AAWAAZ: A Communication System for Deaf and Dumb

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Abstract: **The paper proposes a framework for recognizing hand gesture which would serve not only as a way of communication between deaf and dumb and mute people, but also, as an instructor. Deaf and dumb individuals lack in proper communication with normal people and find it difficult to properly express themselves. Thus, they are subjected to face many issues in this regard. The sign language is very popular among them and they use it to express themselves. Thus, there is a need of a proper translator. The deaf and dumb are not idle as past, they are working outside and doing great at it. So an efficient system must be set up, to interact with them, to know their views and ideas. The framework here, act as a communication system for deaf and dumb individuals. It would take the sign language as an input which would display the result not only in the form of text but also in the form of audio. Similarly, if there is any input in the form of text, it would display the corresponding image.**

Keywords: **sign language; deaf; dumb; hand gesture; image matching; feature matching; feature extraction; gesture recognition**

I. INTRODUCTION

According to a survey conducted by disabled welfare department, about eight lakh people in India are deaf and dumb. The issues confronted by the deaf and dumb individuals in India can be comprehensively grouped into classes like social connection, communication, behavioral issues, psychological well-being, and safety concerns. Their issues have been intensified by the absence of a legitimate gesture based communication translator in India [1]. They can, however write and communicate easily. But it is not feasible. And they suffer a lot in face-to-face communication. Generally, these individuals make use of sign language for interaction; but they discover it gesture is of our concern as they are very popular among these individuals and they find it easy to interact using these gestures. hard to deal with the ones who do not understand this language. Hence, there is a need of a proper interpreter. The number of educators trained in Indian Sign Language is less so we require a framework which can act as an instructor as well. If these individuals are not trained at an early age i.e. between 3 to 5 years, their social survival gets to be troublesome.

Thus, we aim to develop such a system which serves both the purposes: communication flexibility and absence of proper teaching centers of the sign language. The sign language is difficult to interpret by the individuals who are not well-aware of it. Gesture is a non-verbal communication, which includes the movements of head, hand and other body parts [2]. Here, handgesture is of our concern as they are very popular among these individuals and they find it easy to interact using these gestures.

II. LITERATURE SURVEY

The deaf and dumb make use of sign language to communicate which is difficult to interpret by the individuals who are not well-aware of it. Thus, there is a need of building up a device that can interpret the gestures into text and speech. This will be a great step to make the communicationpossible between the deaf and dumb individuals and the general public.

Hand gestures being very popular among these individuals, serve as a good means of communication. Thus, the hand is considered as an input for a system which would display the corresponding result either in the form of text or speech, or both. Thus, Human Computer Interaction(HCI) is the need here for image matching. It is the best use of computer technology, concentrating especially on the interfaces between individuals and PCs. Computer recognition of sign language is an important research.

There have been different sign languages in the world but the American Standard Language(ASL) is considered standard in many countries [7].

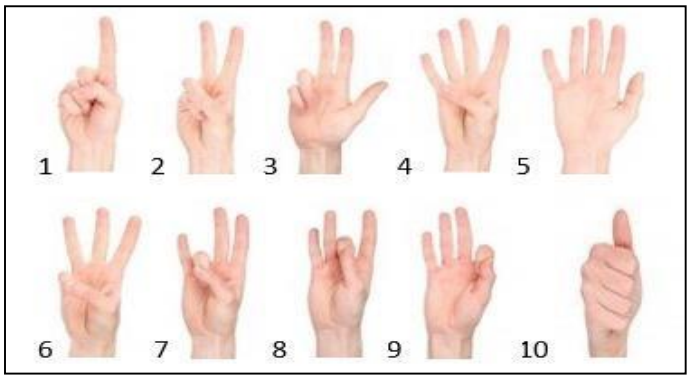

Fig. 1. ASL numbers (1-10)

TABLE 1. COMPARIRIVE STUDY OF EXITISING WORK DONE

Article Name	Published year	Methodology	Limitations
Full duplex communication system for deaf and dumb	2015	Mute people can use the gloves to perform hand gesture and it will be converted into speech so that normal people can understand their expression. The speech of normal people is converted into text and the equivalent gesture for that speech signal will be displayed.	Gloves are mandatory. Without them, the system would not work. It is not feasible to carry gloves all the time. These are expensive as well.
Sign language recognition system	2013	By keeping in mind the fact that in normal cases every human being has the same hand shape with four fingers and one thumb, this project aims at designing a real time system for the recognition of some meaningful shapes made using hands. Camera and computer system is used.	The background of an input image must be free from external objects. Also, the distance between the image and the camera is kept fixed.
Intelligent sign language recognition using image processing	2013	An inexpensive computer in the communication path so that the sign language can be automatically captured, recognized and translated to speech for the benefit of blind people. In the other direction, speech must be analyzed and converted to either sign or textual display on the screen for the benefit of the hearing impaired.	There is a specific camera orientation and specification. Thus, it is not feasible in every environment.
Real-time Vision-based Hand Gesture Recognition Using Haar-like Features	2007	a two level approach. The lower level of the approach implements the posture recognition with Haar-like features and the AdaBoost learning algorithm. The higher level implements the linguistic hand gesture recognition using a context-free grammar-based syntactic analysis.	Matching the image frames from input video with the database is time-consuming and a bit expensive. It also lacks the capability to deal with singularities that arise from ambiguous views

Much work has been done in this context with different methodologies and techniques each having its own pros and cons. Table 1 shows some of the examples of technical publications [1][2][5][6].

As hand is of major concern here, many challenges make it difficult as well as complex to recognize a particular gesture as it can be noted from the Table 1. The human hand comprises of numerous associated parts and joints, making it a complex object for input [6]. Also, each hand is of different size. The majority of the signs make utilization of both the hands together. The speed of both the hands is different which is a problem. Some signs require contact with the body thus, their recognition becomes an issue. It is difficult to maintain a huge data set for gestures as each number and letter has its own sign. There have been many issues but there is always the possibility of improvement.

The Hand Gesture Recognition is referred to as the process of tracking human gestures and then translating them in the form of some meaningful commands [3]. The applications of hand gesture recognition include:

- Sign language- The problems of deaf and dumb have been worsened by the absence of a proper sign language interpreter in India. The number of teachers, instructors trained in Indian Sign Language are very low so we need a

system which teaches this sign language. It narrows the communication gap with the normal people.

- Medical Applications- Doctors can manipulate digital images during medical procedures using the simple hand gestures instead of touch screens or computer keyboards, which would be very beneficial. It allows the doctors to remain in place during an operation and not move for any procedure, without the need to operate traditional computer-based interfaces. They even have the option of zooming in and out a particular image by moving the hand clockwise or counterclockwise.
- Automated Home- The smart TV support motion control as we can easily switch channels, change volume, play games, pause videos, and even surf the web all using hand gestures. Similarly, the smart refrigerators, air-conditioners and microwave ovens can be controlled using hand gestures. Another important application is controlling the wifi-connection using hand gestures.

Of all these, this paper focuses on the application of sign language which would prove beneficial to the society. It is a great step towards the progress and development of the society.

III. PROPOSEDFRAMEWORK

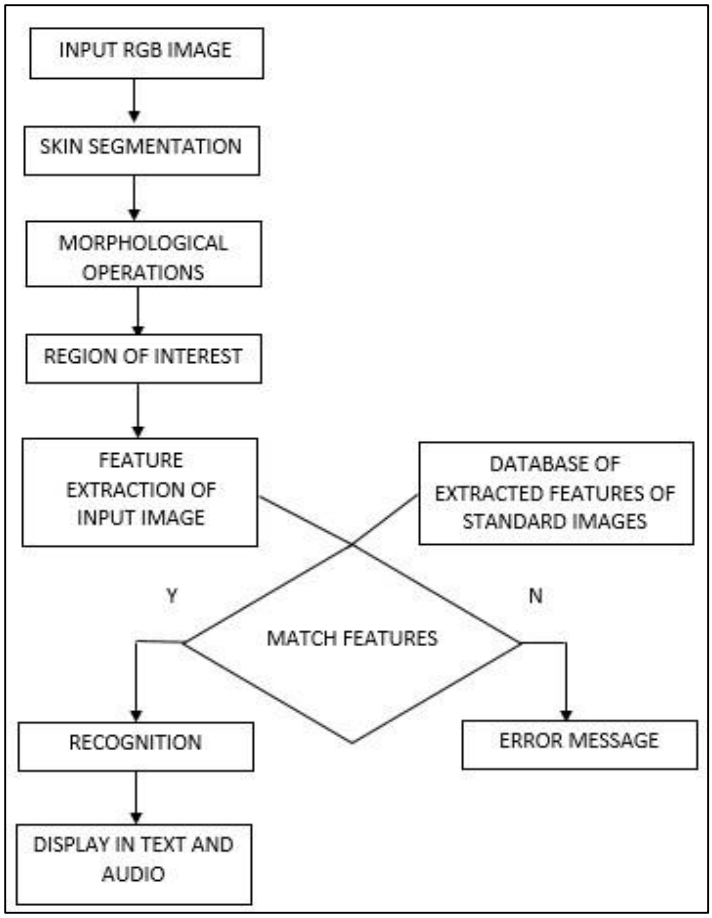

Fig. 2 Flow of proposed framework

Figure 2 explains the flow of proposed framework system. Gesture recognition system is mainly composed of image acquisition, segmentation followed by morphological erosion and feature extraction for gesture recognition [3]. Considering all the previous work done, many components have been added in this framework to avoid the errors and improve the efficiency of the system.

This proposed system shows the various processes involved in hand gesture recognition. The hand gesture is captured through a webcam. This image is segmented using skin detection algorithm. All the possible noise is removed using median filter followed by morphological erosion. Thus, we get an image of interest. The features are then extracted which are matched with the features already stored in database. Now, if the features match, desired output is shown in the form of text and speech; else, the proper error message will be displayed asking for the input again. This framework is inexpensive and easily accessible.

This process is very feasible as it can easily detect the skin irrespective of the background. If there is any gesture which is in contact with the body, hand region can be segmented using bounding boxes for all skin regions and then sorting out the one for hand as different body part is of different size. But it is not always 100% accurate.

A.INPUT IMAGE

This is the first step of the proposed framework where the image is captured using the webcam. This process is also called image acquisition. The input image is then resized to reduce the computational errors and complexity. The query image is in RGB format as shown in Figure 3.

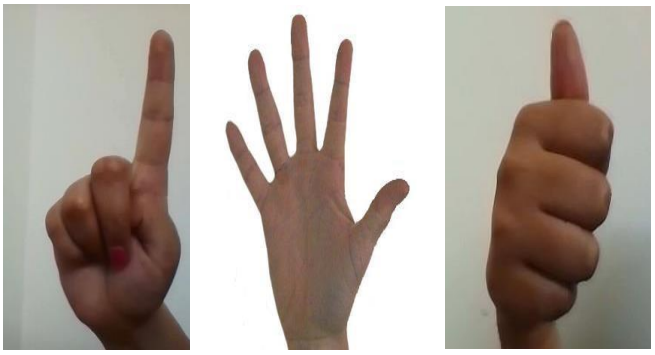

Fig. 3. Input RGB image

B. SKIN SEGMENTATION

This a very important step where the skin region is to be detected. This is done using Hue-Saturation-Value(HSV) histogram. It considers all the illumination changes. Range is considered for all possible skin values from dark to light. So that the mask can be generated for finding the region of interest. Then the median filter is applied followed by morphological operations so as to remove the noise and get a smooth image with edges detected thus, region of interest is

obtained. On which image matching is to be done. Figure 4 shows thhe skin segmentation on an input RGB image.

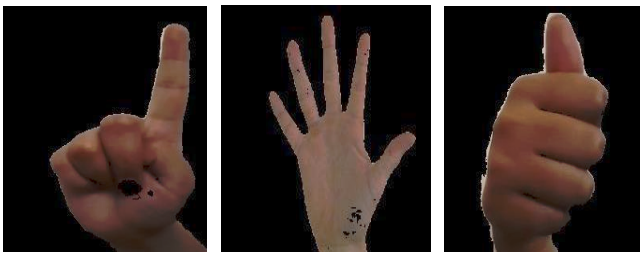

Fig. 4. Skin detection of input image (ROI)

C.FEATURE EXTRACTION

This is an important part. The features are extracted using Harris algorithm. It detects the necessary interest points in the form of a Nx2 matrix, where N is the number of feature points extracted. The first column gives the row position of the interest points and the second column gives the column position of the interest points It then draws those points on the query image, as shown in Figure 5.

The region of interest is converted to a graylevel image on which this algorithm is to be applied. Firstly, derivative mask is composed considering some luminance value. The image derivative is then calculated. Afterwards, the local maxima on the neighborhood is calculated. Hence, the threshold value can be set. The local maxima greater than threshold serve as the interest points, while the rest are excluded. The evaluation of interest points is done referring [4].

This matrix A averages derivatives of the signal in a window W around a point (x, y):

$$A(x, y) = \begin{bmatrix} \sum_W (I_x(x_k, y_k))^2 & \sum_W I_x(x_k, y_k) I_y(x_k, y_k) \\ \sum_W I_x(x_k, y_k) I_y(x_k, y_k) & \sum_W (I_y(x_k, y_k))^2 \end{bmatrix}$$

where I(x, y) is the image function and (x_k, y_k) are the points in the window W around (x, y)[4].

Fig. 5. Feature Extraction

D. FEATURE MATCHING AND RECOGNITION

After the extraction, comes the most important part, that is, feature matching. The data set already has the features extracted of every standard image stored in the form of a Nx2 matrix in a mat file. The matrix value of the query image is then matched with each of those in the data set of every image. And the minimum distance between the matched features is calculated to get the desired result. The one with the minimum value is the maximum matched image. The result is displayed in the form of text and audio (for the blind people who are unable to read the text). Thus, the desired result could be achieved.

If the interest points are not easily extracted, the error message would be displayed asking for the input again.

E. RESULTS AND DISCUSSIONS

Now, the query image is clicked using webcam, then detection takes place. It works well with the static images and the result is more efficient in that case. There are some limitations to these results. The very light brown to somewhat dark brown background gives error as they are considered in the range value for skin segmentation. Figure 6 shows some of the results.

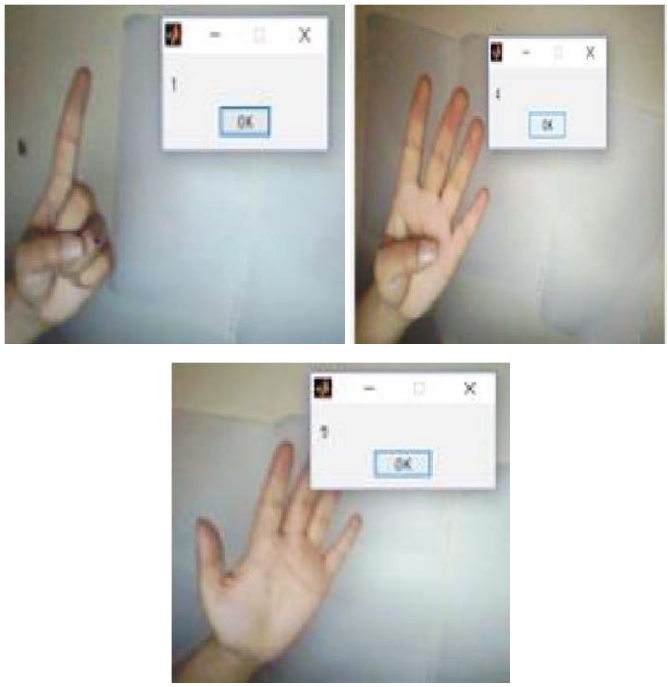

Fig. 6. Result with real time images.

IV. SYSTEMASANINSTRUCTOR

With the lack of number of instructors in India, the system could act as an instructor as well. It might be useful in many teaching center and thus, is an inexpensive way to do so. The deaf and dumb can be taught at an early stage using this system.

The input is to be taken in the form of audio or some text. After searching from the database and processing, the corresponding number gesture can be returned as an output. The audio can be converted to text using some already defined functions and techniques. This could help not only deaf and dumb but also other individuals to learn the sign language easily.

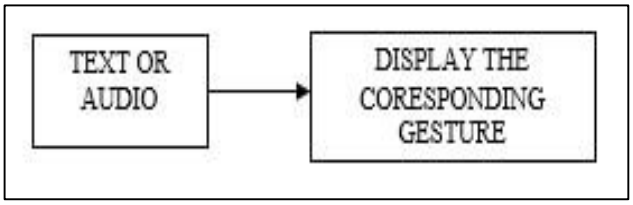

Fig. 7. System as an instructor

V. CONCLUSIONSANDFUTUREWORK

The deaf and dumb are not sitting in the house as past, they are working outside and doing great. So an efficient system must be set up, to interact with them. Sign language is very popular among them and hand gesture recognition is just a small part of it.

The proposed system fulfils the hand gesture recognition process but with some limitations as both the hands cannot be used with this technique, the results are not that efficient. Proper light conditions help in easy detection of region of interest.

The system can be further expanded for alphabets. Like numbers, each alphabet has its own unique gesture. Thus, the detection and recognition would be efficient using this technique. Not only this, the input can be taken in the form of videos. The videos can then be divided into frames. From those frames, the necessary hand region could be extracted using bounding box, and then following the same procedure as mentioned in the proposed framework. Every language has its own grammar. The sign language has it as well. By recognizing the frame images and using proper parsing algorithm, a grammatical structure could be formed. This would take the system of hand gesture recognition a step ahead.

This system can be made handy by incorporating it in a mobile phone. Just a click, the image is captured and corresponding result is obtained. Thus, a more efficient way of interaction could be achieved.

REFERENCES

[1] Shraddha R. Ghorpade, Surendra K. Waghamare, "Full Duplex Communication System for Deaf & Dumb People," International Journal of Emerging Technology and Advanced Engineering (IJETAE), Volume 5, Issue 5, May 2015, ISSN 2250-2459.

[2] Er. Aditi Kalsh, Dr. N.S. Garewal, "Sign Language Recognition System," International Journal of Computational Engineering Research (IJCER), Volume 03, Issue 6, June 2013.

[3] Vishal Bhame, R.Sreemathy, HrushikeshDhumal, " Vision Based Hand Gesture Recognition Using Eccentric Approach for Human Computer Interaction," International Conference on Advances in Computing, Communications and Informatics (ICACCI), 2014.

[4] Cordelia Schmid, Roger Mohr, Christian Bauckhage, "Evaluation of Interest Point Detectors," International Journal of Computer Vision (IJCV), 151–172, 2000.

[5] Qing Chen, Nicolas D. Georganas, Emil M. Petriu, "Real-time Visionbased Hand Gesture Recognition Using Haar-like Features," Instrumentation and Measurement Technology Conference (IMTC) Warsaw, Poland, May 1-3, 2007.

[6] SawantPramada, Deshpande Saylee, NalePranita, NerkarSamiksha,

[7] Mrs.Archana S. Vaidya "Intelligent Sign Language Recognition Using

[8] Image Processing," IOSR Journal of Engineering (IOSRJEN), Volume 3, Issue 2, Feb. 2013, PP 45-51

[9] www. http://www.lifeprint.com/asl101/pages-signs/n/numbers1-10.htm

[10] M.K. Bhuyan, Debanga Raj Neog and Mithun Kumar Kar, "Fingertip Detection for Hand Pose Recognition," International Journal on Computer Science and Engineering (IJCSE), Vol. 4 No. 03 March 2012, ISSN : 0975-3397.