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Radio Frequency Based Automatic Control of Electrical Loads

M. Narayanan[*1], M. Ashok Kumar[2], A. Ranjith Kumar[3], K. Raja[4]

[*1]Assistant Professor, Department of EEE, INFO Institute of Engineering, Coimbatore, Tamilnadu, India
[2, 3, 4] UG Student, Department of EEE, INFO Institute of Engineering, Coimbatore, Tamilnadu, India

ABSTRACT

This paper discusses the application of Radio Frequency (RF) signal in controlling the electrical loads automatically through remote. With the objective to save energy, switch the loads ubiquitously, to avoid unnecessary human moves and to make electrical loads free from wired connection to respective switches, a low cost automation system is proposed. The proposed method uses PIC 16F877A microcontroller, Encoder, Decoder, RF module to control electrical loads. About 15 loads within a distance of 30m can be controlled reliably.

Keywords: Microcontroller, Radio Frequency and Electrical Load

I. INTRODUCTION

The advancement in electronics and communication technologies has made automation as an integral part of every process. From domestic to commercial and power and process industries to save energy, to increase work efficiency of human by reducing tiring moves, to improve productivity and to save time automation is recommended. Here it is done by using RF signal to control electrical loads through remote.

Wireless communication among electronic devices became alive due the technological development in the form of Radio Frequency (RF) and Infrared (IR). RF remotes are very common; they are used in devices such as garage door openers, remote control toys and remote car-entry key, remote wall sockets, etc. Cell phones, walkie-talkies, WiFi setups and cordless phones are all transmitting radio signals at varying frequencies. The problem with RF remotes is the sheer number of radio signals flying through the air at any given time [3].

IR stands for Infrared and it is produced by LED source. A single IR remote control is developed for controlling several home appliances like Television, DVD, Set top box, Home theatre and Air Conditioner. IR transmit and receive systems are inexpensive and are generally reliable. However, interference from other IR sources can be a minor issue. Interference can also be caused by other light sources such as fluorescent lights (the ballast can cause IR interference). Sometimes some electronic ballast powered light can cause interference problems. In order to avoid any interference with this kind of equipment, the operating frequency of all electronic ballasts has to be chosen so that problems in the 36k Hz frequency area are out of the question [4].

The useful feature of RF remotes that sets them apart from infrared (IR) remotes is they can transmit signals up to 100 feet (30.5 meters) and can travel through walls and furniture [3] whereas Infrared uses “line of sight”.

II. METHODS AND MATERIAL

A. Literature Survey

Control of electrical loads is usually done through wires. The control strategy changed rapidly as technologies advanced [10].

In GSM based Home automation, the system primarily uses SMS messages to communicate the commands issued by the user to the main control system at home. This system offers the ability to control the appliances

from all over the world. The main drawback is no assurance of the delivery of the message. Thus such a system cannot be used as a real time system.

A Bluetooth system may use either a mobile phone or a PC as the receiver. The Bluetooth system can offer comprehensive control of the home appliances as long as the user is at home. It can function as a real time system. The speed of communication is high. This means that the user can be alerted about events as and when required. There is also greater security in Bluetooth technology. However, it cannot offer control when outside home. The range of Bluetooth appliances is around 10 meters. This is a significant drawback of this system.

Phone based systems can use the dual tone multiple frequency to transmit commands. This system depends on the ability to make phone calls from a remote location to a phone line at home. This has the advantage of offering remote access from anywhere in the world from where they can make a call. This can offer an almost real-time system. The drawback here is that it limits the number of possible devices to the number of possible DTMF tones.

ZigBee is an alternate technology that is similar to Bluetooth. This has the same advantages and drawbacks as the Bluetooth based system. This is a fairly new technology.

Wireless automation systems can use a host of wireless communication techniques. This may be radio frequency waves or infrared waves. This can also be used to power a real time system. The only downside her is the range and availability of the spectrum. Radio waves have a much larger range and offer good options for remote access.

Many systems exist that use a combination of the methodologies to compensate for the drawbacks of each. The only thing that may affect such systems is the cost of the systems and the possibility of redundancy.

B. Block Diagram

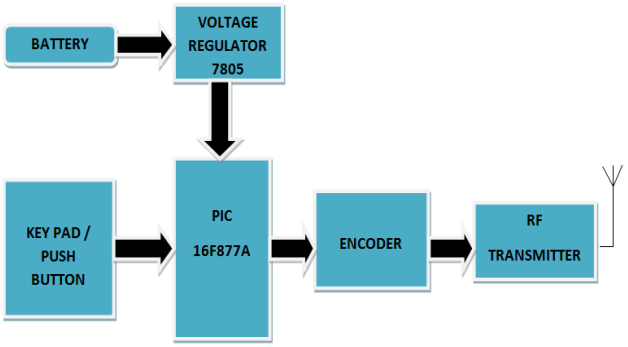

Figure 1. RF Transmitter Module

The RF module consists of RF transmitter and RF receiver. The RF transmitter block diagram is shown above and the modules associated with it are: PIC 16F877A, Encoder, RF transmitter, Battery, Voltage regulator, Key pad / Push button. The data is transmitted via RF transmitter which is placed alongside of microcontroller. An Encoder is used between microcontroller and RF transmitter which encodes parallel data bits into serial data for RF transmission.

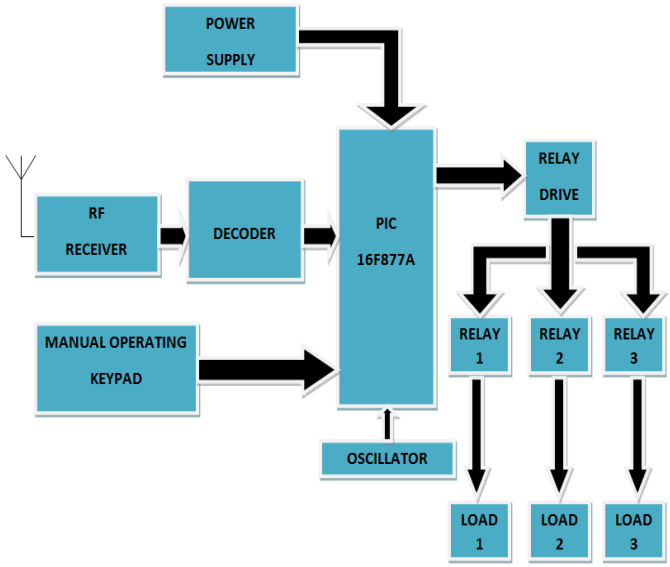

Figure 2. RF Receiver Module

The RF receiver block diagram is shown above and the modules associated with it are PIC16F877A, Decoder, RF receiver, Relay drive, loads, manual operating keypad and oscillator. The Decoder receive the serial address and data from its corresponding encoder, transmitted by a carrier using an RF transmission medium and gives output to the output pins after processing the data.

III. RESULTS AND DISCUSSION

Table I. Component Specification

COMPONENTS	RANGE
PIC microcontroller IC	16F877A
Encoder IC	HT-12E
Decoder IC	HT-12D
Voltage regulator (adapter)	12V/2A
Voltage Regulator	LM-7805
RF Transmitter	433 MHz
RF Receiver	433 MHz
Crystal oscillator	20MHz
PIC microcontroller drive	12V/2A
Relay drive	10 Channel
Manual Operating switches	Mounting type
Capacitor	100mf/16V, 22PF, 104PF
Resistor	10K
Battery	9V
Push Button	Micro Type
Jumper Wires	As Required
GP Board	1mm
Antenna	-

The Table II shows the 4-bit transmitted logic and the switched mode status of the electrical loads. Here transmitted logic for 10 loads is shown. However a maximum of 15 loads can be controlled with high accuracy. To turn OFF the load the same 4 bit is transmitted i.e. the same key is pressed once again to turn off the respective load. Pressing 1 in the remote, controls load 1, pressing 2 controls load 2 and so on. Any desired load can be switched on and off by pressing same key on the transmitter remote. A 4-bit logic is transmitted by pressing the key of the transmitter and the load controlling function is done accordingly.

IV. CONCLUSION

In this paper RF based automatic control of electrical load is presented. The use of PIC 16F877A is used to control a maximum of 15 loads reliably. The remote for controlling uses radio frequency signals with which accurate control within a distance of 30m is possible and the frequency of operation is 433 MHz. Safe switching of electrical loads by old people, children, person with disabilities is assured.

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