2023 IEEE International Conference on Distributed Computing, VLSI, Electrical Circuits and Robotics (DISCOVER) | 979-8-3503-4012-9/23/$31.00 ©2023 IEEE | DOI: 10.1109/DISCOVER58830.2023.10316691

Dictowriter: Speech-to-Text Plotter

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***Abstract*—Individuals with disabilities face unique challenges in both their daily lives and education. As society becomes increasingly complex, visually impaired and physically disabled students may find it challenging to keep up. Therefore, it is essential to understand the eeds of these students and explore how technology can help them. Assistive technologies, including both hardware and software, can help individuals overcome barriers obtain better results in life and academic achievement. One example of an assistive technology is a voice-activated plotter that can recognize speech using a Bluetooth app and transcribe spoken content onto paper or other writing materials. Such a tool can be especially helpful for individuals with visual or physical impairments who may have difficulty writing or typing. However, creating an accurate and accessible voice-activated plotter can presentsome design challenges that need to be addressed**

***Keywords*— Raspberry Pi, Arduino Uno, CNC, G-Code, Bluetooth SSP Manager**

I. INTRODUCTION

The purpose of this project is to address the challenges faced by people with physical disabilities and vision impairments receiving an education, especially during exams. These students often require assistance from scribes, who may not fully understand their needs or represent them accurately. The use of technology, such as a voice- activated plotter, can enhance the user experience and enable these students to become more self- sufficient.

The Raspberry Pi-based plotter with voice recognition recognizes speech using a Bluetooth app and converts it to G-code, which writes the uttered words down on a paper. This solution is less susceptible to tampering and can provide a more secure and dependable method of taking exams.

The Ministry of Social Justice and Empowerment has established rules that permit the use of assistive technology in place of a scribe, including computers, Braille readers, and audio recorders. This project complies with those guidelines and can empower disabled students to become more self-sufficient and shape their future.

Overall, the development of assistive technology can significantly improve the lives of disabled students and provide them with equal opportunities in education,

Besides scribes, students with visual disability may need helping aids like screen readers or Braille displays to access digital materials and participate in online courses. Many educational institutions offer disability support services that provide accommodations for students with disabilities, including scribes and assistive technologies. It is critical for teachers and professors to understand the needs of their disabled students and collaborate with them to ensure that they have access to the materials and resources required to excel in their studies. Inclusion and accessibility should be a top priority in education to ensure that all students have equal opportunities to learn and succeed. By providing accommodations and support to disabled students, we can help them overcome the obstacles they face and achieve their academic goals.

The voice-activated plotter is being designed to be user-friendly and easy to operate, with simple voice commands for the writing process. The plotter will feature a high-quality Bluetooth app to ensure precise speech recognition and a quick printing mechanism to increase writing speed.

The device will also have a built-in dictionary to ensure accurate spelling and pronunciation of course terms. The plotter will be portable and lightweight, making it easy for visually impaired and physically disabled students to carry it around and use it as needed.

The project will entail collaboration with disability support services and organizations to ensure that the voice-activated plotter fulfills the specific needs and requirements of disabled students.

The project will also involve testing and user feedback to ensure that the voice- activated plotter is effective in assisting disabled students in completing their coursework activities.

II. LITERATURE SURVEY

Deepak Mehendiratta et al [1, 11], have proposed a project to design a low-cost CNC plotter machine using

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Arduino UNO V3, which can create 2D designs and sketches. The machine is controlled using G codes. This work focuses on the advantages of this low-cost Computer Numerical Control plotter machine compared to other CNC machines.The software used, BANBOX, is open-source and user-friendly. Additionally, the machine does not require skilled labor, making it accessible to a wider range of people.

Patil et al [2], developed a machine which controls the movement of the stepper motors. One of the project's advantages is that it is cost-effective, making it an accessible option for educational institutions and laboratories.

The use of open- source software, such as Inkscape and Universal G- code sender, also makes the project[2] more accessible to a wider range of users.

Pandey et al [3], reported a low-cost CNC plotter machine using Arduino and a CNC shield that is capable of designing mechanical parts and 2D designs. The project's goal is to bring down the cost and complexity of the CNC machine while still being able to design and fabricate mechanical parts and 2D designs. The project uses G codes. The CNC plotter machine is capable of designing 3D objects on 2D paper.

Hasan et al [4], studied low-cost CNC plotter machine that is designed to sketch 2D pictures of objects. The system requires a device with three-axes for controlling the X, Y, and Z-axes. he Arduino IDE is used for programming, while the CAMotics software is utilised to produce G-code. Using the Processing software, GCTRL code is transformed into Arduino code. The three motors can function as directed by the CPU through the motor driver after the G-code has been loaded.

Kamble et al [5], investigated the integration of CNC technology and 3D printing to create a 2D plotter machine for drawing circuits on any surface. The use of conductive ink or marker is a novel idea. Benbox software for generating G-code and inputting image data for the plotter.

Hyder et al [6], The CNC Plotter machine can be used for drawing, engraving, cutting, and even for 3D printing. The machine can read G code which is generated by different software such as Inkscape, CorelDraw, AutoCAD, etc. The G code is loaded into the Arduino board, which translates the code into electrical signals that can be processed by stepper motors. The machine can then execute the instructions and move the pen to create the desired design or object.

Girhe et al [7], The CNC machine is designed with three-axis control for X, Y, and Z directions The G code is generated using CAM software and is loaded into the system using Arduino IDE. The system is then controlled by a computer to draw and drill the PCB.

Ahmed et al [8], built a project to build a low- cost Arduino-based plotter machine using open-source hardware and software. The plotter machine is controlled by Computer Numerical Control and operates on three axes: X, Y, and Z. The Solid Works software is used to model the system, while G-code is used to operate the machine.

Nagdewani et al [9], reported a work aimed at examining the various Text-To-Speech (TTS) and Speech-To-Text (STT) conversion strategies that will be employed in an interactive voice response- based speech-based email system. The study concludes that Hidden Markov Model (HMM) is a statistical model that is most suitable for both STT and TTS conversions due to its accuracy and efficiency.

Based on the review study, the proposed model uses HMM and Artificial Neural Network (ANN) methods for STT and HMM for TTS conversions.

Shinde et al [10], developed a machine to detect any human intrusion and stop the machine immediately to avoid any accidents. The proposed system has high accuracy and can efficiently mill PCBs with high accuracy and precision.

Operation of the System:

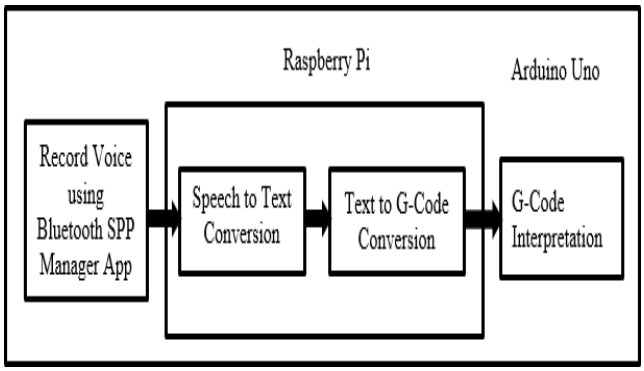

Fig 1. Block Diagram of Dictowriter Operation

Fig 1. shows the block diagram of dictowriter operation which takes speech as the input.

The Bluetooth Serial Port Protocol (SPP) Manager App accepts the voice command given by the user and converts it into text format. The formed text is sent to Raspberry Pi wirelessly through Bluetooth.

The communication between the app and Raspberry Pi is done using Bluetooth technology. The Raspberry Pi has operating system contains hf2 G-code library which is written in C language that converts the text into G-code. G-code is a programming language for CNC that instructs a machine where and how to move. The G-code formed is sent to the CNC plotter controller which has Arduino as the main controller. The serial communication between Arduino and Raspberry Pi is done through USB (universal serial bus) cable. The CNC controller has two components Arduino and CNC shield.

The Raspberry Pi sends the G-code to the CNC plotter controller, which then interprets it to control the movement of the CNC plotter. A servomotor is used to elevate the pen in the Z- axis, and two Nema 17 stepper motors are utilised to move the X and Y axes. These motors are driven by two A4988 stepper drives. The two A4988 stepper motor drivers are embedded in the pin ports of the CNC shield.

The Arduino accepts the G-code which is interpreted by open source high functional software called GRBL firmware that runs directly on Arduino. Thus the GRBL software executes the G-code formed from the input and plots the

spoken contents of the paper. The main uniqueness of this project is that it doesn't use the internet and the usage of a Bluetooth app in the system makes the user convenient to use.

1. Mechanical Assembly

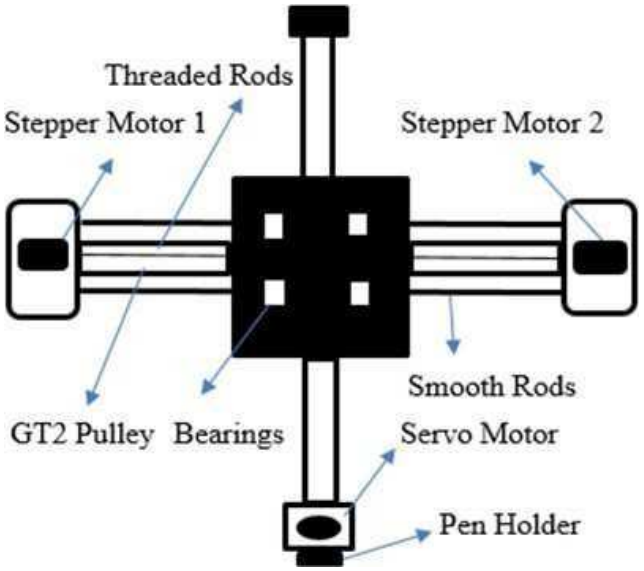

Fig 2. Mechanical Structure of Dictowriter

According to Fig. 2, the plotter must move in both the X and Y directions. There are primarily three travelling mechanisms: the H-bot, the T-bot, and the core XY. To create the motion for this project, we are using a basic XY control system. Core XY is a motion control method for 2D axes that utilises a single continuous belt for both axes.

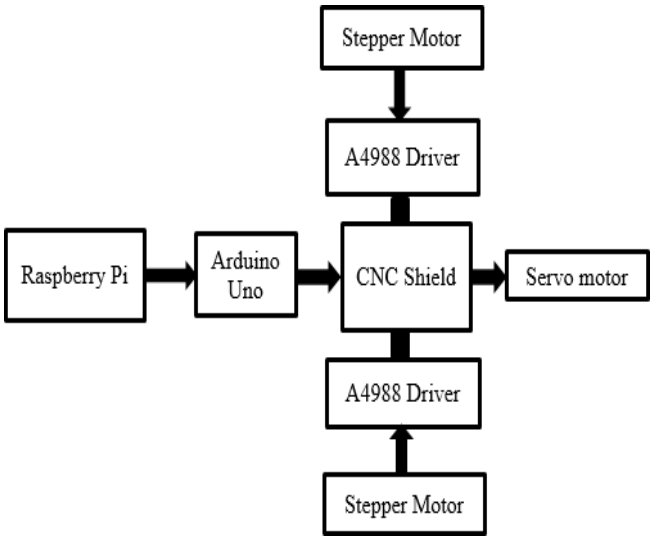

Fig 3. Hardware Connection of Dictowriter

The core XY mechanism's advantage is that the Y axis motor and the X axis motor are both mounted on the main chassis. This keeps the centre of gravity near to the chassis and minimises the weight of the X axis mechanism because it does not need to support the weight of the Y axis stepper motor.

III. CONCLUSION

It has been suggested to create a speech-to-text plotter, and a prototype has been created. The speech-to-text plotter that has been constructed and tested on a Raspberry Pi is described in depth in this project. The output is produced utilising the fundamental XY motion control mechanism and an Arduino-based X-Y plotter.

The first stage in building this plotter is speech-to-text conversion, which is accomplished by utilising the Bluetooth SPP Manager App. The suggested system is then tested for speed, and various measures have been taken to increase the system's writing pace. The font and feed rate used for plotting have a significant impact on the system's speed. Although the text tends to become unreadable as the feed rate is increased, this can be done to obtain faster speeds. Different single-line typefaces created specifically for CNC plotters are available.

The Bearings provide precise, safe and reliable linear motion systems. Linear motion bearings are mostly used in 3D printers and CNC machines. In the robotics field, smooth metal rods and Threaded Rods are usually used on the axis for 3D printers or CNC machines to slide on.

IV. RESULT AND DISCUSSION

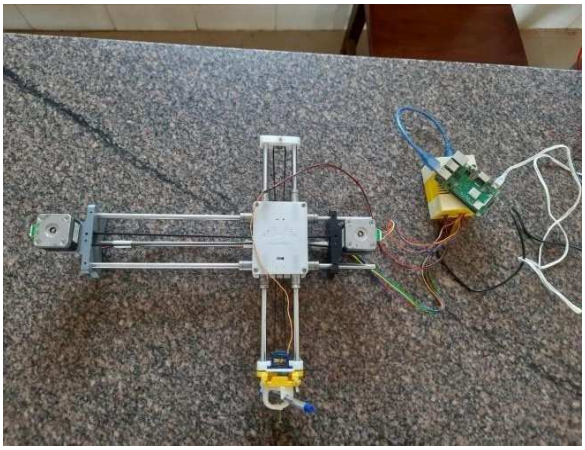

Fig 4. The Final Proposed System

The proposed system uses a Bluetooth spp manager app to record speech that converts speech to text. Raspberry Pi receives the text, converts s into G- code using the Hf2gcode library and sends the G- code of each character serially to Arduino which controls the plotter through execution of G-code in GRBL Firmware. Thus the spoken text is plotted on Paper or any writing material. For Bluetooth accepting voice and plotter writing the text is through threading operation.

The actual conversion of the prototype into a finished product is significantly influenced by the plotter's speed. The plotter machine is told to transcribe random text. An adult can write about 60 characters per minute on average.

Human writers typically produce between 50 and 70 characters per minute. We have attempted to write 20 characters per minute using this prototype's initial iteration; however, this speed can be boosted by employing smaller character font sizes.

When compared to the speed of a human writer, the comparison's results, however, have a 40% efficiency rate. Using high-quality stepper motors with faster speeds and raising the feed rate of the motor can boost the speed.

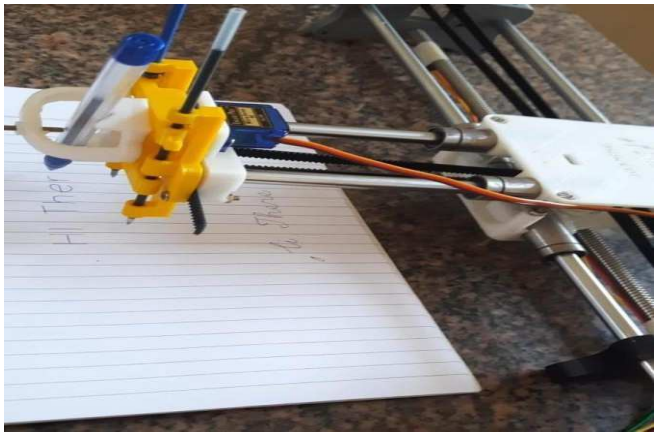

Fig 5. The Proposed System in action

However, one of the drawbacks in this situation is that it is impossible to translate the speech-to-text interface's symbols into the text file's symbols. Instead, it can be plotted on the paper if the symbols are manually written. Additionally, while speaking, the first letter of the sentence cannot be capitalised; however, it can be done manually. Additionally, this technique is useful in schools for children with physical disabilities and schools for blind students. Exams can also be written by students with physical disabilities using this technique.

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