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Hand Gesture Recognition and Conversion Application

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ABSTRACT

The differently-abled (i.e. the Speech and Hearing impaired) people communicate with each other using Sign language. But they face difficulties while communicating with normal people in day-to-day life because the latter are unaware of the Sign language. The purpose of this paper is to bridge the communication gap between them. The paper intends to depict a real-time, portable and a cost-efficient system which captures, recognizes and translates a given hand gesture based on ASL(American Sign Language) into an English language textual and audio format. The goal of this paper is to achieve the maximum recognition rate.

Keywords:-Human computer interaction, Hand gesture recognition, Real-time, Image processing, American sign language, Feature vectors etc.

1.INTRODUCTION

Human Computer Interaction (HCI) is a research field which deals with interaction of humans with machines or computers. In last few decades, even though the computational power of computers has doubled, but the HCI has not transformed much, we still use intermediary devices like keyboard and mouse. However, these are problematic and have become a bottleneck in HCI.It is the need of the hour for advancements in HCI using Gesture recognition which is a subfield of HCI which enables humans to communicate with the machines and interact naturally without any mechanical device or any sort of physical link. Gestures are movement of part of the bodydone to pass information from one person to another. Gesture recognition is basically interpreting human gestures (mainly hand and face) via mathematical algorithms. Mainly hand gesture recognition research can be categorised into two parts: One is Electromagnetic gloves and sensors, but it is costly and impractical approach. Second is the Computer Vision based approach involving Image Processing which is complex but the best way for Gesture recognition.

Hand gestures can be classified into different categories base on its application scenarios: conversational gestures, controlling gestures, manipulative gestures and communicative gestures. Out of which communicative gestures are used by the differently-abled people for their communication. There are around 70 million differently-abled people in the world for them to communicate with there are more than a hundred sign languages today for example American Sign Language (ASL), British Sign Language (BSL), Japanese so on.

Fig-1:Standard American Sign Language Hand-Gestures for 0-9 and A-Z.

By the standard definition, a sign language is a way of communicating by using the hands and which is an important way for deaf and dumb people to communicate. Spoken or Natural languages use sounds from the mouth and are understood with the ears while Sign languages use hands and are understood with the eyes.Here we propose a system for the recognition of American Sign Language (ASL) since most of the signs in ASL are single handed and thus, complexity is less. Another attractive feature is that ASL already has a standard database that is available for use.

2.LITERATURE SURVEY

Many researchers are working on hand gesture recognition, Mohiminul Islam and Sarah Siddiqua[1] in 2017 introduced a combination of five algorithms, which are fingertip finder which uses combination of K curvature and convex hull, automatic pixel segmentation, eccentricity, elongatedness and rotation. Feature vectors are extracted of individual image for each hand gesture, with an overall better accuracy. PranaliLoke, JuileeParanjpe, SayaliBhabal, KetanKanere, [2] proposed an Indian sign language converter which uses HSV i.e. Hue, Saturation, Intensity and classification using neural network. The edge detection algorithm and skin detection algorithm were applied together in [3] using MATLAB for a better solution. The Canny edge detection algorithm for the purpose of detecting points at which image brightness changes sharply. They used ANN algorithm for gesture identification for fast computational ability. Static hand gesture recognition analysing three algorithms named Convexity defect, K curvature and Part based hand gesture recognition was developed using Microsoft Kinect sensors [4]. Microsoft's Kinect camera allows for capturing pseudo-3D image called the depth map which can easily segment the input image and track the image in 3D space. But this camera is very costly. Anu P.D and PhilomonJoseph[5] compares the difference in angles made by each finger of inputs. If the values are similar, it is a gesture. Then compare ratios of finger lengths. Shrinking or growing of hand by a constant factor can be detected. Background removal algorithms and convex hull algorithms are used to identify fingertips. DeepaliKaushik and AnkurBhardwaj [6] in 2016 proposed a method of orientation histogram that finds feature vectors to classify an image. It uses a combination of neural networks to train datasets. Proposed method offers an above accuracy of 93.32%. NehaTavari and A.V. Deorankar[7] make use of gradient computation and Gaussian filters to remove the background. A feed forward back propagation neural network is used to train the network. A directional search algorithm allowed for entire hand contour, the K curvature algorithm was employed to locate fingertips over that contour. Identification of Bengali Sign Language for 46 hand gestures was presented in [8]. ANN was trained by feature vectors of the fingertip finder algorithm. A database of 2300 images of Bengali signs was constructed. The experiment showed an accuracy of 88.69%. In [9], three techniques were explored: K curvature, Convex Hull, Curvature of Perimeter for fingertip detection. A new approach was suggested called Curvature of Perimeter with its application as a virtual mouse. A static and dynamic hand gesture recognition system was proposed in depth data using dynamic time warping in [10]. Another noteworthy development was the HCI system for recognizing faces and hand gesture from a video camera presented in [11]. They combined head position and hand gesture to control equipment. The position of the eyes, mouth and face centre were identified to determine head position. Automatic gesture area segmentation and orientation normalization of the hand gesture gave recognition rate 93.6%.

3.PROPOSED MODEL

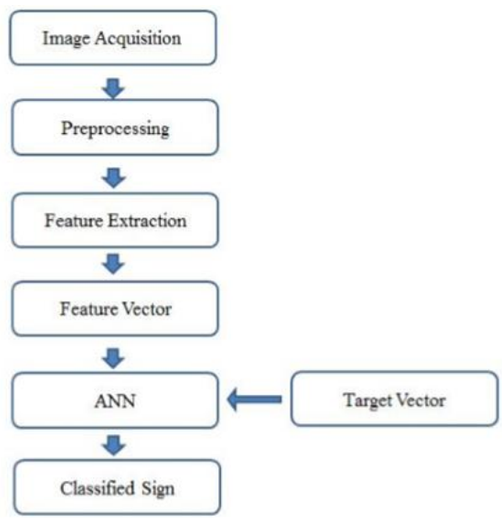

Fig-2:Flow Diagrams

The proposed system is a client-server based web and phone application. The system had to identify all the static hand gestures of the ASL. Different users have different hand shapes and skin colours, making it more difficult for the system to recognize a gesture. The system combines five feature extraction algorithms for user independent and robust hand gesture recognition. The whole system works in four steps for gesture recognition such as image acquisition, pre-processing, feature extraction and feature recognition. The flow diagram of proposed system is shown in Fig-2.

A. Image Acquisition

For the ASL standard set of A-Z and 0-9 gestures, the feature vectors are stored in the database at the web server. The differently- abled person will perform the hand gesture in front of the Android mobile camera.Once the image is captured, the image file will be uploaded on the server using the android application.

B. Pre-processing

Pre-processing of an image is necessary as the image received from the camera may contain different noises. For sign detection, the portion from wrist to fingers of a hand is needed. So the rest of the part is eliminated from the image by cropping it. The pre-processing will be carried on the server side. Different pre-processing algorithms will help the image to further undergo image processing.

C. Image Processing

The pre-processed image will be used for image processing. The image is converted into a set of 30 feature vectors using different image processing algorithms like fingertip finder, eccentricity, elongatedness, pixel segmentation and rotation which is called Feature Extraction. Using the proposed image processing algorithms gives the most minimum necessary feature vectors which are needed for feature recognition. Using lesser than 30 feature vectors for each sign gesture hampers the recognition rate and gives inefficient results.

D. Feature Recognition

ANN mimics biological neural network system. Actually neural networks are trained so that a particular input leads to a specific target output by adjusting the values of the connections between elements. In the training phase of the neural network, input vector is equal to the feature vectors and target vector is equal to the number of signs used for recognition. Each sign is represented by a vector containing 30 features. ANN has three layers such as input, hidden and output. Hidden layer has a variable number of neurons with radial basis function. Here hidden layers are used with trial and error basis for best performance. Sample images of each sign from different individual are taken to train, test and validate the ANN. Feature vectors of the test image are compared with the feature vector sets in the training database using the ANN classification to identify the meaning of that test image in the textual format.

4. SYSTEM ARCHITECTURE

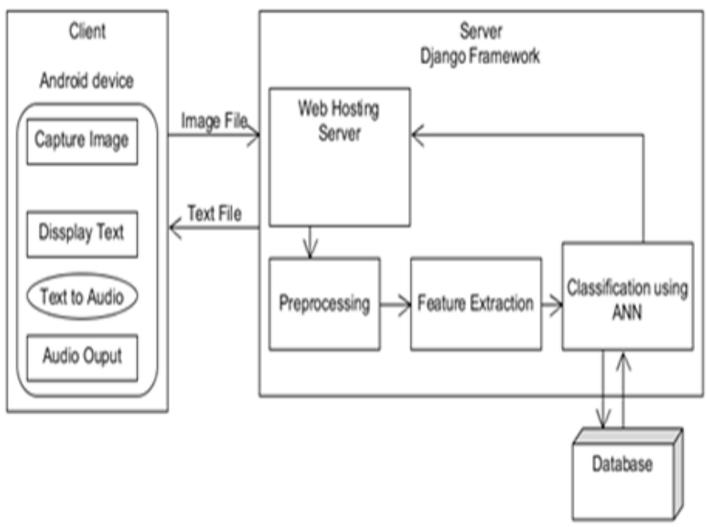

Fig-3: Block Diagram of system architecture

The system architecture as shown in Fig.3depicts that when the differently-abled person does the ASL hand gestures before his/her android phone camera. An image will be captured and this image will be sent to the web-hosting server by the android phone application. The image file uploaded on the server which can be implemented on the Django framework will translate the image into text. The translation will be done by first pre-processing the image input and then applying a series of image processing algorithms to extract 30 feature vectors of the image. Feature vectors are basically integer values specifying different peculiar features of the image. These feature vectors will be compared to the set of vectors of the standard ASL stored in the database by the artificial neural network classification which is a supervised learning type classification.

5. CONCLUSIONS

In this paper, we have proposed a system which takes the hand gesture inputs from the differently abled person via the mobile camera and using various efficient image processing algorithms translates that ASL hand gesture into an equivalent text and also converts into audio format in English language. A supervised learning classification method i.e. Artificial Neural Network is used for effective recognition. The advantage of using the neural networks is high processing speed so that the results in real-time manner. It is also advantageous as even noise corrupted; the signs can still be retrieved. Developing such a system translating sign language to text/voice format will prove very useful for physically impaired people in their day-to-day life. This system can be further developed to increase the scope to recognize dynamic gestures in real time via video format. Many other gestures of the sign language can also be made a part of the database with higher and accurate recognition. The system can also be extended for different regional Sign languages.

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