Assistive Technology For Deaf And Dumb

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***Abstract*—More than a million people around the world have speech and hearing impairments. Deaf and dumb individuals now use sign language to communicate, which has a difficult learning curve and is not understood by the majority of people without the corresponding handicap. It also has no impact. due to the fact that blind persons cannot see the signage. In our proposed work, a hardware component that uses flex sensors to detect hand movements is packaged with an application that users may use to personalise their hand motions. The solution provided by our proposed work addresses this issue by converting hand motions into universally understandable, short sentences. The project's goal is to make it easier for those who are deaf and dumb to communicate with each other.**

I. Introduction

Humans use both voice and gestures to communicate with one another when they talk. Without the ability to speak, some persons can only interact with others through sign language.Those who are not dumb or deaf are not familiar with language. In order to make those persons more autonomous and to facilitate easier communication with the outside world, we seek to take on this social cause as a challenge. Many people who have a hearing loss that makes them partially or fully deaf and dumb. They comprise 466 million people, or more than 5% of the world's population, according to the World Health Organization. In this work, a unique continuous finger gesture detection system based on flex sensors is presented. A series of gestures can be accurately recognised by the system. We'll be using wireless smart gloves with flex sensors. Moreover, the system will have a Bluetooth module and an Arduino. The goal of this project is to create a functional gadget that can convert hand gestures into verbal language via speakers and visual writing via screens. In order to recognise a series of finger motions, we intend to introduce a revolutionary sensor-based gesture recognition system. The system is capable of accurately recognising gestures. Flex sensors are used to capture the finger movements.

A wireless smart glove is incorporated into the proposed system to gather and distribute the sensory data generated by the flex sensors. Flex sensors, an Arduino microcontroller, a battery module, and a wireless communication module make up the glove. Additionally, it will be linked to a mobile device from which the user can personalise phrases using an app. The overall objective of this assistive technology is to enable deaf and dumb people to interact with others more effectively by allowing them to express themselves through hand gestures or movements that the device can recognise and translate. The Arduino Nano micro controller is specifically attached to a group of 2.2" flex sensors. The Arduino receives the information gathered from the flex sensors, such as current levels.

Some existing Sensor-based gesture recognition techniques for hand gesture recognition have the shortcoming like only letters can be represented so only people with knowledge of standard sign languages can use it. In our system it is not necessary that the user should know standard sign languages. In this, with the help of a mobile app the user can customize some words for each sign. This makes it easier for the user to effectively communicate using gestures.

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II. Literature Review

This section describes the related literature surveys conducted.

Subhas Chandra Mukhopadhyay et al. [1] The information conveyed from the sensor can be broke down with AI so that the man made intelligence empowered iot devices can make machines smarter.Smart houses can utilise AI-based sensors to operate their heating, lighting, and security systems. They can also be applied in industrial settings to keep an eye on manufacturing procedures and avoid equipment breakdowns. The capacity of AI-based sensors to learn and adapt is another benefit. These sensors may be taught to spot patterns in the data they collect and base their judgements on that knowledge. As a result, they are quite adaptable and ideal for a variety of applications. They are a crucial component for achieving the full potential of the IoT due to their prodigious data processing, decision-making, and adaptation capabilities. To handle smart sensing systems, these two streams (AI and IoT) should be combined for the benefit of everyday demands for the average person. IoT controls how devices collaborate online, but AI enables the devices to benefit from human knowledge and experience.

Ajay Suri et al. present a solution for Smart Parking System Using Image Processing and Artificial Intelligence in [2].To support them and make it easier for them to communicate their message. Flex sensors, an Arduino, a Bluetooth module, an accelerometer, a glove, and an android application to show the findings are all included. The components utilised to measure the bend values of motions made and take input are called flex sensors. The signs are then translated into the corresponding resistance values. With an increase in bend, these resistance values rise. A gyroscope measures rotation or angular bend. The Arduino then verifies the resistance values that were measured. The text corresponding to that is sent to the Android application via the Bluetooth module if the input value matches any of the values previously recorded in the controller. The text is subsequently transferred to the application via Bluetooth integration. An Android application, which is a software component, can be created or created by a third party.By merely wearing the glove and using their fingers to make various gestures, a user may communicate in sign language. It is true that a glove-based Sign Language translator greatly facilitates communication between a hearing/dumb person and a normal person. The main benefit is that the output is provided in a matter of seconds and the sensors directly provide the bend value to the glove. The number of sensors can be increased to improve translation accuracy.

Godwin Ponraj and Hongliang Re. shows The design and implementation of a sensor fusion algorithm, which tracks finger level data based on inputs from two different types of sensors, as well as the operation of the leap motion controller and the flex sensors[3]. The system consists of two input devices: a sensorized glove (SG) constructed with Flex sensors and a Leap motion controller (LM). Most of the time, the Leap Motion Controller can track the positions of the finger tips with excellent accuracy. Flex sensors are analogue input devices that, when bent by an outside force, change resistance. They can be used to determine if a human finger is flexed or extended. The amount of flexion as they flex with the finger can be measured by mounting them above the fingers and utilising a straightforward voltage divider circuit. The amount of flexion as they flex with the finger can be measured by mounting them above the fingers and utilising a straightforward voltage divider circuit. Kalman filter is used for this application.

Anchal Sood and Anju Mishra. proposed a system which has [4] for identifying hand gestures that might be used as an instructional tool as well as a means of communication for the deaf, dumb, and mute. Individuals who are deaf or dumb struggle to communicate effectively with other people and find it challenging to communicate effectively. They consequently have to deal with a lot of problems in this regard. They utilise sign language, which is highly common among them, to communicate. Thus, a qualified translator is required.The first phase in the suggested framework is picture capture, which involves taking an image with a webcam. Skin segmentation, in which the skin region is to be found, is a crucial phase. The Hue-Saturation-Value (HSV) histogram is used for this. The Harris algorithm is used to extract the characteristics. In the form of a Nx2 matrix, where N is the total number of feature points extracted, it finds the required interest points. After feature extraction follows feature matching and recognition, which is the most crucial step.

Sruthi Upendran and Thamizharasi. A. present in [5] a fresh method for deciphering ASL alphabets from visual input. If computers can recognise and react to human non-verbal communication, such as hand gestures, then human-computer contact will feel more natural. The ASL hand position is used by this technique to extract PCA features. The input consists of hand motions that represent the static ASL alphabets, with the exception of J and Z. The ASL alphabets can be categorised using the PCA features using the k-NN (k- Nearest Neighbor) classifier. Phase One: The system's initial phase is training. The training dataset, which consists of a sizable collection of sample photos for each static ASL alphabet, will be kept. The generated PCA features are kept as column matrices and are helpful in the feature comparison step of the classification process. Testing Phase: The second phase starts when a user sends a query image for recognition that includes an ASL alphabet.

Vishal Pathak et al. [6] proposed a method on how to recognise hand gestures utilising data from the Flex, Contact, and three-axis accelerometer sensor. The sensor results are compared to the values that have already been recorded for each indicator in the database to reach a final determination. Only 16 of the 26 alphabets can be successfully detected using flex sensors, with a success percentage of 61.54. Dynamic motions cannot be accurately recognised using flex sensors alone.To recognise hand movements, a machine learning model, such as a neural network, is trained on the combined sensor data and extracted features.

Yan-Rui Guo et al.[7] propsed a method where flex sensors are used to implement the neck position monitoring feature. The average power consumption is very low, the accuracy of neck posture categorization is 100%, and the system promptly notify the user to correct neck posture. It involves attaching the sensors to the subject's neck, gathering data while they move their neck in different ways, cleaning up the data to eliminate noise, extracting key features, and then using the relevant features to train a machine learning model to identify and categorise various neck positions.

J.Thilagavathy et al.[8] presents an embedded Based Hand Talk Assisting System for Deaf and Dumb.The first stage is gathering the data. Once the sign or gesture has been recorded, the second step—recognizing it—is significantly trickier, especially when there is a continual stream of them. In fact, the research is currently centred on this. The goal of this study is to develop a straightforward embedded system-based communication tool for blind and deaf persons. Here, two significant issues are taken into account. The first is communication between deaf and dumb individuals, and the second is communication between deaf and dumb people.

Areesha Gul et al.[9] explains two-way intelligent communication system for Deaf and Dumb People and Regular People; the project is creating a technology that helps Deaf and Dumb People communicate with Regular People. A regular individual can also reply to their messages. A two-way intelligent communication system exists. In this technique, sitting down with a hearing and speaking individual allows for communication. They frequently employ a square measure. Leap Motion is being misused for hand movement recognition by using its motion track data, and Pakistani Sign Language is being used to train the algorithm.This study explains how a Leap Motion Device can be used to create a novel two-way communication system that can eliminate all barriers that prevent hearing-impaired people from communicating with their surroundings. By connecting hand gesture detection and gesture to speech conversion, the idea applauds a novel kind of communication.

Akash Kumar Panda et al.[10]One of the key fields thought to be significantly influencing the direction of technology is hand gesture recognition (HGR). HGR to speech conversion, which will benefit people with speech impairments, is one of the most sophisticated issues. In this study, they classify various movements using Flex sensors.The proposed work is divided into four main sections: Gesture Recognition, Feature Extraction and Selection, Data Collection and Pre-processing, and Sensor Interfacing.

III. Methodology

The basic processes included are:

• Detection of the gesture: Input is taken by detecting the gesture using a flex sensor.

• Assigning the input values to a command: Each input reading is mapped to a frequently used phrases which can be customised by the user using a mobile app.

• Ouptut is produced: An output is produced using a speaker and a screen that plays and displays the respective phrase.

Fig. 1. Basic Working of the System

The Small and programmable Arduino Nano microcontroller can communicate with its environment by using a variety of sensors and actuators. Flex sensors are a type of sensor that can detect the amount of bending or flexing in a material. They are typically made from a thin strip of material, such as a conductive polymer or thin film, that changes resistance as it is bent. The resistance of the sensor changes in proportion to the degree of bending, allowing the sensor to detect and measure the angle of bending. Here, the Aduino Nano is coupled to a collection of 2.2" flex sensors in this instance which are able to detect changes in their shape or curvature and turn this information into an electrical signal. These signals may be read by the Arduino Nano, which can then use them to learn more about the flex sensors' present levels. The Arduino Nano microcontroller is powered by a tiny lithium ion battery pack or other tiny batteries.

Flex sensors are linked to the microcontroller, here Arduino Nano. Due to its tiny size and accessibility of analogue pins, we chose Arduino Nano. The voltage readings from the flex sensors are input to the microprocessor, which converts them into the bend angle. We also employ Bluetooth, a wireless technology standard for data exchange, for wireless communications.

IV. Architecture

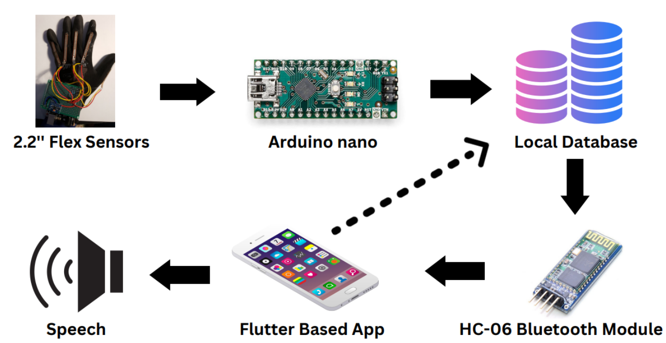

Fig. 2. Architecture

Using a flex sensor, assistive communication technology for deaf and dumb people includes wearing a device on the body, like a glove or a wristband. The device would have a flex sensor built in, which would be used to track user hand gestures and movements. The system would then transform the hand motions or gestures into a form of output, such as text or audio, that other people could understand. For instance, the gadget might emit a predetermined phrase or word, such "hello" or "thank you," if the user makes a particular hand gesture or movement.

The user would need to receive training in order to use the device. Overall, this assistive technology aims to give deaf and dumb people a way to connect with others more efficiently by enabling them to express themselves using hand gestures or movements that the equipment detects and translates. The Arduino Nano micro controller is specifically attached to a group of 2.2" flex sensors. The Arduino receives the information gathered from the flex sensors, such as current levels. A battery module powers the Arduino Nano micro controller. The HC-06 wireless bluetooth module, which has a range of about 10 metres, is then used by the Arduino micro controller to transmit the data values acquired to a mobile app powered by Flutter.

The amount of flex sensors that needed to be placed on each finger determined the structure of the glove. It was decided to use a regular-sized glove that would suit most hands. The parts that would go on the glove were thoroughly tested for strength, flexibility, agility, and stress carrying capacity- that is, the absolute limits we could push them to before being packaged in sealed envelopes and attached to the glove.

Because of its straightforward AT commands for additional configuration and easy-to-use TX/RX connectivity, the HC-06 can send and receive data over Bluetooth using standard serial commands. The HC-06 module has a range of about 10 meters (33 feet) and can communicate at a maximum baud rate of 115,200 bps. It operates at 3.3V and can be powered directly from a microcontroller or other device. The module has six pins, including VCC, GND, TXD, RXD, STATE, and EN.

V. Results And Discussion

There are many potential areas for future work in the field of assistive communication technology for individuals who are deaf or dumb. Some potential areas of focus could include:

Improving the accuracy and speed of speech recognition software: Developing more accurate and faster speech recognition software could make it easier for individuals who are deaf or dumb to communicate using assistive devices.

Enhancing the usability of assistive devices: Making assistive devices easier to use and more intuitive could help to increase their adoption and effectiveness. This could include developing devices that are more portable and easier to carry, or designing devices with simpler interfaces.

Expanding the range of communication options: Developing new technologies for communication could help to increase the range of options available to individuals who are deaf or dumb. This could include exploring new methods of text or image-based communication, or developing new technologies such as brain-computer interfaces or wearable devices.

Improving the affordability of assistive devices: Making assistive devices more affordable could help to increase their accessibility and make them more widely available to individuals who are deaf or dumb. This could include efforts to reduce the cost of production, or developing low-cost alternatives to existing assistive devices.

Researching the effectiveness of different assistive technologies: Conducting more research on the effectiveness of different assistive technologies could help to identify the most effective options for different individuals and situations. This could include studying how different technologies are used, how well they work, and how satisfied users are with them.

VI. Conclusion

Flex sensor-based assistive communication equipment can be helpful for people who have trouble speaking or have speech difficulties or even a partially paralysed person. A sensor called a flex sensor is used to identify the bending of fingers and the resistance associated with it. These sensors can be added to assistive communication tools, like computer keyboards or speech-generating devices, to let users communicate by flexing or bending the tool. Here we connect it to an Anduino Nano. Flex sensors have a number of benefits for assistive communication technology. One benefit is that flex sensors are reasonably priced and simple to use. They can be used by anyone with a range of physical abilities and can be incorporated into a variety of devices. Flex sensors are also strong and have a long lifespan, making them a trustworthy option.

Flex sensor-based assistive communication technology can generally be a helpful tool for people who have trouble speaking or who have speech impairments, but it's crucial to carefully consider each person's unique needs and abilities before deciding whether or not this kind of technology is appropriate. We also developed a mobile app using which the person can customize words according to his or her needs.

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