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Hand Gesture Recognition and Speech Conversion for Deaf and Dumb using Feature Extraction

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ABSTRACT*:* A dumb person always uses gestures to convey his ideas to others. But it is always difficult for a normal person to understand this gesture language. Dumb aid phone is a device which converts these gestures into speech sounds that convey the meaning of the gesture. The system uses the image processing technology and neural networking for the capturing and conversion of gestures. The system has a web camera to capture the hand gestures shown by the user. These gestures are matched with that in the database to generate the corresponding speech sounds. The system is also in cooperated with a GSM module to establish an effective communication.

KEYWORDS: Gesture recognition, Neural network, AT commands.

I.INTRODUCTION

The human beings are blessed with ability to express his emotions and feelings through words and sounds. A normal person sees, listen and react to the situations by speaking himself out. But we have some less fortunate humans living with us, who are deprived of this valuable gift. Such people generally called as dumb, uses gestures as their language of communication. Gestures may be defined as the motion of the body that is intended to communicate with other agents. But for an effective communication to be established the person interacting with dumb should know the gesture language. In this scenario the dumb aid phone may help us. It is a device that converts the gestures into sounds that corresponds their meaning, which establishes a perfect communication link between a normal person and a dumb person. The system uses image processing and neural networking technologies to enable the conversion. A colour web camera is used to capture the gestures shown by the dumb. Image processing is used to process these captured images. These processed images are compared with the gestures stored in the database. When matching is found the message (sound) corresponding to that is send to other person in the communication line over a GSM module

Dumb aid telephone system with voice transmission is complex electronic devices that can help to provide a power of speak to a person who is profoundly deaf or severely hard-of-hearing. With this device a normal man can easily communicate with a dump person via TELEPHONE. The proposed system is a transmitter and a receiver couple device in which the one end will have a normal person and a dumb man in the other end.

This system is a process for recognizing hand gestures captured using video camera and a standard consumer personal computer, developed and implemented using the MATLAB mathematical environment. A pattern recognition system will be using a transform that converts an image into a feature vector, which will then be compared with the feature vectors of a training set of gestures. Computer recognition of hand gestures may provide a more natural-computer interface, allowing people to point, or rotate a CAD model by rotating their hands. Hand gesture recognition has various applications like computer games, machinery control (e.g. Crane), and thorough mouse replacement. One of the most structured sets of gestures belongs to sign language. In sign language, each gesture has an assigned meaning (or meanings) or corresponding voice produced using mat lab algorithms.

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The gesture –voice is transmitted via Telephone with a DTMF coder/ or an application MODEM. A Default number will be configured, in addition with the Manual dialing using a Graphical User Interface designed using MATLAB. The receiver side person can hear voice of dumb person through this system. This system also provides normal person make call to communicate to dumb person. Two way communications is possible through this system.

II. SYSTEM MODEL

The main objective of the system 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 is designed with a minimized cost and higher accuracy. The dumb aid phone has a camera for capturing the hand gestures shown by a dumb person. The orientations of the fingers of the hand are identified by extracting the outline of the hand in the captured image. This outline is then compared with outline 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 send to the normal person on the other side of the communication line. 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 SIFT algorithm.

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 the feature is extracted from the image. Here the feature extracted is outline of the hand in the image. The image in the matrix format is loaded to the database. 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 SIFT algorithm. The technology used here is much more complicated than the existing, but it can ensure more accuracy than the others.

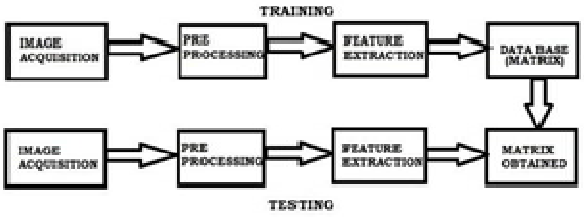

Fig 1: Block diagram of Training and Testing

III. HAND GESTURE RECOGNITION USING MATLAB

A. Image acquisition

The image acquisition is the basic process in the dumb aid phone. 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. After the specified frames are acquired the image is captured with webcam. The captured image is shown in the figure window or MATLAB as shown in fig 2.

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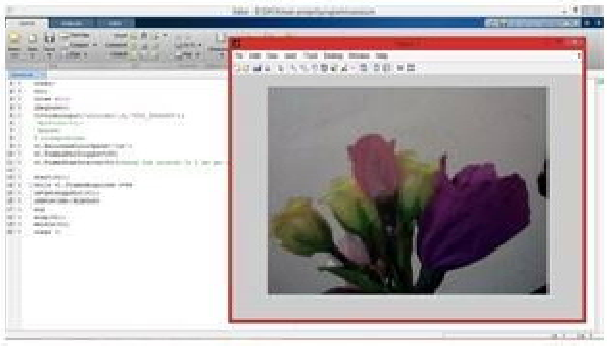

Fig 2: Image captured and displayed on the figure window

Hand recognition

The hand should be recognized, to detect the hand gesture. So this can be considered as the basic step in the gesture recognition. The hand is extracted from the image captured using the image acquisition program. Initially the colour image is converted into HSV format. Then it is converted to gray level. The hand gesture is indicated with red box using the bouding box function and displayed on the figure window as shown in fig 3.

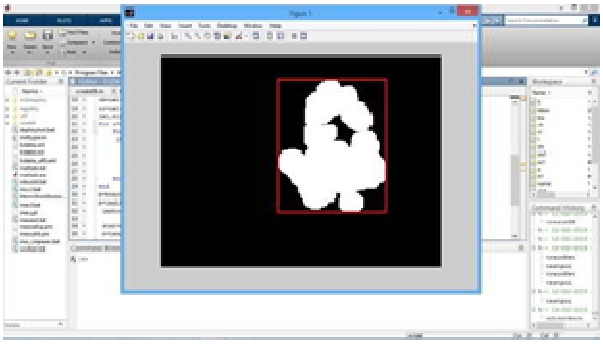

Fig 3: Hand recognized and displayed on figure window

Creating the database

Creating database is important in the dumb aid phone since the sound is generated only after the comparison of the gesture with that stored in the database. GUI is created to make the database creation more users friendly. The GUI is provided with start, stop, set colour, Add to DB buttons each carrying a specific function. That start button is clicked and the hand gesture is shown to the camera. The hand extracted image is displayed on the GUI window. When correct image is obtained stop button followed by add to DB button is clicked add the image is added to the database. Like this five more images of the same gesture in different positions is added to the database. This is to increase the precision of the device. The database can be expanded with more number of gestures and can also be updated.

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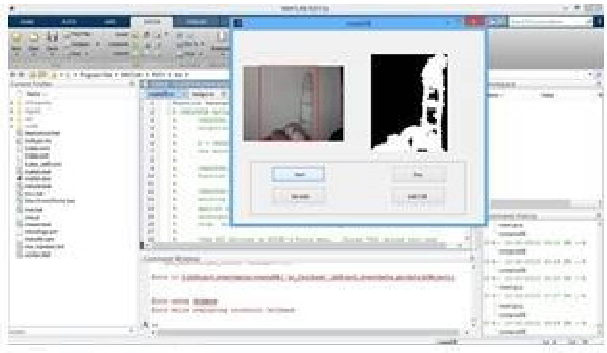

Fig 4: Testing

IV. GSM INTERFACING

To turn the system into an effective communication system, a GSM module should be interfaced to the circuit. GSM module is a device that can accept a valid Subscriber Identification Module (SIM) and perform all the operations that a normal mobile phone or telephone performs. The operations may include making a call, receiving a call, sending SMS, receiving SMS etc.

The GSM module is interfaced to a circuit with AVR microcontroller, MAX 232 and other devices, through DB9 connector. DB9 connector is a 9 pin connector with each pin assigned with a dedicated function. The module also has a built in power supply circuit which can be activated by adaptor. The module is generally controlled by the microcontroller by set of commands known as AT commands.

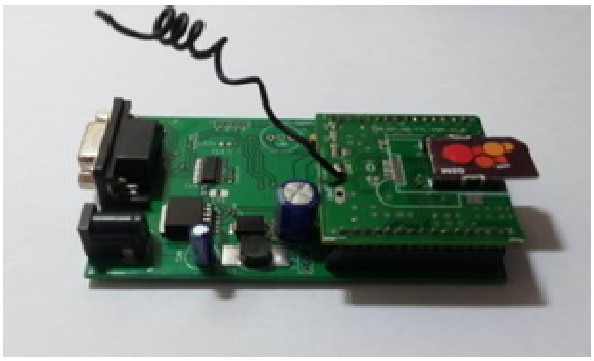

Fig 5: GSM module

In fact a GSM module can interact with the microcontroller or microprocessor only through these commands. The above said basic operations of the module, each has a dedicated AT command. For example, AT+CMGS followed by the phone number and message can send that message to the specified number. The common AT commands used are shown in the table 1. The AVR coding with AT commands is done by embedded C.

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AT Commands	Functions
+CMGS	Send message
+CMSS	Send message from storage(forward)
+CMGW	Write message to memory
+CMGF	Select message format
+CMGD	Delete message
+CMGC	Send SMS command
+CMMS	More messages to send
+CMGR	Read SMS
+CMNI	New SMS indicator
+A	Attend call
+D	Dial number
+H	Disconnect

Table 1: AT commands for GSM

V. CONCLUSION

Communication with a normal person is always a challenging task for a dumb person. In this paper a system called Dumb aid phone is introduced which is an effective communication aid for a dumb person.The system uses the advanced technologies like Image processing, SIFT algorithm to ensure maximum accuracy. Also it is convenient when compared to existing systems, since there is no need of a wearable to use the device. Data base creation and testing using a GUI makes the system more users friendly. The database can be expanded with more number of hand gestures and its different possibilities to improve the performance of the system. The dumb aid phone can be extended to aid the deaf in communication by using the text to speech conversion.

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