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A prototype Punjabi text to Sign Language Automatic Translator

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Abstract

Sign language, which is a method of communication for the hearing-impaired community, conveys meaning through manual communication and body language rather than through sound. This paper describes a Punjabi text to sign language translation method in prototype form. The suggested method accepts Punjabi text as input and produces Sign Language equivalents using synthetic animations. This system will help to disseminate information to deaf people in public utility places like railways, banks, hospitals, etc. This will also act as an educational tool in learning Sign Language.

Introduction

Without communication human life, is not possible. The language utilized by hearing-impaired people is called sign language [1]-[3]. Sign language is a primary language of a deaf community. It is interpreted and translated by the force of vision [4]. The basic parameters of sign language are hand-shape, position, movements [5]. Sign language is not only utilized by the hearing disabled, it has been used by parents of deaf children, teachers of deaf pupils, and several other fields of contact with the deaf [6]. About 466 million individuals have hearing losses globally, of which 34 million are teenagers. People use various sign languages in different areas of the world. Sign language is very rare in comparison to spoken languages [7], [8]. India has developed its sign language, titled Indian Sign Language (ISL). There are very few schools for deaf children in developed nations. In developed nations, the unemployment rate for people with hearing disabilities is very strong [9]. According to Ethnologue [10], the deaf community in India, which accounts for approximately 1% of the total population, has a very low literacy rate. World Health Organization (WHO) ''factsheet'' states that teaching sign language will benefit children with hearing loss. Sign language used the sign to represent a word in spoken language. Signed languages tend to choose concurrent sign internal change over morpheme concatenation [11]. Although sign languages are based on manual movements, they are not naturally iconic [12]. But learners in the initial stages of SL learning use iconicity as a mnemonic aid to remembering new signs. But the lack of iconicity makes it difficult to learn new signs for those who learn SL as a new language. Indian Sign Language (ISL) uses fingerspelling to reflect the English alphabets A-Z. It can be performed one-handed or two-handed, and ISL employs the two-handed technique. Although fingerspelling is used less often [13]-[14] in casual signing, it is an integral part of sign language learning. Without the assistance of a professional sign language instructor, signing is very complex for a novice. Without the assistance of a professional sign language practitioner, sign learning is very complex for a novice. Learning by books is ineffective since it is difficult to illustrate signals in a book. Although there are technological resources available for studying sign language, they cannot include feedback on the user's signals. This complicates the process of learning signals without additional assistance. Human resources

[9] are extremely scarce in this area. According to statistics from India, there are just 250 [15] interpreters or approximately one for every 20284 deaf persons. Difficulties in comprehending spoken and written language, teachers' poor sign language proficiency, and the high cost [16] parents incur in educating their deaf children are all causes that impede sign language learning [17]. Apart from deaf individuals, families, instructors, support workers, and scholars all need sign language training. It is challenging for them to participate in sign language training programs. For listening and communicating parents of deaf infants, the absence of a learning system along with their children's desire to talk causes them to choose lip-reading over sign language. This makes good communication impossible for the child. Like in several spoken languages, sign language has numerous geographic variants [18]-[19]. This creates a barrier to communication within the deaf population.

This paper is organized as follows. Section II gives a brief introduction to sign language in Punjab. Then we discuss current research in this field. After that, we discuss the proposed methodology. Then we have results and the conclusion.

Sign Language in Punjab

Like in every other sign language, sign language practiced in Punjab incorporates all face and hand gestures. ISL adopts a new approach. Punjabi, which follows the subject-object-verb (SOV) structure, follows the same structure as ISL. According to professionals, Punjab does not have a formal system of sign language. The majority of the functionality is taken from ISL. Even people from various parts of Punjab use sign language in a variety of ways. This necessitates the development of a structured sign language for use in Punjab. Our scheme has the potential to serve as a systematic medium for teaching sign language.

Punjabi is spoken by 31.1 million people in India and is recognized as an official language in the state of Punjab. In India, Punjabi is written using the Gurumukhi script, while Shahmukhi is used in Pakistan. There are 654063 total disabled people in Punjab, out of this 28.16 are deaf people [20]. Hearing-disabled is 146696 and speech-disabled is 24549. In Punjab, there is a lack of schools and higher institutions for the hearing-impaired community.

Existing Research

When spoken languages were not adequately organized during the last few decades, citizens used signs to communicate signals of very little context. In the early days of medieval monasticism, monks took vows of secrecy and communicated using a simplified version of sign language. Juan Pablo, a Spanish priest, presented the first system for deaf children's education using the current text in 1620. Abbe Charles established the first school for the deaf in Paris in 1771, which pioneered the creation of standard sign language [21].

Elliott et al. created a framework for sign language called ViSiCAST (Virtual Signing, Animation, Capture, Storage, and Transmission) that can convert spoken language or text to gesture-oriented notation. A significant benefit of the study is that it results in a more versatile and complex method for describing signs gesture animations. The disadvantage of the device is that it needs hardware (sensors) configuration to edit or incorporate new sign animation [22]. Cox et al. studied contact transactions between a United

Kingdom Post Office Clerk and a deaf client by translating their voice into British Sign Language (BSL) using the signing avatar "TESSA" (Text and Signing Support Assistant). For deaf people, the avatar's facial gestures create a more appealing and realistic 3D sign motion. Improved speech recognition where sentences do not have to be said exactly as they are registered in the database word by word [23]-[24]. Hanke defined in depth HamNoSys (Hamburg notation system), which is used for the transcription in 3D animated style of spoken/written sign-lingual text. [25]. Raghavan et al. developed a new architecture for signing gestures for hearing disabled individuals utilizing a 3D avatar. The primary goal was to create a flexible tool for translating English text input to motion animation [26]. Kaur and Kumar explained how to use a web-based method to produce the HamNoSys notation equivalent of an input term. There is no automated animation production method for Sign language representation, and this study required the use of a variety of tools [27]. Kaur and Kumar developed an SMS system for deaf people and validated it with 250 generally used sentences. The machine is composed of three critical components: 1) visual interface of sign language for the deaf 2) generator of sign language to English text sequences 3) Method for translating English text SMS to voice [28]. Shahriar has developed a two-way mobile application for Bangladesh's deaf community. This machine is capable of converting Bangla speech to Bangla sign language and vice versa. The CMU Sphinx toolkit was used as a speech recognition device to convert speech to sign language. In contrast, for text to voice, the text is submitted to the Google Translate server, which reacts with an audio stream of the word [29]. Sugandhi has developed a multilingual text to ISL translator framework built on a 3D avatar animation. The machine accepts text input in both English and Hindi. The input text is transformed to HamNoSys and then translated into the Markup language for Signing gestures (SiGML) [30]. Kaur and Singh demonstrated a method for translating and creating ISL animations for 100 Punjabi sentences. This device accepts only text input and outputs a 3D avatar. It requires the addition of non-manual motion capabilities and the provision of an automated conversion interface for text to 3D sign animation [31]. Verma and Kaur created a method for generating Sign language motion animations from Punjab text. Research in ISL is extremely limited, and researching this area is extremely difficult due to the language's lack of proper grammar [32].

Nair, Nimitha, and Idicula demonstrated the use of HamNoSys to translate Malayalam text to ISL. The precision may be improved by using facial gestures and lip movements, which are currently absent from the system. The implemented scheme can be used as a medium for the citizens of Kerala to learn sign language [33]. Goyal and Goyal constructed a dictionary of ISL utilizing synthetic animation and the HamNoSys notation scheme. Works exclusively for English terms and needs a fully automated computer translation method for the end consumer [34]. Taner Arsan and Oguz Ulgen developed a tool that translates sign language to speech and vice versa. They used two approaches: the first is a motion capture device based on the Microsoft Kinect Sensor for Xbox 360 that recognizes and converts human gestures to audible voice. The second solution is to understand the natural user's audible voice and to view sign language in the form of a picture or video. The CMU Sphinx decoder is implemented in Java to understand spoken words [35]. Goyal and Goyal have developed a translator that translates Hindi text to the ISL with extension using wordnet. During the translation, ISL grammar rules are considered, and reordering of the word into the sentence is done according to the ISL grammar rules. The translator system is flexible enough to add a new word into the dictionary [36]. Joy et al. have developed four assistive software tools for ISL-based learning. Four tools are SignDict (Mobile-based ISL dictionary), SiLearn

(Intelligent ISL vocabulary learning), SignQuiz (Automatic Sign Recognition for Sign Learning), and SignText (Technology-assisted textbook learning) used to learn vocabulary, fingerspell sign and content of the book in different levels [37]. Singh and singh have developed a system that accepts Punjabi text and translates the input into ISL using synthetic animation videos using VisiCAST,s project or human-made videos. The current database contains the most commonly used 100 words for communication under various categories and the developer has been working to increase the size of the database to increase the accuracy of the system. The output of the system has been discussed with and verified by the ISL experts and the teacher of the school for the deaf, saifdipur Patiala (Punjab) [38].

Proposed Methodology

The proposed system takes Punjabi Text and produces the required output in the following stages. For translation from Punjabi text to ISL synthetic animation video the project requires Punjabi POS tagger, Punjabi Stammer, Eliminator, Punjabi ISL grammar rules, Punjabi synonyms database, Punjabi to English database, Punjabi text to ISL SiGML database, and SiGML file player. The proposed system has the following architecture shown in diagram 1 and the following stages.
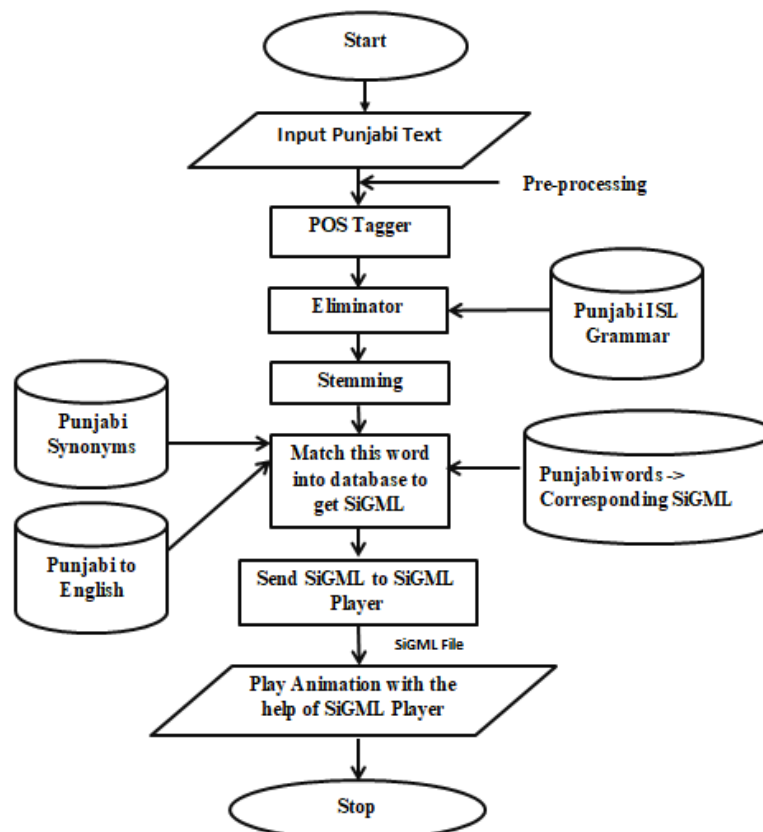
Fig. 1. The architecture of Punjabi Text to ISL Synthetic Animation System.

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In the Pre-processing stage, extra spaces are removed to clean the sentence. In the next stage Part of the Speech, the tagger system is used to assign a POS tag to every input word in a given sentence. In this translation system, an already available POS tagger for Punjabi will be used [39]. Many of the words are not required to be part of sign language, these unwanted words in ISL sentences are to be detected and eliminated by the eliminator. In the next stage stemming is done. Stemming is the process of producing morphological variants of a

root/base word. The output of the fourth stage works as an input in this stage. From the database, the SiGML file is taken corresponding to filtered Punjabi text. If the SiGML file corresponding to the Punjabi word is not available in the Bilingual dictionary then synonyms of the word will be taken from the synonyms database. Fingerspell is performed for the named entity. The result of this prototype system is validated by ISL experts. The figure 2 shows the output 3D animation view of the proposed system. The tool's Avatar is controlled by SiGML file input. A tool named JA SiGML URL App is built into the framework to show the sign animation.

Fig. 2. 3D output animation view.

Conclusion

This research paper describes a demonstration method for translating Punjabi text to sign language. This paper aims to highlight the importance of developing a standardized framework for sign language learners in Punjab. The method introduced in this paper can be used to standardize the usage of sign language in Punjab. This is conveniently portable to smartphones and laptops. Additionally, this method may be expanded to translate text from web pages to sign language. As one of the first attempts at converting Punjabi text to ISL, we hope that this study would spur more social and technical advancements, resulting in the implementation of a standardized framework for sign language learners.

References

[1] Ehnolgue,Lanuage."[Online].Available:https://www.ethnologue.com/subgroups/sign-language. [Accessed: 20- Jun-2018].

[2] R. San-Segundo *et al.*, "Speech to sign language translation system for Spanish," *Speech Commun.*, vol. 50, no. 11–12, pp. 1009–1020, 2008.

[3] S. O. Caballero-Morales and F. Trujillo-Romero, "3D Modeling of the Mexican Sign Language for a Speech-to-Sign Language System," *Comput. y Sist.*, vol. 17, no. 4, pp. 593–608, 2012.

[4] S. M. Halawani, D. Daman, S. Kari, and A. R. Ahmad, "An Avatar Based Translation System from Arabic Speech to Arabic Sign Language for Deaf People," *Int. J. Comput. Sci. Netw. Secur.*, vol. 13, no. 12, pp. 43–52, 2013.

[5] R. Elliott, J. R. W. Glauert, J. R. Kennaway, and I. Marshall, "The development of language processing support for the ViSiCAST project," in *Proceedings of the fourth international ACM conference on Assistive technologies - Assets '00*, 2000, pp. 101–108.

[6] P. Vijayalakshmi and M. Aarthi, "Sign language to speech conversion," in *Fifth International Conference on Recent Trends in Information Technology*, 2016, pp. 1–6.

[7] G. F. Simons and C. D. Fennig, Ethnologue: Languages of the world. Dallas, TX, USA: SIL, 2017.

[8] U. Zeeshan, ''Sign languages of the world,'' in Encyclopedia of Language and Linguistics. Amsterdam, The Netherlands: Elsevier, 2006, pp. 358–365. [Online]. Available: http://clok.uclan.ac.uk/9631/

[9] WHO (2018). Deafness and Hearing Loss. [Online]. Available: http://www.who.int/news-room/fact-sheets/detail/deafness-and-hearingloss

[10] G. F. Simons and C. D. Fennig, Ethnologue: Languages of the world. Dallas, TX, USA: SIL, 2017.

[11] T. Johnston, Sign Language: Morphology. Sydney, NSW, Australia: Elsevier, 2006. [Online]. Available: https://booksite.elsevier.com/samplechapters/9780080442990/Look_Inside/11~Article-Sign_Language-Morphology.pdf

[12] R. Mayberry, ''Learning sign language as a second language,'' in Encyclopedia of Language and Linguistics, K. Brown, Ed. Amsterdam, The Netherlands: Elsevier, 2006, pp. 6–739. [Online]. Available: https://philpapers.org/rec/MAYLSL

[13] J. P. Morford and J. MacFarlane, ''Frequency characteristics of american sign language,'' Sign Lang. Stud., vol. 3, no. 2, pp. 213–225, Jan. 2003.

[14] A. Schembri and T. A. Johnston, ''Sociolinguistic variation in the use of fingerspelling in australian sign language: A pilot study,'' Sign Lang. Stud., vol. 7, no. 3, pp. 319–347, Sep. 2007.

[15] ISLRTC. (2017). Islrtc-Prepared With A Directory of ISL Interpreters in India. [Online]. Available: http:// www.disabilityaffairs.gov.in/content/viewpage/islrtc-prepared-with-adirectory-of-isl-interpreters-in-india.php

[16] B. Price. (2017). Sign Language Costs 'Too High' for Some Families. [Online]. Available: http://www.bbc.co.uk/news/uk-wales-39270335

[17] H. Knoors and D. Hermans, ''Effective instruction for deaf and hard-of hearing students: Teaching strategies, school settings, and student characteristics,'' Oxford Handbook Deaf Studies, Lang. Educ., vol. 2, pp. 57–71, Aug. 2010.

[18] Brour, M., Benabbou, A.: Atlaslang mts 1: Arabic text language into arabic sign language machine translation system. Procedia Computer Science 148, 236–245 (2019). DOI 10.1016/j.procs.2019.01.066

[19] Piper, A.M., Hollan, J.: Supporting medical conversations between deaf and hearing individuals with tabletop displays. pp. 147–156 (2008). DOI 10.1145/1460563.1460587

[20] "State UT wise Persons with Disability," [Online]. Available: http://disabilityaffairs.gov.in/content/page/state-ut-wise-persons.php. [Accessed: 3-October-2019].

[21] Marilyn, D., (1997). Benedictine Roots in the Development of Deaf Education: Listening with the Heart. Praeger Publishers Inc.

[22] Elliott, R., Glauert, J. R. W., Kennaway, J. R., and Marshall, I., (2000). The development of language processing support for the ViSiCAST project, in Proceedings of the fourth international ACM conference on Assistive technologies - Assets '00, (pp. 101–108), ACM.

[23] Cox, S., Lincoln, M., Tryggvason, J., Nakisa, M., Wells, M., Tutt, M., and Abbott, S., (2002). TESSA, a system to aid communication with deaf people, in the fifth international ACM conference on Assistive technologies, (pp. 205–212), ACM.

[24] Wray, A., Cox, S., Lincoln, M., and Tryggvason, J., (2004). A formulaic approach to translation at the post office: Reading the signs, Language and Communication, 24(1), (pp. 59–75), Elsevier.

[25] Hanke, T., (2004). HamNoSys – Representing Sign Language Data in Language Resources and Language Processing Contexts, in LREC, 4, (pp. 1–6).

[26] Raghavan, R. J., Prasad, K. A., Muraleedharan, R., and Geetha, M., (2013). Animation system for Indian Sign Language communication using LOTS notation, in International Conference on Emerging Trends in Communication, Control, Signal Processing and Computing Applications, (pp. 1–7), IEEE.

[27] Kaur, R., and Kumar, P., (2014). HamNoSys Generation System for Sign Language, in International Conference on Advances in Computing, Communications and Informatics, (pp. 2727–2734), IEEE.

[28] Kaur, R., and Kumar, P., (2017). Sign language based SMS generator for hearing impaired people, in 2017 International Conference on Computational Intelligence in Data Science(ICCIDS), (pp. 1–5), IEEE.

[29] Shahriar, R., Zaman, A. G. M., Ahmed, T., Khan, S. M., and Maruf, H. M., (2017). A communication platform between bangla and sign language, in 5th IEEE Region 10 Humanitarian Technology Conference 2017, R10-HTC 2017, (pp. 1–4).

[30] Sugandhi, Kumar, P., and Kaur, S., (2018). Online Multilingual Dictionary Using Hamburg Notation for Avatar-Based Indian Sign Language Generation System, International Journal of Cognitive and Language Sciences, 12(8), (pp. 1116–1122).

[31] Kaur, S., and Singh, M., (2015). Indian Sign Language animation generation system, in 1st International Conference on Next Generation Computing Technologies, (pp. 909–914), IEEE.

[32] Verma, A., and Kaur, S., (2015). Indian Sign Language Automation Generation System for Gurmukhi Script, International Journal of Computer Science and Technology, 6(3), (pp. 117–121).

[33] Nair, M. S., Nimitha, A. P., and Idicula, S. M., (2016). Conversion of Malayalam text to Indian sign language using synthetic animation, in 2016 International Conference on Next Generation Intelligent Systems, ICNGIS 2016, (pp. 1–4), IEEE.

[34] Goyal, L., and Goyal, V., (2016). Development of Indian Sign Language Dictionary using Synthetic Animations, Indian Journal of Science and Technology, 9(32), (pp. 1–5).

[35] Arsan, T., and Ulgen, O., (2015). Sign Language Converter, International Journal of Computer Science & Engineering Survey, 6(4), (pp. 39–51).

[36] L. Goyal and V. Goyal, "Automatic Translation of English Text to Indian Sign Language Synthetic Animations," In 13th International Conference on Natural Language Processing, pp. 144-153, 2016.

[37] J. Joy, K. Balakrishnan, and M. Sreeraj, "SignQuiz: A quiz based tool for learning fingerspelled signs in Indian sign language using ASLR," Journal of IEEE Access, Vol. 7, pp. 28363–28371, 2019.

[38] Dhanjal, Amandeep & Singh, Williamjeet. (2018). An Automatic Conversion of Punjabi Text to Indian Sign Language. ICST Transactions on Scalable Information Systems. 7. 165279. 10.4108/eai.13-7-2018.165279.

[39] S. Mittal, N. Singh Sethi, and S. Kumar Sharma, "Part of Speech Tagging of Punjabi Language using N-Gram Model," International J. Computer Application, Vol. 100, Issue 19, pp. 19–23, 2016.