Touch Screen Based Home Automation System

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for the degree of Bachelor of Technology
In
Electronics and Communication Engineering
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Under the Supervision of

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Certificate

This is to certify that project report entitled “Touch Screen Based Home Automation System”,submitted by Sahil Goyal (111123),Shikha Chaudhry (111126),Saif Ansari (111086) in partial fulfillment for the award of degree of Bachelor of technology in Electrnoics and Communication Engineering to Jaypee University of Information Technology ,Waknaghat, Solan has been carried under my supervision.

This work has not been submitted partially or fully to any other University or Institute for the award of this or any other degree or diploma.

Date: **Supervisor’s Name:Dr.Pradeep Kumar**

Associate professor

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1. INTRODUCTION

1.1 ABSTRACT

Home automation refers to the use of computer and information technology to control home appliances and features. Systems can range from simple remote control of lighting through to complex computer/micro-controller based networks with varying degrees of intelligence and automation. Home automation is adopted for reasons of ease, security and energy efficiency.

As the number of controllable devices in the home rises, interconnection and communication becomes a useful and desirable feature. .In simple installations, automation may be as straightforward as turning on the lights when a person enters the room. In advanced installations, rooms can sense not only the presence of a person inside but know who that person is and perhaps set appropriate lighting, temperature, music levels or television channels, taking into account the day of the week, the time of day, and other factors.

Home automation can also provide a remote interface to home appliances or the automation system itself, to provide control and monitoring on a smartphone or web browser.

A touch panel is interfaced to the microcontroller on transmitter side which sends ON/OFF commands to the receiver where loads are connected. By touching the specified portion on the touch screen panel, the loads can be turned ON/OFF remotely through wireless technology. The loads are interfaced to the microcontroller .

1.2 OBJECTIVE

Our objective is to design a home automation system which uses a touch screen to control the various devices of the house like light, fans ,TV etc. The communication range is also long and there is no loss of data.

1.3 Why this Project? (Motivation)

As technology is advancing so houses are also getting smarter. Modern houses are gradually shifting from conventional switches to centralized control system, involving touch screen switches. Presently, conventional wall switches located in different parts of the house makes it difficult for the user to go near them to operate. Even more it becomes more difficult for the elderly or physically handicapped people to do so. Remote controlled home automation system provides a simpler solution with touch screen technology.

l.4 BLOCK DIAGRAM

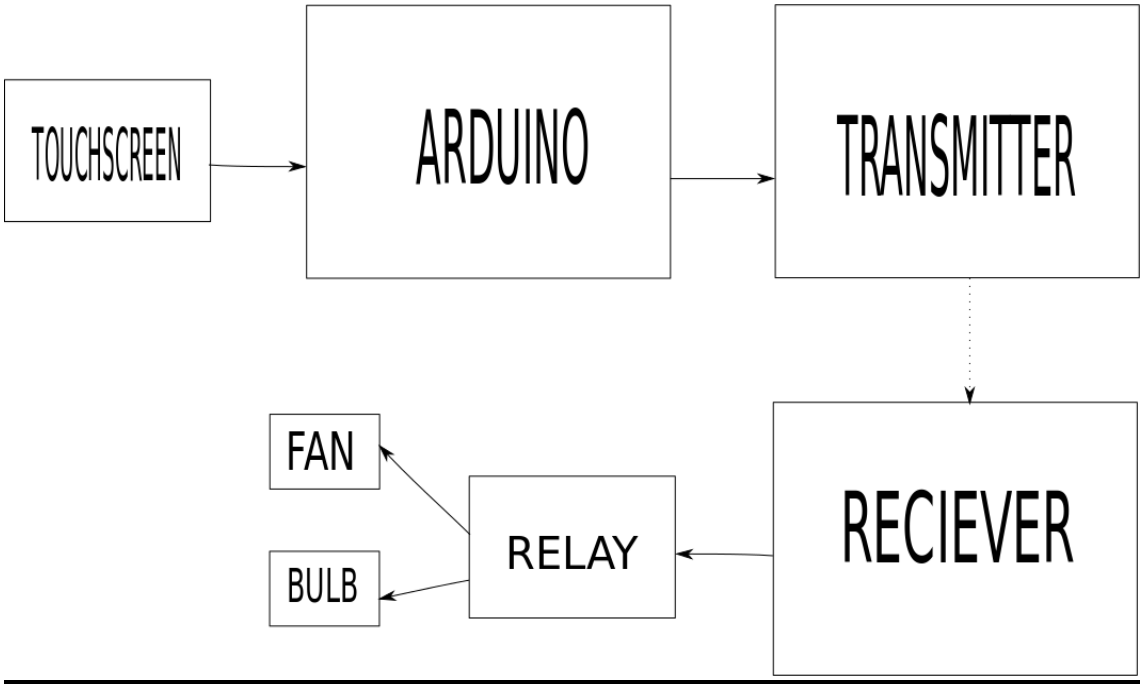


Figure 1: block diagram

The above block digram shows a rough way in which the connections are made in our project.

2. HARDWARE DESCRIPTION

2.1 COMPONENTS USED IN THE PROJECT

- TOUCHSCREEN
- ARDUINO
- ATMEGA328 MICROCONTROLLER
- RELAY
- BLUETOOTH MODULE
- HT12E ENCODER
- RF MODULE TX/RX
- HT12D DECODER
- BREAD BOARD
- FAN/BULB
- 5V/12V POWER ADAPTER

2.2 TOUCH SCREEN

Perhaps the biggest advantage of a touch screen display is that it eliminates the need for a keyboard input, resulting in a cheaper and a lighter overall design. The user input facilities in such devices are usually provided in the form of soft keypads where the layout of a keypad is displayed on a touch screen panel, and required characters and numbers can be entered by simply touching the required key positions on the touch screen. Soft keypad also makes it easier to enter and edit data quickly.

Another advantage of a touch screen display is that it is usually much quicker to navigate around the screen than using a keyboard or a mouse type inputs. Touch screen displays are also used in most POS systems, for example in restaurants and in supermarket check-outs to select a purchased item from a menu quickly, easily and reliably.

Perhaps the biggest advantage in such applications is the speed of making a correct selection.

A touch screen LCD display is usually more expensive than a standard LCD display. The choice of whether or not to use a touch screen display depends entirely on the nature of the application, the cost and the level of user experience.

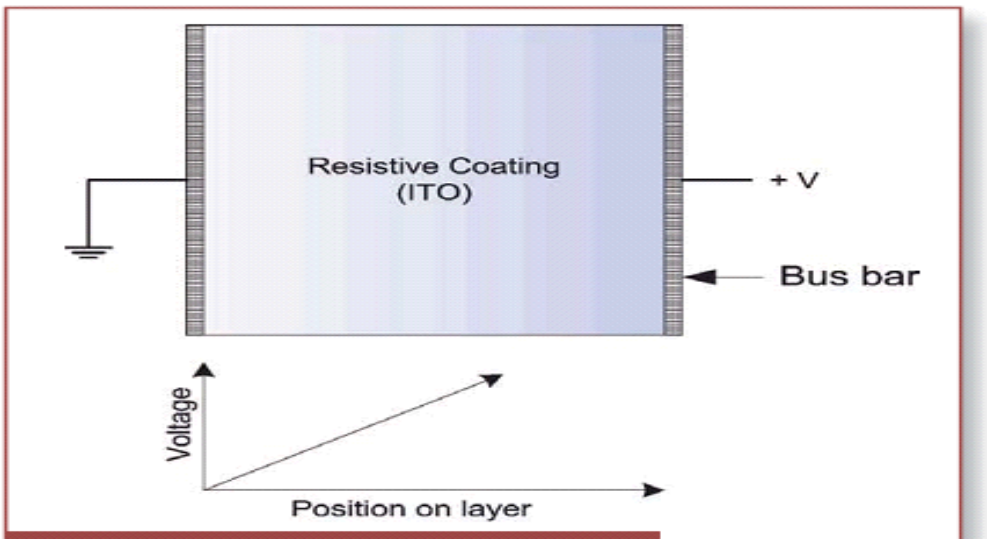


Figure 2: resistive touchscreen

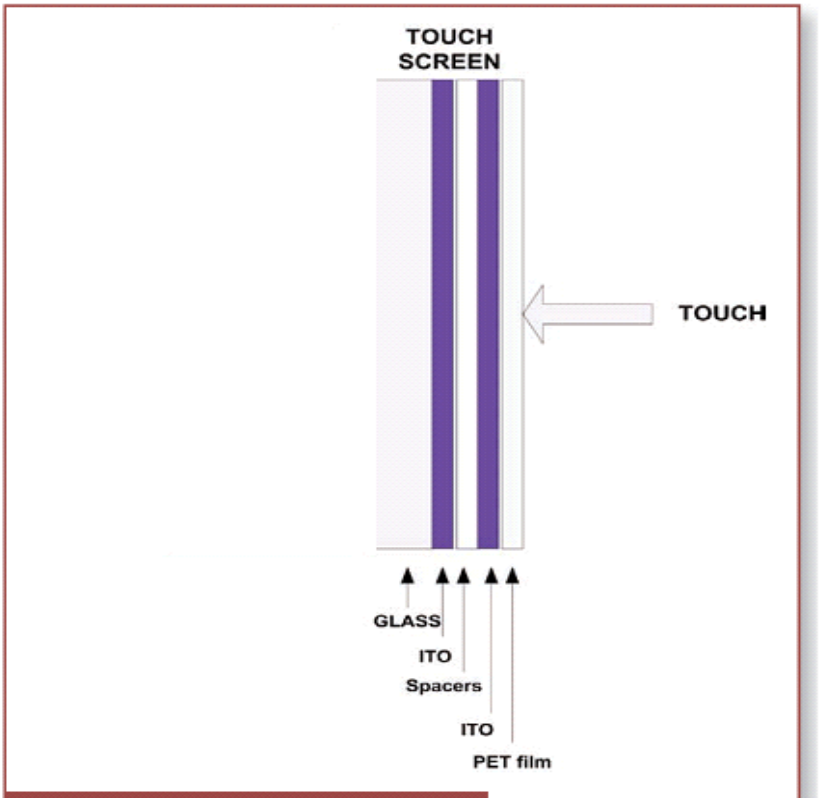


Figure 3: Touch screen description

Types of Touch Screen Displays

Displays usually have resolutions of 128x64 pixels and are used in battery-operated intelligent devices. A touch screen LCD is basically a combination of a graphics LCD (GLCD) and a touch sensitive panel mounted on top of the GLCD. The two parts are independent of each other.

The panel senses the co-ordinates where the user touched and the GLCD displays graphical information on the LCD display based upon user's selection.

There are several types of touch screen LCDs, such as resistive, capacitive, surface acoustic wave, optical imaging, strain gauge and so on.

The most commonly used types are the resistive and capacitive ones and some information about each type is given below. A **resistive touch screen** consists of several layers, where two electrically conductive resistive layers are separated by a very small gap and a flexible layer is used at the top. One of the layers is connected to a voltage source. When a point is pressed on the screen, the touched points of both conductive layers make a contact and if the voltage is read at the other layer this voltage will be proportional to the position of the point touched because of the voltage dividing effect. Further details about resistive touch screens are given later.

A **capacitive touch screen** panel is coated with a material that stores electrical charges. When the panel is touched, a small amount of charge is drawn to the point of contact and the charge is measured at each corner of the panel and is then processed to determine the point touched. Resistive touch screens have the advantages that the screen responds when touched with any kind of object, e.g. finger, stylus, nail, etc. On the other hand, the capacitive screens respond only when touched by a naked finger (but they will not respond when touched with an object or if wearing gloves for example). On the other hand, capacitive touch screens are lower power devices, have higher granularities and also provide higher clarity. In this PROJECT the resistive touch screen is used in a practical microcontroller-based application

Resistive Touch Screens

Resistive touch screens are used in most low cost, medium resolution systems. A resistive touch screen consists of at least three layers. As shown in Figure 1, the touch screen is mounted on a graphics LCD (GLCD). The bottom layer is a glass (or acryl), coated with a resistive Indium Tin Oxide (ITO) solution. On top of this, a resistive ITO coated poly Ethylene Terephthalate (PTE) flexible film is used. The two conductive ITO layers are separated from each other with microdot spacers so that there is no contact between them when the screen is not touched. When a pressure is applied to the top of the screen, e.g. by touching the screen, the two ITO layers will make contact at the point of the touch. Electrical circuits are then used to determine the point of the contact. Usually a 4-wire, 5-wire, or an 8-wire circuit is used to determine the co-ordinates of the point touched by the user. These circuits are described below in greater detail.

2.3 ARDUINO

The Arduino Uno is a microcontroller board based on the ATmega328 (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz crystal oscillator, a USB connection, a power jack, an ICSP header, and a reset button. It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with a AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter.

Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current for 3.3V Pin	50 mA
Flash Memory	32 KB (ATmega328) of which 0.5 KB used by bootloader
SRAM	2 KB (ATmega328)
EEPROM	1 KB (ATmega328)
Clock Speed	16 MHz

Table 1:Arduino specifications

POWER

The Arduino Uno can be powered via the USB connection or with an external power supply. The powersource is selected automatically.External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector. The board can operate on an external supply of 6 to 20 volts. If supplied with less than 7V, however, the 5V pin may supply less than five volts and the board may be unstable. If using more than 12V, the voltage regulator may overheat and damage the board. The recommended range is 7 to 12 volts.

The power pins are as follows:

VIN. The input voltage to the Arduino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). You can supply voltage through this pin, or, if supplying voltage via the power jack, access it through this pin.

5V. The regulated power supply used to power the microcontroller and other components on the board. This can come either from VIN via an on-board regulator, or be supplied by USB or another regulated 5V supply.

3V3. A 3.3 volt supply generated by the on-board regulator. Maximum current draw is 50 mA.

GND. Ground pins.

MEMORY

The Atmega328 has 32 KB of flash memory for storing code (of which 0,5 KB is used for the bootloader); It has also 2 KB of SRAM and 1 KB of EEPROM (which can be read and written with the EEPROM library).

The Uno has 6 analog inputs, each of which provide 10 bits of resolution (i.e. 1024 different values). By default they measure from ground to 5 volts, though is it possible to change the upper end of their range using the AREF pin and the analogReference() function. Additionally, some pins have specialized functionality:

I2C: 4 (SDA) and 5 (SCL). Support I2C (TWI) communication using the Wire library.

There are a couple of other pins on the board:

AREF. Reference voltage for the analog inputs. Used with analogReference().

Reset. Bring this line LOW to reset the microcontroller. Typically used to add a reset button to
shields which block the one on the board.

INPUT AND OUTPUT

Each of the 14 digital pins on the Uno can be used as an input or output, using pinMode(), digitalWrite(), and digitalRead() functions. They operate at 5 volts. Each pin can provide or receive a maximum of 40 mA and has an internal pull-up resistor (disconnected by default) of 20-50 kOhms. In addition, some pins have specialized functions:

Serial: 0 (RX) and 1 (TX). Used to receive (RX) and transmit (TX) TTL serial data. TThese pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip .

External Interrupts: 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value. See the attachInterrupt() function for details.

PWM: 3, 5, 6, 9, 10, and 11. Provide 8-bit PWM output with the analogWrite() function.

SPI: 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware, is not currently included in the Arduino language.

LED: 13. There is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

PHYSICAL CHARACTERISTICS

The maximum length and width of the Uno PCB are 2.7 and 2.1 inches respectively, with the USB connector and power jack extending beyond the former dimension. Three screw holes allow the board to be attached to a surface or case. Note that the distance between digital pins 7 and 8 is 160 mil (0.16"), not an even multiple of the 100 mil spacing of the other pins.

2.4 ATMEGA328 MICROCONTROLLER

The high-performance Atmel 8-bit AVR RISC-based microcontroller combines 32KB ISP flash memory with read-while-write capabilities, 1KB EEPROM, 2KB SRAM, 23 general purpose I/O lines, 32 general purpose working registers, three flexible timer/counters with compare modes, internal and external interrupts,serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8-channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and five software selectable power saving modes. The device operates between 1.8-5.5 volts.

By executing powerful instructions in a single clock cycle, the device achieves throughputs approaching 1 MIPS per MHz, balancing power consumption and processing speed.

PARAMETERS	VALUE
Flash	32 Kbytes
RAM	2 Kbytes
Pin Count	28
Max. Operating Frequency	20 MHz
CPU	8-bit AVR
# of Touch Channels	16
Hardware QTouch Acquisition	No
Max I/O Pins	26
Ext Interrupts	24
USB Interface	No
USB Speed	No

Table 2: ATMEGA 328 specifications

2.5 RELAY

Figure 4: 4-channel relay

This is a 5V 4-Channel Relay interface board, Be able to control various appliances, and other equipments with large current. It can be controlled directly by Micro-controller (Arduino , 8051, AVR, PIC, DSP, ARM, ARM, MSP430, TTL logic) .

Description:

This is a 5V 4-Channel Relay interface board, Be able to control various appliances, and other equipments equipment with large current. It can be controlled directly by Micro-controller (Raspberry Pi, Arduino , 8051, AVR, PIC, DSP, ARM, ARM, MSP430, TTL logic).

5V 4-Channel Relay interface board, and each one needs 15-20mA Driver Current Equipped with high-current relay, AC250V 10A ; DC30V 10A

Standard interface that can be controlled directly by microcontroller (Arduino , 8051, AVR, PIC, DSP, ARM, ARM, MSP430, TTL logic active low) Opto-isolated inputs

Indication LED’s for Relay output status.

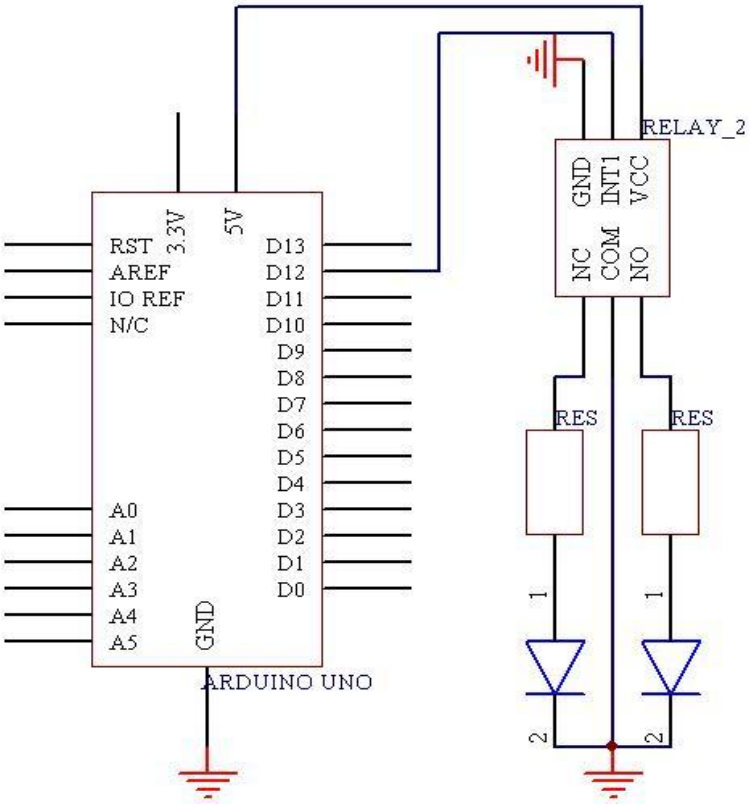


FIGURE 5:RELAY PIN DIAGRAM

2.6 BLUETOOTH MODULE

Figure 6: Bluetooth module

HC-05 module is an easy to use Bluetooth SPP (Serial Port Protocol) module, designed for transparent wireless serial connection setup.Serial port Bluetooth module is fully qualified Bluetooth V2.0+EDR (Enhanced Data Rate) 3Mbps Modulation with complete 2.4GHz radio transceiver and baseband. It uses CSR Bluecore 04-External single chip Bluetooth system with CMOS technology and with AFH (Adaptive Frequency Hopping Feature). It has the footprint as small as 12.7mmx27mm. Hope it will simplify your overall design/development cycle.

Specifications

Hardware features

1) Typical -80dBm sensitivity.
2) Up to +4dBm RF transmit power.
3) Low Power 1.8V Operation, 3.3 to 5 V I/O.
4) PIO control.
5) UART interface with programmable baud rate.
6) With integrated antenna.
7) With edge connector.

Software features

1) Slave default Baud rate: 9600, Data bits:8, Stop bit:1,Parity:No parity.
2) PIO9 and PIO8 can be connected to red and blue led separately. When master and slave are paired, red and blue led blinks 1time/2s in interval, while disconnected only blue led blinks 2times/s.
3) Auto-connect to the last device on power as default.
4) Permit pairing device to connect as default.
5) Auto-pairing **PINCODE:"1234"** as default.
6) Auto-reconnect in 30 min when disconnected as a result of beyond the range of connection.

The use of Bluetooth module HC-05 in our project is to make the touch screen wireless so that it is easy for the user to access it from anywhere in the home which is the purpose of our project.

2.7 ENCODER IC (HT12E)

HT12E is an encoder integrated circuit of 212 series of encoders. They are paired with 212 series of decoders for use in remote control system applications. It is mainly used in interfacing RF and infrared circuits. The chosen pair of encoder/decoder should have same number of addresses and data format. Simply put, HT12E converts the parallel inputs into serial output. It encodes the 12 bit parallel data into serial for transmission through an RF transmitter. These 12 bits are divided into 8 address bits and 4 data bits.

HT12E has a transmission enable pin which is active low. HT12E begins a 4-word transmission cycle upon receipt of a transmission enable. This cycle is repeated as long as TE is kept low. As soon as TE returns to high, the encoder output completes its final cycle and then stops.

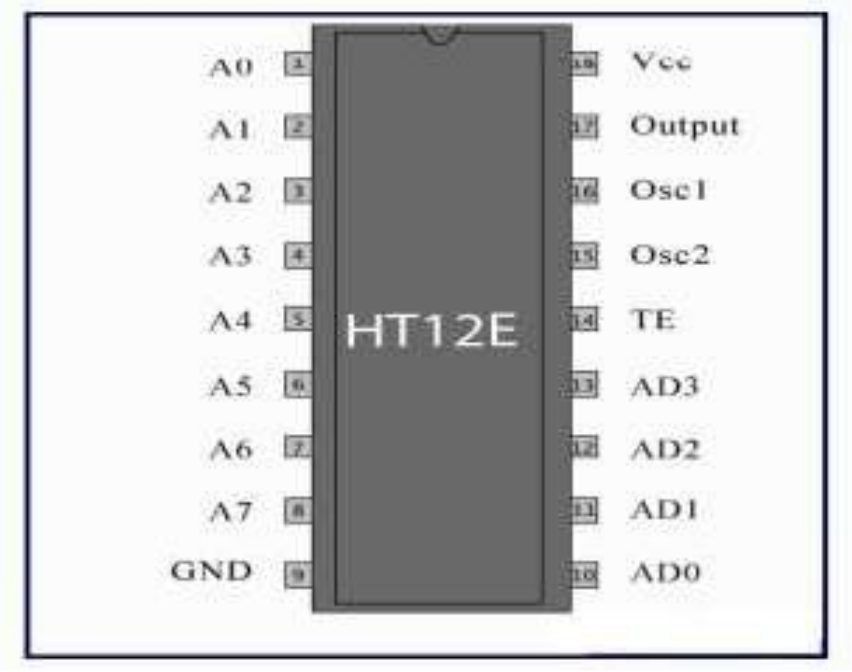


FIGURE 7: PIN DIAGRAM ENCODER

Pin No.	Name	Function
1-8	A0-A7	Address Pins
9	GND	Ground Pin
10-13	AD0-AD3	Data Pins
14	TE	Transmission Enable
15-16	Osc2-Osc1	Oscillator Pins
17	Output	Serial Output Pin
18	Vcc	Voltage Supply

Table 3:Encoder specifications

2.8 RF MODULE (Rx/Tx)

The RF module, as the name suggests, operates at Radio Frequency. The corresponding frequency range varies between 30 kHz & 300 GHz. 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). Transmission through RF is better than IR (infrared) because of many reasons. Firstly, signals Through RF can travel through larger distances making it suitable for long range applications. Also, while IR mostly operates in line-of-sight mode, RF signals can travel even when there is an obstruction between transmitter & receiver. Next, RF transmission is more strong and reliable than IR transmission. RF communication uses a specific frequency unlike IR signals which are affected by other IR emitting sources.

This **RF module** comprises of an **RF Transmitter** and an **RF Receiver**. The transmitter/receiver (Tx/Rx) pair operates at a frequency of **434 MHz** An RF transmitter receives serial data and transmits it wirelessly through RF through its antenna connected at pin4. The transmission occurs at the rate of 1Kbps - 10Kbps.The transmitted data is received by an RF receiver operating at the same frequency as that of the transmitter.The RF module is often used along with a pair of encoder/decoder. The encoder is used for encoding parallel data for transmission feed while reception is decoded by a decoder.HT12EHT12D;

HT640-HT648, etc. are some commonly used encoder/decoder pair ICs.

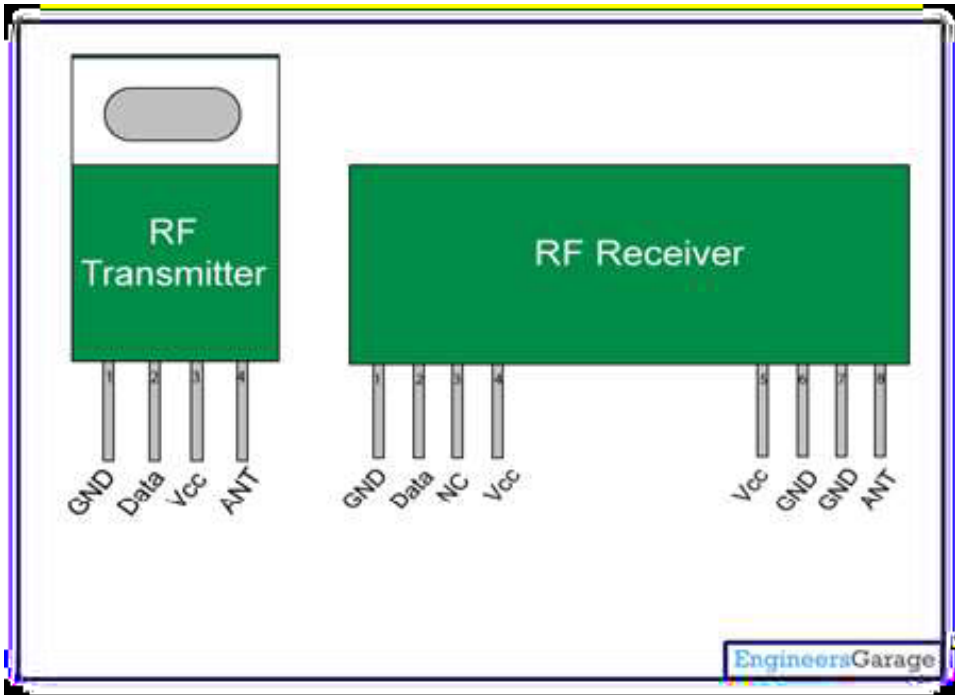


Figure 8:RF module

Pin No	Function	Name
1	Ground (0V)	Ground
2	Serial data input pin	Data
3	Supply voltage; 5V	Vcc
4	Antenna output pin	ANT

Pin No	Function	Name
1	Ground (0V)	Ground
2	Serial data output pin	Data
3	Linear output pin; not connected	NC
4	Supply voltage; 5V	Vcc
5	Supply voltage; 5V	Vcc
6	Ground (0V)	Ground
7	Ground (0V)	Ground
8	Antenna input pin	ANT

Table 4:RF specifications

2.9 DECODER IC (HT12D)

HT12D is a decoder integrated circuit that belongs to 212 series of decoders. This series of decoders are mainly used for remote control system applications, like burglar alarm, car door controller, security system etc. It is mainly provided to interface RF and infrared circuits. They are paired with 212 series of encoders. The chosen pair of encoder/decoder should have same number of addresses and data format.

In simple terms, HT12D converts the serial input into parallel outputs. It decodes the serial addresses and data received by, say, an RF receiver, into parallel data and sends them to output data pins. The serial input data is compared with the local addresses three times continuously. The input data code is decoded when no error or unmatched codes are found. A valid transmission in indicated by a high signal at VT pin. HT12D is capable of decoding 12 bits, of which 8 are address bits and 4 are data bits. The data on 4 bit latch type output pins remain unchanged until new is received.

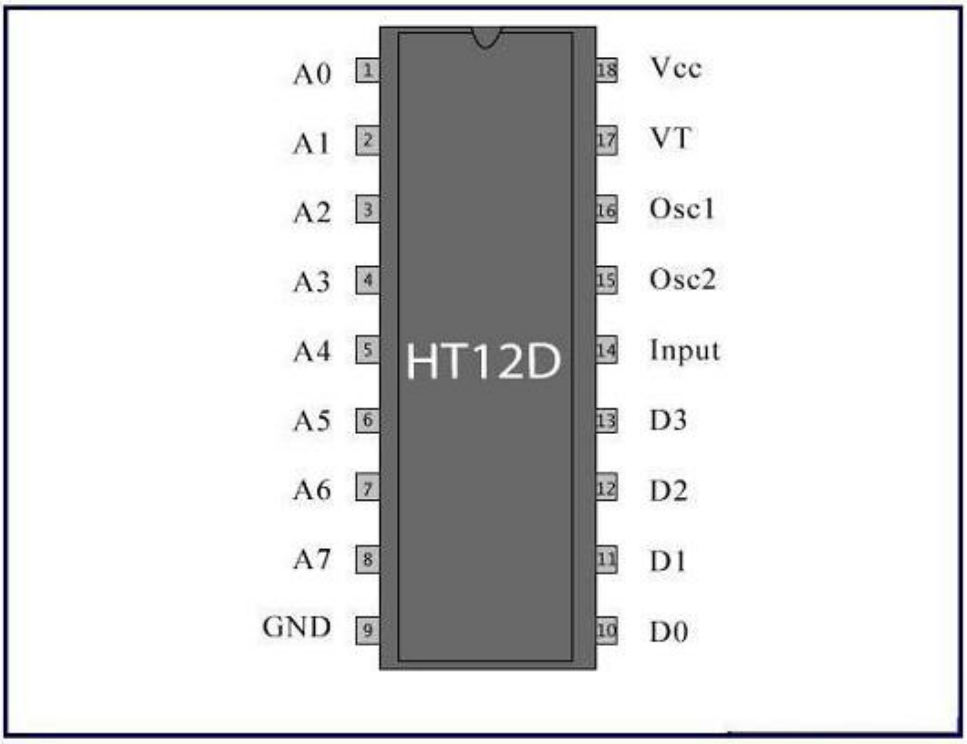


Figure 9:Pin Diagram Decoder

Pin No.	Name	Function
1-8	A0-A7	Address Pins
9	GND	Ground Pin
10-13	D0-D3	Data Output Pins
14	Input	Serial Input Pin
15-16	Osc2-Osc1	Oscillator Pins
17	VT	Valid Transmission Pin
18	Vcc	Voltage Supply

Table 5:decoder specifications

3. LED CONTROL USING ANDROID DEVICE

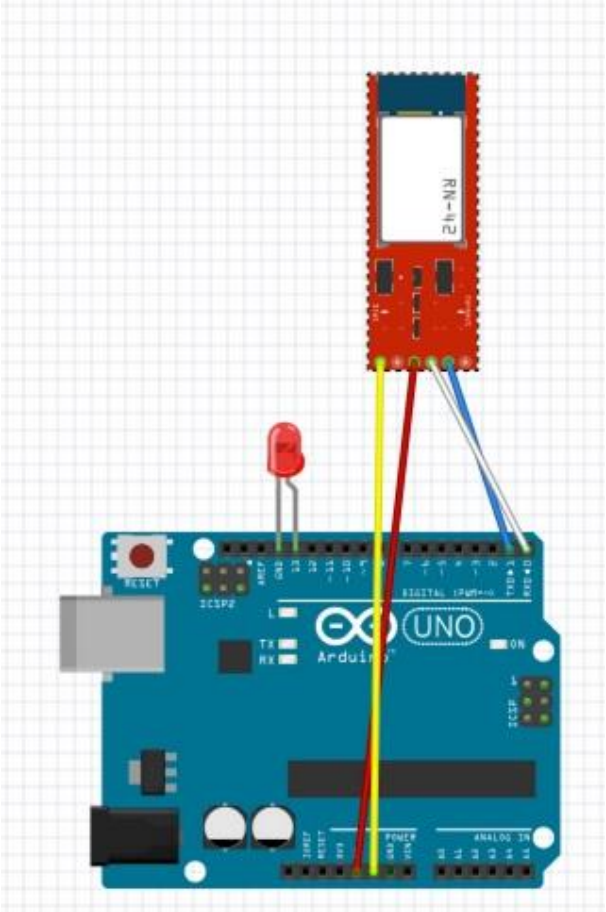


Figure 10:LED control

You can easily control an LED using your android device. Here, we downloaded an application from the Google play store called Ardudriod.

Bluetooth Module HC-05 was used to connect the microcontroller to android device.

4.DESIGN OVERVIEW

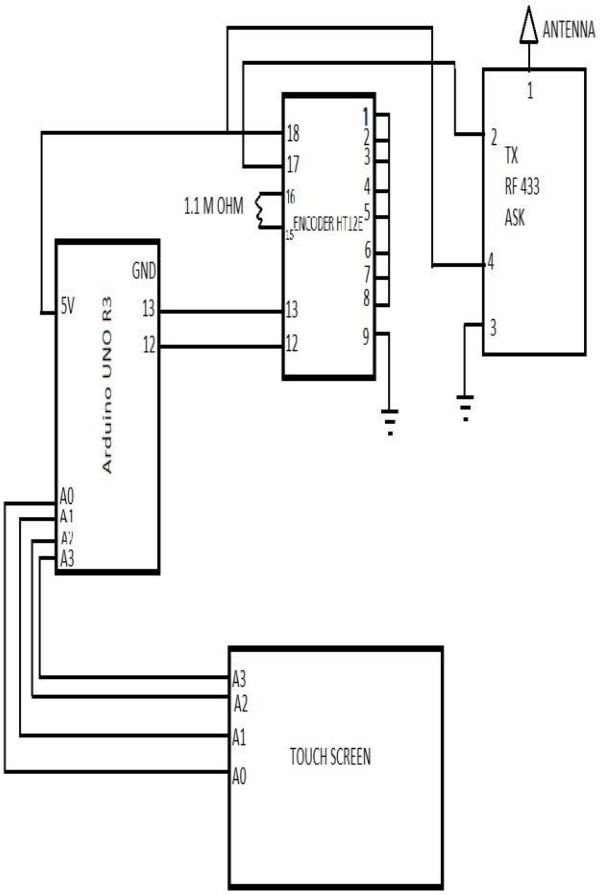


Figure 11:Transmitter circuit

The circuit shows the connection of touchscreen with the analog pins(A0-A1) of Arduino Uno 3.The inputs of the touchscreen is responsible for the pins 13 and 12 of the arduino to turn high or low.The transmitter side of the RF Module sends the data sent by the touchscreen to the receiver side of the RF Module.

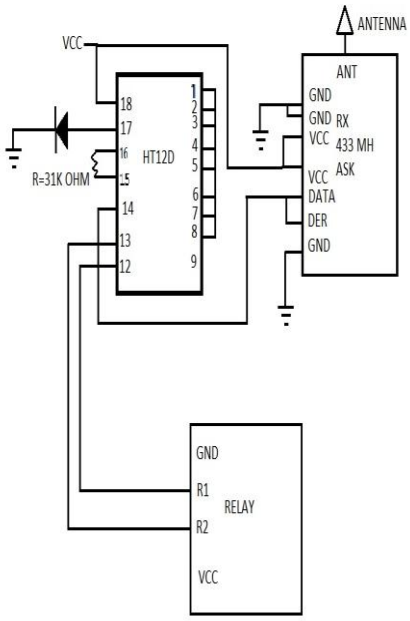


Figure 12:Receiver circuit

The receiver decodes the data with the help of the HT12D Decoder. If the input given by the touchscreen is high, then the relay is turned on ,else it is turned off on giving input as low.

5. SOFTWARE DESCRIPTION

5.1 PYTHON CODE FOR TOUCHSCREEN

```
int xv;
int yv;
void setup()
{
pinMode(13,OUTPUT);
pinMode(12,OUTPUT);
Serial.begin(9600);
}
void loop()
{
pinMode(A1,INPUT);
pinMode(A3,INPUT);
        pinMode(A0,OUTPUT);
            digitalWrite(A0,LOW);
               pinMode(A2,OUTPUT);
                   digitalWrite(A2,HIGH);
               yv=analogRead(1);
              pinMode(A0,INPUT);
         pinMode(A2,INPUT);
       pinMode(A1,OUTPUT);
             digitalWrite(A1,LOW);
          pinMode(A3,OUTPUT);
            digitalWrite(A3,HIGH);
                 xv=analogRead(0);
Serial.println(xv);
Serial.println(yv);
delay(1000);

if((xv<850)&&(xv>780)&&(yv>250)&&(yv<320))
{
```

```
digitalWrite(13,HIGH);
}
if((xv<300)&&(xv>200)&&(yv>240)&&(yv<320))
{
digitalWrite(13,LOW);
}
if((xv<850)&&(xv>800)&&(yv>800)&&(yv<850))
{
digitalWrite(12,HIGH);
}
if((xv<280)&&(xv>200)&&(yv>750)&&(yv<850))
{
digitalWrite(12,LOW);
}
}
```

5.2 PHYTON CODE FOR LED CONTROL USING ANDROID DEVICE

```
int ledPin = 13;
int state = 0;
int flag = 0;
void setup() {
pinMode(ledPin, OUTPUT);
digitalWrite(ledPin, LOW);
Serial.begin(9600);
}
void loop() {
if(Serial.available() > 0){
state = Serial.read();
flag=0;
}
if (state == '0') {
digitalWrite(ledPin, LOW);
if(flag == 0){
Serial.println("LED: off");
flag = 1;
}
}

else if (state == '1') {
digitalWrite(ledPin, HIGH);
if(flag == 0){
Serial.println("LED: on");
flag = 1;
}
}
}
```

6. Application of the Project

There can be thousands of applications possible today with the advancements in the technology. Few of the major applications are listed below:-

HVAC :-Heating, ventilation and air conditioning (HVAC) systems can include temperature and humidity control, including fresh air heating and natural cooling. An Internet-controlled thermostat allows the homeowner to control the building's heating and air conditioning systems remotely. The system may automatically open and close windows to cool the house.

Lighting :-Home automation products can be used for something as simple as adding Multiway switching to existing electric lighting circuits, or can include very complex interactions with other systems.A Lighting control system can be used to switch lights based on a time cycle, or arranged to automatically go out when a room is unoccupied. Some electronically controlled lamps can be controlled for brightness or color to provide different light levels for different tasks. Lighting can be controlled remotely by a wireless control or over the Internet. Natural lighting (daylighting) can be used to automatically control window shades and draperies to make best use of natural light.On the residential market, Z-Wave, Insteon and the older X10 protocol are very commonly used for lighting automation.

Audio-visual :-This category includes audio and video switching and distribution. Multiple audio or video sources can be selected and distributed to one or more rooms and can be linked with lighting and blinds to provide mood settings.

Shading :-Automatic control of blinds and curtains can be used for:

- Presence simulation
- Privacy
- Temperature control
- Brightness control

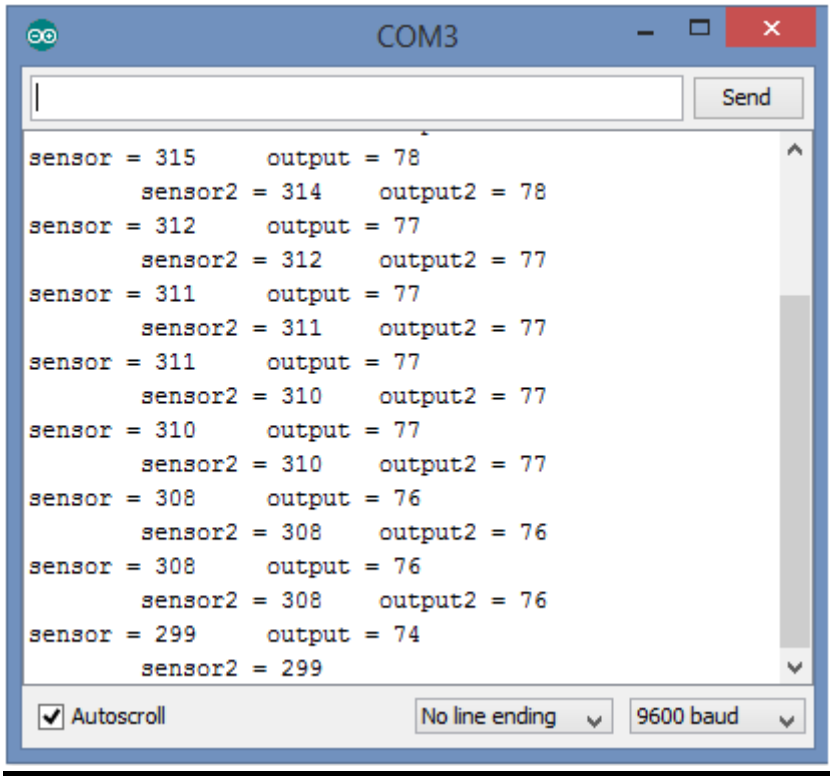
Security :-A household security system integrated with a home automation system can provide additional services such as remote surveillance of security cameras over

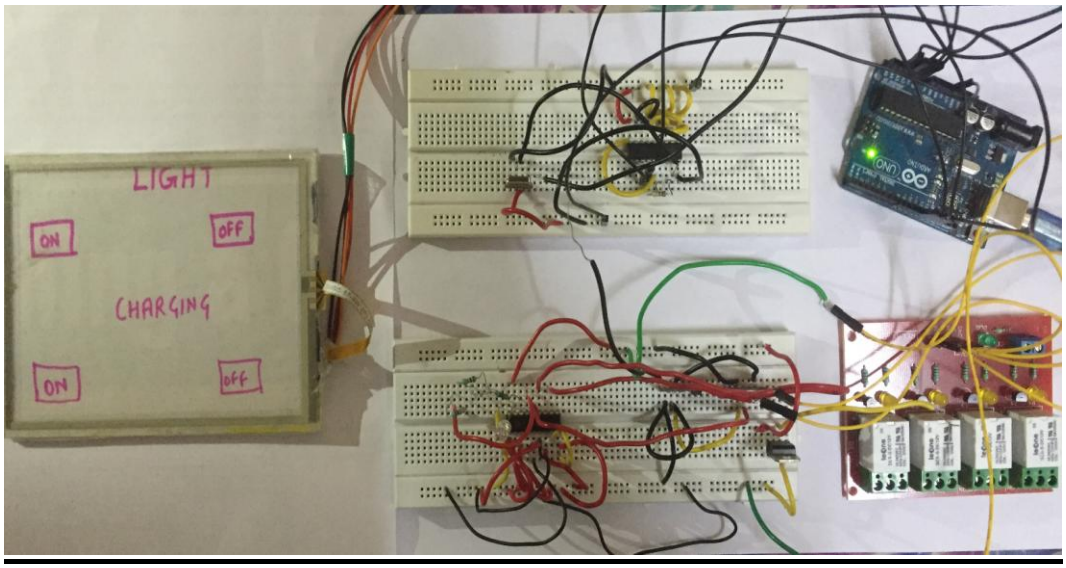
the Internet, or central locking of all perimeter doors and windows.With home automation, the user can select and watch cameras live from an Internet source to their home or business. Security systems can include motion sensors that will detect any kind of unauthorized movement and notify the user through the security system or via cell phone.The automation system can simulate the appearance of an occupied home by automatically adjusting lighting or window coverings. Detection systems such as fire alarm, gas leak, carbon monoxide, or water leaks can be integrated. Personal medical alarm systems allow an injured home occupant to summon help.

Intercoms :-An intercom system allows communication via a microphone and loud speaker between multiple rooms. Integration of the intercom to the telephone, or of the video door entry system to the television set, allowing the residents to view the door camera automatically.

Other systems :-A homemade Internet-enabled cat feeder.Using special hardware, almost any household appliance can be monitored and controlled automatically or remotely, including cooking appliances, swimming pool systems, and others.

7. Results





Above is the actual circuit which we successfully implemented.When a high input was given at the transmitter end, it was successfully decoded by the reciever.Then the relay was turned on.Thus, we were successfully able to control home appliances like bulb,charger,fan,etc.

8. Conclusion

Smart homes need to be both controlled and programmed by anyone within the home. Having reviewed thoroughly the current state of the art of end-user programming and user interfaces for home systems, We believe there is still no single solution which offers a means of both controlling and programming the home that users like. We feel that Touchscreen based home automation system can fill this gap in both research and the commercial market, and can also provide a solution which is suitable for all users within the healthy active older generations or younger people.

9. References

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