

IR Based Home Appliances Control System

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Abstract—IR-Based Home Appliances Control System is a control system using which the user can control different home appliances with a remote controller. The remote controller can be used to switch on/off different home appliances like a light bulb, fan, television, etc. which are connected to the circuit. It can also be used to regulate the speed of the fan. It can be activated from up to 10 meters. It is easy to build and can be assembled on a general-purpose PCB. This paper proposes the use of Infrared Remote controller to control different home appliances. It consists of Infrared Remote controller and receiver, microcontroller and triac. In this, the Infrared Remote sends signals to change the state of a home appliance when the microcontroller receives the signal it performs its task i.e. to change the state of the appliance according to the corresponding signal received.

Keywords—Infrared; triac; optocoupler; remote control; microcontroller

I. INTRODUCTION

Remote control for home appliances is a necessity in our fast-moving life. As technology sector is developing very fast and also have been developed drastically during the last few decades people are becoming more and more lazy, and as a consequence of it we most of the time either forget or neglect some of the basic things which can cause serious problems after a long period of time. Switching “ON” the electrical appliances as per the usage and also switching it “OFF” when not in use is an ideal behavior for a better future, but we don’t do it in this way we most of the time just let most of the appliances switched “ON” if they are not disturbing us, we neglect them because we think they are not consuming much energy or we prioritize our laziness over our environment without thinking of the consequences which can be triggered due to environmental losses which are being made during the production of the energy. So, this situation can be overcome by making some device which is mobile and does not need any locomotion of the whole body for switching ON/OFF the home appliances. As a result, much importance has been given to this aspect and a range of remote controls are popular today. One of the most common ways is to make use of IR radiations at particular frequencies.

In this paper, an IR-Based Home Appliances Control System is discussed. The device is able to control different home appliances within a particular range. The circuit is connected to any home appliances (lamp, fan, TV etc.) to make the appliance switch on/off and regulate the fan speed from a remote control. It can be activated from up to 10 meters. It is very easy to install and can be assembled on the back side of a switchboard.

The circuit essentially consists of an infrared remote, an infrared receiver module, LED’s to indicate the reception of the IR radiations and the state of home appliance(on/off), TRIAC, relay, Arduino Nano [1] and some other components.

II. BACKGROUND STUDY

IR remote has been proved to be the most popular equipment for home appliances for example control of air conditioner, turn on & off light as well as the normal use of

satellite receivers and TVs. Recent researchers concentrate on the use of IR remote control of devices for controlling different applications. Nhivekar G. S. used IR remote control for home applications [2]. Mahmud Shehu and team introduced remote-controlled mains power supply [3]. And Xiao Yuan applied the IR remote control in the management of industrial machine parameters [4].

In this work, firstly the IR code for certain push buttons are decoded by using IR receiver module and microcontroller. After this, a microcontroller program is written to assign different tasks to different buttons of the remote.

The question arise here is Why Infrared? Commonly used medium for wireless control are Radio Frequency (RF) and Infrared (IR) and they lie in the range of 3kHz - 300GHz and 300GHz - 30THz in electromagnetic spectrum respectively.

RF modules can receive or transmit radio signals and can penetrate through obstacles like a wall. This makes them useful for signaling or activating a switch through obstacles too. E.g. car unlocking system. However, in the case of home appliances, it is desirable to have the same controller to operate various appliances in a room without affecting adjoining rooms. This makes RF communication insufficient. Moreover, research has shown that RF can lead to various health hazards [5].

In such case, IR-Remote Controller can be useful. IR rays are invisible to the human eye and can be sensed by cameras and various IR receiver. Thus, IR light can be sensed by means of IR receiver but IR light source and receiver must be in line-of-sight. This very disadvantage of IR over RF makes it suitable for the design of the product. Also, IR rays are of no practical concern from a health hazard point of view [6].

III. PROPOSED IDEA

The work consists of blocks namely IR remote, IR receiver, AVR microcontroller, relay, and triac. IR receiver module receives the IR signal. Now, the microcontroller stores the bit pattern received by the IR receiver and compares with the pre-defined bit pattern. If any bit pattern matches then the microprocessor act as a switch to turn on/off a particular appliance for which the bit pattern is defined.

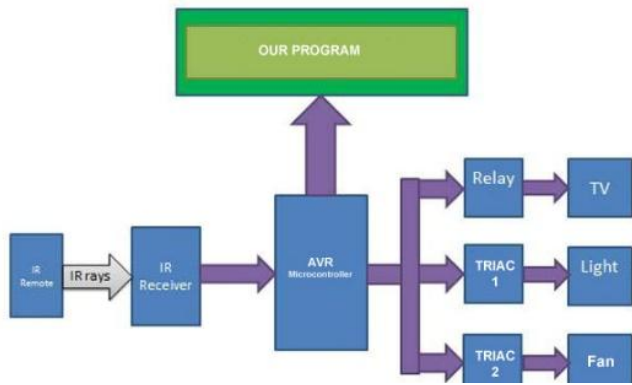


Figure 1. Block Diagram.

IV. COMPONENTS

This project consists of following components: -

- Arduino Nano
- IR Remote
- IR Receiver - TOSP 1738
- TriacBT136
- Relay
- Optocoupler

A. Arduino Nano

The Arduino Nano is a small and breadboard-friendly board based on the ATmega328. It offers the same connectivity and specifications of the UNO board in a smaller form factor. Due to its smaller size, it can be easily placed in a switchboard.

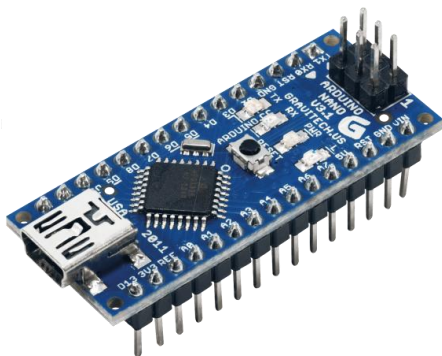


Figure 2. Arduino Nano.

B. IR Remote

In the present system, we have used a remote control which uses NEC Protocol. IR remote works on different protocol so every IR remote has its own protocol. The specialty of the project is that any remote can be used to control the appliances. But, the condition is bit pattern of the particular remote should be stored in the microcontroller. Microcontroller stores the bit pattern for specific buttons of remote and it compares with the pre-defined bit pattern to change the state of the appliance.



Figure 3. IR Remote.

C. IR Receiver - TOSP 1738

TSOP1738 is an Infrared (IR) receiver which is commonly used in a large number of electronic products for receiving and demodulating infrared signals. The received demodulated signals can be easily decoded by using a microcontroller. It supports RC5, RC6 code, Sony format (SIRCS), NEC code, etc.

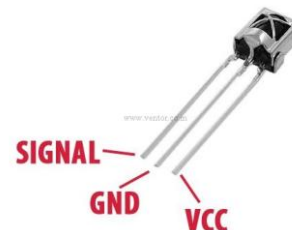


Figure 4. TSOP 1738.

D. Triac BT136

TRIAC (Triode for AC) is the semiconductor device commonly used in power control and switching applications. It has its applications in switching, phase control, chopper designs, brilliance control in lamps, speed control in fans, motors etc. The power control system is designed to control the distribution level of AC or DC. Such power control systems can be used to switch power to appliances manually or under certain conditions.

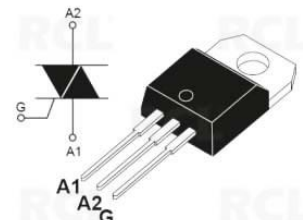


Figure 5. TSOP 1738.

E. Optocoupler

An optocoupler also called an optoisolator, photocoupler, is a component that is used to transfers electrical signals using light between two isolated circuits.

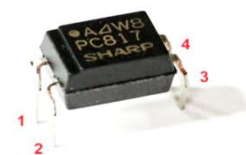


Figure 6. Optocoupler.

V. METHODOLOGY

A. Hardware Part

1) Decoding the IR Signals

In the project, we have used IR remote switch which uses NEC protocol as shown in Figure 7 [7]. NEC protocol uses pulse distance encoding of the bits. Each pulse is 560µs long 38kHz carrier burst (around 21 cycles). A logical "1" takes 2.25ms to transmit, while a logical "0" is only half of logical "1", being 1.125ms as shown in Figure 8.



Figure 7. Message frame using the NEC protocol.

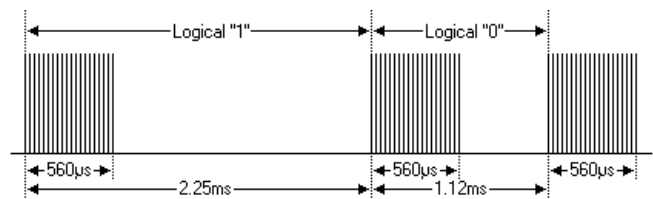


Figure 8. Difference between logic 0 and 1.

2) Zero Crossing Detector

A zero-crossing detector is a type of voltage comparator [8]. It is used to detect a sine waveform transition from positive and negative, that coincides when the input crosses the zero voltage condition. Basically, it is used to detect when the input crosses zero voltage.

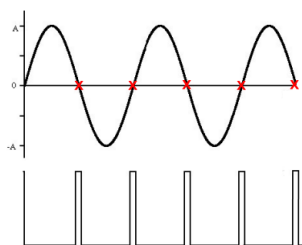


Figure 9. Zero Crossing Detector Output.

3) Microcontroller as Switch

In this project, TSOP-1738 receiver module is used to receive the infrared signal from the remote. When any IR signal is transmitted, microcontroller matches the transmitted bit pattern with the pre-defined bit pattern. If the bit pattern matches then the particular device will switch on/off which is linked with the bit pattern.

4) Triac

TRIAC (Triode for AC) is the semiconductor device commonly used in power control and switching applications. In this project, triac is used to switch on/off the home appliances. One of the terminals of triac is connected with the AC current and another one with the appliance. The gate terminal of triac is connected with microcontroller which sends signals to turn the device on/off.

B. Software Part

The microcontroller code is written in the embedded-C language. The flow chart of the program is given below.

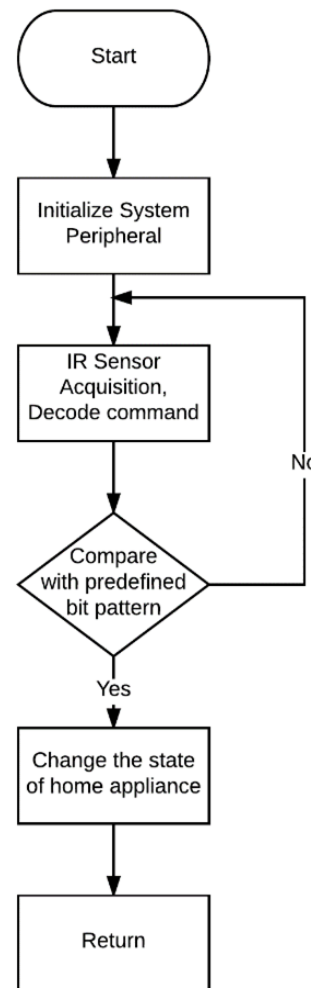


Figure 10. Flow Chart of Proposed System.

VI. RESULT AND ANALYSIS

A. Proper Decoding

IR receiver can decode transmitted IR signal for the proper working of the microcontroller. Switching on/off is tested about 100 times using the remote control. Due to the different bit pattern, for every button make the circuit possible to switch to different appliances.

B. Program Testing

After receiving the IR signal the program will decode the signals and compare stored bit patterns with the pattern received and switch the appliance which is linked to the button. After switching the appliance, the program will return to IR signal Acquisition. For the smooth working of the device the program has been tested again and again and it works as expected.

C. Triac and Relay

The program sends a signal to turn the appliance on/off or to regulate the speed of the fan to triac or relay. If the appliance

is off then it will turn on or vice versa. This has been tested again and again and it is working fine.

VII. CONCLUSION

In this paper, an IR-Based Home Appliances Control System is tried to develop which is used to switch the state of an appliance using a remote. Our target is to make the life of people easy and save electricity. Instead of going near the appliance to turn it on/off we just need to press a button. Also, sometimes we just slack off to turn off an appliance and let the appliance waste electricity.

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