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Infrared Technology: As a Home Appliances Controller via TV Remote

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Abstract: In today's era, the ease of life and simultaneously conservation of energy in most demanding thing. This should be the required contribution for every person for making a better world. In our proposed module we have designed a module which can control maximum four home appliances such as fan, cooler, AC, bulb etc. Via TV remote through Infrared technology. At this stage approximately every person have TV remote at their home and in this paper our purpose and effort is to make maximum digitalization for home appliances. Our proposed module consist mainly two sections TX and RX. Our RX section of proposed module is very efficient and at the same time power consumption is very less. This module can be used efficiently at home, offices, schools, colleges and industries.

Keywords: IR, ATMEGA, TX, RX, NO, NC, COM, PCB, SPP, EDA, CAD, PROTEUS, DIP-TRACE, CIE, EDA.

1. INTRODUCTION

INFRARED TECHNOLOGY

Infrared (IR) is invisible radiant energy, electromagnetic radiation with longer wavelengths than those of visible light, extending from the nominal red edge of the visible spectrum at 70nm (frequency 430 THz) to 1 mm (300 GHz) ,although people can see infrared up to at least 1050 nm in experimentally[1]. Infrared technology was discovered by a Astronomer, Sir William Herschel. A molecules change their rotational-vibrational movement if either they emit or absorb infrared energy. When a molecule get or emit infrared signal it will come in vibration state due to change of dipole moment by molecule itself. Infrared technology is used in various places like industries, scientific purpose and medical applications. There are so many applications of this technology such as thermal efficiency analysis, environmental monitoring, industrial facility inspections, remote temperature sensing, short-ranged wireless communication, spectroscopy and weather forecasting. According to International Commission on Illumination (CIE) infrared radiation has been divided into three band which is described in Table-1.

Table1: IR band division according to CIE

Abbreviation	Wavelength	Frequency
IR-A	700 nm – 1400 nm (0.7 µm – 1.4 µm)	215 THz – 430 THz
IR-B	1400 nm – 3000 nm (1.4 µm – 3 µm)	100 THz – 215 THz
IR-C	3000 nm – 1 mm (3 µm – 1000 µm)	300 GHz – 100 THz

In my proposed design we wave used TSOP-1738 IR detector which can detect any range of IR signal.

RELAY

Relay is an electromagnetic device which is used to isolate two circuits electrically and connect them magnetically[2]. Relays can be used to interface between an electronic circuit to an high voltage electric circuit based on the principle of electromagnetic induction, for example a 230 V AC main can be switched by a relay operated 5V battery . In this way we can use relay circuits to drive our above said appliances efficiently according to our requirements. Input section of a Relay has a coil which generates magnetic field with implementation of a very small voltage from an electronic circuit, called the operating voltage. Commonly used relays with operating voltages are- 6V, 9V, 12V, 24V. There are mainly three connectors in a basic relay-normally open (NO), normally closed (NC) and Common (COM). At no input state COM is connected to NC.

At applied operating voltage coil gets energized and the COM make contact to NO. Depending on different change over contacts different relay configurations are available in the market such as-SPST, SPDT, DPDT etc. Here in our proposed RX part we have used SPDT relays.

PROTEUS SOFTWARE

The Proteus Design Suite is an Electronic Design Automation (EDA) tool including schematic capture, simulation and PCB Layout modules[3]. This EDA Tool was developed in Yorkshire, England by Labcenter Electronics Ltd. Proteus supports Mixed mode SPICE Simulation, microcontroller simulation, Shape based auto-routing, 3D Board Visualisation and MCAD import/export. Proteus software runs on the Windows operating system and this supports English, French, Spanish and Chinese languages.

DIPT-RACE SOFTWARE

Dip-Trace is EDA/CAD Tool for creating schematic diagrams and printed circuit boards. Dip-Trace supports mainly five modules which are Schematic Capture Editor , PCB Layout Editor with built-in shape-based auto-router , 3D Preview & Export, Component Editor and Pattern Editor[4]. Its schematic capture supports multilevel hierarchical schematics. This EDA tool supports schematic capture to PCB layout conversion.

I. USED IC'S and MODULE Description

ATMEGA328P-PU

This is microcontroller based 28 pin ATMEGA328P-PU AVR series IC. It has 14 digital input/output pins out of which 6 pin can be used as a PWM output. This has also 6 Analog input pin. Operating frequency of this is 16MHz. it has flash memory 32kB, EPROM 2kb & RAM 2KB. It has also one UART, 4, 8-bit PWM output and 2, 16-bit PWM output. The pin configuration of ATMEGA328P-PU is described in Table-2.

Table2: Pin Detail of ATmega328

PIN NO.	PIN NAME	MAPPED PIN NAME
1	RESET	RESET
2	RXD	RX/DIGITAL I/O 0
3	TXD	TX/ DIGITAL I/O 1
4	INT0	DIGITAL I/O 2
5	INT1	DIGITAL I/O 3
6	T0	DIGITAL I/O 4
7	VDD	SUPPLY VOLTAGE
8	GND	GROUND
9	XTAL1	CRYSTAL PIN 1
10	XTAL2	CRYSTAL PIN 2
11	T1	DIGITAL I/O 5
12	AIN0	DIGITAL I/O 6
13	AIN1	DIGITAL I/O 7
14	ICP1	DIGITAL I/O 8
15	OC1A	DIGITAL I/O 9
16	OC1B	DIGITAL I/O 10
17	MOSI	DIGITAL I/O 11
18	MISO	DIGITAL I/O 12
19	SCK	DIGITAL I/O 13
20	AVCC	SUPPLY VOLTAGE
21	AREF	VREF
22	GND	GROUND
23	ADC0	ANALOG INPUT 0
24	ADC1	ANALOG INPUT 1
25	ADC2	ANALOG INPUT 2
26	ADC3	ANALOG INPUT 3
27	ADC4	ANALOG INPUT 4
28	ADC5	ANALOG INPUT 5

ULN2003A

ULN2003A is 16-pin based IC which contain seven NPN Darlington pair with common cathode clamp diode. In this IC collector current rating of a single Darlington pair is 500 mA. Applications include relay drivers, hammer drivers, lamp drivers, display drivers (LED and gas discharge), line drivers, and logic buffers[5]. pin description of IC is shown in Table-3.

Table3: Pin Detail of ULN2003A

PIN NO.	PIN NAME	PIN DESCRIPTION
1,2,3,4,5,6,7	INPUT[0:7]	Input Pins
8	GND	Groung
9	COM	High DC Supply Voltage
16,15,14,13,12, 11,10	OUTPUT[0:7]	Output Pins

74HC573

The 74HC573 has octal D-type transparent latches featuring separate D-type inputs for each latch and 3-state true outputs for bus-oriented applications [6]. This IC has 20 pin out of which two pins Are used to control the data from input to output. Pin no. '1' which is denoted as OE which output enable signal. Since it is active low signal hence when OE=LOW at this moment stored value of latches come to at its output otherwise outputs remains very high impedance. and similarly pin no-11 denoted as LE which indicate latch enable input since it is active high signal so inputs value (Din) will store in latches when LE=HIGH. The pin description of IC has briefly explained in Table-4.

Table4: Pin Detail of 74HC573

PIN NO.	PIN NAME	PIN DESCRIPTION
1	OE	3-state output enable input (active LOW)
2,3,4,5,6,7, 8,9	IN[0:7]	data inputs
10	GND	ground
11	LE	latch enable input (active HIGH)
19,18,17,16, 14,13,12	OUT[0:7]	3-state latch outputs
20	VCC	supply voltage

LM7805

LM7805 is a voltage regulator integrated circuit. It blocks the fluctuation of voltage at its output and keep voltage constant. This IC provide +5v regulated output when DC value of 7v to 35v coming to its input.

TSOP-1738

This is 3-pin IR detector. First pin is output pin, second pin for VDD and third pin for GND. when a infrared signal emitted by pressing any key of TV remote that is detected by this sensor and generate a particular hex key
which can be seen in serial monitor of ARDUINO. The program which is to be uploaded to check TV remote hex key is given below

```
#include <IRremote.h>
int RECV_PIN = 2;
IRrecv irrecv(RECV_PIN);
decode_results results;

void setup()
{
  Serial.begin(9600);
  irrecv.enableIRIn(); // Start the receiver
}
void loop()
{
  if (irrecv.decode(&results))
  {
    Serial.println(results.value, HEX);
    irrecv.resume(); // Receive the next value
  }
}
```

In above program "IRremote.h" library is firstly added to ARDUINO library. And then output pin of TSOP-1738 is connected to digital pin 2 of ARDUINO UNO, VDD to +5V and GND to Ground.

II. PCB PREPARATION FOR PROPOSED MODULE (RX PART)

Fig.1 Represents the PCB layout of our proposed receiver part. This has developed in **Dip-Trace** PCB Design Software.

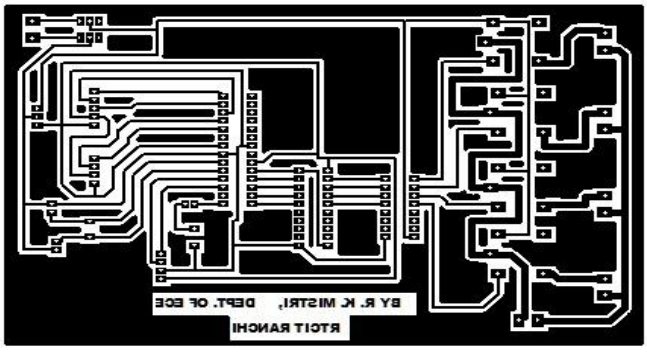

Fig.1: PCB layout of receiver part

PRINTING OF LAYOUT STRUCTURE OF PCB TO COPPER LAMINATE

In order to print layout structure of PCB to copper laminate firstly layout structure is printed on high glossy paper by laser printer with dark black ink. Then after copper is cleaned with thinner(acetone) and printed side of glossy paper is kept on copper laminate in such a manner that it can touch the copper side of laminate and also it is fixed by transparent tape. Then After a hot electric iron is kept on glossy paper and it is pressed continuously with movement of electric iron on whole glossy paper at least 3 minute so that flossy paper can stick with laminate. Then after laminate is dropped in normal water for a 3 minute. Further glossy paper is removed by hand with rubbing by keeping it in water. After doing so layout design will be printed on copper laminate, which will be looking like as shown in fig-2.

Fig.2: Printed layout structure of PCB on copper laminate

ETCHING OF NON-PRINTED PART OF COPPER

Etching is the process of removing non-printed part of copper from laminate. In order to remove non-printed part of copper from laminate, firstly an ferric chloride solution is prepared in platic type pot and then laminate is dipped into the solution and then solution is sacked well untill all non-printed copper remove from laminate. Now our aim is to remove ink which is removed by applying acetone. In this way our PCB become ready.

MASKING AND PROTECTING PCB

To protect PCB, uv curable solder mask ink is applied to whole PCB and then mask is kept acordingly on pcb (which is printed on pvc sheet) and then system is kept on uv exposure system for 35 sec. Then mask ink become solid where uv light is incident on ink and otherwise area ink remains in liquid form that can be easily removed by cleaning PCB in NaOH solution. Now pcb become ready. So in order to put the component on PCB, firsty drilling is done by PCB Drilling Machineand then components or IC'S shockets are fitted on PCB accordingly and soldering is done.

III. PROPOSED MODULE DESCRIPTION

Our proposed model consists of two parts i.e. Transmitter part and Receiver part. Transmitter is nothing but a TV remote . Our proposed receiver part contain TSOP-1738, ATMEGA328P-PU AVR series microcontroller, 9V battery, LM7805 positive voltage regulator, 74HC573 octal d-type transparent latch, ULN2003A relay driver, DPDT 5v-relay and 16 MHz crystal oscillator.

Actually in our proposed module when a key of remote is pressed then IR receiver receive this signal and a specific hex code is generated which is sent to microcontroller. According to received hexcode by microcontroller this specify the work i.e. to on or off the relay. The schematic of our receiver part is shown in fig.3 which has designed and simulated on PROTEUS software (EDA Tool).

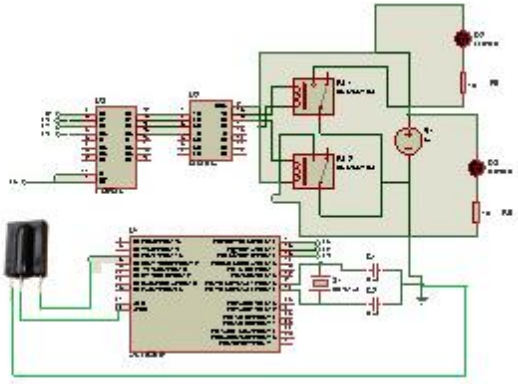

Fig.3: Schematic of RX part

Our proposed RX part can control two home appliances at a time because we have used only two relay in our hardware design instead of four. Our RX hardware part is shown in fig-4.

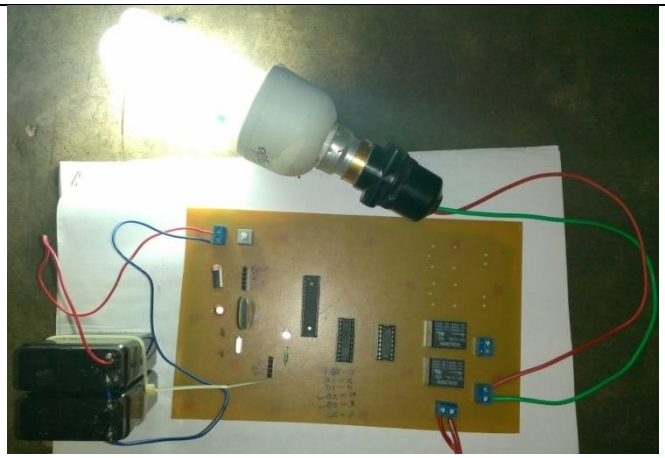

Fig.4: Proposed Hardware Design of RX part

When a key '1' of remote is pressed then first relay change their state (either NC to NO or NO to NC) whichever was previously stays. Similarly information '2' is used to control second relay.

IV. CONCLUSION & FUTURE SCOPE

Our proposed design is very useful in everywhere like offices, homes, schools, colleges, companies and many other places to control any kind electrical equipment. This system has very low power consumption and also has very low cost. As we know that Bluetooth has maximum 10m range so it can only work in 0-10m range. There are various applications of IR technology some of them are Night vision, Thermo-graphy, Heating, Communications, Spectroscopy, Meteorology, Climatology, Astronomy and Health hazard.

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