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# DESIGN OF A FALL DETECTOR USING LABVIEW

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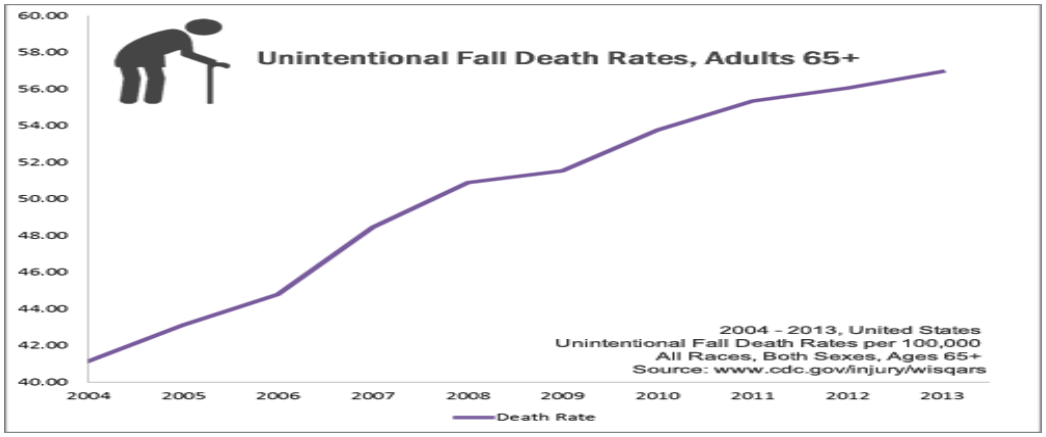
***Abstract:*** **Fall in the present scenario has become a serious issue that causes many instant and long run weaknesses or diseases. Falls turn to be a health hazard if unnoticed in time. The concept is to have a fall detector that can differentiate between a fall and normal activities and sends an alarm to the nearby health centre or relatives without the intervention of the patient when fall is detected so that doctor can attend the patient at right time. In Indian Scenario, the increase of nuclear families is indicating the importance of usage of a fall detection gadget as the youth are leaving their elders in search of job migrating to the cities. This gadget not only is important for the elderly people but also to the people working on heights like mountaineers, painters etc.**

**The hardware implementation of fall detector is avoided as the accuracy of the working of the gadget is to be tested on the elderly person which is difficult and risk some. Thereby we have completely designed the software model using Lab View through which we can approximate the accuracy levels and process of implementing when done on hardware.**

***Keywords:*** **Fall, Fall Detector, GSM, MEMS Accelerometer, Alarm, Elderly people, Activity, Lab View, VI [Virtual Instruments], Threshold, Health Centre, SMS.**

## 1. INTRODUCTION

Each year, millions of older people with age 65 and older undergo fall. In fact, one out of three older people fall each year, but less than half tell their doctor [2]. Falling once doubles your chances of falling again. One out of five falls causes a serious injury such as broken bones or a head injury. Each year, 2.5 million older people are treated in emergency departments for fall injuries. Over 700,000 patients a year are hospitalized because of a fall injury, most often because of a head injury or hip fracture. Each year at least 250,000 older people are hospitalized for hip fractures. More than 95% of hip fractures are caused by falling, usually by falling sideways [12]. Falls are the most common cause of traumatic brain injuries (TBI).Adjusted for inflation, the direct medical costs for fall injuries are $34 billion annually. Hospital costs account for two-thirds of the total.




**Graph 1: The graph showing the death rate due to unintentional falls**

Falls not only cause physical, but also cause severe psychological effects. A low cost gadget which can detect unintentional falls can reduce this kind of complexities i.e., all hospitals can buy the gadget and make the patients to wear it to reduce the injuries due to fall. This can be done by following relevant techniques which makes our product more reliable, efficient, compact and easily operable.

In addition, persons with disabilities are less likely to be employed. A 2013 study showed that 46% of the people ages 21 - 64 with a disability were employed and a significant number of those were employed part time. These figures compare with an employment rate of 84% for those without a disability [14]. These population demographics clearly indicate that over the next 20 years there will be a rapidly expanding need for assistive devices of all types.

## 2. BRIEF DESCRIPTION ABOUT FALL

***Conditions that causes fall:***

Over the years, Research has been carried out on the causes of fall, its effects and detection or prevention. Out of all the articles published related to falls, the reasons are identified that contribute to falling. These are called risk factors. Many risk factors can be changed or modified to help prevent falls. They include:

- Lower body weakness
- Difficulties with walking and balance
- Use of medicines, such as tranquilizers, sedatives, or antidepressants. Even some over-the-counter medicines can affect balance and how steady you are on your feet.
- Vision problems
- Foot pain or poor footwear
- Home hazards or dangers such as
  - Broken or uneven steps
  - Throw rugs or clutter that can be tripped over and
  - No handrails along stairs or in the bathroom.

Most falls are caused by a combination of risk factors. The more risk factors a person has, the greater their chances of falling. Healthcare providers can help cut down a person's risk by reducing the fall risk factors listed.

A simple fall can have devastating consequences for the elderly. If you fall, you can become disoriented, immobilized, or knocked unconscious and unable to call for help. Falls don't "just happen," and people don't fall because they get older. Often, more than one underlying cause or risk factor is involved in a fall. A risk factor is something that increases a person's risk or susceptibility to a medical problem or disease.

As the number of risk factors rises, so does the risk of falling. Many falls are linked to a person's physical condition or a medical problem, such as a chronic disease. Other causes could be safety hazards in the person's home or community environment. Other factors that can lead to falls at home include loose rugs, clutter on the floor or stairs, carrying heavy or bulky things up or down stairs, not having stair railings, not having grab bars in the bathroom.

***What can happen after a fall?***

Many falls do not cause injuries. But one out of five falls may cause a serious injury such as a broken bone or a head injury. These injuries can make it hard for a person to get around, do everyday activities, or live on their own.

- Falls can cause broken bones, like wrist, arm, ankle, and hip fractures.
- Falls can cause head injuries. These can be very serious, especially if the person is taking certain medicines (like blood thinners). An older person who falls and hits their head should see their doctor right away to make sure they don't have a brain injury.
- Many people, who fall, even if they're not injured, become afraid of falling. This fear may cause a person to cut down on their everyday activities. When a person is less active, they become weaker and this increases their chances of falling.

***Why fall detector is used?***

- ✓ The fall detector is a device equipped with a help call button and an automatic release of an alarm in case of a heavy fall followed by immobility.
- ✓ In spite of care taker making diligent efforts to prevent their elderly parent from falling, falls are often inevitable.
- ✓ Falls can result from a variety of conditions such as mobility, difficulty from arthritis, vertigo from poor circulation, negative reactions to meditation etc.
- ✓ Sometimes an alarm based fall detectors are used but they are not highly efficient as it is used only if the patient after falling is in a condition to press the alarm.
- ✓ An automated fall detection means here no alarm or button needs to be pressed. The device automatically detects it and calls for help.

***History of fall detection***

Fall is a common form of injury. Everyone can be at risk of having a fall, but some older adults can be more vulnerable than others due to the presence of long-term health conditions. Falls can have an adverse psychological impact on elderly people. From the time the idea to detect fall was first realized by Wilhelm Hormann, Germany in the early 1970's who called it as "Home Alert Systems" ,a lot of attempts have been made to tackle this form of injury[15].Gyroscopes, accelerometers, pressure sensors and many more sensors have been used to detect fall.

***Block Diagram of Fall Detection System***

The technique of detecting fall relies on deriving human body posture with a suitable sensor placed at appropriate anatomical position which precisely distinguish daily activities and fall. Since, change of plane of body and sudden changes in acceleration are involved in fall; triaxial accelerometer serves as a perfect suitable sensor. The changes of acceleration in 3 axes are monitored continuously. When the changes in acceleration fall in the window of threshold values, it is decided as fall.

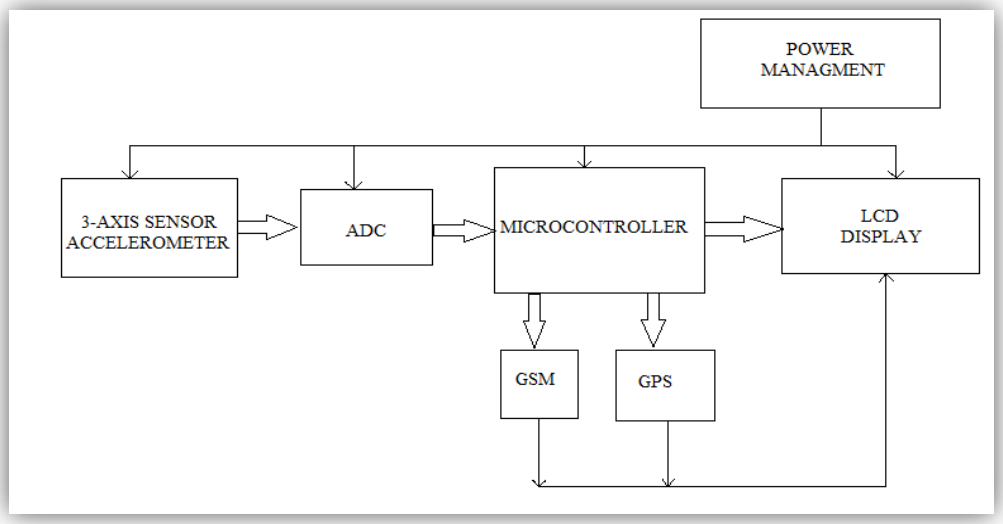



**Fig 1 : Block diagram of fall detection**

The block diagram possesses four main sections namely input, the controller, communication protocols and output devices. The input consists of acceleration values and GPS data. The transmitter pin of GPS is connected to the receiver (UART) of microcontroller. The triaxial accelerometer sensor (adxl335) is used to derive body posture of the subject. Acceleration and angle information of three axes is produced as three analog signals which vary with body posture. Acceleration value generated in each axis is read through separate pins, selecting one analog input at a time. Analog signals generated by the sensor are digitized by analog to digital converter ADC (0804). Here, the GSM and GPS act as the communication protocol that displays the output on the LCD display indicating whether it is a normal activity or a fall.

## 3. FLOW CHART FOR THE ALGORITHM

Researchers generally agree that optimal fall sensor placement is at the waist [10, 12]. Using gyroscopes, a similarly-placed gyroscope measures pitch and roll angular velocities. Applying a threshold algorithm to angular change, velocity, and acceleration can be successful in fall and tilt detection [9]. Testing and data collection involved simulating falls and non-falls or Activities of Daily Living (ADL) [10]. We let the algorithm distinguish between them, followed by algorithm evaluation. Since asking older people to intentionally fall is unreasonable, the simulated falls were completed by using software which can later be embedded into ARDUINO UNO and the results are monitored.

Through the MEMS sensor signals are acquired and analyzed. If there is an activity the amplitude and frequency of the signals from the MEMS sensor changes depending on the nature of activity. If the activity is detected as fall then warning is given or else the signal is analyzed whether it is a normal activity or a seizure activity. If it corresponds to a seizure activity then warning is given.

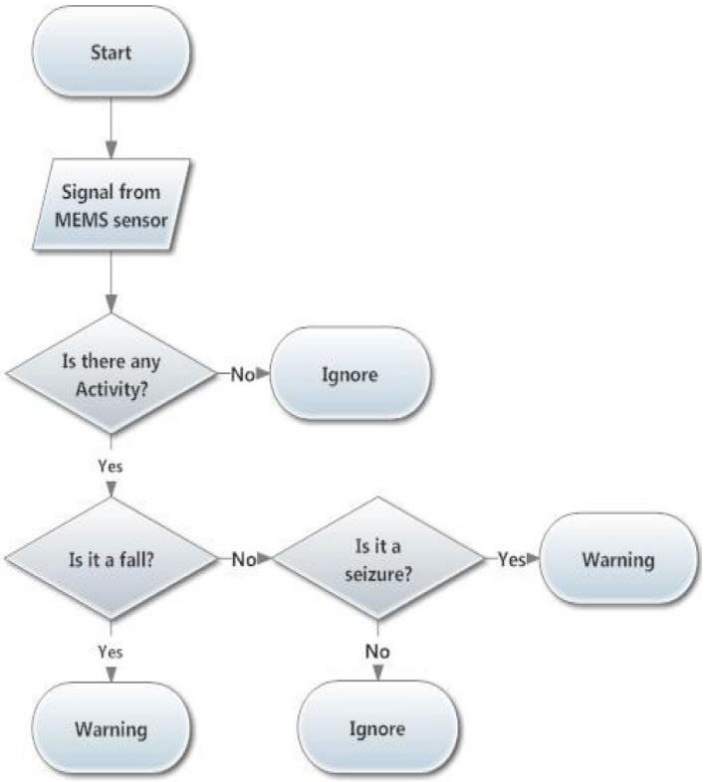



**Fig 2 : Flow chart of the seizure and fall detection**

**ALGORITHM**

Step1: Start the process.

Step 2: Signals are acquired from MEMS sensor.

[The MEMS sensor is placed at the extremity preferably in the hand. Through the MEMS sensor signals are acquired and analyzed.]

Step 3: Is there any activity? If yes, go to step 5 else go to step 4.

[If there is an activity the amplitude and frequency of the signals from the MEMS sensor changes depending on the nature of activity.]

Step 4: Ignore as the activity has not occurred.

Step 5: Is it a fall? If yes,then warning is shown.If no, then continue to step 6

[As the activity is detected,then the alarm indicating the fall detection is to be given.]

Step 6: Is it a Seizure?

[As it is not a fall,then the the signal is analyzed whether it is a normal activity or a seizure activity. If it corresponds to a seizure activity then warning is given and if not it is ignored.]

## 4. SOFTWARE REQUIREMENT

Here, the software used for the implementation of block diagram for the detection of fall is Lab View (NI 2014) which is a real time virtual environment for programming. The attempt has been already made to implement the fall detection using c-coding, mat lab and Lab View is chosen as it is more efficient compared to other programming techniques. Lab view programs are called Virtual Instruments or (VI's) as their appearance and operation imitate physical instruments such as oscilloscopes and multimeters. Lab view is the easiest, most powerful tool for acquiring, analyzing, and presenting real-world data.

## 5. RESULTS AND DISCUSSION

As we couldn't use the original subjects to verify whether the programming is accurate and detects falls efficiently, we have here used software programming for the fall detection where the unnecessary falling of the subjects can be avoided.Here, more concentration is done on the software programming using Lab View that is a real time virtual environment to work on with the hardware units.

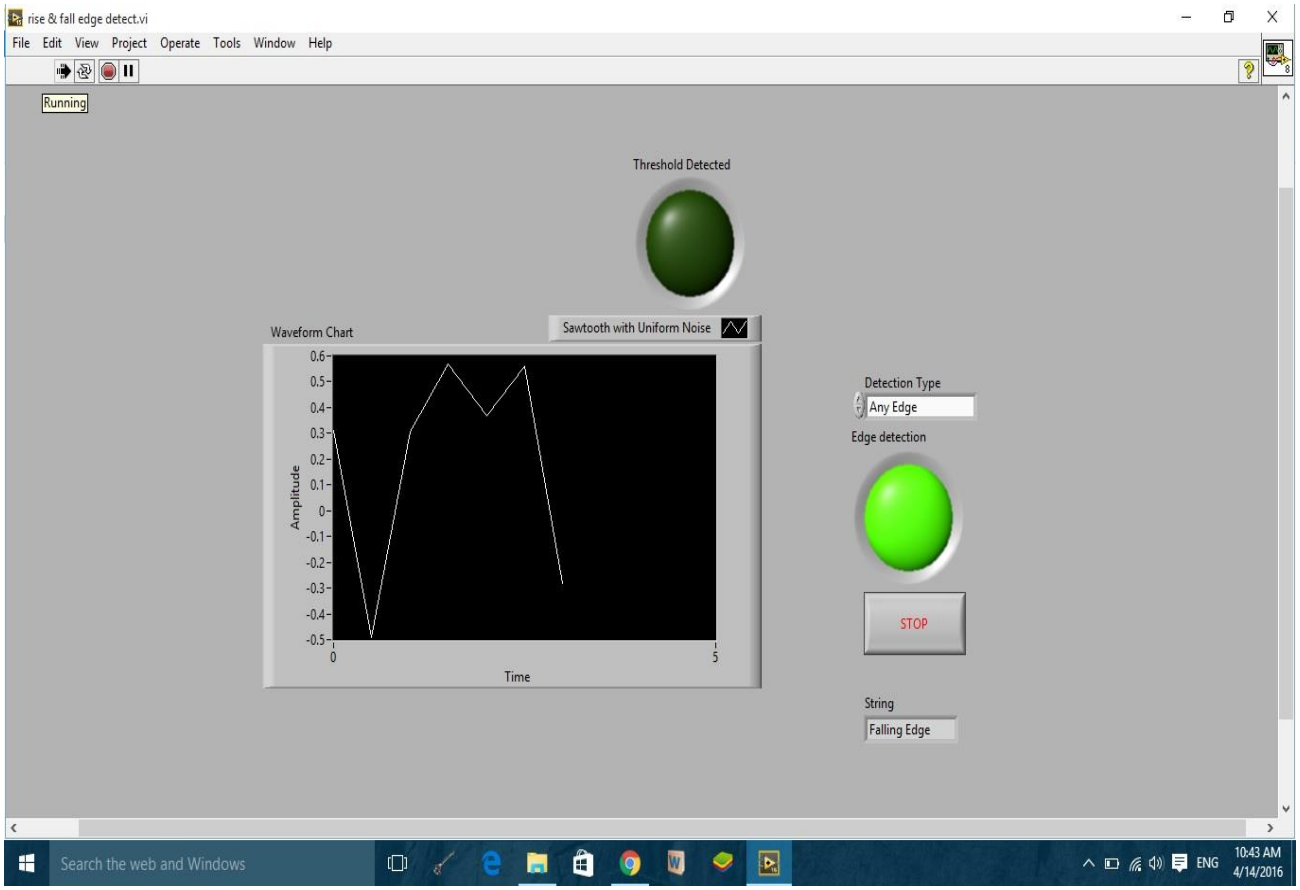



**Fig 3 : VI showing Rising and Falling Edge**

The above figure shows a plot displaying waveform chart, string,threshold detection based on the detection types mentioned to be rising edge or falling edge or any edge.Here,the usage of subject is eliminated and the program is written such that if the threshold is detected above the level, then the alarm indicates stop and the waveform will be displayed.The type of detections are selected and when the program runs continuously,string displays along with the alarm and led and also waveform is seen.The block diagram construction of the programming is done using loops and is run successfully.

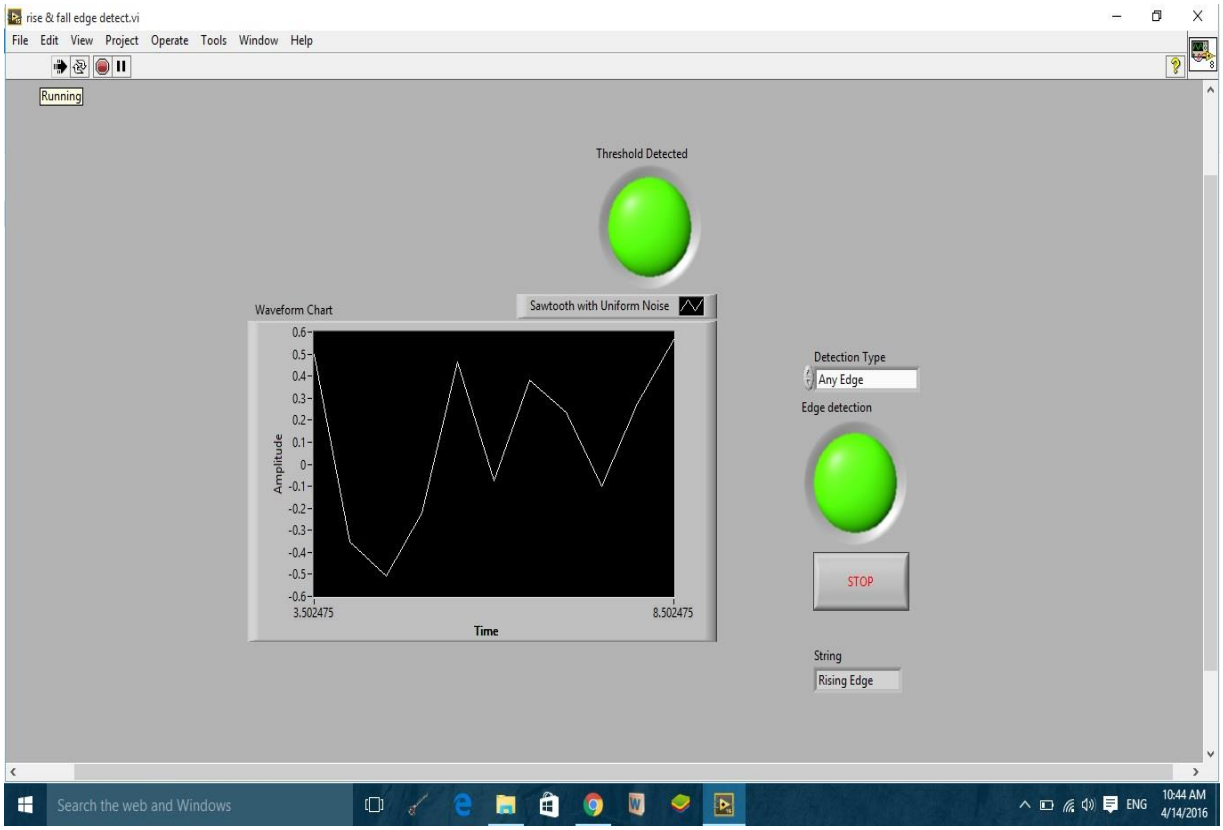



**Fig 4 :VI showing that the edge and threshold are detected**

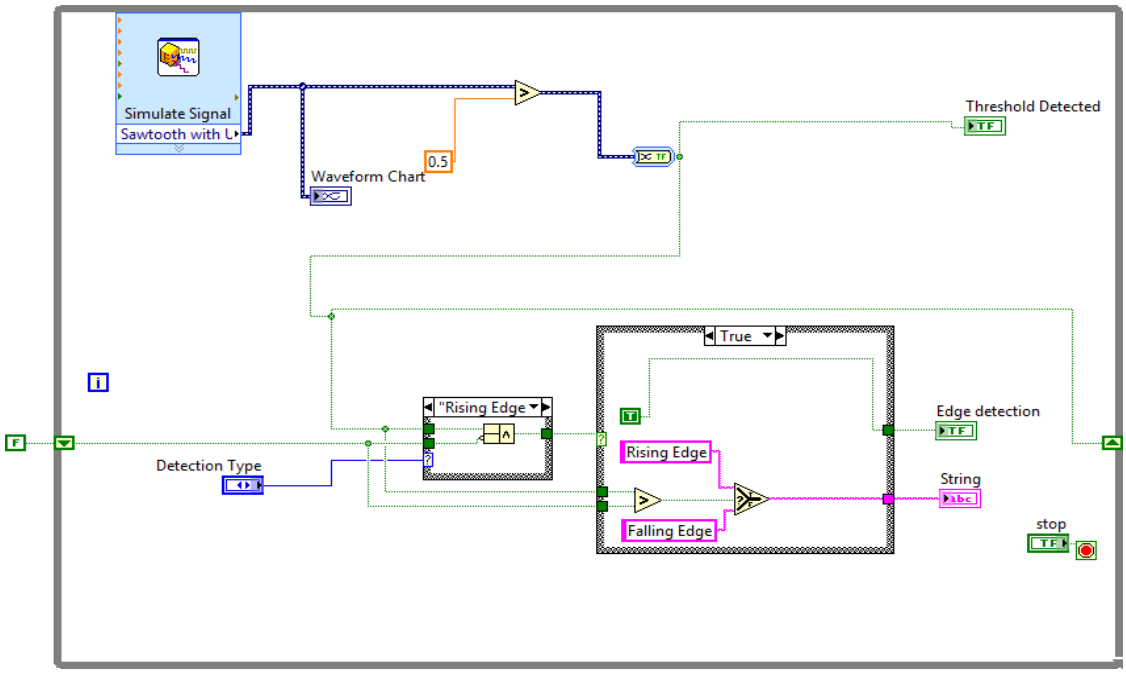



**Fig 5 : Block diagram of the rising and falling edge detection**

## 6. CONCLUSION

The objective of this project is to design a fall detector using MEMS accelerometer through software programming and verify the efficiency achieved.As the technology advances day-to-day ,usage of recent sensors can advance the system efficiency and improve the accuracy of the system.By the conclusion of this project,we had achieved our primary goal of designing a fall detector with the advanced technology and programming using software.Here,we have preferred Lab View as the software programming tool to design a fall detector.

## 7. FUTURE SCOPE

To improve the accuracy and efficiency of the programming , we can opt for a 3D image creation through which a subject is created and is continuously verified whether a fall has occurred,if so then alarm is to be given and a message alert to be sent through relatives and nearest healthcentres. The object is created and then the threshold is calculated for the three axes and when it exceeds the threshold,fall is detected.

In future, the MEMS sensor MPU6050 can be used that contains a three axis accelerometers and gyroscope.Then ,MPU6050 is interfaced with the computer through Arduino Uno. Then the accelerometer data received through LABVIEW is further processed and classified.In this way, we can gain the advantages like high speed,low power and costeffectiveness.

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