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HAND GESTURE RECOGNITION SYSTEM FOR PHYSICALLY IMPAIRED PEOPLE

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***Abstract*-Physically disabled and mentally challenged people are an important part of our society who has not yet received the same opportunities as others in their inclusion in the Society. Therefore, it is necessary to develop easily accessible systems to achieve their inclusion with the new technologies. This paper presents an objective whose aim is to draw disabled people nearer to emerging technologies. It presents a vision-based user interface designed to achieve computer accessibility for disabled users with motor impairments. The interface automatically finds the user's hands and tracks it through time to recognize gestures in real time and also implement vision based hand gesture recognition system for Natural Human Computer Interface. Hand tracking and segmentation are the primary steps for any hand gesture recognition system. The threshold segmentation algorithm is found to be the most efficient algorithm to handle the challenges of a vision based system. The Region Growing method is used for edge detection. The Neural Network algorithm is used for matching the image obtained with the trained datasets. The experimental result shows that the proposed system is robust and efficient when compared with the existing system.**

Keywords: Impairments, Gestures, Segmentation, Region Growing, Edge detection, Neural Network

I. INTRODUCTION

Most of us are fortunate to be born without any disabilities. Physical impairment is a disability that limits a person's physical capacity to move, coordinate actions, or perform physical activities. It is also accompanied by difficulties in one or more of the following areas: physical and motor tasks, independent movement; performing daily living functions. Impairment is a problem in body function or structure; an activity limitation is a difficulty encountered by an individual in executing a task or action; while a participation restriction is a problem experienced by an individual in involvement in lifesituations. Thus disability is a complex phenomenon, reflecting an interaction between features of a person's body and features of the society in which he or she lives. The physically impaired people are unable to perform tasks like a common man. This system initially captures the hand gestures through web camera when launches. After that it tries to segment and match with the trained dataset and produce results. If any of this has failed then the user has to perform the process again. The system does not need extra device. The overall system consists of a complete user interface. The results will be shown immediately after processing.Themain working process includes Image acquisition, Foreground Segmentation, Face and Hand Detection, Hand Trajectory Classification and Evaluation Criteria. It is accurate and highly efficient. Our system is based on image processing techniques which include edge detection, segmentation and so on. In order to make the system more comprehensive, we need to create a small database or use an existing database to compare the image acquired and to store it for further processing. The system will be programmed based on Java and includes a user-friendly interface.

II. ARCHITECTURE DIAGRAM

The Fig (1)architecture diagram depicts the modules of the paper where image acquisition module is used for obtaining an image from the webcam as input. Color and depth analysis is used to easily identify the hand which is analyzed using the color. For segmentation the foreground segmentation algorithm is used which separates the background and the foreground.

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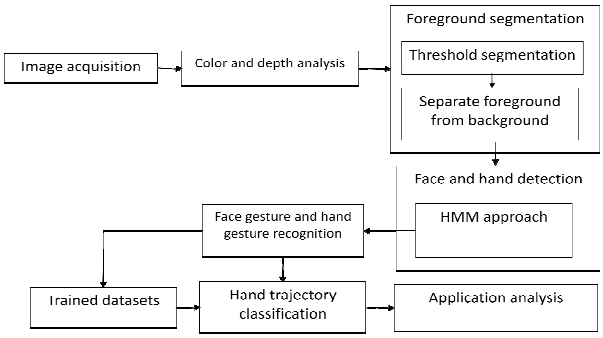

Fig(1).Architecture diagram

For face and hand detection the Hidden Markov Model is used. The neural algorithm is exploited for classification and matching with the trained data sets.

III. ALGORITHM

STEP 1: First open the project into the Net beans IDE.
STEP 2: Capture the image using the web camera.
STEP 3: Convert the RGB Color to Gray Scale on the input image.
STEP 4: Set the Application corresponding to the finger detect.
STEP 5: Face and Skin detection is done.
STEP 6: Segmentation of the foreground image from the input image is done.
STEP 7: The application is opened when the finger is detected.

IV. SYSTEM IMPLEMENTATION

A. *ImageAcquistion*

For efficient hand gesture recognition, data acquisition should be as much perfect as possible. Suitable input device should be selected for the data acquisition. There are a number of input devices for data acquisition. Some of them are data gloves, marker, hand images (from webcam/ stereo camera/ Kinect 3D sensor) and drawings. Data gloves are the devices for perfect data input with high accuracy and high speed. Colored markers attached to the human skin are also used as input technique and hand localization is done by the color localization. Input can also be fed to the system without any external costly hardware, except a low-cost web camera. Bare hand (either single or double) is used to generate the hand gesture and the camera captures the data easily and naturally (without any contact). Sometimes drawing models are used to input commands to the system. The latest addition to this list is Microsoft Kinect 3D depth sensor. Kinect is a 3D motion sensing input device widely used for gaming. In this module, we can input image from web camera and also capture hand and face images. And captured both depth and color image. In 3D computer graphics a depth map is an image or image channel that contains information relating to the distance of the surfaces of scene objects from a viewpoint.

B. *Foreground segmentation*

Segmentation is one of the important parts to process image data. The aim is to segment the Region of Interest (ROI) from the obtained image. In foreground segmentation section, the background was ruled out from the captured frames and the whole human body was kept as the foreground. In computer vision, image segmentation is the process of partitioning a digital image into multiple segments (sets of pixels, also known as super pixels). The goal of segmentation is to simplify and/or change the representation of an image into something that is more meaningful and easier to analyze. Image segmentation is typically used to locate objects and boundaries (lines, curves, etc.) in images. Image segmentation is the process of assigning a label to every pixel in an image such that pixels with the same label share certain characteristics. Thresholding is the simplest segmentation method. Global Thresholding is used. The Equation (1) explains that if the pixel value is greater than the threshold value it is set as 1 and for other pixels which is less than the threshold value 0 is given.

$$T{:}g(x,y) = \begin{cases} 1 \; if f(x,y) > T \\ 0 \; if f(x,y) \leq T \end{cases} \text{----------(1)}$$

C. *Face and hand detection*

Face and hand detection was used to initialize the position of the face and hands for the tracking phase. After initialization, both face and hands were tracked through video sequences by the MCMC based HMM method.Montocarlomarkovian chain method and ROI methods are a class of algorithms for sampling from a probability distribution based on constructing a Markov chain that has the desired distribution as

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its equilibrium distribution. The state of the chain after a number of steps is then used as a sample of the desired distribution. The quality of the sample improves as a function of the number of steps. ROI methods make up a large subclass of MCMC methods. Random walk Monte Carlo methods are a kind of random simulation or ROI. However, whereas

the random samples of the integrand used in a conventional Monte Carlo integration are statistically independent, those used in k-curvature methods are correlated. A ROI is constructed in such a way as to have the integrand as its equilibrium distribution.

A time-domain process demonstrates a Markov property if the conditional probability density of the current event, given all present and past events, depends only on the jth most recent event. If the current event depends solely on the most recent past event, then the process is termed a first order Markov process. This is a useful assumption to make, when considering the positions and orientations of the hands of a gesturer through time. The K-curvature is a double stochastic process governed by: 1) an underlying Markov chain with a finite number of states and 2) a set of random functions, each associated with one state. In discrete time instants, the process is in one of the states and generates an observation symbol according to the random function corresponding to the current state. Each transition between the states has a pair of probabilities, defined as follows: 1) transition probability, which provides the probability for undergoing the transition; 2) output probability, which defines the conditional probability of emitting an output symbol from a finite alphabet when given a state. The K-curvature is rich in mathematical structures and has been found to efficiently model spatio–temporal information in a natural way. The model is termed "hidden" because all that can be seen is only a sequence of observations. It also involves elegant and efficient algorithms, such as Baum–Welch and Viterbi, for evaluation, learning, and decoding.

D. Hand Trajectory Classification

Hand tracking results were segmented as trajectories, compared with motion models, and decoded as commands for robotic control. Neural networks are composed of simple elements operating in parallel. These elements are inspired by biological nervous systems. As in nature, the network function is determined largely by the connections between elements. We can train a neural network to perform a particular function by adjusting the values of the connections (weights) between elements. Commonly neural networks are adjusted, or trained, so that a particular input leads to a specific target output. There, the network is adjusted, based on a comparison of the output and the target, until the network output matches the target.

E. *Evaluation criteria*

The proposed system was able to detect finger tips even when it was in front of palm, it reconstruct the 3D image of hand that was visually comparable. This system claimed results 90-95% accurate for open fingers that is quite acceptable while for closed finger it was 10-20% only and closed or bended finger is coming in front of palm, so skin color detection would not make any difference in palm or finger. According to image quality operator was the main reason for low detection and claims about 90% accuracy in the result, if the lighting conditions are good.

V. EXPERIMENTAL RESULTS

The system recognizes the hand gestures and there is also possibilities of including more and more gestures as they have an own part in enhancing the system's interactivity. The system checks out the needed action for the particular gesture and performs it certainly. As far as our test; all the gestures are recognized by the system using the webcam. And the results show pretty well. The below table shows the analysis of the results, obtained by the proposed system.

The accuracy rate for the below table is calculated as,

ACCURACY = OUTCOMES / COUNT

Table 1. Accuracy of the gestures

	Gesture 1	**Gesture 2**	**Gesture 3**	**Gesture 4**	**Gesture 5**
No. of trials	5	5	5	5	5
Outcomes	5	5	4	3	3

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Failures	0	0	1	2	2
Accuracy	100%	100%	80%	60%	60%

The entire images mentioned in the Table 1.are obtained from the webcam. The table 1.compares the accuracy of the existing system's gestures.

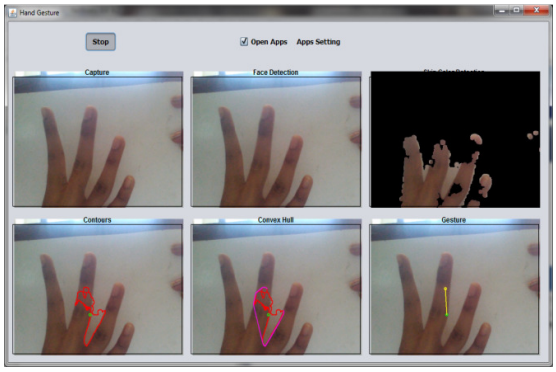

Fig (2). Gesture –4 Fingers

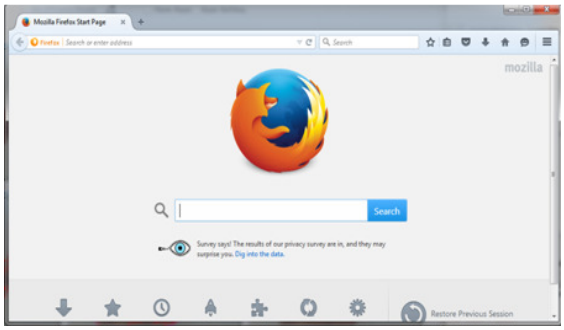

Fig (3). Mozilla Firefox opened for gesture 4

The startup screen contains an option "App Setting" in which the corresponding apps for the gestures can be set by the user accordingly for their convenience. Then the Open Apps option is checked so that the corresponding application opens immediately when a gesture is identified. Gesture 4 is shown in Fig (2) and the response is shown in Fig (3) where Mozilla Firefox a web browser is opened.

VI. CONCLUSION

This paper proposes a system for recognizing the hand gestures through image processing. The design of more natural and multimodal forms of interaction with computers or systems is an aim to achieve. Vision-based interfaces can offer appealing solutions to introduce non-intrusive systems with interaction by means of gestures. In order to build reliable and robust perceptual user interfaces based on computer vision, certain practical constraints must be taken in account: the application must be capable of working well in any environment and should make use of low-cost devices. This work has proposed a new mixture of several computer vision techniques for facial and hand features detection and tracking and face gesture recognition, some of them have been improved and enhanced to reach more stability and robustness. A hands-free interface able to replace the standard mouse motions and events has been developed using these techniques. Hand gesture recognition is finding its application for non-verbal communication between human and computer, general fit person and physically challenged people, 3D gaming, virtual reality etc. With the increase in applications, the gesture recognition system demands lots of research in different directions. Finally an effective and robust algorithm to solve false merging and false labeling problems of hand tracking through interaction and occlusion was attained as a result from the proposed system.

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