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## Continuous Indian Sign Language Gesture Recognition and Sentence Formation

Kumud Tripathi\*, Neha Baranwal and G. C. Nandi

*Robotics and Artificial Intelligence Lab, Indian Institute of Information Technology, Allahabad*

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### Abstract

Hand gestures are a strong medium of communication for hearing impaired society. It is helpful for establishing interaction between human and computer. In this paper we proposed a continuous Indian Sign Language (ISL) gesture recognition system where both the hands are used for performing any gesture. Recognizing a sign language gestures from continuous gestures is a very challenging research issue. We solved this problem using gradient based key frame extraction method. These key frames are helpful for splitting continuous sign language gestures into sequence of signs as well as for removing uninformative frames. After splitting of gestures each sign has been treated as an isolated gesture. Then features of pre-processed gestures are extracted using Orientation Histogram (OH) with Principal Component Analysis (PCA) is applied for reducing dimension of features obtained after OH. Experiments are performed on our own continuous ISL dataset which is created using canon EOS camera in Robotics and Artificial Intelligence laboratory (IIIT-A). Probes are tested using various types of classifiers like Euclidean distance, Correlation, Manhattan distance, city block distance etc. Comparative analysis of our proposed scheme is performed with various types of distance classifiers. From this analysis we found that the results obtained from Correlation and Euclidean distance gives better accuracy then other classifiers.

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**Keywords:** Correlation; Indian sign language (ISL); Orientation histogram; Principal component analysis; Gesture Recognition.

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### 1. Introduction

Motion<sup>1</sup> of any body part like face, hand is a form of gesture. Here for gesture recognition I'am using image processing and computer vision. Gesture recognition<sup>2</sup> enables computer to understand human actions and also acts as an interpreter between computer and human. This could provide potential to human to interact naturally with the computers without any physical contact of the mechanical devices. Gestures are performed by deaf and dumb community to perform sign language. This community used sign language<sup>3</sup> for their communication when broadcasting audio is impossible, or typing and writing is difficult, but there is the vision possibility. At that time sign language is the only way for exchanging information between people. Normally sign language is used by everyone when they do not want to speak, but this is the only way of communication for deaf and dumb community. Sign language is also serving the same meaning as spoken language does. This is used by deaf and dumb community all over the world but in their regional form like ISL, ASL. Sign language can be performed by using Hand gesture<sup>4</sup> either by one hand or two hands. It is of two type Isolated sign language and continuous sign language. Isolated

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\*Corresponding author.

E-mail address: [kumudtripathi.cs@gmail.com](mailto:kumudtripathi.cs@gmail.com)

sign language consists of single gesture having single word while continuous ISL or Continuous Sign language is a sequence of gestures that generate a meaningful sentence. In this paper we performed continuous ISL gesture recognition technique for Indian people. Continuous ISL gestures are mostly made up of two handed and also it is a combination of dynamic<sup>5</sup> as well as static gestures. Therefore it is very difficult to recognize in real word environment.

In continuous SL gesture recognition<sup>6</sup> system preprocessing, key frame extraction<sup>7</sup>, and feature extraction are the major issues which have been solved in this paper. Here we proposed a framework which is flexible towards orientation, size and scaling. In continuous ISL gestures, key frames are extracted using gradient method in which we have measured change in  $x$  direction as well as in  $y$  direction. With the help of key frames each sentence is divided into sequence of words (Isolated gestures). Features of each isolated gestures are extracted using orientation histogram method. After wards, it has been recognized using various distance based classifier. Finally sign language are combined and translated into audio or text format, so that communication will improve between normal people and hearing impaired community. Almost all gesture has already assigned meaning and grammar is used to create a meaningful sentence from set of recognized gestures.

Organization of paper as follows: section 1 tell us about the introduction of gestures, continuous gestures. In second section we explains about analysis of previous research where we explains what are the works already done and what are the drawbacks. Proposed methodology is explained in 3rd section. In 4th section we give experimental results and what are the findings from those experimental results. Section 5 incorporates conclusion and future work of the paper. End of the paper includes acknowledgement and references.

## 2. Analysis of Previous Research

There are many sign language recognition<sup>8</sup> technique have already been developed and get prominent results but still it's a challenging research field for the researcher. Most of the work is done for isolated sign language recognition. Very few literature is available in the area of Continuous sign language recognition because of its complex nature.

Ankita Saxena<sup>9</sup> *et al.* proposed a fast and efficient technique that is principal component analysis for sign gesture. Here they take 3 frames per second from video and analyses them for static gesture. Overall accuracy of this system is 90%. But this system is highly dependent on background and lighting condition. The author Jung-Bae Kim<sup>10</sup> *et al.* proposed a system that uses Fuzzy Logic and Hidden Markov Model for Korean Sign Language recognition. Using these methods, they Obtain 94% accuracy for 15 KSL sentences. They have rejected meaning less gesture motions such as preparatory motion and useless movement between sign words, using fuzzy partitioning and state automata. They concentrate on two features like speed and velocity for motion of hand. They do sentence based recognition so no need to pause between sign words. This system have high computational burden. Rung-Huei Liang<sup>11</sup> proposed a Data Glove<sup>12</sup> based continuous gesture recognition on real time. For this they are created a large vocabulary Taiwanese sign language interpreter. They solved the problem of key frame extraction using time-varying parameter detection. They detected the discontinuities in frames. They do statistical analysis by four features position, posture, orientation, and motion. For gesture recognition they have used Hidden Markov Model. Average accuracy rate of this system is 80.4%. But limitation of this system is this is person dependent and using gloves which is very expensive and need physical connection between user and computer. To remove few such drawbacks like person dependency, scale, orientation, position dependency we proposed an orientation histogram based framework for continuous ISL gesture recognition.

In this work we present a vision based recognition system with only one camera. Our focus is to solve major problems like key frame extraction, orientation dependency, real time processing. For solving major problem of key frame extraction we used gradient method, in which we see the change of orientation of hand in frames. Because sentence is a collection of meaningful and useless gesture, so need to extract useful gesture by this we reduce computational time and also create database for each gesture separately. This makes my system more flexible by recognizing any new sentence whose gestures are already in database.

## 3. Proposed Methodology

This paper focuses on the proposed continuous ISL gesture recognition system. Dataset consisting of a collection of signs where single hand or both the hands has been used for performing continuous ISL gestures. Ten sentences

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