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COHST and Wavelet Features Based Static ASL Numbers Recognition

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Abstract

Bridging communication gap between the deaf and dumb people with the common man is a big challenge. A sign language recognition system could provide an opportunity for the deaf and dumb to communicate with non-signing people without the need for an interpreter. Research in the area of Sign language recognition has become very significant due to various challenges faced while capturing of the sign. Not a single efficient methodology or algorithm is developed which overcomes all the difficulties and recognizes all the signs with cent percent accuracy. This paper proposes two new feature extraction techniques of Combined Orientation Histogram and Statistical (COHST) Features and Wavelet Features for recognition of static signs of numbers 0 to 9, of American Sign Language (ASL). The system performance is measured by extracting four different features of Orientation Histogram, Statistical Measures, COHST Features and Wavelet Features for training and recognition of ASL numbers individually using neural network. It is observed that COHST method forms a strong feature than the individual Orientation Histogram and Statistical Features giving higher average recognition rate. Of all the System designed for static ASL numbers recognition, Wavelet features based system gives the best performance with maximum average recognition rate of 98.17%.

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Keywords: American Sign Language numbers; Gesture Recognition; Neural Network; Orientation Histogram; Statistical Features; Combined Orientation Histogram and Statistical (COHST) Features; Wavelet Features.

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1. Introduction

Computer is used by many people either at their work or in their spare-time. Special input and output devices have been designed over the years with the purpose of easing the communication between computers and humans, the two most known are the keyboard and mouse [1]. Every new device can be seen as an attempt to make the computer more intelligent and making humans able to perform more complicated communication with the computer. This has been possible due to the result oriented efforts made by computer professionals for creating successful human computer interfaces (HCI). Gestures play an important role as input to HCI. Gestures are the non-verbally exchanged information. A person can perform number of gestures at a time. Gesture recognition has significant application in sign language recognition. Sign language allows the deaf and dumb to communicate with each other and the world they live in. The literature reports the sign language recognition using methods of orientation histogram use of artificial intelligence, Generic Fourier Descriptor, local linear embedding, Neural Network shape fitting, object based key frame selection, Haar wavelet representations, Open-finger Distance Feature Measurement Technique, etc. As stated many people have tried to design an efficient and optimum sign language recognition system for various sign languages to detect signs of alphabets, numbers, words, sentences, etc. But still they are not able to come up with a method which is able to recognize the signs cent per cent. This paper deals with two feature extraction techniques implemented for American Sign Language (ASL) numbers recognition and their comparison with respect to average recognition rate. Fig. 1 shows the different static gestures in an ASL for numbers 0 to 9.

Fig. 1 American Sign Language Numbers

2. Related Work

In sign language recognition, shape representation techniques that will sufficiently describe the shape of the hand are used which also have fast computations speed to benefit in real-time recognition. These techniques should also provide translational, rotational, and scaling invariance to make system robust.

Myron W. Krueger first proposed gesture recognition as a new mode of HCI in the middle of seventies [2]. Currently, there are various techniques that are used for hand gesture recognition. Initially glove based recognition was widely used. Zimmerman [3] developed a VPL data glove which was connected to the computer to recognize signs. The glove based recognition mostly dealt with measurement of the bending of fingers, the position and orientation of the hand in 3-D space, etc. In vision-based gesture recognition, in dynamic environment hand-shape segmentation is one of the big problem. It is simplified by using visual markings on the hands. Also the colour markings on the gloves captured by the cameras are also used for sign language recognition. Some researchers have implemented sign language and pointing gesture recognition based on different marking modes [4]. The review of the work carried out in last twenty years are presented by Arpita Ray Sarkar et al. [5] along with brief comparison to analyze the difficulties encountered by these systems, as well as the limitation. Key issues of hand gesture recognition system and their challenges are discussed by Rafiqul Zaman Khan [6]. Also a review on various recent methods of gestures recognition system are presented and compared based on research results obtained and database used along with their advantages and disadvantages. A. Karami et al. [7] presented a system using Wavelet transform and neural networks (NN) for recognizing static gestures of alphabets in Persian sign language (PSL). It is able to recognize selected 32 PSL alphabets with an average recognition rate of 94.06%. Alaa Barkoky [8] proposed a thinning method to recognize the images of numbers in Persian sign language (PSL). In this the thinned image is used to get the real endpoints which have been used for recognition. The method proved good for realtime recognition and was independent of hand rotation and scaling. For 300 images it gave average recognition rate of