REMOTE HOME SECURITY AND AUTOMATION SYSTEM USING ZIGBEE BASED MULTI-BOUNCE COMMUNICATION

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***Abstract*- Nowadays, smart home using wireless communication is replaced by the wired system because which is very messy and tough to setup. However, the existing wireless smart home system only can cover up to a certain range of area that is limited by the range of wireless module being used. Here new concept is introduced for understanding and strategy of ZigBee IEEE 802.15.4 standard to be deployed in smart home environment. ZigBee technology offers a multi-bounce communication capability for data transfer. Multi-bounce communication will provide the unlimited range of communication for the system as long as there are intermediate nodes that will pass the data from one node to another node until it reaches to the destination. Prototype systems of home security and automation are built by utilizing Zigbee based sensor network to present an insight for its practical implementation in smart home concept.**

I. INTRODUCTION

Presently, there are different remote advances accessible, for occurrence Bluetooth, Infrared (IR), ZigBee, Radio Frequency (RF) and so on. Radio recurrence (RF) module is a remote gadget that essentially deals with either 413 MHz or 315 MHz recurrence. Essentially, the module doesn't contain any convention and it will telecast the sign with no security included. RF just backings star topology and the remote reach can conceal to 100 meters. Bluetooth is a remote innovation that had been presented 10 years back for short-run correspondence. Bluetooth innovation is produced to be utilized as a part of Personal Range Network (PAN) system for low power correspondence between gadgets, for example, telephones, PCs, Personal Digital Assistance (PDA) and so on. The reach for bluetooth remote gadget can be up to 10 meters with 2.5mW (4 dBm) force utilization. Bluetooth works in unlicensed Industrial Scientific-Medical (ISM) band at 2.4 G Hz with the ability of recurrence jumping and it just backings star topology correspondence. Zigbee is a convention that had been created in view of Open System Interconnection (OSI) layer model. It expands on IEEE standard 802.15.4 which characterizes the physical and Medium Access Control (MAC) layers. Zigbee has three sorts of correspondence topologies; star topology, tree topology and cross section topology. Zigbee remote gadget works with low power utilization which makes it the most advanced remote gadget to use in Wireless Sensor Network (WSN). Zigbee has multi-bounce correspondence ability, subsequently giving a boundless scope of correspondence. Under the home environment, various sensors. i.e. movement indicators, smoke finders, water sprinklage identifiers and so on. The specialized gadgets can be used for association all through the house, fit for observing and distinguishing the physical occasions. The information from these sensors can be utilized to caution the proprietor of any un approved interruption or control home devices, for example, lightings. Hence, keeping up consistent integration in the middle of gadgets and the principle controller is extremely significant. A lost integration can improve the security of the home. It is additionally an essential element to guarantee the gadgets being utilized work as a part of low power utilization so that they would last more. Components will permit the innovation to exploit short-run remote convention, adaptable lattice organizing, solid security apparatuses, all around characterized application systems.

In the proposed model the signal transfer from the source node to the destination with the help of Zigbee protocol is presented using multi-

bounce communication technology. So that user can achieve the desired output.

II. DIAGRAM OF THE PROPOSED SYSTEM

The fig.1 shows the sender node which is used to send the message through Zigbee model to the GSM device. The message will pass through circuit connection of the system and shows how the signal transferred from source to destination. Here the sender and the receiver both works according the user. Fig 1 contain GSM module used to receive the message from the user. And transmitted to the Zigbee protocol such that with the help of multi-bounce technology the message devided into packets. With the help of the receiver (Fig 2) which consist of the Zigbee will acitivate the corresponding assets according to the user requirements. Fig.1 and Fig.2 are the reduced block diagram of the messy network.

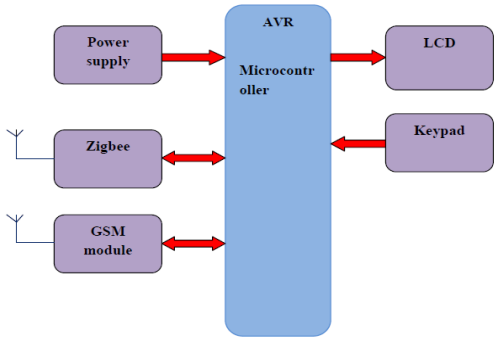

Fig.1 Block diagram of the sender node [3]

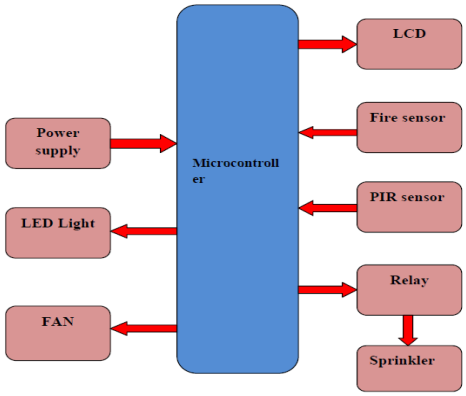

Fig.2 Block diagram of receiver node [3]

III. COMPONENTS USED IN THIS SYSTEM

3.1 TRANSFORMER

Transformers convert AC electricity from one voltage to another with little loss of power. Transformers work only with AC and this is one of the reasons why mains electricity is AC. Step-up transformers increase voltage, step-down transformers reduce voltage. Most power supplies use a step-down transformer to reduce the dangerously high mains voltage (230V in UK) to a safer low voltage. The input coil is called the primary and the output coil is called the secondary. There is no electrical connection between the two coils, instead they are linked by an alternating magnetic field created in the soft-iron core of the transformer. The two lines in the middle of the circuit symbol represent the core. Note that as voltage is stepped down current is stepped up. The ratio of the number of turns on each coil, called the turn's ratio, determines the ratio of the voltages. A step-down transformer has a large number of turns on its primary(input) coil which is connected to the high voltage mains supply, and a small number of turns on its secondary (output) coil to give a low output voltage Step-up transformers increase voltage, step-down transformers reduce voltage.

3.1.1 Significance of Transformer in this System

- Here Transformer is used to convert high voltage power supply to low voltage.
- When the user switching on the model there might be a chances of power fluctuation at that time Transformer helps to convert high voltage signal to low voltage.
- Mainly helps in the circuit board while signal flow from one point to other point.

4.1 LIGHT EMITTING DIODE (LED)

A light-emitting diode (LED) is a semiconductor light source. LEDs are used as indicator lamps in many devices, and are increasingly used for lighting. The LED is based on the semiconductor diode. An LED is usually small in area (less than 1 mm^2), and integrated optical components are used to shape its radiation pattern and assist in reflection. LEDs present many advantages over incandescent light sources including lower energy consumption, longer lifetime, improved robustness, smaller size, faster switching, and greater durability and reliability.

4.1.1 Significance of LED in this System

- LED is used for output purpose.

- To control lights when user send a message to receiver then the corresponding light will glow.
- In the same way when the user send message to switching off the lights, User can send message to the receiver.

5.1 ZIGBEE

One of the emerging standards in the move toward a wireless world is an approach called ZigBee. Pioneered by Phillips, it has since formed into an alliance of companies working together to create a wireless communication protocol. The ZigBee stack unlike Bluetooth is relatively straight forward technology.

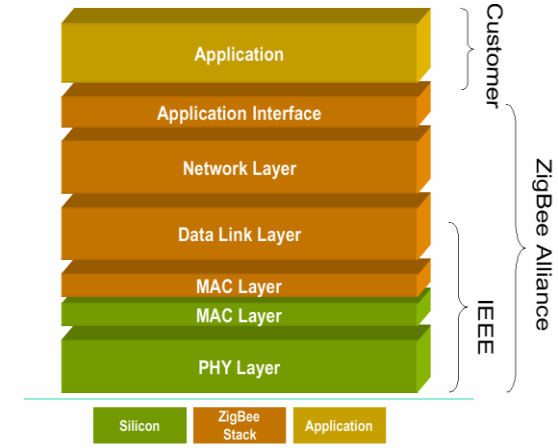

Fig 3.Zigbee Protocol Stack[4]

5.1.1 Features of Zigbee Protocol

RF data rate: 250kbps
Transmit power: 50mW.
Serial data interface: 3.3v CMOS UART
configuration method: API or AT commands
Frequency band: 2.4 GHz
Serial data rate: 1200-250kbps.
ADC inputs: 10-bit
Digital I/O: 8

5.1.2 Significance of Zigbee Protocol in this System

- Zigbee is used to receiving the information from the sender node.
- By using multi-bounce technology Zigbee can convert the information into packets and send to the destination.
- By using Zigbee technology user can avoid losing of data packets.

6.1 GSM MODEM

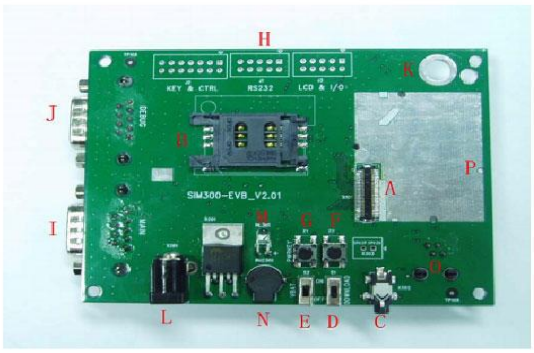

Fig 4. GSM model circuit board[6]

A modem is a device or program that enables a computer to transmit data over, for example, telephone or cable lines. Computer information is stored digitally whereas information transmitted over telephone lines is transmitted in the form of analog waves. A modem converts between these two forms. A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, or it can be a mobile phone that provides GSM modem capabilities. A GSM modem is a specialized type of modem which accepts a SIM card, and operates over a subscription to a mobile operator, just like a mobile phone. From the mobile operator perspective, a GSM modem looks just like a mobile phone. When a GSM modem is connected to a computer, this allows the computer to use the GSM modem to communicate over the mobile network. While these GSM modems are most frequently used to provide mobile internet connectivity, many of them can also be used for sending and receiving SMS and MMS messages. A GSM modem can be a dedicated modem device with a serial, USB or Bluetooth connection, or it can be a mobile phone that provides GSM modem capabilities. In our project we are using SIM300 modem.

6.1.1 Features of GSM Modem

- SIM300 is a Tri-band GSM/GPRS engine
- It works on frequencies EGSM 900 MHz, DCS 1800 MHz and PCS 1900 MHz
- SIM300 features GPRS multi-slot class 10/ class 8 (optional) and supports the GPRS coding schemes CS-1, CS-2, CS-3 and CS-4.
- SIM300 can fit almost all the space requirements in our applications such as smart phone, PDA phone and other mobile devices.

- In this hardware SIM900 is only interfaced with RS232, Regulated power Supply 4.0V, SIM Tray Antenna with LED indications.

6.1.2 Significance of GSM Modem in this System

- GSM Modem helps for receiving message for the user.
- When unauthorised entry happens at that time it will send message to the user automatically.
- In the same way if fire happens in that configured area Modem will send message automatically.

7.1 RELAY

Relays are simple switches which are operated both electrically and mechanically. Relays consist of a n electromagnet and also a set of contacts. The switching mechanism is carried out with the help of the electromagnet. There are also other operating principles for its working. But they differ according to their applications.

7.1.1 Significance of Relay in this System

- Relay used for giving delay to the system.
- When transferring of the data to a destination in terms of packets delay will avoid the losing of packets**.**

Relays are used to realize logic functions. When transferring of data from source to destination relay helps to provide delay which helps in avoiding the loosing of data .While transferring of the data in terms of packets for every packet delay timer get activated and waited for the corresponding task to complete and executed the task simultaneously. Relays are used to control high voltage circuits with the help of low voltage signals. Similarly they are used to control high current circuits with the help of low current signals**.**

8.1 FIRE SENSOR

The Fire sensor design is quite self-explanatory. The LM358 OpAmp is used in the comparator mode. The IR photodiode (receiver) is used in a potential divider in a reverse bias mode. A threshold voltage is set at the inverting terminal of the OpAmp using a potentiometer. So when the heat radiation in front of the photodiode the resistance of the photodiode would decrease and this in turn when exceeds the threshold voltage will make the output of the OpAmp go high. LM 358 has two OpAmps in its 8 pin package, thus two sensors could be built out of 1 IC. Users can also use LM 324 which has 4 OpAmps inside it.

8.1.1 Significance of Fire Sensor in this System

Fire sensor is used to detect fire at the place where the device is installed. Some cases if the place get fired means at that time the sensor absorbe the heat. Inside the fire sensor it contain LM324 OpAmp which is used to detect the fire. In that situation the fire sensor send immediate signal to the receiver node such that that will be transferd in terms of packets to a Zigbee protocol. So immidiatly the Zigbee send a message to the authorized person from the sender node.

9.1 MICROCONTROLLER ATMEGA 32A (AT32A)

The ATmega32A is a low-power CMOS 8-bit microcontroller based on the AVR enhanced RISC architecture. By executing powerful instructions in a single clock cycle, the ATmega32A achieves throughputs approaching 1 MIPS per MHz allowing the system designer to optimize power consumption versus processing speed.

10.1 KEYPAD

The Keypad consist of a keys from 1 to 9 and helps for the user Security purpose as well as if the unauthorised person trying to communicate with the proposed system it will give error while entering the password. So after entering the correct password only user can access the proposed system.

11.1 PIR SENSOR

PIR which stands for passive infrared sensor is a pyroelectric device that detects motion by measuring changes in the infrared level emitted by the surrounding objects. This comes from the fact that any object having temperature above absolute temperature emits heat energy in form of infrared radiation which are invisible to human eye. Since, PIR device do not radiate or emit IR rays and works by detecting the heat energy radiated by objects in the form of IR rays they are called passive infrared sensors.

11.1.1 Significance of PIR Sensor in this System

Passive Infrared sensor is used to detect unauthorized entry in that specific place where the device is installed. That device has a Motion detection IC and Fresnel lens which is used for detection purpose. Which is contain a dual element Sensor with low noise and high sensitivity and this can be directly connected to the Micro controller. Which has a detecting range up to 6 Meters.

12.1 **SOFTWARE REQUIRED ATMEL STUDIO-6**

Atmel studio is a general-purpose interpreted, interactive, object-oriented and high-level programming language. Atmel studio is used

as a compiler to compile the codes used in the proposed system. Atmel studio was created by Alf-Egil Bogenand and Vegard Wollan from Norwegian Institute of Technology (NTH). Atmel studio6 source code is also now available under the General Public License (GPL).

Atmel is extensible, only if the user know how to program in C and java it is easy to add a new built-in function or module to the interpreter, either to perform critical operations at maximum speed, or to link c or java programs to libraries that may only be available in binary form (such as a vendor-specific graphics library). Once you are really hooked, you can link the Atmel interpreter into an application written in C or java and use it as an extension or command language for that application. And code can be added to the corresponding Micro Controller.

IV. OPERATING PRINCIPLE OF THE SYSTEM

In the fig.5 indicates the model of a sender node.

The system can identify the sender and receiver such that the authorized person send a messages. It will be transfer to the ZigBee sender node and in that circuit the message is divided into packets and that packets transfer to the other node (receiver) such that the transferring of the code will be done. The transferring of messages in the form of codes to a Microcontroller and the controller will compile the codes return back to the Zigbee Protocol. Finally it sends to the receiver node with the help of GSM module.

Depends on the user requirements user can control the corresponding device in the proposed system and it can show the working model at the receiver circuit system.

The fig.5 indicates the model of a sender node .

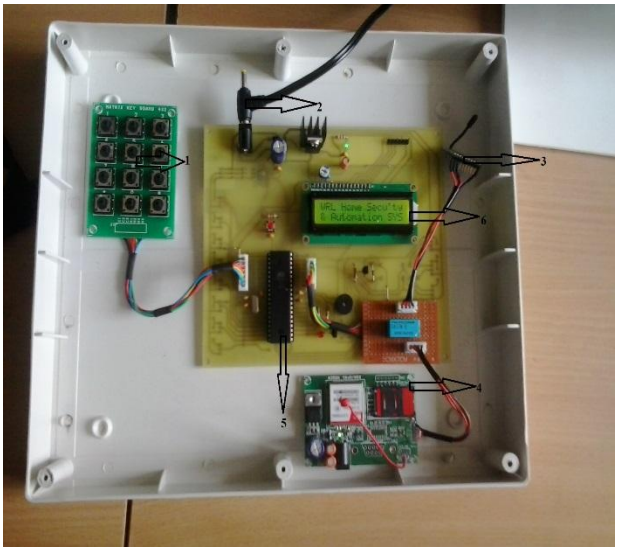

Fig 5. Model of the Sender node

1. Keypad
2. Power supply.
3. Zigbee protocol
4. GSM module .
5. AtMega32A Micrcontroller
6. Display.

The fig.6 indicates the model of receiver node.

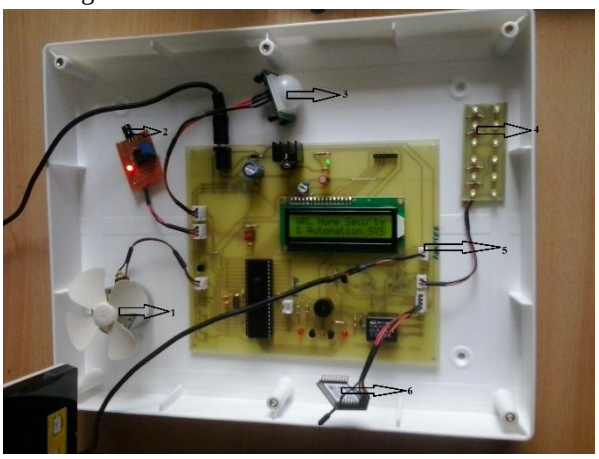

Fig 6. Model of the Receiver Node

1. Fan
2. Fire sensor.
3. PIR Sensor.
4. Led display.
5. Water Sprinkler .
6. Zigbee Protocal.

V. OUTPUT OF THE SYSTEM

The fig.7 and fig.8 shows the sender node and the receiver node which contains a Zigbee device used to control the devices from certain distance. By using multi-bounce communication system user can easily get the desired output.

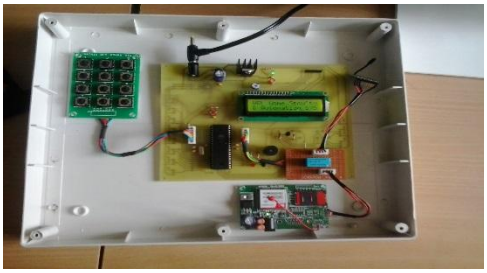

Fig 7.Output of the sender

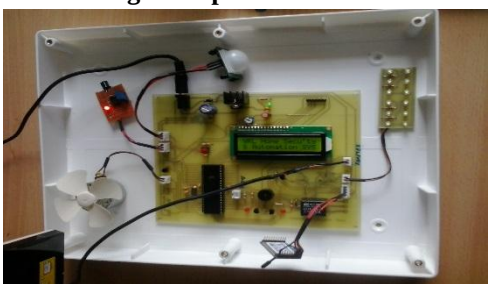

Fig 8.Output of the Receiver

VI. CONCLUSION

The present module explains about the ZigBee communication protocol and presents its potential deployment in smart home environment. Examples of prototype applications in home security and automation utilizing a ZigBee based wireless sensor network are illustrated. A comparison is made between the designed Zigbee based wireless smart home system and other existing systems in market. This system has attractive features such as244 two-way remote control ability via SMS, stores up to 9 contact numbers and home automation via Wireless Personal Area Network (WPAN) with multi-bounce capability. In general, sensors and communication devices used for the deployment in smart home are not required to have high speed communication capacities, rather more consideration needs to be focused on a limited amount of delay in communication and a low energy consumption. In this perspective, ZigBee is emerging network technology as a wireless communication standard which is capable to satisfy such requirements. Moreover, its specification is based on IEEE 802.15.4 wireless protocols, promises robust mesh network and complete interoperability.

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