



## Comparative Study of Zigbee, Bluetooth and Wi-Fi Technology for Constructing Wireless Fire Alarm System

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*Abstract: This paper points out the defect of wired automatic fire alarm system in used, and the necessity and possibility of constructing wireless fire alarm system. In this paper we proposed the comparative study of various wireless technologies like Wi-Fi ZigBee and Bluetooth. we also give out method of constructing wireless fire alarm system based on ZigBee, including the design of construction, hardware and software. This paper consist of fire alarm system that performs function of sensor and usage of microcontroller.*

*Keyword: zigbee, fire alarm system, comparison of zigbee, bluetooth and wifi, construction of fire alarm system*

### I. INTRODUCTION

Now a days usage of fire alarm is popular either in offices or homes. But users are no longer satisfied with simple fire alarm detector that just senses and sounds the alarm. Many would like to have fire alarm that monitors and alert them in case of emergency especially when they are away. However user always suspect the cost of that is cheap and easy to install. Traditional fire alarm systems are classified in a hard wired so it will use many cables to connect to each other. User finds inconvenience to handle wires. Many users would like to have advanced technology which is wireless and easy to manage and install multiple function low power consumption. So in this paper we will include the construction of intelligent fire alarm system using wireless technologies like ZigBee Bluetooth and Wi-fi. Wireless technologies have been rapidly developed during recent years. Starting from military and industrial controls, it is now being widely applied in environmental monitoring and agriculture. Its advantages include the liability, simplicity, and low cost in both installation and maintenance. ZigBee is an IEEE 802.15.4 standard for data communications with business and consumer devices. ZigBee is a technology of data transfer in wireless networks. ZigBee is a low-cost, low-power wireless mesh networking standard. The low cost allows the technology to be widely deployed in wireless control and monitoring applications, the low power-usage allows longer life with smaller batteries, and the mesh networking provides high reliability and larger range. Wi-fi is also a wireless technology that allows electronic device to exchange data or to connect to the internet wirelessly using 2.4GHz UHF and 5 SHF radio waves. A Wi-Fi-enabled device can connect to the Internet when within range of a wireless network which is configured to permit this. The coverage of one or more access points called hotspots can extend from an area as small as a few rooms to as large as many square kilometers. Wi-Fi allows cheaper deployment of local area networks. Another Wireless technology is Bluetooth. Bluetooth is wireless standard technology invented by Telecom vendor Ericsson in 1994 for exchanging data over short distances from fixed and mobile devices and building personal area network. It was originally conceived as a wireless alternative to RS-232 data cables. It can connect several devices, overcoming problems of synchronization. Bluetooth is managed by the Bluetooth Special Interest Group (SIG), which has more than 19,000 member companies in the areas of telecommunication, computing, networking, and consumer electronics. Bluetooth operates in the range of 2400–2483.5 MHz. Bluetooth exists in many products, such as telephones, tablets, handheld and console gaming equipment, and some high definition headsets, modems, and watches. By using fire alarm project we can use Bluetooth device for transferring data from fire alarm system to computer. By using these wireless technologies we can construct wireless fire alarm systems so that no cables are required and maintenance is also easy. Because cables require more maintenance as compare to wireless devices. Wireless technologies have been rapidly developed so with the advancement of technology we should take advantage and develop wireless based systems. conclude which one is best for constructing wireless fire alarm system.

### II. COMPARISON OF VARIOUS WIRELESS STANDARDS

Table No 1: comparison of various wireless standards[1]

Standard	ZigBee	Wi-Fi	Bluetooth
IEEE spec.	802.15.4	802.11	802.15.1
Range	10-100 meters	50-100 meters	10 meters
Network Topology	Peer to peer star,	Point to hub	Very small

	mesh		network
<b>Complexity</b>	Low	High	High
<b>Power Consumption</b>	Very low	High	Medium
<b>Basic Cell</b>	Star	BSS	Piconet
<b>Data Protection</b>	16 bit CRC	32 bit CRC	16 bit CRC
<b>Extension of basic cell</b>	Cluster tree mesh	BSS	Scatternet
<b>Channel Bandwidth</b>	2MHz	22MHz	1MHz
<b>Data Rate</b>	20,40 and 250kbps	11 and 54mbps	1mbps
<b>Frequency Band</b>	2.4GHZ	5 GHz	2.4 GHz
<b>Number of RF channels</b>	16	14	79
<b>Max number of cell nodes</b>	>65000	2007	8
<b>Encryption</b>	AES block cipher	RC4 stream cipher	E0 stream cipher
<b>Maximum signal Rate</b>	250kbps	54Mbps	1Mbps
<b>Coexistence Mechanism</b>	Dynamic freq. selection	Dynamic freq. selection,	Adaptive freq. hopping
<b>Other Information</b>		Device connection requires 3-5 seconds	Device connection requires upto 10 seconds

### III. CONSTRUCTION OF WIRELESS FIRE ALARM SYSTEM USING ZIGBEE

The System which by we are going to construct the wireless fire monitoring system includes three parts:

- The data acquisition node
- Data sink node
- Fire control center

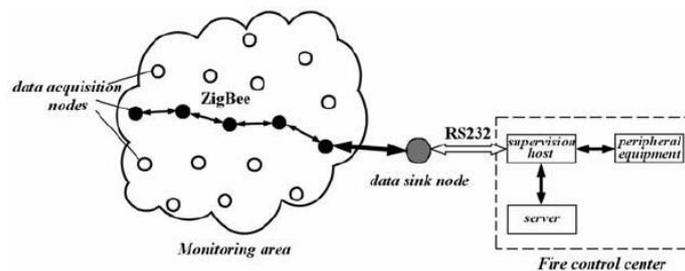


Figure 1: System Structure

- Data Acquisition Node:** It includes wireless sensor module with integrated sensors and Main Control Unit (MCU), and RF communication functions. The fire signals which were detected by sensors it chooses an optimal path so that they can be sent to data sink node.[3]
  - Data Sink Node:** Data sink node transfers the data that it has received from sensor network to the fire control center.
  - Fire control center:** Fire control center consist of two parts
    1. Server
    2. Supervision Host
- Server:** The server store the fire control data electronic map etc.
  - Supervision Host:** It is used for data processing and displaying alarm information through peripherals equipment. It is also responsible for data management query management and interaction with user.[3]

#### A. System Hardware:

Hardware consist of two parts: (a) Data collector  
(b) Data receiver

(a) **Data collector:** It includes sensor MCU, RF chips that are connected by PCI bus. They combine and constitute wireless transmission module.

(b) **Data receiver:** It also constitute same kind of wireless module. Data receiver communicates with PC through RS 232 asynchronous signal interface.

In one direction control signals are emitted from host to the data collector. In other side collected data is uploaded to the host. Whenever the fire signal is detected by sensor the fire control center will process and evaluate the data and then convert into alarm indicator according to the pre-set rules then send out alarm signal. MCU chooses 8 or 16 bit single chip microcomputer with on chip integrated ROM. MCU of data collector receives the signal sent by sensors then it send these signals to the RF chip after A/D conversion. MCU of data receiver receives the data sent from RF chip and send it through RF interface to the microprocessor computer for further analysis. Buzzer and LED are simple audio visual alarm devices. RF chip can use wireless transceiver series

CC series or MC series. They both work on 2.4 GHz band. In this hardware we have taken MC 13192 because it is low cost and low consumption and high performance chip. Its data transfer is 250 kbps

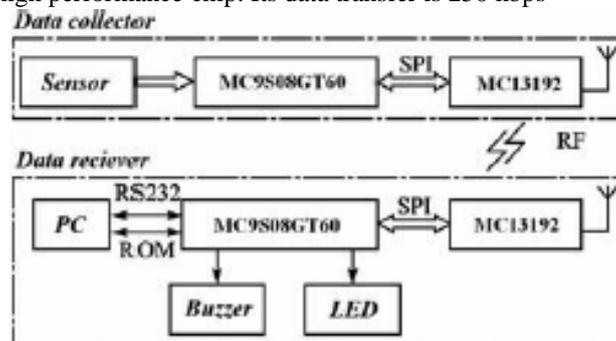


Figure 2: System Hardware Structure

#### B. System software:

It includes

- (a) wireless sensors node procedures
- (b) Data sink node procedures
- (c) Center monitoring procedures

Wireless sensor node procedure function is to detect the environmental procedures. When system starts working MCU and RF chips are initiated then it chooses channel for receiving data then initialize ADC and collect the data process. If there is alarm signal sensor node will be alarm data and then we convert this data into the ZigBee communicational protocol packets. Then we select optimal communication path we send these packets to data sink node and waiting for confirmation from sink node it can collect data immediately in order it can be like real time activity. Main work of sink node procedures is to receive data from wireless sensor, confirming then send it to the supervision. This was the construction of wireless fire alarm system using ZigBee.

#### IV. CONSTRUCTION OF WIRELESS FIRE ALARM SYSTEM USING BLUETOOTH

In this we construct the wireless fire alarm using bluetooth. Bluetooth is device that is used for transferring data from fire alarm system to the computer. In this we will be capable of performing the function of fire alarm and make use of computer as control panel to monitor the temperature. All reading from day can be stored in the database[2]. From that database user can analyse the temperature. The construction is divided into two parts as follows:

**1. Software:** It involve the development to provide a graphical user interface (GUI) and interconnection between bluetooth devices and computer. The GUI can control and monitor the alarm system wirelessly through the computer. we can use C programming and visual basic programming language.

**2. Hardware:** It involves in designing and developing an alarm system prototype that will be integrated with software part.

To make low power consumption we use battery power that will operate when 6V battery is supply. An alternative way to save the battery power, switch will be placed after battery supply. User can easily switch to the fire alarm system anytime. It is different from other fire alarm systems because it communicates without using cables with personal computer. It uses Bluetooth communications to communicate with each other in maximum range of 10 meters without obstacles. With bluetooth technology it can penetrate obstacles, but during obstacles distance range is closer about 3 meters only. In this two way communication and it is cable of performing the function of a fire alarm and make use of PC as control panel. With the help of control panel the user can check the surroundings temperature at any time and make analysis on their own from database that is record. If the bluetooth fails in this case we can use buzzer when temperature is over limits[2].

**A. Benefits of this construction are as follows:**

1. Enhances users experience
2. Connecting devices without use of cables
3. Reduced power consumption
4. Industry wireless communication standard
5. everyone can afford



Figure 3: Bluetooth

## V. ADVANTAGES OF ZIGBEE OVER BLUETOOTH

**A. Origin:** Bluetooth was launched in the year 1994 by German telecom giant Ericsson while Zigbee was devised in the year 1998. The name Bluetooth has been derived from popular European unification king, Harald Blatand while Zigbee gets its name from the dance movements of a honeybee[4].

**B. IEEE Standards:** Bluetooth, though not under IEEE now, was defined under 802.15.1 standard while Zigbee is defined under IEEE 802.15.4 standard.

**C Management Alliances:** Zigbee is managed by Zigbee Alliance which tests and certifies Zigbee based devices. All Zigbee based protocols get standardized under IEEE. On the other hands, Bluetooth is managed for standards and device by a single body: Bluetooth SIG (Special Interest Group).

**D. Frequency:** Bluetooth works under 2.4 GHz while Wi-Fi works at 868 MHz, 915 MHz and 2.4 MHz frequencies[4].

**E. Data Transfer Rates:** Bluetooth based networks have maximum data transfer rates of upto 1Mbps while in Zigbee, data transfer rates are upto 250Kbps.

**F. Wifi fire alarms:** Wi-Fi alarms are the ideal solution for applications in small to medium sized commercial enterprises, offices, car showrooms, schools, village halls and meeting rooms, sports and leisure facilities, and many other applications. Typical Wi-Fi alarm systems incorporate detection devices, manual call points, alarms or sounders, and control panels with remote keypads. Alarms can also be activated and de-activated with a single press of a button on individually programmed key fobs at up to 50m from the control panel. Reducing damage and complex installation make Wi-Fi alarms an attractive proposition amongst a growing number of users. The latest Wi-Fi systems incorporate attractively designed individual components that complement the interiors of both modern or traditional premises and properties. Typical Wi-Fi specification:

- User-friendly LCD display.
- Radio controlled panel with unique connections for up to 100 Wi-Fi devices.
- Bi-directional radio control and alarm functions.
- Individual zones with separate identification of the device activated.
- Control / monitoring and testing functions for all radio devices[4].
- Integrated power supply for 230V connection.
- Internal battery back-up.



Fig :4wireless Fire Alarm

## VII. CONCLUSION

In this paper we have studied various advantages of zigbee over bluetooth and wifi like low data rate low power consumption and long battery life. The wireless automatic fire alarm system constructed based on ZigBee overcomes the limitations of the cable alarm system and avoids high power consumption of the wireless communications technology .Compared with existing wireless sensor network, it has some advantages such as low cost, high network capacity, long life. And system installation does less damage to buildings, conveniently to place nodes and maintenance. Avoiding the unsafe factors of fire, lightning strike in cable systems, it is suitable for various occasions, especially for fire control in museums, ancient building group , with a wide application prospect.

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