Sign Language to Text and Vice Versa Recognition using Computer Vision in Marathi

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ABSTRACT
Sign language recognition is one of the most growing fields of research today and it is the most natural way of communication for the people with hearing problems. A hand gesture recognition system can provide an opportunity for deaf persons to communicate with vocal people without the need of an interpreter or intermediate. The system is built for the automatic recognition of Marathi sign language. Providing teaching classes for the purpose of training the deaf sign user in Marathi. The system can train new user who is unaware of the sign language and the training will be provided through offline mode. In which user can learn sign language with the help of database containing predefined sign language alphabets as well as words. A large set of samples has been used in proposed system to recognize isolated words from the standard Marathi sign language which are taken using camera. The system contains forty-six Marathi sign language alphabets and around 500 words of sign language are taken. Considering all the sign language alphabets and words, the database contains 1000 different gesture images. The proposed system intend to recognize some very basic elements of sign language and to translate them to text and vice versa.

General Terms
Sign language translation, Gesture recognition, Algorithm.

Keywords
Marathi sign language, Human computer interaction, Marathi alphabet, Marathi word, Preprocessing, Pattern recognition and Pattern matching.

1. INTRODUCTION
Sign language is a type of language that uses hand movements, facial expressions and body language to communicate. It is used predominantly by the deaf and people who can hear but cannot speak. But it is also used by some hearing people, most often families and relatives of the deaf, and interpreters who enable the deaf and wider communities to communicate with each other. Sign Language is a structured language where each gesture has some meaning assigned to it used by deaf sign user. Sign language is only the way of communication for deaf sign user. With the help of advanced science and technology many techniques are developed by the researcher to make the deaf people communicate very fluently. Sign Languages (SLs) are the basic means of communication between hearing impaired people. Static morphs of the hands, called *postures*, together with hand movements, called *gestures*, and facial expressions form words and sentences in SLs, corresponding to words and sentences in spoken languages.Imagine you want to have a conversation with a deaf person. Already this may seem a daunting task, especially if you have no idea on how to communicate using sign language. Such is the problem faced by millions of deaf people who are unable to communicate and interact with hearing people. The problem with Deaf peoples are as, they are marginalized in society and are made to feel unimportant and unwanted. How then can we help to improve the quality of life of the deaf community? Information technology is the solution for such problems. In our quest to seek a most natural form of interaction, have promoted the development of recognition systems, e.g. text and gesture recognition systems. The advancements in information technology thus hold the promise of offering solutions for the deaf to communicate with the hearing world. Furthermore, the cost of computer hardware continues to decrease in price whilst increasing in processing power, thus opening the possibility of building real-time sign language recognition and translation systems. Real-time sign language translation systems will be able to improve communication and allow the deaf community to enjoy full participation in day-to-day interaction and access to information and services. Sign languages all over the world use both static and dynamic gestures, facial expressions and body postures for communication. Proposed system implements Marathi sign Language for deaf sign user.

2. LITERATURE SURVEY
M. Mohandes [1] in this paper, Sign language continues to be the preferred method of communication among the deaf and the hearing-impaired. Additionally, this paper highlights the main challenges characterizing Arabic sign language as well as potential future research directions.

V. Kulkarni [2] in this paper, sign language recognition system has proposed. At very first stage database creation of Indian Sign Language (ISL) is done. In next step hand tracking and segmentation is done. The system is implemented successfully and results are presented in this paper. The results demonstrate working of motion tracking, edge detection and skin color detection individually as well as their combined effect. The gesture include in database are alphabets A to Z, number 1 to 10.

G. Khurana, G. Joshi, J. Kaur [3] in this paper, easy and simple approach of shape based recognition of Indian Sign Language (ISL) has proposed. Minimum Euclidian distance is used for sign language recognition. The databases of 26 (ISL) alphabets out of which 19 distinct alphabets are consider. ISL database created using web camera with constant background. 14 alphabets in WEKA as well as in METLAB give 100 percent accuracy. ISL recognition algorithm is implemented using METLAB and Windows 7 (64 bit). For capturing image 2 MP web camera is used.

T. Ayshee, S. Raka, Q. Hasib, Md. Hossian, R. Rahman [4] in this paper, image processing and fuzzy rule based system is used to develop intelligent system that can act as an

interpreter between the Bangali sign language and spoken language. Initially data is processed from raw images and the rules are identified by measuring angles. Initially system is tested on only two Bangali signs. For test dataset total number of input images was 22 for two gestures. The system was implemented using METLAB.

D. Jain, A. Saxena, A. Singhal [5] in this paper, presents principal component analysis which is fast and efficient technique for recognition of sign gesture. Proposed system captures 3 frames per second from video stream. These images are matched with database to know meaning. This system is tested and developed successfully in a real time environment with approx. 90 percent matching rate. Database of 10 sign gesture are taken from Indian sign language has been developed in lab with web camera and an android device. The system database has sign gesture of size 60X80 pixels so it takes less memory and less time to process. The recognition rate achieved is between 70-80 percent which is in acceptable range. The requirement of system is black background.

G. Tofighi, N. Venetsanopoulos, K. Raahemifar, S. Beheshti, H. Mohammadi [6] in this paper, real-time vision based posture recognition approach which is appearance-based features of hand posture. The system proposes three main steps: Pre-processing, Feature Extraction, and Posture recognition. New hand posture dataset called Hand Reader is introduced. Hand Reader is a dataset of 500 images of 10 different hand postures which are 10 non-motions based American Sign Language alphabets taken in dark environment. 20 percent images are used for training purpose and remaining 80 percent are used to test proposed system. To train the system K-NN and SVM classifier are used. The SVM classifier works better with highest recognition rate (96 percent).

M. Mohandes, M. Deriche, J. Liu [7] in this paper, a comprehensive review of image-based ArSLR approaches is presented: Image-based Arabic alphabet signs recognition is described in section II and Arabic isolated signs recognition is discussed in Section III. In Section IV, continuous Arabic signs recognition is presented. Finally future directions and conclusions are summarized in Section V. In finger spelling, the signer performs the sign of each letter separately. Most letters are represented by a static posture and the vocabulary size is limited. In this section, several methods for image based Arabic alphabet signs recognition are presented. The proposed system discusses multiple algorithms and methods and its detection rate. Maximizing the size of vocabulary will increase the complexity of system. To achieve better recognition accuracy, error detection and correction are needed. Fusion recognition method is necessary to implement a system that is more close to the real life.

K. Sarma, A. Chaudhari, A. Talukdar [8] in this paper, System present a Conditional Random Field (CRF) based Indian Sign Language (ISL) recognition system which is effective under complex background using a novel set of features. The most crucial step in every hand gesture recognition system is hand segmentation. Thus better segmented output can achieve better recognition rate. The proposed system also includes efficient and robust hand segmentation and tracking algorithm to achieve better recognition rates. The training set and test set both contains 10 signs each. System is implemented in METLAB and highest recognition rate with one hand is 90 percent and with tow-hands it is nearly 86 percent.

3. MARATHI SIGN LANGUAGE

Each country has its own sign language defined and used over their country. Similarly Marathi Sign Language is the language used by the deaf sign user over India. Marathi sign language alphabets contain the vowels and consonants. Marathi sign Language alphabets are in fig 3.1:

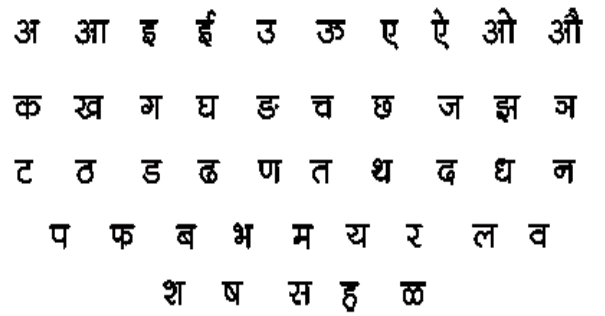

Figure 3.1 : Marathi Alphabets

Figure 3.2: Marathi Sign Language images

Figure 3.2 shows the sign language images for corresponding Marathi alphabets. Proposed system is designed to recognize the 43 Marathi sign. During the recognition Marathi sign language is translated into corresponding Marathi text and similarly for vice versa.

4. METHODILOGY AND ALGORITHM

An architectural description involves modelling and representation of architectures using appropriate mechanisms like architecture description languages and architecture framework. Architectural design gives the relevant relationship for the major structural elements.

Block Diagram

Figure 4.1 shows the block diagram of proposed system that indicates the flow of working of system.

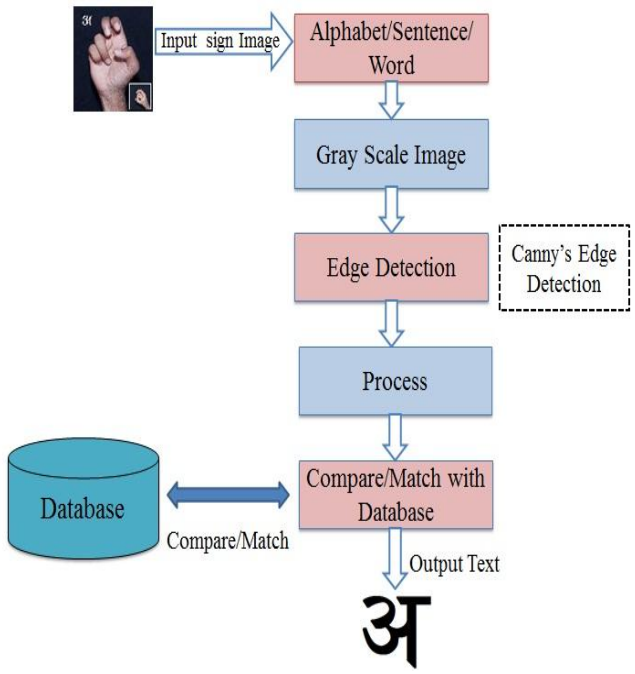

Figure 4.1 Block diagram (Sign to text translation)

Input Image

The input image may be either alphabet image, word image, or image of sentence. Whatever the processing is done it is through predefined and form trained database. Input image will be stored in the database as per in required format.

Input Text

Similar to input image text will be stored either in the form of alphabet, or word, or in the form of sentence. The input text is entered into the system through keyboard.

Pre-processing

Pre-processing includes the selecting input, either image or text. Then gray scale convergence, edge detection, generation of array of image, compare or matching with database. All these functionality comes under preprocessing. If input given to system is correct or in proper way then preprocessing will be done correctly as well as easily.

Edge Detection

For edge detection Canny's edge detection algorithm is used. It gives better accuracy by consuming less time. Canny's algorithm is better in removing noise and detecting clear and accurate input required to system. Canny's algorithm gives low error rate, localized edge points, and single edge point response. Initially it applies Gaussian filter and gets slightly blurred image. Then detect edges with the help of gradient on x and y axis. After detecting edges the array of input image is generated based on the detected edges. This array is stored in the database which will be further used for recognition.

Pattern Recognition/Matching

The parameters obtained from input image or text is compared with database. After matching correct values the corresponding result is displayed.

Text/Sign Output

If input given to system is in the form of sign then output will be text which is meaning of that input sign language image. And if input given to system is text then output is sign language image which has meaning of that text.

Database

Database plays an important role in giving correct and effective output for the system as our output of the system is based or dependent on database. The database contains images of alphabets, words, or sentences of Marathi sign language. Similarly during translation of text to sign input text is taken through keyboard. After that processing is done on input text and its features are extracted. These extracted features are matched with the features stored in the database. After matching correct result the output is displayed on the output screen. Same procedure is carried out for translation of word. Figure 4.2 shows the block diagram for text to sign language translation.

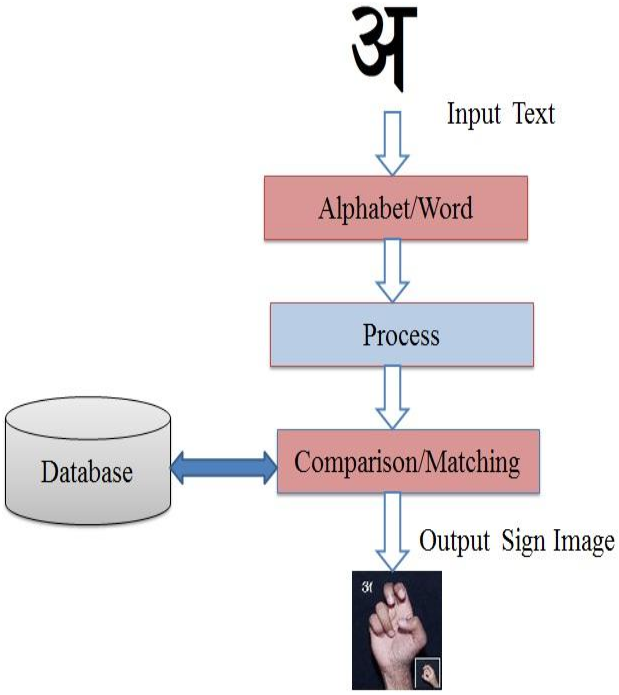

Figure 4.2 Block Diagram (Text to sign language translation)

5. RESULT AND ANALYSIS

The proposed system is implemented through java and used NetBeans as platform to design system. In the result analysis initially look at how is working of system through snapshots.

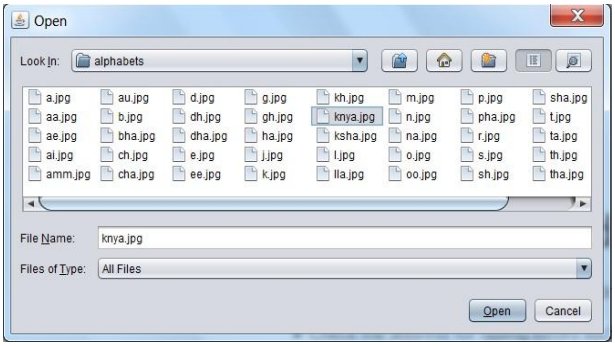

Figure 5.1 Snapshot of selecting input image

In figure 5.1 input sign language image is selected for process. After selecting input image the image is processed and output text is displayed as given below.

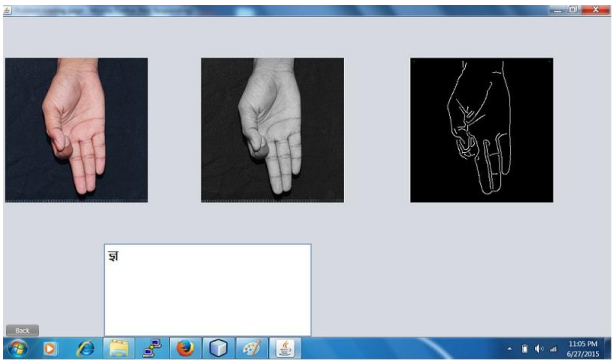

Figure 5.2 Snapshot of recognition of sign image to text

In 5.2 the output initially displays gray scale image of input image after that it apply Canny's algorithm to gray scale image. After edge detection detected pixels of edges are matched with database and displays text for that sign language image.

Similarly text to sign language snapshots are given below

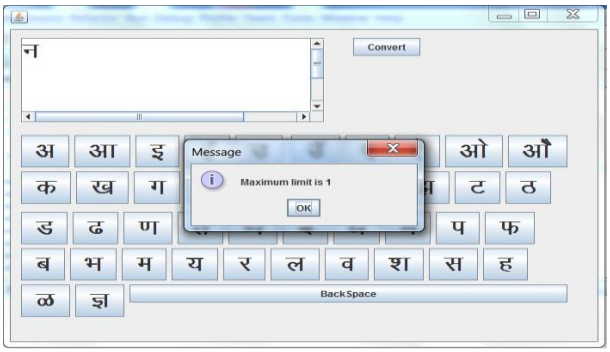

Figure 5.3 Snapshot of selecting input text through keyboard

Figure 5.4 Snapshot of text to sign language translation

As similar to alphabet, words are processed by applying same procedure such as gray scaling, edge detection. The snapshots given below shows the translation of sign language to text and vice versa for recognition of word.

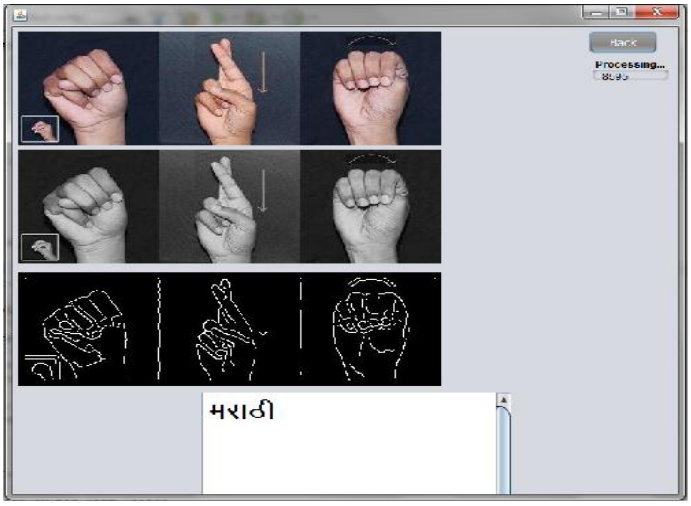

Figure 5.5 Snapshot of word recognition from sign to text

The figure 5.5 shows the processing of word and its recognition and its translation from sign to text. Also figure 5.6 and figure 5.7 shows the translation of text to sign translation of word.

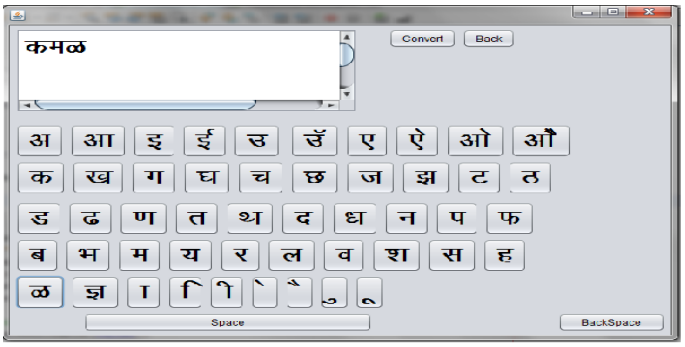

Figure 5.6 Snapshot of selecting input word through keyboard

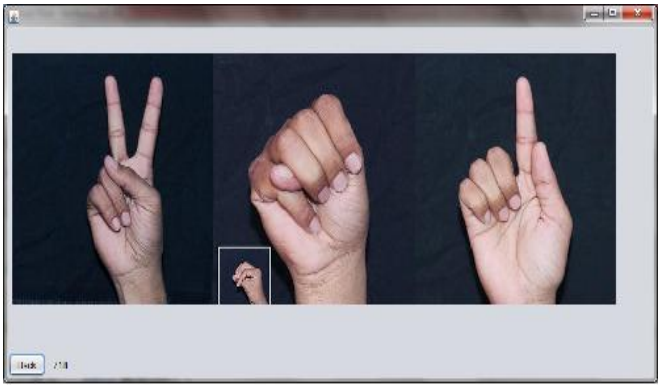

Figure 5.7 Snapshot of recognition of text to sign image

In Proposed system analysis is done based on time required to process the input image as well as the input text. The processing time is calculated in milliseconds. The processing time is considered for translation of sign language to text as well as text to sign language. The processing time is considered for alphabet, words and sentences. We discuss more in detail about the processing time required for this system.

Comparison of Sign to Text and Vice Versa Translation:

A. Alphabet

The comparison between sign language alphabet to text and vice versa shows the difference of processing time. Here time required to translate sign language to text is more because of time required to process image takes time more than text. Figure 5.8 shows the processing time difference and its comparison.

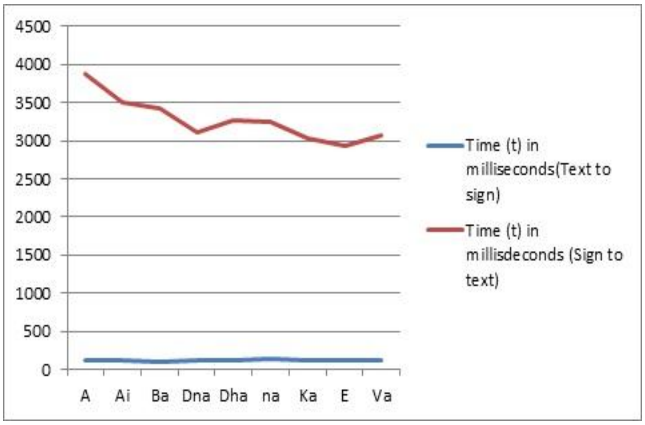

Figure 5.8: Graph of comparison of alphabet of sign gesture to text recognition and vice versa.

B. Word

Similarly, it is done for translation of sign language word to text and vice versa. It also shows the processing time difference between sign language image and text. The word consists of clustered alphabets and combined to form word. Hence its processing time is more. Figure 5.9 shows the processing time difference and its comparison.

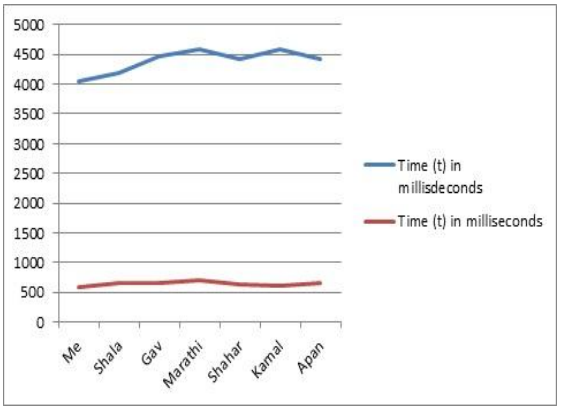

Figure 5.9: Graph of comparison of word of sign gesture to text recognition and vice versa.

C. Sentence

In the formation of sentence of sign language to text and vice versa, recognition is done through MySQL database. Input sign image or text is entered and its extracted features are matched with this database and gives correct match for input. The processing time depends on the size of database, the feature of input are matched with every element in database. Figure 5.10 shows processing time difference and its comparison.

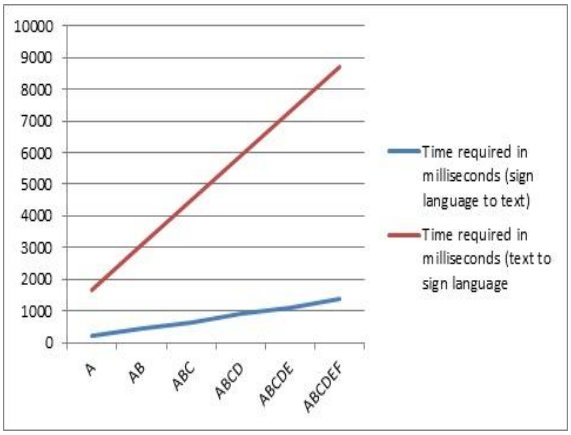

Figure 9.9: Graph of comparison of sentence of sign gesture sentence recognition and vice versa.

6. CONCLUSION AND FUTURE WORK

The proposed system applies a simple and fast method which works suitably to recognize hand gesture images and text. It is low time consumption approach, so that the recognition ratio is achieved easily at very less time. In the system edge detection algorithm is used to recognize the input sign image by gray scaling and detecting the edges of hand gesture. System is capable of handling the different input sign images of alphabets, words, sentences and translates them into text and vice versa. The system is designed to translate Marathi sign language to text. The dataset contains the number of hand gesture images that are taken from multiple user of different hand size which helps to recognize the correct output to any user using the system. To form words from gestures of alphabets concatenation technique is used and words are formed. The system is trained on predefined database. The system is implemented successfully on forty-six

Marathi sign gestures, and 1000 hand gesture words which are made by concatenating alphabets of different hand gesture. The system gives accurate results for each sign image input.

In future work we look forward for dynamic hand gesture recognition system for continuous recognition of sign language. It not only includes hand shapes, but also the whole body of user and its facial expression which is a challenging task. The proposed work can be extended for future work as a grammatical correct sentences formation, facial expression and generating grammatical correct sign interpretation.

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