

# DEPLOYING ZIGBEE-BASED WIRELESS HOME SECURITY SYSTEM

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## ABSTRACT:

Now a days, Home Security threat is the most challenging task in our life. To overcome this threat, our houses must be Smart. This paper gives a solution to overcome the Home security threat. Using Zigbee network enabled digital technology, we can make our home Smart and secure. The technology gives us the opportunity to increase the connectivity of various devices hence we can get an overall security solution. Moreover, as the area of Internet is widening, we can remotely control and monitor the network enabled devices. The device can also send signal to the remote person whom we want to notify about the threat. Common gateway is used by both the Zigbee security system and Wi-Fi network for integration purpose. The use of this system would be user-friendly, flexible and cost effective. This system will based on Zigbee network. Hence, the hardware required would be Zigbee Modules, Micro-Controller (ATMEGA168), Relays, Voltage Regulator and various sensor devices. In this method, The sensors will sense the threat and send signals to the micro-controller through Zigbee network and the micro-controller would take appropriate action and send signal to the remote location on the reception of threat signals. Zigbee technology is simple, flexible and very reliable to use. It is broadly used transceiver standard. It has low data rate and consume low power. It's operational range is in between 10 meters to 20 meters but can be extended upto 150 meters by the use of direct sequence spread spectrum (which is quite well for the purpose of a home).

## INTRODUCTION

Almost every day, we hear about the security issues in our surrounding. This issue might be of robbery, murder and all others by tempering the lock in a house. That means only a lock could not be the solution to check all these threats, our house will have some of the security features so that it could automatically detect the situation and work accordingly like a smart home. We could convert our houses into a Smart Home by using some of the sensors. These sensors will work as the eyes and ears of the house. Like as a human, there must also be a brain to look after the data received by the sensors, here this brain is ATMEGA168 Micro-Controller. This complex system will sense the data and will

have the superior capability of decision making about the subject and its environment.

This system will use the Zigbee technology. Zigbee is an IEEE 802.15.4 based specification of high level Communication protocol which is suited for creating Personal Area Network. This network will connect all the sensor devices and the micro-controller and relay devices. The advantage of using Zigbee is that it works on low power and have sufficient amount of network range. We can also monitor and control the system remotely from any distinct locations.

This security system required for:

- Empty Homes
- Banks
- Industries
- Many more

Suppose, There is no one in the house or bank and someone came with bad intentions and try to temper the lock or try to break the door then this system will automatically came in action and lock the door permanently, cameras will start to take picture of the person standing outside the door and send these picture to the owner and will wait for the response of the owner and then work accordingly.

Smart home could also be called “Automated Home”.

**Home security system**

Zigbee technology was came to be known in 2004, since then it is benefice several networking systems. The main function of the zigbee device is to create network by connecting the input sensors and Electro-Mechanical relays, Motors and Alarms as output.

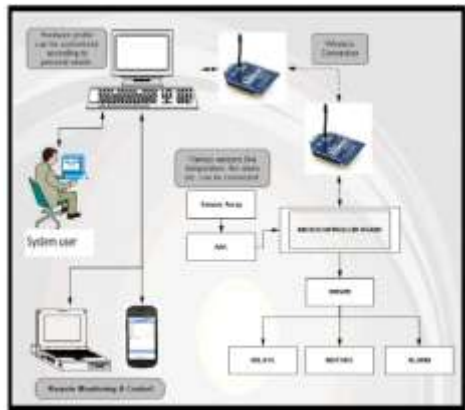


Fig.1: System Architecture

Fig. 1 shows the basic architecture of the security system. This is the proposed architecture for Zigbee based security system. Here, Sensors are used as an input devices. These inputs are cameras, infrared motion sensors and SIM 900A GSM module. These sensors will sense the presence of the person trying to enter into the house or banks, if he is a authorized person then there will be no problem but if the person is

unauthorized then the system will barred the entrance by locking the doors. Here, In this system some drivers are used as an output devices. These outputs are relays, motors, SIM 900 GSM Module. The main purpose of the proposed design is to use of technology for enhancing the security for upcoming threats. Here, We have used Zigbee technology because it is reliable, low power consumption, low data rate, supports up to 65,000 nodes in a network, can automatically established its network and uses small packets compared with WiFi and Bluetooth.

This system consist of two modules-

- Entrance Sensing Module
- Control Module with Relay Controlling Circuits.

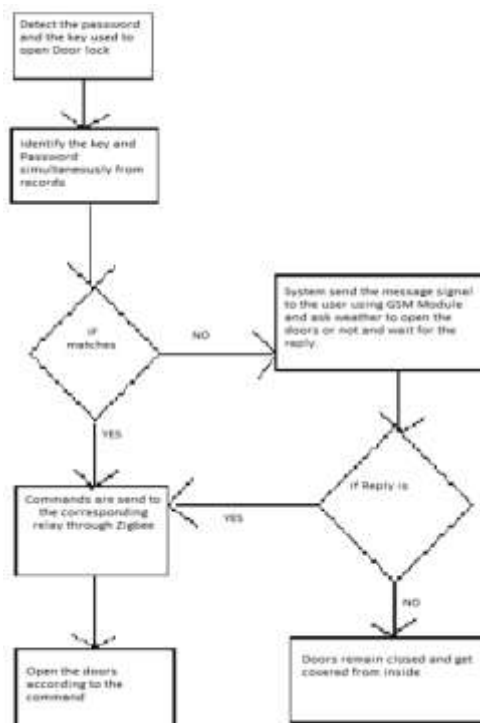


Fig. 2 Flow chart of the system

Fig. 2 shows the sequence of working of the system. As the device will ask for the password and the door key, if key and password is correct then door will get open and the person can get into the house otherwise, if, any of the two is incorrect then door will not open and send a message signal to the owner through GSM Module. After the reply of owner, the device will work accordingly.

The devices used are as follows-

#### 1. **Micro-controller (ATMEGA168):-**

ATMEGA168 is a member of AVR family. AVR is a family of micro-controllers developed by Atmel. This is modified Harvard architecture 8-bit RISC single chip micro-controller. It is high-performance, Low-power Microchip RISCbased CMOS 8-bit micro-controller combines 16KB ISP flash memory with read-while-write capabilities, 512B EEPROM, 1KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, byte-oriented 2-wire serial interface, SPI serial port, 6-channel/10-bit A/D converter, programmable watchdog timer with internal oscillator and five software selectable power saving modes. It has 32 pin count and have operating voltage range of 1.8V to 5.5V.

This AVR microcontroller have internal EEPROM for semi permanent data storage. This EEPROM maintain data stored in it even after the removal of power. The data stored in this micro-controller retains for almost 100 years at 25°C, that means for a very long time.

One of the important feature of this AVR micro-controller is that It has Flash, EEPROM and SRAM integrated on a single chip.

**2. Zigbee RF Communication:-** Zigbee is an open global standard based on the IEEE 802.15.4 standard with low-power, low-cost, wireless mesh networking. Zigbee represents a network layer above the 802.15.4 layers to support advanced mesh routing capabilities.

#### **Zigbee nodes are of 3 types-**

- **Coordinator:-** A node that has the unique function of forming a network. The coordinator is responsible for establishing the operating channel and PAN ID for an entire network.
- **Router:-** A node that creates/maintains network information and uses this information to determine the best route for data packet. A router must join a network before it allows other routers and end devices to join.
- End devices must always interact with their parent to receive or transmit data. They are intended to sleep periodically and therefore have no routing capacity. An end device can be source or destination for data packets but cannot route packets.

**Zigbee Security:-** Zigbee supports various level of security depending upon the needs of the application.

Security provisions include:-

#### **128 bit AES encryption**

- Two security keys that can be preconfigured or obtained during joining.
- Support for a trust center
- Provision to ensure message integrity, confidentiality and authentication.

The Xbee standard supports three security modes:

**Residential security:-** It requires a network key be shared among devices.

**Standard security:-** It adds a number of optional security enhancements over residential security including an APS layer link key.

**High security:-** It adds entity authentication and a number of other features not widely supported.

**Key features of Zigbee Technology:-**

- Cost effective
- Highly reliable and secure.
- Supports multiple network topologies e.g. Point to point, point to multi point, mesh network and cluster tree.
- The speed of data rate is 250 Kbps.
- Low latency
- Long battery life due to low duty cycle.
- It supports 65000 nodes per network.
- Has 128 bit AES encryption for secure data connections.
- Direct Sequence Spread Spectrum provides excellent performance in Signal to Noise ratio environment.

**3. GSM Module SIM 900A:-** GSM Modem RS232 is built with dual band GSM engine. SIM900A works on frequencies 900/1800 MHz. The Modem is coming with RS232 interface. The baud rate is configurable from 9600-115200 through AT command. The GSM modem is having internal TCP/IP stack to enable you to connect with internet via GPRS. It is suitable for SMS, Voice as well as Data transfer.

A GSM modem duly interfaced to the Micro-Controller through the level shifter IC Max232. The SIM card mounted GSM modem upon

receiving digit command by SMS from any cell phone send that data to the micro-controller through serial Communication. While the program is executed, the GSM modem receives command 'STOP' to develop an output at the micro-controller, the contact point of which are used to disable the ignition switch. The command so send by the user is based on an intimation received by him through the GSM modem 'ALERT' a programmed message only if the input is driven low.

**Comparision of Zigbee with related technologies:-**

Technology	Bluetooth	WiFi	Zigbee
Frequency	2.4GHz	2.4GHZ 5GHz	868MHz 915GHZ 2.4GHz
Modulation	FHSS	QPSK COFDM QAM	BPSK O-QPSK
Error Control	CRC(16 bit)	CRC(32 bit)	CRC(16 bit)
Range	10m	100m	10m-100m
Network Size	8	2007	64000
Power Consumption	Medium	High	Very Low

Table-1, Comparision of Bluetooth,WiFi and Zigbee

**EXPERIMENTAL RESULT**

Now analyze the implemented system on both the qualitative measures and quantitative measure with some of the experiments.

To analyze the system, we are going to observe the time taken by the system to respond on different occasions with right and wrong keys and Password. The door was opened with right keys and password 10 times and with either wrong key or password or both 10 time.

	Avg. Time taken by system is sending message (ms)	Avg. Delay after reception of message by system (ms)	Time taken in (if) opening the door (ms)
With right key and Password	N/A	N/A	1230
Without right key and password	1140	470	1610

Table-2, Responce time of the system in different situations

Now the average time taken by system in both sending message to the owner and receiving and opening the door is given is table 2.

In this experiment, We have taken an assumption that there is no problem in GSM operator network and as we send a message it got received to the other one and owner replies immediately.

Previous one was quantitative analysis but when we talk about the quality then in all the 10 time when we uses wrong key or password, system do not open the door and send the message to the owner all the 10 times. The avg time taken in getting message by owner is about 2 min. 40 sec.

### CONCLUSION

A Smart Home Security System using Zigbee technology is built and implemented. The System is targeted for Security of Home, Banks, Industries etc. Now a days, Everybody is conscious about the security of their life and property and if we can provide such a system which will take care of it then it will be the smarter use of technology in everybody's life. The proposed technology is reliable, cost saving and effective.

The prototype can control all the security devices in a home or banks because only one

smart server is enough for monitoring and controlling thousands of device instead using different smart servers. The System implements wireless network using Zigbee Module as it has higher efficiency and low power consumption. The preliminary test results are promising.

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