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Hand Gesture Recognition

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Abstract— **The most important methodology used for communication between hearing and speech impaired person is the sign language. So, it becomes a necessary task to create a bridge between the two persons who wants to communicate. Many algorithms have been developed in the recent years, to help people who are not aware of the sign language but very few with good results exist. The difficult part in the hand gesture recognition is the segmentation of the hand or segregation of the hand and identifying the hand gesture. This paper describes the some possible ways of segmentation using RGB color spaces and models and presents the best algorithm with highest accuracy to perform the same. Various experiments were conducted for different gestures and results were obtained with accuracy. The algorithms were implemented in MATLAB programming language.**

Keywords- **Sign Language, RGB color space, Hand gesture recognition, Image enhancement, Image processing.**

INTRODUCTION

Sign language is a means of communication for people who are hearing and speech impaired. That mode of communication involves simultaneous use of facial expressions, orientation and movement of hand, finger spellings, body language, head movements and eye- gazes in order to effectively convey the messages and thoughts of the speaker effectively.

One of the most precious gifts of nature to the human kind is the ability to express him by responding to the events occurring in his surroundings. Through speech everyone can very convincingly transfer their thoughts and understand each other. But there are some less fortunate ones who are deprived of this valuable gift of speech. It will be injustice if we ignore those who are deprived of this invaluable gift. Such people, mainly the deaf and the dumb, rely on sign language for communicating their feelings to others. Gestures are considered as the most natural expressive way for communications between human and computers in virtual system. Communications between dumb and a normal person have always been a challenging task.

Dumb people need to communicate with normal people for their daily routine. Hence, we have to think of different ways by which a dumb person can communicate with a normal person. Bobick and Wilson have defined gestures as the motion of the body that is intended to communicate with other agents. For a successful communication to take place, the sender and receiver must have the same set of information for a particular gesture. Hand gestures which can represent ideas using unique shapes and finger orientation have a scope for human machine interaction.

Here we are introducing new system for the effective communication between dumb and a normal person. This system consists of a basic web camera which points to the signer, MATLAB - which performs the image processing operations and an audio speaker or a display to convey the message shown by the signer. Here a colored glove is used by signer. The gloves will have red, blue, green color pattern on each finger. The intensity of the color changes with gestures. The gestures are captured by a camera. The intensity changes of the colors are detected. The gestures are detected with image processing using MATLAB. The accuracy of this system depends on the surrounding light intensity. Also user should wear a colored glove to use the system which makes it inconvenient. This system uses the skin color and outline identification for the gesture recognition.

EXISTING METHODOLOGIES

In this section we will explore the recent advances in the field of sign language recognition and hand gesture recognition. The major existing system which aid in the communication of a dumb person is the flux sensor. The flux sensor consists of a metal strip attached to the fingers which senses the orientation of the fingers. As the fingers are moved, the resistance of these metal strip changes

accordingly. An example of flux sensor is shown in "fig 1".

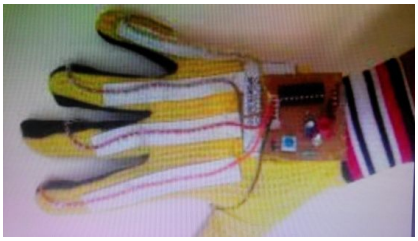

Fig 1: Flux sensor

Thus the gestures are found with corresponding resistance values. The flux sensors are attached to the gloves and wires are drawn from flux sensor through these gloves. This makes the system bulkier and less convenient. The resistance of the metal strip may change after the long use. This may adversely affect the accuracy of the flux sensors. The resistance shown by the metal strip for the same orientation of the fingers may be different with time. So it is also less accurate.

SETUP

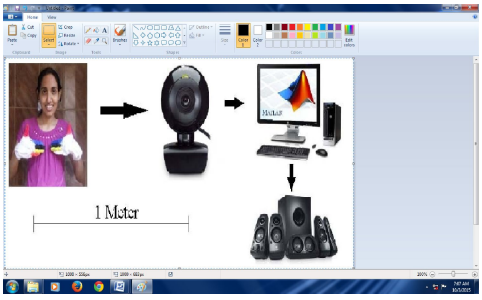

Fig 2: Setup

The main objective of the project is to make the communication between a normal person and a dumb person easy. An emerging technology of image processing is used for that. The system shown above ("fig 2") is designed with a minimized cost and higher accuracy. The project uses a webcam for capturing the gestures shown by a dumb person. The orientations of the fingers of the hand are identified by extracting the RGB color space values of the glove worn by the person in the captured image. These values are then compared with the original values of the hand gestures that are stored in the database of the device. When match is found the sound file or voice note corresponding to the gesture, in the database is given out through a connected speaker. The sound file send from the database convey the meaning of the gesture.

The matrices of the gesture captured (the gestures captured are converted into matrix format) are compared with matrices in the database by correlation operation. The image processing consists of mainly two steps, training and testing. The training step deals with database creation. The image of the gesture captured is pre-processed by changing the brightness, contrast, sharpness etc. After that, feature is extracted from the image. Here the feature extracted is RGB color space values of the glove worn in the image. The image in the matrix format is loaded to the database. Then training and testing are carried out as in "fig 3".

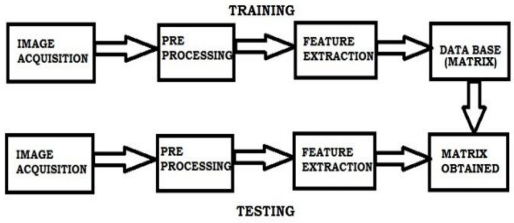

Fig 3: Testing and Training

Likewise all the gestures are loaded to the database. Testing step also has the steps like image acquisition, pre-processing, feature extraction. After the feature is extracted, the matrix obtained is compared with that in the database using correlation operation. The technology used here is much more complicated than the existing, but it can ensure more accuracy than the others.

HAND GESTURE

Gestures can originate from any bodily motion or state but commonly originate from the face or hand. Current focuses in the field include emotion recognition from the face and hand gesture recognition. Different approaches are carried out using cameras and computer algorithms to interpret sign language. Gesture recognition can be seen as a way for computers to begin to understand human body language, thus building a richer bridge between the machines and humans. Sign language is the most important methodology using which hearing and speech impaired people can communicate with rest of the world. Different gestures used by dumb people are shown in "fig 4".

Fig 4: Different gestures used.

IMAGE CAPTURING

The image acquisition is the basic process in the project. An integrated or external web camera is used to capture the hand gestures. These images are

used in the further processes in the system. The image is captured using the image processing toolbox in the MATLAB. Before starting the programming, we should get the information about the camera that is connected to the computer. For that 'imaqhwinfo' (image acquisition hardware information) command is used. Each adapter may have several devices connected to it. So to correctly detect the camera we should get the id of the device. For that type command 'imaqhwinfo('winvideo')' in the command window of MATLAB. The frames per trigger and frame grab intervals are specified in the program. When the specified frame is acquired the image is captured with webcam. The software code and supporting tools used are based on the leading software in the field, MATLAB and the Image Processing Toolbox from The MathWorks. MATLAB is a high-performance language for technical computing which is very popularly used nowadays. It integrates computation, visualization and programming in an easy-to-use environment where problems and solutions can be easily expressed in mathematical notations. The basic commands used are given in "table 1".

TABLE 1: The Basic Commands Used

COMMANDS	FUNTIONS
Imread	To read an image
Imshow	To display an image
Imaqreset	To reset the camera
rgb2gray	To convert a colour image to gray scale image
gray2rgb	To convert a gray scale image to colour image

Another frequently used approach is based on skin color segmentation using different color spaces but it can be ineffective in discarding similar skin color objects. The skin color segmentation becomes difficult and the output would not be accurate because it is difficult to identify the borders of the hand and the hand orientation. Also, while segregating the hand gesture it become difficult to get the exact hand outline. Hence, we opt for hand gesture recognition using colored gloves.

SEPARATION OF COLORS

Initially, the image of the hand gesture is captured using the webcam and provide it to the matlab software. The images obtained from the camera are obtained in the RGB color space. It extracts the RGB color space values in the captured image. The image in the matrix format is loaded to the database. Likewise all the gestures are loaded to the database. Then it is compared with the original values of the hand gestures that are stored in the database of the device. Initially, the all the color components are separated from the image. Then, each color component is converted into its gray scale image. The gray scale image is finally converted into black and white image for further processing.

Using im(:,:,1) only separate the red channel from the image. It is shown in "fig 5".

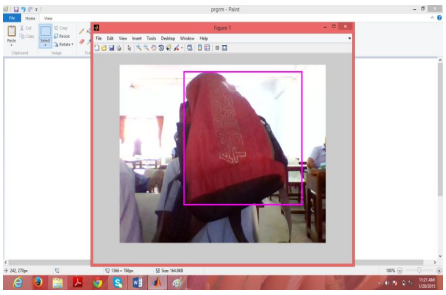

Fig 5 :Extraction of red color

Extraction of blue image

r=im(:,:,2),It extracts the blue color from the image. It is shown in "fig 6"

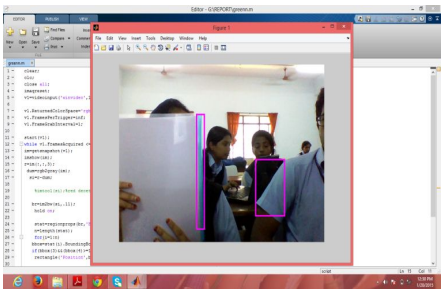

Fig 6 :Extraction of blue color

Once the different color components are detected, each color space will be converted into their respective gray scale image.

r=im(:,:,3), Extracts the grey color from the image. The next process would be the conversion to gray scale image and then extracting the image properties. This process is shown in "fig 7".

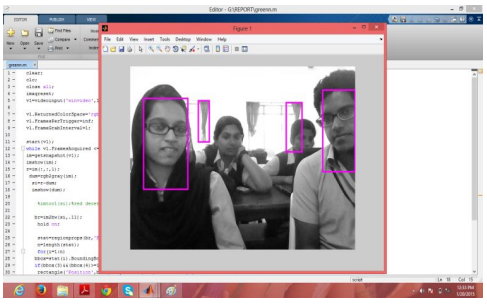

Fig 7 :Conversion to gray scale image

TRAINING AND TESTING

Here, we are training and creating the database required. A white woolen gloves with different color fingers are used. Based on the intensity of the

colors, the system can predict the hand gesture based on the database created. Once a match occurs, the output will be displayed. The database is created in such a way that each hand gesture corresponds to a specific intensity of colors in the RGB color space. This system can be extended to different hand gestures based on the intensity of colors in the RGB color space. The output can also be given to a speaker.

The testing process is the final stage where we show the hand gesture in front of the webcam and the gesture would be identified based on the intensity of colors in the RGB color space. Hand gesture recognition is shown in "fig 8".

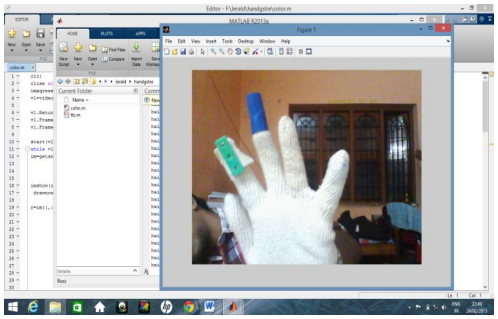

Fig 8 :Hand gesture recognition

CONCLUSION

Communication with a normal person is always a challenging task for a dumb person. In this paper, a hand gesture recognition system is introduced which is an effective communication aid for a dumb person. The system uses the advanced technologies like Image processing to ensure maximum accuracy. Also it is convenient when compared to existing systems.

Capturing the hand without the glove results in inaccurate outputs. Data base creation and testing using a GUI makes the system more user friendly. The database can be expanded with more number of hand gestures and its different possibilities to improve the performance of the system. The GUI created gives a platform for the user to carry out the hand gesture recognition.

APPLICATIONS AND FUTURE SCOPE

The proposed system has a wide variety of applications and can be modified or extended for the future use. The primary application of the system is to help the dumb person in communication with a normal person. The other applications and future scope includes

1. The hand gesture recognition technology can be utilized to control the robotic arms and similar machines.
2. The hand gesture technology can be implemented security systems. A particular set of hand gestures can be used to open the lockers or safes.
3. The dumb aid phone can be installed in offices and other public spots. A normal person can also use the system as a normal telephone.
4. The system can be extended to aid deaf in communication. By using the voice to text conversion a deaf and dumb person can easily communicate with normal person.

The technology can be easily implemented on modern smart phones with front facing camera. The application for the system can be developed on both android and ios platforms.

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