

# WIRELESS SENSOR MODULE BASED HOME AUTOMATION SYSTEM

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## Abstract

This paper proposes a home automation system using wireless sensor module which doesn't require any computers or any handheld devices such as remote controllers. As the name suggests "Home Automation", our home can be converted into a smart home. This paper is mainly concerned with design of a system that controls home appliances based on different sensors, to a remotely control using wireless sensor module. In this paper we make use of ZigBee as a wireless module and a microcontroller to monitor the home appliances. According to the occupancy, temperature and light intensity of the room, fan and light will get on/off automatically. Technically our proposed system consists of a transmitter section and a receiver section. Here transmitter communicate wirelessly to a remotely receiver through ZigBee modules. Furthermore, it also allows users to set the reference temperature and light intensity, which makes this system flexible and more user-friendly. The biggest advantage of our proposed system is that it keeps control of power consumption and reduce energy consumption. Hence it helps us add more intelligence into the home environments rapidly and thus improve life quality.

**Keywords**— Home Automation; ZigBee; User-Friendly

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## 1. INTRODUCTION

Home Automation is growing vastly with the improvement in wireless technologies. Home automation technology and Smart home appeared very much in science fiction of the 1920s. But it is unpredictable as on what date exactly this was invented. The home automation system is not a sudden invention but is a step by step process where there were insignificant improvements time-by-time as per the requirements, demands and human's smart technology improving processes. It was in 1960s when for the first time people started noticing the high technology used in houses and started relating it with some home automation processes. It was called "wired homes" at that time. It was built by some hobbyist. After that, in 1984, the first official name of home automation appeared, name given by the American Association of House Builders. This development was the basic platform to the modern smart homes and at that time people understood that a smart home is not owing to how well it is built, not how effectively it uses space, not due to how it is environmentally friendly but it was of how interactive technologies could be that it consisted of. Those are still useful rules for home automation technology today. In the 1960s, the technologies were not so much interactive. Even though Stanford University researched a lot of this kind of technology, they didn't become so successful.

## 2. LITERATURE SURVEY

In this section, a brief discussion about the existing works regarding smart home network systems is been presented. [1] Proposed a paper on Home Network Configuring Scheme where ZigBee-based Integrated Remote Controller is used for controlling all Electric Appliances. The architecture scheme that is adopted is able to control all appliances without additional hardware. It is generally very difficult to

connect all the appliances through a single home network as protocols for each appliance and their communication are different. It is shown here that integrated remote controller, ZigBee to infrared converter, and ZigBee power adapter, are the three main components of the integrated remote control.

[2] Developed a theoretical model for controlling home appliances with Handheld Microphone which is easy to install, configure, run and maintain. In this system, the command to the specified appliance is given via a microphone and upon recognition of the command that is sent wirelessly, the functions like ON, OFF or increasing or decreasing the speed, are performed. A Handheld Microphone Module and an Appliance Control Modules with relay controlling circuits, are the two modules of which this Wireless Home Automation System comprises of.

[3] Proposed a prototype in which the user with android OS based Mobile is able to send voice commands that could be converted into text using the mobile application and payload it on the GSM network via SMS. On the receiver side a Bluetooth receives and transfers the command to the remote unit through ZigBee transceiver. According to the command received, the appliances are controlled and operated in a proper manner.

[4] Developed a Home Automation system where they also used ZigBee but the control operation is done using the Graphical User Interface. The work design discussed consists of both hardware and software implementations. The hardware part is responsible for the development of the main controller, sensor nodes and the smart home sensor network while the software is responsible for the programming of the microcontroller using Embedded C.

### 3. HOME AUTOMATION

Home automation involves introducing a degree of automatic control to certain electrical and electronics system in a building. It could be the best way to overcome, the problem of unnecessary wastage of energy due to carelessness and forgetfulness of switching off the electrical appliances when not in use, upto an extent.

The use of home automation system is basically for electrical appliances in a home or office using wireless sensors module that is widely used for wireless network. It is very helpful as it has become necessary to optimize and to economize energy consumption. Also these technologies make peoples' life easier, especially for elderly persons and persons with disabilities.

#### 3.1 Motivation

Life is always changing; and so technologies are changing every hour. As a result our lifestyle today is very different from how it was 10 years back. It can be seen that technology has been influencing our life in every aspects, may it be the invention of the wheel, hunting techniques or new agricultural technologies, making our lives more easy and comfortable. It has become next to impossible to live without depending on any technology or skill which is present in our day to day life in different purposes and forms. The most common examples could be the technologies that we avail every now and then like cars, phones, Airplanes, fridges, microwaves, clothes etc. Someday we will become oldtoo; it would be good enough if we could contribute to improve our aging lifestyle. Thus we have been motivated to design a wireless home automation system which we hope would help to resolve these problems upto some extent.

#### 3.2 Problem Formulation

The major problem that leads us to develop such an idea of a smart home system is the common human nature of laziness, carelessness and not knowing to value things and wasting unnecessarily. Carelessly leaving home appliances ON for a long time without any use of it leads to a wastage of high electricity whose percentage is increasing year by year. A

smart home system could be thought of, to overcome such a serious problem.

Secondly, it is a severe problem for older people as it is not possible sometimes for them to maintain or control home appliances by moving all over their house especially if a double storied house. In such cases it becomes a better option to choose a system which is capable of automatically controlling the appliances by just sitting at one place rather than moving near the switches in each and every room. It is known that there are many smart home system products that are available in the market. But most of them are not suitable and compatible for current lifestyle, as latest technology is not being used, have a complicated wired system and less task compliment. Keeping these drawbacks, in the already existing systems, in our mind, we thought to develop a system where the latest wireless technology which minimizes the complication of the connection is used.

#### 3.3 Significance of the Work

In the future world energy plays a vital role in controlling the world. Countries with more energy resources will emerge as the world leaders. In this context it is also important to think about energy saving. Here in this work, home automation systems provide mutual interoperability between various electronic, electrical, and power devices as well as interactive interface for people to control their operation effectively in an easier way. These features are very helpful and has also become very necessary nowadays, to optimize and to economize energy consumption.

### 4. METHODOLOGY

This work is divided into two sections; hardware and software implementations. The hardware implementation part consists of the development of the main controller, sensors and Wireless Sensor Module while the software implementation is responsible for the programming of the microcontroller. The Central Processing unit is developed using the microcontroller which is a low cost and efficient controller used in many applications.

The block diagram of our system has been given below.

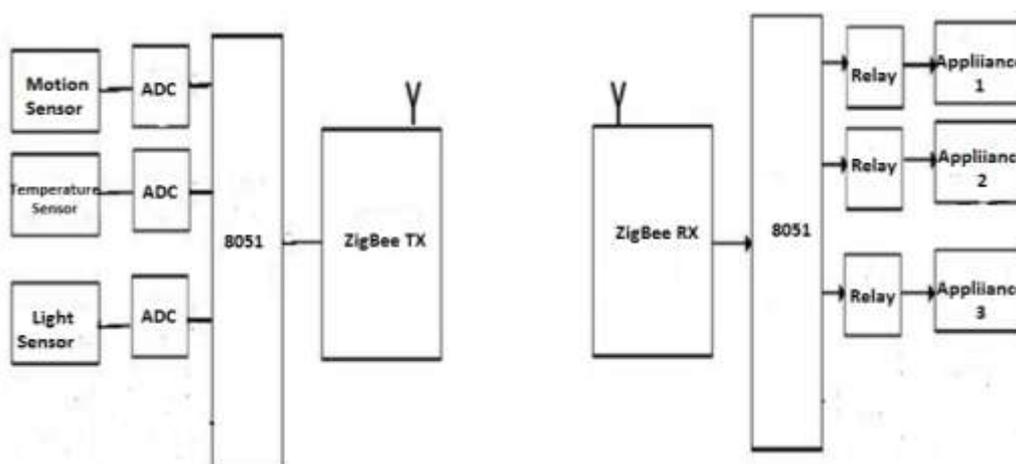


Fig. 1: Block Diagram of the project

The main part of this developed system is the Microcontroller which is the brain of this system. All the interfacing between the sensors and the home appliances will be done by the Microcontroller. Here, the block diagram comprises of two sections; one is the transmitter section and other is the receiver section. The transmitter section consists of sensors and wireless modules. Sensors collect all the necessary data and transfer to the transmitter section. From transmitter the collected data are send to the receiver section through ZigBee module. The receiver section receives all the data and pass the information to microcontroller. Once the microcontroller processes data, it sends back the information to the receiver. The receiver section sends the processed data to transmitter section and transmitter section will take necessary steps.

### 5. SYSTEM IMPEMETATION

#### 5.1 Transmitter Module

The Transmitter section includes the RF communication module, sensors and microcontroller. Fig.2 shows different sensor circuits that are used in the transmitter module. Sensors are designed to monitor the environmental condition around the home. For monitoring the environmental condition, such as temperature and light intensity, corresponding sensors are used and are connected to ZigBee module via microcontroller. 8051 is the

microcontroller, which is used in our work and it also controls the ZigBee transceiver, and executes programs.

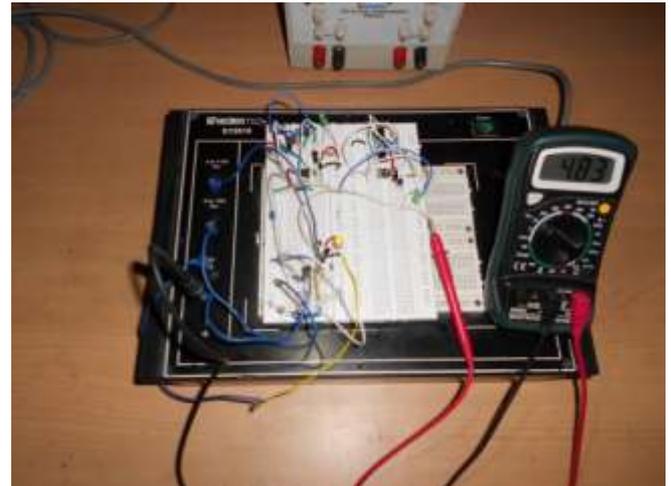


Fig. 2: Sensor circuits used in the transmitter module

As we are using Microcontroller in between ZigBee and sensor modules we have to make use of an analog to digital converter. But addition of an ADC will make the receiver section bulky. So we have used a simple as well as efficient logic circuit. Circuit used for sensor section is given below.

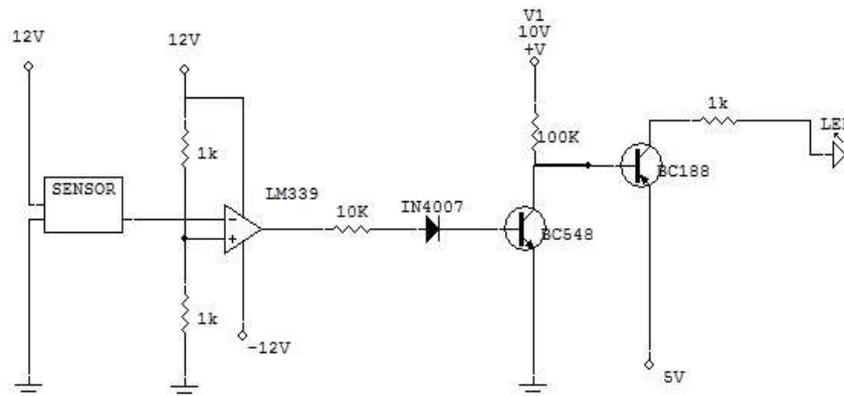


Fig. 3: Logic circuit

So as per this circuit sensors will either give logic '1' (high voltage) or a logic '0' (low voltage). Outputs from respective sensor modules are then given to the port 1 of the microcontroller and the program is executed. We also programmed the microcontroller in such a way that the microcontroller will give logic '1' if and only if the room is occupied with someone. Fig 4 shows the connection of sensors and microcontroller.

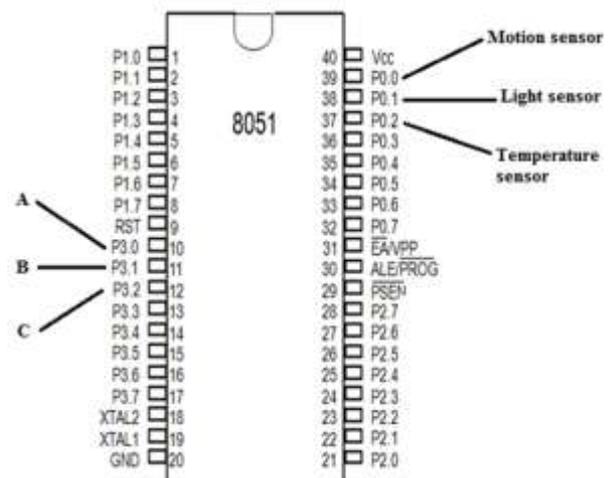


Fig. 4: Sensors and microcontroller.

Here A,B,C are the outputs of the microcontroller which are connected to the pins of ZigBee. The logic used for the programming part is tabulated below.

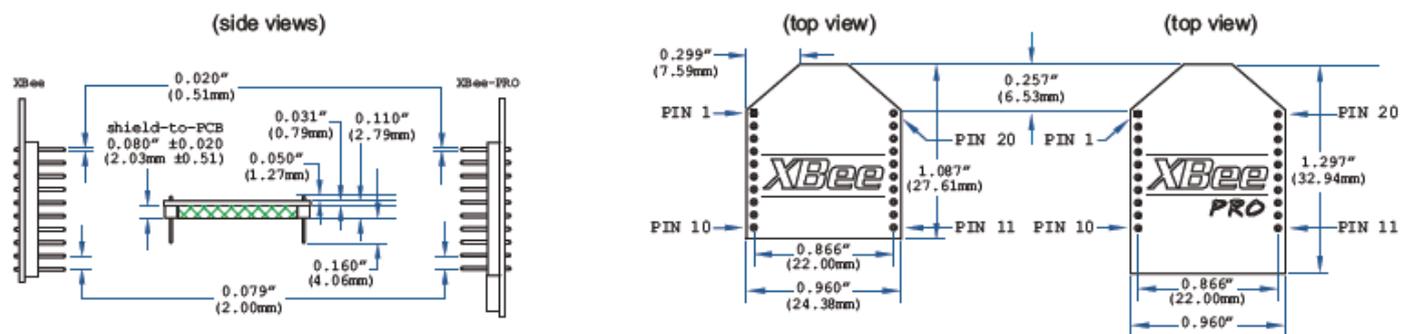
**Table 1:** Logic used for programming

Motion Sensor	Light Sensor	Temperature Sensor	Output
0	X	X	0
1	0	0	0
1	0	1	A
1	1	0	B
1	1	1	C

### 5.2 Receiver Module

The Receiver section also includes an RF communication module, relays and microcontroller. ZigBee module transmits the received signals to microcontroller and then to relays. These relays control the corresponding home appliances.

As already mentioned ZigBee is the RF communication module. ZigBee is a wireless technology developed as an open global standard to address the unique needs of low-cost, low-power wireless M2M networks. The ZigBee standard operates on the IEEE 802.15.4 physical radio specification and operates in unlicensed bands including 2.4 GHz, 900 MHz and 868 MHz.



**Fig. 5:** ZigBee sideview & Top view.

#### ZigBee Key Features:

- Low Power
- Robust
- Mesh Networking
- Interoperability

### 6. EXPERIMENTAL RESULTS

The sensor section of the transmitter module has been fabricated and tested. The data in Table 2, 3, 4 shows the experimental results of sensor circuits.

**Table 2:** Temperature sensor

SI No.	Reference Voltage	Degree Celsius	Sensor Output	Output Voltage
1	3.6V	28	2.8V	0V
2	3.6V	34	3.4V	0V
3	3.6V	38	3.8V	5V
2	3.6V	40	4V	5V

Here we are setting a reference voltage of 3.6V which is equivalent to 36 degree Celsius. As we know that in temperature sensors temperature equivalent voltage is obtained. Normally these are in millivolts, which are converted into voltages using gain amplifier. So if the sensor output is more than reference voltage it will give logic '1'. This reference voltage can be changed to the user's comfort ability.

**Table 3:** Light sensor

SI No.	Reference Voltage	Sensor Output		Output Voltage
		With Light	Without Light	
1	2V	1.5V	0.50V	0V
2	2V	3V	0.61V	5V

Similarly for light and motion sensors a reference voltage is set and the output voltage is high if and only if sensor output is greater than reference voltage

**Table 4:** Motion sensor

SI No.	Reference Voltage	Sensor Output	Output Voltage
1	2V	3.3V	5V
2	2V	1.5V	0V

### 7. CONCLUSION & FUTURE DIRECTION

It is evident from this paper that an individual control home automation system can be cheaply made from low cost locally available components and can be used to control multifarious home appliances ranging from security lamps the television and air conditioning system and even the entire light system and better still, the components required are so small and that they can be packaged into a small inconspicuous container

In future we are planning to make our project in such a way that the light intensity can be adjusted according to the darkness outside.

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