
**“IMPLEMENTING ELDERLY CARE SMART HOME SYSTEM USING A BLUETOOTH AS
WSN”**

¹**DR. C. M. JADHAO**

**Principal, MGI, College of Engineering, Shegoan, India
cmjadhao@gmail.com**

²**PROF. N. B. BHAWARKAR**

**Assistant Professor, Department of Electronics & Telecommunication, MGI College of Engineering, Shegoan, India
nb.bhawarkar@gmail.com**

³**MISS. S. S. DESHMUKH**

**PG-Student, Department of Electronics & Telecommunication, MGI College of Engineering, Shegoan, India
ppdme07@gmail.com**

ABSTRACT: *As compare to the past, in recent years, an increasing number of technologies have been invented to be designed and develop a system for the elderly and disabled due to the aging population and increasing awareness about common problems of the disabled. With increasing age, elder people usually forget things very easily which may create safety problems for them? Here we have designed a Wireless Sensor Network with the help of Bluetooth and Arduino based smart home system for elder people to help them and ease their work and provide them safe, sound and secure living. Here we take one application for implementing same system which is analyzed and monitoring information of logistic system.*

The developed monitoring system is used to recognize the daily living and other similar activity of elderly living person. In smart homes, a group of smart, networked devices and sensors can help make the elderly and disabled more independent by letting family members, relatives and doctors keep tabs from afar. The Wireless Sensor Network deploys various sensors to identify the occurrence of specific events. The latest development in WSNs is the concept of Smart homes. A smart home system based on Bluetooth provides a safe, sound and secure for the elderly people. Sensors like motion sensor, temperature sensor, LPG sensor, and Arduino are proposed to be used for fire detection, gas leakage detection and determination of whether AC is ON or OFF. The vital data got from the above mentioned sensors can be used to monitoring the elderly people by detecting their abnormal patterns in their daily activities and picking appropriate action after occurring the abnormal condition. In case of any problem or emergency, a warning message will be generated, and alert through a loudspeaker for the user to take action of the same and in addition to that an SMS will be sent to the caregiver using GSM modem to take preventive action. Although the presented system design is just an example of how smart homes can be used, the presented system has the ability or potential of affecting all areas improving day to day life of the elderly and disabled.

Keywords: Wireless Sensor Networks, Bluetooth, Smart Home, LM-35, MQ-6 , Rasbery Pi, PIR Sensor, Arduino MEGA 328, GSM Modem.

1. INTRODUCTION

According to the recent study, it has been observed that there is increasing number of elderly and disabled people. As far as physically strangeness is concerned, elderly people are not strong enough and hence they may face to different types of accidents. On the other hand, disabled people are handicapped and cannot perform some movements and activities. However, it costs a great deal amount per year. WSN have become an Essential and needy field for research as well as scientific and technological developments. Wireless Sensor Networks are very easy to install and maintained and also flexible after installation. WSN system comprise of a large number of tiny devices equipped with a few sensors, along with some processing circuits and a wireless transceiver. Such devices are called sensor nodes and these sensor nodes can be deployed either inside the phenomenon to be sensed or very close to its Parameters like the temperature, humidity and chemical activity are constantly detected and reported by these sensor nodes.[1]

Smart home system functions generally based on a wireless sensor network. The wireless sensor network consists of a number of sensors deployed in the environment to

measure physiological parameters. The wireless sensor network is generally in form of star topology and a central coordinator of the sensor nodes collects the data from the sensors connected to various appliances. As the wireless sensor network collects data about the monitored person's activities, it recognizes activities of daily living and life styles of elderly and disabled people living alone. Using the pre-generated activity pattern, smart homes make it possible to predict the unusual behavior of the monitored person based on the classification model of regular and irregular sensor activity. As the year goes on, age of elder people increases, they usually forget their everyday activities like switching off the AC/lights/fans. They might not remember to switch off the gas cylinder which may in turn cause a LPG gas leakage which leads to blow the entire home, or closing the doors leading to thefts in home. [1, 2]

Many devices and sensors are combined and integrated to create a smart home system which is used to sense the required parameters and control some of those characteristics [18]. Sensors like temperature sensor, motion detector sensor and pressure sensor are deployed in order to monitor the health of

elder people. An inertial unit that includes Arduino is also used for fault detection and controlling. In case of any problems or emergency an SMS will be sent to the caregiver and the nearby hospitals using a GSM modem to take action for helping the person [1].

In a Smart home system, sensors are used for detection and monitoring the general parameters like temperature, humidity, LPG leakage, etc. Thus, with the leading development of wireless network systems, some parameters are preferred as low data rate, less complex protocols, long battery life, for such applications as an alternative to wasting bandwidth of high data rate protocols. Large distance wireless communication technologies mainly include Wi-Fi. [2]

The main objective of using Bluetooth amongst above mentioned technologies is for battery-power applications where lower data rate, lower cost, longer battery life and cheap system are the key requirements.[5,6] The lower data rate of the Bluetooth devices allows for better sensitivity and range, but of course offers less throughput. Bluetooth is a wireless technology standard for exchanging data (using short-wavelength UHF radio waves) from fixed or portable devices, or building a personal area networks. It was originally used as a wireless alternative to RS-232 data cables. It can be used to connect more than seven devices, overcoming problems that older technologies had when attempting to connect to each other [4].

Mesh or Star topology is generally employed for reliable communication between devices where in, each device have a dedicated connection and can communicate directly with any other device by establishing a successful communication link [12].

Smart home functions generally based on a wireless sensor network. The wireless sensor network consists of a number of distributed sensor nodes used in the system to measure physiological parameters. At hardware level, the wireless sensor network is typically in form of mesh topology and a central coordinator of the sensor nodes collects the data from the sensors connected to various appliances [10]. As the wireless sensor network gathers data about the monitored person's activities, it recognizes activities of daily living and life styles of elderly and disabled people living alone at home. Using the generated activity pattern, it is possible for smart homes to predict the unusual behavior of the monitored person based on the classification model of regular and irregular sensor activity [13].

Smart homes are dependent on a machine learning based software application to recognize normal routines and send a message to family members, relatives or medical personnel if something changes suddenly. Wireless sensor network-based smart home systems can be plugged in existing home environments with little or no modifications or damage. The rapid grow or progress in the industry standards and installation of lightweight wireless networking hardware has proved that Bluetooth is best standard, a low-cost, low-power consumption, and less-complex wireless standard, is well suited for smart home systems [3].The requirements of smart home systems can be listed as follows [6]

- Smart home systems must be open to improvements and be scalable.

- The sensors should be reduced in size and easily installed in household appliances so that they can be nearly completely invisible.
- The sensors must be highly accurate.
- Smart home systems must be easily-deployable in different home environments [17].

2. LITERATURE REVIEW

The main reason behind use of smart home system is because it constantly monitoring and analyzing the health condition of elderly people and detecting a fault caused by abnormal conditions. The fault detection system consists of an inertial unit that includes a tri-axial accelerometer and a gyroscope[12]. Sensors such as heartbeat sensor, pressure sensor and temperature sensors are used to determine the health and wellness of the elderly people based on their daily activities. The sensor data is then processes and sent to the PIC microcontroller. The PIC compares the data to the pre-existing threshold value to determine if an event has occurred or not [2].

Liu in presents the design and implementation of a smart home system based on ZigBee and GSM/GPRS network. The author explains not only the design of the home network but also how the smart home functions are remotely monitored and controlled. Mendes et al.[11] in investigate the suitability of short-range wireless technologies for smart home services. [6]

In order to reduce the impact of wireless interference on smart home networks, eliminate the need for relay nodes and mitigate unnecessary energy consumption, Li and Lin [11] in combines the advantages of wireless sensor networks and power line communications. Similarly, Ferreira et al. [15] in investigate the use of ultra wide band receivers for low bit-rate data communication transceivers for smart home applications.

The main problem is that most of the available sensors are unable to make the distinction in the monitored environment. In this respect, Malhi et al.[19] in propose a system to monitor daily activities of the elder person in their living environment. The proposed system includes a set of motion sensors network deployed on different areas. The system relies on a novel analysis algorithm to detect abnormal situations and alert the nursing staff in real time [13].

In the further research Ms. Jayshri V. Ekshinge Dr. Santosh S. Sonavane [2] has explained the system which consists of two parts, the wireless sensor network and the security monitoring and management system. In the monitoring and management subsystem, the data will be first processed and then analyzed, and ultimately will be displayed in the form of graphs, and report forms, etc. The wireless network of this system is established by using the ZigBee technology. ZigBee is a wireless network technology with the advantages of low power, short-range, high capacity and high reliability.

3. PROBLEM STATEMENT

The rapid growth in use of wireless technologies in recent years has allowed and proven the emergence and need of several standards, especially in the Industrial Scientific &

Medical (ISM) band. Elderly care smart home automation using wireless sensor networks getting very important in our life as the ratio of elder persons are increasing rapidly year by year. As we studied and seen, most of the safety smart home system used up till now uses the Zigbee technology having following problems:

- 1) ZigBee network technology is quite expensive.
- 2) As the number of nodes in a ZigBee network increases, potential communication bottlenecks can occur in some parts of the network.
- 3) ZigBee network technology is complex and power consuming.

By replacing ZigBee with better class Bluetooth technology can be helpful to overcome the problem of congestion in network which will ultimately increase the performance of the smart home system or failure of automation system due to unreliable network issue[8]. On top of that using Bluetooth technology in smart home system will greatly affect the cost of smart system and can be affordable by medium class elder person also. The use of Bluetooth in smart home system will be as.

4. PROPOSED WORK

The proposed system aims at constantly monitoring the health condition of elderly people and detecting a fall caused by abnormal conditions. The proposed fall detection system consists of an inertial unit that includes a Sensors such as LM 35 Temperature sensor, MQ-6 Gas Sensor, PIR Sensor, Rasbery PI and Arduino MEGA 328 are used to determine the health and wellness of the elderly people based on their daily activities[13]. By placing the sensor in the smart home system a functional assessment can be done. In case of any emergency, SMS will be sent to the caregiver using the GSM modem architecture to take preventive action or help the person by any means necessary. The sensor data is procured and sent to the Arduino for further action[10]. The Arduino compares the data to a pre-existing threshold value to determine if an event has occurred or not. If a life threatening event has occurred then a message is sent to the caretaker and the hospital via the GSM module with the help of Bluetooth as a network device.

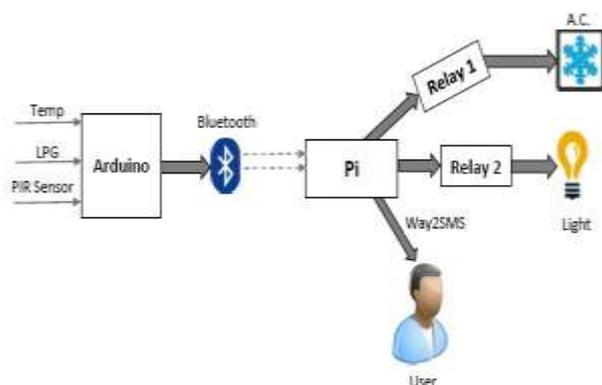


Figure 1: Block diagram of proposed smart home system.

A) Hardware Implementation

The hardware component used for designing the prototype described are:

1) LM 35 Temperature sensor

LM35 temperature sensor is a linear, analog temperature sensor whose output voltage varies linearly with change in temperature. LM35 is three terminal linear temperature sensor from National semiconductors. It can measure temperature from -55oC to +150oC and detects fire[15]. This sensor is used to detect the body temperature of the person nearby it. Once it completes the detection process it sends the detected data to the arduino for processing it. The voltage output of the LM35 increases 10mV per degree Celsius rise in temperature. LM35 temperature sensor can be operated from a 5V supply and the stand by current required is less than 60uA.[5]

2) MQ-6 Gas Sensor

MQ-6 is easy to install and a simple-to-use liquefied petroleum gas (LPG) sensor, suitable for sensing LPG leakage and concentrations in the air. The MQ-6 can detect gas concentrations anywhere within the range 200ppm to 10000ppm. MQ-6 gas sensor is a 6 pin device and it requires maximum 5 volt DC supply to work which is derived from a Zener based power supply. There is a heating element settled inside the sensor which becomes hot at 5 volt and remains stand by. When the sensor detects gas molecules leaked in the atmosphere in range 100 ppm to 1000 ppm, its output turns high and triggers T1 in order to activate the buzzer.

3) PIR Sensor:

PIR sensors is used to sense motion, to detect whether a human has moved in or out of the sensors range. They are small, inexpensive, low-power, easy to use and don't wear out. It can work up to 10 meters at an angle of ± 15 degrees. The PIR detector senses a moving warm objects such as people, animals or vehicles it detects it and electronically turns on the lights[15].

4) Rasbery PI:

The Raspberry Pi is a series of small credit-card-sized single-board computers. Specially design to promote the teaching of basic computer science in schools and in developing countries. While operating at speed/frequency 700 MHz by default, the first generation Raspberry Pi provided a real-world performance which is equivalent to 0.041 GFLOPS. On the CPU level performance is similar to a 300 MHz Pentium II.

Rasbery PI Specification

- CPU: 700MHz ARM1176-JZFS
 - GPU: Broadcom Video Core IV
 - Memory: 256MB LPDDR2-800
 - Video: HDMI, composite
 - Storage: SD card
 - Networking: 10/100 Ethernet
 - Power: 5V micro USB
- #### 5) Arduino MEGA 328

Arduino MEGA 328 is a High Performance and Low Power AVR 8-Bit Microcontroller with excellent interfacing capability. It consist of internal 10-bit ADC, an SPI serial port, and IEEE® std. 1149.1. It also has on chip Debug system and programming used for fault detection and controlling.

Arduino MEGA 328's Specification are as follows

Processor: 16 MHz ATmega328
Performance: 20 MIPS at 20 MHz
Flash memory: 32 KB
Ram: 2 KB
Operating Voltage: 5V
Input Voltage: 7-12 V

6) Bluetooth

HC-05 is a class 2 Bluetooth module with Serial Port Profile (SPP). It is wireless technology standard for exchanging data over short distances (using short-wavelength UHF radio waves in the ISM band from 2.4 to 2.485 GHz) from fixed and mobile devices, and building personal area networks (PANs). Range is approximately 10 Meters (30 feet). It can be configure either as master or salve battery-power application

HC-05 Specification

Bluetooth Protocol : Bluetooth Specification v2.0 + EDR
Frequency : 2.4 GHz ISM band
Profiles : Bluetonoth Serial Port

As the inputs and outputs of the proposed smart home systems cannot be managed by standard Arduino boards because it has limited number of inputs and outputs, an Arduino Mega board was used. An Arduino Ethernet shield was used to provide communication between the sensors and the Arduino Mega board was used to process and send the gathered information to the system's users, and make the system which can be remotely manageable.

The sensors are scattered in such a manner so that the systems get every essential value from every corner of the ambient environment that is applicable to wellness determination of an individual who stays there. These sensing units transmit their data to RF module Bluetooth series-2 end-device to Bluetooth Coordinator connected to home gateway.



Figure 2: Hardware Module of the proposed system



Figure 3: Detailed output on screen

B) Software Implementation

4) Bluetooth on Raspberry Pi with Buildroot

Buildroot is a simple, efficient and easy-to-use tool to generate embedded Linux systems through cross-compilation and it is open source[9].

Steps for configuring the kernel is as follows:

- **Kernel Configuration**

- 1) First enable Bluetooth subsystem support under Networking support.
- 2) Enable RFCOMM protocol support under Bluetooth subsystem support.
- 3) Since we're using a USB adapter, enable HCI USB driver under Bluetooth subsystem support.
- 4) The Kernel Bluetooth stack is called BlueZ. BlueZ also provides a set of utilities that can be used from the command line.

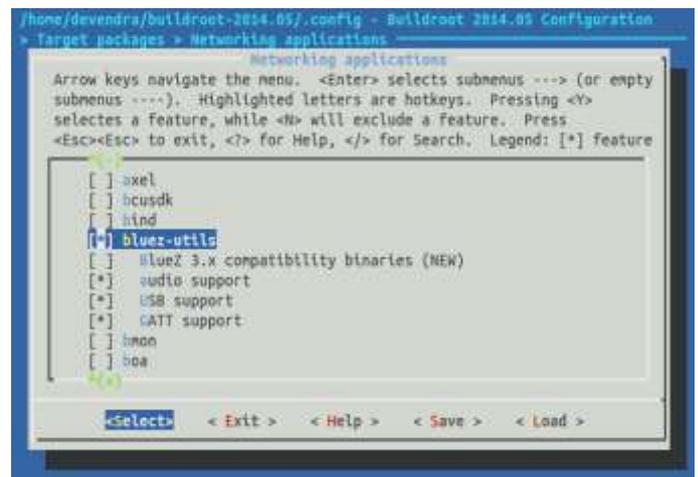


Figure 5: Configuring Kernel

C) FLOW OF PROPOSED SYSTEM

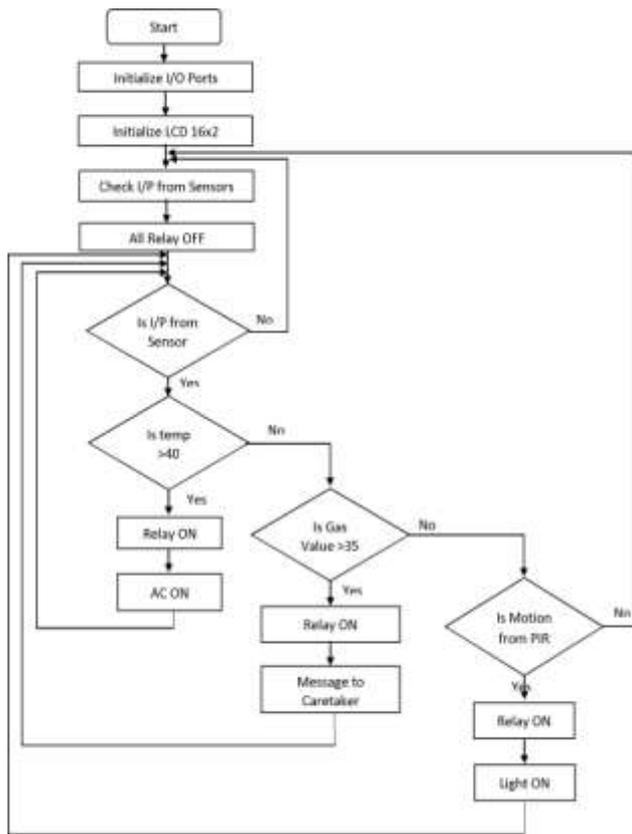


Figure 6: Flowchart of proposed Smart home monitoring system.

5. RESULTS AND DISCUSSIONS

A) Energy Consumption

In the proposed system, the PIC microcontroller board is connected to the GSM module, to make voice calls and to send and receive SMS. In the existing model, which uses Arduino Mega 2560, the power consumption of it comes close to 6000mA. In comparison to the proposed system which uses PIC which only uses less than 1000mA the Arduino kit's power consumption is too high. This difference is shown using the bar graph in Fig 7.

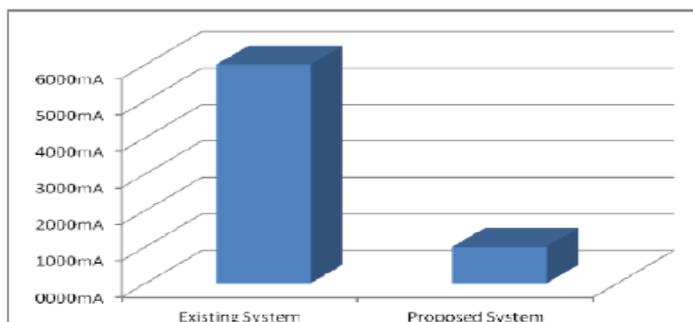


Figure 7: Energy Consumption comparison between the existing and proposed system.

B) Security

The existing system used Precision Centigrade Temperature Sensor and, traditional Gas sensor, contact sensor only. In the proposed system, LM35 is used for detecting room temperature along with MQ-6 Gas Sensor, PIR Sensor, Rasbery PI and Arduino MEGA are used.

Figure 8 shows the display of the mobile handset when Message is received by the caregiver.



Figure 8: Message is received by the caregiver.

6. CONCLUSION

This work specially focus on the use of Bluetooth technology along with Wireless sensor network helps in order to find out different approaches to solve the problem for increasing power saving, efficiency, network traffic.

Smart home control system based on wireless sensor networks to make home area networks more intelligent and energy efficient. From this work it is expected that it contributes towards the development of energy savings. A smart home control system can provide remarkable cost savings in a home network for the home automation.

Advanced energy management systems will become common in residential and commercial buildings because occupant behaviors have noticeable impact on the total energy consumption. This prototype system achieved an energy savings of 6% - 10% by implementing a relatively simple control policy.

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