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An Embedded System based Design for Operating Intelligent Devices with special perspective on elderly people Assistance for operating in-home devices

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ABSTRACT: Hand Gesture can be used an effective alternate compared to traditional methods of interacting with intelligent devices. Elderly People who are not tech savvy as well as people who are unable to move because of their disabilities can operate all the intelligent devices from their place providing an easy way of accessing things. This method provides a robust approach where in interfacing is very easy with all the intelligent devices because of its simplicity. Using sophisticated software packages and Microprocessors, an interoperable and portable design has been proposed where in the captured hand gestures are compared with the templates stored, to produce triggers for operating machines.

KEYWORDS: Hand Gesture, Gesture Recognition, Templates, Controlling remotely, image Processing

I. INTRODUCTION

Hand gestures are one of the universal languages recognized by all and often communicated in unknown environment. But hand gestures are rarely used for interacting with intelligent devices like computers. Only traditional input devices like Remote controls, Buttons, Mouse are frequently used. Hand gestures can be effectively used for replacing the traditional devices so that seamless integration can be done for assisting the elderly to operate those intelligent devices.

In spite of all the improvement in technology many people still find very difficult to operate computers and other intelligent devices using traditional methods. Since hand gesture is spontaneous and natural way of communication even the elderly and disable people can easily interact with all the intelligent devices.

But Recently many people have recognized the impact of replacing traditional input devices with natural human oriented language like signs, words etc.. Tech neology has made the process of gesture recognition for man-machine interface easier since an array of low cost sensors and processors are available even for the stand alone computers helping the end user computing.

(Vladimir I. Pavlovic et.al) have suggested visual interpretation of hand gesture for human computer interface. (Elena Sánchez-Nielsen et. al) have used 26 hand postures for human machine interaction.

There are many active researches that have been carried out in this field.

We propose a method of robust and fully automated remote control for home appliance using free hand gesture. It's not new to study on a remote control for intelligent devices using human's free hand gesture instead of cumbersome hand-held wireless remote controllers. Nevertheless, to the best of our knowledge, there exists no commercial remote controller that uses free hand gesture because it requires high robustness to various illumination changes in living room and full automation without any constraint or direct intervention of users.

In the first part of this paper, the algorithm for detection of hand gesture has been proposed. In the later part methodology used for handling the intelligent devices using the detected hand gestures has been discussed.

II. HAND GESTURE RECOGNITION

The First step in the gesture recognition cycle is the preparation of an image database. Images can be in various shapes, different formats and may be in different scales. The images collected from various sources are first made uniform by converting them in to gray scale by removing the background.

The algorithm robustness depended on the number of persons using it. If different persons are using the

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application more images are needed in the database. If the same person is using the application database size is less since the images are almost of same texture.

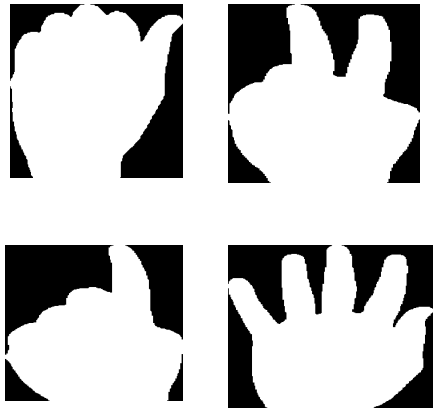

Figure 1: Examples of Images in Database

Shape Recognition

There are two phases involved in shape recognition. In the first phase computer forms various shapes called templates. In the second phase the shapes are compared with the actual image captured to execute various programs which will inturn run the corresponding triggers.

III. HAND TRACKING ALGORITHM

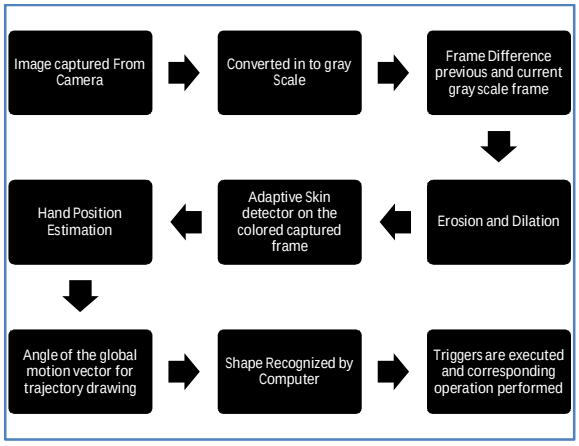

Fig2.Hand Tracking Algorithm

The hand tracking algorithm proposed here is very fast, reliable and effective and can be used for many real time applications. The proposed Algorithm uses motion vector and skin color to recognize the hand gesture. First the images are captured from the camera. The camera we are proposing to use is a RGB camera. The captured image is then converted to gray scale. Then we compute the frame difference between the colored frame and the one in gray scale.

The image which has non-zero pixel values in the regions where motion has taken place. A thresholding algorithm gives a binary image with white pixels indicating the region of motion. A value of 30 is chosen for the threshold for monitoring the difference of the frames as mentioned above. The value 30 gives us the white pixels to track the position of the hand.

Skin Segmentation

Before performing the skin segmentation we convolve the actual image with 5x5 Gaussian filters and then we have to scale this filtered image one half in each dimension to eliminate any noise in the image pixels. Then the subsequent image processing operations are performed. For every available pixel in the frame we perform foreground mask as follows

$$I_F = \begin{cases} 255 \text{ if } |I_i - I_B| > \sigma_B \\ 0 \text{ otherwise} \end{cases}$$

Even though the background subtraction discussed above works well, there are conditions like a coffee cup, shirt sleeves or any other items placed on desk can be detected as hand. In order to avoid those situations and add to more some more flexibility to the system, a skin pixel detector has been implemented to further filter the foreground data.

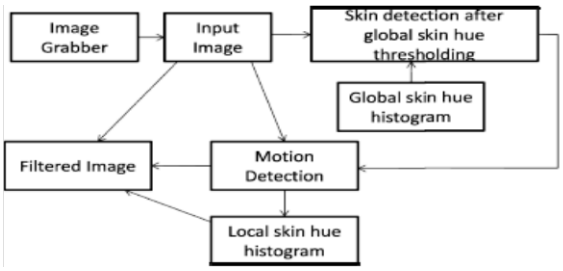

Figure 3: Adaptive Skin Detector

From the above mentioned procedures we can calculate the probability of a RGB color that belong to hand and

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non hand gesture as follows.

$$P(rgb \mid skin) = \frac{s[rgb]}{T_s}$$

$$P(rgb \mid \neg skin) = \frac{n[rgb]}{T_n}$$

IV. SIMULATION

A Computer based simulation was first performed as a pilot study to check out the feasibility of the study. This was also created so that the elderly people who find very difficult to operate mouse and key board because of paralysis and other physical disabilities can use hand gesture to perform various basic computer operations like opening media player for playing songs or video, opening file, opening and closing computer, restarting computer etc.

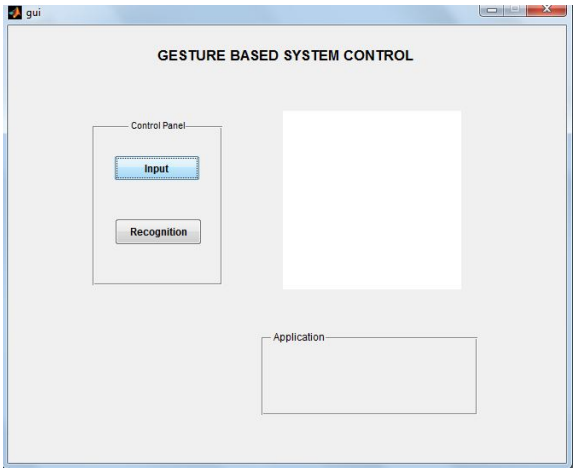

Figure 4: GUI Screen

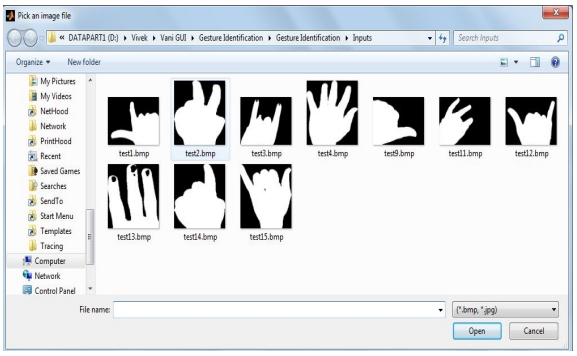

Figure 5: Range of Inputs

Application software was created with the help of Matlab. Image processing was done with the help of Matlab IDE. After the image has been recognized various system triggers are programmed using vb.net.

Figure 6: Recognized unmatched Gesture

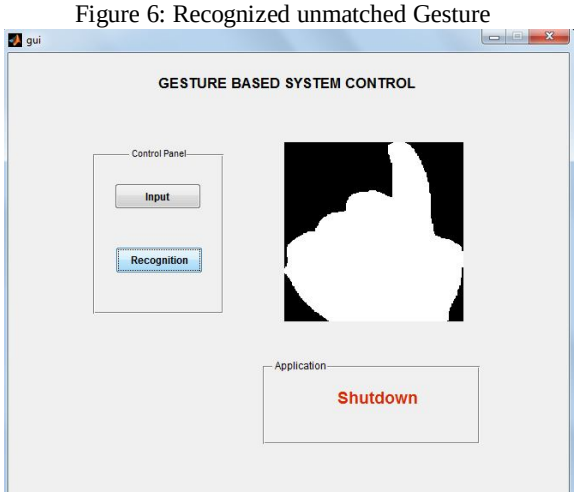

Figure 7: Recognized Shutdown Gesture

APPLICATIONS

1. Can be used by disabled and elderly people for operating many intelligent systems
2. Can be used to operate computer/ intelligent devices in cars while driving
3. Can be used in military applications for remotely operating a computer

V. EMBEDDED SYSTEM DESIGN

An effective embedded system design has been created for assisting the elderly people in using the intelligent devices for day to day home use. The block diagram of the same is given below

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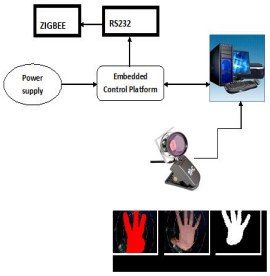

Fig8: Embedded System Design for Remote controlling

The hand gestures are fed in to the camera which in turn transfers the image in to a PC. The PC performs image comparison with an already existing image database and image corresponding to the matched gesture are fed to the embedded control platform which is nothing but ARM 7. The Arm 7 processor in turns performs the controlling of all home devices using RS232 and Zigbee protocol. All the devices in the home are attached with a receiver which receives the signal from Zigbee and performs the corresponding operations.

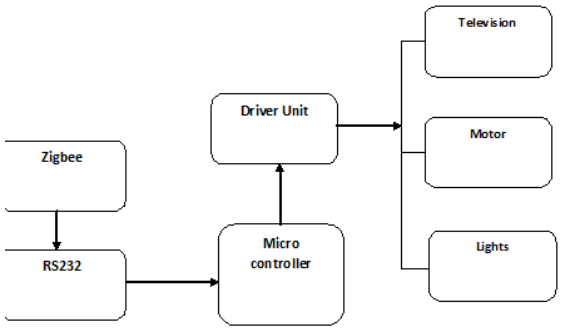

Fig9: Remote Section

VI. SUMMARY AND FUTURE RESEARCH

The future research that has been planned is to control the home appliances even from outside the home using internet or other sophisticated network facilities. This research can also used in military appliances for securely operating importance devices remotely like operating an cannon from safe place so that we can stop shedding of human lives.

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