Summarization of Own Contributory Efforts in the Field of Indian Sign Language Recognition System

Pravin R Futane
Research Scholar
Sant Gadgebaba Amravati
University, Amravati.

R. V. Dharaskar, Ph.D
Professor, Matoshree Sanstan
Swami Ramanand Teerth
Marathwada University,Nanded

V. M. Thakare, Ph.D
Professor and Head, Research
Center, Sant Gadgebaba
Amravati University,Amravati

ABSTRACT
Sign language forms a major communication media among the deaf people through which they try to communicate with others. They successfully communicate with each other when using sign language, but they face lots of difficulties when they try to communicate with normal people, especially those who are unfamiliar with the sign language. Hand gestures have received increasingly more attention in the last two decades. In this paper, we have focused on the efforts carried out by us in the field of Indian sign language recognition system. Initially we have worked in phases. Firstly we have concentrated on the study aspect in the same area, followed by step by step recognition of alphabets, numbers, words, then semantic sentences formation and recognition of the same. This paper is an effort of summarization of all our contributory efforts in the recognition area of Indian sign language.

General Terms
Sign Language Recognition system, Vision based system, Neural Network et. al.

Keywords
Indian sign language, color blob detection, General fuzzy min-max algorithm.

1. INTRODUCTION
Sign language recognition is multidisciplinary research area. The sign language is a general term that refers to any gestural/ visual language that makes use of specific shapes and movements of the fingers, hands and arms, as well as movements of the eyes, face, head and body. The sign languages are complete natural languages, with their own syntax and grammar. There is no international recognized and standardized sign language for all deaf people; as is the case in spoken language. Every country has got its own sign language with high degree of grammatical variations. A functional sign language recognition system can be used to generate speech or text making the hearing impaired person more independent. The most complicated part of sign language recognition system is to recognize the simplest hand gestures that must be detected in the image.

Indian Sign Language (ISL) is a visual-spatial language which provides linguistic information using hands, arms, facial expressions and head/body postures catering the needs of Indians. ISL uses static and dynamic hand gestures, facial expressions, head/body postures, locations of hand with respect to body etc. to represent signs.

The next section covers the literature survey of contributory efforts of my work in the Indian sign language domain; followed by detailed results obtained by implementing the various methods of vision based approach.

2. LITERATURE SURVEY
This section reveals my efforts in studying the insights of Sign language research domain. Initially I focused on the theoretical study of sign language and gesture recognition with its method/ approaches the researchers have used, followed by the comparative study of methods they have implemented. After getting familiar with this domain, I focused on sign language catering to the needs of Indian, precisely Indian sign language. Then I prepared my dataset on ISL alphabets, numbers, words gestures and then sentences containing few word gestures forming meaningful sentences. Following section highlights the literature study of my work in brief.

Reference 1 presents an attempt to devise a theoretical generic framework functioning subset of Universal Sign gesture Language Recognition System that can provide an opportunity for a mute person to communicate with non-signing people without the need for an interpreter. It can be used to generate speech or text making the mute more independent. Although the deaf problem is very severe in India but not to that extend the efforts & work had been carried out which leaves lots of scope for research in this area & has a social relevance and open up opportunity for us to do for the nation. A good theoretical study is presented and a skeleton for a sign gestures supporting to different input sources, methods, approaches, algorithms and outputting mechanism is prepared.

The objective of the proposed research/project work discussed in this paper is to build a system that uses natural gestures as a modality for recognition in the vision based setup. The main focus is to develop a platform in context to Indian Sign language. In a country like India there is a need of automatic sign language recognition system, which can cater the need of hearing impaired people.

Reference [2, 4, 7] highlights the exhaustive literature study based on the work carried by various researchers in the sign language domain. And also the different techniques applied, processed and accordingly outcomes are discussed when applied to vision based approach used in Sign Language Recognition Systems (SLRS).

Reference [3] gives exhaustive study of Indian Sign Language, its dialects and varieties and recent efforts in the

direction of its standardization. Also a proposed methodology is discussed to recognize static single hand gestures of a subset of Indian sign language. The present achievements provide the basis for future applications with the objective of supporting the integration of deaf people into the hearing society.

Here we will be focusing on the recent work carried out by few researchers especially in the domain of sign language, catering the need of Indian deaf community which is decade by decade increasing as per the population statistics are showing. The details of the deaf population in India over the last five decades are given in the Table. I. Neither the 1991 nor the 2001 census included disabilities; hence they were obtained by extrapolating the 1981 data. [8,9]

Table 1. Showing number of deaf people in India [8,9]

Year	Source	Data (total deaf population in India)
1970	Taylor and Taylor (1970)	2 million
1981	GOI, Ministry of Social welfare	1981 6,315,761
1991	Gopinath (1998)	7,770,753
2001	Vasishta (2001)	14 million
2011	UN report	18 million

In reference [5], the focus is on to use simple but cost effective color homemade data glove with fingers painted with fluorescent colors. The colored glove makes hand gestures for static alpha numeric gestures and pass on to two approaches namely color blob detection with pattern storage and thresholding for recognition of gestures. The overall algorithm of thresholding has three main steps: image capture, apply threshold and recognizing the number. This paper highlights both approaches along with the findings of recognition. [5, 6]

Reference [8] focused on Indian Sign Language which is on the way of standardization & very less work has been done on it so far. It also discussed about its history, progress and work carried out by various researchers in Indian Sign language recognition. Also here an approach that will convert the video of full sentence gesture of Indian sign language to text is presented. It will initially identify individual words from the video & convert them on to text. Our clustering algorithm based on General Fuzzy Min Max (GFMM) neural network is discussed. Finally, the system processes those words to form a meaningful sentence in compliance with the simple grammar rules.

3. RESULTS AND DISCUSSIONS

The generic framework for sign language recognition system is presented. A theoretical study shows that this system will definitely bridge communication gaps between the deaf community and other people. This will act as a tool for the researchers in this domain and when it will be fully operational the system will definitely help in minimizing communication gaps, easier collaboration and will also enable sharing & exchanging of ideas and experiences. The study reveals that it is quite feasible and will act as a guiding

tool to all researchers in the sign gesture acquisition and recognition domain [1].

The Indian Sign Language (ISL) diversity, vitality and identity were examined in five cities with the purpose of prioritizing sign language literature development India-wide. This was accomplished with lexical similarity analysis, dialect intelligibility testing with recorded text tests and language attitude assessment. The results suggest one language with many dialects. The details are listed in the summarized Table 2.

Table 2. Showing Results of theoretical study on Indian sign language varieties

Contributory Paper Reference No	Category, Methods, Approach and Dataset Used	Results Obtained	
[1, 2, 3]	Theoretical study Indian Sign Language Varieties	**Sign Language Varieties**	**Findings**
		Mumbai	Most appropriate for initial development Have highest prestige and closest lexical similarity. Moderately high dialect intelligibility
		Hyderabad & Chennai	Most closely related with each other followed by Hyderabad and Mumbai. Chennai have literature developed in them
		Kolkata	Least similar dialect followed by Chennai, Kolkata has literature developed in them.

This paper had nicely presented the contribution of some of the researchers in the Sign language domain. The paper mainly focused on vision based approach only. We have studied some of the techniques such as HMM, IOHMM, Multistream HMM, MVC, PCA, FSM, SRN etc and some of its outcomes are also discussed. The study survey suggests that HMM and its variant techniques are the usual trend to be applied in Sign Language. So this helps us in deciding our own methodology for our recognition framework. [2, 4, 7]

The gesture database of 220 static alphabet gestures of three people with orientation and different lighting condition is taken. As a result for few gestures B, L, W and Y we got 100% accuracy where as overall accuracy we got is 81.81%. The recognition ratio for all 22 static gestures is given in Table 3.

Table 3. Showing results obtained color blob detection algorithm for alphabet dataset

Contributory Paper Reference No	Category, Methods, Approach and Dataset Used	Results Obtained	
		Input Gesture	Recogni-tion Ratio (%)
[5, 6]	Alphabets Color Blob detection and pattern matching Vision based Approach 220 static alphabet gestures of hand made color gloves of three people with orientation and different lighting condition is taken.		
		A	90
		B	100
		C	70
		D	90
		E	60
		F	80
		G	70
		H	70
		I	80
		K	70
		L	100
		M	60
		N	60
		O	60
		P	90
		Q	80
		R	60
		S	70
		T	70
		U	80
		V	80
		W	100
		X	80
		Y	100
	Overall recognition Accuracy		81.81

Table 4 shows recognition ratio of the given input which is number 0 to 9 as shown below in fig 1. But this method is very time consuming as acquisition too takes time and as well precisely a proper lightning condition is required.
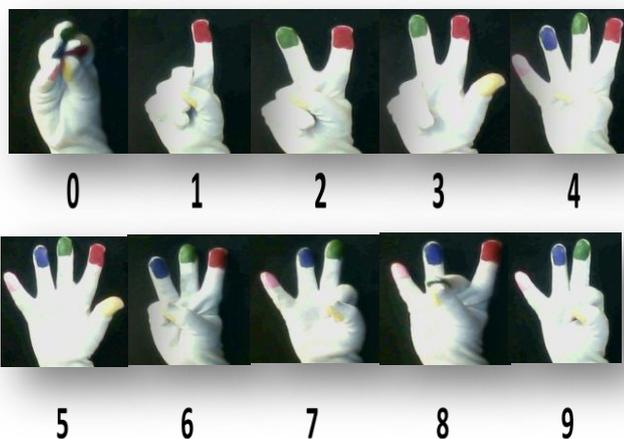

Figure 1. Number dataset with handmade color gloves

Table 4. Showing results obtained thresholding algorithm for number dataset

Contributory Paper Reference No	Category, Methods, Approach and Dataset Used	Results Obtained	
		Input Number	Recognition Ratio (%)
[5, 6]	Numbers Thresholding Vision based Approach 66 static number gestures of hand made color gloves of three people with orientation and different lighting condition is taken.	0	98
		1	90
		2	92
		3	99
		4	85
		5	90
		6	85
		7	85
		8	80
		9	85
		10	90
	Overall recognition Accuracy		89

In Reference [8], the videos consisting of 3 to 4 gestures making the sentences like "You are beautiful", "A bowl is there" are used and corresponding key gestures such as {you, beautiful}, {bowl, there} are identified. The frames are formed from these videos and skin color segmentation is performed on these frames. For the sake of avoiding unnecessary computations, some frames are discarded. Fourier descriptor features are then calculated and stored in the database. Finally, GFMM NN is used to classify these gestures using the extracted features. System has achieved a good accuracy till now in identifying gestures and after training almost 100% accuracy we are getting for our simple grammar constructed and sentence formation.

In the following example, we have considered a simple sentence "A bowl is there". This sentence has the key gestures {Bowl, there}. The input video has frames shown as below.

Figure 2. Gesture images in the input video

After classifying we get 3 clusters.

Figure 3. Clusters formed after gesture classification.

The gesture clusters are renamed and non key-frames are discarded. We get results as below.

1. Rename first cluster as 'Bowl'

Figure 4. Images of first gesture 'Bowl'

2. Discard second cluster as it contains non key frames.

Figure 5. Non key gesture

3. Rename this cluster as 'There' (Figure 6)
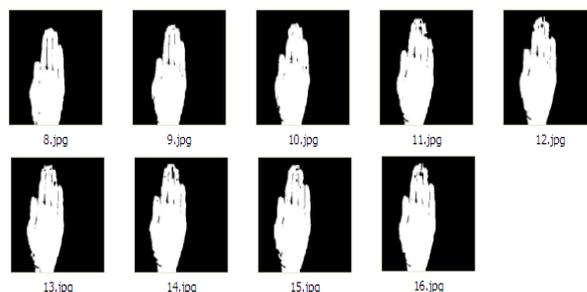
Figure 6. Images of second gesture 'There'

So, the gestures 'Bowl' and 'There' are identified and the sentence "A bowl is there" is formed using the simple grammar rules.

Likewise we tested the system for 5 sentences with the total accuracy – 92.92 %. Table 5 shows the results.

Table 5. Showing results obtained using GFMMNN algorithm for sentences containing 3 to 4 gestures words.

Contributory Paper Reference No	Category, Methods, Approach and Dataset Used	Results Obtained			
		Video Gesture Content	Classification Statistic Total		Correctly Classified %age
			Total frames	classified	misclassified	
[8]	ISL Word Gestures GFMM Neural Network and clustering Vision based approach Dataset used was of 5 sentences containing 3 to 4 gestures. Two videos of each sentence were taken.	bottle_there (A bottle is there)	19	18	1	94.74
		bowl_there (A bowl is there)	16	15	1	93.75
		today_saturday (Today is Saturday)	14	12	2	85.72
		today_thursday (Today is Thursday)	17	15	2	88.24
		you_beautiful (You are beautiful)	33	32	1	96.97
	Overall recognition Accuracy		99	92	7	92.92

4. CONCLUSIONS

This paper reflects my research findings in the field of Indian sign language recognition domain. The summarization of contribution of my efforts with reference to recognition of sign alphabets, sign numbers, sign word gestures and its accuracy is discussed in this paper. The overall recognition accuracy for alphabet sign gestures is 81.81% and for number sign gestures is 89% , where as for few sign gestures like 'B', 'L','W','Y' we got almost 100 %. The classification using GFMMNN accuracy we obtained is 92.92% for ISL word gestures forming sentences and once trained with our simple grammar rules constructed we got almost 100% recognition rates.

6. REFERENCES

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