

Study of Hand Gesture Recognition System for Indian Sign Language - A Review

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Abstract: Sign Language is the primary means of communication for the hearing and speech impaired community. The problem arises when speech impaired or deaf people try to express themselves to others with the help of these sign language grammars. Whereas other people themselves are not aware of the sign language. Hence it is commonly seen that conversation of deaf and speech impaired people are limited to their family members only. Sign language interpretation system can be used to help the impaired communicate and interact with people without the disability. Gesture interpretation systems can be vision based or glove based hardware systems. Thus, this paper compares the vision based systems and the traditional hardware approach. It has been noticed that the traditional hardware approach has challenges over Vision based System. By efficient use of computer vision and pattern recognition, it is possible to implement it for communication purpose.

Keywords - Computer vision, Glove based hand gesture recognition system, Indian sign language, Sign Language, Vision based hand gesture recognition system.

I. Introduction

Speech and hearing impairment is a very common problem globally. Gestures are powerful means of communication among humans. Among different modality of the body, the hand gesture is the most simple and natural mode of communication. Sign language is represented basically by continuously varying different hand shapes and movements by a signer. It decodes and understands the information embedded in the hand shapes and converts them to meaningful words. Much attention has received by computerized hand gesture recognition from industry and academia in recent years, due to the growing popularity of smart devices such as smartphones and the development of human-computer interaction (HCI) technologies. By using the advances in computer technologies an intelligent system can be developed which can act as a translator which converts sign language to speech/text and vice-versa, making the communication between people with hearing impairment and normal people both effective and efficient.

Two methodologies[18] are widely used to interpret gestures for Human-Computer Interaction. Data Gloves: This method consists of sensors (mechanical or optical) which are attached to a glove that transducers' finger flexions into electrical signals to determine the hand posture. There are several drawbacks which make this technology not so popular. Firstly all interactions with the computer-controlled environment lose naturalness and easiness. Secondly, the user is forced to carry a load of cables, which are further connected to the computer. Lastly, it also requires calibration and setup procedures.

Vision Based: The Computer vision based techniques have the potential to provide more natural and non-contact solutions. Moreover, they are noninvasive and are completely based on the way human beings perceive information about their surroundings. It is noticed that it is difficult to design a vision based interface for generic usage. Although it is feasible to design such an interface for a controlled environment but has no lack of challenges including accuracy and processing speed.

Sign Language is not a Universal Language and hence its interpretation is a multidisciplinary research area involving pattern recognition, computer vision, natural language processing, and psychology. The purpose of this paper is to present a review of Traditional glove based and Vision based Indian Hand Gesture Recognition techniques for human-computer interaction, consolidating the various available approaches, pointing out their general advantages and disadvantages.

II. Existing System

2.1. Glove Based Recognition System

In the glove-based technique, the user is required to wear a glove or attach sensors to the fingers that collect raw data, which is then processed to determine the gesture. In the method mentioned in [3], 5 pressure sensors are used which measures the pressure between the knuckle and first joint of the finger. Another glove by

Abhishek, K. S., Qubeley and others in [4] uses capacitive touch sensors, which output binary on/off signal, which are triggered when they are brought within 1.6 mm of human skin. Heera, S. Y., Murthy, and others in [9] have developed a glove that will track three kinds of movements – Finger bends using flex sensors, Angular movement using the gyroscope, Orientation using the accelerometer, that overcomes the drawback of hand moment that persists among other glove based systems.

2.2. Vision Based Recognition System

Vision based gesture recognition technique overcomes the drawbacks of the glove based system. This approach does not require the user to wear gloves, sensors or wires. However, video camera(s) is used to capture the images of hands while they perform certain gestures, which are further processed and analyzed using computer vision techniques. This type of hand gesture recognition reduces the complexity, makes the process look natural and is very convenient for users. At present, it is the most popular approach to gesture recognition. However, there are still several challenges which are not yet addressed, for example, partial or full occlusion, background clutter, illumination change, etc. Hence the study of vision based system is the most essential and is needed for further use.

The earliest reported work on sign language recognition is available in [11] in which Starner and Pentland developed a glove-environment system capable of recognizing a subset of the American Sign Language (ASL). Sushmita Mitra and Tinku Acharya had provided a survey on gesture recognition, with particular emphasis on hand gestures and facial expressions [8]. Deng-Yuan Huang, Wu-Chih Hu, Sung-Hsiang Chang conducted a work [12] which explains the use of Gabor filters to acquire desirable hand gesture features. The principal components analysis (PCA) method is then used to reduce the dimensionality of the feature space.

The study presented by Sara Bilal, Rini Akmeliawati, Momoh Jimoh El Salami, Amir A. Shafie [13] aims to develop a system for automatic translation of static as well as dynamic gestures of Indian Sign Language. One prominent approach describes the vision based recognition technique [14] to achieve visual information in the form of the feature vector. A number of approaches have been proposed for curve modeling such as Fourier descriptors, chain codes, polygonal approximation, curvature primal sketch, medial axis transform, autoregressive models, moments, parametric algebraic curves, curvature invariant, stochastic transformation, implicit polynomial functions, bounded polynomials, B-Splines, reaction-diffusion etc. Fourier Descriptor (FD) is one of the well known, relatively simple methods of shape matching. In FD, the contour of the shape is transformed to the frequency domain to perform the comparison. It is noticed that FD method is immune to rotation or scaling of the shape and noise. However, FD is prone to the varying phase of frequency components [15]. There are several methods to extract the local information of the hand like using co-occurrence matrix as in [15], Hu Moments [16] method and Hog Descriptor method [17].

2.3. Color glove based

Wang, R. Y., & Popović, J. Have developed a Color glove in [5] which is a combination of both, the data glove based approach and the vision based approach. However, it is very much similar to the vision based system. With the help of colored gloves, the image preprocessing phase (i.e, segmentation, detection of hands and localization) can be greatly simplified. The disadvantages of the same are similar to that of the data glove based approaches: they are unnatural and not suitable for applications with multiple users due to hygiene issues.

But here the interpretation is successfully achieved only by wearing gloves with sensors, wires, and other electronic components. These gloves are not portable. The movement is limited only to fingers but there are some sign languages which include complete movement of hands, therefore this technique is not feasible. But the advantage of this approach is that it gives high accuracy and fast reaction. However, these techniques are not very natural and flexible, and the data gloves can be quite expensive.

2.4. COMPARISON TABLE

| Criterion | Glove based System | Vision based System |
|-----------------------|--------------------|---------------------|
| User co-operation | Yes | No |
| User intrusive | Yes | No |
| Precise | Yes | Yes |
| Flexible to configure | Yes | No |
| Flexible to use | No | Yes |
| Health issues | Maybe | No |

III. Conclusion

In this paper, a review of glove based and vision based hand gesture recognition methods has been presented for the use of interpretation of the Indian Sign Language Gestures. In the previous years, remarkable progress in the field of hand gesture recognition in terms of hardware and software has been made. There exists a new type of cameras gives us depth information which is now included in algorithms. Hence the analysis of

the detailed survey presented in the paper states the fact that the vision based gesture representations are more preferred than the glove based gesture representations in the hand gesture recognition systems. Though there are a vast amount of information and research publications available in both the techniques but due to the complexity of implementation of the glove based systems these representations are less preferred. Future research in the field of gesture recognition systems provides an opportunity for the researchers to come up with efficient systems overcoming issues faced in both the vision and glove based systems to recognize the hand sign language gesture. Solving these issues and building an optimum hand gesture interpretation system will be a great contribution to the Indian hearing impaired through working on Indian sign language so that they are able to play a useful role in the society in spite of the disability.

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