

Wireless Home Appliances Controller (WHAC)

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Abstract: Home automation become the essential system for the common people in order to address the easy solution for the home in many applications. The home automation systems have gained the momentum due to the development in the Internet and wireless technologies. Because of the ICT devices including mobile computing, wireless devices, IoTs and many inter-related technologies and mobile networks have offer the better solutions in order to develop the more opportune and reachable from ubiquitously at anytime. In this work, the home automation using the Bluetooth technology is implemented. The developed system offers the easy and viable solution to control as many appliances form mobile in easy manner. The significance of the system is enhanced when user from the home is absent. The creation of this system is that most of the people overlook in making on/off their home appliances when they are leaving from their home or away from place from longer time. In addition, the system is designed to decrease the expenditure of electricity in the house for the unused appliances. Bluetooth Technology is used as a medium to transfer a signal that will control all home appliances. It will communicate with the Bluetooth settings on the user's phone and applications to appear on the phone screen to control the appliances which in than control device embedded in the microcontroller module. The microcontroller is important to perform function/ action. Moreover, the use of this system will provide the users ease of access to their appliances. It will help them save money, time and energy and also prevent the occurrences of accidents due to leaving home appliances turning on. This is because the user only needs to control the appliances systems for their homes with only using mobile phones were installed with the WHACUA application and display the condition of the appliances will appear on the LCD display and mobile phone users.

Keywords: Automation; Bluetooth; Aurdino; Application based system

1. Introduction

Wireless technologies are playing a significant role in consumer electronics across the world. Even at the consumer level many of them likes to use these Wireless technologies to improve their lifestyle. Using the embedded Bluetooth the device to device or human to device communication is became viable. This has boost the concept of home automation in order to control the household appliances and monitoring health and many more. This home automation is also known as “domotics”. Some components of an automated home have various control systems such as security

on doors and gates, home appliances, windows, lighting, surveillance camera and etc. The technology used for smart home (i.e. promising area) can be considered as the important tools that deal with the demands of appliances power consumption. Bluetooth has various application benefits such as security, safety and consequently good comfort [2-3]. Therefore, in this modern era, technology has evolved to facilitate human life is who are getting busy in managing their daily lives. Electronic controller is use to control the electrical appliances can be found widely around the world. Technology has been transformed from beginning to advanced level that can control almost everything of human including health, appliances, and machines to do anything at any place, however, connecting these devices is not easy task it has many issues and problems at the level of home automation [4].

In addition, users often forget to turn off unused home appliances system being used when they were not at home [5]. Therefore with the development of this makes it easy for users to turn on/off or control unused appliances only using their mobile phone. Remotely, the system permits the people living inside the home to observe and govern their appliances via mobile or portable devices. In this worlds, human are trying to solve all problems occurs in our daily life. In other word, this work is proposed to solve problems [6]. The problem that is going to be solved with this work is Security and Safety, to avoid wastage of electricity. This work address to build a device that allows user to remotely control and monitor multiple home appliances using a mobile phone and connect a Bluetooth module with Bluetooth settings on the mobile phone, finally, implement applications (apps) that connects with the controlled appliances [7].

2. Background and Literature Review

Home automation is considerably received the attention from many industries since last two decade, when it is the matter of connecting devices with devices or connecting devices with humans. The main purpose of doing this home automation action is that to observe and govern the control of all home appliances whether they are all electrical or electronic in nature [8]. This concept of connecting home appliances emerges from 1915 and 1920 and in 1916, developed a home automation "ECHO IV" but one of the major drawback of that system is it was private but not been public [9]. Despite, many years, home automation still require more attention as it is the popular technology. The system design approach has been approach via different devices that include microprocessor and controller but these have limitations in system design approach. For this reason the focus has been shift towards the other technologies that include the Z-Wave, Bluetooth, WiFi, and many more systems technologies [11].

2.1 Related Work

The related work discussed the work that has been already carried in the field of home automation, the section discussed the development of the controlled home appliances using Arduino [12-14].

K. Atukorala [2009] discussed the design of home system in real-time for monitoring the SmartEye that is have function in terms network functionality. The system is developed in 2 aspects , the first one is automating the devices and second is monitoring via phone of user. In result, the system offers the function of having devices on-off for home appliances. SmartEye utilized a camera in addition to the devices for saving the home.

Jianjun Lv and Zhishu Li [2010] described the remote control system based on infrared system to control the home devices attached to the system. The system also interconnects the entertaining devices The main issue with system is that infrared remote control device can't be used to manipulate the information from different devices and it has the issues of compatibility with the others. The authors proposed an alternate solution for that. They untied microcomputer and USB that can code and decode all signal from the propose the proposed system [14]. Due to that paper

also defines the IRCP system to offer the code and decode functionality of for infrared feature to control the devices [5].

According to Utpal V. Solanki and Nilesh H. Desai [2011] in this work it presents a new system that is known as "Handmote". This system is used to control home appliances through hand gesticulation as a control device. The device will be controlled using infrared where the infrared function as a remote control to govern the appliances. In this paper, the author still retains the same concept but upgrade a few enhancement by defining the finger movements to the camera and hand can be moved in clockwise or anti-clockwise direction to control the volume of TV. The proposed concept is developed using Java it meet the real-time image processing. Rozita Teymourzadeh, Salah Addin Ahmed, Kok Wai Chan, & Mok Vee Hoong [2013] discussed Full Home Control system using GSM. The appliances are controlled for home using Short Message Service. The people that are living in the home will get the feedback from appliances under control to make them on-off remotely [7].

According to Jalpa Shah, Bhavik Modi and Rohit Singh [2014] have developed system for home to make automate the device using Radio Frequency (RF). The approach was carried out in order to avail the low-cost design with high. The developed system can offer the functionality of making devices on-off for 15 appliance from a single remote control that system offer the service in the premise of 20-30 meter, in addition the GSM feature offers the notice to home livers about status of devices at the given mobile number [8]. Based on the paper written by Hideki Matsuoka [2014], in Internet of Thing (IOT) offer the communication using smartphone for controlling the devices as the smartphone are fortified with Bluetooth 4.0 that offers low power consumption in connecting devices.

In this section, mainly the current aspect of home automation were discussed in order to create the concept and better understating of the developed system.

3. Research Methodology

In this section, the system design approach of "Wireless Home Appliances Controlled Using Arduino (WHACUA)" is mentioned. Figure 1 illustrates the different design steps that have been carried out in developing the Wireless Home Appliances Controlled Using Arduino.

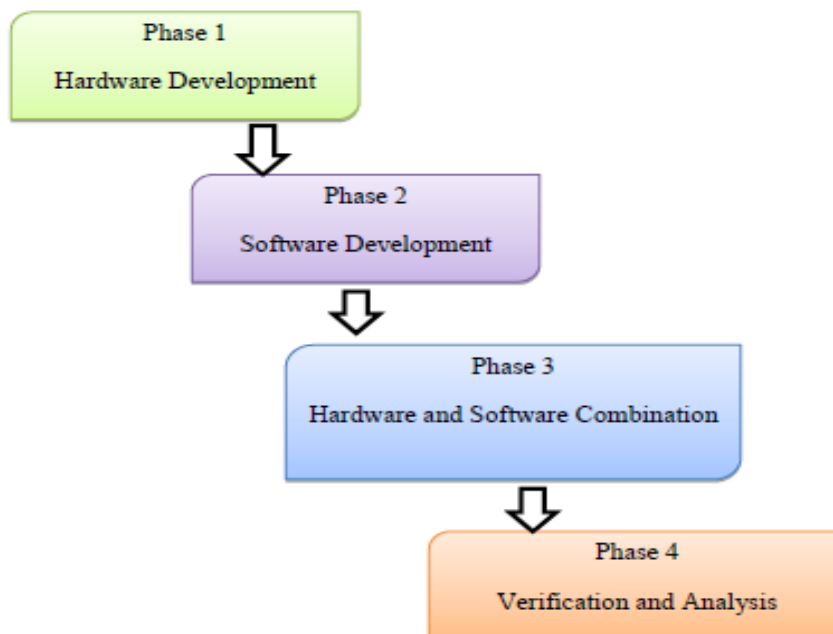


Fig. 1 – System model approach of Wireless Home Appliances Controlled Using Arduino

3.1 Design and Development of Wireless Home Appliances Controlled Using Arduino

The work is carried using different hardware components the system is based on Bluetooth module, Arduino, Solit State Relay, LCD and other components. Bluetooth section offers the communication in terms of Bluetooth cooperation via setting in mobile phone. The second important part is controller that is defined as Arduino to govern the control of entire circuit connecting with its. Solit State Relay(SSR) Crydom Relay 5A will act as the components that allows the appliances to be used for this work is suitable with the current flow to prevent relay is faulty. Finally, LCD display and in addition to that mobile device represents all the information for displaying the each and every aspect of state of the appliances that are connected to the system.

3.2 Design and Development of Wireless Home Appliances Controlled Using Arduino Using Software Deign

In this section the design procedure is carried out using the programming and coding to interconnect the devices. In this section, it represents the connection between all the components used in this work. The design of this circuit is drawn using Proteus 8 professional.

3.3 Design and Development of Wireless Home Appliances Controlled Using Arduino Using Firmware Design Approach

In this design step, both hardware and software design approaches are integrated. The software system defines the simulation, coding and programming with hardware to interconnect the Bluetooth module, Arduino, Solit State Relay, LCD and other components. (The flowchart show in Fig. 2 represent the firmware approach of Wireless Home Appliances Controlled Using.

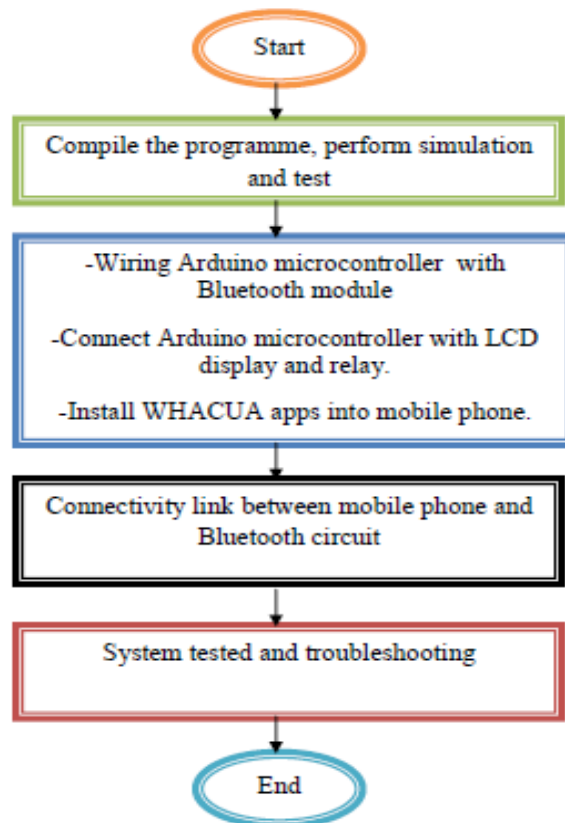


Fig. 2 – Firmware approach of Wireless Home Appliances Controlled Using Arduino

3.4 Design and Development of Wireless Home Appliances Controlled Using Arduino the Verification and Analysis

In this section, the developed system from firmware approach of Wireless Home Appliances Controlled Using Arduino is verified in terms of performance. It was observed that there was no error was incurred during the simulation and coding phase. Programming for this work shows no error. The Wireless Home Appliances Controlled Using Arduino offers the selection of user from WHACUA app on a user mobile device that connects via Bluetooth. After seating Wireless Home Appliances Controlled Using Arduino configuration information performs on user app will facilitates user to meticulous the control of appliances in terms of making them ON/OFF. Furthermore, information is intimate to and mobile screen of the user.

3.5 The system design of Wireless Home Appliances Controlled Using Arduino

The system design of Wireless Home Appliances Controlled Using Arduino is based on various design steps. In the first design step, the user phone having Bluetooth option is connected via Bluetooth module. After that user will opt to select the design mobile featured app of WHACUA to select ON/OFF of the appliances that are connected with system. After that system is categorized in 2 steps, these are hardware and software approaches. In the first design approach, the Bluetooth transmitter Section broadcast the signal to module HC-05.

After that the broadcast signal is attained by receiver module that will processed for further line of action. The information received from the receiver module is centralized in Arduino Mega. The controller transmit the information to mobile device of the user to acknowledge the appliances are currently in the ON-OFF state, and the data will be demonstrated on the user mobile phone. Based on Fig. 3 shows the house floor plan where this system can be used and control, the software control is shown in Fig. 4 and Fig. 5 shows how the system is operated and proceed for system operation. For the phase of software development the c programming is utilized.

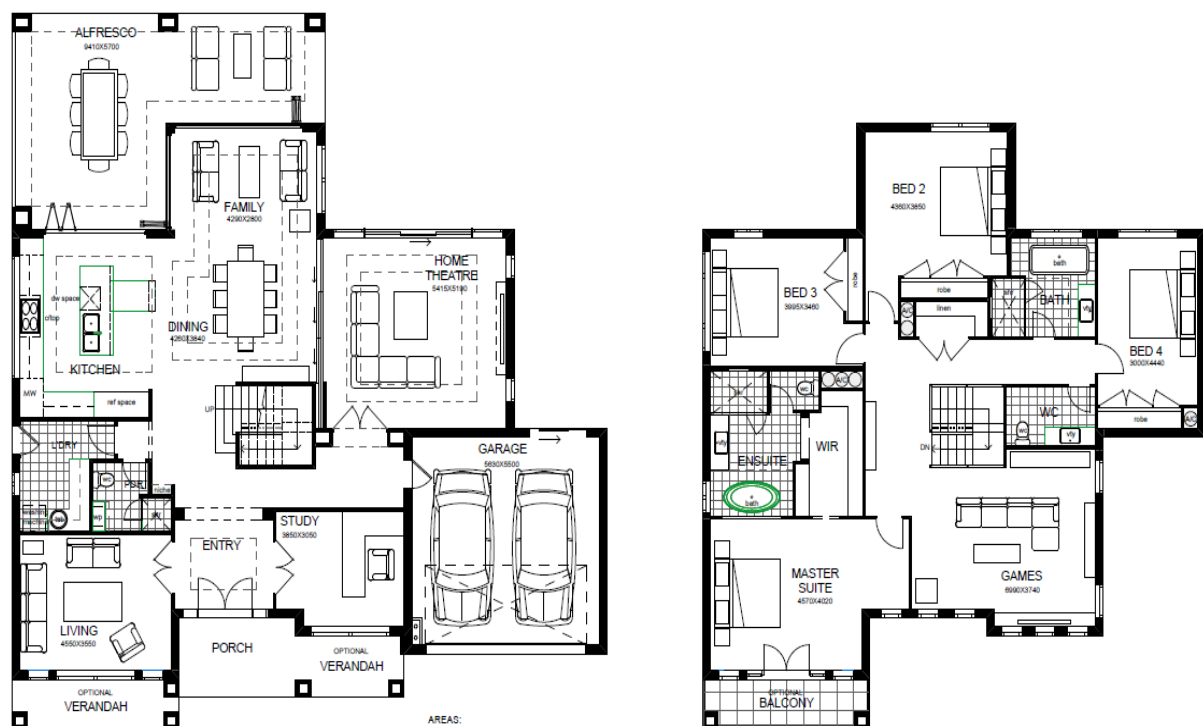


Fig. 3 - Proposed application location according to house floor plan.

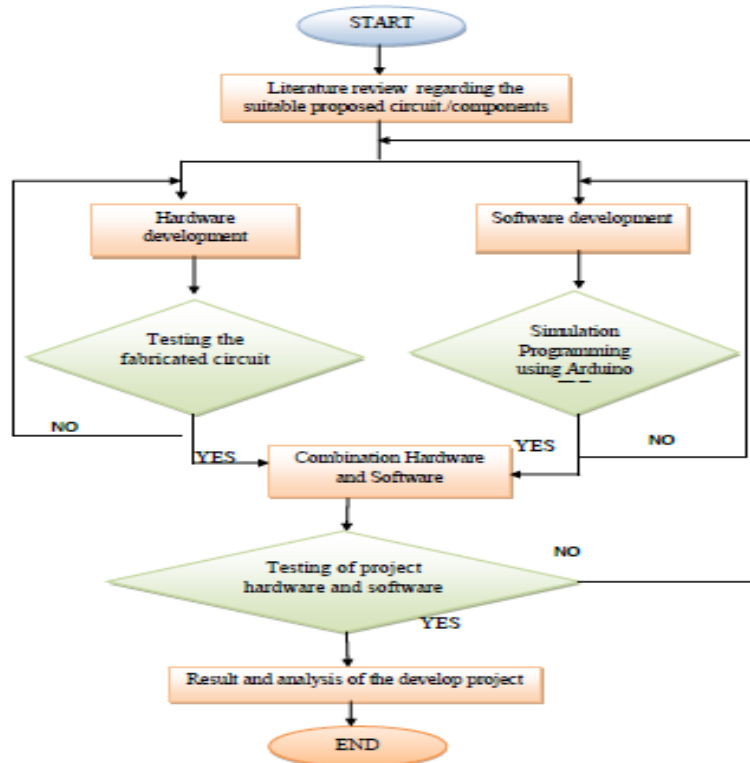


Fig. 4 - Software Implementation

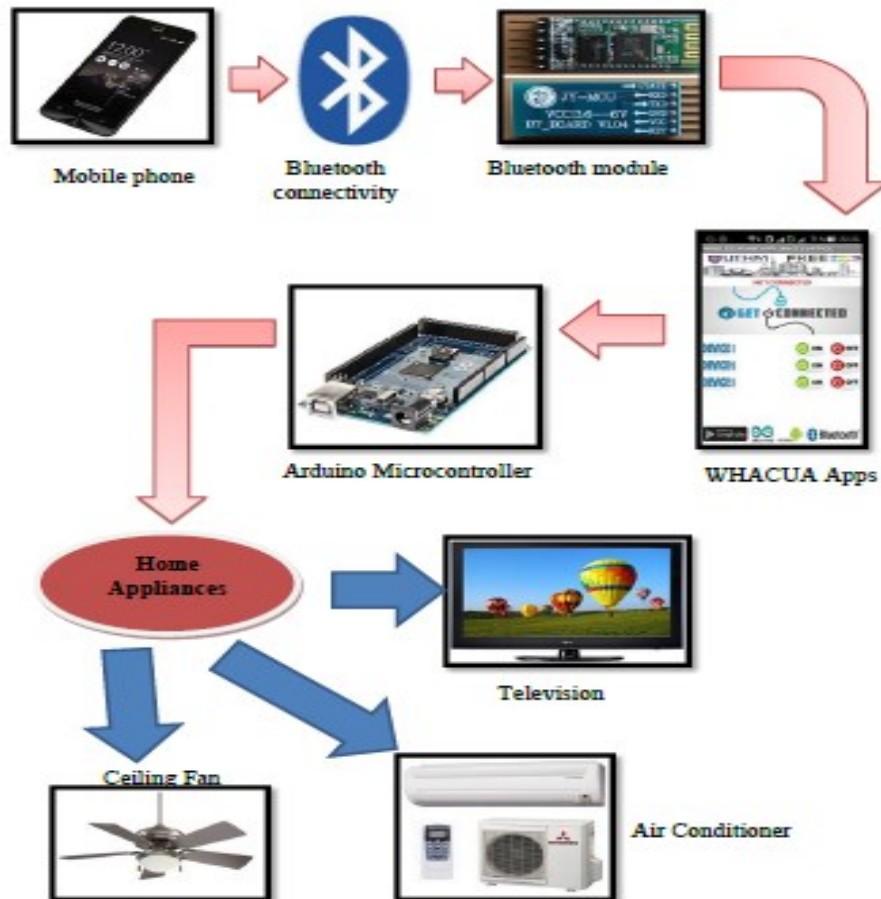


Fig. 5 – Working of developed Wireless Home Appliances Controller Using Arduino”WHACUA”

The interconnection of Bluetooth is offered to the users to communicate between devices under the premises of 10 meters).

4. Results and Discussion

After completing the design phase of Wireless Home Appliances Controlled Using Arduino in terms of both hardware and software development. The next approach is test the developed Wireless Home Appliances Controlled Using Arduino system in terms of functionality and any error is occurred during the design phases. The testing process of Wireless Home Appliances Controlled Using Arduino is based on Bluetooth that is paired with Bluetooth from user mobile phone, - Wireless Home Appliances Controlled Using Arduino WHACUA apps that is an applications designed in mobile phone of user. It is important to note that 4 tests are conducted for Wireless Home Appliances Controlled Using Arduino in testing to assure the functionality of the system, Testing 1: turn ON the Bluetooth on the user mobile phone, Testing 2: turning ON the appliances, Testing 3: turning OFF the appliance and the Testing 4: when one of the plugs is switched OFF.

4.1 Testing Procedure

Testing of Wireless Home Appliances Controlled Using Arduino WHACUA is an important aspect of this work. The simulation or programing can detect whether the circuit is correctly connected to the component or not. The first testing for the controller design using Proteus software. Home appliances such as lamp, fan and etc. are connected via relay in relay circuit. Fig. 6 shows the circuit design of the work using Proteus software.

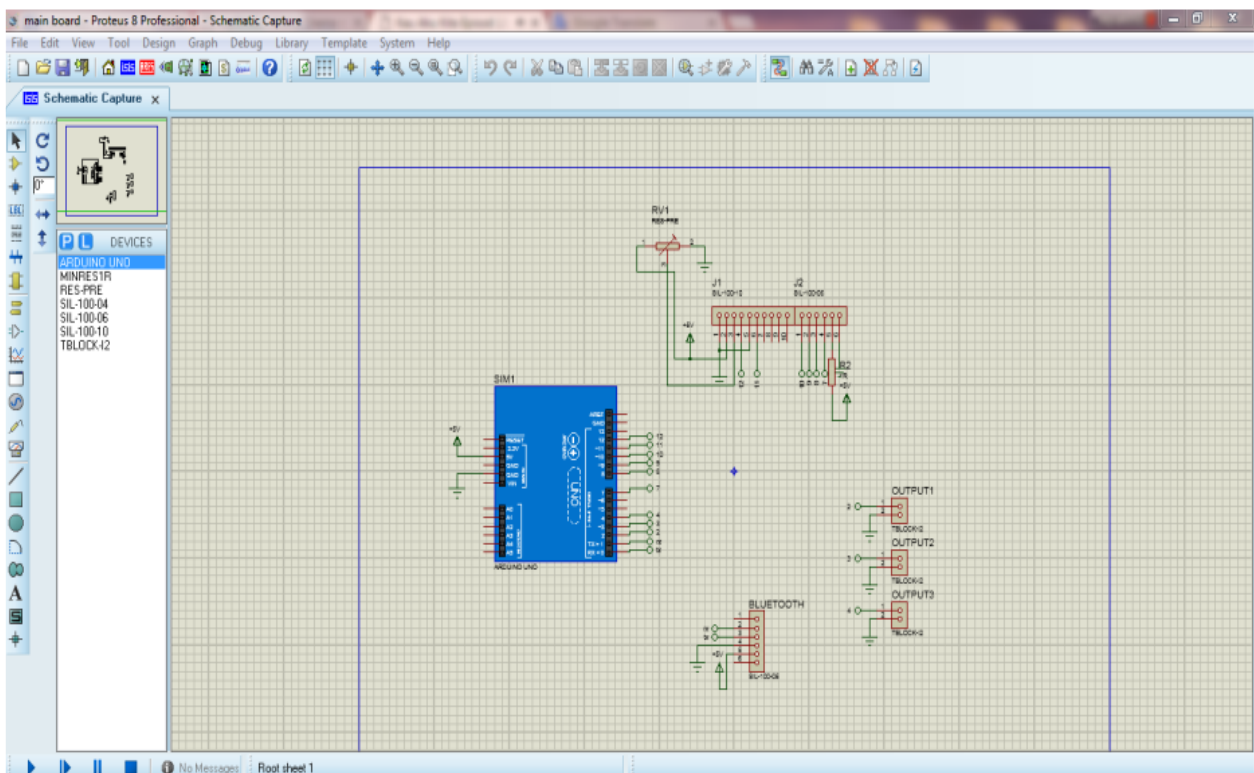


Fig. 6 – Microcontroller circuit and relays circuit

4.2 Software Development of Wireless Home Appliances Controlled Using Arduino

The software code of Wireless Home Appliances Controlled Using Arduino program is written according to the requirement of user description. If an errors are detected during the programming, the program must be redesign and until all the errors are no error display from the programs. The programming used for this work for Wireless Home Appliances Controlled Using Arduino is shown in Fig. 7. After that, upload the programmed into the microcontroller. For Fig. 8, represents the programming for Wireless Home Appliances Controlled Using Arduino that is used in this work by successfully run without an error and the message display are “Done Compiling”.

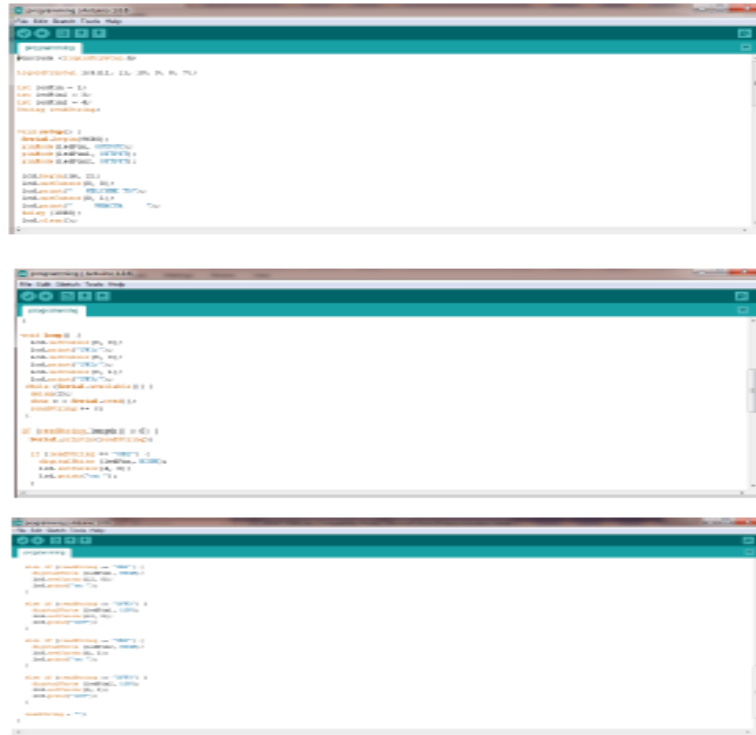


Fig. 7 – Programme using ARDUINO IDE Software.

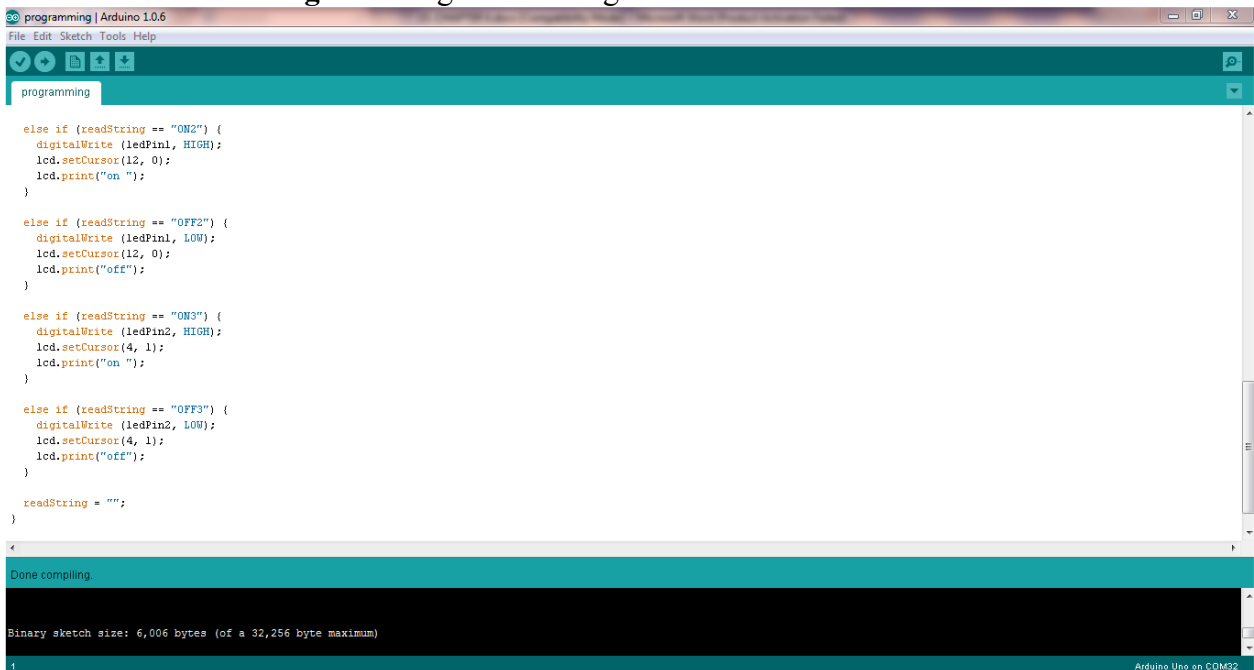
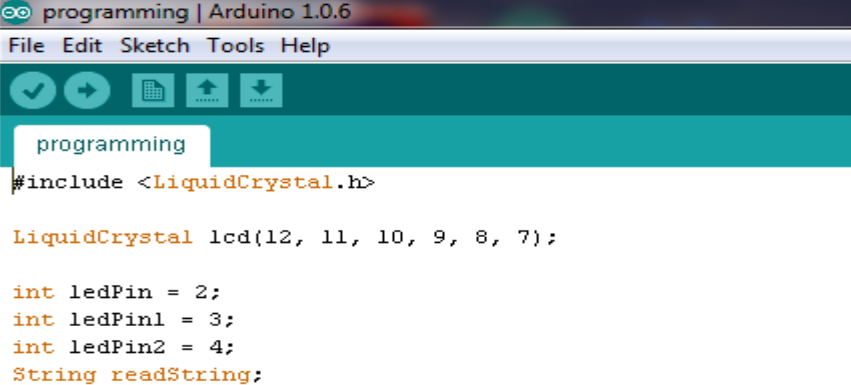


Fig. 8 – Programme was successfully compile

4.3 Analysis of Programming

The developed Wireless Home Appliances Controlled Using Arduino- WHACUA is working in terms of hardware for using the microcontroller to enable its function properly. Each of the microcontrollers has their own programming to make its function according to their desired purposes.



```

programming | Arduino 1.0.6
File Edit Sketch Tools Help
programming
#include <LiquidCrystal.h>

LiquidCrystal lcd(12, 11, 10, 9, 8, 7);

int ledPin = 2;
int ledPin1 = 3;
int ledPin2 = 4;
String readString;

```

Fig. 9 – Declaration of LCD port and pin.

Based on the Fig. 9 “String readStr programming for developing the Wireless Home Appliances Controlled Using Arduino, it set the programming and reads characters from the serial buffer into a string.

```

void setup() {
  Serial.begin(9600);
  pinMode(ledPin, OUTPUT);
  pinMode(ledPin1, OUTPUT);
  pinMode(ledPin2, OUTPUT);
}

```

Fig. 10 – Determine the input / output of digital pin

Fig. 10 shows void setup for developing the Wireless Home Appliances Controlled Using Arduino is used only in function statements. While for Serial.begin(9600) is standard speed for Wireless Home Appliances Controlled Using Arduino based data transfer at bits per second during the communication.

According to Fig. 11, the sentences of “WELCOME TO WHACUA” will display on

```

void setup() {
  Serial.begin(9600);
  pinMode(ledPin, OUTPUT);
  pinMode(ledPin1, OUTPUT);
  pinMode(ledPin2, OUTPUT);

  lcd.begin(16, 2);
  lcd.setCursor(0, 0);
  lcd.print("  WELCOME TO");
  lcd.setCursor(0, 1);
  lcd.print("  WHACUA  ");
  delay (1000);
  lcd.clear();
}

```

Fig. 11 – Sentences display in LCD display.

For Fig. 12, `lcd.setCursor` and `lcd.print` this is a method to reposition the cursor with a row and column position line by line in 16x2 LCD display for SW1, SW2 and SW3.

```
void loop() {
    lcd.setCursor(0, 0);
    lcd.print("SW1:");
    lcd.setCursor(8, 0);
    lcd.print("SW2:");
    lcd.setCursor(0, 1);
    lcd.print("SW3:");
}
```

Fig. 12 – Programme for LCD display reposition cursor.

```
while (Serial.available()) {
    delay(3);
    char c = Serial.read();
    readString += c;
}
```

Fig. 13 – Available for reading from the serial port.

```
if (readString.length() > 0) {
    Serial.println(readString);

    if (readString == "ON1") {
        digitalWrite (ledPin, HIGH);
        lcd.setCursor(4, 0);
        lcd.print("on ");
    }

    else if (readString == "OFF1") {
        digitalWrite (ledPin, LOW);
        lcd.setCursor(4, 0);
        lcd.print("off");
    }

    else if (readString == "ON2") {
        digitalWrite (ledPin1, HIGH);
        lcd.setCursor(12, 0);
        lcd.print("on ");
    }

    else if (readString == "OFF2") {
        digitalWrite (ledPin1, LOW);
        lcd.setCursor(12, 0);
        lcd.print("off");
    }
}
```

Fig. 14 – Programme for Write a HIGH or a LOW value to a digital pin.

Based on Fig. 14, it is a programme to control whole of the state for the switch whether to turn ON/OFF. For example when only SW1 is ON or HIGH, SW2 and SW3 will OFF or LOW. When all the SW are ON the condition of the SW are HIGH but when all the SW is OFF it means all the SW condition are LOW.

4.4 Design and Development of Application Interface for Wireless Home Appliances Controlled Using Arduino

Fig. 15 demonstrated the procedure of creating the app for Wireless Home Appliances Controlled Using Arduino. The app will be configured and installed over the phone of user. The application of Wireless Home Appliances Controlled Using Arduino is developed and designed in MIT Apps Inventor 2. MIT Apps offer the easy editing and configuring the app based on user requirements and at later the many advanced feature can be included. After the design procedure is finished the next part is assembling the program in terms block as shown in Fig. 16. It has been defined that system design of app is based on pieces of the puzzle where actually it is a programme for the apps designed for Wireless Home Appliances Controlled Using Arduino.

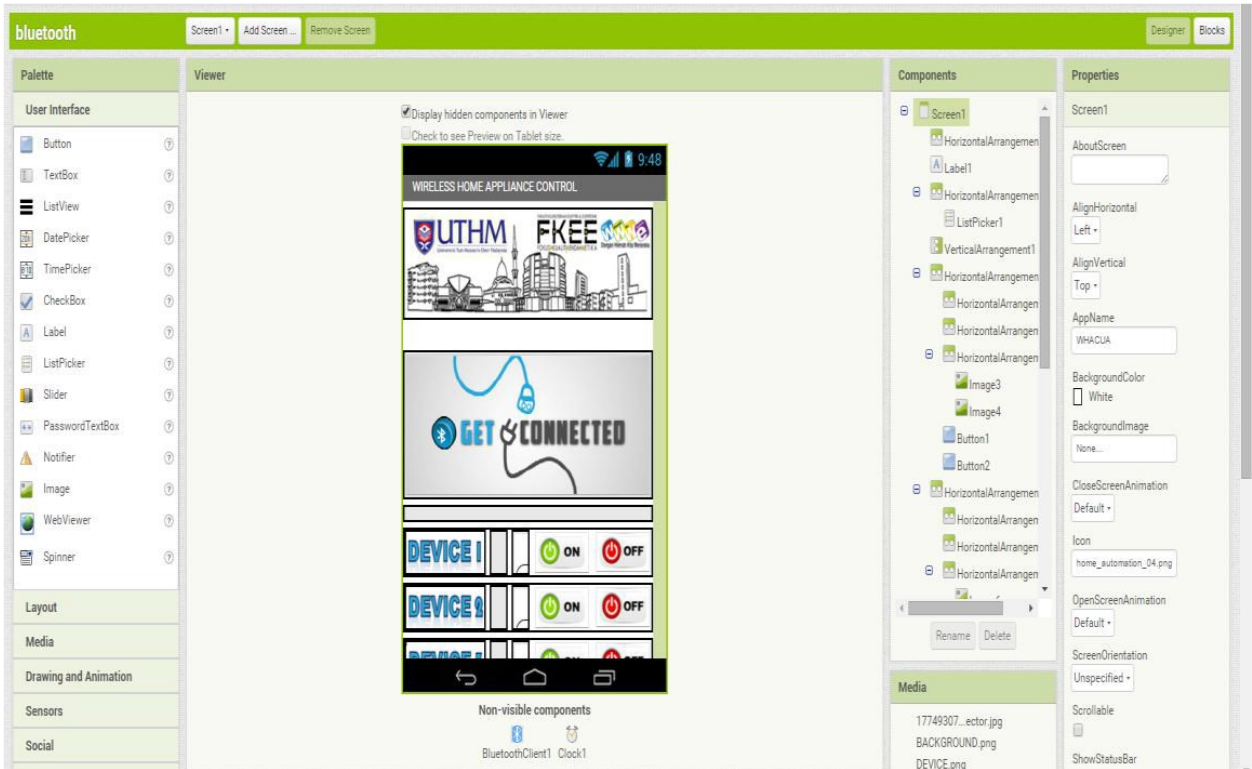


Fig. 15 – Design of WHACUA using MIT Apps Inventor 2

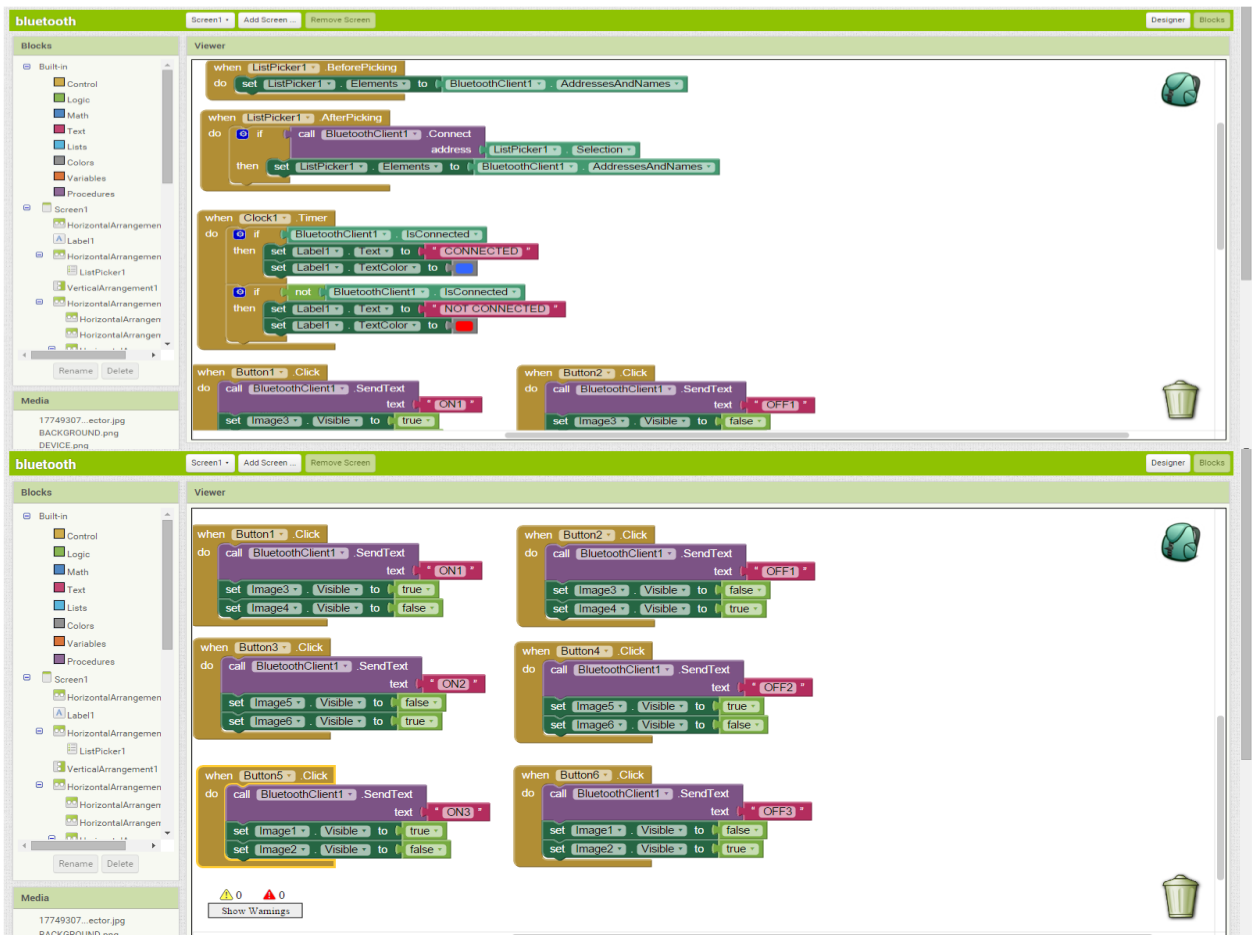


Fig. 16 – Program block accordance to WHACUA design.

5. Conclusion

In this work, Wireless Home Appliances Controlled Using Arduino system is designed and developed to govern the control of devices of home attached to the system. The system has utilized the Bluetooth that will offer the interconnection of system and devices from the mobile device of the user. For the sake of verification and validation system is tested for few devices in terms of a light device, a small fan. However, at later stages it can be designed for many large applications in terms of aircon, TV and many devices to be used in the home. The designed system Wireless Home Appliances Controlled Using Arduino is carried out in hardware and the software approach as discussed in methodology section. This applications Wireless Home Appliances Controlled Using Arduino allow the people living in home to govern the control of many devices in terms of ON/OFF for the devices that are attached to it.

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