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Design and Implementation of a Low Cost Home Automation System

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ABSTRACT: This paper focuses on the development of a remote controlled home automation system using radio frequency. In this digital age, where every device is getting smarter, homes need to be upgraded from conventional switches to a centralized control system by remote controlled switches for a comfortable life especially for physically challenged people. The controlling circuit is built using RF transmitter and Receiver modules which are operating at 434 MHz (RF-434) along with encoder IC HT12E and decoder IC HT12D with few passive components. Encoders are coded using input switches and the decoder output is connected to the relays to control different appliances. The four different channels at the encoder are used as input switches and the four channels at the decoder output are connected to the appliances through a relay. The main objective of this work is to build the circuit without using any microcontroller.

KEYWORDS: RF transmitter, RF receiver, IC HT12E, IC HT12D, ULN2803A , Relays , ASK.

1. INTRODUCTION

The term automation was coined in the automobile industry about 1946 to describe the increased use of automatic devices and controls in mechanized production lines. Automation or automatic control, is the use of various control systems for operating equipment such as machinery, switching on telephone networks, steering and stabilization of ships, aircraft and other applications and vehicles with minimal or reduced human intervention. Automation has been achieved by various means including mechanical, electrical, electronic devices and computers, usually in combination. The biggest benefit of automation is that it saves labor; however, it is also used to save energy and materials and to improve quality, accuracy and precision.

This project demonstrates an automation system which contains a radio frequency transmitter and receiver to control four different appliances. The receiver modules communicate with the transmitter module through a wireless network. The transmitter section takes inputs from switches and decides to operate a particular appliance using relay. The address of encoder and decoder should be exactly the same otherwise the data will not be received by the receiver. The main objective of this work is to create a system to control multiple appliances by using RF Technology without using any microcontroller. One of the main advantages of RF based remote control is that it can operate the appliances without the requirement of line of sight within its specified range efficiently.

II. CIRCUIT IMPLEMENTATION

A. TRANSMITTER SECTION: The transmission section consists input switches, encoder IC HT12E and transmitter to transmit the signal.

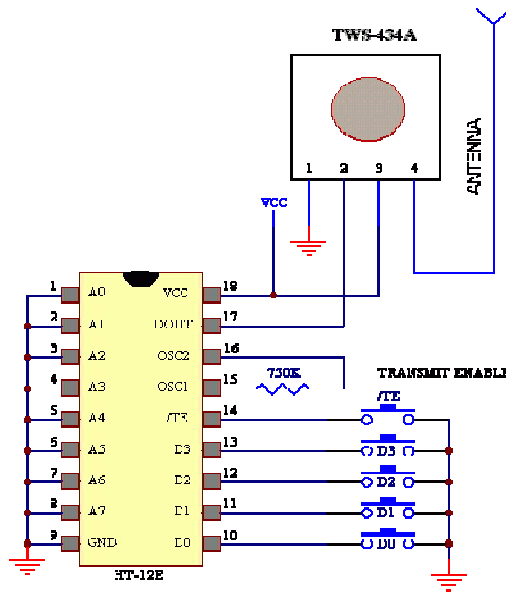


Fig 1. Transmitter module

In this RF system , the digital data is represented as variations in the amplitude of carrier wave. This kind of modulation is known as 'amplitude shift keying'(ASK).In Fig. 1 four input switches are used to encode the parallel data into HT12E encoder IC . HT12E is an encoder of 2^{12} series which converts parallel inputs into serial outputs. It encodes 12 bits parallel data into serial. These 12 bits are divided into 8 address bits and 4 data bits means 16 logical data can be encoded in encoder IC and then the the signals are transmitted serially through the antenna of RF transmitter. The modulation technique at the transmitter follows ASK (amplitude shift keying) which is operating at 434 MHz. The transmission occurs at the rate of 1kbps-10kbps. The transmitted data is received by the RF Rx operating at the same frequency as that of the Tx.

B. RECEIVER SECTION: The receiver section consists a receiver module , decoder IC HT12D , ULN2803A , relays to control different appliances.

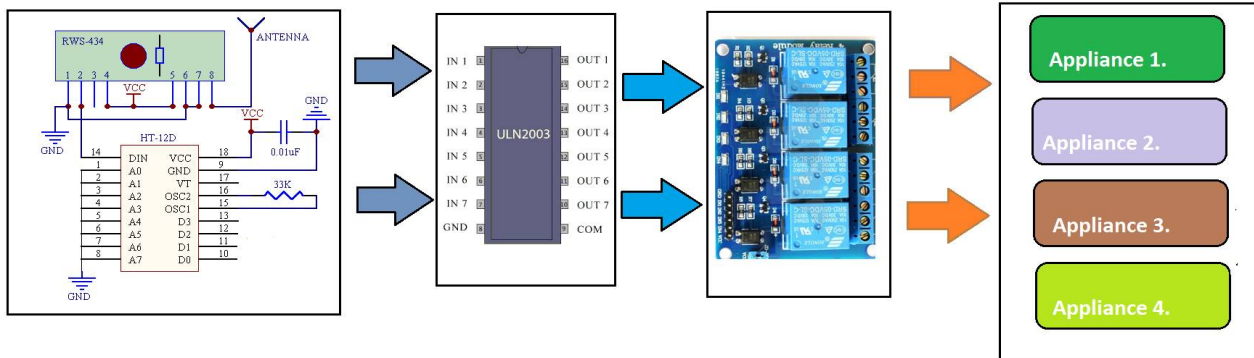


Fig.2 Receiver module

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Fig. 2 represents the working model of receiver section of home automation where serial data is received by receiver module and then the signal is converted into parallel data and decoded by IC HT12D and then send the signal to output data pin by comparing the local addresses with IC HT12E . A valid transmission is indicated by a high signal VT pin. HT12D is capable of decoding 12 bits of which 8 are address bits and 4 are data bits. The output pins of decoder IC sends the data to the IC ULN2803 ,which is a 50 V, 500 mA Darlington transistor array. The device consists of eight NPN Darlington pairs that feature high-voltage outputs with common-cathode clamp diodes for switching inductive loads. The collector-current rating of each Darlington pair is 500 mA. The Darlington pairs may be connected in parallel for higher current capability. Applications include relay drivers, hammer drivers, lamp drivers, display drivers .The ULN2803A device has a 2.7-k Ω series base resistor for each Darlington pair for operation directly with TTL or 5-V CMOS devices. ULN2803A send the signal to different relays according to the logic used to select the relay. Relay is an electrically operated switch which uses an electromagnet to mechanically operate a switch . Finally, different appliances are controlled wirelessly according to the different input combination.

III.RESULT

The design and implementation of the Smart Home Automation Controller using radio frequency has been discussed. The purpose of this system is to control Home Appliances using a wireless remote. The different transmitter and receiver section of this system is described. This system works on logic and hence does not require any microcontroller. In this project , I successfully controlled AC as well as DC appliances . we can control entire home , office and even wheel chair for a physically challenged person .

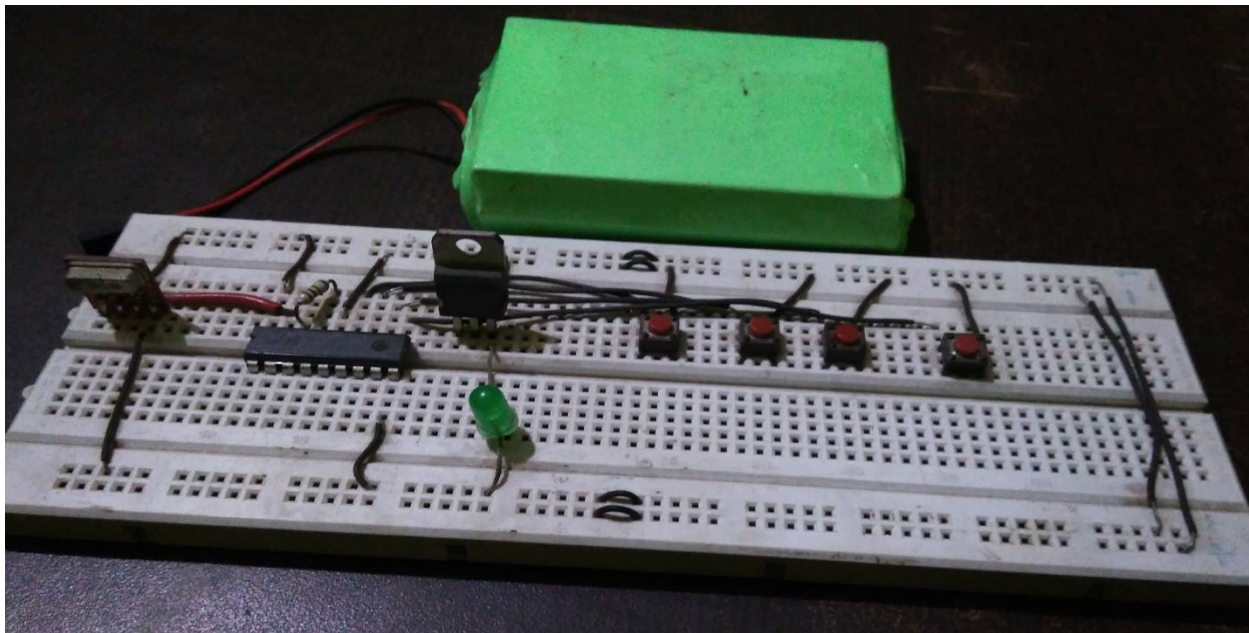


Fig 3. RF Transmitter module (Remote)

Fig.3 represents the transmitter module which is used as remote to control different appliances wirelessly according to the pressed switches. Total 16 combinations of inputs can be designed using these 4 switches. This system is independent of the line of sight and the signal can be transferred through objects. In transmitter section , power is supplied by external battery of 12V but encoder IC and transmitter require 5V to operate and hence IC 7805 is used which is a voltage regulator integrated circuit. It is a member of 78xx series of fixed linear voltage regulator ICs. The voltage source in a circuit may have fluctuations and would not give the fixed voltage output. The voltage regulator IC maintains the output voltage at a constant value . One LED is used to show whether encoder IC is working or not. The range of this module is 500ft. which can be increased by modifying antenna.

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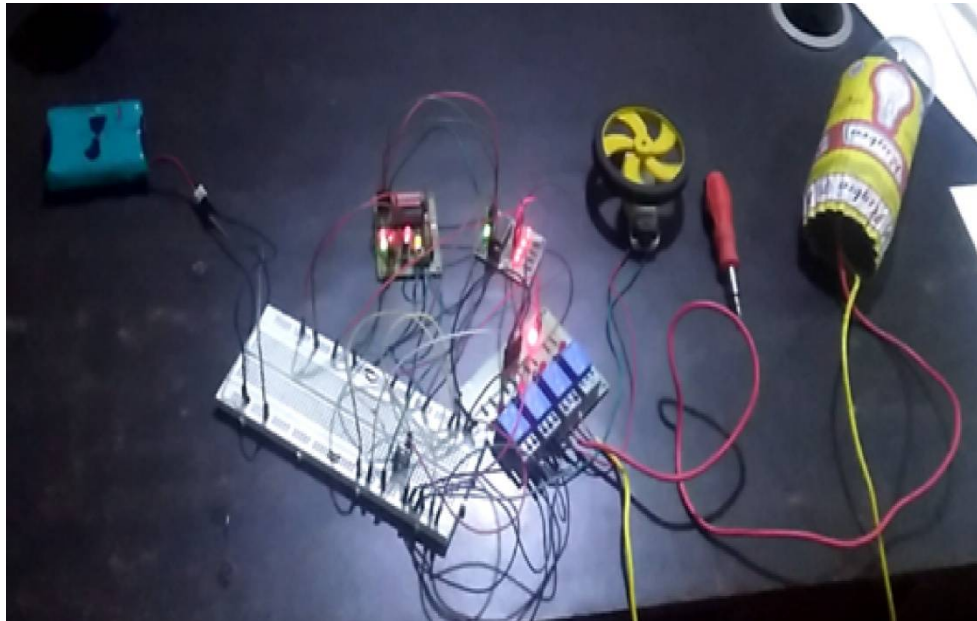


Fig.4 RF Receiver module with load connected

Fig.4 represents the receiver section which is connected to the different appliances. When the receiver receives signal from transmitter module, it decodes it and sends it to the relay through ULN280A IC which works as a relay driver IC. We can control four relays which can be increased by using multiplexer and demultiplexer IC. Here also 7805 IC is used to regulate voltage to 5V for decoder IC. Address of decoder is same as the encoder. All address pins are at low potential. Since there are 8 address pins so there can be 256 different combinations which can be used as a code for security and safety purpose.

IV. CONCLUSION

Home automation is becoming more popular due to the latest developments in hardware which have significantly reduced the cost and improved the capabilities. It is due to the fact that technology around us evolves and the access to needed information is easier than ever.

This radio frequency based home automation system is working completely as designed and as desired. These are very essential in present life style. This paper described a design of effective remote controlling system that can monitor the house. This paper gives the best solution for electrical power wastage. Also the manual operation is completely eliminated. The home appliances can be switched on/off using IR without actually going near the switch boards or regulators. Here I am controlling one AC appliance which is a bulb here and this required one relay and one DC motor which can rotate in both directions and hence required two relays. This is one of the best and cheapest system which can be commercialized in every home and offices for easy and comfortable life especially for elders and patients. This system can be modified using Bluetooth module to control these appliances through mobile using some android application. This system can be modified to send data like temperature, humidity etc wirelessly.

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