AI BASED HUMAN HAND GESTURE RECOGNITION FOR COMMUNICATION BETWEEN IMPAIRED PEOPLE

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ABSTRACT: *Gesture Recognition aims to develop an assistive system that automatically converts an input sign into corresponding text. There are various methodologies of implementing gesture recognition system. The major challenge in the complex backgrounds in the images. In many cases, these complex backgrounds are not eliminated properly and results in more error scenarios. With the industry moving towards to applying Gesture Recognition widely with human interfaces, the accuracy should be good and the error variance should be brought down as much as possible. In the project, we work towards handling complex backgrounds with advanced background elimination techniques and ANN to classify gestures. And then classified gesture signal send through the UART to microcontroller and display the gesture to text recognition.*

KEYWORDS: *ANN, UART*

I. INTRODUCTION

As computer innovation keeps on developing, the requirement for characteristic correspondence amongst people and machines additionally increments. In spite of the fact that our cell phones influence utilization of the touch to screen innovation, it is not sufficiently shabby to be actualized in work area frameworks. In spite of the fact that the mouse is exceptionally valuable for gadget control, it could be badly arranged to use for physically disabled individuals and individuals who are not familiar with utilizing the mouse for connection. The strategy proposed makes utilization of a webcam through which hand gestures gave by the user are captured and identified accordingly. Hand gestures have boundless applications. In this, we apply to a system to make a straightforward easy to understand interaction interface. The detection is done using the various techniques of Contour Analysis and Feature Extraction. The project invokes the use of various computer vision techniques and algorithms which are involved in the determination of hand gestures.

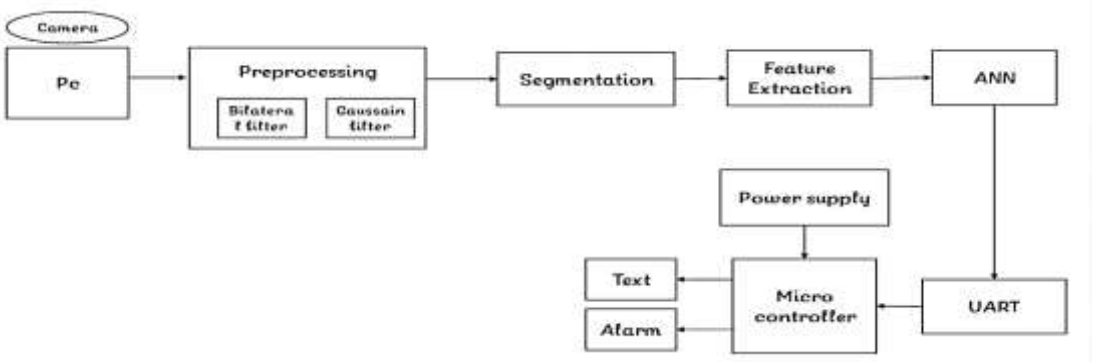

Fig 1 Block diagram of the proposed model

II. RELATED WORKS

S2LV – A Sign to letter and voice converter: There are more than 70 million deaf, mute, or deaf-mute people around the word according to the World Federation of the Deaf (WFD). An obvious solution may be reading lips which is not an easy way to communicate. The S2LV aims at eliminating the barriers in communications between people who have disabilities. The S2LV is a smart talking glove which can be used by any deaf and/or mute person regardless of his/her age/gender. The S2LV is designed to detect the motions of the hand and translate the signs to letters and voice with a high degree of accuracy. In this way, the S2LV solution will also be able to help blind people as well as those who are not able to read letters. The aim of this system is to manipulate a glove in order to translate the letters of the alphabet. The system will be implemented using a micro-controller based circuit that will read the hand articulations, analyze the sign, and then using an android application will generate the letters. The glove can be worn all day and cannot function unless it is connected and used properly. The hand movements will be detected by the five sensors. Then the signal will have different voltages converted to digital values as inputs to the microcontroller to display the desired letters.

Gesture recognition for sign language: This paper proposes two new approaches of hand gesture recognition which will recognize sign language gestures in a real time environment. A hybrid feature descriptor, which combines the advantages of SURF & Hu Moment Invariant methods, is used as a combined feature set to achieve a good recognition rate along with a low time complexity. To further increase the recognition rate and make the recognition system resilient to view-point variations, the concept of derived features from the available feature set is introduced. K-Nearest Neighbour (KNN) and Support Vector Machine (SVM) are used for hybrid classification of single signed letter. In addition, finger spelled word recognition using Hidden Markov Model (HMM) for a lexicon-based approach is also proposed in this paper. The performance analysis of the proposed approaches is presented along with the experimental results. Comparative study of these methods with other popular techniques shows that the real time efficiency and robustness are better.

Hand sign recognition based communication system for speech disable people: Sign languages are used to convey meaning to the other people. Sign language may consist of hand gestures, expressions of face, position of fingers to covey their ideas. In this system they developed a custom-designed data-glove using Intel Galileo Gen 2 Iot kit. He also uses flex sensors and gyroscopes. Five flex sensors are placed on the gloves, one for each finger and the thumb. Flex sensors can measure the bend angle of fingers and give the analog output. He uses XBee for transmitting and receiving purpose. He uses Intel Galileo powerful processor to collect the data from the receiver and then further process and classify the actions into sign language alphabets. The analog data is converted into digital with the help of ADC which is present in the microcontroller. The main aim of this system is to provide a glove which has an ability to identify gesture and display an alphabet which is designed to that gesture. Thus, this system has an ability to provide accurate and simple communication between normal and impaired people.

Dynamic gesture recognition using inertial sensors-based data Gloves: Gesture recognition systems provide a natural interface of interaction between humans computational systems. The multi-modal dataset included the sign language information of data gloves and skeletons is built. Then the convolutional neural network structure for sign language recognition named SLRNet is designed. It mainly consists of a convolutional layer, a batch normalization layer, and a fully connected layer. The collected data is more stable and including more information. A new LS-HAN framework suitable for continuous sign language recognition is proposed, which eliminates the need for time domain segmentation and jointly optimizes correlation and identification loss.

Hand Gesture Recognition Using Computer Vision: The hand gestures are one of the typical methods used in sign language. It is very difficult for the hearing-impaired people to communicate with the world. This project presents a solution that will not only automatically recognize the hand gestures but will also convert it into speech and text output so that impaired person can easily communicate with normal people. A camera

attached to computer will capture images of hand and the contour feature extraction is used to recognize the hand gestures of the person. Based on the recognized gestures, the recorded soundtrack will be played.

III. EXSISTED SYSTEM

Gesture based communication is the normal method for correspondence of hearing, discourse impeded individual and dead-end patients. Gesture recognition as a natural, convenient and recognizable way has been received more and more attention on human-machine interaction (HMI). Sign language communication is utilized over the world to help connect the correspondence hole for the incapacitated patients. Sign language can be used by the patients to convey the message by depicting alphabets using hand gestures and forming a sentence to talk. Specific hand gesture has been assigned specific alphabets, numbers which will then be used to form a sentence and communicate. This would take a lot of time and energy. Among the gesture recognition methods based on wearable devices, the most typical one is the recognition method based on wearable data gloves. In the existing system for the generation of the image feature, takes a picture and transform it. This method uses the six-axis or nine-axis sensor on the data glove to detect the joint angle and bending information of the finger. In addition, the glove usually measures the spatial trajectory of the hand simultaneously through tracking equipment. The gesture will be translated into its recognized character or alphabet or word from the gesture which is beneficial to understand. A sign to letter translator system using a hand glove can be used by person to communicate with people that do not understand sign language. The performed signs, with the hand wearing the glove, are displayed as alphabetic letters or words on the LCD. This glove can be very useful for the communication issues that arise between the people suffering from hard of hearing and the people that do not. It is designed to facilitate the communication between the transmitter and the receiver so that the meaning of the message is properly reached and completely understood.

The proposed algorithm states that three flexi force sensors for three fingers that each sensor has two ranges of voltage and each range indicate one word, this word will display on LCD and vocalize by speaker. Sensors convert the known applied load into voltage and an Arduino microcontroller will receive this voltage and order the LCD and speaker to display and vocalize the defined word. Basically the proposed work consists of two parts,hardware and software parts. The hardware part uses an Arduino microcontroller, three flexi force sensors, LCD, and audio processing, while the software part focuses on programming the Arduino microcontroller to translate highpresses of the flexi force sensors into words and sound.

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A. Hardware Part

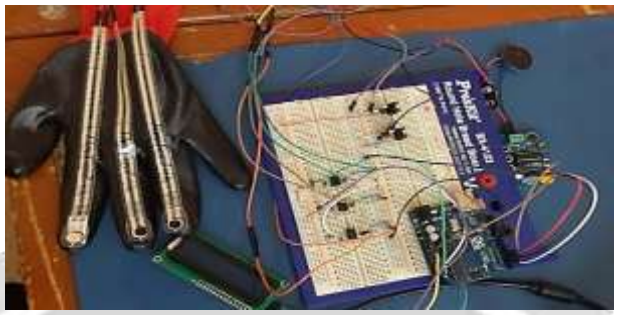
At this part, a A201-25 flexi force sensor that is shown in Fig. 2 with a range of 0 to 110 meter was selected. The thickness of the sensor is approximately 0.2 mm and is very lightweight, the repeatability is ±2.5%. The active area of this sensor consists of an ultra-thin and flexible printed circuit located in a circle with a 9.53 mm diameter. Its analog resistor works as variable analog voltage divider. When the sensor is unloaded, its resistor is very high (greater than 5 MΩ). This resistor is decreased when force is applied to the active sensor area.

The microcontroller consists of an Arduino Uno, the most common version of Arduino is the Arduino Uno. This board is the most common type of Arduino used by the people because it is an easy to use and is open-source which means hardware is reasonably priced and development software is free
When using regular type LCD (Liquid Crystal Display) directly with Arduino, it needs 6 pins: RS, EN, D7, D6, D5, and D4 to talk to the LCD

B.Software part

Processing relates software concepts to principles of visual form, motion, and interaction. A programming language, development environment, and teaching methodology have been integrated into a united system. The purpose of creating processing is to teachfundamentals of computer programming within a visual context, to serve as a software sketchbook, and to be used as a production tool. It can be used by students, artists, design professionals, and researchers for learning, prototyping, and production

The Flexi Force Sensor is use a resistive-based technology. The application of a force to the active sensingarea of the sensor results in a change in the resistance of the sensing element in inverse proportion to the force applied. The principle behind the Flexi Force Sensor is that when the sensor is unloaded, its resistance is very high(greater than 5 MΩ). This resistance decreases when force is applied to the active sensor area. The sensors are constructed of two layers of substrate. This substrate is composed of polyester film .On each layer, a conductive material (silver) is applied, followed by a layer of pressure-sensitive ink.



Adhesive is then used to laminate the two layers of substrate together to form the sensor. The silver circle on top of the pressure-sensitive

Fig 2 Existing Hardware model

Ink defines theactive sensing area. Silver extends from the sensing area to the connectors at the other end of the sensor, forming the conductive leads terminated with a solder able male squarepin. In order for the Flexi Force Sensors to obtain correct readings, they must necessary to use a puck (is a piece of rigid material or polymer smaller than the sensing area). These pucks were needed because they translate a direct force into a more distributed force on the sensor, making them more sensitive. Pucks were created by using a thin artificial leather trimmed slightly into a smaller area than the sensor area itself (7mm in diameter). They were attached to sensor using a two side adhesive tape shows the Flexi force Sensor and glove that is used in a proposed system.

The sensor has been placed under the indexed finger and the program has been uploaded into the Aarduino circuit in order to convert the analog signals of the fingers presses into digital signals, so that the digital signals canbe display on the serial monitor in real time. The program will run and the serial monitor will display the voltage values in which the voltage values change with changing of the finger presses. A rapid changing of the voltage values has been noted with the using of the 100k ohm resistor and 100µF capacitor in the operation amplifier circuit after replacing them with 150k ohm resistor and 10nF capacitor the speed of displaying the values on serial monitor has been slowed. The resistor and capacitor's configuration with the operation amplifier represent a filterthat can speed up or slow down the sensor signals. In the applied program the input on analog pin 0 has been read and converted the analog reading to a voltage then printout the value that the program read

IV. PROPOSED SCHEME

Gesture recognition aims to develop an assistive system that automatically converts an input sign to corresponding text. The System is developed in reference to the deaf and mute people and other surroundings. There are various methodologies of implementing gesture recognition system. The major challenge is the complex background in the images. In many of the cases, these complex backgrounds are not eliminated properly and results in more error scenarios. In this project, we work towards handling complex backgrounds with advanced background elimination techniques and ANN to classify gestures. The strategy proposed makes utilization of a webcam through which hand gestures gave by the user are captured and identified accordingly. This system will allow user to convey the message by hand gestures created infront of a camera which will be mounted. The data set is created dynamically as the user poses gesture infront of camera. The user that is, the person's hand gestures will be different from a normal person's hand gestures while

communicating. If the gesture is not still and accurate it can make the system not work accurately, therefore to solve this problem the data set that will be used will be of the person. The raise of his hand, the stability of his hand will be noted. His actions will be recorded along with his daily needs and requirement. The system is capable to convert the desired hand gesture into corresponding required sentence.

HARDWARE DESCRIPTION

Camera specifications

Description	**Values**
Number of cameras	one
Camera type	RGB HD camera
Camera location	Front camera
Camera sensor type	CMOS sensor technology
Still Image	0.92 megapixel
Video	1280 × 720(HD) at 30fds
Diagonal viewing angle	78.6 degrees

Arduino Uno: The ArduinoUno is an open-source microcontroller board based on the Microchip ATmega328P microcontroller and developed by Arduino.cc. The board is equipped with sets of digital and analog input/output (I/O) pins that may be interfaced to various expansion boards.

Fig 3 Arduino UNO

The board has 14 digital I/O pins (six capable of PWM output), 6 analog I/O pins, and is programmable with the Arduino IDE (Integrated Development Environment), via a type B USB cable. It can be powered by the USB cable or by an external 9-volt battery, though it accepts voltages between 7 and 20 volts. It is similar to the Arduino Nano and Leonardo.The hardware reference design is distributed under a Creative Commons Attribution Share-Alike 2.5 license and is available on the Arduino website. Layout and production files for some versions of the hardware are also available. Microcontroller (Atmega 328p): The Atmel 8-bit AVR RISC-based microcontroller combines 32 KB ISP flash memory with read-while-write capabilities, 1 KB EEPROM, 2 KB SRAM, 23 general-purpose I/O lines, 32 general-purpose working registers, 3 flexible timer/counters with compare modes, internal and external interrupts, serial programmable USART, a byte-oriented 2-wire serial interface, SPI serial port, 6-channel 10-bit A/D converter (8 channels in TQFP and QFN/MLF packages), programmable watchdog timer with internal oscillator, and 5 software-selectable power-saving modes. The device operates between 1.8 and 5.5 volts. The device achieves throughput approaching 1 MIPS/MHz.

Fig 4 ATmega 328p microcontroller

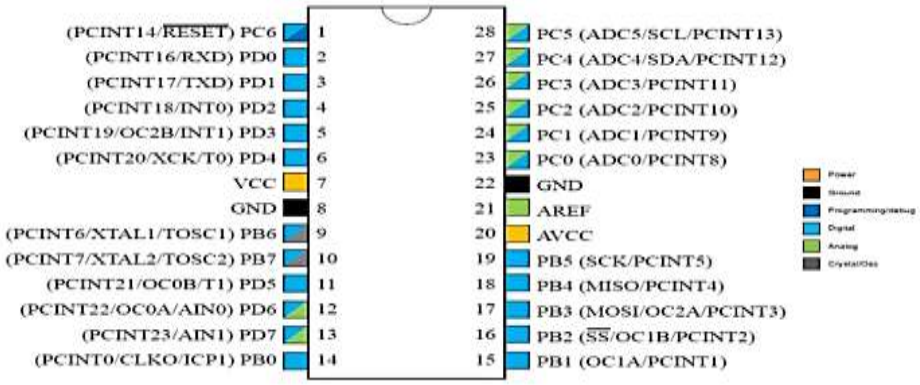


Fig 5 Pin configuration of ATmega 328p

Pin Mapping of ATmega328P with Arduino: ATmega328 comes in Arduino, which helps the users to code the program in Arduino instead of assembly or other controller languages. Arduino is popular because of its vast online data and high-level language, and this helps the developer to code the controller program in Arduino and them convert it into the microcontroller code. In case of Arduino the pin configuration for the controller will be the following.

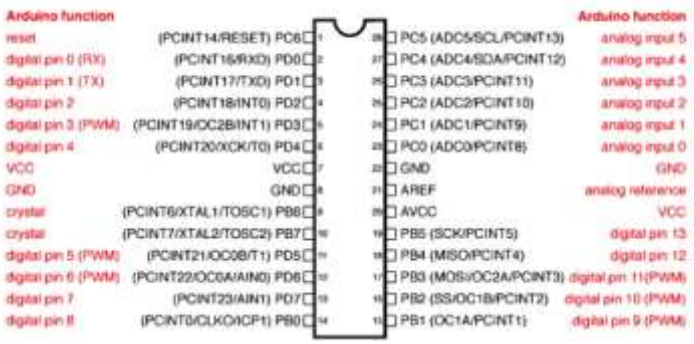


Fig 6 Pin Mapping of ATmega328P

In the case of Arduino, the pins become specific to their functionality. During using the compiler of ATmega328 almost all pins can be used as GPIO. However, during the usage of Arduino, each pin will perform the specific function only, but the controller will still be able to perform all the operations like ATmega328

Universal Asynchronous Receiver Transmitter: UART, or universal asynchronous receiver-transmitter, is one of the most used device-to-device communication protocols. Most commonly used UART has 9600 baud rate. When properly configured, UART can work with many different types of serial protocols that involve transmitting and receiving serial data. Depending on the application and system requirements, serial communications needs less circuitry and wires, which reduces the cost of implementation. The UART that is

going to transmit data receives the data from a data bus. The data bus is used to send data to the UART by another device like a CPU, memory, or microcontroller. Data is transferred from the data bus to the transmitting UART in parallel form and then it adds a start bit, a parity bit, and a stop bit, creating the data packet. Next, the data packet is output serially, bit by bit at the Tx pin. The receiving UART reads the data packet bit by bit at its Rx pin. The receiving UART then converts the data back into parallel form and removes the start bit, parity bit, and stop bits. Finally, the receiving UART transfers the data packet in parallel to the data bus on the receiving end

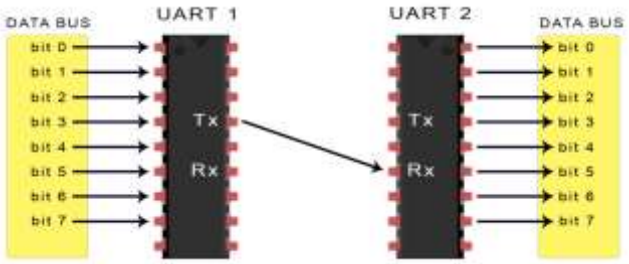


Fig 7 UART

UART transmitted data is organized into packets. Each packet contains 1 start bit, 5 to 9 data bits (depending on the UART), an optional parity bit, and 1 or 2 stop bits:

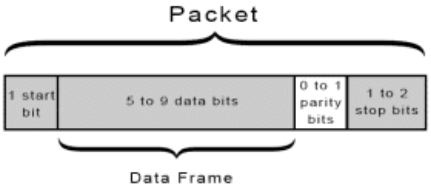


Fig 8 UART data frame

Start Bit: The start bit signals the receiver that a new character is coming.Data bit: The next five to nine bits, depending on the code set employed, represent the character.Parity bit:If a parity bit is used, it would be placed after all of the data bits.Stop bit:The next one or two bits are always in the mark (logic high, i.e., '1') condition and called the stop bit(s). Liquid Crystal Display (LCD): A liquid crystal display (LCD) is a thin, flat electronic visual display that uses the light modulating properties of liquid crystals (LCs). LCs does not emit light directly. They are used in a wide range of applications, including computer monitors television, instrument panels, aircraft cockpit displays, etc. Before applying an electric field, the orientation of the liquid crystal molecules is determined by the alignment at the surfaces of electrodes. In a twisted nematic device the surface alignment directions at the two electrodes are perpendicular to each other, and so the molecules arrange themselves in a helical structure, or twist. PIN DESCRIPTION: The most common used LCDs found in the market today are 1 line,2line, or 4 line LCDs which have only one controller and support at most of 80 characters, whereas LCDs supporting more than 80 characters make use of 2HD44780 controllers. More LCDs with 1 controller has 14 pins and LCDs with 2 controller has 16pins.

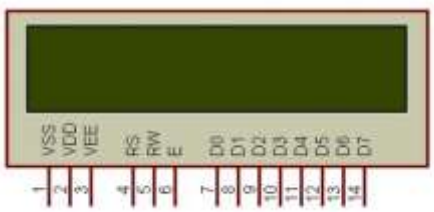


Fig 9 LCD

Buzzer: A buzzer or beeper is an audio signaling device, which may be mechanical, electromechanical, or piezoelectric (piezo for short). Typical uses of buzzers and beepers include alarm devices, timers, and confirmation of user input such as a mouse click or keystroke.

Fig 10 Buzzer

The buzzer is a sounding device that can convert audio signals into sound signals. It is usually powered by DC voltage. It is widely used in alarms, computers, printers and other electronic products as sound devices impedance matcher, etc. Some of the buzzers are also designed with LEDs. The multi resonator of this mainly includes ICs and transistors. Once the supply is given to this resonator, it will oscillate and generates an audio signal with 1.5 to 2.kHz. The impedance matcher will force the piezoelectric plate to produce sound.

SOFTWARE DESCRIPTION

PYTHON

Introduction: Python is a reliable programming language to develop complex and large software applications. The reason is behind the flexible programming paradigms and language features. Python is extensively used because it is supported by most of the operating systems. The same code can be run on multiple platforms without recompilation. Complex software development is simplified using Python. It can be used for desktop and web applications along with complex scientific numeric applications.

Python application

- Python can be used on a server to create web applications.
- Python can be used alongside software to create workflows.
- Python can be connect to database systems. It can also read and modify files.
- Python can be used to handle big data and perform complex mathematics.
- Python can be used for rapid prototyping or for production-ready software development.

Python syntax compared to other programming languages

- Python was designed for readability, and has some similarities to the English language with influence from mathematics .
- Python uses new lines to complete a command, as opposed to other programming languages which often use semicolons or parentheses.
- Python relies on indentation, using whitespace, to define scope; such as the scope of loops, functions and classes. Other programming languages often use curly-brackets for this purpose.

ANACONDA

Anaconda is a free open source data science tool that focusses on the distribution of R and python programming languages for data science and machine learning tasks. Anaconda aims at simplifying the data management and deployment of the same. Anaconda is a powerful data science platform for data scientists. The package manager of Anaconda is the conda which manages package version. Anaconda is a tool that offers all the required package involved in data science at once. The programmers choose Anaconda for its ease of use. Anaconda is written in python, and the worthy information on conda is unlike pip in python, this package manager checks for the requirement of the dependencies and installs it if its required More importantly, warning signs are given it the dependencies already exist. Conda very quickly installs the

dependencies along with frequent updates It facilitates creation and loading with equal speed along with easy environment switching.

The installation of Anaconda is very easy and most preferred by non-programmers who are data scientists .Anaconda is pre-built with more than 1500 python or R data science package Anaconda has specific tools to collect data using Machine learning and Artificial Intelligence. Anaconda vs python: The difference Between anaconda and python is that anaconda is the distribution of python and R programming languages mainly used for data science & machine learning whereas python is a high-level general-purpose programming language used for data science and machine learning purposes.

1. Anaconda and python are a wonderful find for the data science industry.

2. The package manager in Anaconda is called conda while for the python it is pip.

3. Anaconda is written in python, However, it is to be noted conda is the package manager of any software which can be used in virtual system environments whereas the pip, the package of the manager of Python facilitates installation, up-gradation and also uninstallation of python packages only.

4. Anaconda is only used for data science and machine learning tasks, whereas the python is a programming language which also used in creating many web applications, networking programming, and desktop applications.

5.Anaconda is a data science tool which means that it is not necessary for a person who works on it must be a programmer. However, to work in Python programming language, one must have learned the programming language completely.

V RESULTS AND OUTPUTS

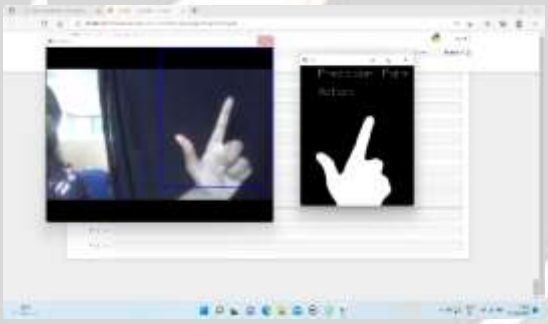


Fig 11 Live input via camera

Fig 12 Displaying the sentences for the gesture.

Fig 13 Output displayed at the LCD

	Steps Loss	**Accuracy**	**Validation Loss**	**Validation Accuracy**
Epoch 1/5	1.6300	0.3189	1.0878	0.7750
Epoch 2/5	1.4608	0.3484	0.9079	0.7875
Epoch 3/5	1.2722	0.4360	0.5719	0.8750
Epoch 4/5	0.6125	0.7890	0.2504	0.9250
Epoch 5/5	0.3273	0.8784	0.1112	0.9625

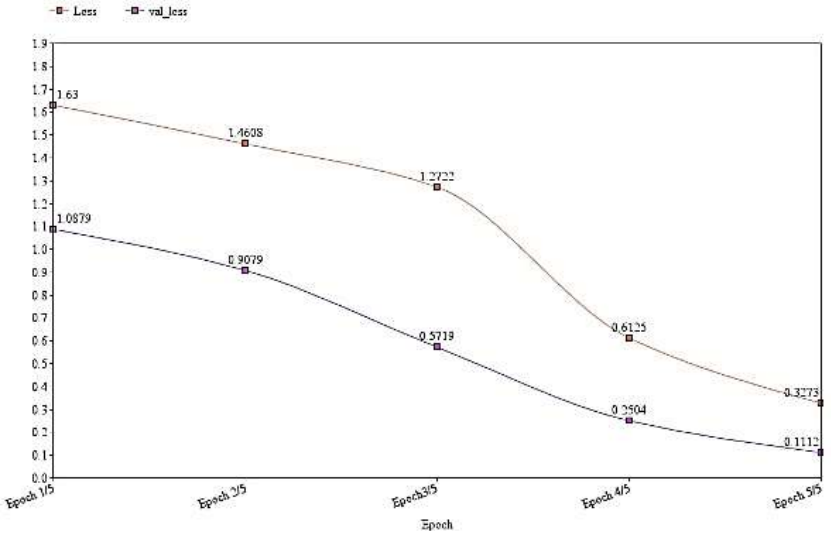


Fig 14 Loss and Validation loss plot

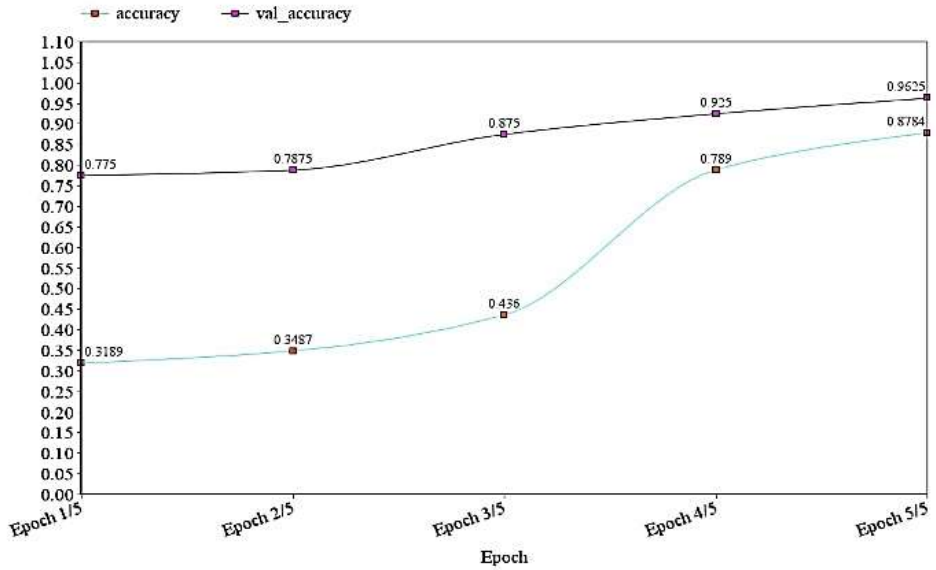


Fig 15 Accuracy and validation accuracy plot

From the figure, we conclude that the two losses (both loss and val_loss) are decreasing and the two accuracy (acc and val_acc) are increasing. So this indicates that, the modelling is trained in a good way. The val_acc is the measure of how good the predictions of the model is. We can see that the val_acc value increases upto 0.9625 . So in our case, it looks like the model was trained pretty well after 5 epochs.

VI CONCLUSION AND FUTURE ENHANCEMENT

The practical adaption of the interface solution for deaf and dumb people is limited by simplicity and usability in practical scenarios. As an easy and practical way to achieve human-computer- interaction, in this solution hand gesture to text conversion has been used to facilitate the reduction of hardware components. On the whole, the solution aims to provide aid to those in need thus ensuring social relevance. The people can easily communicate with each other. The user-friendly nature of the system ensure that people can use it without any difficulty and complexity. The application is cost efficient and eliminates the usage of expensive technology. The application can be integrated with other mobile and IoT devices to improve user interaction and make the system more robust. The accuracy of the program can be further improvised by using neural networks. An alternate stress could be put on the use of the application in the fields of medicines, military, governance etc. A genuine blend of various technologies in mentioned fields could make way for power tools and applications which will serve the community around the world. Finally, the use can be further designed to make more accessible to the consumers. The whole point of making the solution as a commercially viable product for the users is to help the impaired community around the world.

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