

Robotic Writing Arm Based on Voice and Gesture Command for Physically Challenged

¹J. Jijin Godwin, ²G.Shanmugaraj, ³M.Harshithaa, ⁴K.Sandhiya, ⁵S.Arivu Suder

Abstract--Robots will be a powerful replacement of humans in the world future decades. Physically challenged people are facing difficulties to express their views to the world through alphabets. To overcome these hindrances many works have been proposed. In existence robots are trained to assist the physically challenged in writing by voice command or gesture command. The objective is to aid the physically challenged people to write virtually. Amputee and visually challenged are benefitted. Deep neural network algorithm is put forward. SIFT and classification model are the key ingredients of this algorithm. Three different inputs like voice command, camera-based input and MEMS hardware interface using ZigBee are given. In the proposed work, voice command is processed on an android application, image input is given through camera and gesture is given as input using MEMS. A robotic arm is designed, such that it writes alphabets on command. This approach aids the physically challenged people to translate the gestures and speech to written format.

Keywords--Mems, Physically challenged, Robot, Zigbee

I INTRODUCTION

In recent years, robotics has become a major research area. Society's framework has been changed by robots and paved the way for safer conditions of labour. Nowadays robots have become indispensable in almost all industries [1]. Different tasks are done with high precision by robots that help physically challenged people [1]. Handwriting is model of human motion that is crucial for physically challenged people especially people without hands [2]. They find it difficult to express their views in the form of characters or letters for writing. Challenging tasks can be addressed by robots used for real-world exercises[2]. Hand gesture recognition has become a trend in computer vision applications that performs well in real-time systems[3]. Writing with the aid of hand gestures helps the visually challenged to imprint their views on paper. Even amputee can do writing operations by giving voice commands to the robot[4].

¹Assistant Professor, Department Of Electronics and Communication Engineering, Velammal Institute of Technology Department of ECE, India, Email:jjjgodwin.j@gmail.com

²Assistant Professor, Department Of Electronics and Communication Engineering, Velammal Institute of Technology Department of ECE, India, Email:gsraj76@gmail.com

³Assistant Professor, Department Of Electronics and Communication Engineering, Velammal Institute of Technology Department of ECE, India, Email:gsraj76@gmail.com

⁴Assistant Professor, Department Of Electronics and Communication Engineering, Velammal Institute of Technology Department of ECE, India, Email:gsraj76@gmail.com

⁵Assistant Professor, Department Of Electronics and Communication Engineering, Velammal Institute of Technology Department of ECE, India, Email:gsraj76@gmail.com

One of the primary tasks to be performed by the robot is writing skill [4]. A physical ailment is a hindrance on a person's chore. Visual impairment influences their standard of life and the capability to communicate with the surrounding environment [5]. Thus a robot is proposed to address the problem i.e to help people write virtually. The robot is designed in such a way that it can handle inputs like voice command, camera based input and hand gestures. Robot reacts accordingly for any one of the inputs from the user[5]. Gesture is non-verbal form of conveying messages through gesticulation of body parts[11]. Improving their welfare and movability is on-going research process [16]. The long term goal is to promote independence of handicapped [18]. A sophisticated tool used in our day-to-day lives is human hand[18]. Arduino uno board, MEMS (Micro Electro Mechanical Systems) sensor, servo motor, android mobile application, zigbee are used for this purpose. The robot has a pen attached to it and it writes when it receives the input. In the world of developing technology robots have a long way to go. In the next few decades robots will be a complete assistant for physically challenged.

II PROPOSED APPROACH

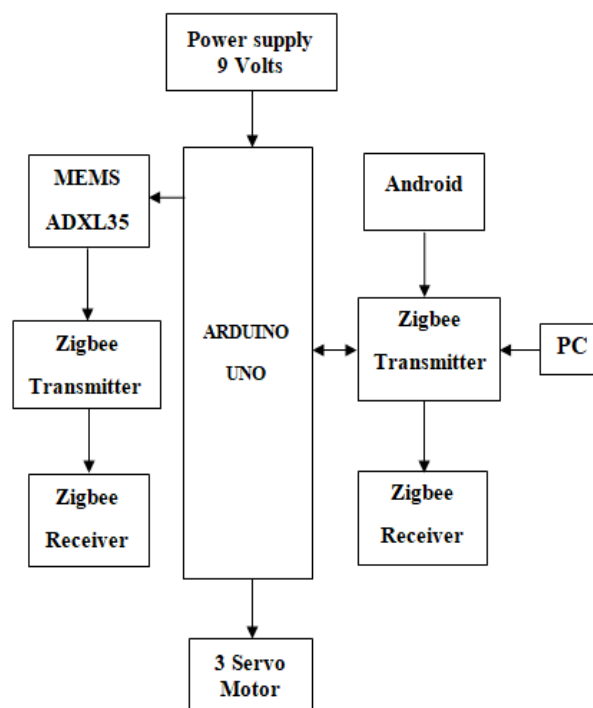


Figure 1: Block diagram of Robotic arm

A positioned that permits for meticulous control of angular stance is servo motor that can be applicable in excessive speed applications. Only minor current is drawn besides uses a encoder, mostly resistive potentiometers are used as the encoder in uncomplicated servo motors. MEMS- Micro-electro-mechanical systems corresponds to micro-mechatronics that utilizes the technique which is associated with the motion parts is microsystems. Here two MEMS sensors of configuration (ADXL3577) are used. It has a IC that helps to

process the data and micro sensors which communicate with the environment furthermore the classification of MEMS is capacitive and ohmic. The steps involved in the fabrication of MEMS are,

1. Deposition process
2. Patterning
3. Etching process
4. Die preparation

IEEE 802.15.4 is the zigbee standard, it is a protocol that was built by the member firms of the zigbee alliance. Zigbee acts as transceiver and principle is based on the method honey bees employs to interact to other bees of the colony which guarantees security. It is used for two-way communication as well as employed for applications that needs low power, cost, data-rate and long lasting battery life. Arduino uno is an one of the open-source platform which not only has simple to use hardware and software but also uses the ATmega 328 microcontroller. Arduino microcontrollers are pre-programmed with a boot loader that makes it easy to load the programs to -the on-chip flash memory along with the digital pins and analog pins are 14 and 6 respectively. The components receive power through the power supply i.e the electric power is delivered to the elements by the power supply furthermore one form of energy is converted to another form including types namely unregulated, linear regulated, and switching of power supplies.

The process is initiated by loading a set of images in the personal computer. Three inputs voice input through android application, hand gesture through MEMS sensor camera input are provided.

Table 1: Type of input

TYPES OF INPUT	CONVERSION	
VOICE	ANDROID EMBEDDED	TC
GESTURE	EMBEDDED EMBEDDED	T ₁
CAMERA BASED INPUT	MATLAB EMBEDDED	TO

Figure 1 shows the working model of the robotic arm. Android app is developed to recognise the voice where the recognised data input is realised by the zigbee which acts as a receiver, located in the robot and the range of zigbee used is 50-100metres. Figure 3 shows the opening screen of the application. Mobile is interfaced with zigbee transmitter, transmits data to the robot through the wireless medium. MEMS are based on direction and these directions include forward, backward, up and down. Two MEMS sensor are installed in which each of the moves is considered a value. If one of the MEMS sensor is idle and the other one is in movement, then the value assigned to it is transmitted through wireless communication by zigbee. Zigbee receiver recognises the gesture input with the value assigned to it and starts to write the recognised word. Camera input is processed by MATLAB software using neural network algorithm. A set of images with certain gestures is loaded where the input is given through camera and that input is compared with the loaded image such that the one which matches accurately is taken as output which is transmitted to the zigbee receiver and it is written by robot. Neural network algorithm is used for image recognition. Arduino board controls the overall operation which works on 5volts

inbuilt arduino power supply but here 9volts power supply is used, as 5volts will not be sufficient for all operation. The robotic arm is designed such that it has 3 servo motors one at top and others at left and right i.e the top servo motor is used to lift the pen and the left and right servo motors are used for the flexible movement for each letters or character according to the prescribed algorithm

III ALGORITHM

Neural Network is nothing more than a set of haphazard functions with alterable framework to give an expected output. Neural network is a sequence of algorithms that attempts to confess primary interrelation in the set of data through a procedure that imitate the method Homosapiens work. Neural networks can adjust to alterable feed in; so the network kindles the finest viable outcome without necessitating remodelling the output category. It interpret sensory data through a quite fairly machine apprehension. Neural network owns extensive learning capabilities and are extensively utilized for more composite function. In this work Neural Network algorithm is used for Image and Pattern recognition. The ANN's way to find solution for a problem is similar to the way human brain does. Figure 2 shows a typical neural network structure. Each node is represented as circle and it denotes an artificial neuron. Arrow indicates the interconnection from the output of one artificial neuron to the input of the other. Neural network has the ability to learn. Learning is acclimation of the network to manage a job by assuming sample considerations. Learning implies to alter the weights of the network to boost the precision of the output. Observed errors are reduced to do this. Learning is fulfilled by verifying supplementary observations. After the learning process if the error rate is immense then the network must be rebuilt. It divides the feed in given into several layer of abstraction. System comprehends to do the works by taking examples without being pre-programmed with particular rules of the task. For example in image recognition, the system has the ability to spot the gestures and relate it to the character that has been already loaded. Recognition relies on kind of the dataset; the images used to teach and evaluate the model. The images should have the similar aspect ratio and dimensions. Generally neural network representations infer a square shape feed in image.

Scale Invariant Feature Transform(SIFT) is used for extracting features in an image that is colour, joints, texture. These features are considered as keypoints and are stored in a separate file. These features are essential in defining an image. Classification model in Neural network is used for matching the images based on the extracted features. Particularly, Deep Neural Network(DNN) is essential for correct matching of the images.

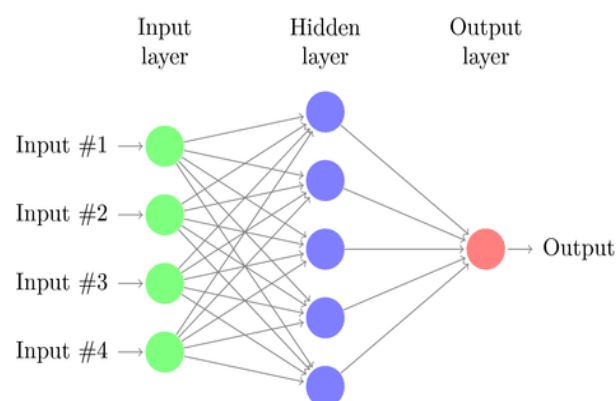


Figure 2: Typical neural network

IV RESULT AND DISCUSSION

Gradually humans are being replaced by robots. The prototype model was developed to help the physically challenged. Figure 3 shows the working model of the proposed work.



Figure 2: Writing set up

In the case of gesture input, gestures are given through MEMS sensor and through the communication between the zigbee transmitter and receiver, the robotic arm writes. Each gesture is assigned an alphabet and when that particular gesture is given as an input, the corresponding alphabet is written. The default pictures of specified gestures are fed into the camera, and when the input images are given, the images will be compared by the neural network to check if they match. The matching is done by neural network algorithm which has data set as their key. If it finds a match, then the alphabet corresponding to the gesture image is written by the robotic arm.

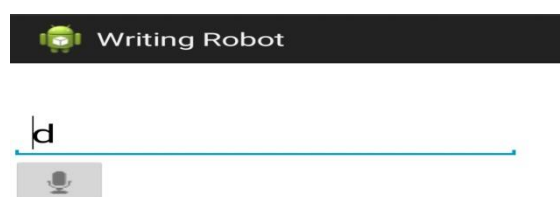


Figure 4: Speech recognition and application

The voice input is shown in Figure 4. Here the screenshot of android application that is associated with googleapk is shown. Voice assistant is used for feeding the input.

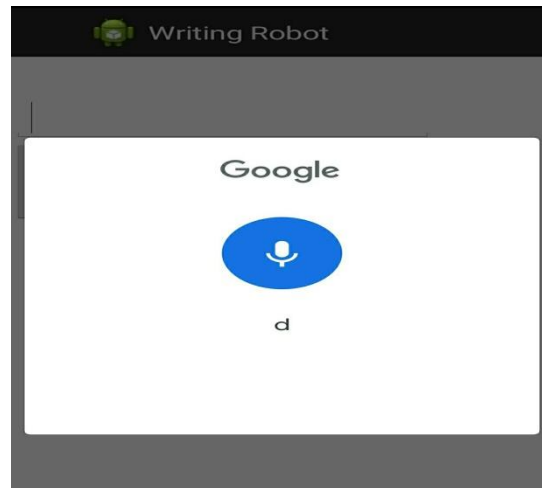


Figure 5: Voice recognition

The input recognition is shown in Figure 5, where the voice input recognition is done through zigbee protocol. The robotic arm writes the recognized alphabets in the paper.



Figure 6: Robot writing - output

The output of robotic writing arm is shown in Figure 6. Here the robotic arm writes in accordance with the instructions given by the user. This can be used as a writing tool even by students to make their work easier.

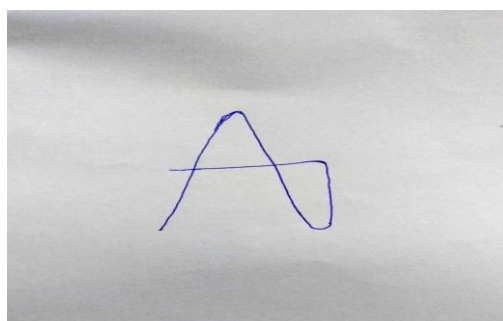


Figure 7: Written alphabet

The output obtained is shown as in Figure 7. The alphabets recognised by any one of the input is obtained in written format.

V CONCLUSION

Robots are not able to perform all the daily tasks but they are capable of assisting people to a great extent. In this paper robotic writing arm using MEMS Sensor and Zigbee has been proposed. Here robot is designed in

such a way that it can handle inputs like voice command, camera based inputs and hand gestures. Voice commands are processed by android application and hand gestures are useful and will aid not only visually challenged people but also people without hands. This viability of operation for high fidelity work is justified in this experiment. In future, zigbee range can be extended to few more meters after getting proper licence so that distant people can also be able to voice out their communication. Visually challenged people will find it more useful when the voice android application emerges on the home screen on the voice commands given by them. The application must automatically open when needed.

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