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Indian Sign Language Recognition System in Marathi Language Text

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***Abstract*—** Sign language is a natural language that is used to communicate with deaf and mute people. It is a significant way of communication between normal and deaf and dumb people, which does not require an interpreter. The main objective of this project is to develop a system that helps hearing and speech impaired people to convey their messages to ordinary people. There are different sign languages in the world. But the main focus of system is on Indian Sign Language (ISL) which is on the way of standardization. This system will concentrate on hand gestures only. Hand gesture is very important part of the body for exchanging ideas, messages, thoughts among deaf and dumb people. The proposed system will recognize the Indian hand sign language of words and sentences and translate the signs into Marathi text with images which have been extracted from the input videos. The process is divided into three parts i.e. preprocessing, feature extraction, classification. It will initially identify the gestures from Indian Sign language. Finally, the system processes the gesture to recognize character with the help of classification.

***Keywords*—**Image processing, Feature extraction, Gesture recognition, SVM, thinning algorithm

I. INTRODUCTION

Sign language is the basic means of communication for those with hearing and vocal disabilities. Deaf and dumb people have difficulty in their day to day lives. Sign language uses facial expressions,body movements and hand gestures for communication[4]. Sign language is not a universal language. Different countries have different sign languages. There are huge number of sign languages used worldwide. American sign language, Afghan sign language, Dutch sign language, Indian sign language are some of the examples of sign languages used. Signs in language are dependent on regional languages[4]. Deaf and dumb people need interpreter for conveying their messages to normal people and finding interpreters in day to day life is very difficult nowadays. The contribution of such a system will prove to be a boon for the deaf and dumb people.We aim to develop a system that would ease this difficulty in communication. Sign language consists of making shapes or movements with your hands with respect to the head or other body parts along with certain facial cues. The proposed design is for a static yet extensible system that is able to recognize static gestures of sign language. The hand gestures are passed to thinning algorithm and the skeletonized image is obtained. Then the features of skeletonized image are extracted and these features are then classified using SVM classifier. This helps map the gesture to a particular Marathi text.

II. RELATED WORK

Umme Santa had proposed a framework of Bangladeshi Hand Sign Language Recognition system for Bangla sentences from any input videos.[1] Dataset had been created which contained some video clips of some specific Bangla sentences as there was no available dataset for Bangla words and sentences.This paper discusses how to recognise hand gesture and convert it into Bangladeshi language.Firstly, input video was been converted into a set of video frames. The hand was identified from the whole image by applying skin colour segmentation using YCbCr colour space[1]. Then the images were been converted into binary images. Binary image wea been cropped which contained only the skin portion. Human face was been eliminated by calculating height of the input frames. Local Binary Pattern algorithm was used for extracting features by applying it on the hand portion of the image[1]. Finally classification had been performed using support vector machine model.

Alaa Barkoky and Nasrollah M. Charkari had

proposed a hand segmentation method where goal is extract the hand gesture region[7]. Hand segmentation consist of following steps: Hand detection, Reconstruction of hand area, Wrist cropping. Thinning algorithm is used for hand gesture recognition[7]. P. Subha Rajam had proposed a methodology in which 32 combinations of binary sign are developed by using right hand palm image which are loaded at run time and images captured at runtime are scanned to identify finger tip positions of five fingers[3]. The tip of fingers is identified by measuring their heights with respect to reference point at the bottom of palm[3].

Akanksha Singh and Saloni Arora had proposed a methodology in which the images are converted into binary format using preprocessing technique[6]. This step is followed by feature extraction step where desired geometric and HOG features for images are calculated. SVM and KNN are then used for classifying gestures on the basis of these features[6].Juhi Ekbote had proposed a method which consist of four major steps: Data acquisition, preprocessing and segmentation, feature extraction, classification. In feature extraction they have used SIFT and HOG. SVM and ANN is used for classification[2]. In this paper accuracy achieved is 93%.

III. METHODOLOGY

The Proposed work is to focus on the algorithms for classification of features extracted from hand gestures.. Proposed model consist of four phases[2]:

A. Data acquisition : Online database is used in proposed system. Both training and testing datasets are downloaded.

B. Preprocessing : Background subtraction is applied on frames extracted from the video. After background subtraction thresholding is applied to convert the image into binary image. Another name of erosion followed by dilation is Opening which is used to remove noise with the help of function, cv.morphologyEx(). Dilation is applied on the image to obtain sure background area. Distance Transform is used to obtain sure foreground area.

C. the above step contains the hand-shape signifying the exact sign. The definite characteristics of the image need to be extracted to categorize the gesture. The features extracted from image are mean, median, standard deviation, variance, skewness, kurtosis. These extracted features are used for comparing test video with training dataset.

D. Classification: The input to the the classification step will be the features extracted from the above step. For this purpose, Support Vector Machine has been used[2].

E. Recognition.: The hand gesture is recognized and the meaning of it will be printed in marathi language as output of the system.

In the proposed model the thinning algorithm is used and also support vector machine (SVM) is used for classification of gesture. There are many features available for gesture recognition, but thinning algorithm is used.

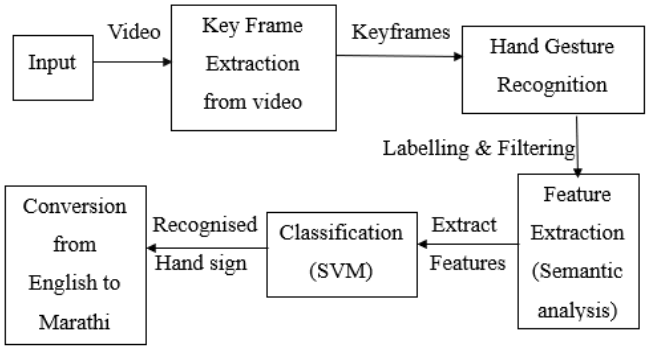


Figure 1. System Architecture

3.1 Thinning Algorithm

This algorithm is used for thinning binary image. Binary image by definition consists of only black and white pixels.

Algorithm

Assume black pixels are one and white pixels zero, and that the input image is a rectangular N by M array of ones and zeros.

The algorithm operates on all black pixels P1 that can have eight neighbors. The neighbors are, in order, arranged as:

P9	P2	P3
P8	P1	P4
P7	P6	P5

Figure 2. Matrix of pixels

Obviously the boundary pixels of the image cannot have the full eight neighbors.

- Define = the number of transitions from white to black, (0 -> 1) in the sequence P2, P3, P4, P5, P6, P7, P8, P9, P2. (Note the extra P2 at the end - it is circular).
- Define = The number of black pixel neighbors of P1. (= sum (P2 ... P9))

Step 1
All pixels are tested and pixels satisfying all the following conditions (simultaneously) are just noted at this stage.

- (0) The pixel is black and has eight neighbors
- (1) 2<=B(P1)<=6
- (2) A(P1) = 1
- (3) At least one of P2 and P4 and P6 is white
- (4) At least one of P4 and P6 and P8 is white

After iterating over the image and collecting all the pixels satisfying all step 1 conditions, all these condition satisfying pixels are set to white.

Step 2
All pixels are again tested and pixels satisfying all the following conditions are just noted at this stage.

- (0) The pixel is black and has eight neighbors
- (1) 2<=B(P1)<=6
- (2) A(P1) = 1
- (3) At least one of P2 and P4 and **P8** is white
- (4) At least one of **P2** and P6 and P8 is white

After iterating over the image and collecting all the pixels satisfying all step 2 conditions, all these condition satisfying pixels are again set to white.

Iteration
If any pixels were set in this round of either step 1 or step 2, then all steps are repeated until no image pixels are so changed.

3.2 Support Vector Machine

Support vector machine is supervised learning algorithm which can be used for both regression and classification.SVM is regulated learning strategy[2].In this algorithm, system plots each data item as point in n-dimensional space with the value of a particular coordinate[2].After that classification by finding the hyperplane that differentiate the two classes very well[2]. Support Vectors are simply the coordinates of individual observation. Support vectors are simply the best segregates the two classes. SVM is one of the best known methods in pattern classification and image classification. SVM classifier computationally costly and also runs slowly. SVM gives very accurate results[2]. It is designed to separate of a set of training images two different classes. (x1, y1), (x2, y2), ..., (xn, yn) where xi in Rd, d-dimensional feature space, and yi in {-1,+1}, the class label, with i=1..n [1]. SVM builds the optimal separating hyper planes based on a kernel function (K). All images, of which feature vector lies on one side of the hyperplane, are belong to class -1 and the others are belong to class +1.

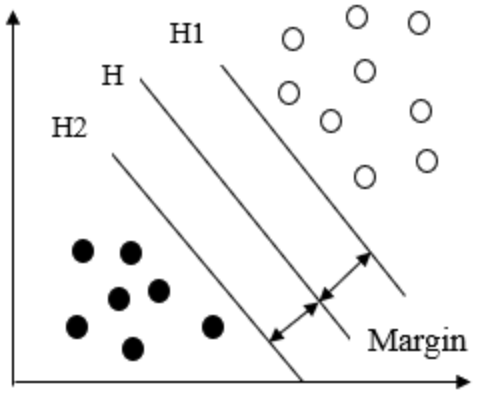
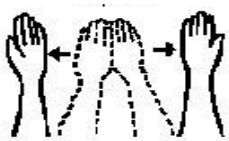


Figure 3. Support Vector Machine [2]

Table 1: Simple Hand Gestures

Sr No.	Image	Word
1		I
2		Need
3		coffee
4		Open
5		Door
6		How

7		Are
8		You

IV. RESULTS AND DISCUSSION

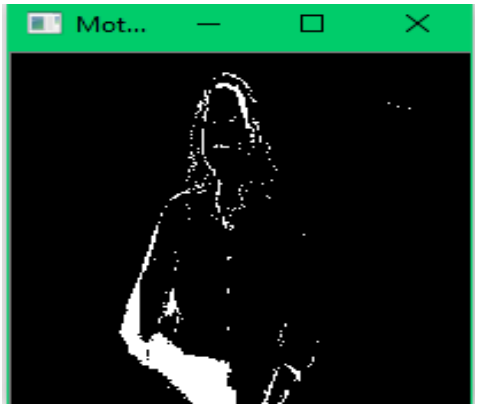


Figure 4. Binary Image

The above image is obtained after background subtraction which outputs a binary(black and white)image as shown.

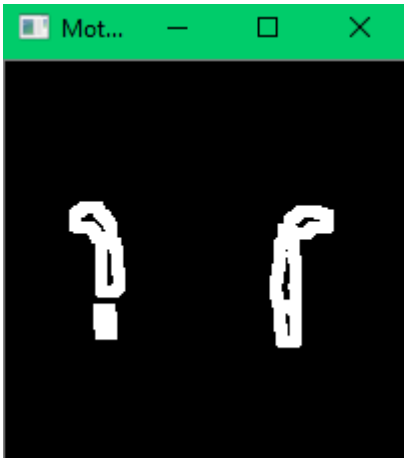


Figure 5. Output of thinning algorithm

The above figure is an example of a gesture obtained after applying the thinning algorithm to the binary image.

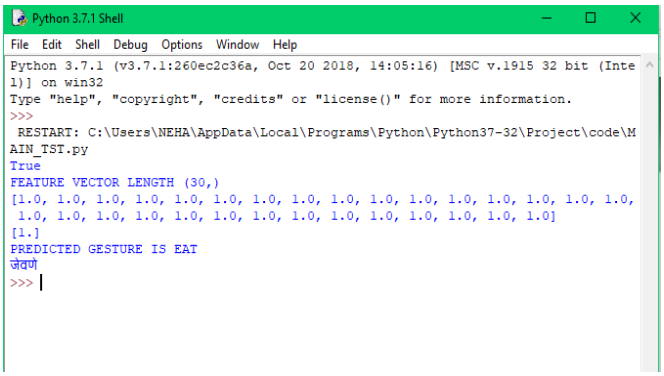


Figure 6. Result

After recognition of hand gesture, the output is displayed both in English and Marathi text.

V. CONCLUSION AND FUTURE SCOPE

Hand gesture recognition for real-life applications is very challenging because of its requirements on the robustness, accuracy and efficiency. In this work good comparative study has been adopted based on the methodology implemented using thinning algorithm and support vector machine. This will help in improving recognition accuracy of gesture. In the system, input gesture is processed in preprocessing phase. Thinning algorithm is then applied. After thinning, features are extracted and finally using SVM the exact gesture name is recognized. It will recognize the hand gesture and display it into Marathi text. The effectiveness of the design in a real world situation has been demonstrated by a physical implementation of the system. This system is developed by using python.

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