Gesture Translator for Physically Impaired People

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***Abstract*—Generally dumb people use sign language for communication but they find difficulty in communicating with others who don't understand sign language. In this paper we have proposed a system to lower this communication gap .It is based on the need of developing an electronic device that can translate sign language into speech in order to make the communication take place between the mute communities with the general public possible. We propose a vision based Hand gesture Recognition system that recognizes hand gesture in midair, especially for physically impaired people, and provides recognized character or number as text and corresponding sound. This system provides a convenient and easy to use human computer interaction (HCI) system for especially visually or physically impaired people. This contour model based recognition system is trained on a set of defined hand images. Training images are processed using contour model from the OpenCV image processing library. We have evaluated the system for both quantitative and qualitative aspects.**

Keywords*— *Contour Analysis, Hand gesture Recognition, Template Matching.

I. Introduction

Communication between Deaf ,dumb and normal person have always been a challenging task .About nine billion people in the world are deaf and dumb .The people who can not speak and hear are using sign language for communication .A sign language is a language which uses visually transmitted sign patterns to convey meaning by simultaneously combining hand shapes and movement of the hands and arms , to fluently express or communicate with each others.

The paper describes an approach to automatically recognize sign language and translate it into speech .Hand gesture recognition is based on contour analysis and template matching. The system objective is to develop a computerized Sign Language (ISL) recognition system. The basic concept is to use computer web camera to capture the gestures made by a disabled person. The computer analyses these gestures, ,neglect the variations and synthesizes the sound for the corresponding word or letter for normal people to understand .

II. Literature Survey

The different researchers have used different methods for hand gesture recognition .Some of them are vision based, gloves based .The paper Gesture Translator for physically impaired people included the skin color detection algorithm along with contour analysis and template matching .

A different method has been developed by Shoiab Ahmed .V which is MAGIC GLOVES (Hand Gesture Recognition and Voice Conversion System for Differentially Able Dumb People).This makes use of a Wireless data gloves which is normal cloth driving gloves fitted with flex sensors along the length of each finger. Deaf and dumb people can use the gloves to perform hand gesture and it will be converted into speech so that normal people can understand their expression.[1]

Another method has been developed by Shreyashi Narayan Sawant in which signs are pre-processed for feature extraction using HSV color model. The obtained features are compared by using Principle Component Analysis (PCA) algorithm. After comparing features of captured sign with testing database minimum Euclidean distance is calculated for sign recognition[2].

A method had been developed by P. Subha Rajan and Dr. G.Balakrishnan for gesture recognition of Indian Sign Language where the proposed that each gesture would be recognised through 7 bit orientation and generation process through RIGHT and LEFT scan[3].

III. Proposed System

In our project, Vision based approach have been discussed for interpreting the Indian sign language using hand modality. A Typical Hand Gesture Recognition system consists of mainly five modules: Image acquisition, Tracking and segmentation, feature extraction and description, Classification and recognition and converting it to audio file. We focused on a study of sign language interpretation system with reference to vision based hand gesture recognition. An attempt has also been made to explore about the need and motivation for interpreting ISL, which will provide opportunities for hearing impaired peoples in Industry Jobs, IT sector Jobs, and Government Jobs.

The objective was to create a system which could detect various hand shapes and hand orientations and identify them for the user in real time. A fast matching system is thus required. For this reason the contour analysis method was chosen. In vision based methods the system requires only camera to capture the image required for the natural interaction between human and computers and no extra devices are needed. It is more useful for real time applications. Although these approaches are simple but a lot of gesture challenges are raised such as the complex background, other skin colour objects and lighting variation with the hand object, besides system requirements such as recognition time, robustness, computational efficiency and velocity. It allows users to give characters/symbols or any assigned operations to the computer or any machine /robot just by waving their hands in air towards it. This expands the use of 3D hand gestures to allow for convenient and unrestricted. The overall image processing take place as follows:

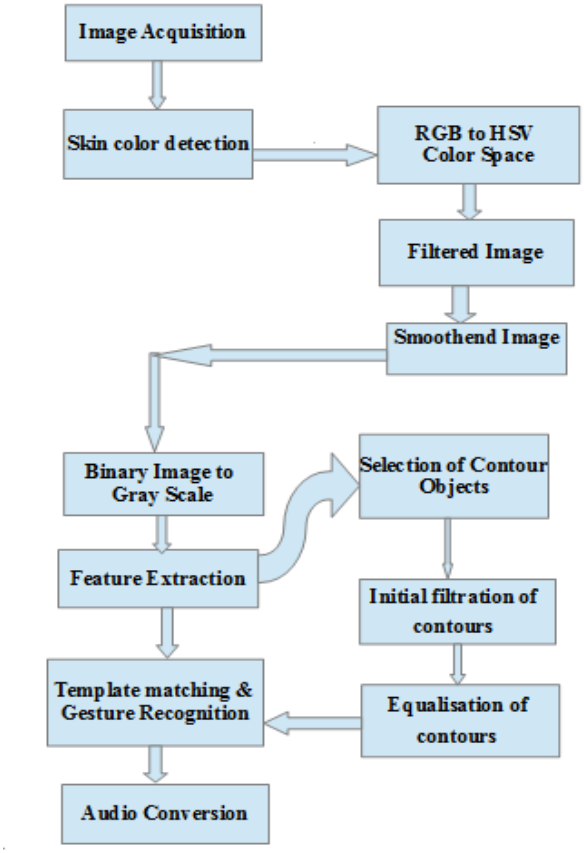


Fig. 1 Flowchart of Gesture Translator.

A. *Image Acquisition*

The input images are captured by a webcam placed on a table or laptop. The system is demonstrated on a conventional PC/ Laptop computer running on Intel Pentium Dual Processor with 4GB of RAM. Each image has a spatial resolution of 620 x 480 pixels and a grayscale resolution of 32 bit. The system developed can process hand gestures at an acceptable speed. Given a variety of available image processing techniques and recognition algorithms, we have designed our preliminary process on detecting the image as part of our image processing. Hand gestures are shown below:

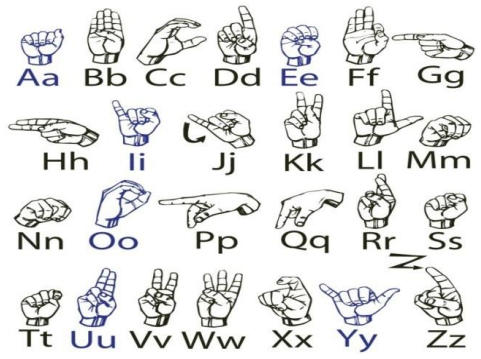
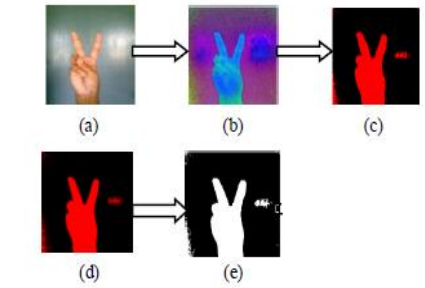


Fig.1 Indian Sign Language

B. *Skin colour detection*

First, the image in RGB was converted to HSV color space, because it is more related to human colour perception The skin in channel H is characterised by values from 0 to 50, in the channel S from 0.23 to 0.68 for Asian and Caucasian ethnics . In this work we used images from different Caucasian people, from different places of the world. Fig. 2 illustrates one of the original image processed.



a) RGB image, b) HSV image, c) Filtered image, d) Smoothened , e) Binary image in grayscale

Fig.2 Skin color detection process.

After some tests we proposed to use only the channel H with values ranging between 6 and 38 and a mix of morphological and smooth filters. In Fig. 2 b) part show the same image of part a) convertion of RGB to HSV, considering now each channel HSV represented on the RGB channels. Part e) illustrates an intermediary image, where all pixels classified as skin (using the range in channel H already established) were set to value 255, and non-skin pixels was fixed to 0. In the image of part d) there are many noises, in the classification of pixels like non-skin and skin. Next step minimize noises, using a 5x5 structuring element in morphological filters. First, we use the structuring element with a dilatation filter that expands the areas in the skin regions. After that the same structured element was used to erode the image and reduce all the imperfections that the dilatation has created. These techniques were used, by approximation, to fill all the spaces that were by H channel range supposed that is skin or non-skin. Then, a 3x3 median filter was used to soften more the results achieved by the dilatation and erosion because these techniques adulterat regions in contour .

C. *Feature Extraction*

For feature extraction this paper used the contour analysis technique. It is explained as follows:

1) *Contour Descriptor: For* fast searching of templates, it is important to introduce the certain descriptor describing the shape of a contour. Thus, close contours should have the close descriptors. It saves the procedure of an evaluation an ICF of a contour with each template. We only need to compare only descriptors and if they are close only in that case it is enough to calculate an ICF. Comparison of descriptors should be fast. Ideally, one number can be a descriptor. ACF is shape descriptor of a contour. Comparing two ACF has complexity O(k) that already considerably it is better than O(k2) for an ICF. Besides, as we remember, because of symmetry, an ACF is defined only on an interval from 0 to k/2 that else twice reduces time of evaluations.If in the base of templates we

store their ACF, searching of a template for a contour, by comparing the ACF, makes O(kt). [6]

2) Equalisation of contours: Contour Analysis methods assumes the identical length of contours.But in the real image contours have arbitrary length. Hence, for searching and comparing of contours, all of them should have the uniform length. The process of making uniform length for all contours is called equalization. At first, we fix length of a Vector Contour which we will use in our system of a recognition.

3) *The General Algorithm of Recognition* : So, we will solve the pattern recognition task on the image. The general sequence of an operation at recognition looks so:

- Preliminary handling of the image - smoothing, a filtration of noise, a contrast raise
- Image binarization and contours of objects selection
- Initial filtration of contours on squares,perimeter, to a crest factor, fractality and so on
- Equalization of contours from arbitrary to uniform length and smoothing of contours
- Search of all discovered contours, search for the template which is maximum similar to the given contour

4) Feature extraction works as follows:

1. At first, the image will be transformed to gray-scale :

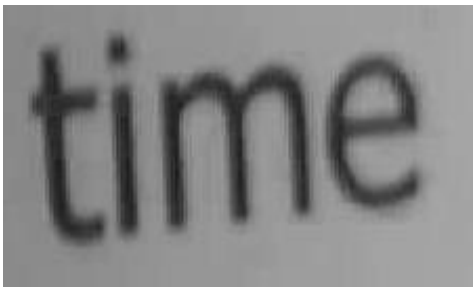


Fig.3 Grayscale image

2. Then it is binarized :

Fig.4 Binarized image

3. Contours are extracted:

Fig. 5 Image after extraction of contours

4. Contours are filtered on linear parameters (length, square, etc.):

Fig 6.Image after filtration

5. Contours are equalized, there is calculation ACF and ACF descriptors:

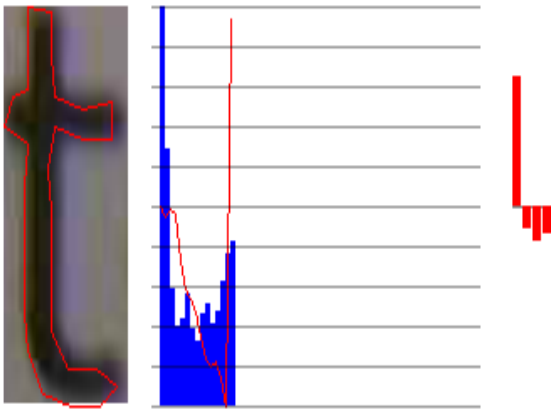


Fig 7 .Image after contour equalization

6. And then there is maximum suitable template:

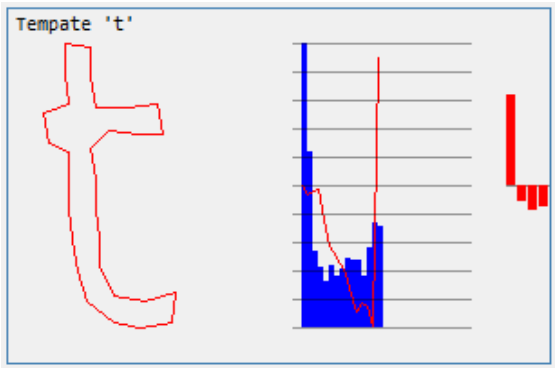


Fig .8 Template Matching

IV. RESULTS

Different images were tested and found that the new technique of image recognition has 97% accuracy. When the mute person will do the gesture of letter "C" in front of web camera as shown in Fig. 9 the "C" will pronounce .

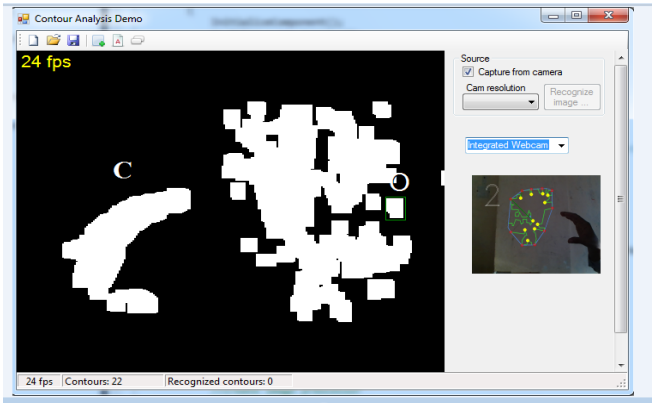


Fig .9 Captured and recognised gesture of letter "C"

Similarly when gesture of letter "O" is made in front of web camera then "O" will be pronounced .

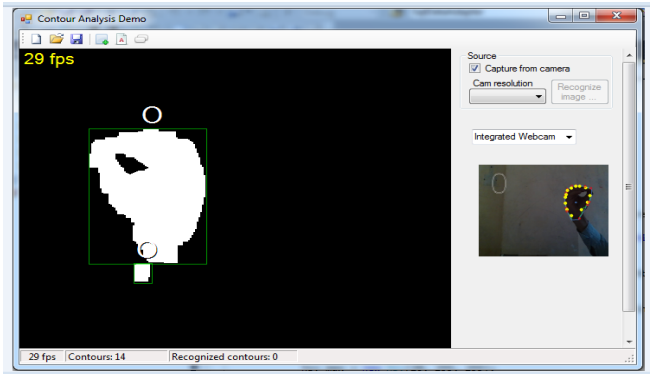


Fig .10 Captured and recognised gesture of letter "O"

V. CONCLUSION

We have presented the system which convert sign language (hand gestures) into speech (sound).Our project solves the communication problem between speech-impaired people and the others. As those people cannot express themselves with the words, they face many difficulties during their daily life. Since almost all of the normal people do not know sign language and cannot understand what speechless people mean by their special language, tasks such as shopping, settling affairs at a government office are so difficult that speech-impaired people cannot handle by their own. This project will eliminate all such types of problems.

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