Identifying Pattern Based on Indian Sign Language For Hearing Impaired

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Abstract- *Gestures are movements of the body used to communicate an idea, intention, or feeling. Many of these activities are made with the hands. Hand Gesture is a concept in human computer interaction which has become popular in recent years for being a natural and suitable interaction device in a virtual environment. Hand gesture recognition is important for the communication between persons with the hearing ability and the hearing impaired. Hand gesture is natural for human users to express themselves and interact with others. It has recently become attractive for spontaneous interaction with consumer electronics and mobile devices. The performance of the gesture recognition method is evaluated in applications of recognizing gestures of different hand size, shape and skew angle. The use of hand gesture is an active area of research in sign language recognition and Human-Computer Interaction. This paper gives the study about the Indian Sign Language and how effectively the gesture recognition can be useful to the deaf and dumb people in their education and recognize hand gestures based on pattern recognition technique.*

Keywords- Gesture Recognition, Hand Gesture Recognition, Indian Sign Language, pattern recognition.

I. INTRODUCTION

Hand gesture is one of the typical methods used in sign language for non-verbal communication. It is used by people who have hearing or speech problems to communicate among themselves or with normal people [1]. Different sign language systems have been developed by manufacturers around the world, but they are neither flexible nor cost-effective for the end users [2].

Sign language is commonly known as a type of language used by the hearing impaired of deaf people. In transmitting this language, there are no sounds emitted by the speaker but only hand signals that correlate with certain meanings [3]. The body is also used as a means of conveying a message that complements the movement of the arms and hand. Even if sign language is not spoken, it conveys as much as meaning and emotions as the spoken language. Aside from the body language and hand signals, facial expression provides emotions that support the thoughts of the speaker [4]. It offers enrichment of message capabilities for the speech and hearing impaired, hopeful improved social opportunities and integration. Sign language is the most natural and expressive way for the hearing impaired. Because of this reason the automatic sign language recognition has attracted vision researchers [5]. Several research works are going on sign language in order to make the communication between a deaf person and a normal person easy [6].

II. INDIAN SIGN LANGUAGE

Indian Sign Language is also known as Plains Sign Language. It was developed by Indian society to meet a need for clear communication between tribes that spoke different languages [7]. It had zero whatsoever to do with hearing loss and used only by Indians on the Plains.

India has several different sign language systems for writing and speaking. However, no system of finger-spelling that is letter by letter communication with hand gestures has achieved any significant level of support within the deaf community [8].

The most important elements of a good finger spelling system are easily distinguishable and comfortable. Some signs are naturally easier than others, then the common letters should be given signs which are easy and quick to do while uncommon ones can be assigned which are relatively slow and difficult gestures. In addition, the system should be easy to teach and learn [9].

The Figure 1 shows the Indian sign Language for the English alphabets and Numbers.

A. Sign Language as a communication

Sign languages are natural languages that use different means of expression of communication in day by day life. Principally it is the only means of communication for the hearing impaired. It offers enhancement of communication capabilities among normal beings and provides replacement for speech among deaf and mute people. In a sign language,

the signs are generated by combinations of hand motions and finger gestures and frequently augmented with mouth movements according to the spoken language [10]. Hand gesture motions are great from one sign to another by the spatial motion pattern, speed and the body parts that the signer touches at the beginning or during or at the end of a sign. In adding together to the hand movement the finger configuration during the slower parts of the hand movements also provides significant meaning to a gesture.

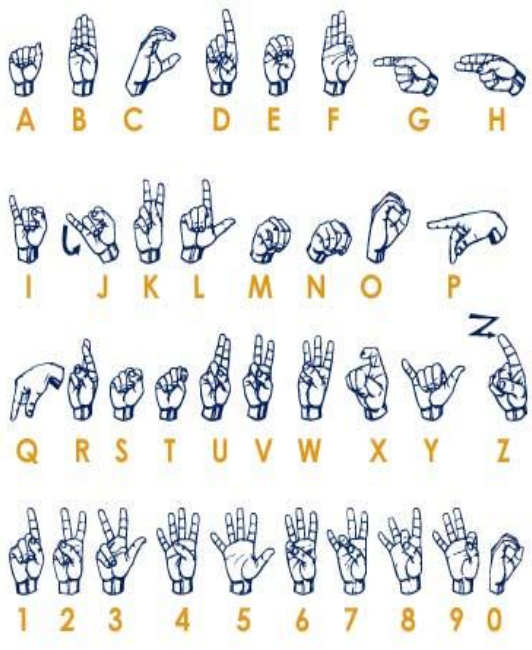

FIGURE 1 : INDIAN SIGN LANGUAGE

B. Sign Language Interpreter

Many people learn sign language with the goal of becoming an interpreter. Sign language interpreters are essential as one of the many ways access is provided to deaf and hard of hearing people [11]. A modern tool does exist for accessibility but there are many situations the deaf person may prefer an interpreter. Sign language interpretation services via Video Remote Interpreting (VRI) or a Video Relay Service (VRS) are useful in the present-day where one of the parties is deaf, hard-of-hearing or speech-impaired. In video remote interpreting a sign-language user and a Hearing person are in one location and the interpreter is in another location. The interpreter talks with the sign-language user via a video telecommunications link and communicate with the Hearing person by an audio link. In video relay service the sign language user, interpreter and the Hearing person are in three separate locations and allow two clients to talk to each other on the phone through the interpreter.

C. *Recognition of a Sign Language*

Sign language recognition is very important not only from the engineering point of view but also for its impact on the human society. Function of the sign language recognition system can provide an opportunity for the deaf to communicate with non-signing people without the need for an interpreter. The system can be used to generate speech or text making the deaf more independent but there has not been any system with these capabilities so far. Research has been limited to systems capable of recognizing a minimal division of a full sign language [12]. The reason for this recognizing a full sign language vocabulary recognition of gestures representing words and sentences definitely is the most difficult problem in the context of gesture recognition research.

Sign languages are well structured languages with a, morphology, syntax, grammar and phonology characteristic from spoken languages. The arrangement of a spoken language makes use of words linearly whereas a sign language makes use of several body movements' parallel in the spatial as well as in temporal space. The characteristics of a sign language are different than that of spoken languages due to the existence of several components. It affects the context such as the use of facial expression, head movements and the hand movements.

III. APPLICATIONS OF GESTURE RECOGNITION

Gestures are useful in communication meaningful information or interacting with the environment. They represent one interesting small subspace of possible human motion. A gesture may also be supposed by the environment as a compression technique for the information to be transmitted and reconstructed by the receiver [13].

Gesture recognition has lot of applications such as recognizing sign language, medically monitoring patients emotional stress levels, lie detection, navigating and manipulating in virtual environments, communicating in video conferencing, developing aids for the hearing impaired, enabling very young children to interact with computers, designing techniques for forensic identification, distance learning monitoring automobile drivers alertness and drowsiness levels.

A. Sign Language in Education

Sign language has its own grammatical structure independent of any spoken or written languages. The majority of deaf children are born to hearing parents and

therefore do not get sign language as a mother tongue. They need to learn it at school. Minority of deaf children are born to deaf parents. They get sign language as a mother tongue to the deaf children. Some studies reveal that children can learn sign language earlier than they can learn to speak.

Teaching is a rewarding job since there is a sense of fulfillment after realizing that the learners have been equipped with knowledge and skills. For this matter, it is also interesting to teach sign language since the learners would greatly benefit from the skills acquired. If one is interested in teaching sign language, it is better to inquire with the national or local deaf association to see the prospects of teaching sign language. It is necessary for a sign language teacher to be accredited by legitimate deaf association. Usually, one of the requirements for sign language teaching is solid educational background on sign language.

IV. IMAGE DATABASE

The image database is a collection of digitized images. The database is divided into volumes based on the basic character of the pictures. Images are of various sizes such as 256 x 256 pixels, 512 x 512 pixels, or 1024 x 1024 pixels. All images are 8 bits per pixel for black and white images, 24 bits per pixel for color images. The starting point was the creation of a database with all the images that would be used for training and testing. The images stored in the database can have different formats. Images can be digitized photographs, hand drawn, or a 3D dimensional hand. Photographs were used in the most reasonable approach. Images came from two main sources; they are from Internet and photograph from a digital camera. The images are different sizes, resolutions and different angles of shooting. In all picture, two operations were carried out in all of the images. They were transformed to grayscale and the background was made uniform. The internet databases have uniform backgrounds but in this work photos taken from digital camera and processed in Adobe Photoshop.

A. Train Set

There are eight training sets of images and each on containing three images. Each set originates from a single image for testing gesture recognition. Some examples for train images in the figures. Training images for the letters A, 1 and 0 is represented in the figures 2, 3 and 4 respectively.

Figure 2: Train image for "A"

Figure 3: Train image for "1"

Figure 4: Train image for "0"

B. Test Set

The number of test images varies for each gesture. There is no reason for keeping those on a constant number. Some images can tolerate much more variance and images from new databases and they can be tested extensively, while other images are restricted to fewer testing images. Examples for test images A is in the figure 5.

Figure 5: Test image for "A"

V. PATTERN RECOGNITION SYSTEM

The system could be approached either in high or low-level. The former would employ models of the hand, finger, and joints and perhaps fit such a model to the visual data. This approach offers robustness and the expense of speed. A low level approach would process data at a level not much higher than that of pixel intensities. The pattern recognition system used is in figure 6. Some transformation T, converts an image into a feature vector, which will be then compared with feature vectors of a training set of gestures.

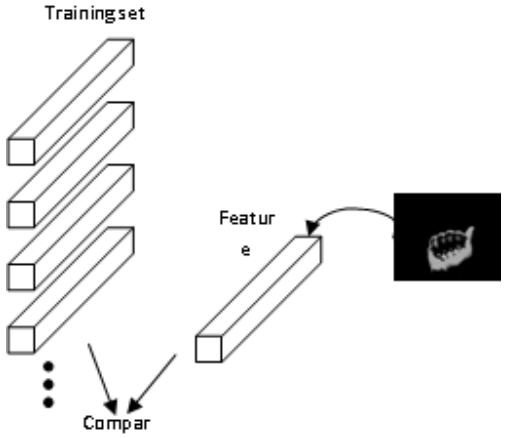

Figure 6 : Pattern Recognition System

Histogram orientation has the advantage of being robust in lighting change conditions. In the pixel intensities approach certain problems can arise for varying illumination. Taking a pixel by pixel difference of the same photo under different lighting conditions would show a large distance between these two identical gestures.

Figure 7: Illumination Variance

For the pixel intensity approach no transformation T has been applied. The image itself is used as the feature vector. The same hand gesture under different lighting conditions is in figure 7.

Another important aspect of gesture recognition is translation invariance. The position of the hand within the image should not affect the feature vector. This could be enforced by forming a local histogram of the local orientations. This should treat each orientation element the same, independent of location. Therefore, orientation analysis should give robustness in illumination changes while histogramming will offer translational invariance. This method will work if examples of the same gesture map to similar orientation histograms, and different gestures map to substantially different histograms.

I. Orientation Histograms

One can calculate the local orientation using image gradients. In this paper, used two 3 – tap x and y derivative filters. The outputs of the x and y derivative operators will be dx and dy. Then the gradient direction is atan (dx, dy) and used the edge orientation as the only feature that will be presented to the neural network. The reason for this is that if the edge detector was good enough it would have allowed to test the network with images from different databases. Another feature that could have been extracted from the image would be the gradient magnitude using the formula $\sqrt{dx^2 + dy^2}$.

This would lead though to testing the algorithm with only similar images. Apart from this the images before resized should be of approximately the same size. This is the size of the hand itself in the canvas and not the size of the canvas. Once the image has been processed the output will be a single vector containing a number of elements equal to the number of bins of the orientation histogram. Blurring can be used to allow neighboring orientations to sense each other.

The static hand gesture recognition program can be divided into the following steps: The first thing for the program to do is to read the image database. A *for* loop is used to read an entire folder of images and store them in MAT Lab's memory. The folder is selected by the user from menus. A menu will firstly pop-up asking you whether you want to run the algorithm on test or train sets. Then second menus will pop-up for the user to choose which ISL sign he wants to use. Resize all the images that were read in Step1 to 150x140 pixels. This size seems the optimal for offering enough detail while keeping the processing time low.

Next thing to do is to find the edges.

- For the x direction set x = [0 -1 1]
- For the y direction y = $\begin{bmatrix} 0 \\ 1 \\ -1 \end{bmatrix}$, which is the same as x but transposed and multiplied by –1.

Figure 8**:** ***x-y*** filters

In the above figure 8 represent two images of the result of convolving an ISL sign of A with the x-filter and y-filter. As this would meant the only feature extracted from the images it had to offer enough discrimination among them. From the images above it doesn't seem like a good edge detector. An interesting way of testing various edge detectors and changing their values is an Adobe Photoshop filter which

lets you input the values of the mask in a matrix and see the result on the image in real time. Dividing the two resulting matrices (images) *dx* and *dy* element by element and then taking the atan (tan−1). This will give the gradient orientation.

VI. RESULTS AND DISCUSSION

The figure 9 are some screen shots displaying the results obtained from the program. Sign images of the same letter are grouped together on every table. The table gives us information about the pre-processing operations that took place (i.e. blurring, noise, translation) and also if the image belongs to the same database with the training images. The amount of each filter is also recorded and estimate the maximum values of noise the network can tolerate. This of course varies from image to image. The result also varies for every time the algorithm is executed. The variance is very small but it is there. The results come out of the network in column format. Each column is a classified image vector. The position of the '1' in the vector among the '0s' indicates which sign it is. Therefore there should be only one '1' in every vector, but this is not always the case.

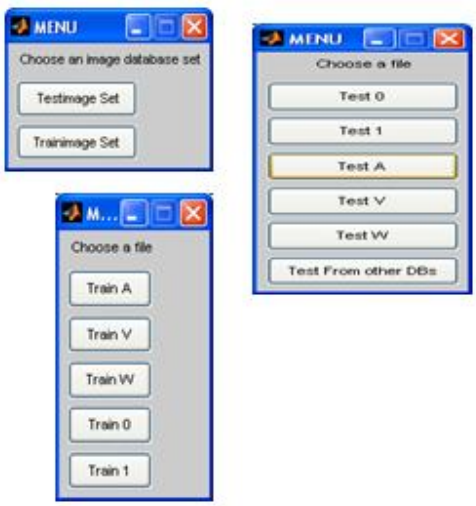

Figure 9: Output Screen Shots

VII. CONCLUSION

The Indian sign language is still in research. One reason some hearing people resist learning sign language is because they think they need to become fluent in it. It is not necessary to become fluent in sign language unless your intention is to work with deaf people. Most hearing and deaf people can benefit from learning just enough sign language to be able to communicate. At a minimum, the sign language alphabet should be learned. Deaf heritage includes many deaf and hearing people who have made their mark in the deaf and hard of hearing community. Some stood outstanding in the world of entertainment; others made a contribution to the field of deaf education, or in sports. To achieve these they have to educate themselves in sign language. This paper gives a clear study about the gesture recognition in Indian sign language and effectively used for deaf and dumb people in their education recognize hand gesture based on pattern recognition technique.

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