HOME AUTOMATION WITH AN ARDUINO

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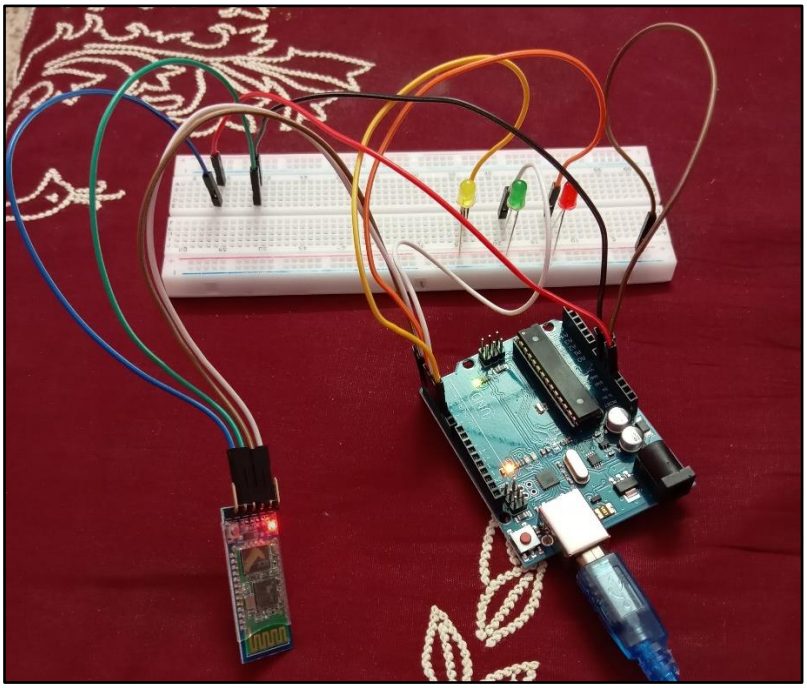
1. Introduction

The Problem

The world is advancing in a drastic rate all thanks to the technologies and people are finding more efficient ways to make their life easier and hassle-free. Automation of home appliances is now a trendy development that has made living more comfortable and access at arm's length. But as the quote defines, "With great power, comes a sacrifice", existing automated home technologies require more resources, storage and are usually available with lower power limits.

The production of the existing products has set the bar of their prices high and consumes higher power. The products have high manufacturing complexity and repairing any damaged parts often prove too difficult. Therefore, we have explored ways of using low power consuming components to build an autonomous home appliance that is affordable, reliable and fairly simple, yet powerful and accurate.

The Solution



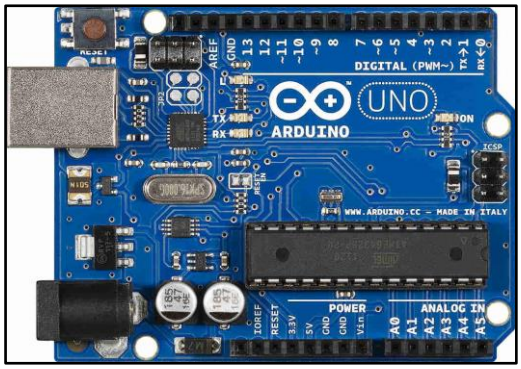
We built a home automation system using Arduino that can control home appliances within the palm of your hand. An app in the smartphones can remotely control home appliances with this device and therefore one does not need to get up from their leisure resting and switch the devices.

The main advantage of our device compared to existing devices is that it is cost effective, cutting down the cost of powerful CPUs and can be remodelled to run any kind of devices. All it requires is a smartphone with a Bluetooth and the app to control the devices.

2. Design

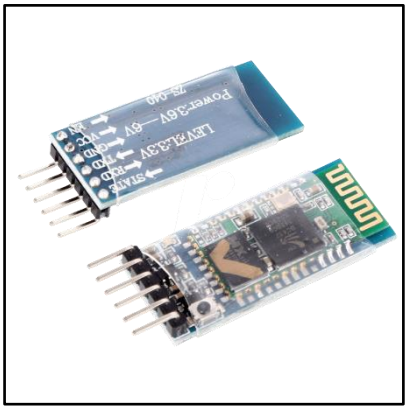
Components

1. Arduino Uno



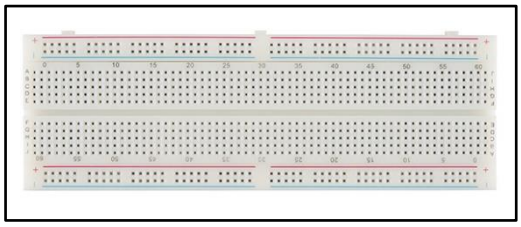
Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz ceramic resonator (CSTCE16M0V53-R0), a USB connection, a power jack, an ICSP header and a reset button.

2. HC 05 Wireless Bluetooth Module



HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration. It has range up to <100m which depends upon transmitter and receiver, atmosphere, geographic & urban conditions. It is IEEE 802.15.1 standardized protocol, through which one can build wireless Personal Area Network (PAN). It uses frequency-hopping spread spectrum (FHSS) radio technology to send data over air. It uses serial communication to communicate with devices. It communicates with microcontroller using serial port (USART).

3. Breadboard



A breadboard, solderless breadboard, protoboard, or terminal array board is a construction base used to build semi-permanent prototypes of electronic circuits. Unlike stripboard (Veroboard), breadboards do not require soldering or destruction to tracks and are hence reusable. For this reason, breadboards are also popular with students and in technological education.

4. LEDs

A light-emitting diode (LED) is a semiconductor device that emits light when an electric current flow through it. When current passes through an LED, the electrons recombine with holes emitting light in the process.

5. Jumper wires

For connecting all the components to the breadboard and among each other.

Bill of the Materials

The maximum cost of the project was decided to be BDT 2500. After careful selection of components with highest efficiency, the project was successfully built for a total of BDT 1840. The cost breakdown of the components is given below:

Table 1: Bill of Materials

Components	Price (BDT)
Arduino Uno	1200
HC 05 Wireless Bluetooth Module	350
Breadboard	140
Jumper Wires (40 Pieces)	80
LEDs (5 pieces)	10

3. Implementation

Hardware Connection Diagram

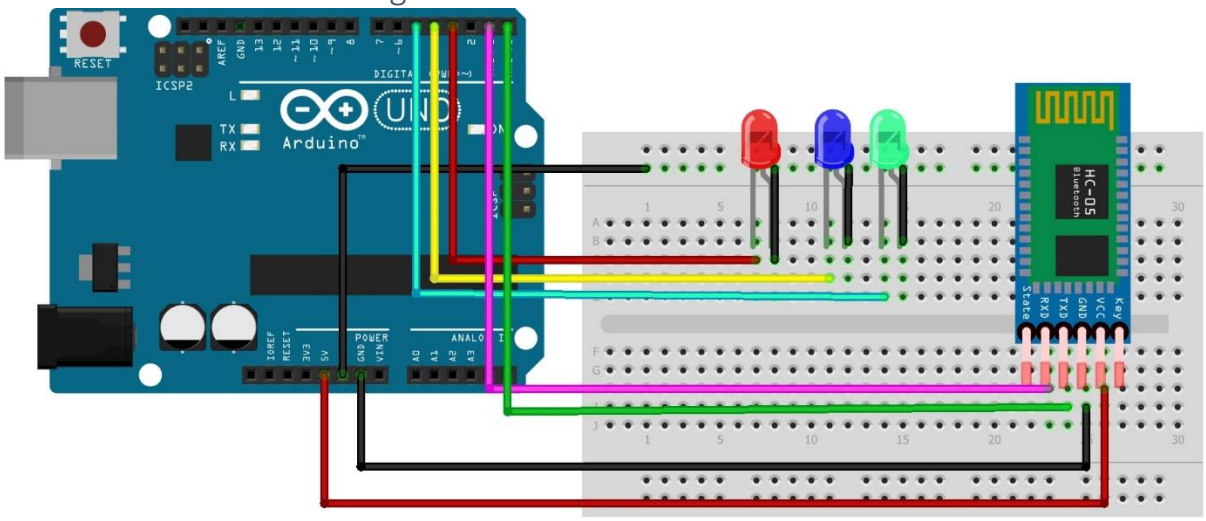


Figure 1: Hardware Connection Diagram

The Embedded Device

The diagram in Figure 1 shows the interconnections in the embedded device.

Connecting the HC-05 Bluetooth to the Arduino

1. Connected the GND pin of HC-05 to the GND slot of Arduino.
2. Connected the Vcc pin of HC-05 to the Vcc slot of Arduino.
3. Connected the TXD pin of HC-05 to the RX slot of Arduino.
4. Connected the RXD pin of HC-05 to the TX slot of Arduino.

Connecting the LEDs to the Arduino

1. Connected the GND pin of Arduino to the Breadboard and all the GND pins of the LEDs were connected to it.
2. Connected the Vcc pin of Red LED to the 3rd pin of Arduino.
3. Connected the Vcc pin of Green LED to the 4th pin of Arduino.
4. Connected the Vcc pin of Yellow LED to the 5th pin of Arduino.

Uploading the code

After we have successfully wired things up, the next step is to upload the code to the Arduino. In order to upload the code, we connected the Arduino through the USB port on our computer, opened the Arduino IDE and uploaded the following code.

Code:

```
void setup() {
Serial.begin(9600);
 pinMode(3, OUTPUT); // setup code here, to run once:
 pinMode(4, OUTPUT);
 pinMode(5, OUTPUT);
 }

void loop() {
  // main code here, to run repeatedly:
 if(Serial.available()>0)
   {
      char data= Serial.read(); // reading the data received from
the bluetooth module
      switch(data)
      {
        case '1': digitalWrite(3, HIGH);break;
        case '2': digitalWrite(4, HIGH);break;
        case '3': digitalWrite(5, HIGH);break;

        case '4': digitalWrite(3, LOW);break;
        case '5': digitalWrite(4, LOW);break;
        case '6': digitalWrite(5, LOW);break;

        default : break;
      }
      Serial.println(data);
   }
   delay(50);
}
```

Configuring the Smartphone

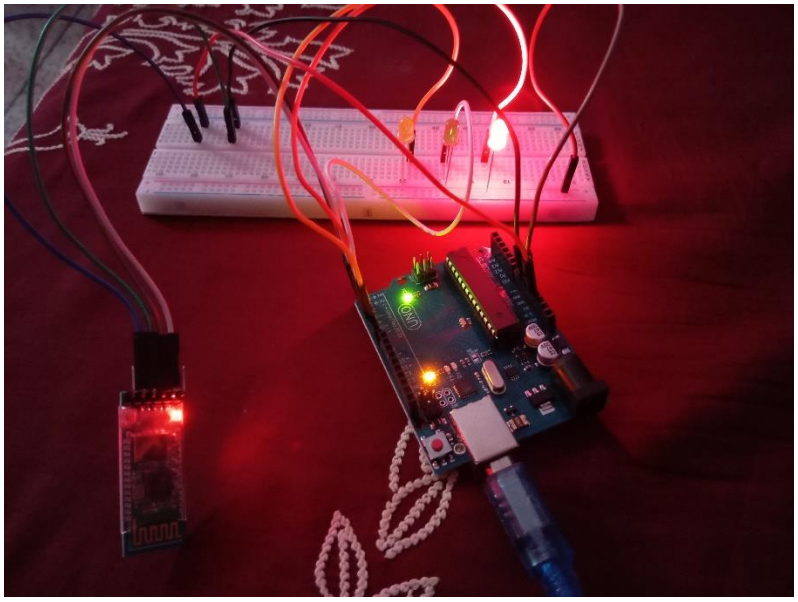
1. Downloaded the “Bluetooth Electronics” app from the Play Store.
2. Selected a new panel and clicked on “Edit”.
3. Added a button for Red light, edited the configuration: “Turn On Text: 1”, “Turn Off Text: 4” and clicked “Ok”. Added a “Text” to indicate the colour of the light i.e. “Red”.
4. Added a button for Green light, edited the configuration: “Turn On Text: 2”, “Turn Off Text: 5” and clicked “Ok”. Added a “Text” to indicate the colour of the light i.e. “Green”.
5. Added a button for White light, edited the configuration: “Turn On Text: 3”, “Turn Off Text: 6” and clicked “Ok”. Added a “Text” to indicate the colour of the light i.e. “Yellow”.
6. Connected the app to the HC-05 using the Bluetooth feature of the phone and controlled the lights of the device.

4. Conclusion

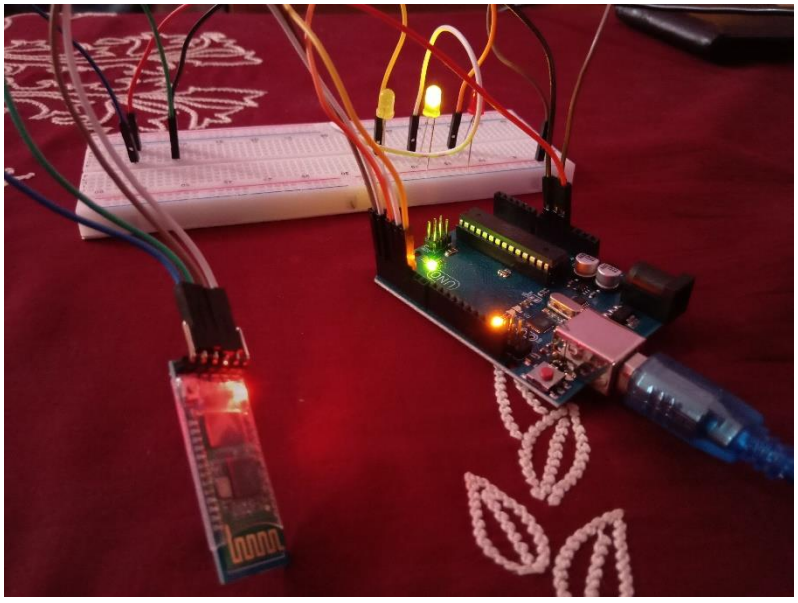
The project presents a powerful proof of concept that it is possible to build powerful and accurate home automation system at very low costs and effectively. Control any home appliances at the ease of your palm from any place of the house (within the range). With the growth of modern technologies more research should be done with wireless controls, find more advantages and provide more efficient and powerful systems that makes life even easier. The areas of application for the device ranges from house appliances such as lights, fans etc.

5. Project Snapshots

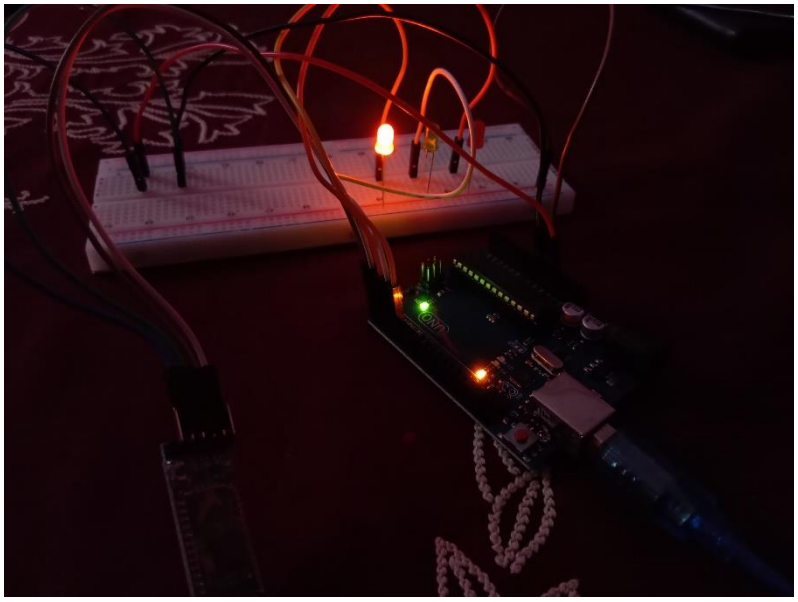
Red LED



Green LED



Yellow LED



All LEDs