The event of a fall in the case of an elderly person is more likely to result in hospitalization when compared to children. This fear hinders the independence of older people preventing them from leading a normal life like other individuals. A dread of fall event also has dramatic psychological consequences in the older adult since it drastically reduces the self-confidence of the individual. This distress may also contribute to future falls with more severe impact and the mental and physical health of the individual. The consequences of a fall event also depend on the time delay in providing appropriate medical assistance. Consequently, the providing care process and the effect of the fall-related occasions can be enhanced by receiving frameworks for the programmed discovery of fall occasion and creative methods for relief of fall and fall-related injuries. Thus, the care-giving process and the impact of the fall-related events can be improved by adopting systems for the automatic detection of fall event and innovative techniques for mitigation of fall and -related injuries. This project aims at developing a fall detection system capable of accurately detecting a fall event and minimizes the impact of the fall. This system also notifies the fall event along with the current location of the elder to track easier. The project also includes a false detection switch to overcome the issues of false alarm trigger event when performing daily activities like doing simple workouts or lying down on a bed.

**KEYWORDS:**GSM network, Patient Monitoring System, MEMS accelerometer, acceleration, Solenoidal Valve, GPS module.

### I. INTRODUCTION

Elderly individuals are the quickest growing section of the total populace. As indicated by the World Health Organization, 30 % of the older person fall at least once every year. Fall and fall-related injuries are responsible for 70% of accidental death in persons who are aged 75 years and above. A dread of fall additionally has emotional mental results on the psychological wellness of an elderly individual since it ruins the self-assurance of the person.

Falls and fall-related injuries are the third cause of chronic disability. Along with this increase, the proportion of older adults who are frail and dependent is also likely to rise significantly. Therefore, fall and fall-induced fractures are common among the oldsters, this shift in demographic patterns will lead to an exponential increase in numbers of individuals who experience the ill effects of injuries because of fall and fall-related occasions.

Hip fractures account for most of the costs associated with fall and fall-induced fractures, particularly among older people. Also, older people who are living alone have the highest risk of delayed medical intervention. To address the consequences mentioned above of fall and fall-related injuries and the problem of deferred medical assistance, it is imperative to detect the falls as soon as they occur so that immediate assistance can be provided. Hence, the primary aim of this project is to detect and minimize the impact of fall when an old person falls and ensure timely medical assistance by sending the information of the fall event to the caregivers.

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## II. RELATED WORK

In the previous years, different technologies have been implemented in identifying an event of fall which was based on pressure, orientation or tilt and vibration of the object as indicators of a fall event. Some fall detectors also make use of video monitoring and vibration analysis. These monitoring devices are subjected to various design limitations and flaws related to low light, field of view, dependency on location, and high cost. The major limitation involved in many non-automatic fall detectors imposed a restriction on the user with a need to press the button after a fall event which is very unlikely after a fall event. Furthermore, these wearable devices may also be subject to many false alarms caused by fall like activities in daily routines, such as sitting on a sofa or lying on a bed.

In order to overcome the above-mentioned limitation, this system makes use of automatic fall detection and innovative methodologies to mitigate the harmful impacts of fall and fall-related injuries. The electronic Jacket is an acceleration based system which detects the fall event by measuring the applied acceleration along the three axes. As acceleration is the most reliable information that can be used for detecting a fall, while other kinematic data, such as angular velocity, is less relevant.

In addition to automated fall detection mechanism, the system also employs various novel techniques for mitigating the hazardous impact of a fall event. This product is designed as wearable jacket which consists of pressurized plastic air bags storing compressed air and a Solenoidal valve, which helps in mitigating the impact of a fall. Additionally, false detection switches are employed to overcome the issue of false trigger alarms caused by various day to day activities.

## III. ADVANTAGES OF E-JACKET FOR FALL DETECTION

- The activity of the user is continuously monitored using an entity acceleration, which, when crosses a threshold value indicates that fall has been detected.
- The module also includes pressurized plastic bags which are filled with air pumped with the help of a solenoid valve arrangement. This arrangement helps in mitigating the harmful impact of fall and fall-related event.
- The system consists of a GPS module; it provides an accurate location of the user using which the user's location can be easily found.
- After the fall event, a request for help is sent to the caregivers who can provide the required medical assistance in time.
- The module is designed in the form of a wearable jacket which is best suited for both indoor and outdoor events.

## IV. PRINCIPLE OF OPERATION

Implementation of e-Jacket for fall detection is based on the principle of activity monitoring. Initially, the user will be wearing this system around his waist. The Electronic Jacket consists of a MEMS accelerometer (sensor) which keeps on monitoring the user's activity. Whenever the person falls down, the acceleration due to the mechanical movement of the body becomes greater than a given value. This change in acceleration is sensed by a sensor module. This sensor module will be continuously monitored by a Microcontroller.

During the event of a fall, the acceleration at the center of gravity of the user's body crosses a previously calibrated threshold value which in turn triggers the Microcontroller. The Microcontroller activates the solenoid valve and the pressurized plastic bags are filled with air. The air filled pressurized plastic bags helps in reducing the impact of the fall and prevents any major injuries which could lead to serious health implications.

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Additionally, the Microcontroller also triggers the GPS Module, which fetches the location of the user and sends it to the Microcontroller. The Microcontroller in turn provides appropriate control signals for the GSM Module to send a message to the doctor for the immediate medical assistance.

### V. PROCESS FLOW

The process of fall detection is comprised of the following four stages of operation.

- a) Input stage – MEMS Accelerometer
- b) Processing stage – Microcontroller
- c) Trigger stage – Arrangement of pressurized plastic bags, miniaturized air pumps, solenoid valve.
- d) Communication Stage – GSM Module and GPS Module.

The block diagram in Fig. 1 shows the process flow of the mechanism.

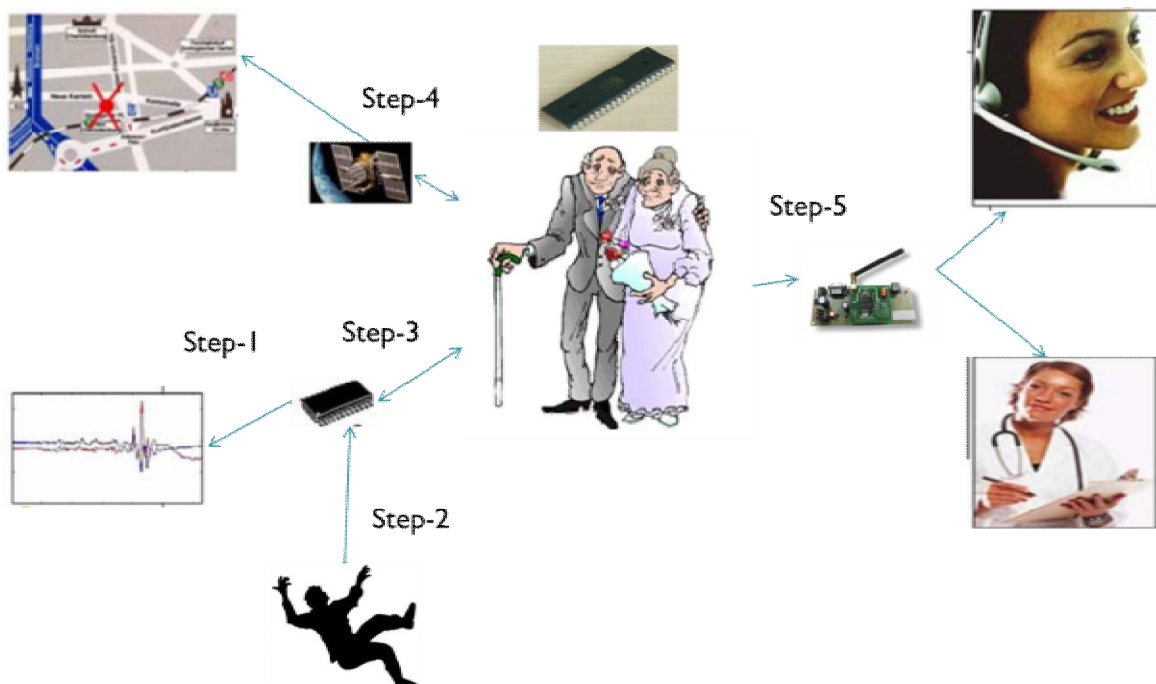


Fig 1: Process Flow

#### a. Input Stage

As the name suggests, it is concerned with taking the input from the sensor. Since the input needed here is the movement of the user, i.e. the acceleration, a MEMS (Micro Electro Mechanical Systems) accelerometer is used. It measures the acceleration in all three axis, which helps in detecting the posture of the user. The positioning of the sensor module strongly influences the accuracy of a fall event. Waist and head provide the most relevant acceleration data during the fall event. However, waist represents the most comfortable position for the user to wear. Also placing

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the accelerometer at the waist indicates close to the center of gravity of the user's body, which makes the sensor less sensitive to spurious movements. The output of the accelerometer i.e. an analog signal which varies as per the acceleration is sent to the processing stage.

### b. Processing Stage

This is the most important stage of the system. It consists of a Microcontroller, which is the brain of the system. The Microcontroller hardware platform used is PIC18F46K22 of PIC Microcontroller family. The Microcontroller takes the input from the sensor module continuously and processes the data, i.e. the user's acceleration is continuously monitored.

Whenever a person falls down the acceleration due to the mechanical movement of the body crosses a threshold value. This change in acceleration is continuously monitored by the Microcontroller. The input to the Microcontroller is an analog value, but since the Microcontroller is a digital device, a conversion from analog to digital is required, which is done by an inbuilt Analog to Digital Converter (ADC) within the Microcontroller. Once the Microcontroller observes for an abrupt change in acceleration it further triggers the Solenoidal valve arrangement and communication stage.

### c. Trigger Stage.

This main responsibility of this stage is to mitigate the hazardous impact of fall and fall-related injuries. The module is designed in the form of a wearable air jacket. This air jacket consists of pressurized plastic bags filled with compressed air and a solenoid valve. During the event of a fall, the Microcontroller module activates the Solenoidal valve. As a result, the inflated airbag is now filled with air from the pressurized plastic bags and thus mitigate the impact of fall and fall-related injuries.

### d. Communication Stage

This stage deals with the informing the caretakers regarding the fall event through a set of communication devices. The communication devices include GSM Module and GPS Module. Once the change in acceleration is monitored by the Microcontroller it enables the GPS Module and GSM Module. GPS Module fetches the location of the user and sends it to the Microcontroller whereas GSM Module sends a request message for help to the doctor who can provide the necessary medical assistance, for the victim's relative regarding the fall event, for the tele-operator services who can contact the nearest ambulance service and provide them with the exact location of the user.

## VI. CIRCUITRY

The sensor circuit and other circuit components are made in the form of a belt and it is attached to the air jacket. This air jacket consists of pressurized plastic bags filled with compressed air and a solenoid valve. The user is advised to wear this jacket while going out. Whenever the person falls down, the mechanical movement of the body will be recognized by sensor circuit, i.e., the angular acceleration becomes greater than a given value, as a result, the sensor module triggers the Microcontroller circuit which in turn provides appropriate control signals to trigger the solenoid valve.

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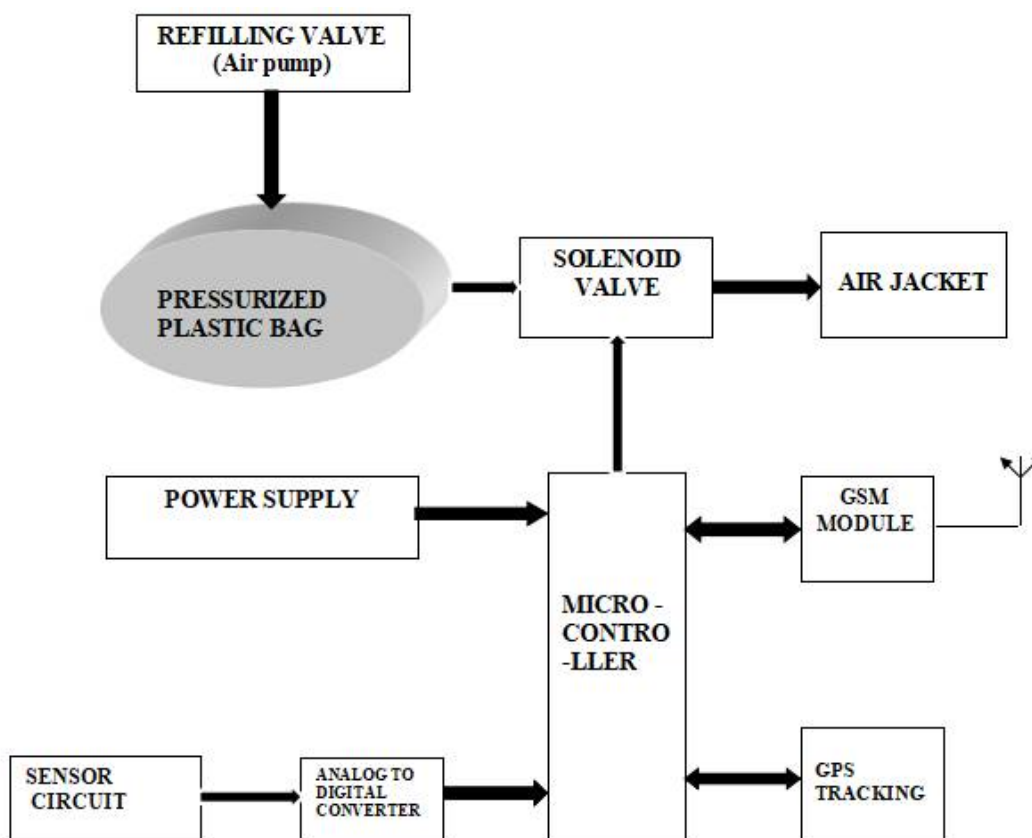


Fig 2: Block Diagram

As a result, the inflated airbag is now filled with air from the pressurized plastic bags and thus prevents the impact of fall and also reduces the chances of head injury. At the same time, the GSM module is also activated to send a message to the doctor. The doctor is able to locate the victim with the help of a GPS system and thus can provide the required treatment in time. Here the air jacket serves two purposes, namely as a protection from cold weather conditions and also to reduce the impact of fall.

### VII. CONCLUSION

The development of a fall detection system requires a non-negligible warm-up time to understand the problem of falls fully. In this project, the basics of the fall-problem together with the most relevant approaches have been described. The aim is to provide guidelines to speed up the design process of a new fall detection system by compiling the merits of efforts taken during the past 30 years in developing a fall detection system.

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The scientists adopted a wide range of strategies to take care of the issue of falls among elderly with the absence of any standard testing rules. This study also provided a standard structure for considering the issues and challenges of a fall detection system. A step further from the detection is the prediction of non-accidental falls. Some papers left prediction as a future work, suggesting consideration of the physiological state of elderly. This project also introduces a new innovative approach to mitigate the impact of a fall.

The first problem to face is the selection of the physiological measurements that are relevant to a fall and the ways to measure them. It is presumable that even if the complexity of such a predictive system increases, the advantages are much more.

## VIII. FUTURE ENHANCEMENT

- If the device can be connected to the Internet then the GSM module will be capable of locating the nearest hospital and transmitting the message to the concerned doctor.
- With the help of an additional sensor circuit, it is possible to transmit the victim's medical conditions at the time of fall so that the doctor can make arrangements for the appropriate treatment to be provided.
- In addition to ECG rate, we can also send EEG (electroencephalogram) and EMG (electromyogram) signals for analyzing.
- With the help of GSM technology, we can display the ECG signal on the doctor's mobile phone.

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