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IoT Device for Disabled People

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Abstract

Sign language is a medium used for communicating feelings and emotions with normal people using expression and gestures. The focus of this research work is to create an IoT device that connects the real world and the people with disability. Physically challenged still prefer using sign language and our aim is to create a bridge that removes the communication gap between the disabled and normal people. The proposed design makes use of hand gloves mounted with flex sensors which recognize the characters and commands [4].

The gestures recognized will be displayed as audio and visual output through LCD and Bluetooth speaker. The Optical Character Recognition is used for the blind people in order to recognize the text-based images for audio and LCD display [16]. This system consists of live tracking as one of the modules for tracking the physically challenged people. The purpose is to enhance and improve the system for detecting sign language. The device not only converts sign languages to speech but also have incorporated modules like Optical Character Recognition (OCR) and live tracking[I].

Keywords: *Hand Gesture, Braille, Hand Glove, Flex Sensors, Live tracking, OCR.*

I. Introduction

In the world, the statistics state that there are around ten billion people who are either blind, deaf or dumb. One of the challenging tasks is to have a mode of communication between a disabled person and a normal person. So, it becomes an essential task to establish a mode of communication with them. For dumb, deaf and blind people sign language is the best possible way to communicate. It uses patterns, gestures instead of sound to elaborate on their information. It involves the usage of different body parts for sign language such as palm, bending of fingers and hand, arms or body, facial expressions and lip-patterns for conveying the messages. There are various versions of

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sign languages in the world which are used for communication such as British Sign Language (BSL), Indian Sign Language (ISL), and American Sign Language (ASL), etc. Gesture recognition is divided into two categories namely the data glove based and vision based [3]. The data glove-based technique achieves higher accuracy, fast reaction, and frequency and offers greater mobility. The problems faced by vision-based techniques includes noise interference and complex algorithms for data processing. One of the challenging works in image and video processing includes the variation of lighting conditions and background suppression [2]. This system efficiently translates the Indian Sign Language gestures into an understandable format in the form of both text and audio. The model implements the flex sensor-based technique which takes output obtained from flex sensors and then sends it to Arduino Flex sensor works on the principle of bending. The more the sensors are bend, more resistance generates. The amount of bending has been compared to the initial value and then the text has been displayed. Bluetooth module is used for audio output. The alert button is present for blind people through which the location of the person is sent to the emergency contact. The live location value can be seen in the site from any place in the world. The system comprises pi camera which captures text-based images for text analysis [17]. In India, 20% of the disabled persons are having a disability in movement, 19% are with disability in seeing, and another 19 % are with disability in hearing. 8% has multiple disabilities. Among the male disabled, 22% are having a disability in movement, 18% each has a disability in seeing/ in hearing while 8% of them suffered from multiple disabilities. In the case of the female disabled, 20% each has a disability in seeing / in hearing, 18% has a disability in movement and 8% of them are having multiple disabilities.

II. EXISTING METHODOLOGIES

Many ideas were proposed for smart gloves in recent years involving wireless mode which are cost-effective, lightweight, reliable and Easy to use. The components consist of flex sensors, microcontrollers and wireless transmitters that are normally available. The battery is heavy and hence assembling it for usage is quite difficult and hard [6]. To try and spark a conversation between humans who have hearing-impaired or have speaking disabilities, Goldsmiths University in London has developed a glove named “Sign Language Glove” that aims to translate the sign languages from hand gestures into an audio and visual text.

Advantages and disadvantage are as follows: -

1. The device has wireless, display and voice feature.
2. The device is portable and has a feature of inbuilt battery.
3. It's quite bulky to wear and hence is difficult to handle.
4. The device consists of delicate components which are quite expensive.

III. Approach

The research work is done for an IoT device which enhances communication between the physically disabled (Deaf, Dumb and Blind). The various functionalities performed by each module is as follows:

- **Hand Gesture Model:** The flex sensor records the resistance obtained by performing the gestures. The value is then processed by the Arduino and the corresponding character is sent to the text to speech application which then generates the output.
- **OCR Model:** The camera captures the image placed in front of it and the image is processed by the raspberry pi using the OCR and the OpenCV libraries. The result is processed and sent to the text to speech for further processing of the output.
- **Live Tracking Module:** Whenever the alert switch is pressed, the GPS module activates, and the alert text message is generated and forwarded to the respective mobile number of the user. The output is further sent to the text to speech for generating an audio and visual.

I.I Hand Gesture Recognition

The Hand Gesture Recognition model has Flex sensors mounted on the gloves to recognize gestures made by bending the fingers. Flex sensor is a variable resistor where resistance increases with the bending Key Features:

1. For a linear bend, the resistance will have a nominal resistance.
2. For a bend of 45º the resistance increases to twice as before.
3. For a bend of 90º the resistance goes as high as four times the nominal resistance.

The resistance rises linearly with bending angle. The Flex Sensor converts flex angle as a parameter of Resistance. The bending is determined by the angle of bending. When not bent, the value of the resistance of flex sensor is 25k ohms. When the angle of deflection is 45 degrees, the resistance will increase to 45k ohms. The maximum bending resistance of the flex sensors is 125k ohms. For flex sensor, the range of bending resistance is from 45k ohms-125k ohms. Flex sensor produces analog values as the output. Hence to make microcontroller sense the output of flex sensor, there is a voltage divider concept by connecting a resistor in between flex sensor and 5-volt supply in the microcontroller (ARDUINO Uno). LCD screen's (16x2) are used as output device which displays 16 characters in a single line. The characters displayed are in 5x7 pixel matrix format. The data pins interfaced with ARDUINO UNO display the desired output on the screen. Select register consists of two registers: the data and the command register. Data register is used to determine the data to be displayed whereas Command register is responsible for giving commands to the LCD. Read and Write pin are responsible for reading and writing the values on the LCD display and VSS pins are used for power supply and ground purposes [14]. Analog pins in the ARDUINO UNO are responsible for the brightness on the LCD display.5v pin and ground pin are connected to LCD for power supply. The LCD consists of 16 pins (shown below). LCD (Liquid crystal display) are electronically modulated optical device consisting of light modulating particles which is similar to light-emitting diode (LED), having a display much thinner than cathode ray tube (CRT) technology. LCD uses a backlight or reflector to produce the images since it cannot emit light directly. LCD Display has been to output the characters formed by bending of the flex sensors [8]. The device uses Bluetooth Module designed for wireless communication that works for a short range. It's a serial-based connection that serves in Master or Slave configuration. The range of Bluetooth module is 10 meters. The data of the flex resistance will map to character and the data will go to the application for audio output via Bluetooth [11]. This system uses GSM (Global System for Mobile Communication) model for voice and data transmission which operates at a varying frequency band. It is used to receive, send or delete messages in a SIM [10].

I.II OCR MODEL

The text is scanned by the camera's view ensures good quality and fewer distortions of the obtained image. The system sacrifices some amount of precision for higher recall. The Pi consists of an integrated peripheral device such as USB, ADC, Bluetooth, etc. The Pi uses Raspbian OS based on Linux. When the application starts, it checks for the connection and availability of all the devices [18]. The python program executed for testing displays the status of the image captured. When the program runs, the image of the document placed in front of the camera is captured by the system connected to Raspberry Pi. The captured image undergoes processing for text-recognition. The system uses OpenCV libraries such as TESSERACT for processing the image and Pyttsx 3 library for the conversion of the processed data into audio. The camera is used for the detection of the document, the image is processed using OpenCV libraries and result is played through the audio device. For OCR module, the proposed algorithm is a neural network model, trained to predict the text from images. The model uses fully-convolutional neural network, adapted for text detection that predicts per-pixel output of words or text lines. The model eliminates certain steps like candidate proposal, text region formation & word partition. Thresholding and NMS of the predicted shape is done during post-processing. The proposed system uses EAST (Efficient and Accuracy Scene Text detection pipeline) text algorithm which is a neural network model [18]. The architecture of the system consists of mainly of two main microcontrollers:

1) ARDUINO UNO

2) RASPBERRY PI B+ Model.

I.III Live Tracking Model

This system uses GSM (Global System for Mobile Communication) model for voice and data transmission which operates at a varying frequency band. It is used to receive, send or delete messages in a SIM [10]. Alert Switch is attached on to the gloves. When pressed, the alert switch sends an alert message to the guardian informing about the whereabouts of the person [9].

IV. Flow Chart of the Model

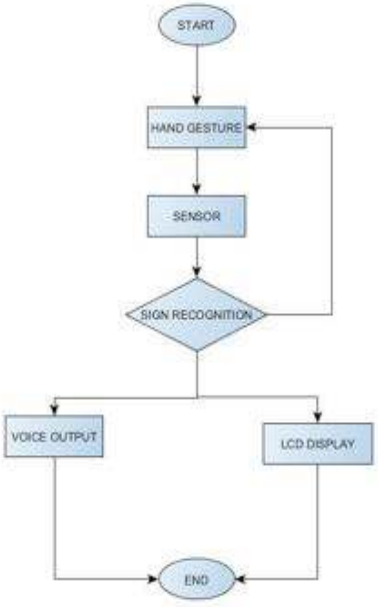

Figure 1: Flowchart depicting the working of Gesture Recognition

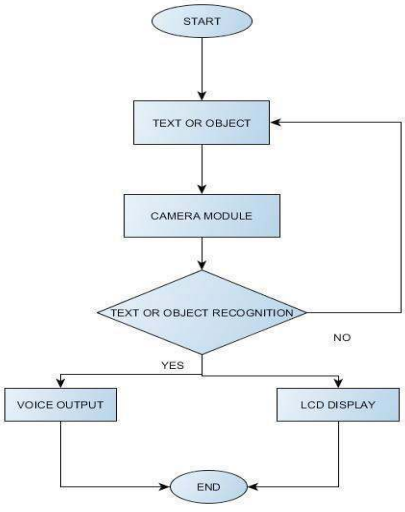

Figure 2: Flowchart depicting the working of OCR Model

V. Implementation Results

Figure 3: Corresponding character to the performed hand gesture.

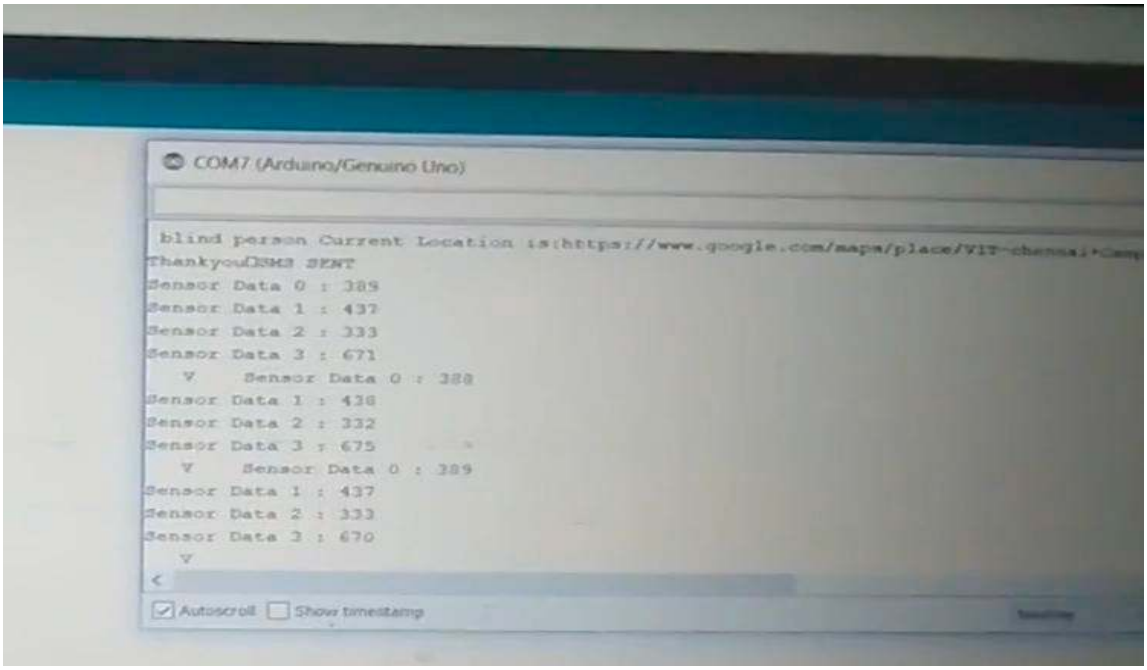

Figure 4: Live location of the person when the switch is pressed.

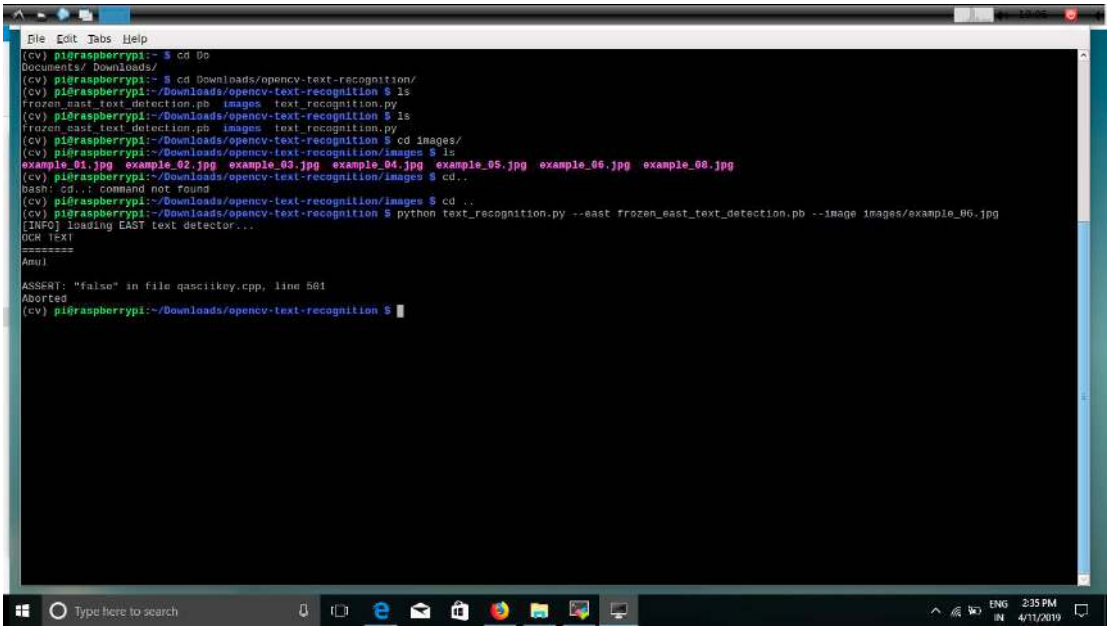

Figure 5: Result for the OCR Model

VI. Conclusion

In this proposed system, maximum of combinations can be used because for every flex sensor can have only one bend, but if all of the bends are used then the combination will become 7776 sentences. The hand gesture recognition system enables the usage of affordable gloves with sensors in engineering applications that requires complex gestures and simulations.

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