SRR GOVERNMENT ARTS & SCIENCE COLLEGE (A)

KARIMNAGAR

STUDENT STUDY PROJECT

Title: Home automation by Arduino

SUBMITTED TO THE COMMISSIONER OF COLLEGIATE EDUCATION, HYD

Under the

JIGNASA-2024

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DECLARATION

We do hereby declare that the work presented in this study project entitled **"Home automation by Arduino"** is an original one and has been carried out by us in the Department of physics, SRR Government Arts &Science College (Autonomous), Karimnagar Dist: Karimnagar and has not been submitted either in part or in full for the award of any Degree or Diploma of any University earlier.

Date: 18-01-2024
Place: Karimnagar

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CERTIFICATE

This is to certify that the JIGNASA-Students' Study Project entitled **"Home automation by Arduino"** is an original one and has been carried out by M. SUMITH, IIIYR BSc (MPCs) K. RAJASHASHANK, IIIYR BSc (MPCs), P. ABILASH IIIYR BSc (MPCs) S. MANISHA, IIIYR BSc (MPCs) K. SAIPRIYA, IIYR BSc (MPC) in the Department of Physics, SRR Government Arts & Science College (Autonomous), Karimnagar, Dist: Karimnagar, Telangana and completed under my supervision. It is a bonafide work done by them and has not been submitted elsewhere for the award of any Degree or Diploma or Competition. This study project is of the standard expected and I strongly recommend that it may be sent for evaluation.

Date: 18th Jan 2024

Place: Karimnagar

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Study Project Supervisor

ACKNOWLEDGEMENTS

We feel it great honour and privilege to extend our heartfelt gratitude to **Sri. Burra Venkatesham IAS** garu, the Commissioner of Collegiate Education, Hyderabad, Telangana, for introducing such a wonderful, research oriented and skill development programme of JIGNASA to Degree College Students across the State of Telangana. Indeed, this programme develops the academic qualities, inquisitiveness, creative talent and the bent of research in the students. Thank you very much Sir for giving us an opportunity to undertake study projects under the **JIGNASA-Student Study Projects.** We owe a great debt of gratitude to **Sri. Dr K. Ramakrishna**, beloved principal of this college and the man of dedication and enthusiasm, for his constant motivation, encouragement for undertaking this study project and constructive suggestions for completion of this project. We feel immensely happy to extend deep sense of gratitude to **Sri. Dr B. Satyanarayana,** In-charge, Department of physics and our teacher and research supervisor **Sri. M.A. Shukur**, Asst. Professor, Department of physics, SRR Government Arts &Science College (Autonomous), Karimnagar who has guided our research work with meticulous care and scholarly advice. He spared his valuable time, and personal care and offered constructive suggestions at every stage of our research work, without which this study project would not have seen the light of the day. We thank all our teaching and non-teaching faculty members of department of Physics and all those who have directly and indirectly encouraged and supported us to carry out this study project.

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SYNOPSIS/ ABSTRACT

Internet of Things (IoT) conceptualizes the idea of remotely connecting and monitoring real world objects (things) through the Internet. When it comes to our house, this concept can be aptly incorporated to make it smarter, safer, and automated. This IoT project focuses on building a “HOME AUTOMATION BY ARDUINO” which is mainly concerned with designing a system that allows users, upon authentication, to remotely control and monitor multiple home appliances using a cellphone-based interface. The advantage of choosing this system over similar existing ones lies in the capability to receive alerts and status updates from the Wi-Fi connected microcontroller system on the user's phone, regardless of the user's location and internet connectivity status.The microcontroller used in the current prototype is the Arduino Uno 3 board which comes with an embedded micro-controller and an onboard Wi-Fi shield making use of which all the electrical appliances inside the home can be controlled and managed.

The Internet of things has been governing the electronics era with cloud services dominating the ever-increasing electronics product segment. By using this we can switch on or off the lights or fans automatically when we are outside. This proposes a smart home automation system based on Open-source cloud server and a low-cost Bluetooth module.

The System transmits an alert signal to the Open-source cloud which provides a alert signal on the users mobile phone. The system employs a second Bluetooth module which is programmed to act as a web server, which allows the user to activate or deactivate the security system by means of any device with internet.

Smart connectivity with existing networks and context-aware computation using network resources is an indispensable part of IoT. With the growing presence of Wi-Fi and 4G-LTE wireless Internet access, the evolution towards ubiquitous information and communication networks is already evident. However, for the Internet of Things vision to successfully emerge, the computing paradigm will need to go beyond traditional

mobile computing scenarios that use smart phones and portables and evolve into connecting everyday existing objects and embedding intelligence into our environment. For technology to disappear from the consciousness of the user, the Internet of Things demands: a shared understanding of the situation of its users and their appliances, software architectures and pervasive communication networks to process and convey the contextual information to where it is relevant, and the analytics tools in the Internet of Things that aim for autonomous and smart behavior. With these three fundamental grounds in place, smart connectivity and context-aware computation can be accomplished.

A radical evolution of the current Internet into a Network of interconnected objects that not only harvests information from the environment (sensing) and interacts with the physical world (actuation/ command/control), but also uses existing Internet standards to provide services for information transfer, analytics, applications, and communications. Fueled by the prevalence of devices enabled by open wireless technology such as Bluetooth, radio frequency identification (RFID), Wi-Fi, and telephonic data services as well embedded sensor and actuator nodes, IoT has stepped out of its infancy and is on the verge of transforming the current static Internet into a fully integrated future Internet.

INTRODUCTION

In a typical house there are several rooms with several electrical items that use electric power. The most used ones are lights and fans. It is very common for people to forget switching off lights or fans when they are not in use. This results in wastage of power and therefore wastage of money. In some cases, there are old or handicapped people who cannot reach the wall outlets to use the switches. They are not able to switch on or off lights or fans without assistance.

Robotics is a multidisciplinary field of science and engineering that involves the design, construction, programming, and operation of robots. A robot is a mechanical or virtual artificial agent that can perform tasks autonomously or semi-autonomously, often in response to its environment. The goal of robotics is to create machines that can automate repetitive or dangerous tasks, assist humans in various activities, and execute complex operations with precision.

The general aims and objectives of robotics encompass a broad range of goals that reflect the diverse applications and potential impact of robotic technology. Here are some overarching aims and objectives in the field of robotics:

1.1 General Aims of robotics:

1.To automate repetitive, dangerous, or labour-intensive tasks using robotic systems.

2. To achieve high levels of precision and accuracy in various applications.

3. To optimize industrial processes through the integration of robotic systems.

4. To deploy robots in environments that are dangerous or challenging for humans.

5. To develop robots that can assist humans in various activities.

6.To enhance medical procedures and healthcare services through robotic technology.

7. To address challenges in agriculture through robotic solutions.

8. To explore and conduct tasks in space with the help of robotic systems.

9. To use robotics as a tool for education and scientific research.

10. To promote ethical considerations in the development and deployment of robotic systems.

1.2 General Objective of robotics:

1. Improve efficiency, reduce human involvement in hazardous tasks, and enhance overall productivity.

2. Enable robots to perform tasks with a level of accuracy that surpasses human capabilities, particularly in fields such as manufacturing and surgery.

3. Improve production speed, reduce costs, and enhance the quality of manufactured goods.

4.Enhance safety by utilizing robots for tasks such as search and rescue, handling hazardous materials, and exploration in extreme conditions.

5.Create robotic systems that complement human capabilities, providing support in healthcare, rehabilitation, and other fields.

6.Develop surgical robots, robotic prosthetics, and assistive devices that improve patient outcomes and the quality of healthcare delivery.

7.Create robots for precision farming, automated harvesting, and monitoring crop health to improve efficiency and reduce environmental impact.

8.Design and deploy robots for planetary exploration, maintenance of space infrastructure, and other space missions.

9.Provide educational platforms for learning robotics, and contribute to research in artificial intelligence, machine learning, and human-robot interaction.

10.Establish guidelines and regulations to ensure the responsible use of robotics, considering ethical, social, and safety implications.

These aims and objectives collectively contribute to the ongoing evolution of robotics, shaping a future where robotic technology plays a crucial role in improving various aspects of human life and industry.

Robotics finds applications across a wide range of industries and sectors. The main applications of robotics include Manufacturing and Industrial Automation: assembly

lines, welding, painting, packaging, and quality control, Healthcare and Medical Robotics: Surgical robots, rehabilitation robots, telepresence robots for healthcare monitoring. Agricultural Robotics: Automated harvesting, precision farming, and crop monitoring Logistics Warehousing, Space Exploration: Planetary rovers, robotic arms on spacecraft. Defence and Security: Unmanned Aerial Vehicles (UAVs), bomb disposal robots, surveillance robots. Education and Research: for learning programming and robotics. Entertainment and Leisure: Robotic toys, animatronics, theme park attractions. Environmental Monitoring: Robotic devices for monitoring pollution, climate, and wildlife. Consumer Electronics: Robotic vacuum cleaners, robotic lawn mowers. Autonomous Vehicles: Self-driving cars, drones. Humanoid Robots: Social robots, companionship robots which assist with social interactions, provide emotional support, and perform tasks in a human-like manner.

In the field of robotics, the study involves a diverse range of topics that cover various aspects of Kinematics, dynamics, materials science, mechanical design, circuits, electronics, sensors, Programming, algorithms, data structures, artificial intelligence (AI), Control theory, feedback systems, Robot operating systems (ROS), programming languages (e.g., C++, Python), computer vision, signal processing, Machine learning algorithms, computer vision, natural language processing, Integration of hardware and software components, Ethical considerations, legal implications.

MOTIVATION

Embarking on the journey of robotics training at SRR GASC KNR@ Soham Academy and subsequently training hundreds of students in workshops has been an incredibly enriching experience. The motivation behind our project stems from several key factors:

(a) Undergone Robotics Training @ SRR GASC KNR@ Soham Academy:

The initial exposure and training in robotics at SRR GASC KNR@ Soham Academy provided a solid foundation and ignited a passion for exploring the possibilities in this exciting field. The hands-on experience and guidance received during the training inspired a desire to delve deeper into robotics.

(b) Trained Hundreds of Students in Schools in Three Workshops:

The opportunity to share our knowledge and skills in robotics through workshops in various schools was immensely fulfilling. Witnessing the enthusiasm and creativity of students as they engaged with robotics reinforced the belief in the transformative power of education. It became evident that robotics could serve as a powerful tool to nurture innovation and problem-solving skills among students.

(c) While Solving Robotics Challenges, We Got This Idea:

Engaging in the process of solving robotics challenges not only honed our technical skills but also sparked innovative thinking. It was during these problem-solving moments that the idea for the current project emerged. Recognizing a gap or an opportunity during these challenges often leads to groundbreaking concepts, and this project was no exception.

(d) We Spoke to Our HoD, Faculty & Academy Personnel to Develop the Idea into Today's Project:

Realizing the potential of our idea, we took the initiative to discuss it with our Head of Department, faculty members, and Academy personnel. Their guidance, support, and belief in the project were crucial in transforming the concept into a tangible reality. Collaboration with experienced mentors and professionals added depth to our understanding and fuelled our determination to turn the idea into a fully-fledged project.

AIMS AND OBJECTIVES

Aims:

1. To enhance the functionality, convenience, and efficiency of residential living through the integration of Arduino-based automation solutions.
2. To deliver a smart, and user-centric living environment that enhances the quality of life.

Objectives:

1. To simplify daily tasks and enhance the overall comfort of occupants.
2. To enable users to remotely monitor and control their home automation system through mobile devices control from anywhere with an internet connection.

REVIEW OF LITERATURE

1. Flesh and Machines: How Robots Will Change Us" by Rodney Brooks: provides insights into the history of robotics and explores the impact of robots on human life. The book discusses both the technical aspects of robotics and the societal implications of robotic advancements.
2. "Robots: A Reference Handbook" by David E. Newton: This comprehensive reference handbook covers the history, development, and impact of robots from ancient times to the present day. It provides a detailed overview of the evolution of robotics and its intersection with technology, science, and culture.
3. "Robotic Explorations: A Hands-On Introduction to Engineering" by Fred G. Martin: This book takes a hands-on approach to introducing robotics and engineering. While focusing on practical aspects, it provides historical context and background information on the development of robotic technologies.
4. "Arduino: A Quick-Start Guide" by Maik Schmidt: it briefly touches upon the history and development of Arduino.
5. "Arduino Workshop: A Hands-On Introduction with 65 Projects" by John Boxall: This book provides hands-on projects for Arduino enthusiasts. While it emphasizes practical application, it might include information about the historical context and development of Arduino.
6. "Arduino Project Handbook: 25 Practical Projects to Get You Started" by Mark Geddes: While this book is project-oriented, it might include introductory information about Arduino's development, offering readers context on how and why Arduino became a popular platform for electronics enthusiasts.
7. “Practical Robotics” – Soham Academy by Komaragiri Sahadev: This book contains the activity procedures in detail, detailed notes about the sensors, motors and devices, and finally the design and implementation of four advances activities.

Materials and Methods

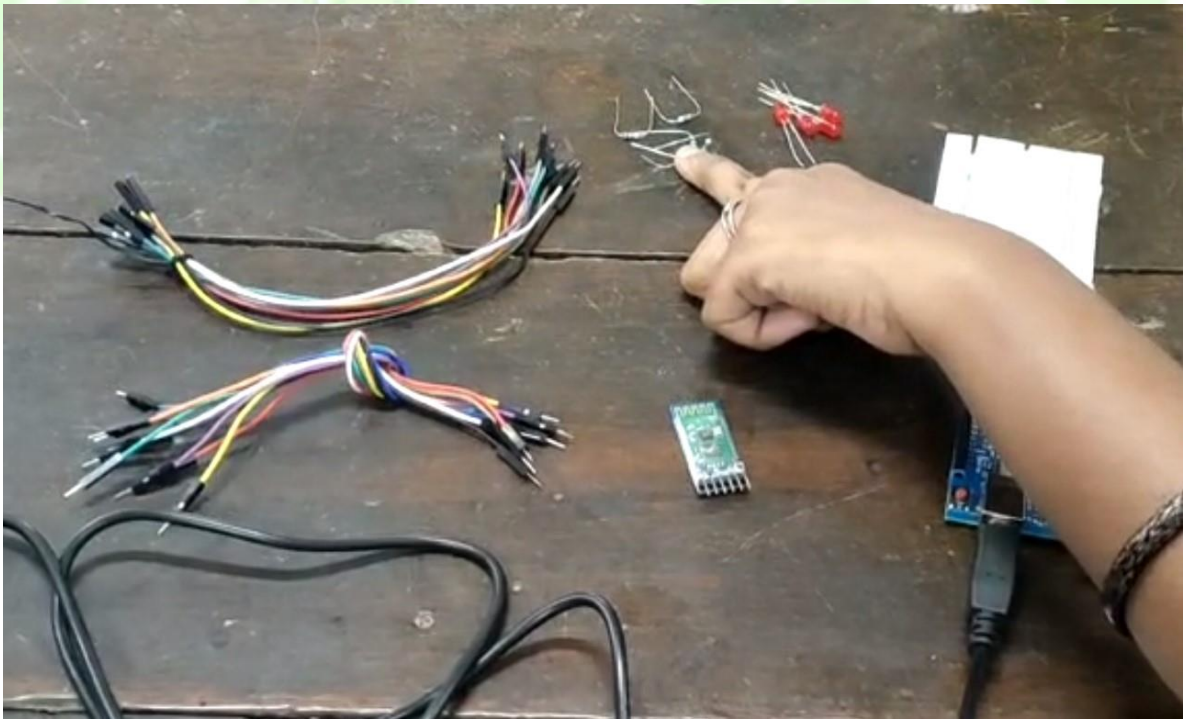
Materials:

Arduino UNO R3, USB Cable, Breadboard, Bluetooth Module, four 220Ω Resistors, four LEDs, Jumper Wires

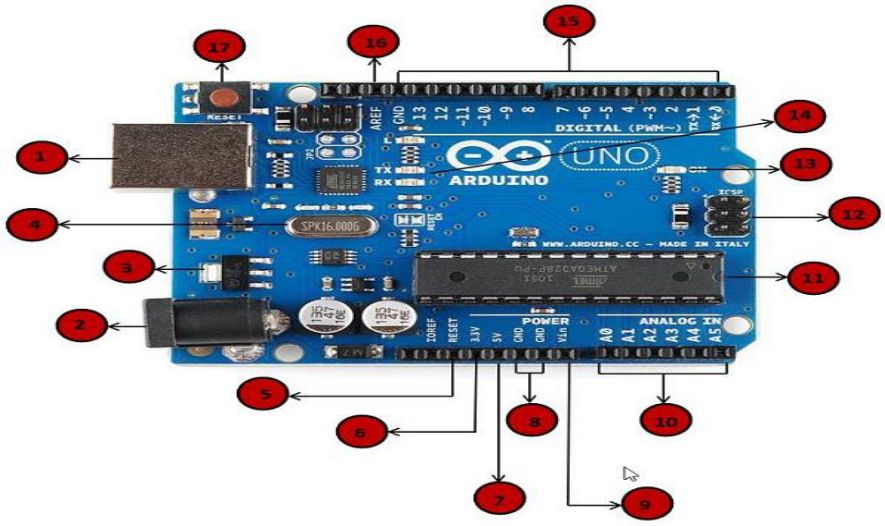
Arduino board:

Arduino boards are compatible with the Arduino Integrated Development Environment (IDE), a software platform that allows users to write, compile, and upload code to the Arduino board. The programming language used is a simplified version of C/C++, making it accessible to beginners.

Arduino is popular for prototyping and creating a wide range of electronic projects, from simple blinking LED lights to more complex applications involving sensors, actuators, and communication with other devices. The open-source nature of Arduino encourages a vast community of developers, makers, and hobbyists who share their projects and contribute to the continuous evolution of the platform.



Components of Arduino Uno 3 board



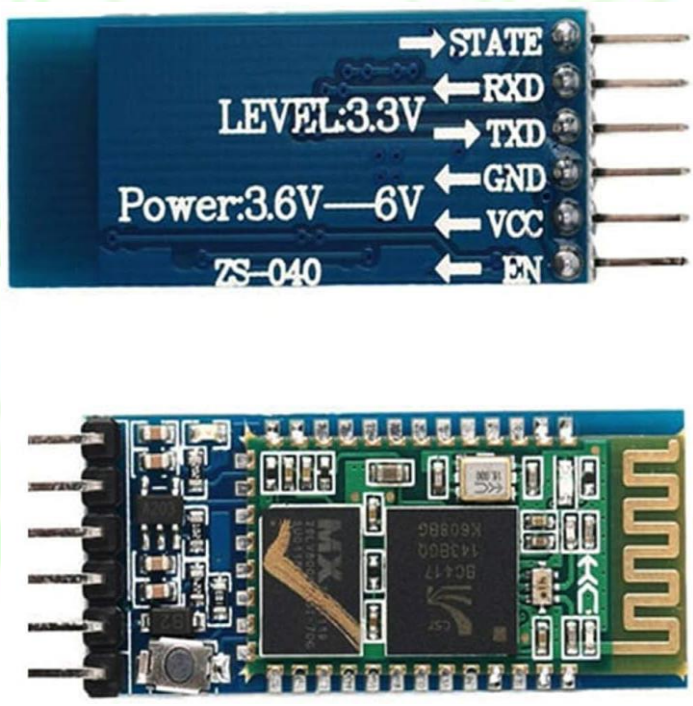
1	**Power USB:** Arduino board can be powered by using the USB cable from your computer to the USB connection (1).
2	**Power (Barrel Jack):** Arduino boards can be powered directly from the AC mains power supply by connecting it to the Barrel Jack (2).
3	**Voltage Regulator:** The function of the voltage regulator is to control the voltage given to the Arduino board and stabilize the DC voltages used by the processor and other elements.
4	**Crystal Oscillator:** The crystal oscillator helps Arduino in dealing with time issues. The number printed on top of the Arduino crystal is 16.000H9H. It tells us that the frequency is 16,000,000 Hertz or 16 MHz
5,17	**Arduino Reset:** You can reset your Arduino board, i.e., start your program from the beginning. You can reset the UNO board in two ways. First, by using the reset button (17) on the board. Second, you can connect an external reset button to the Arduino pin labelled RESET (5).
6,7 8,9	**Pins (3.3, 5, GND, Vin):** 3.3V (6) − Supply 3.3 output volt. 5V (7) − Supply 5 output volt. GND (8) (Ground), Vin (9) − used to power the Arduino board from an external power source.

10	**Analog pins:** The Arduino UNO board has six analogy input pins A0 through A5. These pins can read the signal from an analogy sensor like the humidity sensor or temperature sensor and convert it into a digital value that can be read by the microprocessor.
11	**Main microcontroller** (11). The microcontrollers are usually of the ATMEL Company. You must know what IC your board has before loading up a new program from the Arduino IDE. This information is available on the top of the IC.
12	**ICSP pin:** Mostly, ICSP (12) is an AVR, a tiny programming header for the Arduino consisting of MOSI, MISO, SCK, RESET, VCC, and GND. It is often referred to as an SPI (Serial Peripheral Interface), which could be considered as an "expansion" of the output.
13	**Power LED indicator:** This LED should light up when you plug your Arduino into a power source to indicate that your board is powered up correctly.
14	**TX and RX LEDs:** On your board, you will find two labels: TX (transmit) and RX (receive). They appear in two places on the Arduino UNO board. First, at the digital pins 0 and 1, to indicate the pins responsible for serial communication. Second, the TX and RX led (13). The TX led flashes with different speed while sending the serial data. The speed of flashing depends on the baud rate used by the board. RX flashes during the receiving process.
15	**Digital I/O:** The Arduino UNO board has 14 digital I/O pins (15) (of which 6 provide PWM (Pulse Width Modulation) output. These pins can be configured to work as input digital pins to read logic values (0 or 1) or as digital output pins to drive different modules like LEDs, relays, etc. The pins labelled “~” can be used to generate PWM.
16	**AREF:** Analog Reference. It is used to set an external reference voltage (between 0 and 5 Volts) as the upper limit for the analogy input pins.

Components of Bluetooth module:

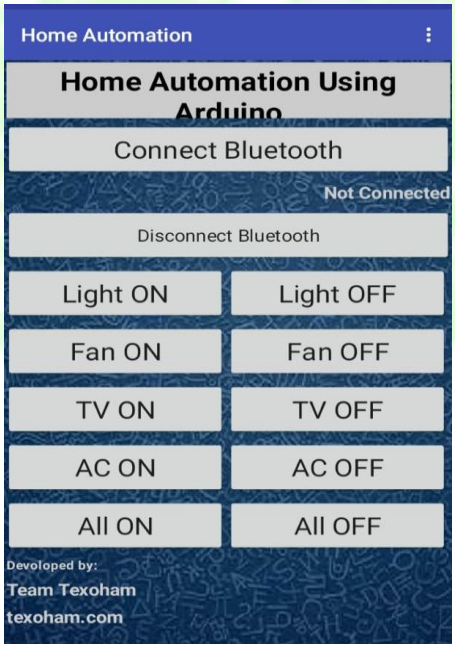
A Bluetooth module is a hardware device that facilitates wireless communication between electronic devices over short distances using radio waves.

1. VCC (Voltage Supply):
2. GND (Ground):
3. TXD (Transmit Data): Connects to the RX (Receive) pin of the microcontroller or other devices.
4. RXD (Receive Data): Connects to the TX (Transmit) pin of the microcontroller or other devices.
5. STATE : Indicates the current state of the module (e.g., connected or not connected).
6. KEY: It can be used for various purposes, including setting the module to AT command mode or configuring the module



Android Phone App:

- In home automation, an Android app serves as a user interface and a control hub for managing and monitoring various smart devices within a home.
- This app is used to work with up to 4 lights in your unit using Bluetooth communication.
- The Android app acts as a bridge, allowing users to interact with their connected devices, set preferences, and automate tasks.



Source Code

```
#include <TM1637Display.h>
#include <Wire.h>
#include <SoftwareSerial.h>
#include <Servo.h>
void executeHomeAutomation()
{
 if (act == 3) {
  String command = "";
  Serial.println("do home automation");
  while (BT.available())
  {
   //Check if there is an available byte to read
   Serial.println("BT Available - Command");
   delay(10);                    //Delay added to make thing stable
   //char command[] = "";
   char c = BT.read();           //Conduct a serial read
   command += c;                 //build the string.
   Serial.println(command);
  }
  if (command == "1")
  {
   Serial.println("Executing 1 command");
   Serial.print("1 ON");
   PORTD |= B00000100 ; //Light on
  }
  else if (command == "2")
```

```
{
  PORTD &= B00111000 ; //Light off
}
else if (command == "3")
{
  PORTD |= B00001000 ; //Fan on
}
else if ( command == "4")
{
  PORTD &= B00110100 ; //Fan off
}
else if (command == "5")
{
  PORTD |= B00010000 ; //TV on
}
else if (command == "6")
{
  PORTD &= B00101100 ; //TV off
}
else if (command == "7")
{
  PORTD |= B00100000 ;  //AC on
}
else if (command == "8")
{
  PORTD &= B00011100 ;  //AC off
}
else if (command == "9")          //using this command you can switch on all
devices
```

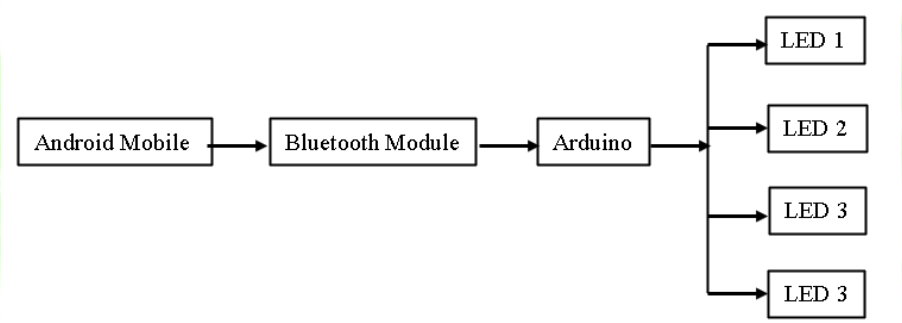
```
    {
      PORTD |= B00111100 ; //ALL on
    }
    else if (command == "0")          //using this command you can switch off all
devices
    {
      PORTD &= B00000000 ; //ALL off
    }
  }
}

void loop() {
  executeREncoder();
  executeHomeAutomation();
  }
```

Figure 1: Transferring the source code into Arduino Uno 3 board.

Project Implementation

1. Download and install the Arduino Integrated Development Environment (IDE) on computer from the official Arduino website.
2. Upload the source Code.
3. Connect the Arduino Uno to your computer using a USB cable.
4. Select the correct board type (Arduino Uno) and port in the Arduino IDE.
5. Click the "Upload" button to transfer source code to the Arduino board.

The flow chart shows below.



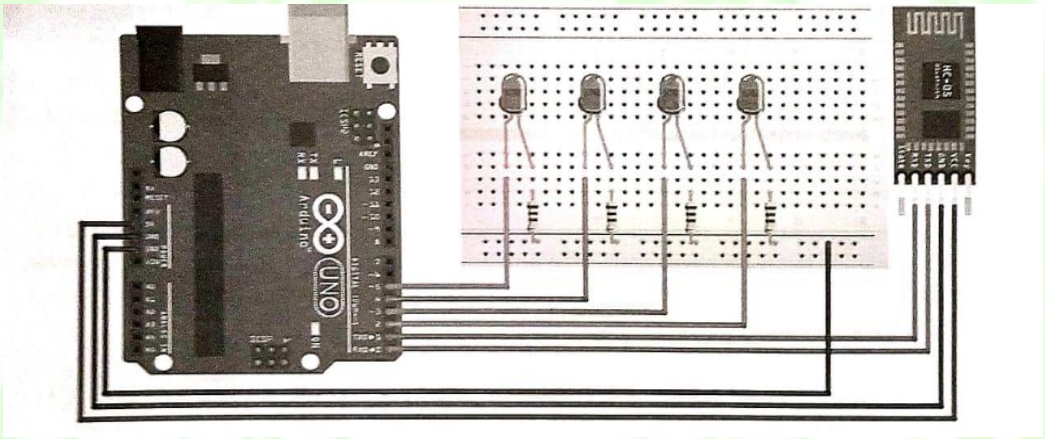
The primary communication with the lights is managed using a Bluetooth app that is installed on a smart phone. Bluetooth module in the Home Automation unit is paired with the Blue- tooth module on a smart phone.

The app has all the necessary buttons to switch ON or OFF up to 5 items, one each for each of the lights.

The signal from the smartphone goes to the Bluetooth module. This module in turn conveys the signal to Arduino. Arduino directs the instructions to the lights connected to it. The lights switch ON or OFF based on the instructions received by it. The entire set of instructions go from the app installed on the smartphone. The Home Automation unit is designed to follow the instructions it gets from the app. The program that is uploaded to the Arduino unit contains the necessary instructions to react to every command it receives from the smartphone.

Circuit Connections

1. Place 4 LEDs on a breadboard.
2. Connect the resistors to each of the LEDs and ground them to the power rails of the breadboard.
3. Connect a power rail ground wire to the GND pin of the Arduino.
4. Connect the 4,5,6,7 pin of the Arduino to four LEDs.
5. Connect the Bluetooth module as follows:
   a. VCC to 5V and GND to GND pin on the Arduino
   b. Connect RX and TX pins to pin numbers TX (1) and RX (0) the Arduino board.



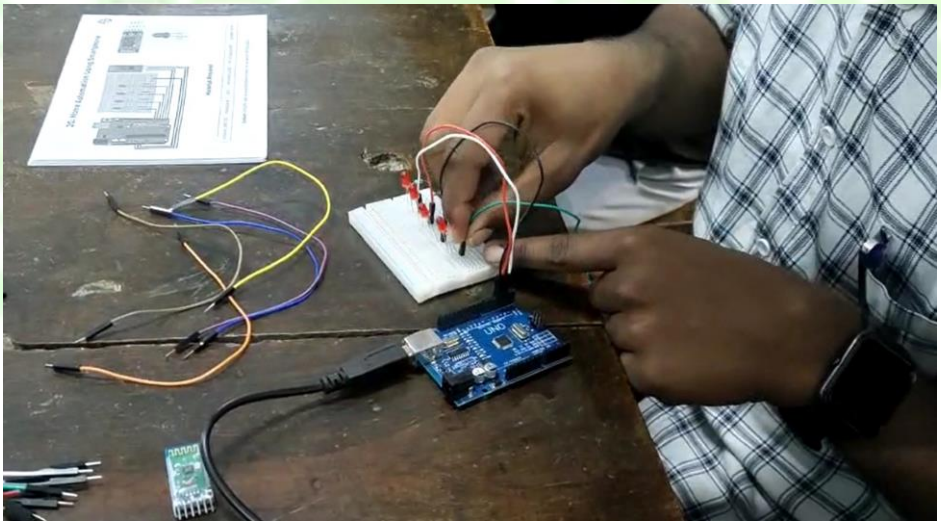


Figure 2: Circuit Connections of Home Automation by Arduino Uno 3 board.

Procedure:

1.Pair the Bluetooth module with the Bluetooth in smart phone.

2.Using the buttons on the Android app, switch ON one of the lights, the corresponding light in the broad unit is switched ON. Then switch OFF the lights using app and correct responding light is switched OFF. Try other lights.

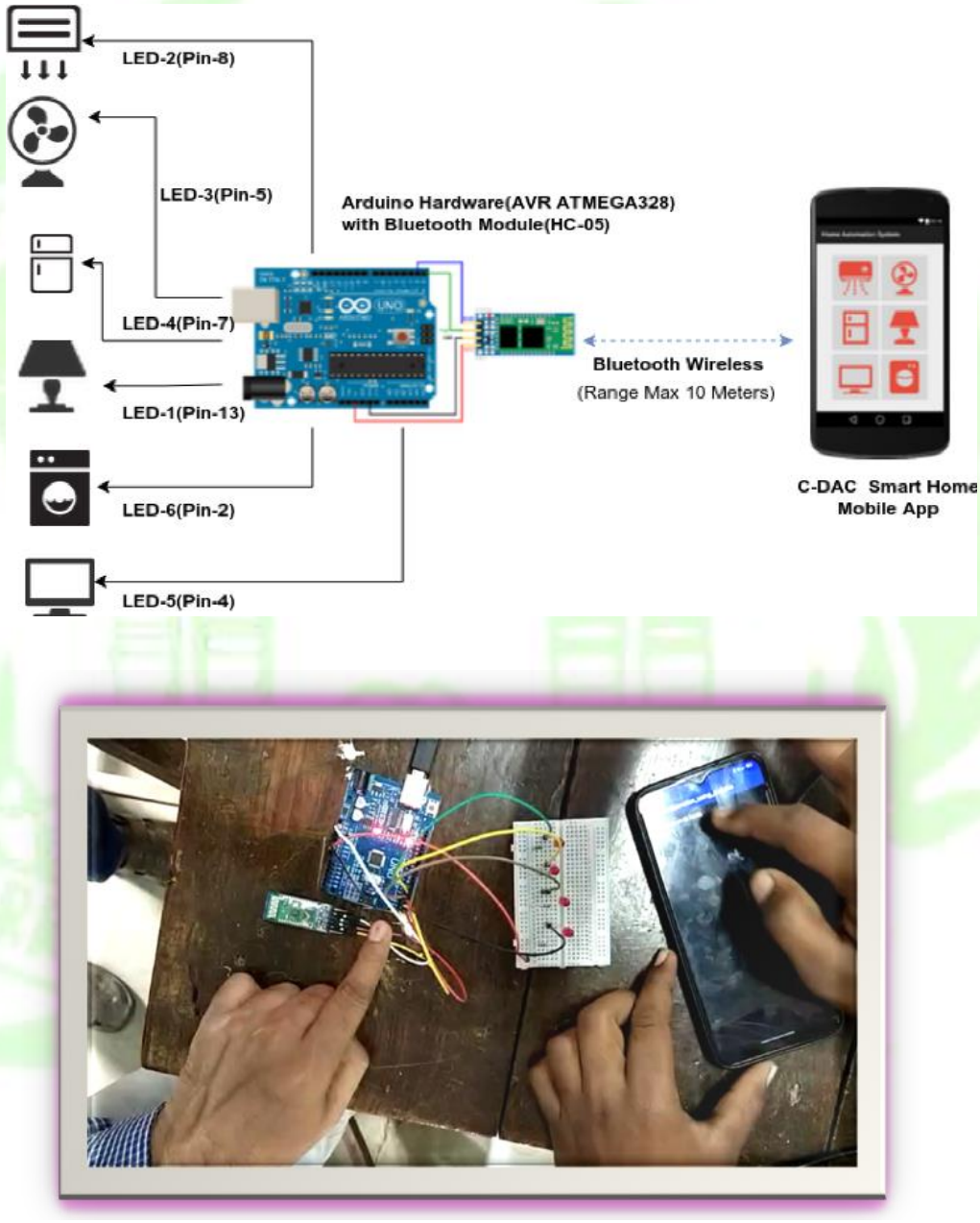


Figure 3: Pairing the Bluetooth module with the Bluetooth in smart phone.

DEMONSTRATION OF THE PROJECT

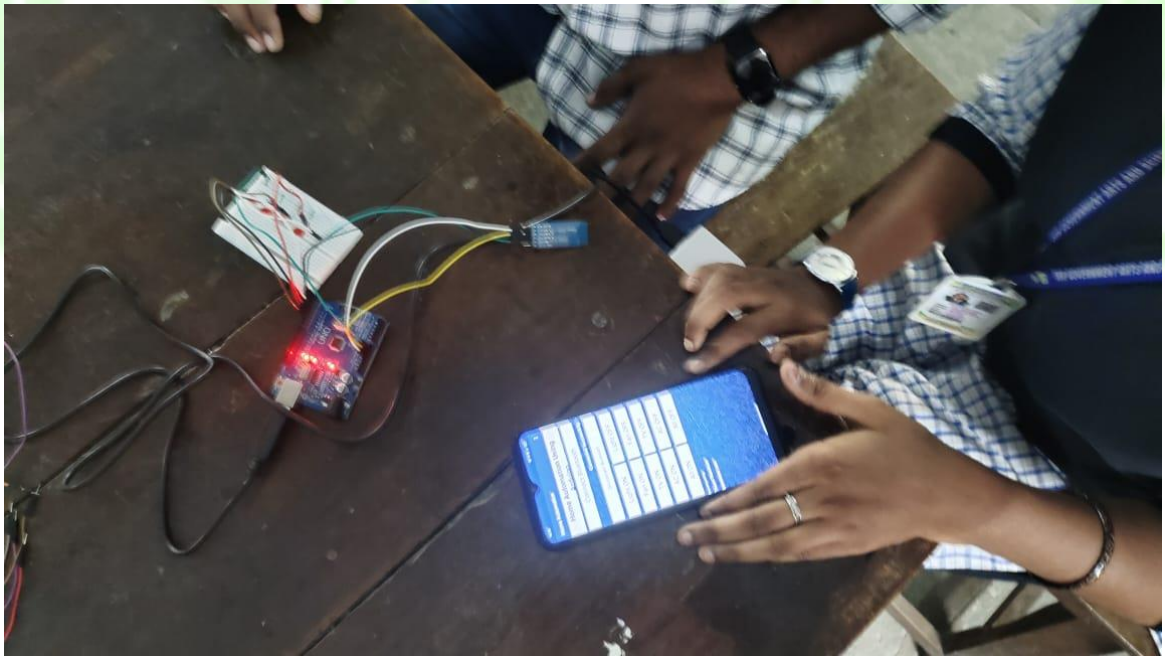


Figure 4: Circuit Connections of Home Automation by Arduino Uno 3 board.

TABLE & OBSERVATIONS

Buttons on the Android app	O/P
Light ON/OFF	1st LED is ON/OFF
Fan ON/OFF	2nd LED is ON/OFF
TV ON/OFF	3rd LED is ON/OFF
AC ON/OFF	4th LED is ON/OFF
All ON/OFF	All LEDs are ON/OFF

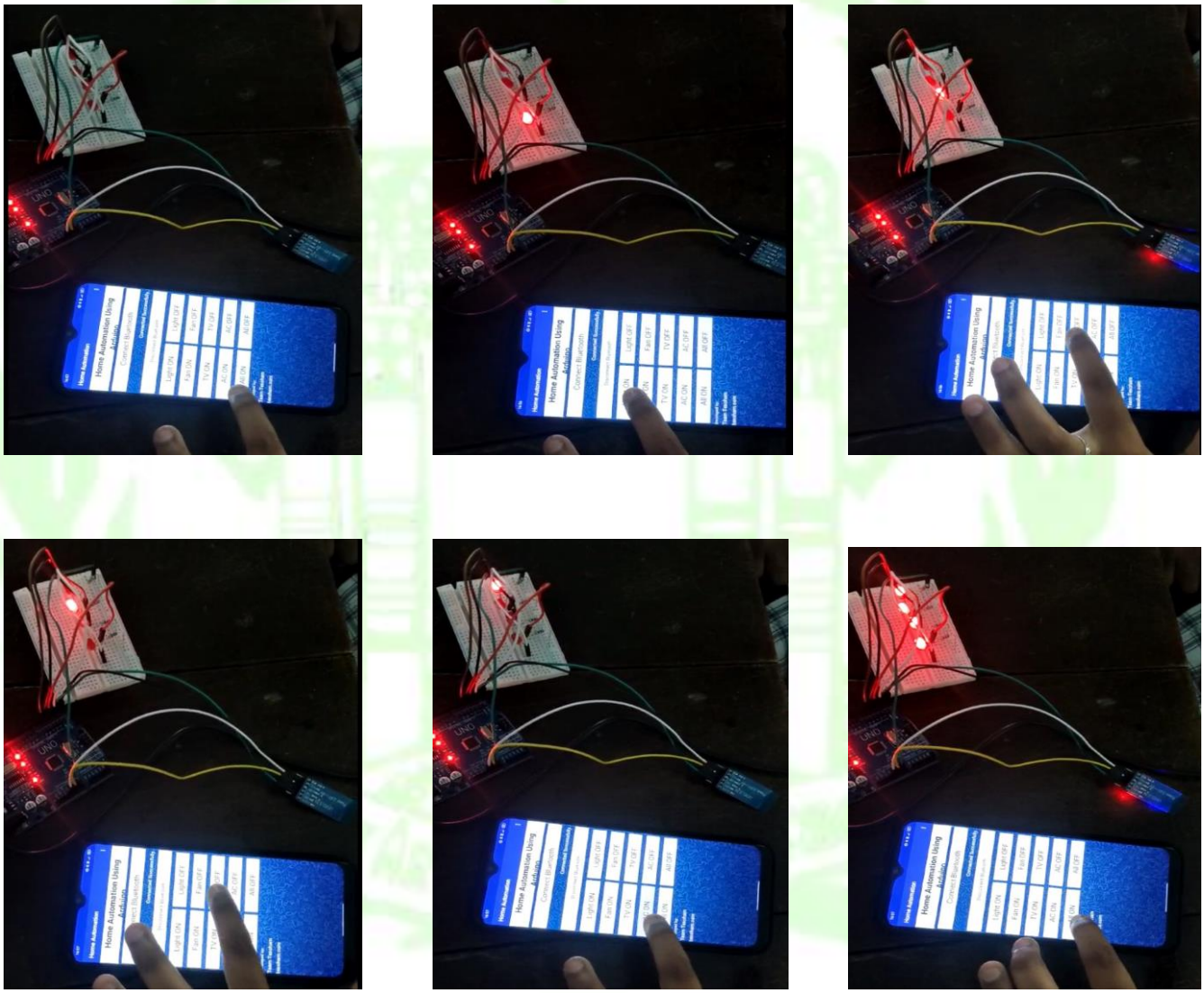


Figure 5: Observations of Home Automation by Arduino Uno 3 board.

RESULT

Switch **ON/OFF** using android app and we will notice that the corresponding light is switched **ON/OFF**.

CONCLUSION

Home Automation using Arduino project provides solution to the problems like forgetting to switch off lights or fans when they are not in use. The old and handicapped people able to switch on or switch off lights or fans without assistance.

REFERENCES

1. Book of Practical ROBOTICS by Soham Academy.
2. Book of THE INTERNET OF THINGS by Samuel Greengard.
3. Book of GETTING STARTED WITH INTERNET OF THING by Cuno Pfister
4. List of Sample IOT Projects: https://electronicsforu.com/iot-projects-ideas
   https://www.skyfilabs.com/blog/best-iot-projects-using-arduino
5. Arduino download: https://www.arduino.cc/
6. Basic Electronic Components: https://circuitdigest.com/arduino-projects