

# Comparative Analysis of RFID and Wireless Home/Office Automation

Manasee Patil, S.R.N. Reddy

*Abstract- Wireless Sensor Network (WSN) is most widely used wireless technology in different applications. Home automation makes day to day life of people easier. WSN provides flexible management of lighting, heating, cooling and security from anywhere in the home/office [20]. In this project we propose use of both wired and wireless technology for home/ office automation. RFID technology is used for automatic door opening & closing. We also propose use of wireless sensor network for temperature, lighting, smoke detection and automatic door opening & closing. GSM technology is used in this project to monitor and control various devices from outside the home/office.*

**Keywords -Bluetooth, GSM, RFID, Wireless Sensor Network.**

## I. INTRODUCTION

The goal of this project is to develop home automation system using RFID, Wireless Sensor Network (ZigBee) technology and GSM. ZigBee is low power wireless technology used for monitoring and controlling various devices [11]. One purpose of this project is to allow users to be identified securely without being intruded by anyone. Automatic door opening and closing implemented by using RFID technology. More secure door opening system implemented by using wireless sensor network. Transmission of data in long distances to control the opening of magnetic sensor doors using ZigBee. The door which is far away can be controlled by anyone inside the house. User can place his or her RFID card on RFID reader placed inside the house, thus opening and closing the door. We will develop a secure and effective transmission of data using wireless sensor network ZigBee. RFID technology is an emerging technology used in wide range of applications. RFID technology is fast and reliable means for identification of objects. RFID is composed of two main components RFID reader and RFID tag. In RFID system RFID tags are interrogated by RFID reader. Primary goal of RFID technology is to automatically identify data that are contained in electromagnetic fields. RFID tags are inexpensive and small. RFID tags derive its power from the signal produced by RFID reader.

Wireless Sensor Networks are being gradually introduced in different application scenarios. ZigBee is one of the most widely used transceiver standard in wireless sensor networks. ZigBee over IEEE 802.15.4., defines specifications for low data rate WPAN (LR-WPAN) to support low power monitoring and controlling devices. This paper presents a comparative study of different wireless standard and its application for home/office automation.

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## II. RELATED WORK

Oke et.al. (2009)<sup>[1]</sup> Successfully presented a functional, low cost and low complexity microcontroller based door access control system. They proposed security door system which adopted a valid smart card to authenticate and/or deny entry to a room or building. A real-life equivalent of the prototype was developed with minimal development costs and with relatively low operational costs for environment where high degrees of security were required like banks, military research areas, and big private investment companies.

Verma and Tripathi (2010)<sup>[2]</sup> implemented a digital security system contains door lock system using passive RFID. A centralized system was deployed for controlling and transaction operations. The door locking system functioning in real time, as when the user put the tag was in contact with the reader, the door opened and the check-in information is stored in central server along with basic information of the user. They utilized RFID technology to provide solution for secure access of a space while keeping record of the user.

Muhammad Naveed et al., (2012)<sup>[5]</sup> observed that identification was very important, whether there was need to identify persons, animals or objects. They proposed that RFID provided a very good solution to the problem of identification and authentication. Authentication was very important and it was done at the airport, railway stations, in library etc but manually. Proposed system by Naveed et al., was low cost identification and authentication system which was be deployed at doors of building to authenticate people. Proposed system was also accompanied with PC interfacing to see authentication details with date and time.

Tully and Bleythe (2008)<sup>[14]</sup> reviewed that wireless communication technologies were expected to be widely employed in the near future in Intelligent. It was evident that wireless communication technologies could be used in-vehicle, inter-vehicle and between vehicle and infrastructure in transport applications. Among the different possibilities, Bluetooth is currently the most widely used automotive wireless technology for in-vehicle communication while Wi-Fi is used for vehicle to vehicle communication by several pilot research projects. ZigBee also had a role, mainly in the interconnection of wireless sensor with vehicles and infrastructure. It was necessary to find suitable communication technologies to integrate heterogeneous devices such as sensors inside the vehicle level up to motes belonging to the infrastructure.

Yong and Sthapit (2009)<sup>[15]</sup> proposed a smart digital door lock system for home automation. A digital door lock system was equipment that used the digital information such as a secret code, semi-conductors, smart card, and finger prints as the method for authentication instead of the legacy key system. In their proposed system,

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a ZigBee module was embedded in digital door lock and the door lock acts as a central main controller of the overall home automation system. Technically, proposed system was the network of sensor nodes and actuators with digital door lock as base station. A door lock system proposed here consisted of RFID reader for user authentication, touch LCD, motor module for opening and closing of the door, sensor modules for detecting the condition inside the house, communication module, and control module for controlling other modules. Sensor nodes for environment sensing were deployed at appropriate places at home. Status of individual ZigBee module can be monitored and controlled by the centralized controller, digital door lock. As the door lock was the first and last thing people come across in entering and leaving the home respectively, the home automation function in digital door lock system enables user to conveniently control and monitor home environment and condition all at once before entering or leaving the house. Furthermore, it also allowed users to remotely monitor the condition inside the house through Internet or any other public network. The biggest advantage of their proposed system over existing ones was that it could be easily installed when and where necessary without requirement of any infrastructures and proper planning.

Saravanan and A.Vijayara 2011<sup>[10]</sup> devised a system that realized remote home automation control based on the emerging wireless communication technology, and implemented hardware, the device nodes could be placed anywhere in the room, this solution also future in low power consumption, the energy conservation and the environmental protection, software of home gateway and device node. The design realized the wireless connection between device node and in experiments in a home network tested to prove its feasibility and effectiveness. The proposed architecture was expected to contribute to the development of ubiquitous service systems not only for home network service domains but also for a variety of service domains including automotive, office, and hospital services. The current priority for the proposed architecture was to enhance its security. For instance, if a ZigBee device node that contains a URL to a proxy service bundle with malicious code is deployed, the home gateway and the entire home network might be in danger. Thus, it was essential to authenticate ZigBee device nodes and their proxy service bundles for the security of home network systems that were based on the proposed architecture.

Felix C and Raglend I.J (2011)[17] were of view that in recent years, the home environment has seen a rapid introduction of network enabled digital technology. This technology offered new and exciting opportunities to increase the connectivity of devices within the home for the purpose of home automation. Moreover, with the rapid expansion of the Internet, there was the added potential for the remote control and monitoring of such network enabled devices. However, the adoption of home automation systems has been slow. There paper identified the reasons for this slow adoption and evaluates the potential of ZigBee for addressing these problems through the design and implementation of flexible home automation architecture. The rapidly advancing mobile communication technology and the decrease in costs made it possible to incorporate mobile technology into home automation systems.

[21]Reddy & Sharma (2012) designed home automation using wireless sensor networks. Their main objective was to

survey WSN for home automation and present different technology used, interface techniques. They proposed a simple and flexible wireless model for domestic automation of temperature, light and security against burglary, water leakage, fire and gas leakage by implementing reliable sensor nodes which are monitored from a pc connected to master node. The paper addressed challenge of low cost and low power consumption.

The most recent review of wireless mote platforms was done by Madan & Reddy (2012)[22]. They analyzed WSN devices under different parameters and criteria, including processors used expected lifetime protocols, cost, application and their pros and cons. They found that sunspot motes were best option if processing power and high computational overhead were envisaged in application requirements. SHIMMER, motes with their small form factor and integrated 3 dimensional accelerometer sensors, were best suited for wearable application such as health monitoring, Mica Z & TelosB were cheapest amongst all and could be used where cost was a factor. Finally they concluded that IRIS motes had increased range and could be used for long distance communication.

A detailed survey of Wireless Sensor Network was done by Akyldiz et. al.2001 [23]. They analyzed concept of sensor networks made viable by convergence of micro electro mechanical system technology, wireless communication and digital electronics. They explored sensing tasks, potential sensor network applications, a review factor influencing design of sensor network. It was concluded that more encouragement was required for insight into problem and more development in solution to the open research was need of time.

[24]Singh et.al (2012) worked on new standard called ZigBee developed for control & sensor network, based on IEEE 802.15.4 Standard. They focused on ZigBee Alliance, IEEE 802.15.4 model, application and advantages of ZigBee and found that ZigBee is most promising standard for low data rate, low power consumption and has long battery life. ZigBee networks were found to be more reliable and self healing, being easy to self deploy. But gap pointed was complexity of ZigBee network and hacking of security by intruder.

**Table: comparison table of existing home/office automation techniques.**

Reference	Technology	Processor	Tools	Applications	Advantages
[1]	Smart card	PIC16f84A	Electromechanical relay interface, card reader	Secured door system	Low cost & low complexity
[2]	RFID	PC	Passive RFID	Digital door lock system	Secure access
[3]	RFID	PC	24 bit tag & 6 bit user ID tag	Secure Access of Home	Information in tag is protected
[4]	RFID	89S52	RFID, MAX 232	Exam hall maintenance	security
[5]	RFID	Atmel 89S52	Low cost antenna system, RFID reader	Authentication system	Reduced cost enhanced reliability
[11]	Voice command, ZigBee	8051	HM 2007	Electrical devices	Cheap easy to install & easy to run
[12]	ZigBee	ARM, x51	Beekit, Code warrior IDE	Light switching, temp. Control, Window movement control	Easy network creation & modification
[15]	RFID, Zig Bee	PC	ZigBee	Smart digital door lock system	Easy installation
[16]	RFID communication system	PIC	DTMF, ZigBee	Automatic door opener Finger print recognition	Prevents entry for unauthorized user.
[18]	Wi-Fi, ZigBee	ZigBee µc, wi-fi µc	ZigBee & Wi-Fi network	Light switch, radiator valve, safety sensor	Increases connectivity of devices within home, remote access
[21]	ZigBee	PIC16F877A	RS232 interface, ZigBee module	Temp., gas, water leakage	Less computation, low power demand
[26]	RFID WSN	89c51	Smart node	Temp. into Warehouse	Highly integrated smart nodes, inexpensive, flexible
[25]	GSM, Bluetooth	8051 family	GSM module, Bluetooth module, RS232 interface	Controlling light fan & other appliances	Bluetooth eliminates usage charges
[27]	WSN, GSM	ARM7	WSN center node module, TC35GSM module IR detector, PIR sensors	Home security with Voice and face recognition	Detect the theft, cost effective, more acceptable security system

### III.COMPARISON OF DIFFERENT WIRELESS TECHNOLOGY

There are different wireless technologies available in the market. Bluetooth wireless technology is short range communication technology. Bluetooth serves as short range, moderate speed and wire replacer. Bluetooth is wireless technology standard used for data transfer over short distances. Bluetooth operates in the 2.4GHz RF range. It forms Personal Area Network (PAN) for secured data transfer with fixed or mobile devices. Bluetooth was standardized as 802.15.1. Bluetooth is packet based protocol with master slave structure. A Master Bluetooth device can communicate with maximum of 7 devices in Pico net.

Wi-Fi is wireless networking technology used for data transfer over computer network. Wi-Fi operates in 2.4 GHz range Wi-Fi alliance referred Wi-Fi as wireless Local Area Network (WLAN) based on IEEE 802.11 standards. A device that can use Wi-Fi can connect to network through wireless network access point. Access point or called as hotspot has range of 20 meters inside and several meters outside. Wi-Fi is less secure wireless technology. Bluetooth and Wi-Fi have similar applications but Wi-Fi is replacement for cabling in WLAN and Bluetooth is replacement for cabling in WPAN. Wi-Fi and Bluetooth works on 2.4GHz range, Wi-Fi works with higher power, higher data rates and longer distances than Bluetooth.

ZigBee is the reliable, cost effective and low power wireless technology. ZigBee is based on IEEE 802.15.4 standard unlike other wireless devices ZigBee devices are ability to form Mesh network between nodes. ZigBee devices can transfer data over longer distances. ZigBee is used in applications which require low data rates and secure Networking. ZigBee works on data rate of 250 Kbps. ZigBee technology is simpler, less expensive and more secure than Bluetooth and Wi-Fi. ZigBee Networks are secured by 128bit symmetric Encryption key. ZigBee used for monitoring and remote control solutions. Comparing various wireless technologies we choose ZigBee best suited for proposed work.

**Table 2: comparison of different wireless technologies**

Standard	Bluetooth	Wi-Fi	WSN
Coverage	10m	100 m	10m- several Km
Battery life	days	Hours	Years
Complexity	complex	High complexity	simple
Data rate	1 Mbps	11 Mbps	250 Kbps
Nodes number	7	32	65000
Security	secured	Less secured	More secured
Time for network communication	10 seconds	3 seconds	30ms
Applications	Wireless USB, handset	Internet browsing, Pc networking, file transfer	Remote control, battery operated products, sensors

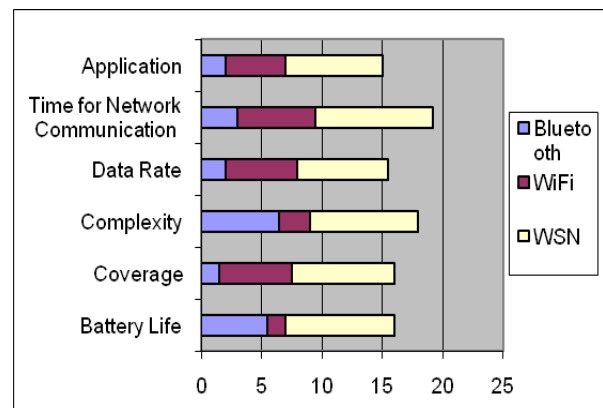
**Table2: comparison of wireless technologies based on priority and effectiveness**

Sr.no.	Standard	Bluetooth	Wi-Fi	WSN
1	Battery Life	Medium (days)	Low (hours)	High (years)
2	coverage	Low (10 m)	Medium (100m)	High (Km)
3	Complexity	Medium (Complex)	Low (High complex)	High (Simple)

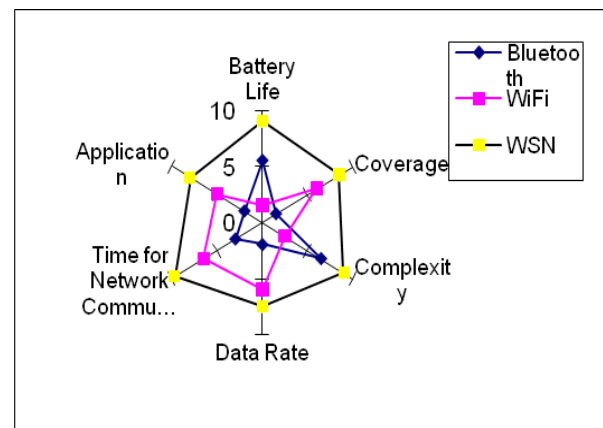
4	Data Rate	Low (1mbps)	Medium (11mbps)	High (250 Kbps)
5	Time for Network Communication	Low (10 seconds)	Medium (3 seconds)	High (30 milli sec)
6	Application	Low	Medium	High

**Table 3: comparison of wireless technologies based on priority and effectiveness with wait age factor**

Sr.no.	Standard	Bluetooth	WiFi	WSN
1	Battery Life	5.5	1.5	9
2	Coverage	1.5	6	8.5
3	Complexity	6.5	2.5	9
4	Data Rate	2	6	7.5
5	Time for Network Communication	3	6.5	9.7
6	Application	2	5	8



**Figure1:Graphical representation of various standards of wireless technologies**



**Figure2: Prioritiation of standards of different wireless networks with radar graph**

### IV. PROPOSED WORK

In this project we propose home/ office automation using 3 different technologies RFID, WSN & GSM. RFID technology is used for opening & closing of main door. We have placed RFID readers at the main door. This prevents entry of unknown user to home/office. More secure door system implemented with the use of wireless sensor Network ZigBee (XBee Pro). We have ZigBee transmitter & receiver module.

We connect temperature sensor to monitor and control the temperature of the room. Smoke detector circuit connected to inform gas leakage in the home. Opto coupler connected to sense number of persons in the room. Depending on no. of persons in the room we can change the lighting in the room.

If there is gas leakage sms is send to the respective mobile number and safety controls can be carried out immediately. GSM technology is used to send sms to the person. With the help of this technology person outside the home/office can monitor or control various devices in the home/office

### V.CONCLUSION AND FUTURE WORK

Prototype for home/ office automation using RFID, WSN & GSM technology is successfully researched and designed. Automatic door opening and closing is implemented using both RFID and ZigBee technology. Along with automatic door control this prototype can control various devices using ZigBee technology. With the help of this prototype one can build secure home automation system. Further security measures can be taken by sending information to the emergency call centre using GSM technology. Information about fire can be send to fire station; intruder detection information can be send to police station.

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