HAND GESTURE RECOGNITION AND VOICE CONVERSION SYSTEMS FOR PHYSICALLY IMPAIRED PEOPLE

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Abstract : Communication between normal and handicapped person such as deaf, dumb, blind and paralyzed patients has always been a challenging task. It has been observed that they find it really difficult at times to interact with normal people with their gestures, as only very few of those are recognized by most people. The home appliances can be modified and made to operate automatically with the modern home automation technology. This technology is growing drastically due to increasing demands in a wide range of sectors. The proposed system deals with the technology which uses a wearable gestural glove that interacts with physical world around us with digital information and convert those gestures into the voice output. The aim behind this approach is to develop a system which is trained to recognize and perfect gestures of a human arm using a smart glove.

***IndexTerms* – IOT[Internet of Things], Cloud Computing, flex sensors.**

I. INTRODUCTION

Now a days, there is an increase in the number of physically challenged people like hearing impaired, paralysed people and speech disabled, which is caused due to birth defects, accidents and so on. These people find it more difficult to interact with the normal people, as normal people fail to understand them. Thus for the better understanding they use hand gestures to communicate among themselves as well as with the normal people. Researches have been made to find the hand gestures and have succeeded in developing the applications in robotics, and artificial hands which can function similar to the normal human hand.

Thus we propose a Hand gesture recognition and voice conversion system which enables users to improve health related risks and reduce healthcare costs by recording and analyzing the gestures to produce a voice output. Using this proposed system time of both doctors and the patients is saved as the doctors can access the health parameters of the patients regularly which are updated in cloud. The proposed project is useful for the deaf and dumb, it can also be used for the (speechless) patients with half of their bodies paralyzed and who are not able to speak but are able to move their fingers.

The aims and objectives of this proposed technique includes:

- Designing of embedded system.
- System to be user friendly to detect the gestures correctly.
- Cost effective, reliable data acquiring method and signal conditioning

II. LITERATURE SURVEY AND SUMMARY

[1] This paper proposes a system which uses the sixth sense Technology, also known as wear your world (WUW) which is a wearable gestural interface, that uses the digital information to interacts with the physical world using the natural hand gestures. According to the sixth sense prototype proposed by Pranav Mistry,the camera identifies the images, individuals picture sand gestures one makes using hands. The collected information is given to the Smart phone to process it. The output image is projected on to the mirror with the help of a downward facing projector. Mirror reflects the image on the desired surface. Thus, digital information is freed from its confines and placed in the physical world. According to the Iot based Automation using sixth sense technology, the user shows images drawn on paper to the web camera of the laptop. It creates a machine vision and image processing application using Lab View VI. These images are used to turn on or turn off the electronic devices. The Raspberry PI acts as a server which receives information based as per the images from the client through TCP/IP connection. It is connected to the hardware devices which receives information sent by it via relay circuits and appliances are controlled accordingly. In this system, the input to the system is the hand gesture, given by the smart glove which is deployed with flex (meaning bent) sensors on the fingers. It is a resistive type of sensor which is used as a transducer which converts the physical energy into electrical energy. As the fingers bend the resistance of the flex sensor changes depending upon the amount of bend and it converts it into analog voltage. The input from the sensors is given to RF-433MHz transmitter and receiver. With the help of RF module the data is then sent to the micro controller i.e arduino nano/uno. The microcontroller processes the input voltage and sends control signals to the Relay driver IC Circuit. Relay driver enables a low power circuit to control signals or to shift high current ON and OFF. From the relay driver, control signals are then sent to various home appliances like fans, ACs, bulbs etc. And hence the appliances are controlled using sixth sense technology. This paper has an advantage of real time access, allowing parallel programming and code optimization using python.

[2] This paper includes a Micro electro mechanical Systems (MEMS) accelerometer to sense the accelerations of a hand in motion in three perpendicular directions that is (x, y, z) and transmitted to wireless protocol using Radio Frequency (RF). This system is designed for visually challenged and partially paralyzed persons. This system includes accelerometer, micro-controller, RF transmitter and receiver out of which the communication is through RF signals. The accelerometer senses the hand gestures and the signals are transmitted by the RF transmitter to the receiver. The receiver compares the received signals with the already stored gestures and controls the home appliances only when there is a match in the gestures made and the stored gestures. The MEMS accelerometer recognizes four types of hand gestures such as UP, DOWN, HORIZONTAL and VERTICAL. This accelerometer accelerates the hand gestures and sends the signal from the receiver section to the microcontroller in which the gestures are stored as templates. If there is a match in the gestures recognized by the microcontroller then the home appliances are controlled as to turn on the fan if the gesture made is UP, to turn off the fan if the gesture is DOWN and so on. Here since the gestures are already stored it makes the work simpler, is cost effective, less complex and useful for physically challenged, visually impaired, old age people which makes it advantageous.

[3] The main aim of this proposed system is to translate the hand gesture of a person to audio signal. It is usual for mute people to convey their message through the hand gestures, in order to convert this into a speech signal a whole new system is introduced, here the proposed system checks over the bent angles of the fingers and also the detects the tilting of the palm, with accordance to these two measured values the outputs are obtained. The flex sensor and accelerometer measurements are the basic inputs. To process the information a PIC microcontroller is being used in 2 modes that is coaching mode and operation mode. In coaching mode the information and the measured voltages are being stored and in operational mode the values are compared with values which were predefined. On finding the matched gestures the information now has to be converted to speech. The controller can take the input directly from digital input ports which is an 8-bit ADC. Therefore the measured information is of 8-bit which is held by the controller. The same is sent to speech synthesizer. The speech convertor modules consists of Speak jet and TTS block. Each 8-bit address represents a different allophones, therefore the 8 bit address is converted to the word to be spoken. The signal output of synthesizer is being amplified and is given out from a speaker. The same voice message is represented in the form of text using TTS module. So this entire system is made portable and expects to decrease the communication gap between the world and the voice impaired community. These has an advantage of using accelerometer which can give the tilt angles of the entire palm which would help indicate many information through more precise bending angles.

[4] The main objective here is to build a portable embedded system which can detect finger gestures. A human hand can exhibit many gestures through finger movements, so detect the gesture of a hand a flex sensor is used. Flex sensors can change their resistance upon the amount of bend and these sensors are very sensitive to every movement. In this system the flex sensors are placed inside the glove. The supply voltage is given to a voltage divider circuit which has the series of all flex sensors connected to it as load resistors. On obtained voltage is further fed to a AVR microcontroller through one of its built in ADC pin. The controller takes input from all five flex sensors (i.e. of each finger) and store in 5 8-bit resistors. Every value is sent to speak jet to convert it into speech using USART. Each 8 bit information contains a phenomenon which can be combined to form a word. The serial data is accepted by speech synthesizer by combining all phenomena's a sentence is generated and that is synthesized to audible human voice. It has a compact structure and it can operate on a single lithium-ion rechargeable battery. This makes it a less weight system which is portable and can be carried anywhere by anyone which makes it advantageous.

[5] There are many system which have proposed a 1 way communication, but this proposed a system which has a hardware built for two way communication. It uses the flex sensors and android technology. There are two parts in proposed system. The first one is gesture recognition. In this part of gesture recognition the system uses five flex sensors which are fitted to a glove to detect the gesture from the bent angles of all fingers. It uses a Arduino Nano for data synthesis and after the data processing there is a speaker attached with the glove which gives out the audio output which defines the gesture. The module consists of an SD card that stores all the voice or sound files in it. In the second part the audio signal is being converted into text but its functionality is confined to English language. This part is an android app with a google API which is developed using android studio. This module converts the speech signal into text and displays it on the mobile screen which also works in offline mode. It has 2 way communication deployed which can be helpful for dumb as well as deaf community. It has an android application which can work on offline condition which is of good advantage.

[6]Speech impairment people find it difficult to communicate with normal people through sign language. This paper proposes an idea of smart glove which helps in converting sign language to speech output. This glove is embedded with an Inertial Measurement Unit and flex sensors to recognize the gesture. A method of State Estimation has been developed to track the movement of hand in three dimensional spaces. The prototype was checked and tested for its feasibility in converting
Indian Sign Language to voice output. Though the glove is made for sign language to speech conversion, it is a multipurpose glove and finds its applications in gaming, robotics and medical field. The gloves are embedded with five flex sensors to track finger orientation and an Inertial Measurement Unit (IMU) to track hand movement using 3 dimensional space. It provides High accurate output using flex sensors and IMU unit.

[7] A hand gesture recognition system provide a innovative and modern way of non verbal communication. It has a wide area of application in human computer interaction and sign language. This paper discusses a novel approach of hand gesture recognition based on detection of some shape based features. The setup consists of a single camera that captures the gesture formed by the user and take this hand image as an input to the proposed algorithm. The overall algorithm is divided into four different steps, which includes segmentation, orientation detection, feature extraction and classification. The proposed algorithm is independent of user characteristics. Any kind of training of sample data is not required. The proposed implemented algorithm has been tested on 390 images, gives a recognition rate of approximately 92% and average elapsed time of 2.76 sec. It takes a less computational time when compared to other approaches. The strength of this approach is it is simple, ease of implementation, no complex feature

calculation, and no any significant amount of training or post processing required, gives higher recognition rate with less computation time.

[8] In this paper, the development of a device that can assist the speech and hearing-impaired people in Communication is proposed which is also cost effective. The user will have to depict the illness condition to the concerned doctor by selecting an appropriate picture from the pictures file which describes the particular illness condition. This is accompanied by choosing another picture of a relevant hand gesture to convey the message. Further, the processing is performed by comparison and combination with the previously constructed words that are stored in the memory of STM32F429ZIT6 microcontroller having flash memory of 2MB. This leads to the formation of corresponding sentence, which gets displayed on the Thin Film Transistor LCD. The method is effective in establishing communication between speech and hearing-impaired person and the doctor. This generates a one-way communication where the transmitter is the speech and hearing-impaired person and the receptor being the doctor. It has the advantages of Cost effectiveness, Easy to implement, High Performance STM32F429ZIT6 microcontroller with on-board touch screen LCD, TFT LCDs consume less energy, thereby helping in energy conservation, Simple in terms of usability of the device.

[9] The system aims at performing the function of interpreting the hand gestures and conversion of the same into English language. The primary data of hand gestures is in the form of a video and may contain redundant information or noise that are not of use, hence the processing of frames is performed as explained below. From the input hand gesture of the form of a video, frames are extracted. The frames are cropped for vital information, neglecting the other; by the use of crop coordinates. After which, the difference image is obtained by the subtraction of two subsequent frames. For segmentation of image, equation $T_i = T\{F_i - F(i+1)\}$ is applied on the difference image. At the same time, skin color detection algorithm using YCbCr model is applied to determine the skin color of the hand performing gestures. The boundary detection implemented using canny edge detector helps determine the boundary of the hand performing gestures. These combindly help in Motion detection of the hand, which is significant as the gestures are made with the movement of hands and get recognizedeasily. Processed frame can be obtained by the combination of Skin color detected output and the combined output of Edge detection and Segmentation.

Next, feature extraction is carried out as part of pattern recognition. This is to represent larger data as simplified data. The method employed for which is Fourier Descriptor(FD). Using Fast Fourier Transform(FFT) algorithm, the fourier series were calculated, so as to represent the boundary points of a hand. The system was best suited to produce the results for Feature extraction using 28 Fourier descriptors per frame of gesture video. The extracted data of the above process was large and had to be compressed to be stored into a Codebook database, for which Linde- Buzo- Gray (LBG) type of vector quantization was made use of. As part of further step, Euclidean distance method is used to match the features extracted out of a testing sequence with the previously stored vectors in the codebook. The minimum distance thus obtained is considered as a match and the corresponding gesture output gets displayed on the screen. It is Efficient for most of the alphabetic character recognitions. The accuracy of alphabets individually is 85.73%, accuracy of numbers individually is 95.5% and accuracy of phrases is as high as 97.5%.

[10] In the paper, a new and efficient method for real time hand gesture recognition has been conceived which by skin color segmentation using suitable color model can detect the hand portion in real time. This section explains the various steps of proposed algorithm. The last step of this algorithm is skin color segmentation which is further a sub algorithm. Both the algorithms can be implemented in MATLAB. Image is given as input from the camera. The dimensions are set to get the required part of the image. The image is resized. The background is separated from the image. Skin color segmentation is applied using any of the color models. The image from our webcam is in RGB format. This RGB image requires to be converted into grayscale image with the help of a command in MATLAB; as several image processing algorithms can be applied on grayscale images rather than on images in RGB format. This is achieved by applying the threshold value for skin color detection. This step marks the skin pixels in the image, which is then converted to binary image. And we get the segmented image. After the skin color detection apply the morphological operation on the image to remove the imperfections obtained in binary image by segmentation. Morphological image processing pursues the goals of removing the imperfections by accounting for the form and structure of the image. This method for hand gesture recognition in real time can provide efficient results with the segmented image free from noise.

III. GAPS FOUND IN LITERATURE

[1]The techniques which are required to implement a G programming language are of a very high quality. The memory management and the syntax of Lab View should be properly known by the programmer so as to implement algorithms which are complex and complicated. Images need to be drawn and must be understood by the Lab View application. In future, the proposed system can be made more efficient by increasing the accuracy of the system by resolving ambiguity issues in case of similar gestures. Advanced features like 3D gesture tracking can be incorporated. As this system is also beneficial for the handicapped, another future advancement would be to make the sixth sense work as a fifth sense for the disabled.

[2] In this paper only 7 gestures can be recognized and is Less efficient. In future more home appliances can be controlled by incorporating those devices with newer versions of gestures, also implemented in every home at low cost.

[3] System uses PIC microcontroller which can be replaced into any better development boards like Arduino which would provide a better environment for programmers. The power supply can be improvised using batteries which would give better power backup. Two way communication can be adopted which can convert audio input to text to help deaf people.

[4] If the person in front seems to be deaf a text displaying module can be implemented to convey the gesture information through text. The system uses synthesized voice this can be replace by having a memory space which could hold real human recorded voice which would make it more natural. Two way communication can be adopted to convert speech to text which can help the deaf community as well. The system is portable and can be made waterproof as some layers are not completely water resistive.

[5]The application can be improvised to visual gesture recognition using Open CV which can capture images analyze the finger positions and provide a voice output. It can be improvised under virtual reality. For example: use of a data glove as input device instead of joystick in gaming application, or a robot control system to regulate machine activity.

[6] In this paper it does not follow any systematic approach to define certain parameters for gesture recognition, and all the threshold values taken in this approach are based on assumption made after testing on some number of images.

[7]This paper uses the flex sensors which are very expensive and has very less gestures to communicate. In future more gestures can be accommodated to increase the efficient communication.

[8]In this paper non availability of certain Images may lead to inability in conveying the information and can generate only one-way communication. In future two-way communication can be established
and animations can be implemented to convey the informations easily.

[9] This paper includes multiple complex step and is observed that accuracy is less in case of alphabets: C, M, O,R and X. Hence future work is to be made in order to improve the accuracy of phrases and alphabets with similar gestural movements.

[10]In this paper Specific mix model approach is proposed for better segmentation of hand which is not demanding. In future this can be improved to perform color space by applying various color combinations.

IV. CONCLUSION

As per the analysis we see that, all the system had certain drawbacks such as complexity in coding, less efficient, less accurate, expensive and constrained to only one application like either gesture to voice conversion or home automation. In future such systems can be implemented by using easy coding languages, more gesture recognition, less expensive modules like Arduino board and copper plates instead of flex sensors or camera for gesture recognition and also implement more applications like health monitoring and Home Automation. Hence we can propose a system that aims to design a cost effective system that would enable people to communicate easily with the normal people and automate their homes by means of a single wearable interface -the customized smart glove. This also has a technology to access the patient details on cloud and send a message immediately to the care taker or doctor if any health issues is monitored. This system would be beneficial for common man as well as the physically disabled as one can communicate well, could be taken care and can operate the appliances sitting on one place. Based on the research so far, it can be concluded that this system will be a new, innovative approach towards gesture to voice conversion, home automation and health monitoring as it reduces the cost considerably and is user friendly as well.

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