

Design and Development of Dual Axis Voice Recognition Writing Robot for Physically Challenged Person

Submitted in fulfillment of the requirements for the award of
Bachelor of Engineering degree in Mechatronics

by

Gumanan P (39090010)

Jenis Tony R (39090012)



**DEPARTMENT OF MECHATRONICS ENGINEERING
SCHOOL OF MECHANICAL ENGINEERING**

SATHYABAMA

**INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)**

**Accredited with Grade "A" by NAAC | 12B Status by UGC | Approved by AICTE
JEPPIAAR NAGAR, RAJIV GANDHI SALAI, CHENNAI - 600 119**

MAY - 2023

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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **Gumanan P (39090010)**, **Jenis Tony R (39090012)** who have done the project work entitled "**Design and Development of Dual Axis Voice Recognition Writing Robot for Physically Challenged Person**" under our supervision from June 2022 to May 2023.

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Submitted for Viva Voce examination held on ____ May 2023

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DECLARATION

We **Gumanan P (39090010)** and **Jenis Tony R (39090012)** hereby declare that the Project Report entitled “**Design and Development of Dual Axis Voice Recognition Writing Robot for Physically Challenged Person**” done by us under the guidance of **Dr.B.Kanimozhi, M.E., Ph.D.** is submitted in fulfillment of the requirements for the award of Bachelor of Engineering degree in Mechatronics.

1. 

2. 

DATE: ____ May 2023

PLACE: Chennai, Tamil Nadu

SIGNATURE OF THE CANDIDATE

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ABSTRACT

voice recognition technology has become increasingly popular and widely used in various fields. However, most voice recognition systems have limitations, such as difficulty recognizing commands accurately in noisy environments or from a distance. To address these issues, the paper proposes the development of a writing robot with dual axis voice recognition.

The writing robot is designed to recognize voice commands in two different directions, allowing it to perform tasks with greater precision and accuracy. This is achieved through the use of two microphones and advanced signal processing algorithms. The robot is also equipped with a user-friendly interface, making it easy for users to input text and select desired parameters. To evaluate the accuracy and speed of the voice recognition system, a series of experiments were conducted. The results demonstrated that the dual axis approach significantly improves the performance of the voice recognition system, even in noisy environments and from a distance. This makes the writing robot with dual axis voice recognition a promising solution for various applications, such as education, healthcare, and business.

Moreover, the report highlights the potential impact of the writing robot in improving communication and accessibility for individuals with disabilities. A novel approach to voice recognition technology through the development of a writing robot with dual axis voice recognition. The robot's high accuracy and precision make it a promising solution for various applications, and its potential impact on improving accessibility for individuals with disabilities is significant. automatic writing pen is a wholesome approach where the pen assures flawless and accurate writing according to the voice recognition and few extra features for blind and deaf peoples. In this System, The input voice will be given to the System using Bluetooth module via the Bluetooth Voice Controller Mobile Application.

TABLE OF CONTENT

CHAPTER.NO	TITLE	Pg.No
	ABSTRACT	V
	LIST OF FIGURES	VI
1	INTRODUCTION	1
	1.1 ROBOTS	4
	1.2 ADVANTAGES OF ROBOTS	4
	1.3 DISADVANTAGES OF ROBOTS	5
	1.4 WRITING ROBOT	5
	1.5 DRAWING ROBOT	6
	1.6 FEATURES OF WRITING AND DRAWING ROBOT	6
	1.7 TYPES OF WRITING AND DRAWING ROBOTS	6
2	LITERATURE SURVEY	8
3	AIM AND SCOPE	13
	3.1 AIM OF THE PROJECT	13
	3.2 OBJECTIVE OF THE PROJECT	13
	3.3 PROBLEM DEFINITION	14
	3.4 SCOPE OF THE PROJECT	15
4	MATERIALS, FABRICATION AND METHODOLOGY	16
	4.1 FABRICATION PROCESS	17

CHAPTER.NO	TITLE	Pg.No
4.2	METHODOLOGY OF WRITING ROBOT	19
4.3	SETUP OF THE WRITING ROBOT	22
4.4	3D DESIGN OF THE MOUNTING PARTS	24
4.5	COMPONENTS USED	26
4.5.1	Power Supply Module	27
4.5.2	Bluetooth Module	27
4.5.2.1	HC-05 Bluetooth Module	28
4.5.3	HC-05 Module Information	29
4.5.3.1	Bluetooth Communication Between Devices	29
4.5.4	Servo Motor	31
4.5.4.1	Working Principle Of Servo Motor	32
4.5.5	Stepper Motor	32
4.5.6	Avr Microcontroller	33
4.6	SOFTWARE USED IN THE MICROCONTROLLER	34
4.6.1	Embedded C	34
4.7	COMPARISON OF EXISTING AND PROPOSED SYSTEM	35
4.7.1	Existing System	35
4.7.1.1	Disadvantages Of The Existing System	35
4.7.2	Proposed System	35

CHAPTER.NO	TITLE	Pg.No
	4.7.2.1 Advantages Of The Proposed System	36
	4.7.2.2 Applications	36
	4.8 TECHNOLOGIES USED	36
	4.8.1 History of Embedded system	37
	4.8.2 Characteristics of an Embedded System	38
	4.8.3 Basic Structure of an Embedded System	39
	4.8.4 Important terminologies used in embedded system	40
	4.9 PROGRAM CODE	41
5	RESULT AND DISCUSSION	43
	5.1 RESULT	43
	5.2 DISCUSSION	43
6	SUMMARY AND CONCLUSIONS	46
	6.1 SUMMARY	46
	6.2 CONCLUSION	46
	REFERENCES	47
	ANNEXURE	48

LIST OF FIGURES

Figure.No	Figure Name	Pg.No
4.1	Methodology of Writing Robot	22
4.2	Right Side View of the Writing Robot	23
4.3	Isometric View of the Writing Robot	23
4.4	Stepper Motor of the Writing Robot	24
4.5	Top View of the Writing Robot	24
4.6	3D Design of Front View	25
4.7	3D Design of the Isometric View	25
4.8	3D Design of the Top View	26
4.9	3D Design of the Side View	26
4.10	HC-05 Bluetooth	28
4.11	Bluetooth Communication	30
4.12	Servo Motor	31
4.13	Stepper Motor	33
4.14	Pin Diagram	34
4.15	Characteristics of Embedded system	39
4.16	Structure of Embedded system	39

CHAPTER - 1

INTRODUCTION

A writing robot is a machine that can create digital designs on a physical surface, such as paper or canvas, using a pen or similar instrument. Writing robots are often designed to be precise, efficient, and customizable, allowing users to create intricate designs and patterns with high accuracy. These machines can be controlled using a computer interface or other user-friendly input methods, and they can be used in a variety of applications such as art, calligraphy, or sign-making. Writing robots can provide an efficient and automated solution that can improve the productivity and quality of design tasks. They are becoming increasingly popular among artists, designers, and makers who want to explore new ways of creating digital art and designs on physical surfaces.

The writing robots are assistive technology that can aid individuals with physical, visual, or cognitive impairments in writing and communicating. Writing robots are designed to be user-friendly and intuitive, and can be particularly useful for those with limited mobility, visual impairments, or cognitive impairments. The paper highlights that writing robots can help individuals communicate more effectively and efficiently, and can become even more sophisticated and accessible with advancements in technology. Overall, writing robots are a valuable tool for enhancing the ability of individuals with disabilities to engage fully in society.

Physically challenged people have several difficulties in their everyday life, such as social hurdles and restricted access to infrastructure. Because physically challenged people may not have access to the same tools and resources as able-bodied people, writing can be extremely difficult for them. Although this may impair their capacity for verbal expression, individuals are still capable of writing and communicating clearly when assisted by others or assistive technology. Physically challenged people may also encounter difficulties interacting with others, navigating their surroundings, and getting information. It's crucial for society to acknowledge these issues, take action, and endeavour to make society more accessible and inclusive for all people, regardless of their ability.

The most difficult task for those with physical disabilities, especially those who are visually impaired or blind, is navigating their environment. Visually impaired or blind people may easily navigate their houses since they have memorised where everything is. Avoid moving anything without asking the person's permission or alerting them first if you live with or visit someone who is visually impaired or blind. Despite the availability of tactile tiles, businesses frequently neglect to make their establishments accessible to physically challenged people. This poses serious obstacles for those who want to visit these places. It is necessary to increase accessibility in public spaces and utilise tactile tiles, among other alternatives, to address these issues. The quality of life for physically challenged people can be improved by stepping up efforts to make places more accessible to them.

Accessing reading materials, especially in accessible versions, is extremely difficult for those who are visually impaired. There is a chronic lack of reading textbooks and other reading resources in India, where millions of people are blind. Furthermore, since most websites are not made to work with screen reading software, the main tool used by the blind, accessing online information is particularly challenging. Additionally, inadequate picture descriptions make it difficult for blind people to comprehend visual material. The blind can benefit significantly from improved digital accessibility, which will provide them more access to information and leisure reading resources. This might be done by creating web pages that are accessible with screen readers and including detailed and short visual explanations. These steps will increase the general quality of life for blind people by giving them reasonable access to information and reading-related items.

For blind people, arranging laundry can be a difficult undertaking since they frequently rely on the shape and feel of goods to identify them. Even though blind people may have their own ways of dressing, it may still be a difficult task, especially when it comes to matching and arranging socks. This is because people who are completely blind find it extremely difficult to identify colours. As a result, those who are visually impaired frequently need to adopt substitute strategies for classifying and sorting their laundry, such as using tactile markers or grouping clothes according to texture. Despite these initiatives, organising laundry for blind

people continues to be a big difficulty. Creating innovative tools or technologies that facilitate laundry organisation for people with visual impairments, such as tactile sock identification or blind-friendly laundry sorting systems, might improve accessibility in this field.

Although it's often regarded as a desirable quality, being extremely helpful might be problematic for those who are blind or visually impaired. Despite the fact that many individuals are eager to help folks with impairments, they occasionally neglect to inquire as to whether the person genuinely needs assistance. It's crucial to avoid assuming control abruptly and without sufficient communication while working with blind people since they could move more slowly. For someone who is blind, this may have unforeseen repercussions and cause problems. Instead of presuming what the other person needs, it's critical to approach the issue sensitively and inquire how you can help. This will enable those who are blind or visually impaired to preserve their freedom and autonomy while still getting help when they need it. Ultimately, being helpful should not come at the expense of the person's dignity or agency.

For those with disabilities, particularly those who are blind or visually impaired, independence is essential. A blind person can live freely with the use of specially developed adapted equipment, although such equipment is sometimes hard to come by in local markets or shops. This means that those who are blind must look hard and work very hard to find the tools that might help them become more independent. The correct equipment may take a major time and effort commitment, even while there are organisations and resources available to help blind people get the equipment they need. Navigating these resources can be difficult. It would be much easier for blind people to live independently and with dignity if adapted technology were to be made more accessible and widely available.

Everyone has difficulties in life, but blind people frequently encounter particular and serious difficulties. However, this does not imply that one should feel sorry for them or sympathise with them. Like everyone else, those who are blind face problems in life and work to lead meaningful lives. While they may not have the same experiences as those who can see, it's vital to remember that blind people

may enjoy rich, fulfilling lives. Blind people's feeling of agency and self-worth may be harmed by pity or other forms of discrimination. Instead, it's critical to treat blind people with the respect and dignity shown to every other human being, as well as to acknowledge and encourage their attempts to overcome the difficulties they experience.

1.1 ROBOTS

Engineering's field of robotics focuses on the creation, maintenance, and use of robots. Robots are automatically controlled machines that can carry out jobs that would otherwise need human assistance, albeit they don't always look like people or behave in ways that humans do. Robots that are created to look like humans or to carry out tasks in a manner that is like people are known as humanoid robots. While manufacturing and industrial automation have historically been associated with robotics, technological advancements have allowed for the creation of robots for a variety of other purposes, such as exploration, entertainment, and healthcare. As robots develop further, it has the potential to drastically alter how we live and work and to solve some of the most important global problems.

1.2 ADVANTAGES OF ROBOTS

- I. In several sectors, robots have the potential to greatly improve uniformity, production, and efficiency.
- II. They are not bored like humans and can keep doing the same thing again and over until they are exhausted.
- III. They can also achieve extremely high accuracy, precise to fractions of an inch, which is crucial for producing microelectronics, for instance.
- IV. Robots can also work in hazardous or inappropriate locations for humans, like the chemical or nuclear industries.
- V. They don't need the same ambient conditions that people do, including lighting, air conditioning, or noise protection.
- VI. Robots can carry out activities that are beyond the capacity of humans because of their sophisticated sensors and actuators.

- VII. Overall, robots are gaining popularity across a variety of industries and offer a number of benefits that improve procedures.

1.3 DISADVANTAGES OF ROBOTS

- I. While robots may have certain advantages, there are also some disadvantages to be aware of. The potential loss of jobs when human employees are replaced by robots is one of the biggest worries.
- II. Robots also have the disadvantage of being limited to the jobs for which they have been instructed; unlike humans, they are unable to innovate or adjust to novel circumstances.
- III. Therefore, safety precautions must be taken to safeguard both people and robots in potentially dangerous circumstances.
- IV. Robots can be more exact than humans, but they lack human strength and intelligence, making them less agile.
- V. Finally, certain businesses or sectors may find robots to be impracticable due to the enormous expenditures involved in purchasing, maintaining, and programming them.

1.4 WRITING ROBOT

Robots have both benefits and drawbacks. A key worry is the possibility of job losses when robots replace human employees. Furthermore, unlike people, robots are constrained to the jobs they have been designed for and are unable to adapt to new circumstances or innovate. Additionally, safety precautions must be taken to safeguard both humans and robots in dangerous circumstances. Robots can be more exact than people, but they are less adaptable since they lack human power and intellect. Finally, because robots are expensive to buy, operate, and program, some firms may find them to be impractical.

1.5 DRAWING ROBOT

Robots that can generate or reproduce drawings without the help of a human have been created. Drawing robots may be divided into two groups, mono-colour and

multi-color, depending on the amount of colours they can generate. We shall examine the state of these two forms of robotic sketching in this essay.

1.6 FEATURES OF WRITING AND DRAWING ROBOTS

- I. Handwriting Machine Can Imitate handwriting using a pen at an angle of 45 degree
- II. Laser engravings on various surfaces including wood, paper, and leather
- III. Corexy movement algorithm for producing flawless drawings
- IV. Perfect for writing and drawing.
- V. Easy to assemble and use for everyone
- VI. Completely lead-free

1.7 TYPES OF WRITING AND DRAWING ROBOTS

1. Cartesian robots: These writing and sketching robots are the most prevalent kind. They may be used for precise and accurate writing and sketching since they move in a straight line. The 3D printing process also employs them.
2. SCARA robots: Robots called SCARAs (Selective Compliance Assembly Robot Arms) are utilised for more dexterous jobs like sketching curves and circles. They may move in a circular or semi-circular manner thanks to their two parallel joints.
3. Delta robots: Delta robots can draw and write in addition to being utilised for high-speed pick and place activities. They are normally hanging from above and have a triangle shape, which allows them to move quite swiftly.
4. Polar robots: While SCARA robots have a planar workspace, polar robots have a spherical one. They are frequently employed in situations when several access points must be made to the workspace.
5. Art robots: These are machines created especially for producing works of art, such paintings or sculptures. They may be programmed to utilise various paints, brushes, and drawing methods to produce wholly creative works of art.

6. Handwriting robots: These machines are made to resemble human handwriting. They may be configured to write in many styles and languages, and they use a special pen or stylus to create letters and words.
7. CNC machines: For difficult and precise tasks like milling and engraving, computer numerical control (CNC) machines are employed. Although they can be used for art and design, they are frequently used in industrial applications.
8. Plotter robots: Large surfaces like walls or billboards may be drawn on and printed on using plotter robots. To produce large-scale graphics or designs, they employ a special pen or inkjet.

CHAPTER - 2

LITERATURE SURVEY

Dr.M.Narayana, et.al (2015) The "Voice Control Robot Using Android Application" paper presents a design and development of a voice-controlled robot that can be controlled using an Android application. The authors used various hardware components and software tools to build the robot, which can move in different directions and perform various actions based on the user's voice commands. The robot is designed to be user-friendly and intuitive, with a simple interface that allows users to control the robot's movement and actions using their voice. The authors suggest that the robot can be used in various applications such as home automation or security, enhancing convenience and accessibility. The paper is a significant contribution to the field of robotics and automation and can be beneficial for researchers, developers, and end-users.

Yong, Yan, et.al (2020) The paper titled "Research and Design of Writing Robots Based on Attitude Information" by Yan Yong, published in the Journal of Physics: Conference Series in 2020, discusses the design and development of a writing robot based on attitude information. The robot uses a series of sensors to detect its orientation and movement, which are then used to generate text. The paper describes the hardware and software components of the robot, including the sensors and the natural language processing algorithms used to generate text. The results of experiments conducted to evaluate the performance of the robot are also presented, which indicate that the robot is capable of generating coherent and meaningful text. The paper concludes by discussing the potential applications of the writing robot in fields such as education, journalism, and creative writing.

Vaibhav Pawar, et al. (2018) The design and development of a cost-effective and effective robotic arm are presented in the paper "Design and Development of Robotic Arm Generation-1". With four joints that can swivel up to 180 degrees, the robotic arm can carry out a range of activities. A microcontroller that is in charge of the arm enables it to be programmed to carry out particular tasks. The scientists

also created a graphical user interface (GUI) so that people could operate the arm through a computer. The robotic arm's usage of 3D printing technology to make the pieces is one of its distinguishing characteristics. The components of the arm were made by the authors using PLA material, which is biodegradable and safe for the environment. This strategy lowers the cost of production while increasing the arm's marketability. By programming the robotic arm to carry out a variety of activities, including picking up and putting down things, writing, and sketching, the authors evaluated the robotic arm's performance. The arm's capacity to be employed in a variety of industries was demonstrated by its ability to carry out these duties with great precision and accuracy.

Mr.R.Augustian Isaac, et al. (2018) The "Homework Writing Machine" paper describes the design and development of a machine that can write homework assignments automatically. The machine consists of a robotic arm that holds a pen and can write on a paper, and a microcontroller that controls the arm's movements. The authors used 3D printing technology to create the parts of the machine, and programmed it to write various assignments such as mathematical equations and paragraphs. The machine was able to write accurately and efficiently, demonstrating its potential to reduce the workload on teachers and students in schools and other educational institutions. Overall, the paper presents an innovative and cost-effective solution to address the challenges of writing homework assignments.

M Aditi, et al. (2019) The "Automated Writing and Drawing Machine" paper describes the design and development of a machine that can automate the process of writing and drawing using a pen and paper. The machine consists of a robotic arm that is controlled by a microcontroller and a graphical user interface. The authors used 3D printing technology to create the parts of the machine and tested its performance by programming it to write and draw various designs and patterns. The machine is designed to be low-cost, portable, and easy to operate, with potential applications in art, calligraphy, and design. The authors suggest that the machine can reduce the workload of writers and artists while improving the accuracy and quality of the output.

B Raghavendhar Reddy and E Mahender (2019) The paper "Speech To Text Conversion Using Android Platform" describes the design and development of an Android application that can convert speech to text. The authors used the Android platform and various software tools to build the application, which can recognize spoken words and convert them into text. The application is user-friendly, accurate, and efficient, making it a practical solution for various applications such as transcribing interviews or recording lectures. The authors' approach provides an efficient and automated solution that can improve the productivity and accessibility of users.

J.Jenitta, et al. (2019) The "Voice Based Writing Machine Using Speech Recognition" paper presents an innovative solution to convert speech to text using a voice-based writing machine. The machine is designed to recognize spoken words and convert them into text in real-time using speech recognition technology. The machine comprises various hardware components and uses various software tools to achieve its functionality. The authors used the Arduino IDE and integrated various libraries to enable speech recognition and text conversion. The machine is designed to be user-friendly and intuitive, and the authors tested its performance by evaluating its accuracy and efficiency, comparing it with other similar machines. The results showed that the machine has high accuracy and efficiency, with minimal errors and delays. The authors suggest that the machine can be used in various applications such as transcribing meetings or recording lectures and can benefit individuals with disabilities. The paper provides an efficient and automated solution that can improve the productivity and accessibility of users.

The paper "Research And Design of Writing Robot Based on Attitude Information" by Yan Yong presents the development of a writing robot that can write in a specific direction using attitude information. The robot is user-friendly, with a simple interface that allows users to input the desired direction of writing. Various hardware components and software tools were used to build the robot, which was tested for its accuracy and efficiency, and found to have high accuracy and efficiency with minimal errors and delays. The robot can be used in various applications such as calligraphy or art and can be used as a learning tool for students interested in calligraphy or writing. The paper is a significant contribution

to the field of robotics and automation, providing an efficient and automated solution that can improve the productivity and quality of writing tasks.

Thanvi Fathim,et al. (2020) describes a voice-controlled writing machine that can write in different directions and perform various actions based on user commands. The machine is built using the Atmega microcontroller and various sensors and modules for voice recognition and movement control. The machine can be controlled using an Android app, making it accessible and convenient. The authors suggest that this writing machine can be used in various applications such as calligraphy or art and as a learning tool for students interested in writing. The machine's accuracy and efficiency were evaluated, and the results showed high performance with minimal errors and delays. Overall, this paper presents an innovative solution to control writing machines using voice commands, which can improve the productivity and accessibility of users.

Shubhan Agarwal, et al. (2020) The "Arduino Based CNC Drawing Machine" paper describes the design and development of a CNC drawing machine that can draw digital designs on a physical surface with high precision and accuracy. The machine uses an Arduino microcontroller and various sensors and modules to enable movement control and digital-to-physical conversion. The machine is user-friendly and efficient, with a simple interface for users to input their desired designs and control the machine's movement. The authors tested the machine's performance and found it to have high accuracy and efficiency, with minimal errors and delays. The machine has various applications in art, decoration, or prototyping, and can be used as a learning tool for students interested in CNC machining or digital fabrication. Overall, the paper provides an innovative and practical solution to enhance the productivity and quality of design tasks in the field of digital fabrication.

The "Drawing Robot" paper by Raut Madhuri, et.al. (2020) describes the development of a drawing robot that can create digital designs on a physical surface with high precision and accuracy. The robot uses an Arduino microcontroller and various sensors and modules to enable movement control and digital-to-physical conversion. The authors tested the robot's performance by

evaluating its accuracy and efficiency and found that it had minimal errors and delays. The robot can be used in various applications such as art, decoration, or prototyping and can help users create complex designs and patterns. Additionally, the robot can be used as a learning tool for students interested in robotics, digital fabrication, or programming. The paper presents an efficient and automated solution to improve the productivity and quality of design tasks and is a significant contribution to the field of robotics.

Sindhuja R ,et al.(2020) The "Robotic Speech Recognition and Writing System" paper describes a user-friendly robotic system that can recognize speech and convert it into written text. The system uses hardware components such as a Raspberry Pi, microphone, and speakers, and software tools like Python and Google Speech API. The system's accuracy and efficiency were tested and compared with other similar systems, showing high performance. The authors suggest that the system can be used in education, communication, and healthcare to help individuals with speech impairments and as a learning tool for students. Overall, the paper presents an innovative solution that can improve productivity and quality of communication tasks, making it a significant contribution to the field of robotics.

CHAPTER - 3

AIM AND SCOPE

3.1 AIM OF THE PROJECT:

The aim of the "Design and Development of Dual Axis Voice Recognition Writing Robot for Physically Challenged Person" is to create a robot that can write or draw based on voice commands given by a physically challenged person who may not have the use of their limbs.

3.2 OBJECTIVE OF THE PROJECT

The dual axis speech recognition writing robot aims to develop a tool that can instantly translate spoken words into written text. People who struggle to write, such as those with physical limitations or limited writing skills, may find this to be especially helpful.

The robot's capacity to move in two directions—horizontally and vertically—is known as its dual axis function, which enables it to write on a surface with higher accuracy and precision. The robot can properly translate spoken words into printed type thanks to speech recognition technology.

In general, this device's goal is to give those who have trouble with standard writing techniques a quick and easy approach to express themselves in writing.

3.3 PROBLEM DEFINITION

A dual-axis speech recognition writing robot is a system that can receive voice commands from a user and use them to move a writing instrument in two dimensions to produce written text. The problem definition for this type of system would involve defining the technical requirements, functionality, and usability goals of the system.

The system would need to include two axes of movement, which would typically be provided by a pair of stepper motors or servo motors. These motors would be controlled by the system's microcontroller, which would interpret the voice commands and translate them into movements of the motors. The system would also need to include a writing instrument, such as a pen or marker, which could be moved in the two dimensions to produce text.

The functionality of the system would depend on the specific application it is intended for. For example, it could be used for artistic drawing, writing out mathematical equations, or producing handwritten notes. The system should be able to accurately interpret the user's voice commands and produce the desired output with a high level of precision.

Usability goals for the system would include ease of use, reliability, and robustness. The system should be designed to be intuitive and user-friendly, with clear instructions and feedback provided to the user. It should also be designed to operate reliably over an extended period of time and be resistant to mechanical wear and tear.

Overall, the problem definition for a dual-axis speech recognition writing robot would involve defining the technical requirements, functionality, and usability goals of the system to ensure that it meets the needs of its intended users.

3.4 SCOPE OF THE PROJECT:

The scope of this project includes designing and developing a robot that can understand voice commands and convert them into written or drawn outputs. The robot will need to have a dual-axis mechanism that enables it to move in two directions, allowing it to write or draw in any direction. The system will also need to be user-friendly and easy to operate by the physically challenged person.

- I. In the future, we will research the use of a writing robot for blind people in the educational area, and it will encourage the use of a robot with more characteristics for blind people than this project.
- II. In this sector, there are more opportunities to grow or convert this project in a variety of methods. This is the next phase in blind people's education.
- III. On the other hand the development of Machine Learning models to predict perfect speech recognition also grows and therefore increases the accuracy.

CHAPTER - 4

MATERIALS, FABRICATION AND METHODOLOGY

Dual-axis writing is a technique used to create patterns, designs, or words on a two-dimensional surface by controlling two axes simultaneously. This technique is commonly used in various fields such as robotics, calligraphy, printing, and engraving. In this write-up, we will discuss the fabrication process of dual-axis writing.

Materials Required:

- I. 2 stepper motors
- II. Motor driver
- III. Microcontroller (e.g., Arduino)
- IV. Power supply
- V. Belts and pulleys
- VI. Writing tool (e.g., pen)
- VII. Two-dimensional surface (e.g., paper, canvas)

4.1 FABRICATION PROCESS

1. Firstly, connect the stepper motors to the motor driver and attach the motor driver to the microcontroller.
2. Determine the distance between the two motors and cut two belts to that length.
3. Install one end of each belt on each motor and secure it with a pulley.
4. Attach the other end of each belt to a common stationary point, such as a wall or table leg.
5. Install the writing tool (pen or marker) onto one of the motors.
6. Mount the two motors on a stable frame or structure, so that they are perpendicular to each other.
7. Connect the power supply to the microcontroller, motor driver, and

motors.

8. Write a program for the microcontroller that can control both motors simultaneously, allowing them to move in the desired direction and distance. The program should be able to create any pattern or design desired on the two-dimensional surface.
9. Once the program is uploaded, turn on the power supply and run the program to test the dual-axis writing system.
10. Place the two-dimensional surface on the writing platform and adjust the height of the writing tool to ensure that it touches the surface without causing any damage.
11. Start the program, and the motors will begin moving the writing tool across the surface, creating the desired pattern or design.
12. Once the writing is complete, turn off the power supply and remove the two-dimensional surface.

In conclusion, the fabrication of a dual-axis writing system requires a few materials and some basic programming skills. Once constructed, it can be used to create intricate and detailed designs on a two-dimensional surface, making it a useful tool in various fields.

4.2 METHODOLOGY OF WRITING ROBOT

1. A dual-axis speech recognition writing robot is a device that uses speech recognition technology to convert spoken words into text and then writes them down using a robotic arm that moves along two axes. The following is a possible methodology for building such a device:
2. Define the project scope and requirements: Determine the use case for the device, the accuracy requirements of the speech recognition and writing capabilities, and the available resources and budget for the project.

3. Select hardware and software components: Research and select the hardware components such as microphones, robotic arms, motors, and controllers, and software components such as speech recognition engines, text-to-speech engines, and programming languages.
4. Design the mechanical structure: Design the mechanical structure of the device, including the robotic arm, the base, and the supports for the microphones and other components. Use 3D modelling software to create a detailed design that can be used for manufacturing.
5. Develop the software: Develop the software for the device, including the speech recognition and text-to-speech engines, the motor control algorithms, and the user interface. Use programming languages such as Python, C++, Java or embedded.
6. Integrate hardware and software: Integrate the hardware and software components, ensuring that they work together seamlessly. Test the device thoroughly to identify and fix any issues.
7. Calibration and fine-tuning: Calibrate the device to ensure accurate speech recognition and precise writing. Fine-tune the device to optimise its performance and accuracy.
8. User testing and feedback: Test the device with users to get feedback on its usability and functionality. Incorporate user feedback into the design and make necessary improvements.
9. Documentation and maintenance: Document the device's design, software, and hardware components, and create user manuals and maintenance guides. Establish a maintenance plan to ensure the device's long-term reliability and functionality.
10. Deployment and support: Deploy the device to the end-users, provide training and support as needed, and monitor the device's performance to ensure continued satisfaction and success.

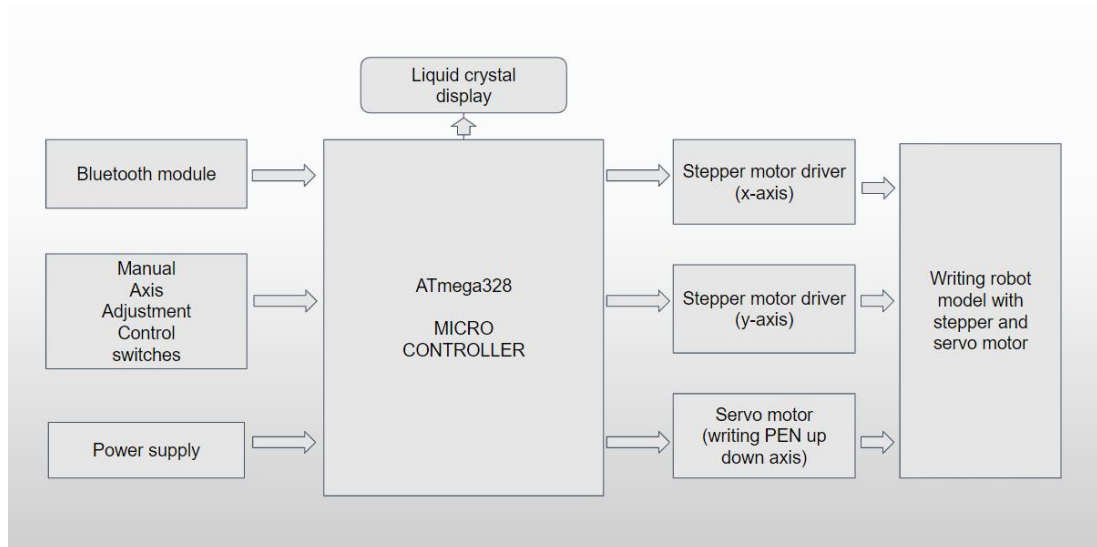


Fig 4.1: Methodology of Writing Robot

4.3 SETUP OF THE WRITING ROBOT

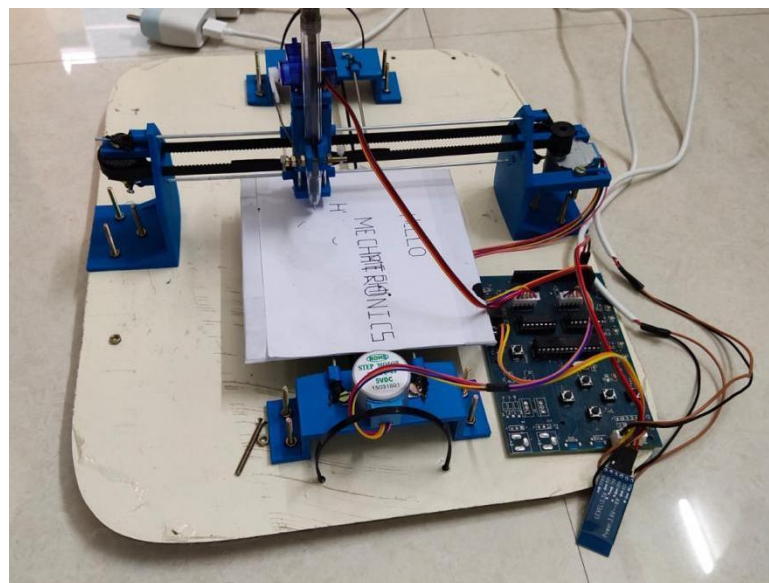


Fig 4.2: Right Side View of the Writing Robot

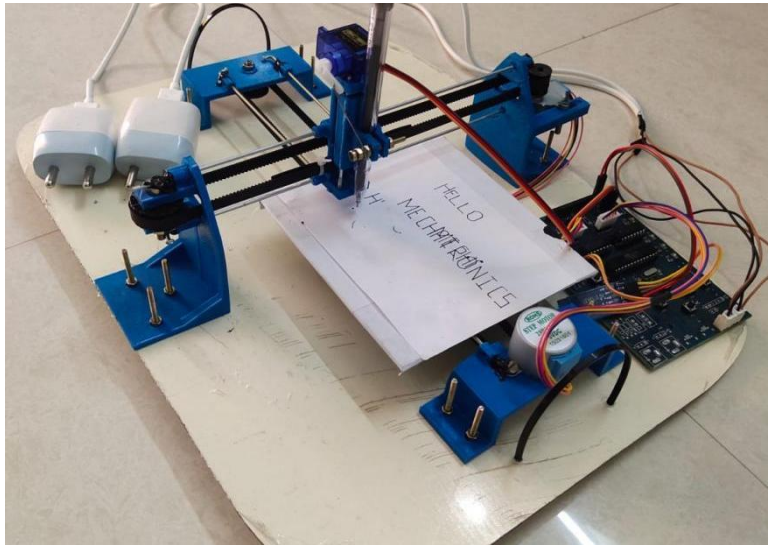


Fig 4.3: Isometric View of the Writing Robot

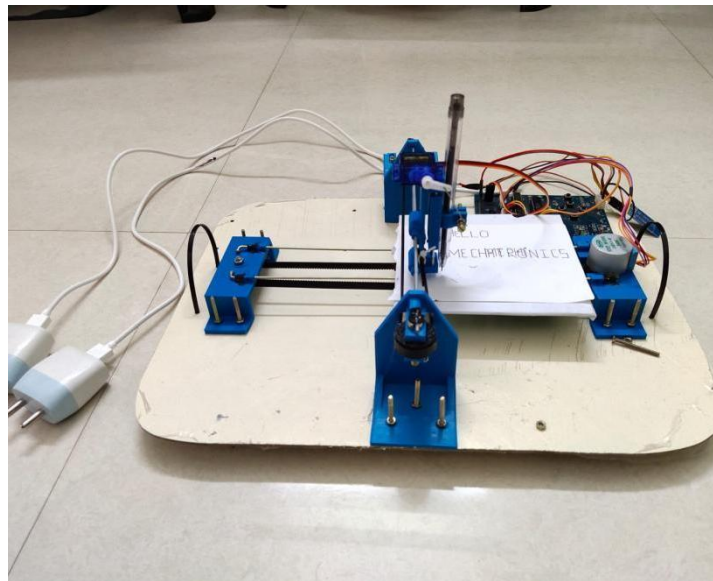


Fig 4.4: Front view of the Writing Robot

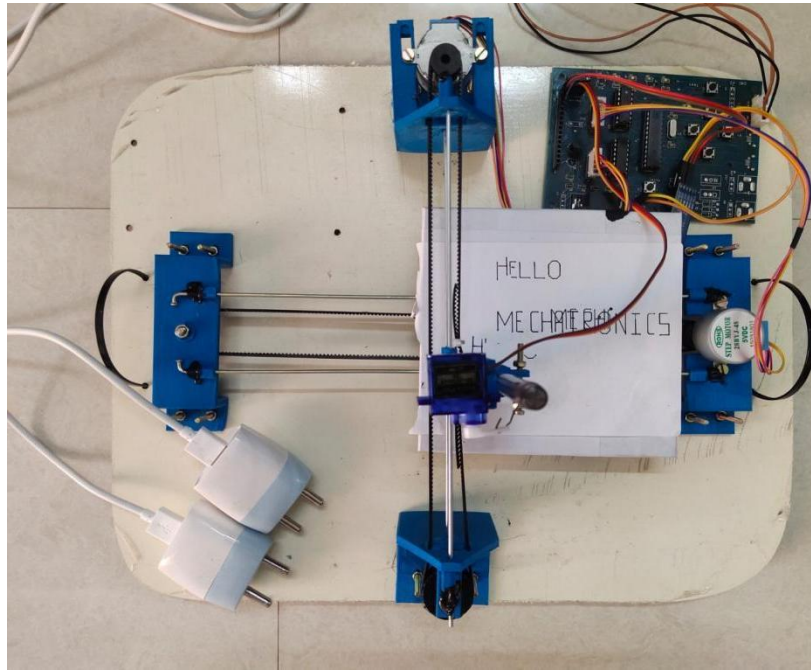


Fig 4.5: Top View of the Writing Robot

4.4 3D DESIGN OF THE MOUNTING PARTS

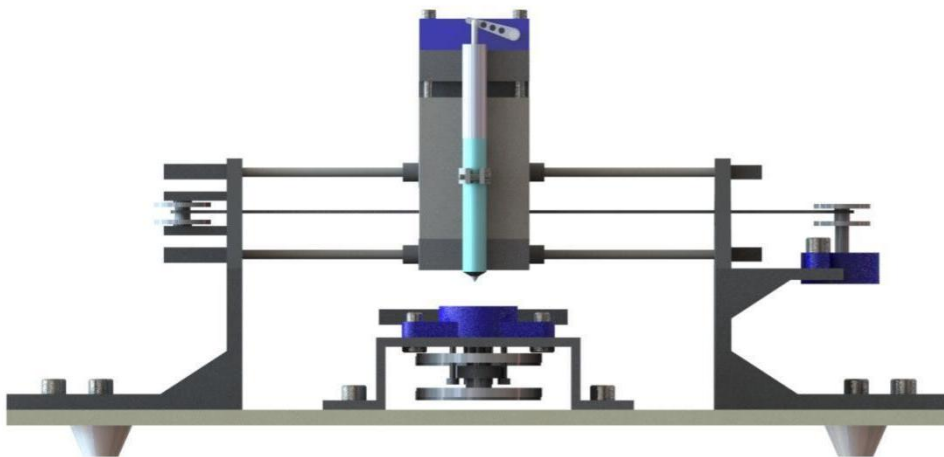


Fig 4.6: 3D Design of Front View

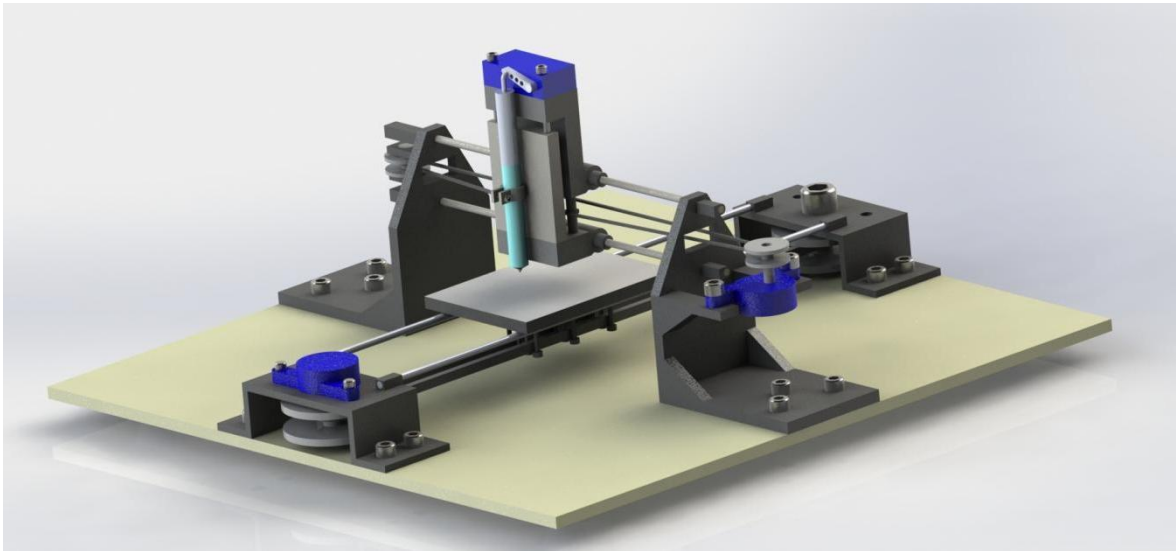


Fig 4.7: 3D Design of the Isometric View

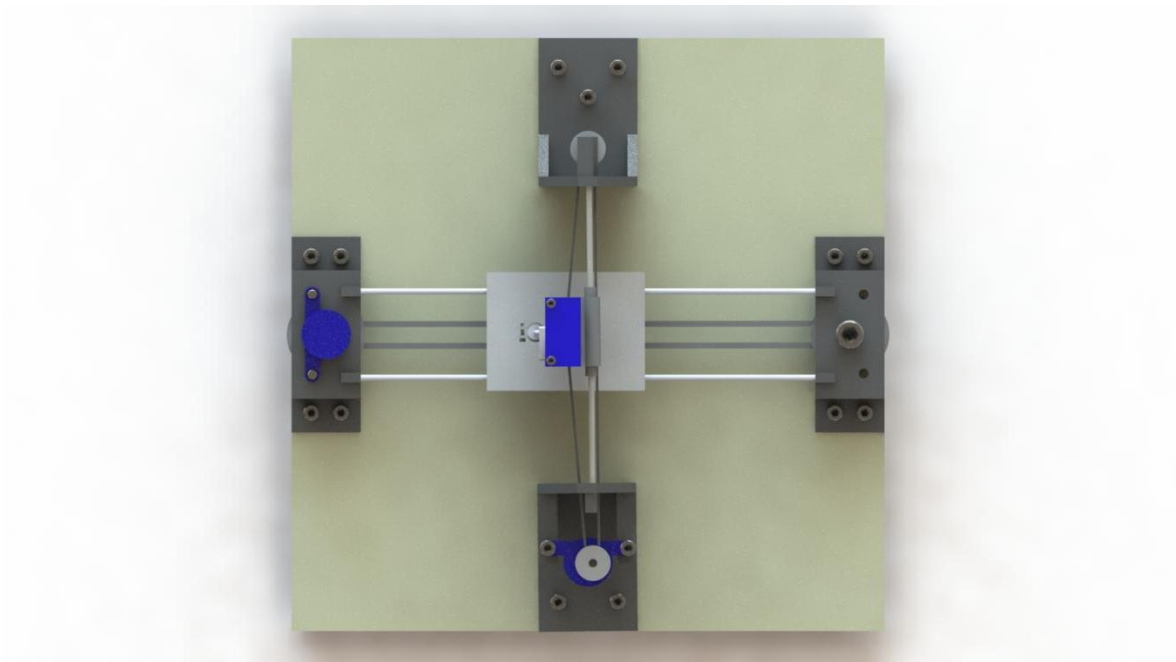


Fig 4.8: 3D Design of the Front View

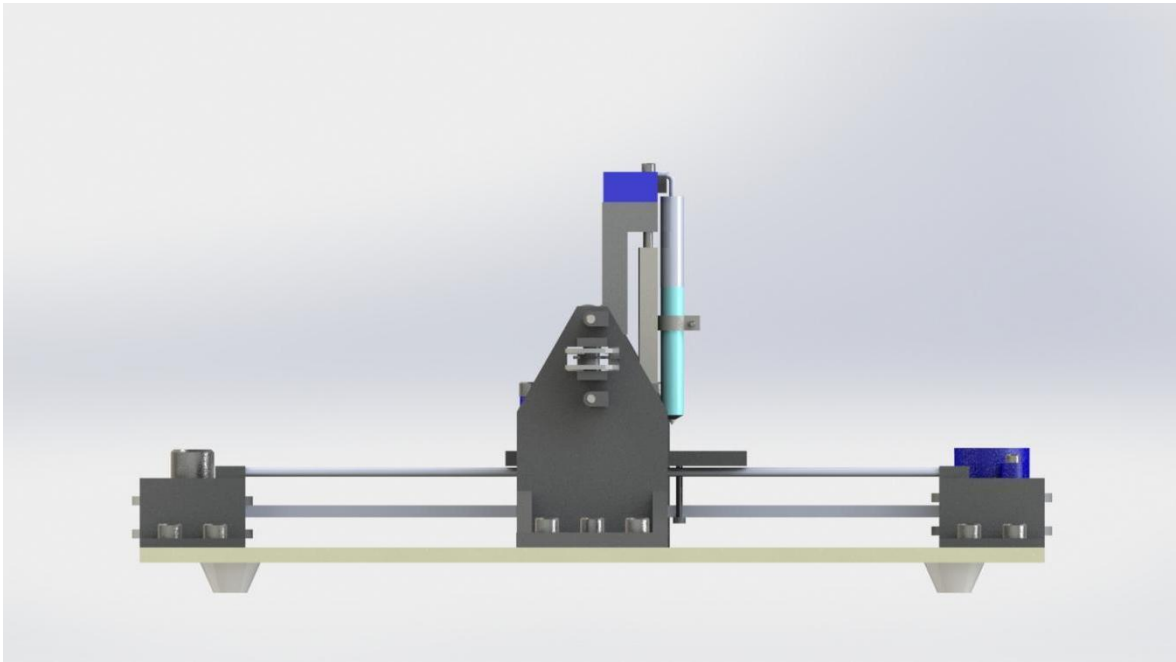


Fig 4.9: 3D Design of the Side View

4.5 COMPONENTS USED

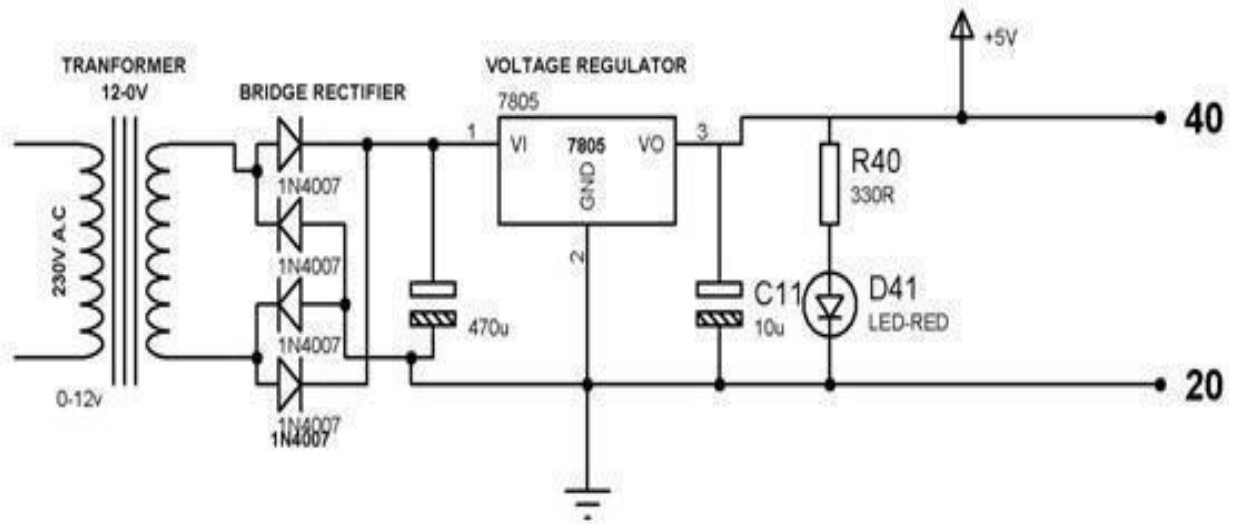
- I. Power Supply Module
- II. Bluetooth Module
- III. Servo Motor
- IV. Stepper Motor
- V. AVR Microcontroller

4.5.1 Power Supply Module

The transformer used in the power supply circuit converts 230 volts to 12 volts. In this circuit, four diodes are used to create a bridge rectifier that produces pulsing dc voltage and is then sent to a capacitor filter to remove any a.c. components that may still be present after rectification.

The regulator receives the filtered DC voltage and outputs a constant 12 volt DC voltage. 12V AC power is produced from 230V AC power (12V RMS, with a peak value of about 17V). However, 5V DC power is required; therefore, 17V AC power first has to be converted into DC power before being stepped down to 5V DC. One

of the power electronic converters and rectifiers may transform AC power into DC. Different varieties of rectifiers exist, including bridge rectifiers, full-wave rectifiers, and half-wave rectifiers. The bridge rectifier is widely used to convert AC to DC because it has benefits over half-wave and full-wave rectifiers.



4.5.2 Bluetooth Module

It is used in several consumer applications, including wireless keyboards, wireless mice, wireless headsets, and gaming controllers. Depending on the transmitter and receiver, atmospheric, geography, and urban conditions, its range can reach up to 100. Using the IEEE 802.15.1 standardised protocol, a wireless Personal Area Network (PAN) may be created. Data is sent over the air using frequency-hopping spread spectrum (FHSS) radio technology. It converses with devices using serial communication. It uses a serial port (USART) to connect with the microcontroller.

4.5.2.1 HC-05 Bluetooth Module

- I. HC-05 is a Bluetooth module which is designed for wireless communication. This module can be used in a master or slave configuration.



Fig 4.10 HC-05 Bluetooth

Bluetooth serial modules allow all serial enabled devices to communicate with each other using Bluetooth.

It has 6 pins,

1. **Key/EN:** It is used to activate the AT commands mode on the Bluetooth module. This module will operate in command mode if the Key/EN pin is high. Otherwise, it is in data mode by default. In command mode, the HC-05's standard baud rate is 38400 bps, while in data mode, it is 9600bps.

1. **Data mode:** Data exchange between devices is one of the two modes available on the HC-05 module.

2. **Command mode:** It makes use of AT commands to modify the HC-05's settings. These commands are sent through the module's serial (USART) port

2. **VCC:** Connect 5 V or 3.3 V to this Pin.

3. **GND:** Ground Pin of module.

4. **TXD:** Transmit Serial data (wirelessly received data by Bluetooth module transmitted out serially on TXD pin)

5. **RXD:** Receive data serially (received data will be transmitted wirelessly by Bluetooth module).

6. **State:** It tells whether module is connected or not.

4.5.3 HC-05 module Information

- I. HC-05 has a red LED which indicates connection status, whether the Bluetooth is connected or not. Before connecting to the HC-05 module this red LED blinks continuously in a periodic manner. When it gets connected to any other Bluetooth device, its blinking slows down to two seconds.
- II. This module works on 3.3 V. We can connect 5V supply voltage as well since the module has on board 5 to 3.3 V regulator.
- III. As HC-05 Bluetooth module has 3.3 V level for RX/TX and microcontroller can detect 3.3 V level, so, no need to shift transmit level of HC-05 module. But we need to shift the transmit voltage level from the microcontroller to the RX of the HC-05 module.

4.5.3.1 Bluetooth communication between Devices

E.g. Send data from the Smartphone terminal to the HC-05 Bluetooth module and see this data on PC serial terminal and vice versa. To communicate with a smartphone with HC-05 Bluetooth module, the smartphone requires a Bluetooth terminal application for transmitting and receiving data. You can find Bluetooth terminal applications for android and windows in respective apps Store.

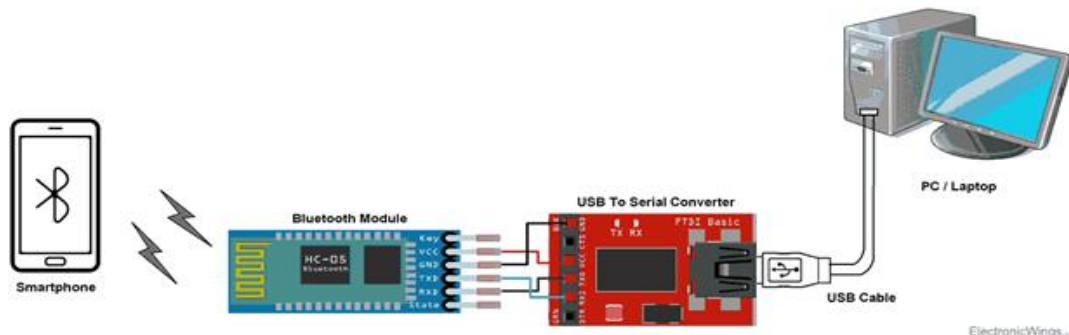


Fig 4.11: Bluetooth Communication

Bluetooth Module Serial Interface

Therefore, use a serial to USB converter to connect the HC-05 Bluetooth module to the PC while using it to converse through a smartphone.

The HC-05 module must first be paired with a smartphone in order for two Bluetooth devices to communicate.

Pair HC-05 and smartphone:

From your phone, lookup new Bluetooth devices. A Bluetooth device with the name "HC-05" can be found.

Select the connect/pair device option; the HC-05's default pin is 0000 or 1234.

Open terminal software (such as TeraTerm, Realterm, etc.) on the computer after connecting two Bluetooth devices, then choose the port to which the USB to serial module is connected. Choose the 9600 bps default baud rate as well.

Open the Bluetooth terminal app on a smartphone and connect to the linked HC-05 device.

To communicate, all we need to do is input into our smartphone's Bluetooth terminal application. Characters are wirelessly sent to the Bluetooth module HC-05. It will automatically be transmitted in serial form to the PC via the HC-05 and displayed on the terminal. We can transfer data from a PC to a smartphone in the same way.

4.5.4 Servo Motor

An electric motor known as a servo motor is one that is made for finely controlling angular or linear position. A tiny DC motor, gearing, and a feedback mechanism—typically an encoder or a potentiometer—make up the device. Robotics, CNC machines, and automation systems are just a few examples of devices that frequently employ servo motors to achieve precise and repeatable placement.

A servo motor's capacity to accept and react to control signals, which enables precise control over its location, speed, and torque, is one of its important qualities. The controller adjusts the operation of the motor to maintain the intended position

based on data from the feedback mechanism, which continuously tracks the motor's actual position.



Fig 4.12 Servo Motor

Servo motors are extremely accurate and capable of precise motions because of their closed-loop control mechanism.

Servo motors come in a range of sizes and power ratings and can function in a number of different ways, including continuous rotation and restricted angle rotation. They are ideal for a variety of applications in fields including robotics, aircraft, automotive, and manufacturing because of their high torque, quick reaction times, and outstanding positional precision. Servo motors are crucial parts of many contemporary automation and motion control systems because of their precise control abilities.

4.5.4.1 Working principle of Servo Motors

Electro-mechanical servo motors employ feedback control to accurately regulate a load's position, speed, and acceleration. They are made up of a motor, a control circuit, and a position sensor (often a potentiometer). The control circuit provides an error signal after comparing the load's desired position to the actual position as determined by the sensor. The motor is then driven by an amplified version of the error signal, which moves to reduce the error. Servo motors are perfect for applications that demand precise positioning, such as robotics, automation, CNC

machines, and aerospace systems, thanks to their closed-loop control system that enables them to accomplish accurate and smooth motion control. Due to their excellent precision, dependability, and quick response times, servo motors are often employed.

4.5.5 Stepper Motor

An electromechanical device called a stepper motor transforms electrical pulses into exact mechanical motions. It is widely utilised in many fields, including robotics, 3D printing, CNC machines, and automation systems, where precise control of position and speed is necessary.

A stepper motor's rotor, stator, and a number of coils or windings make up its fundamental structure. The moving component of the motor is the rotor, while the stationary component is the stator. The rotor rotates in distinct stages as a result of the magnetic fields created by the coils, which are coiled around the stator and energised by electrical pulses.

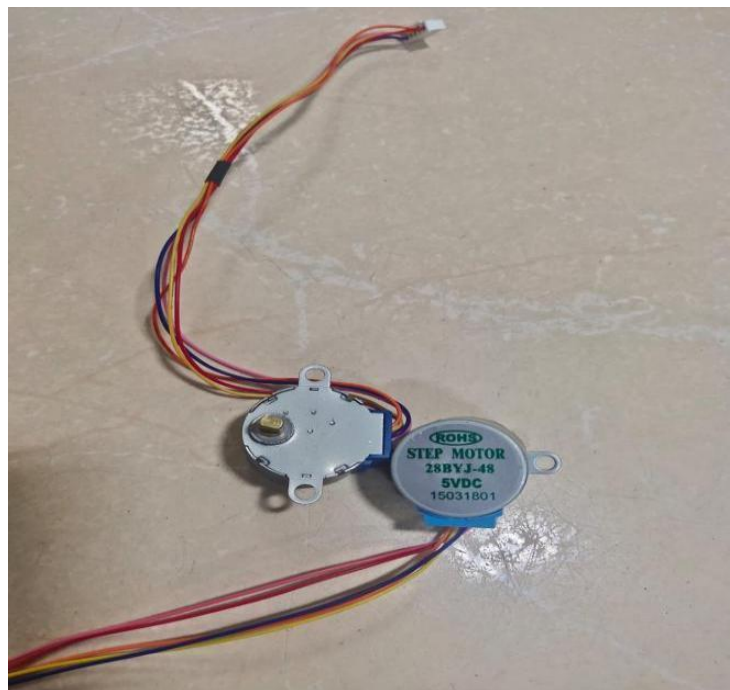


Fig 4.13 Stepper Motor

4.5.6 AVR Microcontroller

AVR microcontroller is a type of microcontroller based on the AVR (Alf and Vegard's RISC) architecture, developed by Atmel (now Microchip Technology). It is a well-liked and often employed microcontroller platform renowned for its ease of use, effectiveness, and adaptability. AVR microcontrollers are embedded systems that combine a CPU, RAM, ROM, and several peripherals onto a single chip. This makes them perfect for a variety of applications including industrial automation, consumer electronics, robotics, and Internet of Things (IoT) devices. The GPIOs, timers, UART, SPI, I2C, and other built-in peripherals, as well as the low power consumption and quick execution speed of AVR microcontrollers, are some of its distinguishing features. They are backed by a strong development environment with a range of tools, compilers, and libraries, and are coded in C/C++ or assembly language.

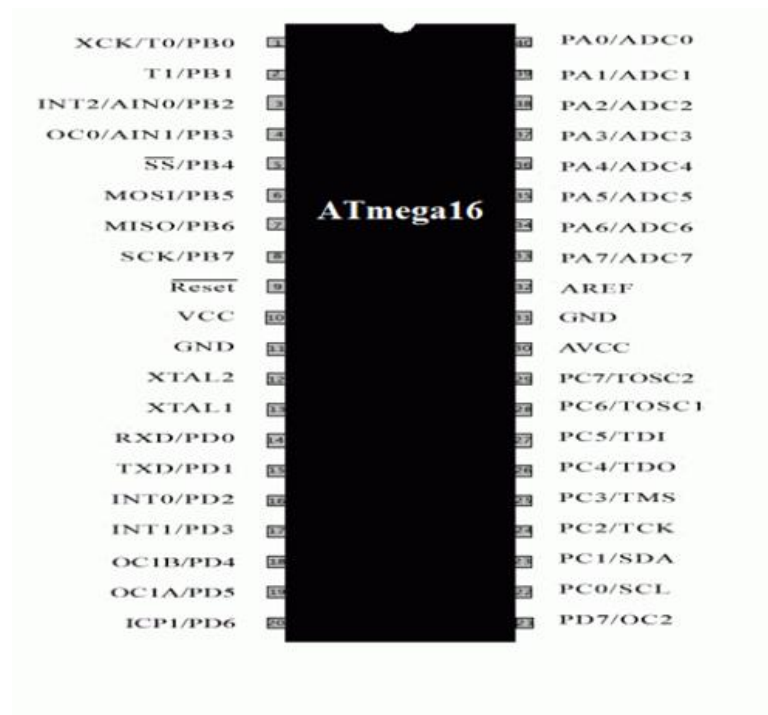


Fig 4.14 Pin Diagram

4.6 SOFTWARE USED IN THE MICROCONTROLLER:

4.6.1 *Embedded C* :

Embedded C is a programming language specifically designed for developing software for embedded systems, which are specialised computer systems with dedicated functions, such as those found in devices like microcontrollers, IoT devices, and automotive systems. A portion of the C programming language is included in embedded C, along with other features that are tailored for situations with constrained memory and computing capability.

One of the important characteristics of Embedded C is its capacity to operate directly on hardware registers, enabling programmers to create code that manages the embedded system's hardware, including GPIOs, timers, and interrupts. Embedded C is appropriate for real-time applications because of the efficient and precise hardware interactions made possible by this level of control.

The support for Embedded C is another noteworthy feature.

4.7 COMPARISON OF EXISTING AND PROPOSED SYSTEM

4.7.1 *Existing System* :

We provide a method for building quick, fluid movements for an all-purpose robot that replicate the motions and duration that accompany human handwritten signatures. The parts of the experimental research that were carried out included collecting handwriting samples, analysing writing samples, writing by robots, and comparing online signatures from humans and robots. The stages are the steps in implementing the suggested technique. In the presented study, greater focus was placed on the description of the experimental robotic set-up, the technology used to analyse written specimens, and the control scheme used by UR5 to carry out writing tasks. Writing samples from humans and robots were collected and processed. The pace and trajectory of acquired writing by humans and robots were contrasted and assessed. The robot's trajectory profile created for this study is of the highest quality. Future work will focus on lowering the inertia of the robot

arm components and improving the arrangement of jobs inside the robot's workspace in order to improve the robot's speed profile.

4.7.1.1 Disadvantages of Existing System:

- I. It only exploits the writing specimen processing.
- II. Process of UR5 is difficult to understand.
- III. No real time implementation.

4.7.2 Proposed System

The writing robot uses wireless connectivity to create the student's exam paper. The G-Code file is sent to the microcontroller using the movement Code file developed with the aid of the Inkscape programme and processing software. The stepper motors and servo motors are then given control signals via the CNC shield drive. The relevant code, which delivers data to the controller block, is connected to the motor driver unit through a DAC, providing pulse width signals to drive the motor, and the motor unit processes the signals and generates the final output, which is then written and displayed on the paper. The XY axis operates as a result of commands given to the controller unit.

4.7.2.1 Advantages of Proposed System

- I. Helps blind people to write the exams on their own.
- II. Increases the confidence of blind people.
- III. Precision.
- IV. Improved the character axis.
- V. Reduced latency.
- VI. Cost-effective.

4.7.2.2 Application:

- I. This project helps to blind people to write the exams on their own.
- II. Mainly used to blind people to write their ideas on their own.

4.8 TECHNOLOGIES USED

An object that is linked to or integrated with another object is referred to as an embedded object. A computer hardware system that also includes software is known as an embedded system. It could operate independently or as a component of a bigger system. An embedded system is constructed typically on a microcontroller or microprocessor and is intended to carry out a certain task. An embedded device that is primarily used for smoke detection is a fire alarm, for instance.

An embedded system has three components –

- I. It has equipment.
- II. It has software for applications.
- III. A Real-Time Operating System (RTOS) is also included, which controls the application software and offers a framework for task scheduling to reduce latencies. The RTOS defines guidelines for the application program's execution and specifies how the system should operate. It's important to keep in mind that certain compact embedded systems are unable to include an RTOS.
- IV. Thus, a dependable, real-time control system based on a microcontroller and operated by software is an embedded system.

4.8.1 History of Embedded system

Here, are important milestones from the history of embedded system:

- I. Charles Stark Draper designed the Apollo Guidance System at MIT in 1960 using an embedded system.
- II. The D-17B computer used in the Minuteman missile guidance system was created by Autonetics in 1965.
- III. The first embedded system for a car was introduced in 1968.

- IV. In 1971, Texas Instruments created the first microcontroller.
- V. Wind River launched VxWorks, the first embedded operating system, in 1987.
- VI. In 1996, Microsoft released Windows embedded CE.
- VII. The first embedded Linux system originally debuted in the late 1990s.
- VIII. In 2013, the embedded market was worth \$140 billion.
- IX. By 2030, analysts predict that the Embedded market will be worth more than \$40 billion.

4.8.2 Characteristics of an Embedded System

- I. **Single-functioned** – An embedded system typically carries out a certain task and continuously repeats it. An example might be: A pager functions solely as a pager, maintaining its intended purpose
- II. **Tightly constrained** – All computer systems have strict restrictions on the design metrics, and numerous elements are subject to strict limitations, but they might be more so in embedded systems. Design metrics are a way to gauge an implementation's cost, size, power, and other characteristics. It needs to be small enough to fit on a single chip, quick enough to analyse data in real time, and power-efficient enough to prolong battery life.
- III. **Reactive and Real time** – Many embedded systems have to constantly respond to changes in their environment and calculate specific outputs instantly. Take a cruise control system in a car as an example; it continuously analyses and responds to speed and braking sensors. It must repeatedly calculate accelerations and decelerations within a set amount of time; if the computation is delayed, the automobile may not be controlled.
- IV. **Microprocessors based** – It must be microprocessor-based, either through a microprocessor or a microcontroller.

- v. **Memory** – Since its software is often embedded in ROM, it must have a memory. The PC doesn't require any extra memory.
- vi. **Connected** – It must have peripherals that are connected in order to link input and output devices.
- vii. **The HW-SW system** – For greater functionality and flexibility, software is utilised. Hardware is employed for security and performance.

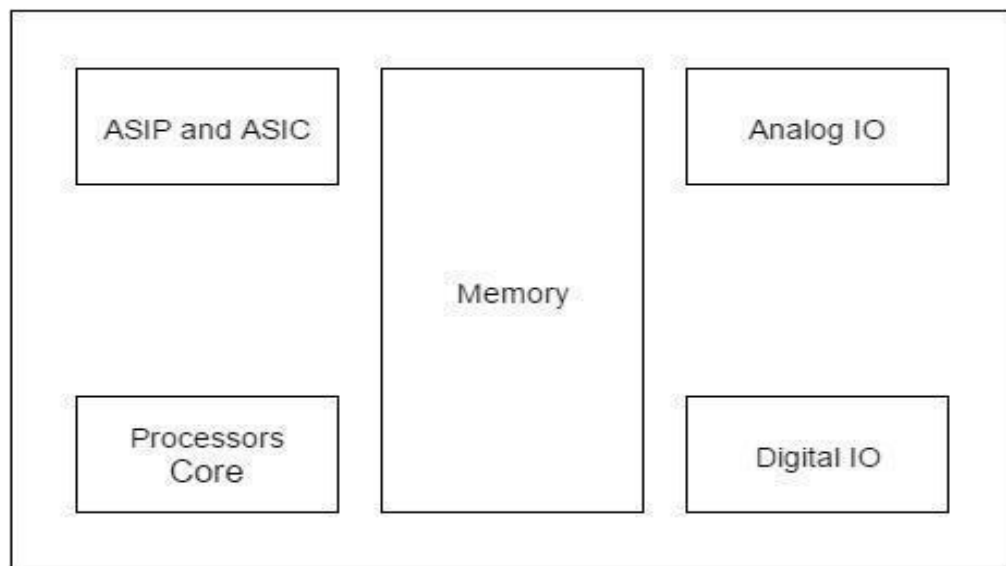


Figure 4.15: Characteristics of Embedded system

4.8.3 Basic Structure of an Embedded System

The following illustration shows the basic structure of an embedded system

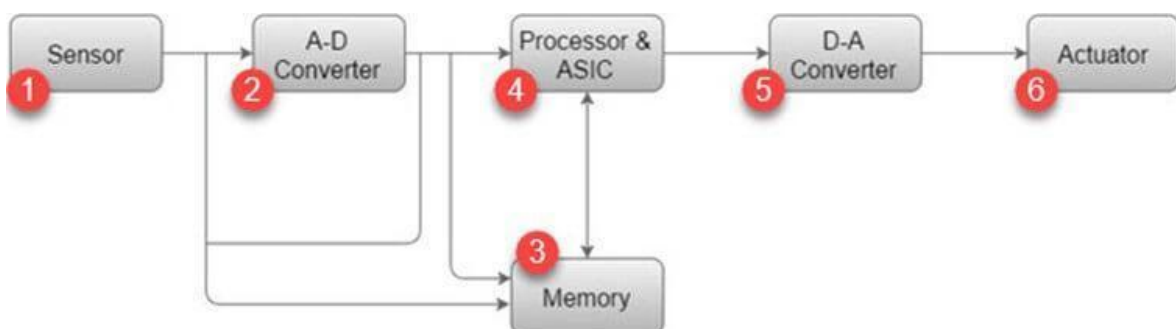


Figure 4.16: Structure of Embedded system

- I. **Sensor** – It measures the physical amount and transforms it into an electrical signal that an observer or any other electronic device, such as an A2D converter, can read. The quantity that was measured is stored in memory by a sensor.
- II. **A-D Converter** – The analogue signal that the sensor sends is transformed into a digital signal via an analog-to-digital converter.
- III. **Processor & ASICs** – Data is processed by processors to determine the output and store it in memory.
- IV. **D-A Converter** – The digital data provided by the processor is converted to analogue data via a digital-to-analog converter.
- V. **Actuator** – And actuator saves the permitted output after comparing the D-A Converter's output to the real (anticipated) output that was previously stored in it.

4.8.4 Important terminologies used in embedded system

Reliability:

This indicator indicates the system's survival probability during a critical period of operation.

Fault-Tolerance:

A computer system's fault tolerance refers to its capacity to continue operating in the face of errors.

Real-Time:

Systems that are embedded must adhere to a variety of time requirements. The inherent behaviours of the outside world in real time force them on it.

A strict real-time deadline, for instance, forces an air force department that monitors incoming missile assaults to accurately calculate and execute their counterattack. It will be destroyed if not.

Flexibility:

The development of systems with built-in debugging features enables remote maintenance.

For instance, you are developing a spaceship that will touch down on another planet in order to gather different kinds of data and relay the information back to us. We need to be able to do some crucial diagnostics in the event that this spaceship lost control and went nuts. So, while building an embedded system, adaptability is key.

Portability:

The convenience of employing the same embedded software in different contexts is referred to as portability. Between the application programme logic and the low-level system interfaces, generalised abstractions are necessary.

4.9 PROGRAM CODE

- MultiStepper steppers;
- Servo penServo;
- const int penServoPin =7 ;
- const int penZUp = 125;
- const int penZDown = 95;
- String inputString = ""; // a string to hold incoming data
- boolean stringComplete = false; // whether the string is complete

```

· long posx, posy;

· long positions[2];

· void move(long x, long y)

· {

·   posx = posx + x;

·   posy = posy + y;

·   positions[0] = posx;

·   positions[1] = posy;

·   steppers.moveTo(positions);

·   steppers.runSpeedToPosition(); // Blocks until all are in position

·   Serial.print("X=");

·   Serial.print(posx);

·   Serial.print(" Y=");

·   Serial.println(posy);

· }

```

CHAPTER - 5

RESULT AND DISCUSSION

5.1 RESULTS

Writing robots that can recognise speech have amazing accuracy rates. Over the years, speech recognition software's accuracy has significantly increased; some models now claim accuracy levels of up to 95%. As a result, voice recognition robots are a realistic choice for those who need to produce text fast and accurately since they can accurately translate speech.

Speech recognition writing robots increase efficiency in addition to accuracy. They enable users to produce written texts far more quickly than they could with manual typing since they can translate voice in real-time. For those who must generate a lot of text, like authors, journalists, and students, this is extremely helpful.

However, speech recognition writing robots have some drawbacks. For instance, outside influences like background noise or accents might influence how accurate the programme is. Furthermore, the software might have trouble decoding complex or technical language, which could lead to transcription errors.

5.2 DISCUSSION

Writing robots that can recognise speech have the potential to completely change how humans produce written material. These robots may save consumers a lot of time and effort by doing the manual typing for them. They are especially useful for anyone who must produce vast amounts of text, such authors, journalists, and students.

It is crucial to remember that speech recognition writing robots are not flawless. They still need human review to make sure the text being transcribed is accurate. Furthermore, the software might have trouble comprehending certain accents or technical language, which could lead to mistakes.

Speech recognition writing robots are anticipated to grow more precise and effective as technology advances, making them an even more beneficial tool for those who need to produce written content fast and accurately.

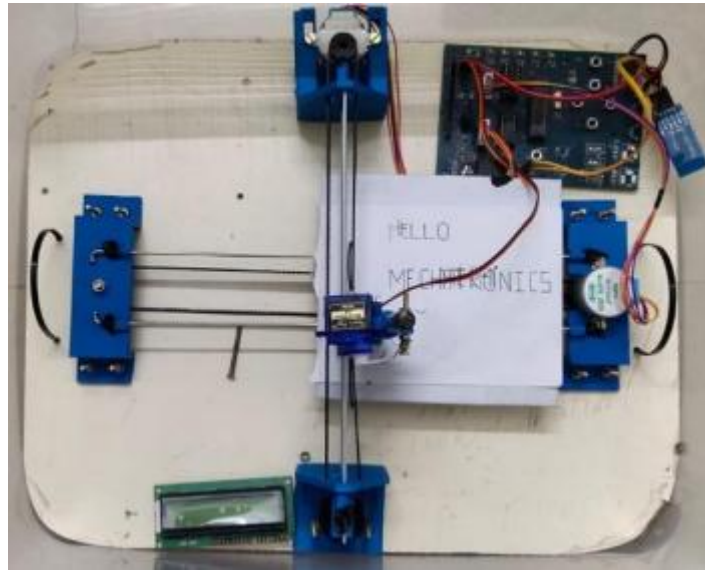


Figure No: 1

Here in the board we are using an Arduino controller to receive the speech data through Bluetooth and the same will be converted into the action using the motors in the device. The conditions will be provided in the form of code in the Arduino microcontroller.

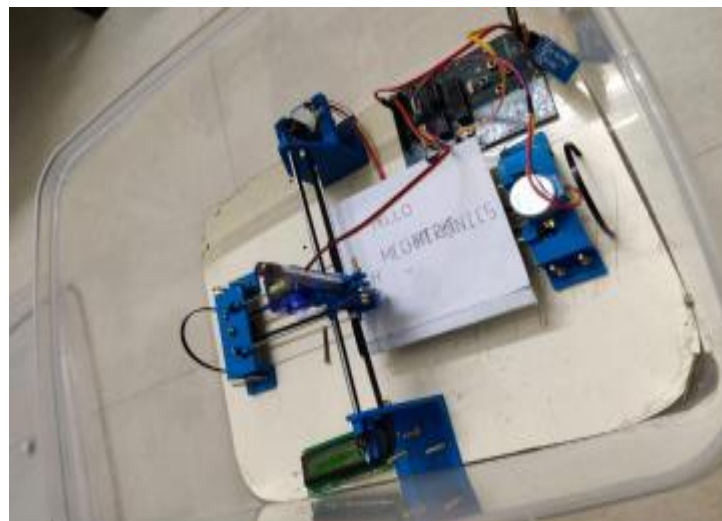


Figure No: 2

Here in figure 2, we can see that the robot is writing using the motors. We have attached a pen by creating a suitable setup. The setup is moved as per the lines

and the robot starts writing the content provided to it through the speech. Apart from writing, the robot will also shift the line automatically.

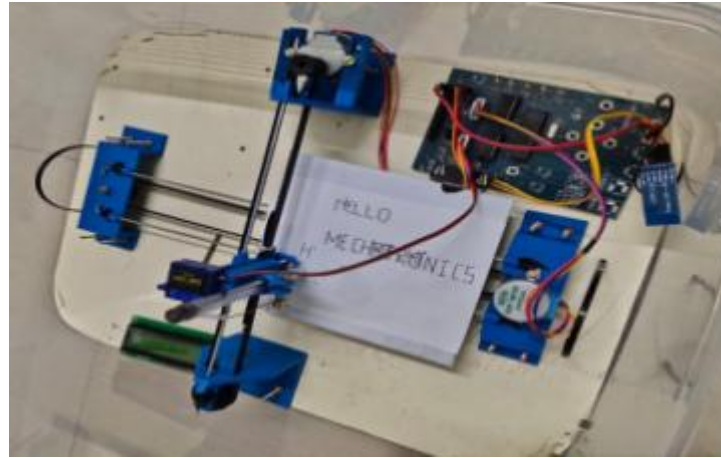


Figure No: 3

In this pic the content provided using the speech is being printed on the paper. Which can be verified.

CHAPTER 6

SUMMARY AND CONCLUSIONS

6.1 SUMMARY

Speech recognition writing robots are software applications that use natural language processing and machine learning algorithms to convert spoken words into written text automatically. These robots have become increasingly popular in recent years due to their ability to save time and effort for individuals who frequently need to transcribe spoken words into text.

The development of speech recognition technology has come a long way in recent years, and speech recognition writing robots are now more accurate than ever before. They can understand a wide range of accents and dialects and are able to accurately transcribe even complex sentences.

One of the main advantages of speech recognition writing robots is their ability to save time and increase productivity. They can transcribe speech much faster than a human, and this can be especially beneficial in situations where there is a lot of spoken content that needs to be converted into text quickly.

6.2 CONCLUSIONS

However, speech recognition writing robots are not perfect, and there are still some limitations to their accuracy. They can struggle to accurately transcribe speech in noisy environments, and they may struggle with complex or technical language.

Overall, speech recognition writing robots are a valuable tool for individuals and organisations that need to transcribe spoken words into text quickly and efficiently. While they are not perfect, they can save a significant amount of time and effort and can be a valuable addition to any transcription workflow.

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ANNEXURE

Submitted the review paper titled "A REVIEW ON WRITING ROBOT" in IJCRT-2022 on 2nd December 2022.

Review paper under scrutiny for Journal publication.

Filed the Design Patent titled "Bi-axial Speech to Text Writing" on 17 th March 2023.

Submitted the Research Paper titled "DESIGN AND DEVELOPMENT OF DUAL AXIS VOICE RECOGNITION WRITING ROBOT FOR PHYSICALLY CHALLENGED PERSON" for RASET 2023 Conference on 17th April 2023.

Presented the Research paper in National Conference RASET-2023 held at Bannari Amman on 4th May 2023.

Research paper under scrutiny for Journal publication