

# Design of Smart Home System for Internal Threats

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## Abstract

Senior citizens are very precious for us. Senior citizen is our responsibility and we have to take care of them. In this era, the lifestyle has completely changed due to busy schedule and we will be unaware from any accident will happen with the senior citizen. Many researchers used technology for monitoring health issue of the senior citizen. Health related issue was discussed by many researchers but no one considers internal threats occur in home. The health parameters are considered in home and hospital for monitoring patient, if abnormal condition is occur then alert will send to caretaker and doctor. In this smart system internal threats like fall detection, electric shock and water blockage are handling by propose smart system for senior citizen at home. If any threat occurs then the system send SMS on doctor mobile and caretaker mobile or any senior person mobile at home.

**Keyword:** Fall detection, internal threats, health issue, SMS.

## 1. Introduction

There are many elder people in our community who want to leave independently in home environment. Elderly people have many problems like infirmity, memory loss or impaired judgment. If they want to live alone they require constant monitoring system so that they get help in their emergency time.

We developed a cognitive based system for senior citizen. The sensors detect the usage of appliances at home and collect important information. The purpose is to monitor people's daily activities in a noninvasive manner and also provide reassurance that should something happen for which assistance is required; the system will alert the appropriate people. By measuring the activity of specific appliances in the home of the person, the system will be able to build a profile of the person. Any major deviation in the routine of their daily life is defined as an abnormal activity.

People like elderly, disabled or chronically ill people, who are often suffering from coexisting troubles, are not encouraged to dare benefiting from ICT and

innovations. As available solutions are not complete, not compatible with the others, not scalable, neither end-to-end nor comprehensive, and remain unaffordable for someone who would try to subscribe to each relevant service. The service covers a more or less significant part of its medical and social needs, without ensuring a global management of the daily problems. Most of the people are not familiar with these types of innovation-based solutions. Especially in such a medical or health-related purpose, although their development requires the natural component of the medical and social environment and infrastructure. Nowadays, the best choice for elderly fall detection is to use a bracelet with a push button around the neck. Unfortunately, if the person forgets to carry the system accomplish a system of surveillance at home for the seniors living alone, it is possible that the help does not arrive early. The idea of this project is to resolve this problem by using sensors attach to body of the senior citizen for automatic detection of threats.

By using wireless sensing technology parameters values are send to the system with the help of Bluetooth, Wi-Fi and cellular networks. All the sensors check the value automatically if any threat is occur and send emergency alert to caretaker and doctor for medical help.

## 2. Literature Survey

### 2.1 Based On Sensors

#### A. Accelerometer

Accelerometer is to measure acceleration in one, two, and 3 axes. 3 axes unit are most common for because cost of development is less. Capacitive plates are places internally in accelerometer. Some of the capacitive plates are fixed, while others are attached to miniscule springs that move internally as acceleration forces act upon the sensor. Due to

moving plates in relation with each other capacitance is change in between them. From these change in capacitance, the acceleration can be determine.

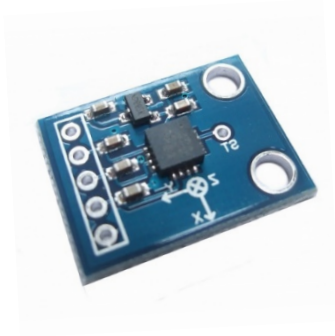


Fig. 1 ADXL 335

### B. Cardio tachometer

It is an instrument that measure heartbeat and it provide detail heart rhythm as it progress from one beat to next beat. It collects and analyze the heartbeat or other biophysical characteristics over period of time.



Fig. 2 Cardio tachometer

### C. Heart rate sensor

When a finger is placed on heart beat sensor digital output is form. When the heart beat detector is working, the beat LED flashes in unison with each heartbeat. This digital output can be connected to microcontroller directly to measure the beats per minute rate. It works on the principle of light modulation by blood flow through finger at each pulse. For further information please refer to its datasheet.

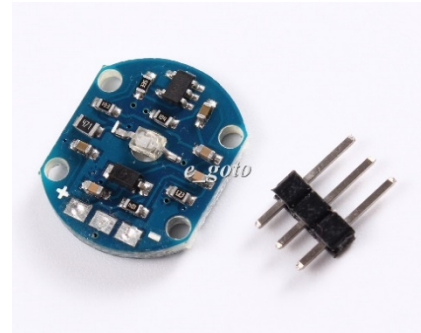


Fig.3 Heart Rate Sensor

### D. Temperature Sensor

The LM35 sensor used to measure temperature. The LM35 series are precision integrated circuit temperature sensors, whose output voltage is linearly proportional to the Celsius temperature. LM35 sensor measure temperature more accurate than thermistors. It is sealed and does not undergo oxidation. It does not require output voltage to be amplified.

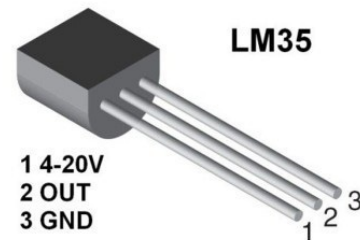


Fig.4 Temperature sensor LM35

### E. Gyroscope

A gyroscope is a device that determine orientation with the use of Earth's gravity. It consists of a freely-rotating disk called a rotor, mounted onto a spinning axis in the center of a larger and more stable wheel. When the axis turns, the rotor remains stationary to indicate the central gravitational pull, and thus which way is down.



Fig. 5 Gyroscope

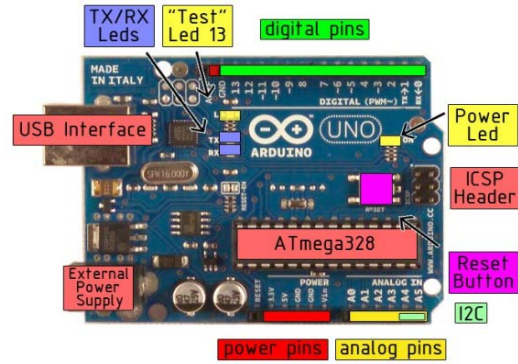


Fig. 7 Arduino Microcontroller

## 2.2 Based on Microcontroller

### A. ARM Cortex M3

ARM Cortex M3 is 32-bit processor used for cost sensitive, low power, real time embedded applications. The chip can operate up to 100MHz CPU frequency. The universal asynchronous receiver/transmitter (UART) interface provides the sampling frequency up to 4Mb/s. UART is a microchip with programming which controls a computer interface to its serial device.

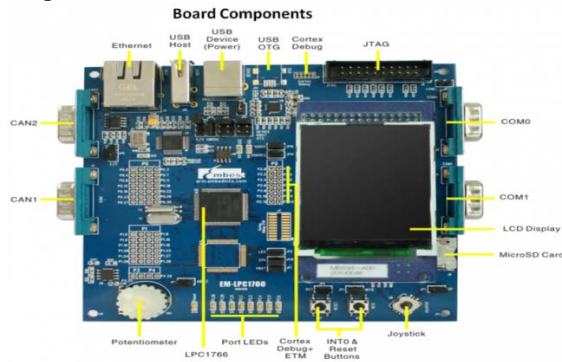


Fig. 6 ARM Cortex M3 Microcontroller

### B. Arduino

Arduino uses the architecture of Harvard, which contain separate program memory and data memory for program code and data.

Arduino is a microcontroller which directly connected to a computer with USB cable or powers it with the battery to get started. Arduino send the information to server through GSM module. Arduino Uno is a microcontroller board based on the ATmega328P. The ATmega contains a CPU, RAM, Flash ROM, timers, I/O, including an A/D converter etc.

### C. Raspberry pi

The raspberry pi is credit card sized computer that directly connected to a computer or TV, and uses a standard keyboard and mouse. The Raspberry Pi Model B+ has dual core ARM11 processor with 512MB SDRAM and powers through Micro USB socket of 5V.

Sensors are directly connected to the raspberry pi model and then raspberry pi send the information to servers.

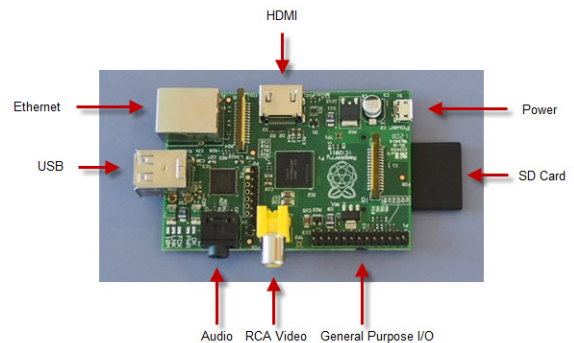


Fig. 8 Raspberry pi

## 2.3 Based on Smart communication techniques

In wireless network system sensing parameters are transmitted through Bluetooth, Wi-Fi and Zigbee.

### A. Zigbee

Zigbee is wireless Networking technology use for digital radio connection between computers and related devices. This type of network does not use physical data buses like USB and Ethernet cables. Health monitoring systems used zigbee networks for transmitting sensor a reading. The data send by sensors is transmitted wirelessly to microcontroller. Microcontroller will match the data limit predefined

in code of microcontroller. If the collected data is more than limit defined then SMS is send to the doctor or caretaker.

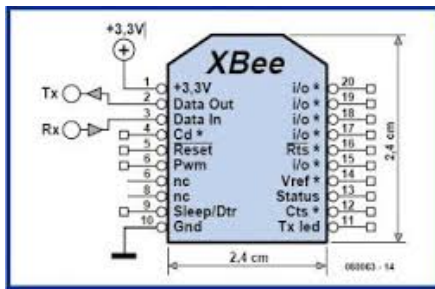


Fig. 9 Zigbee

### B. Wi-Fi

Wi-Fi allows you to access or connect to a network using radio waves wirelessly. For example you can join network to get internet access without use of wires.

### C. LAN

One or more computers and peripherals are connected wirelessly to share common communication link in organization. Different computers and mobile devices use LAN to share resources such as network storage or printer.

### D. Bluetooth

Bluetooth is use for interconnection between mobiles, computers and personal digital assistant over a short range wireless connection. Using this technology, parameters are sending to the microcontroller for further processing.

## 2.4 Based on Message Techniques

Once the health parameter of senior citizen cross the threshold value then message is send to caretaker, doctor. Also the parameters are displayed on LCD in hospital. Sometimes message is send through email on doctor pc and doctor will check the previous database of the patient.

## 2.5 Limitations of Existing System

1. Short range in terms of communication with the system, Zigbee has shorter range over WIFI.
2. Low data speed in term of vision based monitoring, vision based monitoring uses high bandwidth.
3. Vision base monitoring system with one cover limited area in home.

4. Most of the researchers concentrate on fall detection and health related issues no one considers another issues related to the senior citizen.

## 3. Existing System

Most of the existing systems are developed for health monitoring for patients and senior citizen. An enhance fall detection system used for monitoring elderly person. If fall event occur then the system will check change in acceleration and check with predefine values. If these values over the threshold then system will call caretaker. Then system checks heart rate, if it is over the threshold then system call relative to take preventive action. After system check trunk angle, if trunk angle over the threshold then system will call caretaker, relative and ambulance also to take preventive action [2]. Combination of accelerometer and gyroscope is used for fall detection [3]. This system includes wireless sensor system and detection algorithm. Wireless sensor system transmits and receives real time data of accelerometer and gyroscope after fall event. Many researchers developed system for monitoring health parameters like Heart Rate, Temperature and blood pressure for hospital and homes environment [4][5][7]. Data transmission is done wirelessly through zigbee. Raspberry pi will send the patient parameters on personal computer and mobile.

HONEY (Home healthcare sentinel system), is a three-step detection system, accelerometer, audio, image and video clip. This system detect falls by leveraging a tri-axial accelerometer, speech recognition and on demand video. If the fall event was detected then alert email was send and video was uploaded to network storage [6].

An integrated health monitoring system is developed to monitor a patient starting from home to hospital. Patient in a critical condition are monitored through this system. This system facilitates communication between professional at local hospital and specialist available consultation from different hospital to take decision with the patient [9]. Fall detection system using accelerometer developed for older people. If the fall event occur the system will check the values of thee axes with respect to define threshold. If value is below the threshold then it will send a message with latitude and longitude of person location [10].



## 4. Proposed System

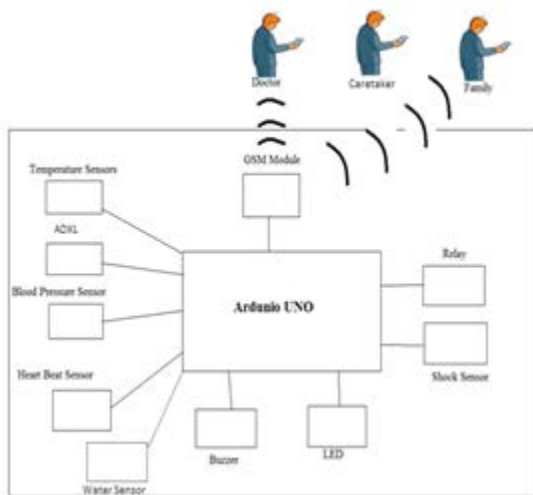


Fig. 10 System Architecture

The propose system is to detect internal threats and preventive action against it. There are many internal threats for senior citizen at home. The propose system only consider three internal threats like fall detection, shock mechanism and water blockage. Accelerometer is use for detect the fall condition, if the three axes values of accelerometer goes beyond the predefine threshold values then the system will check heartbeat, temperature and blood pressure of the elderly person if the parameters are above the threshold then system will send SMS automatically to respective doctor, caretaker, and senior person at home to take preventive action.

Sometimes senior citizen may contact with the faulty sockets and plug, also accident is happen due to Cable cut, wear and tear in home and elderly person get contact in the socket, plug, cable. The system is also take a preventive decision by sending a SMS through GSM to caretaker, doctor and senior person at home, if any accident is happen with senior citizen.

Due to water blockage near kitchen and bathroom it may harm to senior citizen because most of the times senior citizen are alone at home. For their safety our system alert caretaker and senior person by sending a SMS through GSM module.

### 4.1 Advantage

1. Time related event setting can be achieved
2. System is globally accessed
3. Improve the speed due to fast respond

4. Emergency is detected quickly monitor.

5. No need of manual updating of data.

### 4.2 Assumptions.

Assumptions are on the basis of ideal condition for senior citizens who stay alone at home or who want to live independently. We have taken three internal threats fall detection, Electric shock and Water blockage.

1. Fall detection: Fall is due to any condition, fall due to slippery area, fall due to hurdle during walk and natural fall. If the fall happened heart rate, blood pressure suddenly increase due to fear, we have taken these parameters for fall detection. Our system efficiently handle if fall occur and send alert SMS to doctor, caretaker and senior person at home to take a preventive action.

2. Electric shock: Elderly person often more risk of electric accident and injuries due to faulty appliances. If any socket, plug is damage in the home then it is dangerous for elderly person. Sometimes accident is happened due to Cable cut, wear and tear in home and elderly person get contact in the socket, plug, cable. In shock mechanism heart rate is consider if shock occur. Also alert SMS is send to doctor, caretaker and senior person at home to take a preventive action.

3. Water Blockage: Many people says that home is safe place for elderly people but again internal threat is that water blockage. In our home these types of conditions are arises near the bathroom and in kitchen. Due to blockage near the bathroom and kitchen it may get harmful for the elderly person. We have taken this threat because elderly person can live safely in home. Due to blockage senior citizen may slip from these area and fall occur. Our system detect water with the water sensor and send SMS to caretaker and senior person.

## 5. System Analysis

We have taken initial readings for accelerometer, temperature sensor, blood pressure sensor and heart rate sensor. When fall occur the values of (x, y, z) axis are change and heart rate also increase with respect to normal heart rate. Also body temperature is change after fall. In shock mechanism we consider acceleration and heart rate. If senior citizen get shock then these parameters are helpful to detect shock.

Table 1: Initial Readings

X	Y	Z	Temp	BP	Heart Rate
400	250	300	26	95	66
250	400	325	23	99	70
12	14	16	20	92	65
222	400	350	24	90	74

## 6. Conclusion

This proposed system is basically develop for senior citizens when they are alone at home. System detects a various internal threats like fall, electrical shock, water blockage with the help of sensors. Sensor will send data to Arduino for further processing. Arduino will send SMS through GSM in emergency situation to the doctor, senior person at home and caretaker.

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