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An Integrated Two Way ISL (Indian Sign Language) Translation System – A New Approach

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Abstract – Sign language is a language which uses visually transmitted sign patterns to convey meaning. It is the combination of hand shapes, orientation and movement of hands, arms or body, and facial expressions. Our System is capable of recognizing sign-language symbols can be used as a means of communication with hard of hearing people and hard speaking people. Our paper proposes a system to help those people to communicate with normal people without sophisticated devices like power, data gloves and coloured finger cap and etc. Instead we are using a camera and microphone as a device to implement the Integrated Two Way ISL (Indian Sign Language) system. The Two Way ISL translation system has two parts, translation of sign language into voice and reverse. The Two Way ISL translation system uses webcam or USB camera to get images or continuous video image (from hard speaking) which can be interpreted by the application. Acquired images are assumed to be translation, scale and rotation invariant. Assuming signer is right angle to the camera. In this process the steps of translation are acquisition of images, binarised, classification, hand shape edge detection and feature extraction. After getting vectors feature extraction state then pattern matching done by comparing existing database. The interpreted symbols (meaning – words) can be translated into text information (Words in English or Tamil). Using text to voice synthesis, text will be converted as a voice output or voices file (to normal person). The GUI application is displaying and sending the message as a text message or voice message to the receiver. The reverse is, getting voice input (from normal person) converted to text then it is matching with database for sign symbol to display (to hard hearing receiver).This system makes deaf/dumb people to communicate easily with normal speaking person. Also in video calling or chatting this application helps the hard speaking and hearing people.

Keywords – Indian sign language(ISL), translation, image processing, hard hearing and hard speaking

I. INTRODUCTION

In recent years, research has progressed steadily in regard to the use of computers to recognize and render sign language. Technology is rapidly changing and improving the way the world operates. Barriers for people who are hard hearing are diminishing as projects of the past two decades have unfolded. Through the use of image processing, artificial intelligence and pattern matching techniques, researchers are striving to develop hardware and software that will impact the way hard hearing individuals communicate and learn. Using sign language hard speaking and hearing people could communicate among them and with normal people.

Practically, world's hard hearing and hard speaking people has been in a difficult situation in the society because of their inability to communicate vocally with normal speaking and hearing people in connection with that the indifference of others to learn their language, the sign language. With the arrival of multimedia, animation and other computer technologies, it is now becoming possible to bridge the communication gap between the hearing-impaired and normal person.

Sign language is a visual/gestural language that serves as the primary means of communication for hard hearing individuals, just as spoken languages are used among the hearing. Hard hearing individuals encounter the difficulty that most hearing individuals communicate with spoken language [12].

Generally, there is no problem when two hard hearing persons communicate using their common sign language. The real Difficulties arise when a hard hearing person wants to communicate with a non-deaf (normal) person [9].In such scenario there is need of sign language and sign language translator.

Sign language (SL) is the native language for the hard hearing people. Although they successfully communicate with each other when using sign language. They face many difficulties when they try to communicate with hearers, especially those who are incompetent in sign language .Solutions such as pointing, writing, or lip-reading, combined with some new technological means, i.e., faxes, computers (e.g., e-mails), mobile phones (e.g., SMSs), facilitate such communication.

There are 700,000,000 deaf or hard of hearing people worldwide (World Health Organization) and the 143 existing different sign languages (types with dialects). Being as complex as any spoken language, Sign L has many thousands of signs formed by specific gestures (related to the hands) and facial expressions, each differing from another by minor changes in hand motion, shape, position, and facial expression [17].

What is Sign Language? Sign language is a language which uses visually transmitted sign patterns to convey meaning. It is the combination of hand shapes, orientation and movement of hands, arms or body, and facial expressions. Sign languages are not international. Every country has unique sign language. Ex: American Sign Language (ASL) has its own grammar and rules—it is not a visual form of English. Sign language is unique for every nation [1].Countries like Arabic, Bangla, and Malay, Taiwanese, Chinese, Japanese, Spanish and many has their own sign language. There are approximately 70 million people with hearing deficiencies in the world [1].

Sign language translator is system which converts sign symbols to text or voice in any native language. These systems are called as human computer interaction systems (HCI).It could be done in two ways (i) glove based systems (ii) vision based systems. For sign language translation system we are using vision based system.

A sign language translation system would make it possible to communicate with hard hearing people. Compared to speech commands, hand gestures are advantageous in noisy environments, in situations where speech commands would be disturbing, as well as for communicating quantitative information and spatial relationships.

Sign languages primarily consist of hand gestures performed by the hearing impaired as a means of communication. Automated sign language recognition systems can greatly facilitate the communication between the vocal and the non-vocal communities as they can be used to translate signs into spoken words [10].

Machine vision methods for sign language spotting, i.e., detecting and recognizing signs in a known vocabulary, in videos of sentences and stories produced by native signers. The difficulty of sign language spotting is that instances of signs vary in both motion and appearance. For dealing with motion, previous vision-based methods have demonstrated some successes using Hidden Markov Models [15].

Gesture description involving hand shapes, movement, position, and palm orientation have been employed to recognize and segment sign image sequences. These methods focus on image processing more than machine translation and sign language analysis and have limited vocabularies [12]. Sign Language Translation System or software that translates text into sign language animations could considerably improve hard hearing lives especially in communication and accessing information [13].

Sign language is a visual language and consists of 3 major components [2] they are,

(i) finger-spelling: used to spell words letter by letter
(ii) word level sign vocabulary: used for the majority of communication
(iii) non-manual features: facial expressions and tongue, mouth and body position

In our proposed system we focus finger spelling initially alphabets and then words letter by letter, word level sign vocabulary and finally including facial expressions.

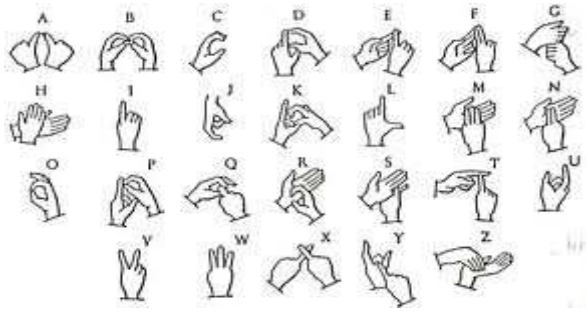

Figure 1. Indian Sign Language Alphabet

Now-a-days video calling-chatting and many facilities are offered for communication. Hard speaking and hearing peoples couldn't use these facilities effectively or fully. These people find difficulty in communicating with normal people. Our paper discusses solution to this problem and proposed a system for translation of sign language using webcam,mic in laptops or multimedia smart mobile phones.

II. RELATED WORKS

Gestures are expressive, significant body motions involving physical movements of the fingers, hands, arms, head, face, or body with the intent of: 1) conveying meaningful information or 2) interacting with the background. The importance of gesture recognition lies in building efficient human–machine interaction. Its applications range from sign language recognition through medical rehabilitation to virtual reality. The tools surveyed for gesture recognition are HMMs, particle filtering and condensation algorithm, FSMs (Finite State Machines), and ANNs (Artificial Neural Networks) [3].

A practical low cost visual communication system for sign language translation using low-cost cameras and low-bandwidth telephone lines and using binary sketches. They described an efficient feature extraction scheme and filter for reducing noise from low-cost cameras. They also stated irreversible pre-processing techniques along with a simple, fast and efficient compression scheme for binary images [4].

The older systems were uses gloves or visual markings but they proposed a system to recognise alphabets of Arabic sign language ,which getting image of bare hand and feature -edges of finger- was extracted hence vector were generated. The extracted features were assumed as translation, rotation and scaling invariant [5]. Means that signing hand is considered it make almost 90 degree with visual input device to avoid unwanted mathematical calculation since the mobile device has limited in memory and processing issues.

A new method for skin colour segmentation approach that identifies the hands and face each video frame. This method is robust in terms of variations in skin pigmentation in a single subject, in skin pigmentation across a population of potential users, subject clothing, and image background [6].Video images of people performing ASL were segmented using a skin colour-based ROI method, and pre-processed using a dual-clarity compression scheme. High compression of the background reduces the coding of those segments of each image that are less important to sign language and reduce the average transmission requirements for each frame [6].Instead of using finding skin colour using algorithms, we are proposing a sign language translation system where the signers to use bare hand for signing and

wear a any dark coloured dress. So as to find easily hands from background.

A fuzzy decision tree with heterogeneous classifiers is proposed by Gaolin and et al, for large vocabulary sign language recognition to reduce the recognition time without loss of accuracy [7].

A language model (LM) for text generation From Taiwanese Sign Language, based on a predictive sentence template (PST) tree which is trained by a corpus collected from the deaf schools was used to model the correspondence between signed and written Chinese. The AAC (Augmentative and alternative communication) system will be transferred to a palm-sized platform and other multimedia applications. More importantly, portable communication system are designed and fabricated for the cerebral palsied or stroke with motor disorders in their daily activities [8].

Mohandes and Buraiky introduce a system to recognize isolated signs from the Arabic sign language using an instrumented glove and a machine learning method. Signs from different aspects of life are chosen from the Unified Arabic Sign Language Dictionary that is adopted by all Arab countries [10].But using glove are limited to usage. So we are proposing system without these technical equipments rather a simple camera from mobile device.

Automatic analysis of Sign Language gestures has come a long way from its initial beginnings in merely classifying static signs and alphabets. But now a proposal by Sylvie Ong and Surendra Ranganath, successfully deals with dynamic signs which involve movement and which appear in continuous sequences. A lot attention has also been focused on building huge vocabulary recognition systems [11]. In this survey, they examine data acquisition, feature extraction and classification methods employed for the analysis of sign language gestures.

Yu-Hsien Chiu and et-al had presented an innovative approach to joint optimization of TSL (Taiwanese Sign Language) translation and sign video synthesis for teaching and learning TSL. They transliterate the Chinese into Taiwanese Sign Language by estimating the aligned probabilities of the grammatical structure. They proposed sign video database provides rich information of motion transitions between sign videos for displaying the translation result [12].They did different inflections of sign in the sentences for sign video film. They were building gesture recognition systems with large vocabularies.

Arabic Sign Language Translation Systems (ArSL-TS) Model that runs on mobile devices. This system connects web server through wireless medium for internet connectivity. So as to translate text input and getting sign output as an animation.HTML or WML was used to render the content from web server. The application web server has the signed animation database [13].

The sign language translation system: Speech to Sign. It is made up of a speech recognizer (for decoding the spoken utterance into a word sequence), a natural language translator (for converting a word sequence into a sequence of signs belonging to the sign language), and a 3D avatar animation module (for playing back the hand movements).

San-Sengudo and et-al, gave 2 proposals for natural language translation (i) a rule-based translation module (that computes sign confidence measures from the word confidence measures obtained in the speech recognition module), (ii) a statistical translation module (parallel corpora were used for training the statistical model)[14].And also problems in reducing time delay between spoken utterance and sign animation were discussed.

Hee-Deok Yang and et-al, proposed a novel method for designing threshold models in a conditional random field (CRF) model is proposed which performs an adaptive threshold for distinguishing between signs in a vocabulary and non sign patterns. A short-sign detector, a hand appearance-based sign verification method, and a sub sign reasoning method are included to further improve sign language spotting accuracy. The proposed threshold model with CRF is an excellent mechanism for distinguishing in-vocabulary signs and non-sign patterns [15].

Data sparseness is a major problem in machine translation, especially for minority languages. Converting a sentence into the corresponding syntactic structure can reduce the data sparseness problem by using grammar rules which are used to generate languages [16].

SL recognition scheme was proposed based on the application of the IMEn (Intrinsic Mode Entropy) on sEMG (surface electro-myogram) and 3-D-Acc data acquired from the dominant hand. This system can be combined with portable devices (e.g., Pocket-PC) and Text to speech/speech to text engines could be integrated into a portable SL recognition device. So we propose based mobile ISL translation system [17].

Rudiduo and et-al designed and explored the enhanced level building algorithm. It was built around dynamic programming, to tackle the problem of movement epenthesis in continuous sign sentences. This method solves problem of recognizing motion patterns [18].

Biswajit Sarkar and others proposed a translation system which converts Bangla text to sign language by playing Pre recorded or stored video from database. They said that they will try the reverse i.e. from sign language to text. With that idea we are proposing method for two way conversion that too in mobile devices [19].

Nashwa El-Bendary and et-al proposed a translator for Arabic language alphabets using Desktop computer. They didn't use any gloves or visual markings, bare hands used for signing. Using image processing techniques they acquire and process image and convert as alphabet [20]. They said that this system will be refined and implemented in mobile devices. Having that point in mind and previous works done by of above others, we are proposing our own sign language translation system i.e. Mobile Based Indian Sign Language translation system. This system can be used multipurpose like translator for hard speaking/hearing people, class room education for hearing impaired and intelligent sign language translator for all.

III. PROPOPSED METHODLOGY (FOR SIGN LANGUAGE TRANSLATION SYSTEM)

In this paper we are proposing our Two Way Indian Sign Language translation system. In this system we are giving two modes of translation. First one is if a deaf-dumb person can communicate with normal person (who doesn't know sign language). And the second one is reverse of first one i.e. a normal person speaks, it is converted to text and then appropriate text meant sign will be displayed.

A. Sign To Speech Translation:

Hard speaking community can communicate with normal people with less training and requirement using our proposed sign to speech translation system.

The hand movement or fingers movement of signer (hard speaking person) will be is taken as an images or continuous images from the input devices (Cell phone camera, web cam, video conferencing cam etc.). The captured image will be sent to pre-processing, classification and filtering, and then image feature vector is created. It is compared with existing sign symbol database for finding the meaning of the sign. The recognized sign's meaning translated as text or word will be generated. If any hard hearing person in the receiver side he may display with text (sentence display or sign itself displayed). The generated text will be sent to voice generator and voice transmitted to the receiver's speaker or head phone.

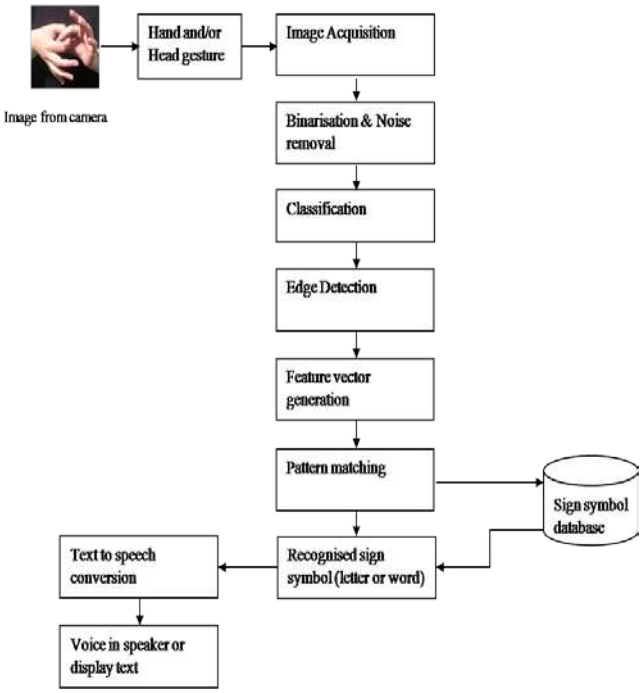

Figure 2.Sign to speech translation system architecture

a. Preprocessing

Hand gesture by signer, Image acquisition and smoothing are the part of this pre-processing stage. Hand gesture or Sign will be taken as an image from (mobile phone camera or web cam).Frame rate is 20 frames per second are enough. To reduce the complexity of orientation we are assuming that the signer is right angle to camera. Now we are not considering motion picture, we are taken as still images of signed hand. To differentiate between signs we are maintaining a time gap. For example 3 seconds for signing and gap between sign is 3 seconds. If there is no sign after 3 second we conclude that signing is completed. Captured sign image will be sent to binarisation i.e. conversion of image in black and white pixels. It is easy to identify the edges in black and white tone. Next is removing the noise from binarised image. So the background unnecessary pixels will be removed by noise removal filter.

b. Classification:

The best frame among available input images will need to detect in this phase. Each frame here is having time gap of 3 seconds. Suppose the signer is not followed the time frame definitely signs are not clear. Some time misinterpretation may happen. At the classification phase, we use HMMs to model each sign and classify with maximum likelihood criterion. HMMs are used in many research areas, like speech recognition and bioinformatics, for modelling variable-length sequences and dealing with temporal variability within similar sequences. The system trains the HMM models for HMM manual [14]. Then, it extracts the cluster information through the joint confusion matrix of HMM. Summing the validation sets' confusion matrices in a cross-validation stage forms this joint confusion matrix. The system then investigates the misclassifications using the joint confusion matrix. If the system correctly classifies all samples of a sign class, the sign class cluster only contains itself. Otherwise, for each misclassification, the system marks that sign as potentially belonging to the cluster

c. Feature Extraction:

Feature extraction phase is to identify the meaning of the signed letters and accordingly to understand the signed word. Feature extraction phase is in two stages (i) edge detection stage, (ii) feature vector creation stage. In this stage the system detects the frame edges using image processing filters, and then giving a new frame containing only the contour (edges) pixels to make use of it in the following stage of the feature extraction phase that is feature vector creation stage. There are many methods for edge detection. They are Roberts Detection, Prewitt Detection, Sobel Detection and Canny Edge detection. In these methods Canny is best method to do edge detection [21]. Feature vectors are generated by machine learning algorithms i.e. Hidden Markov Model.

d. Pattern Matching:

During the training phase all the possible letters in English Indian sign alphabet were signed, pre-processed, classified, features extracted and stored in database. For the initial work our research we are using trained vector of sign alphabets for matching. Latter it is planned to apply suitable pattern matching procedure for sign matching. During training phase the features and vector are created were stored in sign database. In testing phase the feature vector which is obtained from feature extraction module will be compared with sign database and possibly if a match found it is a recognized sign's text meaning. Initially we are recognizing (translating) English alphabets to Indian Sign Language. Then we planned to implement our system in to word by word and then sentence level with grammar. The recognized letter (latter words) sent to text to voice convertor to the receiver end. Based on shape and appearance of feature the text meaning found for the sign [22].And finally the recognised sign, text is displayed as well as played as an audio in the receiver's side.

B. Speech To Sign Translation:

Here it is the reverse process of the above proposed method. Here the normal people can speak with hard speaking and hard hearing community.

The speech from normal person is taken via micro phone of cellular phone or computer. For the need of good quality of voice signal it will be sent for noise removal. Voice data is converted to text by speech-recognition module i.e. voice

to text conversion with the use of trained voice database. The converted text is compared with database for finding meaning and symbol (sign). Display the Sign Symbol with text to the receiver (hard speaking and hard hearing person)

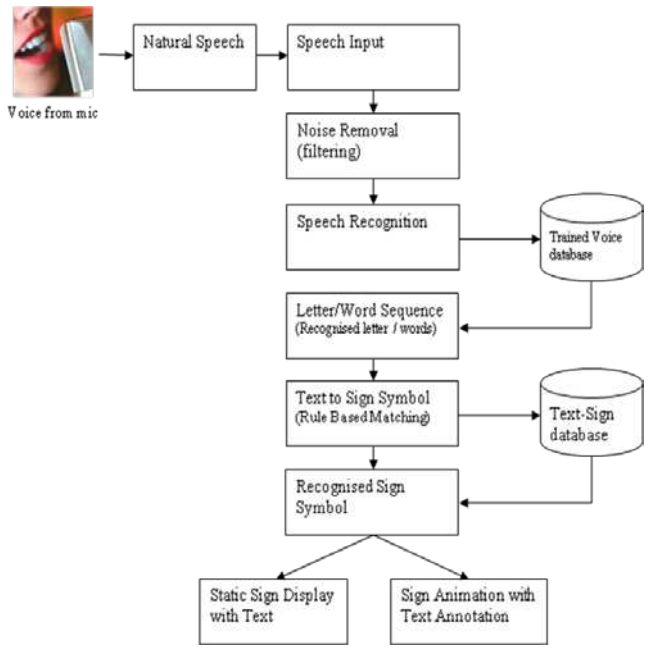

Figure 3. Speech to sign translation system architecture

a. Noise Removal:

The speech from normal person is taken via micro phone of cellular phone or computer and it will be sent to noise removal. There are several types of noise removal techniques like Filtering Techniques (spectral subtraction method, weiner filter, least mean square filter and kalman filter)[23] ,Spectral restoration(minimum mean square error short time spectral amplitude) and many. There are another two types of noise removal methods also, Modulation detection and Synchrony detection. This algorithm speech detector analyses in signal amplitude. Speech modulations are slow and have big amplitude fluctuations. Noise modulations are more constant with rapid and smaller fluctuations.

b. Speech Recognition:

After noise removal the voice sent for speech recognition module. Here the speech recognizer converts voice into single letter (latter words and sentences).For new user voice training has to be done for making trained voice database. In testing phase or real time the voice database used for quick and easy recognition. This paper proposes for single letter or alphabet into Indian way of Sign Language. Then we planned to implement this idea for individual words and then continuous word spoken.

c. Rule Based Text To Sign Matching:

Recognized voice is now in the form of text i.e. voice to text conversion module gives us text output. Then text to sign matching is done by rule based technique. Here the relationship between text and sign has been defined. For word and continuous matching we have to more because of word meanings and context meaning in sentence (continuous speech). The relationship rules are defined carefully with extreme logic to achieve good translation.

IV. CONCLUSION

This paper presented a proposal of methods for an Integrated Two Way Indian Sign language Translation System. Our paper proposes a two way communication system to help those people to communicate with normal people without sophisticated devices like power, data gloves and coloured finger cap and etc. The first translation system is –sign to speech – if a deaf-dumb person can communicate with normal person (who doesn't know sign language).Image from camera acquired is binarised, noise removed, boundary of finger detected, finding exact text match and finally text with audio is sent to receiver(a normal person who doesn't know Indian sign language). The second translation system is –speech to sign –a normal person speaks, it is converted to text and then appropriate text meant sign will be displayed. We planned to extend this idea for words and sentences by using new methodologies. We planned to implement the complete idea of this paper in smart mobile phones also. The Challenge in implementing this idea in mobile phone is implementing the methods used for image processing.

V. REFERENCES

[1] World Federation of the Deaf (WFD). http://www.wfdeaf.org/

[2] O. Aran, I. Ari, L. Akarun, B. Sankur, A. Benoit, A. Caplier, P. Campr,A.H. Carrillo, and F.-X. Fanard, "SignTutor: An interactive system for sign language tutoring," IEEE Multimedia, vol.16, pp. 81–93, 2009.

[3] S. Mitra and T. Acharya, "Gesture recognition: A survey," IEEE Transactions on Systems, Man, and Cybernetics, Part C: Applications and Reviews, vol. 37, pp. 311-324, 2007

[4] M. D. Manoranjan and John A. RobinsonAsda, "Practical low-cost visual communication using binary images for deaf sign language", IEEE Transactions on Rehabilitation Engineering ,vol. 8,pp 81-88 ,March 2000.

[5] Omar Al-Jarrah,Alaa Halawani, "Recognition of gestures in Arabic sign language using neuro-fuzzy systems "Artificial Intelligence :ElseVier Artificial Intelligence - AI , vol. 133, no. 1-2, pp. 117-138, 2001.

[6] David M. Saxe and Richard A. Foulds, "Robust Region of Interest Coding for Improved Sign Language Telecommunication", IEEE Transactions on Information Technology in Biomedicine, vol. 6, no. 4, pp.310-316, December 2002

[7] Gaolin Fang, Wen Gao, and Debin Zhao, "Large Vocabulary Sign Language Recognition Based on Fuzzy Decision Trees "IEEE Transactions on Systems, Man, and Cybernetics —Part A: System and Humans, vol. 34, NO. 3, pp. 305-314, May 2004.

[8] Chung-Hsien Wu, Yu-Hsien Chiu, and Chi-Shiang Guo, "Text Generation From Taiwanese Sign Language Using a PST-Based Language Model for Augmentative Communication", IEEE Transactions on Neural Systems and Rehabilitation Engineering, vol. 12, no. 4, pp.441-454, December 2004.

[9] Khaled Assaleh, M. Al-Rousan, "Recognition of Arabic Sign Language Alphabet Using Polynomial Classifiers"

EURASIP Journal on Applied Signal Processing 2005:13,2136–2145

[10] M. Mohandes, S. Buraiky, "Automation of the Arabic Sign Language Recognition using the PowerGlove", AIML Journal, Volume 7, Issue 1, June, 2007.

[11] Sylvie C.W. Ong and Surendra Ranganath, "Automatic Sign Language Analysis: A Survey and the Future beyond Lexical Meaning", IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 27, no. 6,pp.873-891, June 2005

[12] Yu-Hsien Chiu, Chung-Hsien Wu, Hung-Yu Su, and Chih-Jen Cheng, "Joint Optimization of Word Alignment and Epenthesis Generation for Chinese to Taiwanese Sign Synthesis IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 29, no. 1,pp.28-39, January 2007

[13] Dr.Sami M.Halawani, "Arabic Sign Language Translation System On Mobile Devices", IJCSNS International Journal of Computer Science and Network Security, vol.8,no.1, pp. 251-256,January 2008.

[14] R. San-Segundo , R. Barra, R. Co´rdoba, L.F. D'Haro, F. Ferna´ndez, J. Ferreiros,J.M. Lucas, J. Macı´as-Guarasa , J.M. Montero , J.M. Pardo, "Speech to sign language translation system for Spanish", Speech Communication 50 (2008) 1009–1020, www.sciencedirect.com

[15] Hee-Deok Yang,Stan Sclaroff,andSeong-Whan Lee, "Sign Language Spotting with a Threshold Model Based on Conditional Random Fields", IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 31, no. 7,pp.1264-1277, July 2009

[16] Hung-Yu Su and Chung-Hsien Wu, "Improving Structural Statistical Machine Translation for Sign Language with Small Corpus Using Thematic Role Templates as Translation Memory ", IEEE Transaction on Audio ,Speech and language Processing ,vol. 17, no. 7,pp.1305-1315 September 2009.

[17] Vasiliki E. Kosmidou, and Leontios J. Hadjileontiadis, "Sign Language Recognition Using Intrinsic-Mode Sample Entropy on sEMG and Accelerometer Data", IEEE Transaction on Biomedical Engineering, vol. 56, no. 12,pp.2879-2890, December 2009.

[18] Ruiduo Yang, Sudeep Sarkar, and Barbara Loeding, "Handling Movement Epenthesis and Hand Segmentation Ambiguities in Continuous Sign Language Recognition Using Nested Dynamic Programming", IEEE Transactions on Pattern Analysis and Machine Intelligence, vol. 32, no. 3,pp. 462-477, March 2010

[19] Biswajit Sarkar, Kaushik Datta, C. D. Datta, Debranjan Sarkar , Shashanka J. Dutta, Indranil Das Roy, Amalesh Paul, Joshim Uddin Molla, Anirban Paul, "A Translator for Bangla Text to Sign Language",India Conference INDICON 2009,Annaul IEEE feb 2010.

[20] Nashwa El-Bendary, Hossam M. Zawbaa, Mahmoud S. Daoud,Aboul Ella Hassanien, and Kazumi Nakamatsu, "ArSLAT: Arabic Sign Language Alphabets Translator", International Journal of Computer Information Systems and Industrial Management Applications,ISSN 2150-7988 Volume 3 , pp. 498-506,2011.

[21] N. Senthilkumaran and R. Rajesh, "Edge Detection Techniques for Image Segmentation – A Survey of Soft Computing Approaches", International Journal of Recent Trends in Engineering, Vol. 1, No. 2, May 2009.

[22] Alex Yong-Sang Chia, Deepu Rajan, Maylor Karhang Leung, and Susanto Rahardja," Object Recognition by Discriminative Combinations of Line Segments, Ellipses,and Appearance Features", IEEE Transactions on Pattern Analysis and Machine Intelligence,vol. 34, no. 9, september 2012

[23] Komal R. Borisagar and Dr. G.R.Kulkarni, "Simulation and Comparative Analysis of LMS and RLS Algorithm Using Real Time Speech Input Signal", Global Journal of Researches in Engineering, Vol.10 Issue 5 (Ver1.0), October2010.

