www.ijecs.in
International Journal Of Engineering And Computer Science ISSN: 2319-7242
Volume 4 Issue 9 Sep 2015, Page No. 14239-14243

Devnagari Sign Language Recognition using Image Processing for Hearing Impaired Indian Students.

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Abstract: ***Some people in society are hearing impaired due to which they can't communicate with other people easily. Hand gesture is one of the most natural and expressive ways for the hearing impaired. Since people with hearing impairment or deaf people cannot talk like normal people so most of the time they have to depend on some sort of visual communication. Dumb people are usually deprived of normal communication with other people in the society. It has been observed that they find it really difficult at times to interact with normal people with their gestures, as only a very few of those are recognized by most people. Hand gesture is one of the most natural and expressive ways for the hearing impaired. Sign language is the primary means of communication in the deaf and dumb community. It also got grammar and vocabulary but uses visual modality for exchanging information. Normal people are usually unaware of sign language. E.g. American Sign Language (ASL) or Devnagari Sign Language. The gestures are of many types like hand gesture which include one hand, two hands and face gestures. Hand gestures can be classified in two categories: static and dynamic. A static gesture is a particular hand configuration and pose, represented by a single image. A dynamic gesture is a moving gesture, represented by a sequence of images. However, because of the complexity of dynamic gestures, most researches are focused either on static gestures, postures, or a small set of dynamic gestures.***

Keywords: Hand gesture Image, RGB gray-scale image, Contour recognition and Templates.

1. Introduction

As the primary input to this system is hand gesture, so specification of gesture and its recognition is necessary. Gestures can originate from body motion or state but commonly originate from the face or hand. Gestures are usually understood as hand and body movement which can pass information from one to another. Since we are interested in hand gesture and so the term "gesture" is always referred to hand gesture. Gesture recognition is a topic in computer science and language technology with the goal of interpreting human gestures via mathematical algorithms. Gesture recognition can be conducted with techniques from computer vision and image processing. Gesture recognition enables humans to communicate with the machine and interact naturally without any mechanical devices. Some common facts regarding sign languages are the pictorial representation of spoken languages, an integral part and an identifying feature of membership in the deaf culture. The normal people never try to learn the sign language for interacting with the deaf people. This will increase the communication gap

between the deaf and normal people. The important motivation to develop a devnagari sign language recognition platform for mute people. If the system can be programmed in such a way that it can translate sign language to text format, the gap between the normal people and the deaf people can be minimized. The main objective aimed to develop an automatic Devnagari sign language recognition and education platform for hearing impaired student of India. The system can substantially help in the primary/vocational/higher education of hearing impaired student and people of India. The most important aspect is that, the proposed interactive system will be able to recognize different hand gestures of Devnagari sign language and the system can interpret the recognized gestures in the form of devnagari alphabet displayed in the computer monitor. It would be quite useful in the educational process of hearing impaired/mute students of India. The main goal is to build a system that uses natural gestures as a modality for recognition in the vision-based and/or gesture-based setup. The entire focus to develop a Human Computer Interaction (HCI) platform in context to devnagari sign language. The development of a system for translating devnagari sign language into spoken language would be of great help for deaf as well as hearing impaired people of our country. In a country like India there is a need of automatic sign language recognition system, which can cater the need of hearing impaired people. Moreover, there is no officially recognized devnagari sign language system. The ultimate gain of the developed system would be enormous. The student will get acquainted with a comparatively latest technology in the form of HCI. The deaf and mute people who use sign language for the communication purpose, for those people this innovation translate the signs, hand gestures into Devnagari alphabets and further into readable text for communication with normal people. A Sign Language Recognition System Using Hidden

Markov Model and Context Sensitive Search [1] is based on Taiwanese Sign Language, a statistic based context sensitive model is presented and both gestures and postures can be successfully recognized. A gesture is decomposed as a sequence of postures and the postures can be quickly recognized using hidden Markov model. With the probability resulted from hidden Markov model and the probability of each gesture in a lexicon, a gesture can be easily recognized in a linguistic way in real-time. A Real-Time American Sign Language Recognition from Video Using Hidden Markov Models [2] is based on the hand tracking process of the system produces a coarse description of the hand shape, orientation, and trajectory. While a skin color hand tracker has been demonstrated, it requires that the user wear solid colored gloves to facilitate the hand tracking frame rate and stability. The shape, orientation, and trajectory information is then input to a HMM for recognition of the signed words. Through the use of HMM, low error rates were achieved on both the training set and an independent test set without invoking complex models of the hands. .

2. Related study

The main motivation of the proposed project is to develop an Indian Sign Language education/recognition platform for mute people. The goal of this project is to develop a system that can substantially help in the primary/higher and/or vocational education of hearing impaired students/people of India. A multimedia comprising of audio and video will be played for each alphabet, number, word and sentence for interpreting them. Moreover, there will be a provision for text and animation describing the interpretation process.

Figure 1: RGB image

They have planned to add more features like provision of online courses, interactive session in sign language etc. The another important aspect is that, the system can recognize different hand gestures of Indian Sign Language in the form of some text messages displayed in the computer monitor. Development of an Indian Sign Language Education and Recognition Platform for Hearing Impaired Students of India [3].The idea is to make computers to understand human language and develop a user friendly human computer interfaces (HCI). Making a computer understand speech, facial expressions and human gestures are some steps towards it. Gestures are the non-verbally exchanged information. A person can perform innumerable gestures at a time. Since human gestures are perceived through vision. The main aim to determine human gestures by creating an HCI. Coding of these gestures into machine language demands a complex programming algorithm. In this project they are focusing on image Processing and template matching for better output generation. To translate the signs and hand gestures performed by the user into appropriate alphabet, system first of all have to acquire the sign or hand gesture of user through webcam. Webcam takes the hand gesture as image. In order to perform image processing first we have to discuss Image and its properties.

2.1 Image and its properties

To translate the signs and hand gestures performed by the user into appropriate alphabet, system first of all have to acquire the sign or hand gesture of user through webcam. Webcam takes the hand gesture as image. In order to perform image processing first we have to discuss Image and its properties.

2.2 RGB and Gray-scale image

The system uses two types of images RGB (Fig 1) and gray-scale (Fig 2), RGB image is taken as input from webcam and RGB is converted to grayscale image while processing. The system uses grayscale image for the sake of performing point operations.

Figure 2: Grayscale image

Green and blue components all have equal intensity in RGB space, and so it is only necessary to specify a single intensity value for each pixel, as opposed to the three intensities needed to specify each pixel in a full color image. Often, the grayscale intensity is stored as an 8-bit integer giving 256 possible different shades of gray from black to white. If the levels are evenly spaced then the difference between successive gray-levels is significantly better than the gray-level resolving power of the human eye.

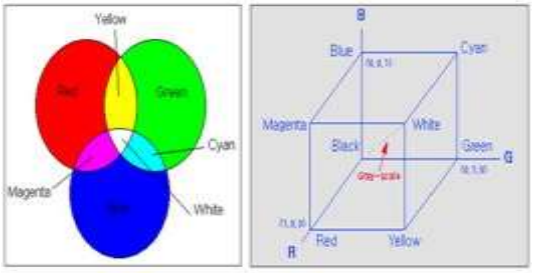

Figure 3: RGB and grayscale model

2.3 Noise and Filtering

Image that system takes as input may contain noise, which should of any type. The noise must be removed before image is going too preprocessed by point operations. Image noise is random variation of brightness or color information in images, and is usually an aspect of electronic noise. It can be produced by the sensor and circuitry of a scanner or digital camera. Type

of Noises: photon noise, thermal noise, on-chip electronic noise, ktc noise, amplifier noise, quantization noise. Filtering is a technique for modifying or enhancing an image. For example, you can filter an image to emphasize certain features or remove other features. Image processing operations implemented with filtering include smoothing, sharpening, and edge detection. Filtering is neighborhood operation, in which the value of any given pixel in the output image is determined by applying some algorithm to the values of the pixels in the neighborhood of the corresponding input pixel. A pixel's neighborhood is some set pixels, defined by their location relative to that pixel.

2.4 Thresholding

Thresholding is the simplest method of image segmentation. From a grayscale image, thersholding can be used to create binary image. During the thersholding process, individual pixels in an image are marked as object of their value is greater than some threshold value (assuming an object to be brighter than background) and as background pixel otherwise. This convention is known as threshold above. Variant include threshold below, which is opposite of threshold above; threshold inside, where a pixel is labeled object if its value is between two threshold and threshold outside which is the opposite of threshold inside. Typically, an object pixel is given a value "1" while a background pixel is given a value of "0". Finally a binary image is created by coloring each pixel white or black, depending on pixel's labels.

2.5 Region of Interest

Region identification is necessary for region description. One of the many methods for region identification is to label each region (or each boundary) with a unique (integer) number; such identification is called labeling (or also connected component labeling), and the largest integer label usually gives the number of regions in the image. Another method is to use smaller number of labels, and insures that no two neighboring regions have the same label; then information about some region pixel must be added to the description

To provide full region reference .this information is usually stored in separate data structure. Alternatively, mathematical morphology approaches may be used in region identification

2.6 Contour recognition and matching

Contour recognition algorithms generally aim to provide a reasonable answer for all possible inputs and to perform "most likely" matching of the inputs, taking into account their statistical variation. This is opposed to Contour matching algorithms, which look for exact matches in the input with pre-existing Contours. Contour matching is generally not considered a type of machine learning, although Contour-matching algorithms can sometimes succeed in providing similar-quality output to the sort provided by Contour-recognition algorithms.

2.6 Edge Detection and Canny

An edge in an image is a significant local change in image intensity usually associated with a discontinuity in either the image intensity or the first derivative of image intensity. The edge detection schemas compute the approximate gradient of the intensity map of image by applying a filter and then use a thresholding to extract of the edges identified aw areas with large gradient. The Canny edge detector is an edge detection operator that uses a multi-stage algorithm to detect a wide range of edges in images.

2.6 Contours

A contour is a list of points that represent, in one way or another, a curve in an image. This representation can be different depending on the circumstance at hand. There are many ways to represent a curve. Contours are represented in Open CV by sequences in which every entry in the sequence encodes information about the location of the next point on the curve. A contour is represented in Open CV by a sequence that is, one way or another, a sequence of points.

2.7 Templates

To compare the real time image with stored ones the templates has to be created and stored initially. Templates are the images stored at the disk. Templates should be there for comparison. Rather than storing only one image of each alphabet, it will be very helpful if more than one templates of each alphabet is stored. If the number of alphabets is more, then the system will give accurate result.

3. Proposed work

3.1 Input Constraints

The scope of this project is to capturing the hand gesture through standard image capturing device like camera or webcam. In order to perform efficient image processing function on captured image the following constraints are desirable.1.Input gesture should given by single hand.2. Input image should be taken by webcam which should be of 200x200size.3. Input image should be stable while capturing the image through webcam.4. Background of image should be stable or uniform.5.Followed by the above constraints this project analyses the images and converting captured gestured image corresponding vector binary form.

3.2 Processing Mechanism

These vector images are needed to be compared with processed and stored Contour. When the match is found corresponding alphabet will be displayed to the user on the screen. In order to achieve the scope of the project the following conventions needs to be implemented as per traditional system. It requires plane and smoothed image.

3.3 Output

The expected outcome of the system is the probable Devnagari alphabet corresponding to the hand gesture performed by the end user. The matching percentage should be nearly 90% equivalent while comparing Contours. The system involves the following modules.

3.4 Proposed modules

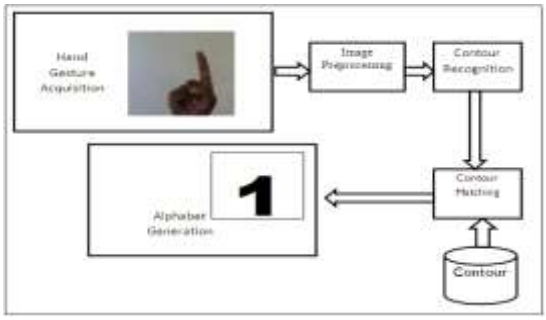

Figure 4: System Architecture

3.4.1 Hand Gesture Acquisition

This module is necessary to capture the image presented in front of camera by the user. The presented image is static with stable background. Captured image is of resolution 640x480 pixels. The resolution of image is adjusted to 160x120 and this image is stored in vector array form.

3.4.2 Image preprocessing

The image may contain noise and may not have better contrast. For getting the filtered image and to adjust its contrast to specific value the following operations are done on image vector array.1. Convert stored image to grayscale image.2. Improve the contrast of image and obtain uniform histogram using histogram equalization.3 Filter the image to reduce the noise.4 Set the background pixels to black and object pixels to white color

3.4.3 Contour Recognition

The preprocessed image is needed to process for Contour generation. In the Contour generation of image the following activities are done. And then Contour are stored in array 1. Identify region of interest from processed image. 2.Select the edges of desired object using sobel operator.3 Create the contour and store the contour vector array.

3.4.4 Contour Matching

For generation of devnagari alphabets the generated Contours should compared with the stored templates. This module follows steps described below to generate the alphabet.1. Fetch the contour vector array stored in Contour database.2. Compare it with contour vector array of image using Euclidean distance method.3. Generate devnagari alphabet if match found, display the alphabet to user

3.4.5 Templates

Templates are the contours which are of different shapes. Templates are to be compared with the real time changing image. Templates should be there before execute the system. The templates of different size and shape should be there to make the system more accurate and less probabilistic. These templates are created while testing the system to familiar with the template's size and shape. In this system each alphabet or number contains four templates of different shape and size. In the construction of template for each sign four contours are created as template this template are constructed with the solid background and proper intensity of light. First step in creation of template is we stared the web-cam .the mat img function used to construct matrix of images .mat is the function provided by OPENCV for matrix creation of image . then gray image are created with cvtColor().This gray image passed through the filters like threshold() .the size of image resized with Resize() function . Contour is constructed using canny() .ImWrite() function is used to store the frame of image on enter event. In below table, it is shown that how the template are created for respective gesture and alphabets in the figure the middle column shows the template that is contours of thegesture

Figure 4: Template Construction

4. Conclusion

Devnagari Sign Language Recognition provides effective and efficient method for dictation of the signs and produces the devnagari characters. This system reduces extra efforts that may require learning the sign language. It generates the alphabet faster than the manual dictation of signs. Higher accuracy can be achieved when the numbers of sampled template images are increased. This system will help deaf people to communicate with single person or to communicate with group of person which may or may not know the Devnagari sign language.

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Taro Denshi received the B.S. and M.S. degrees in Electrical Engineering from Shibaura Institute of Technology in 1997 and 1999, respectively. During 1997-1999, he stayed in Communications Research Laboratory (CRL), Ministry of Posts and Telecommunications of Japan to study digital beam forming antennas, mobile satellite communication systems, and wireless access network using stratospheric platforms. He now with DDI Tokyo Pocket Telephone, Inc.