HOME AUTOMATION USING GESTURE RECOGNITION FOR DISABLED PERSON

A DESIGN PROJECT REPORT

Submitted by

SABARI PRIYAN G

NAVEEN KUMAR K

NEELA MUGESH S

SHAI SHARATH VIJEY S

in partial fulfilment for the award of the degree of

BACHELOR OF TECHNOLOGY

in

ARTIFICIAL INTELLIGENGE AND DATA SCIENCE

K. RAMAKRISHNAN COLLEGE OF TECHNOLOGY

(An Autonomous Institution, affiliated to Anna University Chennai and Approved by AICTE, New Delhi)

SAMAYAPURAM–621112

JUNE 2024

K. RAMAKRISHNAN COLLEGE OF TECHNOLOGY
(AUTONOMOUS)

SAMAYAPURAM–621112

BONAFIDE CERTIFICATE

Certified that this design project report titled **"HOME AUTOMATION USING GESTURE RECOGNITION DISABLED PERSON"** is the bonafide work of **NAVEEN KUMAR K (REG NO: 811721243037), NEELA MUGESH S (REG NO: 811721243039), SABARI PRIYAN G (REG NO: 811721243044), SHAI SHARATH VIJEY S (REG NO: 811721243050)** who carried out the project under my supervision.

SIGNATURE	**SIGNATURE**
Dr. T. Avudaiappan M.E., Ph.D.,	Mrs. G. Nalina Keerthana M.E.,
HEAD OF THE DEPARTMENT	**SUPERVISOR**
Associative Professor	Assistant Professor
Department of AI	Department of AI
K. Ramakrishnan College of Technology	K. Ramakrishnan College of Technology
(Autonomous)	(Autonomous)
Samayapuram – 621 112	Samayapuram – 621 112

Submitted for the viva-voce examination held on ………………

INTERNAL EXAMINER **EXTERNAL EXAMINER**

DECLARATION

We jointly declare that the project report on **"HOME AUTOMATION USING GESTURE RECOGNITION FOR DISABLED PERSON"** is the result of original work done by us and best of our knowledge, similar work has not been submitted to **"ANNA UNIVERSITY CHENNAI"** for the requirement of Degree of **BACHELOR OF TECHNOLOGY**. This design project report is submitted on the partial fulfilment of the requirement of the award of Degree of **BACHELOR OF TECHNOLOGY**.

<u>SIGNATURE</u>

____

NAVEEN KUMAR K

____

NEELA MUGESH S

____

SABARI PRIYAN G

____

SHAI SHARTH VIJEY S

PLACE **:** SAMAYAPURAM
DATE **:**

ACKNOWLEDGEMENT

It is with great pride that we express our gratitude and in - debt to our institution "**K. RAMAKRISHNAN COLLEGE OF TECHNOLOGY (AUTONOMOUS)**", for providing us with the opportunity to do this project.

We are glad to credit honourable chairman **Dr. K. RAMAKRISHNAN**, **B.E.,** for having provided for the facilities during the course of our study in college.

We would like to express our sincere thanks to our beloved Executive Director **Dr. S. KUPPUSAMY, MBA., Ph.D.,** for forwarding to our project and offering adequate duration in completing our project.

We would like to thank our principal **Dr. N. VASUDEVAN, M.E., Ph.D.,** who gave opportunity to frame the project the full satisfaction.

We whole heartily thanks to **Dr. T. AVUDAIAPPAN**, **M.E., Ph.D.,** HEAD OF THE DEPARTMENT, **ARTIFICAL INTELLIGENCE** for providing his encourage pursuing this project.

I express my deep and sincere gratitude to my project guide **Mrs. G. NALINA KEETHANA M.E.,** ASSISTANT PROFESSOR, **ARTIFICIAL INTELLIGENCE** for her incalculable suggestions, creativity, assistance and patience which motivated me to carry out the project successfully.

I render my sincere thanks to my project coordinator **Mrs. G. NALINA KEETHANA M.E.,** other faculties and non-teaching staff members for providing valuable information during the course. I wish to express my special thanks to the officials & Lab Technicians of our departments who rendered their help during the period of the work progress.

ABSTRACT

A home automation system is developed for disabled individuals using gesture recognition represents a significant advancement in enhancing the quality of life and independence for disabled persons with challenges. This innovative system utilizes a camera to capture gestures of disabled persons, which are then processed using sophisticated machine learning algorithms. The recognized gestures are translated into commands that control various home appliances, such as lights, fan and smart devices. By reducing the need of assistance from other persons, this system streamlines home automation processes, making the home environment more accessible and comfortable. Users can configure and customize the system through a user-friendly mobile app or web interface, allowing for their personalized control and adaptability to individual needs. Real-time feedback and monitoring ensure the system operates efficiently and reliably, providing users the confidence and security of an automated home environment. This system leverages advanced technologies like computer vision and machine learning to create a robust and scalable solution tailored specifically for disabled persons. By setting a foundation for future innovations, this system encourages continuous improvement and the development of new solutions to meet the evolving needs of disabled individuals.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF ABBREVIATIONS

CNN	Convolutional Neural Networks
RNN	Recurrent Neural Networks
SVM	Support Vector Machines
MQTT	Message Queuing Telemetry Transport
PCA	Principal Component Analysis
PID	Proportional-Integral-Derivative
HMM	Hidden Markov Models
DTW	Dynamic Time Warping
YOLO	You Only Look Once
LiDAR	Light Detection and Ranging
CCTV	Closed-Circuit Television

CHAPTER 1

INTRODUCTION

The development of a gesture-based home automation system aims to enhance the independence and quality of life for disabled individuals. By utilizing gesture recognition technology, the system allows users to control home appliances effortlessly, reducing the need for physical interaction and fostering a more accessible living environment.

1.1 BACKGROUND

The integration of gesture recognition in home automation for disabled individuals addresses critical accessibility challenges. Traditional control methods often require physical interaction, which can be difficult for those with mobility impairments. Gesture recognition technology leverages cameras and machine learning algorithms to interpret hand or body movements, translating them into commands for controlling smart devices. This technology not only simplifies the user experience but also reduces dependence on caregivers, fostering greater autonomy.

The system's adaptability allows for customized gestures to meet individual needs, ensuring a personalized and user-friendly interface. Advances in computer vision and machine learning have made these systems more accurate and reliable, paving the way for widespread adoption. By creating a more accessible and empowering home environment, gesture-based home automation systems represent a significant step forward in enhancing the quality of life for disabled persons.

1.2 PROBLEM STATEMENT

Disabled individuals often face significant challenges in controlling their home environments due to physical limitations, making daily tasks cumbersome and reducing their independence. Traditional home automation systems primarily rely on physical interaction with switches or voice commands, which may not be feasible for everyone. There is a need for an accessible and intuitive system that allows disabled persons to manage household devices effortlessly, thereby enhancing their autonomy and quality of life. Gesture recognition technology offers a promising solution by enabling users to control their environment through simple hand or body movements, eliminating the need for physical or voice interactions.

1.3 OBJECTIVES

- Enable gesture-based control of home appliances for enhanced accessibility.
- Provide a user-friendly interface for configuring and customizing gestures.
- Ensure reliable and accurate gesture recognition using advanced technologies.
- Streamline the automation of household tasks, reducing manual intervention.
- Enhance user independence and quality of life by simplifying home control.
- Facilitate easy integration with existing smart home devices.
- Offer real-time feedback and monitoring to ensure system reliability.
- Promote security and privacy in gesture data processing and usage.
- Accommodate diverse user needs with customizable gesture options.
- Encourage innovation and continuous improvement in accessible home automation.

CHAPTER 2

LITERATURE SURVEY

2.1 LITERATURE REVIEW ON HOME AUTOMATION SYSTEM FOR PHYSICALLY DISABLED PEOPLE

Author: Muhammad Nauman Ali

Year Of Publication: IEEE 2018

Algorithm Used: Gesture recognition, Voice recognition, Machine learning.

Abstract

Ali's paper delves into the development of home automation systems tailored for individuals with physical disabilities. The review outlines various methodologies and technologies employed in existing systems, emphasizing the importance of intuitive interfaces and accessibility features. It explores the utilization of gesture recognition, voice control, and sensor-based automation to enhance user experience and independence. Additionally, Ali discusses the challenges and limitations faced by current systems, including cost, complexity, and interoperability issues. The paper concludes with recommendations for future research directions aimed at addressing these challenges and further improving the effectiveness and inclusivity of home automation solutions for individuals with disabilities.

Merits

In-depth analysis, comprehensive overview of existing systems, identification of key challenges and future research directions

Demerits

Limited focus on specific technical implementations, lack of empirical data or case studies

2.2 IOT BASED SIGN LANGUAGE RECOGNITION SYSTEM

Author: Punsara K.K.T, Premachandra H.H.R.C

Year Of Publication: IEEE 2020

Algorithm Used: Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs)

Abstract

The paper presents an IoT-based system for recognizing sign language gestures, facilitating communication for individuals with hearing impairments. The system utilizes sensors to capture hand movements, which are then processed using deep learning techniques. Through a combination of CNNs and RNNs, the system accurately interprets sign language gestures in real-time. This innovative approach holds promise for enhancing accessibility and inclusivity for the hearing-impaired community.

Merits

Advancement in sign language recognition, real-time processing, potential for improving communication accessibility

Demerits

Dependency on sensor accuracy, limited evaluation in diverse environments, potential challenges in complex gestures.

2.3 EYE MOVEMENT BASED CURSOR CONTROL AND HOME AUTOMATION FOR DISABLED PEOPLE

Author: Sharon Mathew, Sreeshma A, Theresa Anitta Jaison, Varsha Pradeep

Year Of Publication: IEEE 2019

Algorithm Used: Eye Movement Detection Algorithm, Gesture Recognition Algorithm

Abstract

This paper presents a novel approach for enabling disabled individuals to control cursor movement and home automation systems using eye movements. Traditional input devices are often inaccessible for people with disabilities, necessitating alternative solutions. The proposed system utilizes eye tracking technology to detect and interpret eye movements, allowing users to control a cursor on a computer screen. Furthermore, gesture recognition algorithms are employed to enable users to interact with home automation devices through predefined gestures. The system aims to enhance accessibility and independence for disabled individuals in controlling digital interfaces and household appliances.

Merits

Innovative approach, potential for enhancing independence and accessibility for disabled individuals.

Demerits

Possible limitations, complexity, potential challenges.

2.4 ANDROID HOME AUTOMATION USING PIC MICROCONTROLLER AND BLUETOOTH

Authors: Vulavabeti Raghunath Reddy, Shaik Anusha, Orugunti Rajeswari, B Hari Chandana, S Farhat Sujana

Year Of Publication: IEEE 2019

Abstract

This paper presents an Android-based home automation system utilizing a PIC microcontroller and Bluetooth technology. The system aims to offer convenient control over home appliances through a mobile application, enhancing user comfort and energy efficiency. By integrating PIC microcontroller technology with Bluetooth communication, the system enables users to remotely manage various household devices from their Android smartphones. The proposed solution offers a user-friendly interface and demonstrates the feasibility of implementing home automation using readily available technologies.

Merits

Practical implementation, user-friendly interface, integration of PIC microcontroller and Bluetooth technology

Demerits

Limited discussion on system scalability and security considerations

2.5 ASSISTIVE SYSTEM FOR PHYSICALLY DISABLED PEOPLE USING GESTURE RECOGNITION

Author: Subhankar Chattoraj, Karan Vishwakarma

Year Of Publication: IEEE 2017

Algorithm Used: Convolutional Neural Networks (CNNs), Recurrent Neural Networks (RNNs)

Abstract

The paper presents an innovative assistive system designed to empower physically disabled individuals through gesture recognition technology. With the increasing demand for solutions enhancing the independence and quality of life for people with disabilities, the proposed system offers a promising approach. The system's design integrates advanced CNNs and RNNs algorithms to accurately interpret user gestures, ensuring reliable and responsive functionality. Through a comprehensive evaluation, the effectiveness and usability of the system are demonstrated, highlighting its potential for real-world application in enhancing accessibility for disabled individuals. However, challenges such as computational complexity and data limitations pose areas for further exploration and improvement in future iterations.

Merits

Innovative solution addressing disability challenges, comprehensive evaluation, potential for practical implementation.

Demerits

Computational complexity, data limitations, scope for further benchmarking and refinement.

CHAPTER 3

SYSTEM ANALYSIS

3.1 EXISTING SYSTEM

Current home automation systems for disabled individuals predominantly rely on physical controls or voice commands. These systems often use devices such as switches, remotes, or voice assistants to manage household appliances, which can be challenging for users with certain disabilities. While these technologies have improved accessibility to some extent, they are not universally suitable for all disabled individuals, particularly those with severe mobility or speech impairments. The primary drawback of these systems is their dependence on physical interaction or vocal clarity, which can limit their effectiveness for users with specific disabilities.

ALGORITHMS USED

1) **GESTURE RECOGNITION**

   Gesture recognition involves the use of deep learning algorithms to interpret hand movements and gestures captured by sensors in the glove interface. These algorithms are trained to recognize patterns and gestures, enabling the system to understand user commands accurately.

2) **CONVOLUTIONAL NEURAL NETWORKS (CNN)**

   CNNs are a class of deep learning algorithms specifically designed for analysing visual data, making them well-suited for gesture recognition tasks. They consist of multiple layers of interconnected neurons that can extract features from input data, such as images of hand gestures, and classify them into predefined categories.

3) **RECURRENT NEURAL NETWORKS (RNN)**

RNNs are another type of deep learning algorithm that can be used in conjunction with CNNs for gesture recognition. Unlike traditional feedforward neural networks, RNNs have connections that form loops, allowing them to retain information over time. This makes them particularly effective for tasks involving sequential data, such as recognizing gestures that occur in a specific order or sequence.

4) **SUPPORT VECTOR MACHINES (SVM)**

SVMs are a type of supervised learning algorithm commonly used for classification tasks. While not a deep learning algorithm per se, SVMs can be employed alongside deep learning techniques to improve the accuracy of gesture recognition systems. SVMs work by finding the optimal hyperplane that separates different classes of data, making them useful for distinguishing between different types of hand gestures.

3.1.1 Drawbacks

- Systems may not accommodate users with severe mobility impairments.
- Voice-controlled systems can struggle with speech impairments or background noise.
- Limited customization and adaptability to individual user needs.
- High cost and complexity of installation and maintenance.

3.2 PROPOSED SYSTEM

The proposed system is a gesture-controlled home automation interface designed to enhance accessibility and convenience for individuals with disabilities. Utilizing a camera to capture hand or body gestures, users can control various household appliances and devices. The system integrates advanced gesture recognition algorithms, such as Convolutional Neural Networks (CNNs) and Support Vector Machines (SVMs), to accurately interpret user gestures and translate them into actionable commands. Communication between the gesture recognition module and controlled devices is facilitated through wireless protocols, ensuring seamless and real-time interaction. The system aims to empower users with disabilities by providing them with an intuitive and accessible means of managing their home environment independently, ultimately improving their quality of life and promoting inclusivity in home automation technology.

ALGORITHM USED

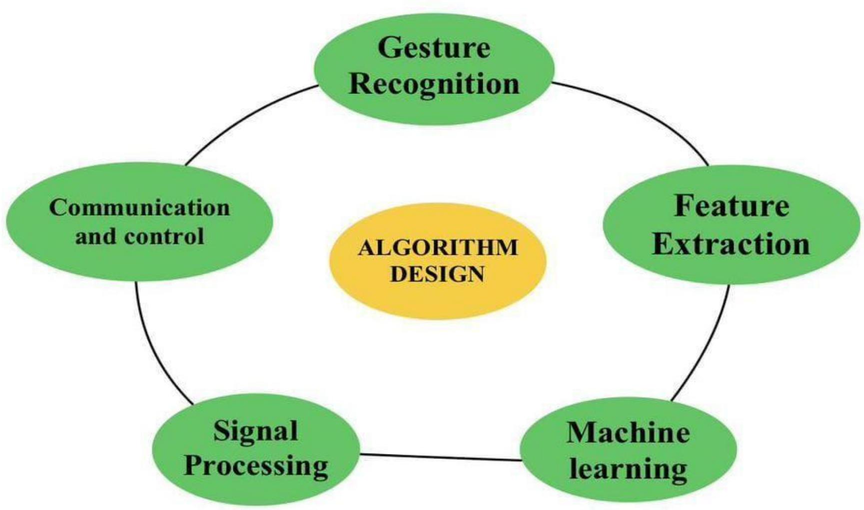

Figure No. 3.1. Design Phases of System

GESTURE RECOGNITION ALGORITHM

- Algorithm: Convolutional Neural Networks (CNN)
- Description: CNNs are widely used for image recognition tasks, making them suitable for interpreting hand gestures captured by sensors in the glove interface. They analyze the spatial features of the input data and classify gestures into predefined categories.

SIGNAL PROCESSING ALGORITHM

- Algorithm: Fourier Transform
- Description: Fourier Transform can be utilized for preprocessing sensor data, extracting frequency information from hand movements captured by the glove sensors. This helps in reducing noise and enhancing the accuracy of gesture recognition algorithms.

FEATURE EXTRACTION ALGORITHM

- Algorithm: Principal Component Analysis (PCA)
- Description: PCA can extract relevant features from the sensor data, reducing its dimensionality while preserving important information. This enables efficient processing and classification of hand gestures, improving the overall performance of the system

MACHINE LEARNING ALGORITHM

- Algorithm: Support Vector Machines (SVMs)
- Description: SVMs can be employed for gesture classification, mapping the extracted features to specific hand gestures. They learn to distinguish between different
  gestures based on labelled training data, facilitating accurate recognition and command execution.

COMMUNICATION AND CONTROL ALGORITHM

- Algorithm: MQTT (Message Queuing Telemetry Transport)
- Description: MQTT provides a lightweight and efficient communication protocol for transmitting gesture commands from the glove interface to controlled devices. It ensures reliable and real-time communication, enabling seamless interaction between the user and the automated system.

3.2.1 Advantages

- Enhances accessibility.
- Promotes independence.
- Intuitive gesture-based interface.
- Simplifies daily tasks.
- Empowers disabled individuals.
- Seamless interaction with devices.
- User-friendly configuration.

CHAPTER 4

SYSTEM SPECIFICATION

4.1 H/W SYSTEM SPECIFICATION

Sensors

• Gesture Recognition Sensors (accelerometers, gyroscopes, flex sensors)

• Communication Module (Bluetooth or Zigbee for transmitting commands)

Actuators

• Relay Modules (for controlling appliances)

• LED Indicators (for feedback)

Communication System

• Wireless Communication Protocol (Bluetooth Low Energy or Zigbee)

• Gesture Recognition Interface for seamless interaction

Control System

• Microcontroller (Arduino or Raspberry Pi)

• Gesture Recognition Algorithm for interpreting hand gestures

4.2 S/W SYSTEM SPECIFICATION

Gesture Recognition Software

- Algorithm: Convolutional Neural Network (CNN) for real-time gesture recognition.
- Libraries: TensorFlow or PyTorch for deep learning.
- Developing Environment: Python with TensorFlow or PyTorch.

Device Control Software

- Algorithm: Command translation algorithm to convert recognized gestures into device commands.
- Libraries: Python libraries for serial communication.
- Developing Environment: Python.

User Interface Software

- Development Platform: Mobile application for user interaction.
- Interface Design: Intuitive and user-friendly interface for gesture selection and device control.
- Developing Environment: Swift for iOS or Java/Kotlin for Android.

Communication Software

- Protocol: MQTT for communication between glove interface and controlled devices.
- Libraries: MQTT library for Python or Java.
- Developing Environment: Python or Java.

4.3 SOFTWARE DESCRIPTION

For gesture recognition and device control, TensorFlow or PyTorch libraries are ideal, offering robust support for deep learning models. Additionally, OpenCV facilitates image processing tasks like gesture recognition. For seamless communication, Paho MQTT ensures efficient interaction between the user interface and controlled devices, supporting both Python and Java environments for integration.

4.3.1 Library

- TensorFlow or PyTorch

  These libraries offer extensive support for deep learning, ideal for implementing gesture recognition algorithms.

- OpenCV

  OpenCV provides powerful tools for computer vision and image processing, facilitating gesture interpretation and device control.

- MQTT Client Library

  Paho MQTT is a reliable choice for efficient communication between the glove interface and controlled devices, ensuring seamless interaction.

4.3.2 Developing Environment

- Python for Gesture Recognition and Deep Learning:

  Python is well-suited for developing gesture recognition algorithms and deep learning models. TensorFlow and PyTorch, with Python APIs, enable efficient implementation of gesture recognition.

- Java for Device Control and Communication:

  Java is suitable for implementing robust control logic and communication modules. It can handle communication with external devices and ensure reliable device control based on recognized gestures

CHAPTER 5
ARCHITECTURAL DESIGN

5.1 SYSTEM DESIGN

- The system design for the gesture-controlled home automation interface focuses on creating an accessible and intuitive solution for disabled individuals. The system comprises several interconnected components, including a camera for capturing gestures, a microcontroller or processor for processing these gestures, and smart devices that are controlled based on the interpreted commands. The camera continuously captures real-time video of the user's gestures, which are then processed by advanced machine learning algorithms, such as Convolutional Neural Networks (CNNs) and Support Vector Machines (SVMs). These algorithms analyze the spatial and temporal features of the gestures, accurately classifying them into specific commands. The processed commands are then transmitted to the home automation system via the MQTT protocol, ensuring reliable and real-time communication.

- The system includes a user-friendly interface, accessible through a mobile app or web portal, where users can configure and customize gestures according to their preferences. This interface also provides real-time feedback, ensuring users are aware of the system's status and actions. Allowing for seamless integration with various smart home devices and future technology upgrades. By leveraging cutting-edge technology and focusing on user-centric design, this system aims to significantly improve the life.

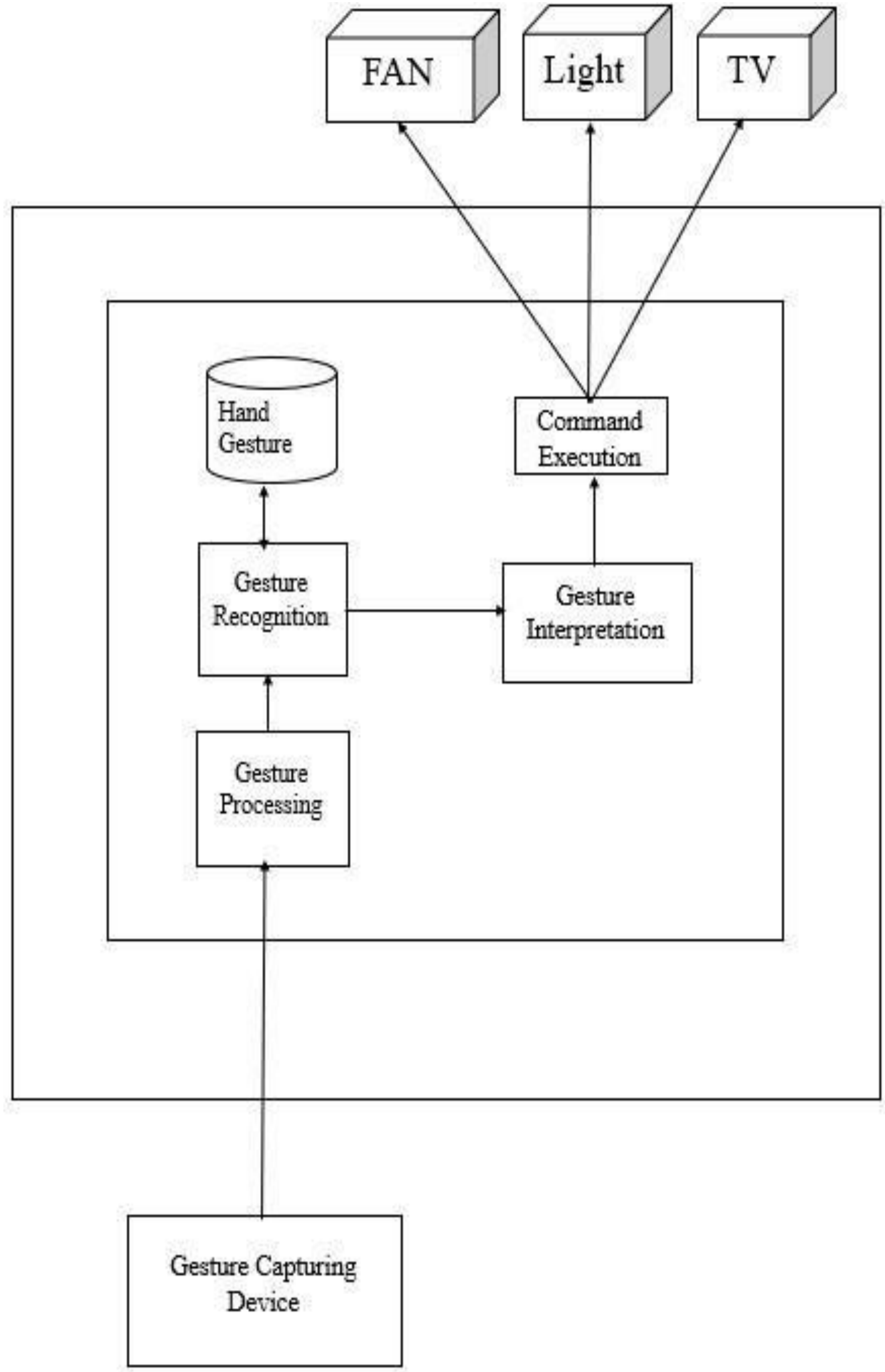

Figure. No. 5.1. System Architecture

5.2 DATA FLOW DIAGRAM

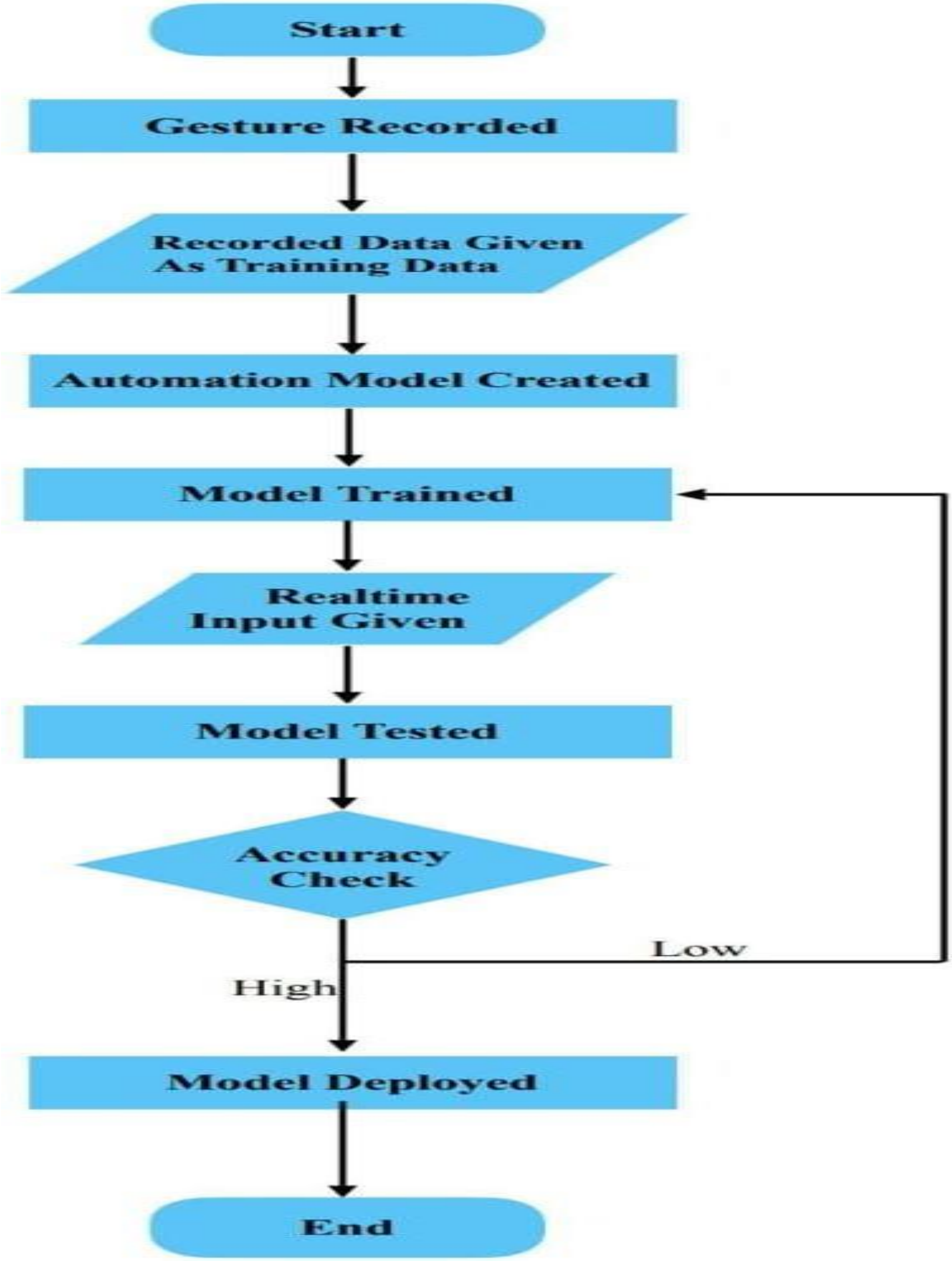

Figure. No. 5.2. Dataflow Diagram

5.3 USE CASE DIAGRAM

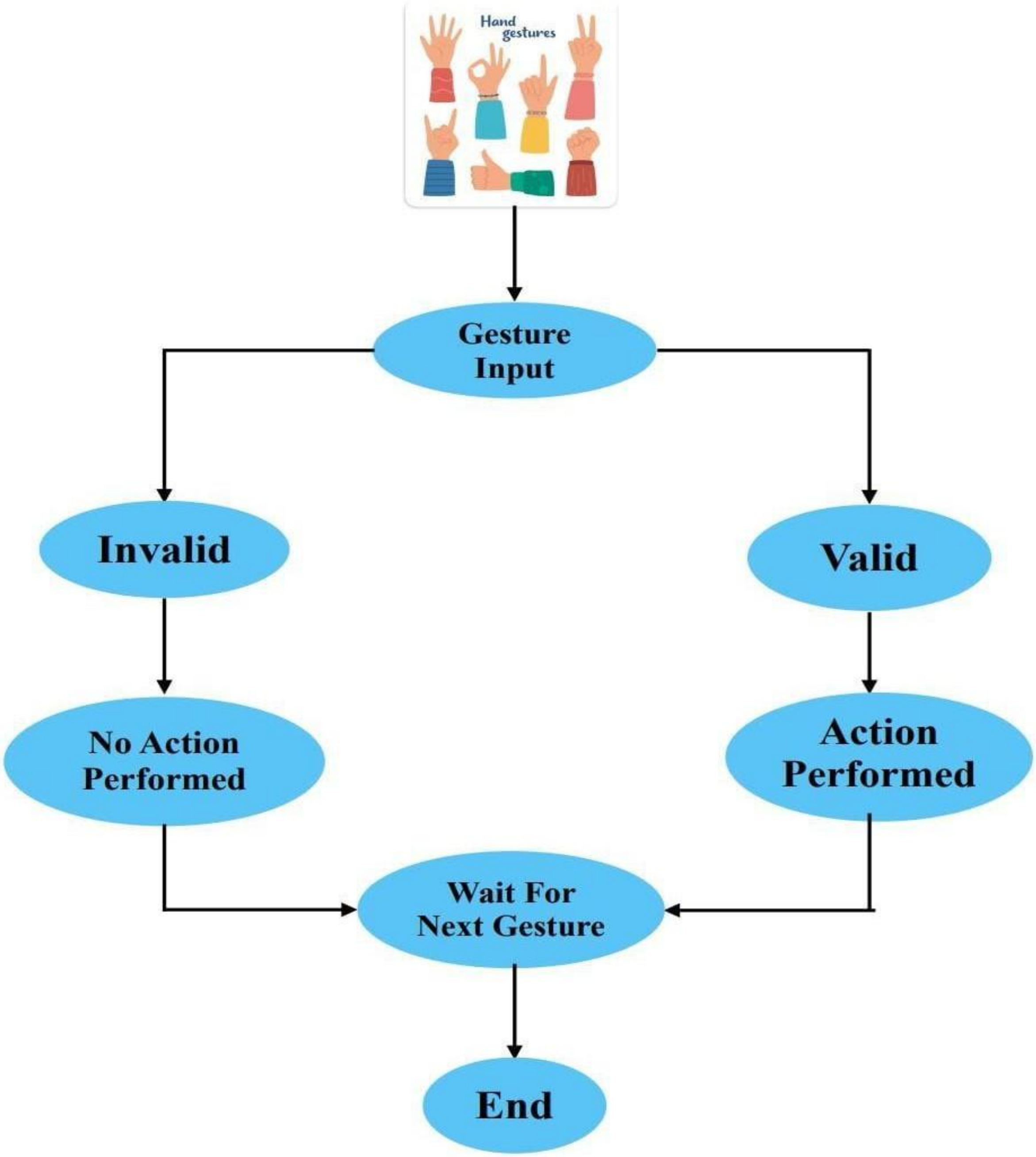

Figure. No. 5.3. Use Case Diagram

5.4 ACTIVITY DIAGRAM

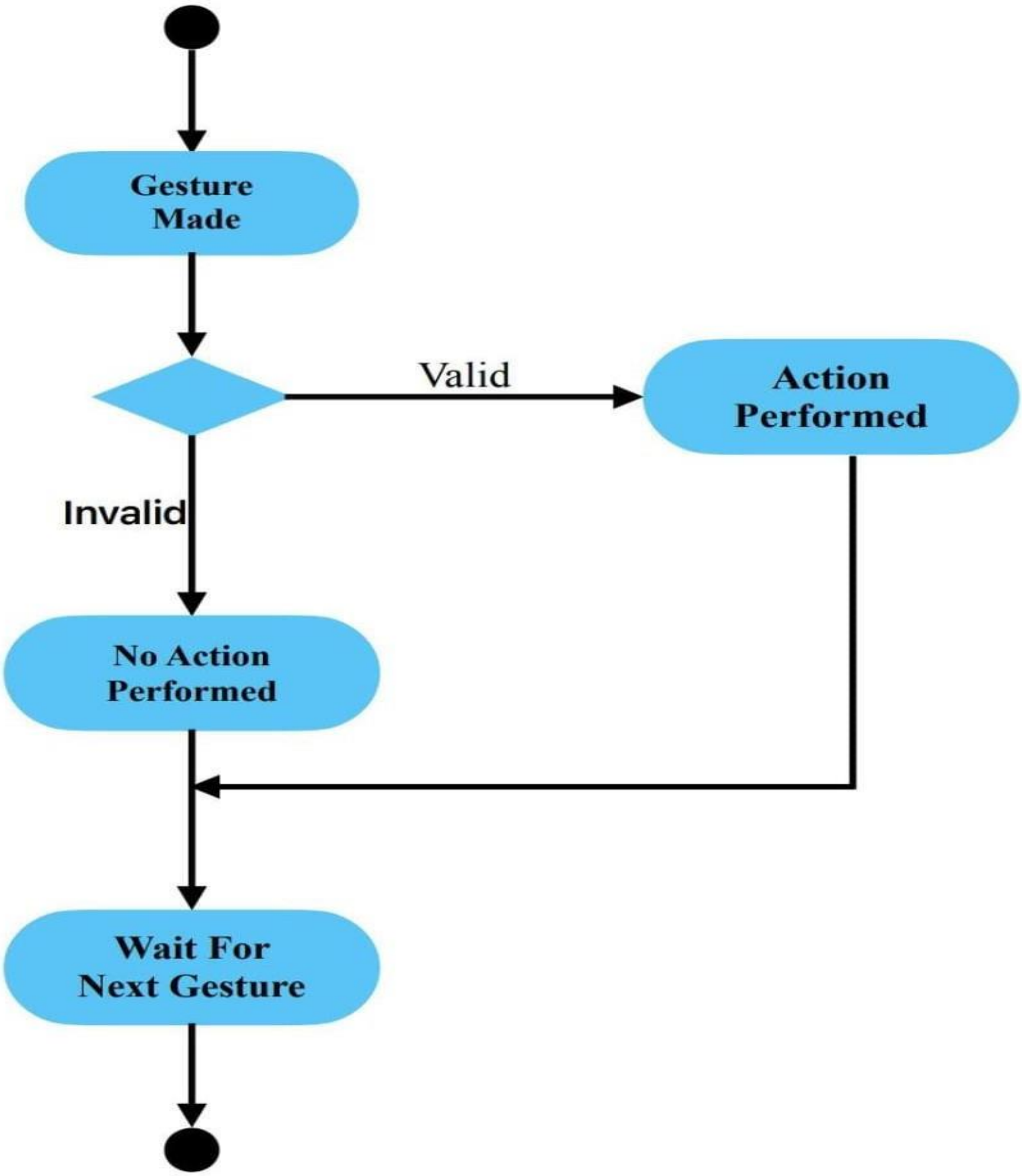

Figure. No. 5.4. Activity Diagram

5.5 SEQUENCE DIAGRAM

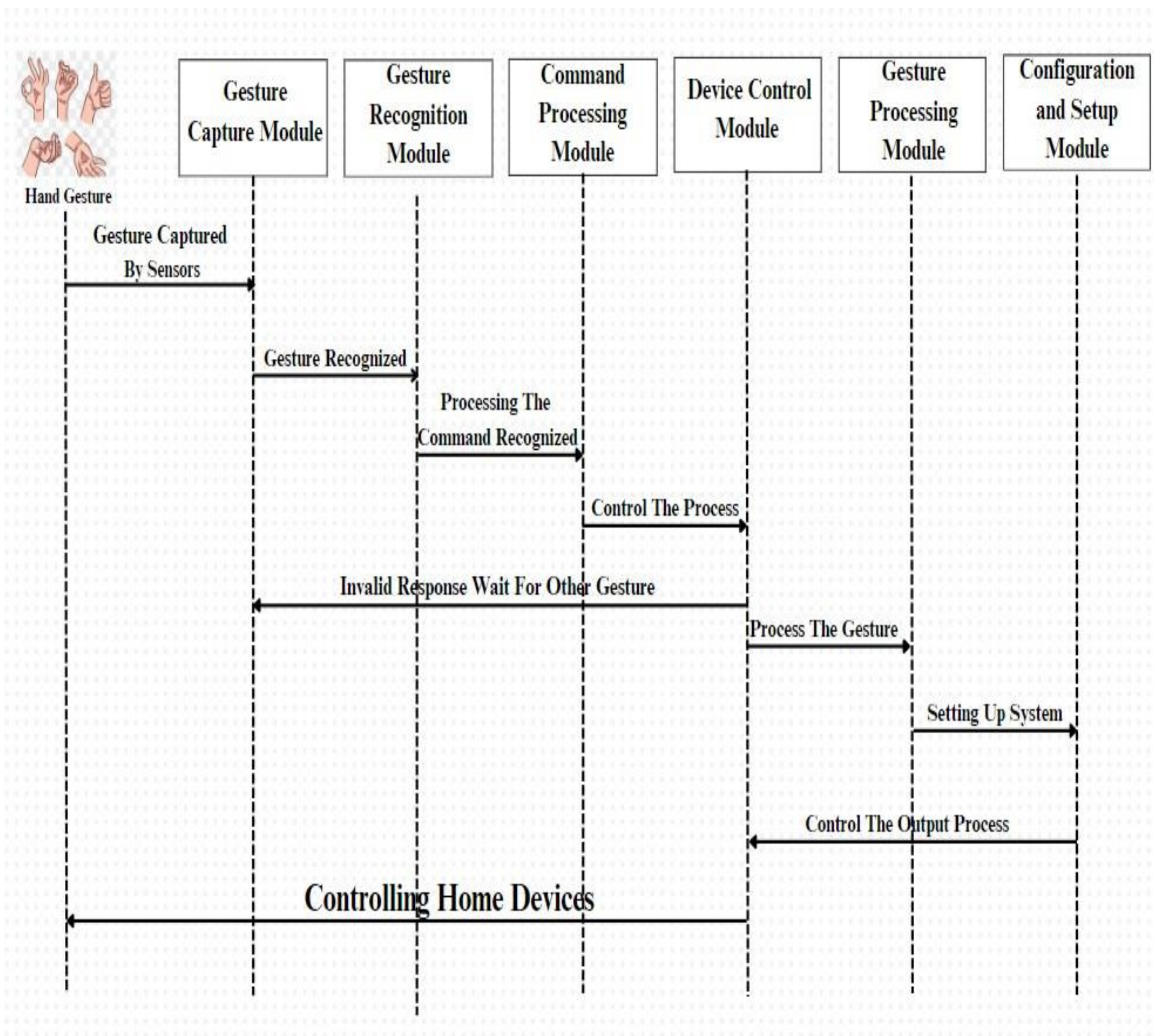

Figure. No. 5.5. Sequence Diagram

5.6 FLOW CHART

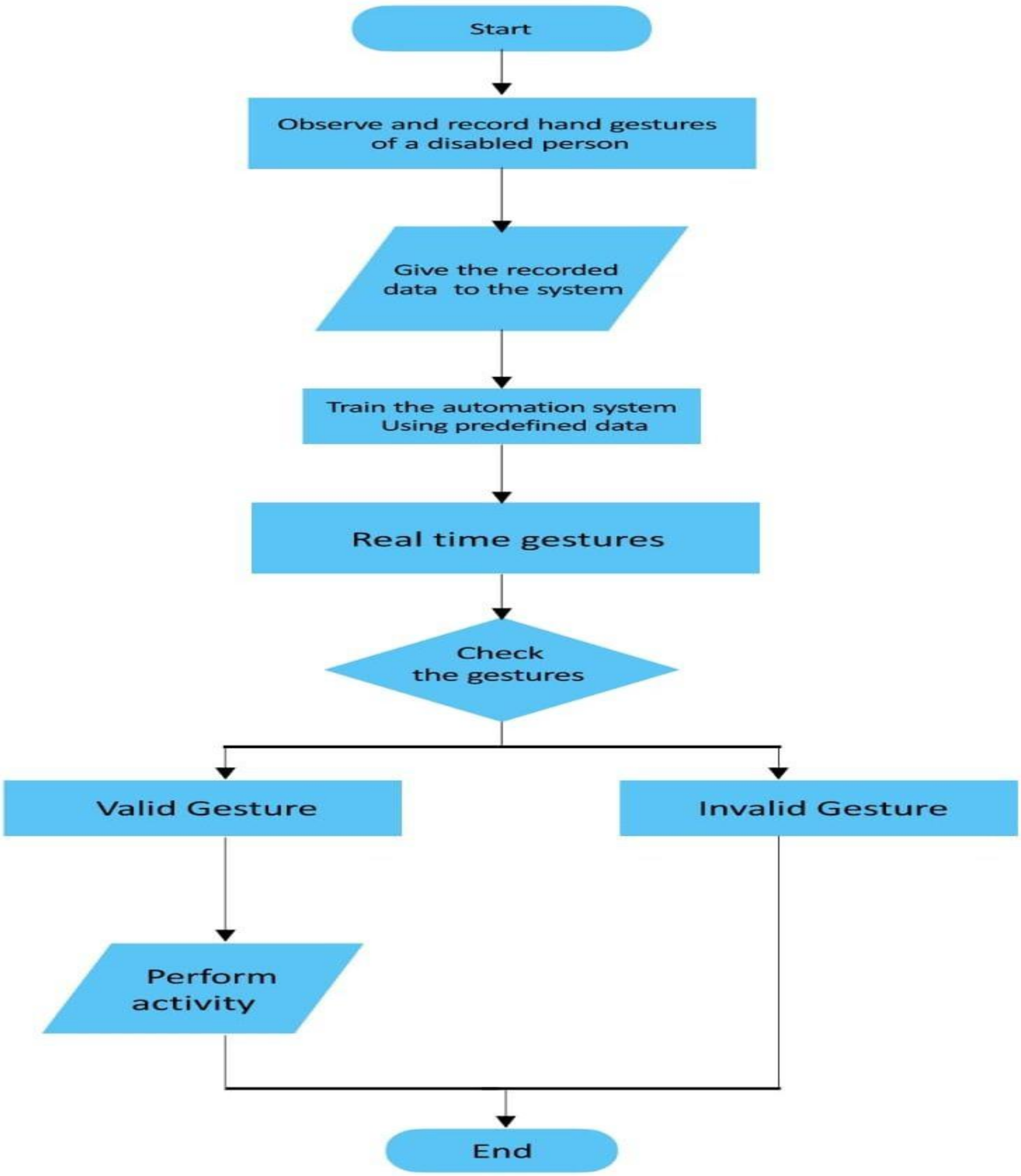

Figure. No. 5.6. Flowchart

CHAPTER 6
MODULE DESCRIPTION

6.1 MODULE

6.1.1 Gesture Capture Module

Purpose

- To capture hand or body gestures in real-time.

Key Components

- Camera: A webcam or depth camera to capture video of gestures.
- Processor/Microcontroller: A device like Raspberry Pi or Arduino to handle initial data acquisition from the camera.

Explanation

- This module captures continuous video feed, detecting and isolating gestures for further processing.

6.1.2 Gesture Recognition Module

Purpose

- The Gesture Recognition Module interprets hand movements and gestures captured by the sensors, translating them into actionable commands for device control.

Key Components

- Deep Learning Algorithms: Utilizes CNNs or RNNs for accurate gesture recognition.
- Gesture Classification: Classifies hand gestures into predefined categories.
- Real-time Processing: Analyses sensor data instantaneously for responsive interaction.
- User Gesture Mapping: Maps recognized gestures to corresponding device commands.

Explanation

- Utilizes machine learning to analyse the captured gestures, classifying them into predefined commands based on trained models.

6.1.3 Command Processing Module

Purpose

- To translate recognized gestures into actionable commands for home devices.

Key Components

- Microcontroller/Processor: Executes scripts to convert recognized gestures into commands.
- Software: Custom scripts or home automation software for command translation.

Explanation

- Maps recognized gestures to specific home automation tasks, creating executable commands for the system.

6.1.4 Device Control Module

Purpose

The Device Control Module executes commands received from the Command Generation Module, controlling various household appliances and devices accordingly.

Key Components

- Actuator Interface: Interfaces with actuators (e.g., relays, motors) to initiate device actions.
- Communication Protocol Handling: Receives and interprets commands transmitted via communication protocols.
- Feedback Mechanism: Provides feedback to the user confirming successful command execution.
- Error Handling: Manages errors or failures in command execution, ensuring system reliability.

Explanation

- Sends control signals to various devices, performing actions like turning on lights or adjusting the thermostat.

6.1.5 Feedback and Monitoring Module

Purpose

- To provide users with real-time feedback and system status.

Key Component

- User Interface: Mobile app or web portal.
- Sensors: Optional sensors to monitor environment and device status.

Explanation

- Displays real-time feedback and system status, ensuring users know the outcome of their gestures and the current state of their home automation system.

6.1.6 Configuration and Setup Module

Purpose

- To allow users to configure and customize the system and gestures.

Key component

- User Interface: Mobile app or web portal with a user-friendly design.
- Database: To store user preferences and custom gesture mappings.

Explanation

- Provides tools for users to set up the system, define custom gestures, and configure device preferences, ensuring the system is tailored to their specific needs.

CHAPTER 7

CONCLUSION & FUTURE ENHANCEMENT

7.1 CONCLUSION

- In conclusion, the developed home automation gesture system embodies a revolutionary advancement in accessibility technology, catering specifically to individuals with disabilities.
- By integrating sophisticated gesture recognition algorithms with sensor technology, the system offers a seamless and intuitive interface for controlling household appliances and devices.
- The combination of CNNs and RNNs ensures accurate gesture interpretation, enabling users to effortlessly interact with their environment. Moreover, the system's modular design allows for flexibility and scalability, paving the way for future enhancements and integration with emerging technologies.
- Overall, this system promises to significantly enhance the independence and quality of life for individuals with disabilities, ushering in a new era of inclusive home automation technology.

7.2 FUTURE ENHANCEMENT

- Enhance gesture recognition algorithms with continual machine learning advancements.

- The future scope is a wide open in research aspect for all applications. Various other feature extraction methods can be applied to test the accuracy of the system. There are several potential future enhancements.

- Extend system compatibility to integrate with a broader range of smart home devices.
- Explore advanced computer vision techniques for enhanced gesture interpretation and environment perception.
- Implement predictive analytics to anticipate user preferences and optimize system response.

APPENDIX 1 (SAMPLE CODE)

```
#include <Wire.h>
#include <SparkFun_APDS9960.h>
#include <LiquidCrystal.h>
LiquidCrystal lcd(13, 12,6, 5, 4, 3);// Pins used for RS,E,D4,D5,D6,D7
#define APDS9960_INT    2 // Needs to be an interrupt pin
SparkFun_APDS9960 apds = SparkFun_APDS9960();
char* myMenu[]={"BULB1","BULB2","BULB3"," TV"};
int isr_flag = 0;
int a=0,b=0,c=0,d=0,e=0,f=0;
int i=2,j=0,k=0,pos=1;
int swtch =7;
byte left[8] ={    0b10000,
                0b11000,
                0b11100,
                0b11110,
                0b11110,
                0b11100,
                0b11000,
                0b10000};
 byte right[8]={   0b00001,
                0b00011,
                0b00111,
                0b01111,
                0b01111,
                0b00111,
```

```
0b00011,

0b00001};
void setup() {
pinMode(A0,OUTPUT);
pinMode(A1,OUTPUT);
pinMode(A2,OUTPUT);
pinMode(A3,OUTPUT);
pinMode(swtch,INPUT);
digitalWrite(A0,LOW);

digitalWrite(A1,LOW);
digitalWrite(A2,LOW);
digitalWrite(A3,LOW);

// Set interrupt pin as input
pinMode(APDS9960_INT, INPUT);
lcd.begin(16,2);
lcd.setCursor(0,0);
lcd.print("Engineers Garage");
lcd.setCursor(0,1);
lcd.print("    APDS-9960    ");
delay(1000);
lcd.setCursor(0,1);
```

```
 lcd.print("   GestureTest  ");

 delay(1000);
 lcd.clear();
 // Initialize Serial port
 Serial.begin(9600);
 // Initialize interrupt service routine
 attachInterrupt(0, interruptRoutine, FALLING);
 // Initialize APDS-9960 (configure I2C and initial values)
 if ( apds.init() ) {
   Serial.println(F("APDS-9960 initialization complete"));
 } else {
   Serial.println(F("Something went wrong during APDS-9960 init!"));
 }

 // Start running the APDS-9960 gesture sensor engine
 if ( apds.enableGestureSensor(true) ) {
 Serial.println(F("Gesture sensor is now running"));
 } else {
   Serial.println(F("Something went wrong during gesture sensor init!"));
 }
}
void loop() {
 while(pos==1){
```

```
   lcd.setCursor(0,0);

 lcd.print("Engineers Garage");
   lcd.setCursor(0,1);
   lcd.print("    Gesture HA    ");
  if(digitalRead(swtch)==HIGH){
      lcd.clear();
      delay(500);
     pos=2;
     break;
  }
 }
 lcd.setCursor(0,0);
lcd.print("Engineers Garage");
if( isr_flag == 1 ) {
   detachInterrupt(0);
   handleGesture();
   isr_flag = 0;
   attachInterrupt(0, interruptRoutine, FALLING);
   controlAppl();
  }
 i=2;
 k=0;
 lcd.setCursor(6,1);
```

```
lcd.print(myMenu[j]);

if(digitalRead(swtch)==LOW){
  pos=1;
}
if(j<3){
    lcd.createChar(2,left);

    lcd.setCursor(11,1);
    lcd.write(2);
  }
  if(j>0){
    lcd.createChar(1,right);
    lcd.setCursor(5,1);
    lcd.write(1);
  }
  if(j==0){
    lcd.setCursor(5,1);
    lcd.print(" ");
     }
  if(j>=3){
    lcd.setCursor(11,1);
    lcd.print(" ");
     }
```

```
}

void interruptRoutine() {
 isr_flag = 1;
}
void controlAppl() {
 if(j==0 && i==1){
 if(a==0){
 digitalWrite(A0,HIGH);
 a=1;}
   }
 if(j==0 && i==0){
   if(a==1){
   digitalWrite(A0,LOW);

     a=0;}
   }
 if(j==1 && i==1){
   if(b==0){
   digitalWrite(A1,HIGH);
   b=1;}
  }
 if(j==1 && i==0){
   if(b==1){
```

```
    digitalWrite(A1,LOW);

  b=0;}
    }
if(j==2 && i==1){
  if(c==0){
  digitalWrite(A2,HIGH);
  c=1;}
 }
if(j==2 && i==0){
  if(c==1){
  digitalWrite(A2,LOW);
  c=0;}
 }
if(j==3 && i==1){
  if(e==0){
  digitalWrite(A3,HIGH);
  e=1;}
  }
if(j==3 && i==0){
  if(e==1){
  digitalWrite(A3,LOW);
```

```
e=0;}


 }
 if((k==1 || k==3) && f==0){
  digitalWrite(A0,HIGH);
  digitalWrite(A1,HIGH);
  digitalWrite(A2,HIGH);
  digitalWrite(A3,HIGH);
 }
 if((k==2 || k==3) && f==0){
  digitalWrite(A0,LOW);
  digitalWrite(A1,LOW);
  digitalWrite(A2,LOW);
  digitalWrite(A3,LOW);
 }
}
void handleGesture() {
 lcd.setCursor(6,1);
 lcd.print("     ");
    if ( apds.isGestureAvailable() ) {
    switch ( apds.readGesture() ) {
    case DIR_UP:
       Serial.println("UP");
           i=0;
```

```
        break;


    case DIR_DOWN:
        Serial.println("DOWN");
         i=1;
        break;
      case DIR_LEFT:
       Serial.println("LEFT");
        if(j>0){


        j--;
        delay(200);
        }
       break;
      case DIR_RIGHT:
       Serial.println("RIGHT");
        if(j<3){
        j++;
        delay(200);
        }
      break;
      case DIR_NEAR:
          k=1;
       Serial.println("NEAR");
```

```
      break;

    case DIR_FAR:
         k=2;
        Serial.println("FAR");
      break;
    default:
     Serial.println("NONE");
        k=3;
         }
  }
}
```

APPENDIX 2 (SCREENSHOTS)

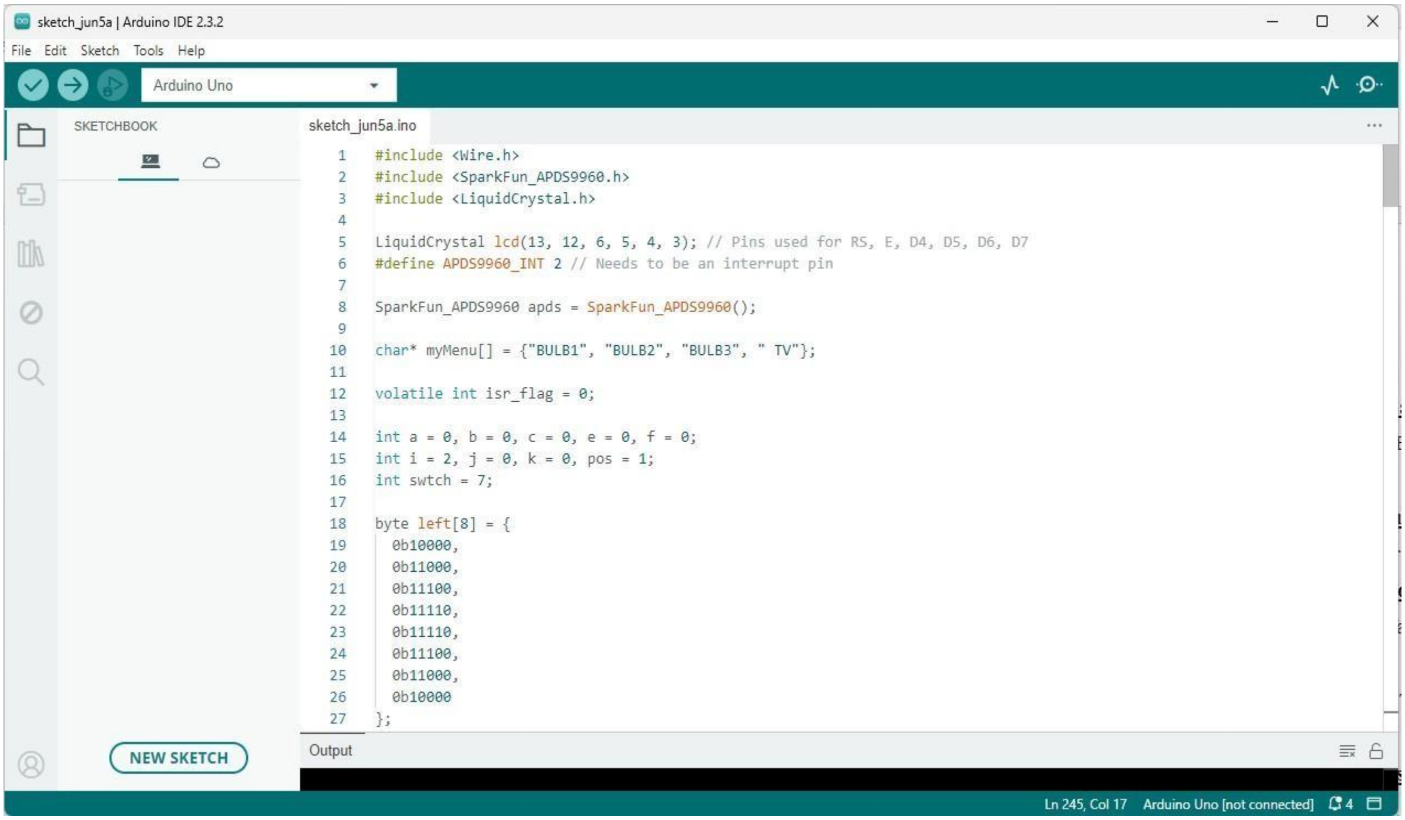

Figure. No. A.1.1. Arduino Interface

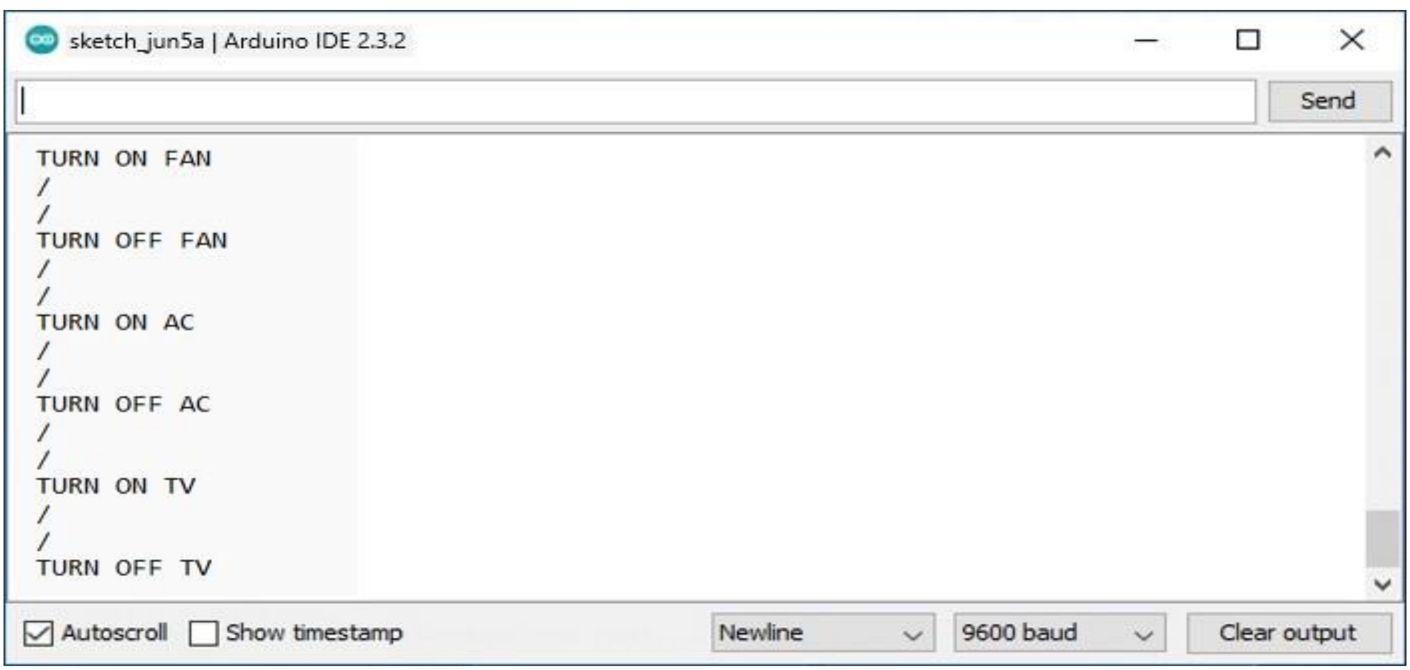

Figure. No. A.1.2. Arduino Output

REFERENCES

1. **Android Home Automation using PIC Microcontroller and Bluetooth-** vulavabeti raghunath reddy, Shaik anusha, orugunti rajeswari, b Hari Chandana, s Farahat sujana & Published in the year of IEEE 2019
2. **Assistive System for Physically Disabled People using Gesture Recognition-** Subhankar Chattoraj, Karan Vishwakarma & Published in the year of 2017
3. **Eye Movement Based Cursor Control and Home Automation for Disabled People-**Sharon Mathew, Sreeshma A, Theresa Anitta Jaison, Varsha Pradeep & Published in the year of IEEE 2019
4. **IoT Based Sign Language Recognition System-** Punsara K.K.T, Premachandra H.H.R.C & Published in the year of IEEE 2020
5. **Literature Review on Home Automation System for Physically Disabled People-** Muhammad Nauman Ali & Published in the year of IEEE 2018