Planned Outline for Indian Sign Language Recognition

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***Abstract*- Sign language recognition will be a boost to the hard hearing and deaf people. It is a topic of current research in Computer Science and Engineering field. Deaf people are not able to use the computers and other hand held devices as it is very difficult for them to interact with such devices. So, a lot of research is going on to help them in this area. Either no standard database or no system is available to carry research in this area in India for them. In this research paper we developed a system for hard hearing and physically impaired persons. Here we presented a framework about Indian Sign Language (ISL) with international standards.**

***Keywords*- Indian Sign Language (ISL), Sign Language, Pattern Recognition, Human Computer Interface (HCI), Classification.**

I. INTRODUCTION

A visual-gestural language used by deaf and hard-hearing people for communication purposes is known as sign language (SL) [1]. In this the three dimensional spaces and the hand movements (and other parts of the body) are used by them to convey meanings. It has its own vocabulary and syntax entirely different from spoken languages.

Spoken languages use the rhetoric faculties to produce sounds mapped against specific words and grammatical combinations. The rhetoric elements are then received by the aural faculties and processed accordingly. Whereas sign language uses the visual faculties. As in spoken language there are some rules to produce comprehensive messages similarly sign language is also governed by a complex grammar.

For each country or sub-continent the Sign Language development is different. The following table presents the development of sign languages of influencing countries/sub-continent. Table 1 highlights the similarities and differences in their sign languages. The table briefly presents history and characteristics of sign language of various countries.

A. The British Sign Language

BSL [2] have gone through many phases. The British history shows that in 16th century a community program conducted in sign language. A far more positive time in history for BSL have been appeared in the 18th and 19th Centuries. Almost all sign languages are derived from BSL. In 1720 Daniel Defoe did the documentation of BSL. The first public school for deaf children was established by Charles Michael del'Epee in 1755. In 2003 British Sign Language was recognized by British Government as a language in its own right.

TABLE I
Development of sign languages in Different countries

S. No.	Country/Sub-Continent	Sign Language	Abbr-eviation
1	United Kingdom	British Sign Language	BSL
2	United States of America	American Sign Language	ASL
3	Common wealth of Australia	Australian Sign Language	Auslan
4	Japan	Japanese Sign Language	JSL
5	People's Republic of Chaina	Chinese Sign Language	CSL
6	Middle-East	Arabic Sign Language	ArSL
7	Republic of India	Indian Sign Language	ISL

B. American Sign Language

In 1880, the National Association of the Deaf (NAD) [3] was established by deaf leaders for the right of the American deaf community to use sign language. The NAD struggles to recognize the sign language from birth is a human right for every person, and the opportunity to acquire and develop proficiency in ASL should be given to deaf infants and children as early as possible. This

stance is also in line with the position of the World Federation of the Deaf and the United Nations on human rights, including the recognition of sign languages.

C. Australian Sign Language

From the sign languages of Australia during the 19th century from Britain and Ireland, Auslan [4, 5] has evolved. Auslan and BSL are very closely related. Both the modern BSL and Auslan have evolved from variants of BSL used in the early 1800s. John Carmichael moved to Australia in 1825 from England was the first known deaf person to introduce BSL to Australia. Sydney school and Melbourne school were established in Australia in the mid 19th century by Thomas Pattison and Frederick Rose.

Today, Auslan seems to be undergoing a rapid change. The massive expansion of sign language interpreter services, especially in the area of secondary and tertiary education and in the delivery of legal, governmental and medical services, has great demands on the language by both deaf people and interpreters. These developments have produced three main responses:

(i) Attempts to normalize usage

(ii) To meet new needs the development of new signs

(iii) The borrowing of signs from other sign languages.

D. The Japanese Sign Language

A family of complex visual-spatial languages used by deaf communities in Japan is known as Japanese Sign Language [6]. There is no single standard JSL, although the Tokyo form has some hegemonic force since many of the meetings and TV broadcasts are sponsored by Tokyo Deaf groups. The national sign languages in Korea and Taiwan apparently have included some JSL signs and forms from the colonial occupation of these countries by Japan prior to World War II.

JSL appears to be a "younger" language form from many other national sign languages. In 1878 the first school for the deaf was established in Kyoto and no evidence was found for sign language communities before that time. The current form of finger spelling is based on the finger spelling used in Spain, France, and the United States and was introduced in the early 20th century. Most deaf born before the end of World War II did not attend school. Many older deaf did not know the finger spelling forms or numerals. But after the war compulsory education for the Deaf was instituted.

JSL is not identical to ASL (ASL also has geographic and cultural/ethnic variation). Signs from Tokyo are different from that of the northern island and southern signs.

E. The Chinese Sign language

The first school for the deaf in China in 1887 was established by an American missionary [7, 11]. The first deaf school was established by an American, it was an oral school but ASL did not have a strong influence on CSL. It has many variations within Mainland China. The dialect used in Shanghai is the most famous, but other dialects include: Taiwan Sign Language, Hong Kong Sign Language (HKSL), and Tibetan Sign Language. The Shanghai language is also signed in Taiwan and Malaysia

There is a rising consciousness about deaf schooling and care in China. Some reports that in China there are 21 million people with hearing loss. From the last 50 years, CSL has been discouraged, even barred in most classrooms. Instead an oral-only policy has been pushed. 1,500 pre-school known as "hearing rehabilitation centers" runs by the China Disabled People's Federation established since 1980. Less than 10% of the children who attend these schools are able to have an enough grasp on the Chinese spoken language to enter formal Schools.

New job opportunities to the deaf people are being created by the local authorities now in Tianjin with the cooperation of UNICEF. In 2001 CSL was adopted as the main method of communication for the deaf by the Tianjin school and made some effort to have deaf employees. The Tianjin Technical College for the Deaf is the first technical college for deaf Chinese students. To giving opportunity to work outside of a factory to the deaf people the college focuses on **computer technology education.** Now there are also schools for the deaf in Nanjing, Shanghai, Beijing, Chengdu, Hong Kong, Kunming, and Yantai

F. Arabic Sign Language

Arab has a huge number of deaf people in the world. At the same time, there is a great shortage in deaf education. One important reason for the same is the absence of institutions and materials for the education of sign language.

Even before the deaf and hearing children are one year old, are capable of creating language. Hearing children learn from media: TV, radio, movies, and computer programs with voice. They also learn the spoken language of their families. Deaf children, unless

they are born to deaf parents, frequently lack role models from whom to learn sign language. This may result in delayed language acquisition. Arabic text is a second language for deaf people. They also miss interactive educational programs which help them to learn ArSL.

G. Indian Sign Language

There is the shortage of special schools for deaf people in India which uses sign language as a medium of instruction. Due to the lack of proper and effective audio visual support in oral education in these schools, inadequate language and communication skills in the majority of hearing-impaired children, impacting on poor literacy skills in the deaf society. The reality is that deaf schools mainly do not use ISL and nearly 5% of deaf people [12,13,16] attend deaf schools. The use of ISL is restricted only to professional programs and short term courses. BSL partly influenced ISL in the finger spelling system and some other signs, but most are not related to European sign system.

There was no formal ISL until 1978. Banerjee [15] compared signs used in some schools for the deaf situated in West Bengal and part of Assam. He concluded that same gestures were not used in each school. He believed that signing started in India in the 18th century but its use was strongly depressed. Madan Vasishta [17] sent a questionnaire to the heads of more than hundred schools for the deaf in India in 1975. Almost all the respondents approved that that deaf child used some kind of gestures but there was no ISL. A similar survey was conducted 20 years later, using questionnaires sent out to schools for the deaf. Some of the responses show the misconceptions about sign language that signing is "based on English", or "based on spoken language", or "difficult to provide a sign for every spoken word". Some statements showed that a more optimistic attitude towards manual communication, and here offender talked about sign language, rather than gestures. Increasing alertness about the nature of sign languages is evidenced later on.

II. LITERATUTE REVIEW

Subha Rajam, P., Balakrishnan, G., et al [3] in their work, proposed a new method for all 32 combinations of fingers (25 = 32), where DOWN fingers represented by '0' and UP fingers are represented by '1'. The UP and DOWN positions of fingers are identified by Canny edge detection technique. They used a new idea for extracting features from sign images. Images are scanned from left to right and also from right to left to locate the finger tips and also to locate the bottom of the palm. The up position of a finger can be identified by the help of 'LEAST' height. From five fingers of a sign they extract the binary equivalent of finger positions. Two set of database used in experiments: one set is without angular movements and other is with angular movements. This information is used for classification of sign images. The experimental result reported for Tamil signs was 96.87% in without angular movements and 98.75% in with angular movements.

Deora, D and Bajaj, N [10] developed an Indian Sign Recognition System for 25 English alphabets (double handed signs) and 9 numeral signs. The signers used for data acquirement were required to be dressed in blue and red gloves. They used PCA for classification and segmentation and finger tip algorithm for feature extraction of signs. The overall recognition rate reported was 94%.

Rekha, J.[4] proposed an approach to recognize ISL double handed static and dynamic alphabet signs. 23 static ISL alphabet signs from 40 signers were used as training samples and 22 videos were used as testing samples. The shape features were extracted by the method of Principle Curvature Based Region Detector, texture features of hand were extracted by Wavelet Packet Decomposition [18] and features from fingers were extracted by complexity defects algorithms. Multi class non-linear SVM, KNN and DTW were used as sign classification. The recognition rate achieved were 91.3% for static signs and 86.3% for dynamic signs.

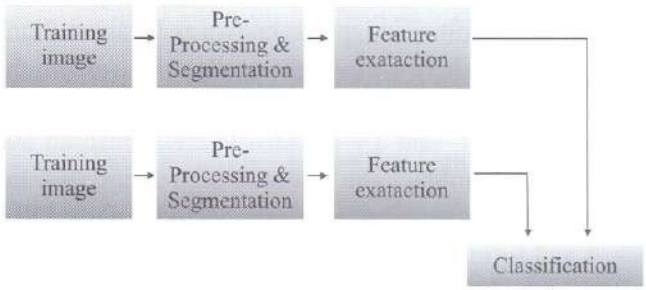

Fig. 1: Flow of image recognition system

III. METHODOLOGY USED

We have collected all static sign of numbers (0-9) for creating the database of sign language recognition i.e. called the image acquisition process. After creating the database the images are pre- processed by the method of cropping and resizing. Resized images are 200*300 pixels and are stored in JPEG format. Feature extraction techniques are applied after pre-processing to extract the features from images and these features work as an input for classification system. Some classification techniques are used to verify the accuracy of all input data. The

obtained results are analyzed so that a better recognition system can be established.

Methodologies to be used in the research work can be divided into the following phases:

A. Data collection

The Indian sign data necessary in this research are to be collected from different deaf schools situated in India.

B. Critical review of data

To form a standard data the collected data are to be reviewed critically. The review process is progress.

C. Pattern recognition

The requirement for computerized machine recognition of objects, signals or images, or the need for automated decision-making based on a given set of parameters pattern recognition is required. The following table represents various methods used in pattern recognition.

D. Feature extraction

Feature Extraction is a form of dimensionality reduction. Entered images are too big for processing, so to process these images in time we decrease the dimension of the input image by feature extraction. Transforming input data into feature is called feature extraction. Feature extraction is selected in such a way that image information must be retained.

After detection edges of image we extract features from image. For extracting features from image, we used Hierarchical Centroid method and Direct pixel value.

E. Classification

Classification is a good example of Pattern Recognition. Classification is identifying inputs to a set of class on basis of training dataset. Algorithm that implements classification is called classifier. Two main classification methods are Supervised Classification and Unsupervised Classification. In my work I used KNN classifier and NPR tool classifier to classify inputs to target class.

F. Testing of data

The standard data are to be used in sign language recognition. The result of various recognition techniques are then to be compared to find out the better among them.

TABLE-II
Various Pattern Recognition Methods

Method	Meaning
Template matching	The pattern to be recognized is matched in opposition to a stored template while taking into account all allowable pose (translation and rotation) and scale changes.
Statistical method densities).	Focuses on the statistical properties of the patterns (i.e., probability
Structural method	Describe complex objects in terms of simple primitives and structural relationships.
Syntactic method	Decisions consist of logical set of laws or grammars.
Artificial Neural	Inspired by biological neural network models. Networks

IV. RESULT

A.kNN classifier Result with Direct Pixel Value

The kNN classifier is a good estimate of Bayes error and its probability of bayes error. The classification is used training samples of data and it predicts the class by the test sample.

1) Experiment I

TABLE-III
confusion matrix for experiment1

	0	1	2	3	4	5	6	7	8	9
0	**278**	1	0	3	3	9	10	43	3	0
1	1	**275**	9	1	11	0	8	39	6	0
2	5	37	**244**	12	11	2	2	36	1	0
3	6	1	61	**229**	22	3	3	25	0	0
4	0	9	4	12	**264**	17	2	23	4	15
5	0	0	0	0	8	**266**	0	17	1	58
6	0	12	0	0	2	9	**300**	21	0	6
7	0	3	0	0	0	1	0	**342**	0	4
8	6	16	2	0	13	45	20	13	**207**	28
9	0	3	3	0	3	99	1	8	34	**199**

TABLE-IV
Percentage result of individual Experiment I

Signs	0	1	2	3	4	5	6	7	8	9
Recogn--ition on (Rate%)	79.42	78.57	69.71	65.42	75.42	76.00	85.71	97.71	59.14	56.85

Overall Result of Experiment I is 74.40%

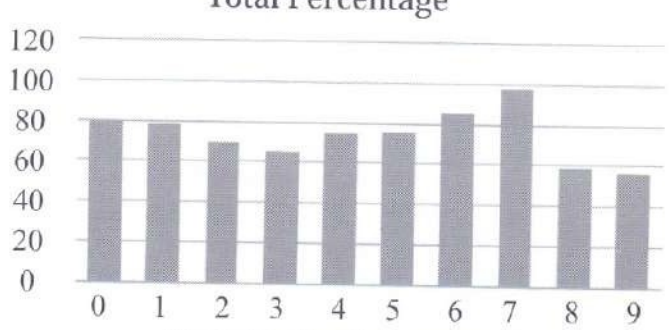

Fig. 2 : Overall result of experiment I

2) Experiment II

TABLE-V
Confusion Matrix of Experiment II

	0	1	2	3	4	5	6	7	8	9
0	**148**	0	0	0	0	0	0	0	0	0
1	7	**119**	4	0	0	0	5	3	5	0
2	0	17	**99**	21	0	0	0	4	0	0
3	3	4	8	**123**	2	1	2	0	0	0
4	0	1	3	17	**139**	10	1	0	1	5
5	0	0	0	0	0	**134**	0	0	0	7
6	9	1	0	4	0	3	**145**	2	0	0
-7	0	1	0	0	0	0	0	**149**	0	0
8	0	6	0	10	0	8	0	0	**121**	28
9	0	0	0	0	0	45	0	0	8	

TABLE-VI
Percentage Result of Individual Experiment II

Signs	0	1	2	3	4	5	6	7	8	9
Recogn--ition on	98.66	79.33	66.00	82.00	92.66	89.33	96.66	99.33	80.66	76.00

Overall Result of Experiment II is 86.06%

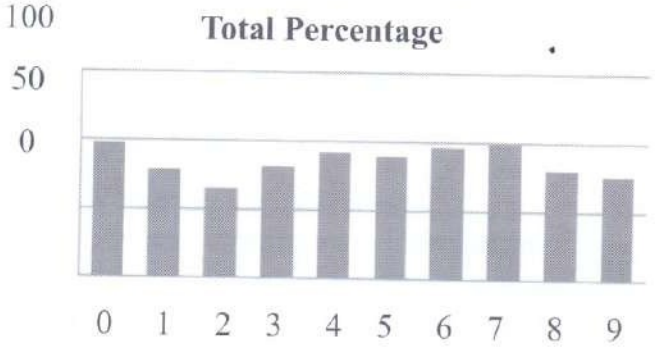

Fig. 3 : Overall rest

3) Experiment III

TABLE-VII
Confusion Matrix of Experiment III

	0	1	2	3	4	5	6	7	8	9
0	**350**	0	0	0	0	0	0	0	0	0
1	0	**350**	0	0	0	0	0	0	0	0
2	0	0	**350**	0	0	0	0	0	0	0
3	0	0	0	**350**	0	0	0	0	0	0
4	0	0	0	0	**350**	0	0	0	0	0
5	0	0	0	0	0	**350**	0	0	0	0
6	0	0	0	0	0	0	**350**	0	0	0
7	0	0	0	0	0	0	0	**350**	0	0
8	0	0	0	0	0	0	0	0	**350**	0
9	0	0	0	0	0	0	0	0	0	**350**

TABLE-VIII
Percentage Result of Individual Experiment III

Signs	0	1	2	3	4	5	6	7	8	9
Recogn--ition on (Rate%)	100	100	100	100	100	100	100	100	100	100

Overall Result of Experiment III is 100%

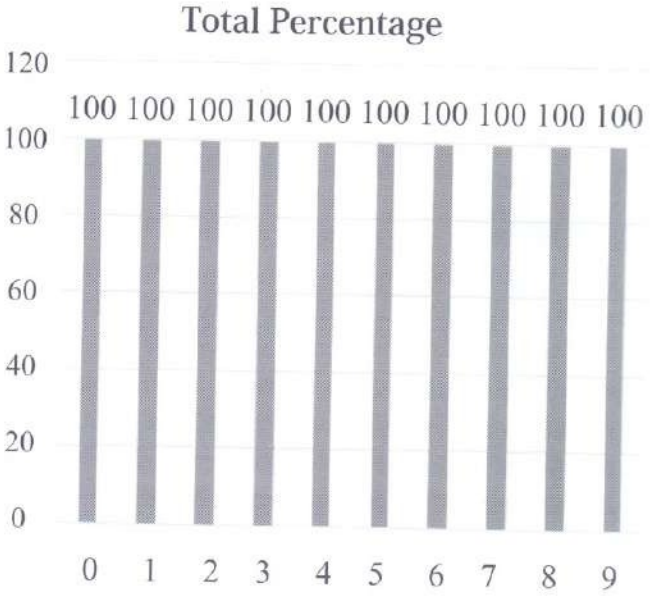

Fig. 4 : Overall result of Experiment III

4) Experiment IV

TABLE-IX
Confusion Matrix of Experiment IV

	0	1	2	3	4	5	6	7	8	9
0	**150**	0	0	0	0	0	0	0	0	0
1	0	**150**	0	0	0	0	0	0	0	0
2	0	0	**150**	0	0	0	0	0	0	0
3	0	0	0	**150**	0	0	0	0	0	0
4	0	0	0	0	**150**	0	0	0	0	0
5	0	0	0	0	0	**150**	0	0	0	0
6	0	0	0	0	0	0	**150**	0	0	0
7	0	0	0	0	0	0	0	**150**	0	0
8	0	0	0	0	0	0	0	0	**150**	0
9	0	0	0	0	0	0	0	0	0	

TABLE-X
Percentage Result of Individual Experiment II

Signs	0	1	2	3	4	5	6	7	8	9
Recogn--ition on (Rate%)	100	100	100	100	100	100	100	100	100	100

Overall Result of Experiment III is 100%

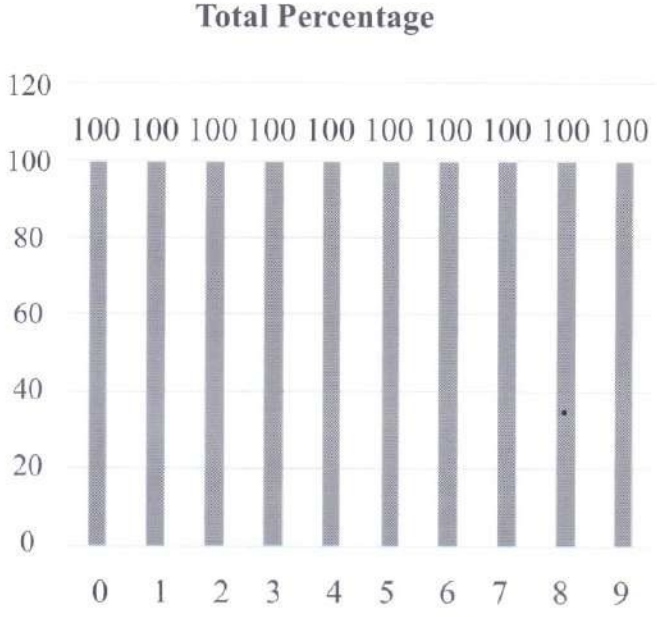

Fig. 5 : Overall result of Experiment IV

V. CONCLUSION AND FUTURE WORK

A. Conclusion

The gesture recognition system recognizes different type of numerical static sign between 0 to 9. The experimental result shows that system is sufficient to claim a "working system" for native Indian sign language numerical recognition.

The experimental results show that system can be used as a "working system" for Indian Sign Language numerical recognition.

B. Future Work

The system can be useful for static ISL numeral signs only. The ISL recognizer system cannot be considered as a complete system, as for complete recognition of sign language, we have to include ISL alphabets, words and sentences. These signs can be included in future. Also other feature extraction algorithms like Wavelet transform, Invariant moments, Shapelets descriptors and other existing methods can be included in conducting experiments for improvement in the results. Other classifiers like multi class Support Vector Machine (SVM), Principal Component Analysis (PCA) and Linear Discriminant Analysis(LDA) or a combination of these classifiers can be included in conducting experiments to improve the recognition rate.

REFERENCES

[1] Brill, R. The Conference of Educational Administrators Serving the Deaf: A History. Washington, DC: Gallaudet University Press, 1986.

[2] http://ezinearticles.com/?A-History-of-British-Sign-Language&id=920959 (Accessed on 10 Feb 2011)

[3] P. Subha Rajam and G. Balakrishnan, "Real time Indian sign language recognition system to aid deaf-dumb people", IEEE 13th International Conference on Communication Technology (ICCT), 2011, pp. 737-742.

[4] J. Rekha,, J. Bhattacharya S. Majumder, "Shape, texture and local movement hand gesture features for Indian Sign Language recognition", 3rd International Conference on Trendz in Information Sciences and Computing (TISC, 2011, PP.30-35.

[5] http://www.nad.org/issues/americansignlanguage/position-statement-american-sign-language-2008 (Accessed on 10 Feb 2011)

[6] Johnston, T., & Schembri, A. "Australian Sign Language: An introduction to sign language linguistics". Cambridge: Cambridge University Press, 2007.

[7] Johnston, T. (Ed.). "Signs of Australia: A new dictionary of Auslan". North Rocks, NSW: North Rocks Press, 1998.

[8] Chen, Y. Q., et al, "CSLDS: Chinese SignLanguage Dialog System", Proc. IEEE Intern. Workshop on Analysis and Modeling of Faces and Gestures (AMFG'03), 2003.

[9] http://www.cnad.org.tw/page/english.htm (Accessed on 10 Feb 2011)

[10] Divya Deora and Nikesh Bajaj, "Indian sign language recognition", 1st International Conference on Emerging Technology Trends in Electronics Communication and Networking (ET2ECN), 2012, pp.1-5

[11] Yang, J. H. & Fisher, S. D., "Expressing negation in Chinese Sign Language, Sign Language and Linguistics", vol.5, Pages 167-202, 2002.

[12] http://www.lifeprint.com/asl101/topics/chinesesignlanguage.htm (Accessed on 10 Feb 2011)

[13] Zeshan, U., Vasishta, M. M., and Sethna, M., "Implementation of Indian Sign Language in Educational Settings", Asia Pacific Disability Rehabiliation Journal, Pages 16-40, No. 1, 2005.

[14] http://www.hindilanguage.org/hindi/signlanguage.asp (accessed on 10 Feb 2011)

[15] Banerji, J. N. "India. International Reports of Schools for the Deaf", Pages 18-19.Washington City: Volta Bureau, 1928.

[16] Zeshan, U. et al. "Sign languages of the Indian Subcontinent" (Linguistic research forum 4). Munich: Lincom Europa, 2000.

[17] Vasishta M., Woodward, J. and DeSantis, S. "An Introduction to Indian Sign Language", All India Federation of the Deaf (Third Edition),1998.

[18] M. James Stephen, P.V.G.D Prasad Reddy "Implementation of Easy Fingerprint Image Authentication with Traditional Euclidean and Singular Value Decomposition Algorithms", International Journal Of Advanced Soft Computing Application, Vol-3, No.2 July 2011.

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