HAND GESTURE RECOGNITION SYSTEM FOR DISABLED PEOPLE USING ARDUINO

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ABSTRACT

One of the important problems that our society facing is people with disabilities which are finding hard to cope up with the fast growing technology. About nine billion people in the world are deaf and dumb. Communications between deaf-dumb and a normal person have always been a challenging task. Generally deaf and dumb people use sign language for communication, Sign language is an expressive and natural way for communication between normal and dumb people. Some peoples are easily able to get the information from their motions. The remaining is not able to understand their way of conveying the message. In order to overcome the complexity, the artificial mouth is introduced for the dumb people. So, we need a translator to understand what they speak and communicate with us. Hence makes the communication between normal person and disabled people easier. This work aims to lower the barrier of disabled persons in communication. The main aim of this proposed work is to develop a cost effective system which can give voice to voiceless people with the help of Sign language. In the proposed work, the captured images are processed through MATLAB in PC and converted into speech through speaker and text in LCD by interfacing with Arduino.

Keyword : - *Disabled people, Sign language, Image Processing, Arduino, LCD display, Speaker.*

1. INTRODUCTION

One of the most precious gifts to a human being is an ability to see, listen, speak and respond according to the situations. But there are some unfortunate ones who are deprived of this. Humans know each other by conveying their ideas, thoughts, and experiences to the people around them. There are numerous ways to achieve this and the best one among the rest is the gift of "Speech". Through speech everyone can very convincingly transfer their thoughts and understand each other. It will be injustice if we ignore those who are deprived of this invaluable gift, the deaf and dumb people. Communication is the best media used by the people to communicate with each other. The problem arises when normal people and deaf-dumb people want to communicate with each other [15]. It actually becomes the same problem of two persons which knows two different language, no one of them knows any common language, so it becomes a problem to talk with each other and so they requires a translator physically which may not be always convenient to arrange and this same kind of problem occurs in between the Normal Person and the Deaf person or the Normal Person and the Dumb person.

To overcome this problem, we introduce a unique application. Our application model is a desirable Interpreter which translates. Natural English Sentences as, an text input by Normal Person for Deaf Person and Sign Language, in form of Gesture by a Dumb Person to Synthesize English Words which have a corresponding meaning in Sign Language which interprets a particular thing, as an Audio Output for Normal Person. This will help Normal and Deaf and dumb communities by removing the communication gap between them [4]. The big reason behind this is lack of communication, as deaf people are unable to listen and dumb people are unable to speak. The communication between a dumb and hearing person poses to be an important disadvantage compared to communication between blind and ancient visual people. The blind people can speak freely by implies that of ancient language whereas the dumb have their own manual visual language is referred as sign language. The only

means of communication available to the deaf and dumb people is the use of Sign Language [5]. Limitation prevents them from interacting with the outer world to share their feelings, creative ideas and Potentials.

2. BACKGROUND

Shraddha R. Ghorpade et.al [15], reviewed various methods and techniques which are provided by different authors for recognition of hand gestures. Hand gesture recognition provides an intelligent and natural way of human computer interaction (HCI). Human computer Interaction (HCI) is a branch of artificial intelligence, it is a scientific discipline that is concerned with the development of algorithms that take as input empirical data from sensors or databases, and yield patterns or predictions thought to be features of the underlying mechanism that generated the data. Hand gesture is one of the most expressive and most frequently used among a variety of gestures. Applications of hand gesture recognition are varied from sign language to virtual reality. Thus, we propose a new technique called artificial speaking mouth for dumb people which will be very useful to them for conveying their views to others. Mute people can use fingers to perform hand gesture and it will be converted into speech so that normal people can understand their expression. Pallavi Verma et.al, [10] describes about a hand gesture based device for deaf and dumb person as communication for a person, who cannot hear is visual, not auditory. There is a barrier in communication between these two communities. This work aims to lower this barrier in communication. The main aim of the proposed project is to develop a cost effective system which can give voice to voiceless people with the help of Smart Gloves. With the proposed work sign language is converted into text and speech using flex sensor and microcontroller. It means that using smart gloves communication will not be a barrier between two different communities**.**

Gowri.D and Vidhubala .D [5] have proposed a work to produce an algorithm for recognition of hand gestures with accuracy. This project has a hand gloves model for gesture recognition. MEMS sensor is used to detecting the hand motions based on the stress. This project is used for the deaf and dumb people to communicate with normal people. The hand motions are detected by the MEMS sensor and the values are stored on the microcontroller memory unit. The output voices are previously stored on the voice processor unit. Depends on the hand motions the output will be displayed on the LCD and also played through the speaker. R.Pradipa and Ms S.Kavitha [12] proposed a discussion of various techniques, methods and algorithms related to the gesture recognition. The hand gesture is the most easy and natural way of communication. Hand gesture recognition has the various advantages of able to communicate with the Technology through basic sign language. The gesture will able to reduce the use of most prominent hardware devices which are used to control the activities of computer. The Segmentation is the process of finding a connected region within the image with a specific property such as colour or intensity, or a relationship between pixels, that is, a pattern and the algorithms should be adaptable. There are few Segmentation algorithms such as Anticipated Static Gesture Set, Hand Segmentation Using HSV Colour Space and Sampled Storage Approach, Hand Tracking and Segmentation (HTS) Algorithm provide the segmentation of given input to be sent for recognition without any noise. The Hand gesture recognition models such as Hidden Markov model(HMM), YUV colour space model, 3D model and Appearance model will detect the input and process them for recognition. Ms. Rashmi R Gundaet.al [14] have proposed the project about design and development of a user friendly technology to communicate between the deaf as well as dumb person and a blind person .In this project image processing is used to recognize gesture, comparing that with stored database, recognizing correct expression using MATLAB and displaying output in the form of voice through voice processor. And on other side speech of blind person is transmitted to pc through mike. Speech signal is processed through MATLAB present in the pc and displaying as text through LCD by interfacing with micro controller. Pooja Dongare et.al, [11] proposed a project that aims to lower the communication gap between the deaf or mute community and the normal world. This project was meant to be a prototype to check the feasibility of recognizing sign language using sensor gloves. With this project the deaf or mute people can use the gloves to perform sign language and it will be converted into speech so that normal people can easily understand. The main feature of this project is that the gesture recognizer is a standalone system, which is applicable in daily life.

3. PROPOSED METHOD

This paper describes the system for disabled people which will be very useful to them for conveying their views to others. The main approach is processing and classifying hand gestures in the Vision based techniques. The proposed system Fig-1 consists of mainly four processes i.e. Image acquisition, Image pre-processing, Feature extraction and Image classification. The initial stage of the proposed work is image acquisition. In image acquisition, the images are captured by using camera for testing and training. The next step is pre-processing, where the original image is converted into gray image and the noise is filtered from the original image, it involves Wiener filter.

The essential step is feature extraction where the Histogram of Oriented Gradients is applied. Then the identification of sign language takes place in the classification stage using Maximum Euclidean distance technique. After classification, the testing gesture image is converted into text in LCD display and speech in speaker by interfacing PC and arduino through serial port as shown in Fig -2.

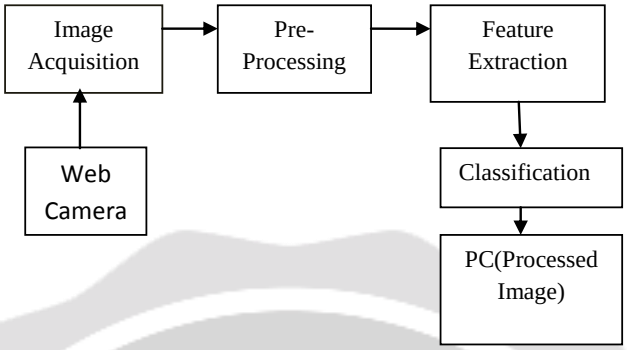


Fig-1: Processing system

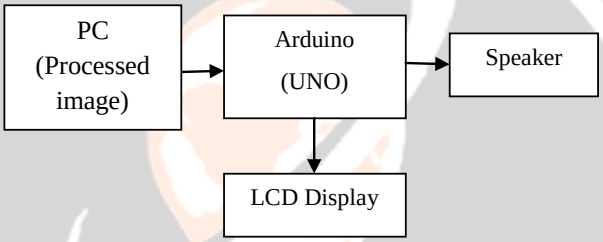


Fig-2: Proposed system

3.1 Image Acquisition

Image acquisition is the process to capture the hand gesture images which represents different signs. The resolution of various images captured by the camera may not be the same and it results in different resolution. For accurate comparison of the features and to reduce the errors present in the images, all the images should be scaled to a uniform size. Here 36 hand gesture images were considered with numeric (0-9) and alphabets (A-Z) as shown in Fig-3. Thus the images for training and testing are captured in a white background with camera and database is created [6]. The system works offline recognition i.e. gives a test image as input to the system and system tells which sign is recognized.

Fig-3: Hand Gesture Images

3.2 Pre-processing

Image processing is processing of images using mathematical operations by using any form of signal processing for which the input is an image, a series of images, or a video, such as a photograph or video frame, the output of image processing may be either an image or a set of characteristics. Pre-processing is a common name for operations with images at the lowest level of abstraction both input and output are intensity images. The aim of pre-processing is to improve the image quality to make it ready for further processing by removing or reducing the unrelated and surplus parts in the background of the images. It aims to correct some degradation in the image. A Pre-processing is very much required stage for reducing the computational noise using filters. The Pre-processing is applied to images before we can extract the features from images [1]. The main aim of pre-processing is an improvement of the image data that suppresses undesired distortions or enhances some image features relevant for further processing and analysis task. In the pre-processing technique, the images are converted into gray image and the noise is reduced by the filter called Wiener filter.

3.2.1 Gray Image Conversion

A gray scale or greyscale image is one in which the value of each pixel is a single sample representing only an amount of light, that is, it carries only intensity information. The luminance of a pixel value of a gray scale image ranges from 0 to 255 [10]. The conversion of a colour image into a gray scale image is converting the RGB values (24 bit) into gray scale values (8 bit). Various image processing techniques and software applications converts colour image to gray scale image. Conversion of colour image to gray scale image is one of the image processing applications used in different fields effectively.

3.3.2 Wiener Filter

The Wiener filter can be used to filter out the noise from the corrupted image to provide an estimate of the underlying image of interest. The Wiener filter is based on a statistical approach. This Wiener filter aims to describe the process of recovering an image, degraded through some digital acquisition process [12]. Wiener Filter works in frequency domain trying to minimize the noise impact when the image is deconvolved. As we will describe, the image may not be completely recovered, but the Wiener Filter give use a good approximation. From image components, a set of properties are used to manipulate the process of image sampling to obtain an equation which models the degradation treated by the filter.

3.4 Feature Extraction

Feature Extraction is the important tool which can be used to analyze and explore the image properly. In machine learning, pattern recognition and in image processing, feature extraction starts from an initial set of measured data and builds derived values (features) intended to be informative and non-redundant, facilitating the subsequent learning and generalization steps, and in some cases leading to better human interpretations. Feature extraction is related to dimensionality reduction. The Perfect Features Extraction plays an important role in a recognition process. There are many interesting points on every object which can be extracted to provide a "feature" description of the object. Features vector of the image can be extracted in different ways according to particular application [13]. The nature of the background, existence of other objects (occlusion), and illumination must be considered to determine what kind of features can be efficiently and reliably detected.

Feature extraction is a method of reducing data dimensionality by encoding related information in a compressed representation and removing less discriminative data. The selection of which features to deal with and the extraction method are probably the most significant design decisions in hand motion and gesture recognition development. Histogram of Oriented Gradients (HOG) is one of the methods used for extracting the features. For hand gestures recognition, HOG method is used to detect the magnitude and directions of the images.

3.4.1 Histogram of Oriented Gradients (HOG)

The histogram of oriented gradients (HOG) is a feature descriptor used in computer vision and image processing for the purpose of object detection. The technique counts occurrences of gradient orientation in localized portions of an image. The HOG descriptor has a few key advantages over other descriptors [20]. Since it operates on local cells, it is invariant to geometric and photometric transformations, except for object orientation. HOG is an edge orientation histograms based on the orientation of the gradient in localized region that is called cells. Therefore, it is easy to express the rough shape of the object and is robust to variations in geometry and illumination changes.

3.5 Classification

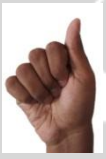
Image classification analyzes the numerical properties of various image features and organizes data into categories. Classification algorithms typically employ two phases of processing: training and testing.[20]. In the initial training phase, characteristic properties of typical image features are isolated and based on these a unique description of each classification category (i.e. training class) is created. In the subsequent testing phase, these feature-space partitions are used to classify image features. Image classification is assigning the pixels in the image to categories or classes of interest. It is a process of mapping numbers to symbols. In this process, Minimum Euclidean Distance is used to determine the minimum distance between trained images and a real time image to identify the unknown image data.

3.5.1 Minimum Euclidean Distance

The minimum distance classifier is used to classify unknown image data to classes which minimize the distance between the image data and the class in multi-feature space. The distance is defined as an index of similarity so that the minimum distance is identical to the maximum similarity. In mathematics, the Euclidean distance or Euclidean metric is the "ordinary" straight-line distance between two points in Euclidean space. With this distance, Euclidean space becomes a metric space. The associated norm is called the Euclidean norm [22].

4. RESULTS AND DISCUSSION

Table-1: Output of Hand gesture sign system

Captured Images		**Gesture recognition output**	
Trained Image	**Testing Image**	**LCD display**	**Audio Output**
		**A**	
		**S**	
		**1**	
		**5**	

The images are captured through web camera and they are preprocessed to filter out the noises and obtained filter image is undergone feature extraction. The testing image is compared with the trained images in classification stage through Euclidian minimum distance method and then PC is interfaced with arduino through serial port and shows the output as in Fig-4. The output is displayed as text in the LCD display and voice in the speaker as shown in Table-1.

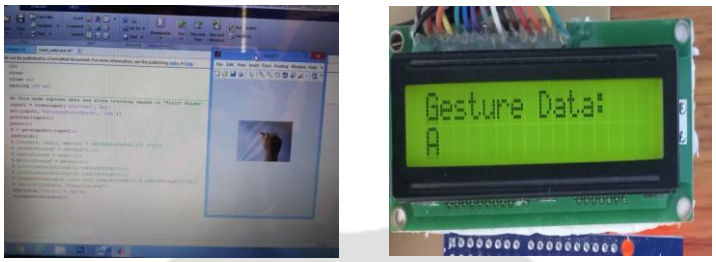


Fig-4: Output of Hand Gesture in LCD display

5. CONCLUSION

Sign language is the medium for deaf and dumb people to share their feelings or thoughts with others. But their communication is restricted to other disabled persons as normal who cannot understand what they wants to say.The vision-based solutions can overcome some of their difficulties and disadvantages, they appear to be the best choice for raw data collection. Here, designed a system for the purpose of recognition of numbers and alphabets in the Sign Language. This system converts the sign language into voice and displayed on LCD which is easily understandable by disabled and normal people. Also it provides a cheap, portable and efficient solution.

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