Bridge the Gap Between Deaf and Normal

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ABSTRACT

Communication is the exchange of ideas between individuals. Humans communicate verbally, in writing, or visually. In everyday life, most people communicate verbally. This is because it is the easiest and most efficient method of communication. Although the hearing people communicate verbally, the deaf cannot exchange their thoughts in the same manner. Therefore, people with hearing impairments use the british sign language to communicate with each other. However, it is difficult for the deaf to communicate like the hearing people. In addition, they find it challenging to perpetrate the activities performed by the hearing people in their daily life. Thus, this paper proposes a system that not only enables the deaf to communicate with the hearing people but also performs their daily life activities. The proposed system is able to convert a text in a picture or video into a british sign language and a video in british sign language into standard text. In addition, hearing people can use it to learn the british sign language method.

Keywords-- Deaf People, British Sign Language, Natural Language Processing, Convolutional Neural Networks, Image Processing

I.   INTRODUCTION

The act of expressing intended meanings from one entity or group to another using mutually understood signs has been defined as communication. For the existence of humans, communication plays a vital role. It allows to build trust and respect, resolve differences, and maintain a sustainable environment in which problem-solving, caring, and creative ideas can flourish. Inattentiveness, arguments, vilification, and a language barrier between communicators are all signs of poor communication.

All of these characteristics have an impact on both physically fit and physically challenged people. According to research, approximately nine billion people throughout the world are physically challenged in terms of communication, whether they are blind, deaf, or dumb. In 2021, World Health Organization (WHO) estimated that over 5.3% of the world population, 432 million adults and 34 million children have hearing disabilities and close to 2.5 billion people are expected to have hearing loss by 2050 with at least 700 million requiring hearing

rehabilitation. It is necessary to bridge the gap between physically challenged and normal.

According to our research study, we could find lot of issues which both deaf people and normal people face when they communication each other and do their daily basis. As examples issues of hearing-impaired person in capturing and sharing information from embedded images and plain text in English, Deaf people have difficulty documenting their valuable ideas in a way that they can share with the world, difficulties in teaching children with hearing impairment and difficulties caused by a normal person not knowing the British Sign Language etc. Therefore, we have to mainly consider on Entertainment, Information Sharing, Conveying the thoughts of hearing-impaired people.

Thus, this paper proposes a web-based system to overcome the challenges mentioned above. Using the proposed system, people without any hearing impairments only require to upload an image to the system to obtain a downloadable card image of the converted British Sign Language. On the other hand, a deaf person can upload a video with the British Sign Language into the system to obtain the converted British text. Not only that, when a user adds any type of normal video to website, it is converted into British Sign Language. This is very supportive to improve entertaining purpose of deaf people. If normal person wants to learn British Sign Language, the developed website supports to learn and improve their knowledge of British Sign Language by given different activities.

II.   LITERATURE REVIEW

Most of the existing researches for hearing impaired people are done for text translation and text input using a sign language keyboard. Some of the existing research are regarding converting sign language performed by a hearing-impaired person into a camera which will be converted to a preferred language using various technologies. Translating texts embedded in images to sign language is not much taken into consideration much research has done to identify and translate those text in images to normal languages. This approach and text translation together can be used to create a new system for

hearing – impaired people to translate image text to sign language.

In the research conducted by Tariq Jamil [1], The Java programming language and ScreenBuilder, an application for building user interfaces, screen buttons, and text fields, were used to develop our entire system. For efficient and precise processing of Arabic text, the Qatar Computing Research

Institute (QCRI) developed the "Farasa" toolbox. This toolkit provides a free Java library that can break down a sentence into its component parts. Additionally, it can be useful in determining the word's part of speech, such as whether it's a noun, verb, adjective, or adverb. To display the ArSL signs for the translated word in the system, MindRockets, Inc.'s animated character is used. Because of this, the signs were stored in "GIF" format.

According to Shubham Nagmoti [2], The image processing library OpenCV and the tesseract package from Python are used to implement the project. Google Trans (formerly known as GoogleTrans) is used for language translation.

A study conducted by Kamrul Hasan [3], has a process of extracting text from an image is sequential. Their approach divides word extraction from an image into three steps: I Input pre-processing marking each text location on the image. Then text extraction method. Next the input for the suggested technique is a visual in color. Consequently, some preparation of the input image is necessary. The picture is initially separated to two smaller photos. If the picture isn't split into text that is very small in size, sub pictures, and the resulting extracted data has some missing information and noise. Image of text Afterward, two sub images are transformed into two photos in grayscale are combined into two photos in binary. They used the text extraction procedure to create two sub-images after applying it to each individual sub-image. Finally, another grayscale image is created using the retrieved text. Preprocessing steps are not necessary if the input image is a grayscale image.

The research study of Ritika Bharti, Sarthak Yadav, Sourav Gupta and Rajitha B, the goal of their research was to create an automated software system that converts speech to sign language so that a deaf person can understand what a normal person is saying. This automated method first detects the voice, then converts it to text, then matches the tokenized text with the visual sign word library (sign language videos), then concatenates all the matched videos based on the text detected and lastly displays the merged video to the deaf person [4].

According to the study of Y. He, A. Kuerban, Q. Yu, and Q. Xie, they were done subtitle processing and Chinese word segmentation were adopted to find corresponding words in the sign language dictionary. Next, the transcoding is sent to unity through the socket technique. Then Deaf people can watch videos with Chinese subtitles and see clear, smooth, and natural sign language translation animation when using it. The unified, standardized, and common grammar sign language is the foundation of the sign language translation animation

library. Users may readily obtain information via video, and the usage of sign language will progressively become more standard. The movie sign language translation system is especially important for hearing-impaired people to improve their quality of life and has contributed to social progress [5].

III.   METHODOLOGY

Main users of developed systems are the hearing impaired people who has followed British sign language. The web application can be used to translated image embedded text, normal test translation into British sign language, British sign language translation into British English, video translation to sign language, and learn sign language. There are four primary aspects of the proposed system. They are translating normal English text and image embedded English text to British sign language. British Sign language translate into English text, Video translation into sign video and Educate British Sign Language Signs. Fig1 shows the overview of the system.

Text Recognition and Text to British Sign Language Translation

There are primarily two parts to the identification of the text and translation into British sign language.
1) Textual Image Processing
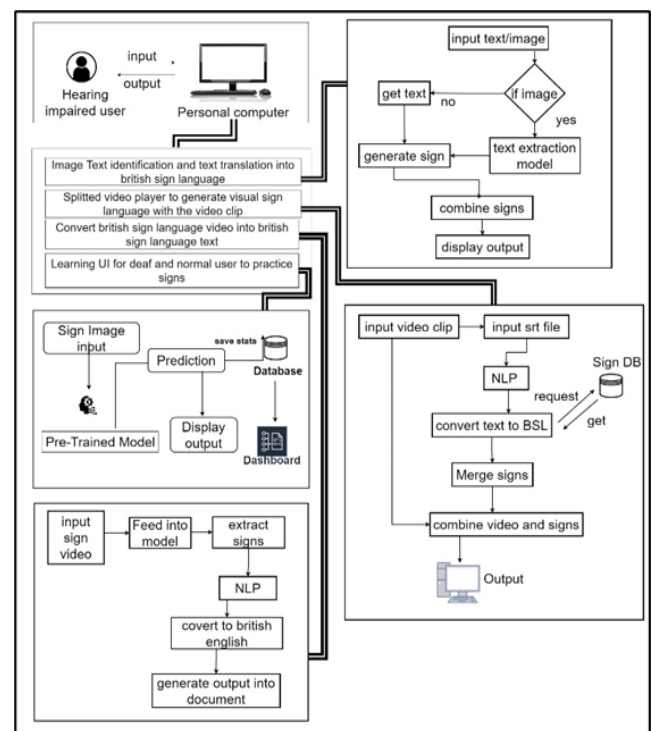2) English to British Sign Language text translation.

Figure 1: System Overview Diagram

Using image processing techniques in Open CV the uploaded image will be stored as an 2D array. Then the further processing happens as follows:

1) Textual Image Processing

Textual Image Processing includes,

Using a Python optical character recognition (OCR) program, text is identified and extracted. Google's OCR Engine is wrapped with EasyOCR. Following text extraction, the text will be divided into meaningful complete words using a Python-created algorithm.

The processing is done using the Python-based Natural Language Toolkit for the identification of the meaningful text parts. It is a set of Python-coded modules and tools for processing English in symbolic and statistical natural language.

The text that has been detected and divided into segments will be saved in a computer-readable file and accessible for additional processing. Through a text box, users can enter text into the system, and that content will be saved in a file alongside any extracted text. Then the procedure will advance to the following phase.

2) English to British Sign Language text translation

In British Sign Language, there are separate signs for distinct words as well as finger printing for other words. An algorithm is used to produce and retrieve an image data set of British Sign Language signs, Alpha Numeric values, and special characters.

The saved text file is first retrieved and read by lines to identify the words, after which the algorithm is run to determine whether the word will have a symbol. If a word doesn't have a sign, the letters will be pulled one at a time from the finger spelling images and displayed as a word. Thus, the algorithm will continue to execute until the text file is finished. Images of sign language that have been retrieved will be used to display the output. Fig. 4 depicts the input picture, which is text. The resulting output is displayed in Figure 5.
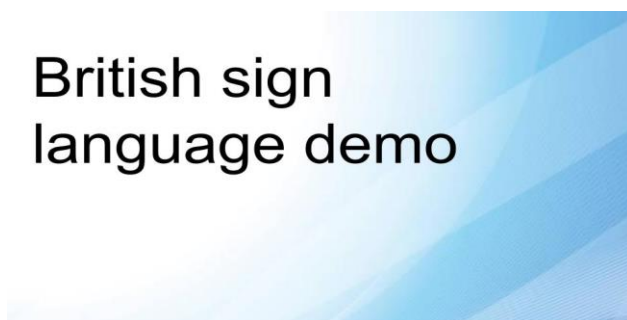

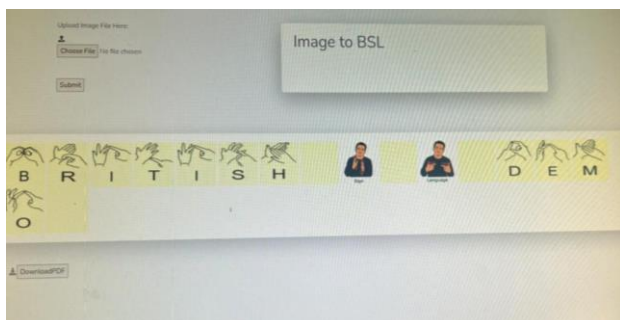
Figure 4: Input image with text

Figure 5: Output after the translation

A. Convert British Sign Language to British English using advanced Video Processing Technology

First, the deaf person should create a British Sign Language video and upload it into the website. Then video is proceeded by website and generate a text document by converting British Sign Language video into text. Then anybody able to download that document and refer it. NLP, TensorFlow, keras, Django framework, CNN were used to develop the function.

The purpose of the developed function is generating a real time text document by processing a British Sign Language video. Specially, when deaf people want to write a book or any other writing document this feature is very useful.

B. Video translation into Sign Video

In here, deaf people can translate normal video into sign video. Tensorflow, Keras, NLP and Django were used to develop the function. First, a user upload sample video clip and SRT (subtitle) file as an input. Then SRT file is converted into a text file. System able read the text file line by line. After that word order for English text is converted into BSL text using NLP. The meaning of Word order is in English text word order is Subject, verb, object. In BSL (British Sign language) text word order is object, subject, verb). After generating a BSL txt, system retrieve relevant sign video clips from database according to the above created BSL text file. Database was created by manually using sign language video clips for every English word.

Then system concatenate all the sign video clips according to the correct order using *moviepy* library in python. Finally, the system provides the output to the web application from above generated video clip and user input video clip side by side in creative User interface.

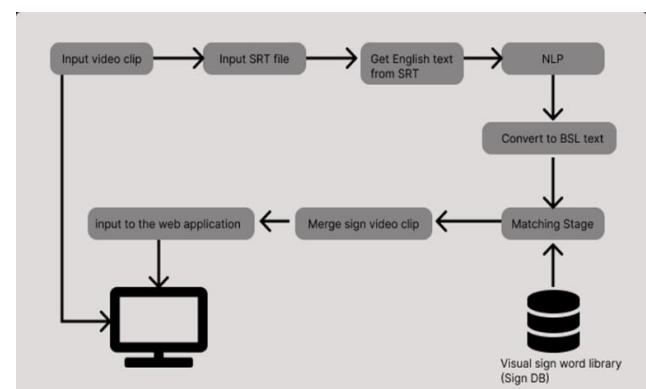Complete system was implemented by using python language. Fig 6 shows the flow of the video translation.

Figure 6: Overview diagram of Video translation into sign video

C. Teach British Sign Language to a Normal Person

This was developed for user to train and learn sign language.in this learning part first user can study sign by looking at the sign images attached to separate web page.

When user start the learn sign, user can show input of particular sign to webcam. Then user can see the outcome of input given. Fig 7 shows the British sign language alphabet and the Fig 8 shows the numerical signs in British sign language.

Purposed component of Learn Sing is capable of below methods:
a) Learn Signs and Text in British Sign Language.
b) Predict the accuracy of user Performed sign.
c) Real Time Result for Signs.

1) *Learn Signs and Text in British Sign Language*

In this section user gets Idea about British sign language by looking web UI. web applications are included to the function.
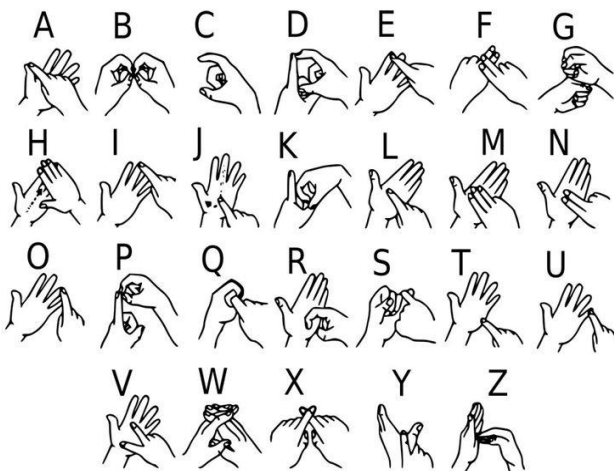
Figure 7: British Alphabet signs

Figure 8: British Number signs

2) *Predict the Accuracy of User Performed Sign*

By comparing the total accuracy with the test dataset and trainset, we can draw the conclusion that the convolutional neural network performed remarkably well in the classification of sign language symbol images.

In this learning part user can study sign by looking at the sign images attached to separate web page. When user start the learn sign, user can show input of sign to webcam. Then system, analyze the sign of user and generate the result for user. CNN model built by using

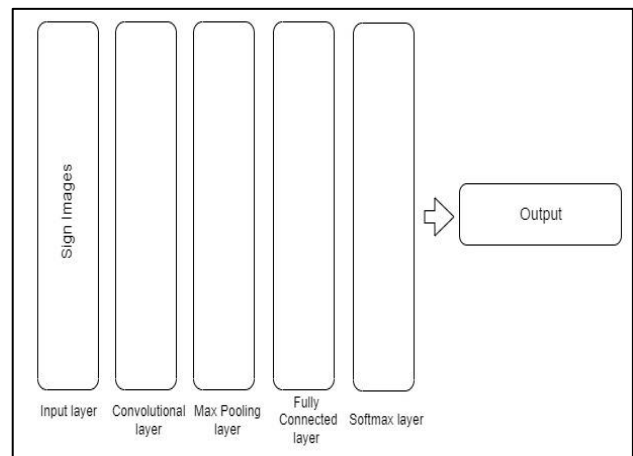TensorFlow and keras. Fig 9 shows the structure of the CNN Model used.

Figure 9: CNN Model

This is the CNN model that use to build image classification.it contains 4 layers convolutional layer max pooling layer fully connected layer and SoftMax layer. Initially to build the model the collected images feed into the CNN model and let train.

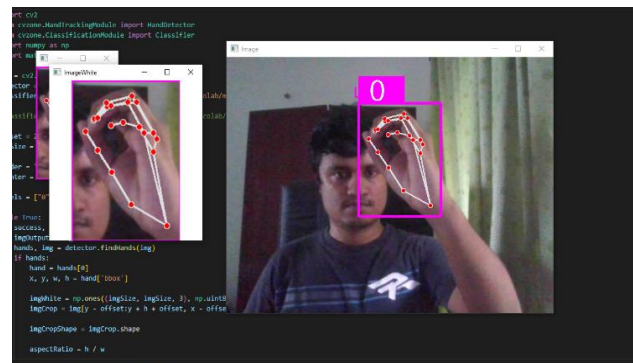Below Fig10 shows the real time result of the described function.

Figure 10: Real time result

IV.   DISCUSSION

Here, we developed a system which able to communicate with deaf people easily. In here, the main features of the system are extract text from image and convert it into British Sign language, convert video into British Sign language, convert British Sign language video into normal text and supports learn British Sign language by given small activities. All the functions are working accurately by given expected results. The accuracy of overall system is high. The system as a whole is error-free and user-friendly. All type of images as letters only images, images with special characters, images with numbers, images with different fonts and colors were tested and focused on special characters and numbers when type. Different type of video which have time differences are used to test the video clips. Small video clips which created by deaf people were used to test the

video uploading. Web cams was provided to people and supported to perform sign to test the learning features of system.

V.   CONCLUSION & FUTURE WORKS

In this research we introduced an efficient system which supports to communicate with deaf people by identify the image, extract the text and convert it into British Sign language, convert British Sign Language (BSL) to British English using advanced Video Processing Technology, to generate visual sign language with movies by split video and British Sign Language learning activity to normal people. Developed system support to maintain smooth communication between normal people and deaf people and minimize the space between them by providing very supportive features. TensorFlow, Regression, Clustering, Classification and Convolutional Neural Network (CNN) were used as machine learning technologies and Open CV, pytesseract, NLP and Python were used for image processing and Java Script, HTML, CSS, Django were used to develop website. SQL Lite was used to develop the database.

As a future work developers can implement this system to the online learning process websites which specially developed base on deaf people.

REFERENCES

[1] T. Jamil. (2020). Design and implementation of an intelligent system to translate arabic text into arabic sign language. *IEEE Xplore*. Available at: https://ieeexplore.ieee.org/document/9255774. J. Clerk Maxwell, A Treatise on Electricity and Magnetism, 3rd ed., vol. 2. Oxford: Clarendon, 1892, pp.68–73.

[2] I K. H. Talukder & T. Mallick. (2014). Connected component based approach for text extraction from color image. *IEEE Xplore*. Available at: https://ieeexplore.ieee.org/document/7073114.

[3] Nagmoti Shubham, Bhoyar Kapil, Raut Shantanu, Jamgade Saransh, Mangrulkar Nikhil & Pathade Aniket. (2021). Image text extraction and its language translation. *Journal of Research in Engineering and Applied Sciences, 6*, 95-97. DOI: 10.46565/jreas.2021.v06i02.000.

[4] Bharti, R., Yadav, S., Gupta, S. & B, R. (2020). *Automated speech to sign language conversion using Google API and NLP*.

[5] He, Y., Kuerban, A., Yu, Q. & Xie, Q. (2021). *Design and implementation of a sign language translation system for deaf people*. Available at: https://ieeexplore.ieee.org/document/9537868. [Accessed 12 August 2022].