

Designing A Home Automation System by Using RF Receivers

Md. Nasfikur R Khan¹, Md. Rakib Hasan²

¹Department of Electrical and Electronic Engineering, Independent University, Dhaka, Bangladesh

²Department of Electrical and Electronic Engineering, Independent University, Dhaka, Bangladesh

ABSTRACT

Home automation is a famous and most used technology in the world. The main object of this project is to develop a home automation system with a four button key fob transmitter by using RF (Radio Frequency) technology. This four button key fob transmitter is also very productive for commercial uses in Industrial and medical systems. To accomplish this object, it is designed into two parts. Both the parts have individual toggle type receivers but they work in same frequency. One of these toggle receivers works individually with some of the home appliances but the other one interfaced to an Arduino Uno Rev3 microcontroller to convert the signals from toggle to latching format. Along that we used both latch and toggle techniques to get the best result. Integrated Development Environment software has been used to accomplish the programming goal to control the microcontroller, Atmega328 based Arduino Uno. This proposed system will help the elderly people and physically challenged people to run the home appliances by using a small key fob only.

Keywords: - Microcontroller, Arduino, Zigbee, Antenna, RF receivers.

1. INTRODUCTION

Nowadays, houses are gradually shifting from normal switches to centralized control system, involving a remote control transmitter. This technology is not only easy to use but also helps to prevent misuses of energy. Remote control (key fob) transmitter is small and very light weight, which will work from a decent distance. It helps elderly people to control switches from anywhere up to 75 feet. This four button key fob transmitter is also very productive for commercial uses in Industrial and medical systems. To accomplish this object, it is designed into two parts. Both the parts have individual toggle type receivers but they work in same frequency. One of these toggle receivers works individually with some of the home appliances but the other one interfaced to an Arduino Uno Rev3 microcontroller to convert the signals from toggle to latching format. Arduino IDE software has been used to compile some programs related to the microcontroller ATmega328 [1]. This project can be upgraded by using GSM modem, which can control home appliances by sending an SMS through a mobile or a computer. Benefit of using this technology is there will not be any range limitation compared to Radio Frequency technology. Here, in this paper we introduced home automation system based on wireless technology and remote controlled Home automation system is very famous, and the most utilized Home automation system. Recently, people started to use broad band system, Wi-Fi networking system and many more [2].

2. EXISTING SYSTEMS

2.1 Embedded System

All computing systems other than general purpose computer (with monitor, keyboard, etc.) are embedded systems. Embedded system is a way of working, organizing or performing one or many tasks according to a fixed set of rules, program or plan. In other words, an arrangement in which all units assemble and work together according to a program or plan. An embedded system is a system that has software embedded into hardware, which makes a

system dedicated for an application (s) or specific part of an application or product or part of a larger system. It processes a fixed set of pre-programmed instructions to control electromechanical equipment which may be part of an even larger system (not a computer with keyboard, display, etc.) (Godse, Mulani (2009: 1 – 5)). For organizing an embedded system, microcontrollers are the most essential elements.

2.2 Microcontrollers

A microcontroller is a small computer that contains a microprocessor which controls some aspects of the environment. Microcontrollers are used for control some devices and engines automatically, such as home automation system, automobile system, medical devices, remote control devices, power controlling tools, quad-copter and other embedded system [3]. Some microcontrollers use 4-bit words. For low power consumption, this kind of microcontrollers operates at clock rate frequencies as low as 4000 Harz. Microcontroller is the main aspect of designing an embedded system.

2.2.1 Most common Microcontrollers

There are lots of microcontrollers from different brands. Here, a discussion about some of the microcontrollers has been used for home automation system.

- Atmel AT89 series: AT89 series is an Intel 8051 family microcontrollers, which is an 8-bit microcontroller and manufactured by the Atmel Corporation.
- Atmel AVR series: Atmel AVR is a single chip microcontroller which is developed by Atmel in 1996.
- AT91SAM (AT91 Smart ARM Microcontrollers) series: AT91 is a 32-bit microcontroller integrated circuit and produced by Atmel.
- Intel MCS-51 or 8051 series: 8051 is a single chip microcontroller series developed by Intel and used in embedded system.

For the prospect of the project, an Atmel AVR series microcontroller (ATmega328) has been used. ATmega328 is actually a reset microcontroller, which helps to build a strong reset circuit. All in all, this project's primary aspect is to develop a Home automation system working as an embedded computer and a microchip works to control some of the procedure.

3. DESIGN DESCRIPTION

According to the previous discussion, Home automation system makes the home condition and utilization of appliances easy, simple, comfortable and flexible, user friendly, secure and saves energy. Therefore, the Home automation system designed in this project with automatically control of following factors.

- Energy to start with
- Temperature
- Windows and doors
- Power socket
- Water heating
- Illumination
- Entrance control

These points organize into four different systems.

- Power Supply: Energy to start with
- Lighting System: Illumination
- Temperature Controlling System: Air conditioning system
- Security System: Access control, Windows and doors etc.

3.1 Power Supply

The perfect remote-control Home automation system can be achieved by provide a sufficient power to utilize the whole system properly. Though it is a remote-control system, but the system needs two individual power supplies for the transmitter and the receiver part. As example, if a user tries to use a mobile phone as a transmitter, he needs to charge it first to make it utilizable. Then he needs to use a different power supply for the lighting system he tries to use. For a smart home, two kinds of power supplies need to be used [4].

- Switching Power Supply
- Automatic Power Supply
- Rechargeable Power Supply

3.1.1 Switching Power Supply

As the name suggests, this is a simple switch controlled power supply. This power supply controlled by turning switch on and off. This system could be used for something which is less usable like the water heater in toilet. User could use it during the time of using the toilet. For the prospect of the project, this kind of power supply has been used only for the only for the bedroom sector. However, this power supply can start working by getting the signals manually from the user or the automatic power supply.

3.1.2 Automatic Power Supply

This is the power supply which helps user to control home environment for making it comfortable and flexible before he gets in. Through this power supply user can turn on most of the home appliances without entering the house. User can control all the electronic devices very easily and with comfort any time whenever he wants. Automatic power supply is always working and this power supply does not need to turn on and off. This supply system will be connected with the living room appliances and also connect with the switch which turns on the bedroom power supply. According to this project through this power supply user can easily control the living and kitchen area. It helps to turn on the whole house heating system that makes our home more comfortable before getting in.

3.1.3 Rechargeable Power Supply

Rechargeable or the battery controlled power supply has been used for charging the remote control console. As example, if the user wants to control the home automation system through a mobile phone then he needs to make sure the phone is always charged on or the console's batteries are not damaged. In this project, it has been tried to use this battery controlled remote console as the only transmitter. Through this device user can transfer the signals from the transmitter towards the receivers. Therefore, overall home automation system constituted by several kinds of power supplies. Through this system, it has been trying to provide the main energy for the all appliances of the house [5].

3.1.4 Lighting System

Lights are the most important home appliances in a house and intelligent lighting system is the most important part of a smart home. An integrated system used to control or contain a soothing visual environment is called lighting system. Core of the lighting system is the brightness of the level adjustment. The whole house has couple of windows and doors, that's why the day light motion would be considerable. In a bright day, the indoor lighting system would be essential at all. Besides on that kind of times through this procedure user can save a huge amount of power and energy.

On the other side, it has been tried to arrange a form for the whole system that it can measure the necessity of lights during any time of day. As example through this system user can get the signal through a mobile phone or a remote control transmitter that he does not need to turn on the light before getting inside the house. A pre-set peak value has been arranged to help to roll down the situation quickly. Through this way, the system also can control the brightness of the lights. After turning on the automatic power supply for the whole system, the transmitter starts to deliver signals and then the receivers started to receives the signals without any delay. 315 Mega Harz transmitter has been used which consists of four keys or buttons which work for four different parts of the whole process.

In that part, a briefly explanation of the overall outcome of the project has been discussed. As it was discussed that, the project has been designed for a small one bedroom flat and whole system has been divided into two sections. One of those sections is the living area and the other one is the bedroom area. First we will discuss about the living room area, which is included with kitchen facilities and bedroom area is attached with a toilet and shower facilities. Living room area is getting energy from an automatic power supply and on the other hand bedroom area gets it from a switch controlling power supply.

3.2 Living room area:

Automatic power supply turns on whenever any movement happens around the entrance door of the building. After turning on the automatic power supply which controls all the home appliances for the living room and the kitchen area, it has been that the LED in Arduino board will turn automatically on and it starts to latch or blink with minimum delay. It happens because of the compilation of the program has been written for that purpose. As explained in Chapter 3, for the prospect of the project a same range of receiver and transmitter has been used for the whole system. Through this transmitter user can transfer signals for four different kinds of appliances including the lighting system, temperature controlling system, power sockets and cooking facilities.

- Key 'A' for lighting system
- Key 'B' for the whole temperature controlling system
- Key 'C' works for the power sockets
- Key 'D' will act to utilize the cooking facilities

For the use of living room facilities key 'A' has been used for turning on the lighting system, key 'B' is working for turning on and off whole internal home temperature or air controlling system (which also connected with the Arduino board for latching the system properly), key 'C' is used for all the power socket includes the socket for refrigerator, television, oven, table lamp etc. and key 'D' helps to turn on the whole cooking systems including the cooker, air distinguisher, water heater for kitchen facilities. Besides it has been planned to use an alarming system for the whole house security. By using the power socket system, user can accomplish this facility by spending a little amount.

3.3 Bedroom area

Bedroom area connects with the switch controlling power supply, so to run the home appliances of bedroom area first user needs to turn on this power supply. It can be done through the automatic power supply or by sending signal manually by using the transmitter. Considering the previous discussions, user will use same transmitter for both the power supplies. However, the bedroom sector can get the energy from the automatic power supply too, but it needs to come via the switch controlling power supply [7]. User can use both of this power supplies together or he can use automatic power supply and turn off the switch controlling power supply. Anyhow, automatic power supply will be always on if the user is inside the house else he turn it off manually. Now, the outcome of the bedroom circuit will be discussed here. For that sector,

- Key 'A' turns on and off the lighting system.
- Key 'B' works for the temperature controlling system for that sector.

Key 'C' controls a separate lighting system for using the toilet and shower facilities.
 Key 'D' helps to use the water heating facilities only for the toilet and shower area.

For using this area of the house, first user needs to turn on the power supply connected with this area. Then, for turning on the lighting system of bedroom, button or key 'A' of the transmitter need to press. Lighting system for the bedroom will remain on until the user presses the button 'A' second time. For turning on the cooler facility or fan, user needs to press key 'B' and it continue to cooling the environment of the room until he turns it off by pressing it again. As mentioned before, key 'C' works for the lighting system of the toilet and shower area and same way, user needs to press key 'C' to turn it on and off. Last but not the least key 'D' helps to use the water heating system to enhance the toilet and shower facilities. If user wants to use hot water for toilet and shower purposes, he just needs to press button 'D' and for cancelling the use same way press it again. Security of bedroom area also confirmed through the same security system oriented for living room area. All the windows are connected with some sensors and all of those sensors are getting power from the automatic power supply (power sockets). Through the following flow chart the whole system can be explained easily.

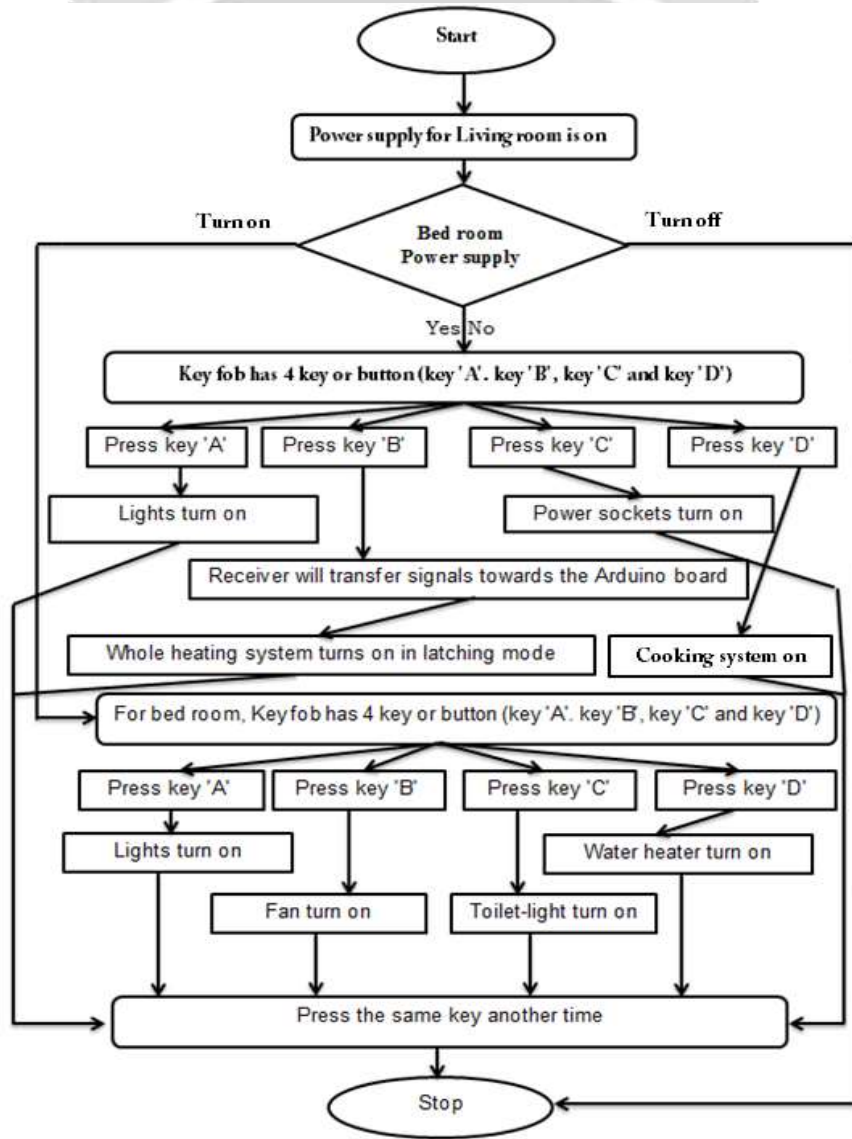


Figure 1. Flow chart of the system



4. CONCLUSION

This Project could be design in nature by using handy portable key fob facility. The cost of the project is also not that high and it is also take less time to consume. This Project can be useful for the people who want to use unconventional way to use switches and that can help to reduce exceeding use of energy and power, such as electricity. So, overall it could be a beneficiary project for the practical, busy and urban life. However, this project can be upgraded by using GSM modem, which can control home appliances by sending an SMS. Benefit of using this technology is there will not be any range limitation compared to RF technology.

REFERENCES

- [1] Md. Faijul Haque, Sabrina Hossain, Ayesha Siddika and Md. Nasfikur R. Khan, "Smart Home Automation System based on Environmental Monitoring System," *National Conference on Electronics and ICT*, Dhaka, 2017, pp. 1-4.
- [2] Arduino (2014), [Online]. Last accessed 23rd, 2016.http://arduino.cc/en/uploads/Main/Arduino_Uno_Rev3-schematic.pdf
- [3] B. Somanthan Nair (2006). *Electronic Devices and Applications* (3rd Printing). pp. (343).
- [4] Cblambert (13 march, 2016). Ideal transformer (own work).
- [5] D. M. calcutt, Frederick J. Cowan, G. Hasan Parchizadeh. *8051 microcontrollers: hardware, Software and Applications*. pp. (2-4).
- [6] EEWeb (2014), *Electrical Engineering Community* [Online] http://www.eeweb.com/extreme_circuits [07/11/16]
- [7] M. N. R. Khan, M. N. H. Pias, K. Habib, M. Hossain, F. Sarker and K. A. Mamun, "Bolte Chai: An augmentative and alternative communication device for enhancing communication for nonverbal children," *2016 International Conference on Medical Engineering, Health Informatics and Technology (MediTec)*, Dhaka, 2016, pp. 1-4.

BIOGRAPHIES

	<p>Md. Nasfikur R Khan completed his B.Sc. in Electrical and Electronic Engineering from Sheffield Hallam University, United Kingdom and M.Sc. degrees in Biomedical Engineering from Newcastle University, UK in 2014 and 2015, respectively. He was Senior Lecturer in City University, Bangladesh. Right now he is involved as a research associate, AIMS Lab, UIU. He is now working as a Lecturer of Independent University, Bangladesh (IUB).</p>
	<p>Md. Rakib Hasan is doing B.Sc. in Electrical and Electronic Engineering from Independent University, Bangladesh (IUB). He is working as a Teaching Assistant of Independent University, Bangladesh (IUB). He is a member of Engineering Student Association Bangladesh (ESAB) and International Association of Engineers (IAENG).</p>