FINGER RECONGITION AND GESTURE BASED VIRTUAL KEYBOARD

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ABSTRACT- Hand gesture recognition is very significant for human-computer interaction. In this work, we present a novel real-time method for hand gesture recognition. The proposed system is vision based, which uses machine learning techniques and inputs from a computer webcam. Vision based gesture recognition tracking and gesture recognition in our framework, the hand region is extracted from the background with the background subtraction method. Finally, a rule classifier is applied to predict the labels of hand gestures. Our method shows better performance than a state-of-art method on another data set of hand gestures.

1. INTRODUCTION

The Computers today have become an important aspect of life and are used in various fields however, the systems and methods that we use to interact with computers are outdated and have various issues. Hence, a very new field trying to overcome these issues has emerged namely HUMAN COMPUTER INTERACTIONS (HCI).

Although, computers have made numerous advancements in both fields of Software and Hardware, Still the basic way in which Humans interact with computers remains the same, using basic pointing device (mouse) and Keyboard or advanced Voice Recognition System. The proposed project is the Hand gestures recognition system to replace the basic pointing devices used in computer systems to reduce the limitations that stay due to the legacy systems such as mouse and Touchpad.

A. Hand Gesture Recognition System

A Hand Gesture Recognition System recognizes the Shapes and or orientation depending on implementation to task the system into performing some job. As humans through vision perceive human gestures and for computer, we need a camera, Sometimes in a situation like machine, electricity failure, emergency hostiles condition or some remote areas which are inaccessible to humans, it could very dangerous for human operators to be physically appear to operate the machines or in the working conditions. So, we can take help of the telepresence where telepresence is the area of intelligence which provides the ability of physical operation.

For instance, the robotic arm maps and repeat the actions performed by the operator arm to carry out a specific operation. The prospects of Virtual Presence or tele-presence also include applications like space missions, underwater mission, maintenance of nuclear power reactor and anywhere the human presence is not possible or risky.

B. Machine Learning

Machine learning is an application of artificial intelligence (AI) that provides systems the ability to automatically learn and improve from experience without being explicitly programmed. Machine learning focuses on the development of computer programs that can access data and use it learn for themselves. The process of learning begins with observations or data, such as examples, direct experience, or instruction, in order to look for patterns in data and make better decisions in the future based on the examples that we provide. The primary aim is to allow the computers learn automatically without human intervention or assistance and adjust actions accordingly.

Machine learning algorithms are often categorized as supervised or unsupervised. Supervised machine learning algorithms can apply what has been learned in the past to new data using labeled examples to predict future events. Starting from the analysis of a known training dataset, the learning algorithm produces an inferred function to make predictions about the output values. The system is able to provide targets for any new input after sufficient training. The learning algorithm can also compare its output with the correct, intended output and find errors in order to modify the model accordingly. In contrast, unsupervised machine learning algorithms are used when the information used to train is neither classified nor labeled. Unsupervised learning studies how systems can infer a function to describe a hidden structure from unlabeled data. The system doesn't figure out the right output, but it explores the data and can draw inferences from datasets to describe hidden structures from unlabeled data. Semi-supervised machine learning algorithms fall somewhere in between supervised and unsupervised learning, since they use both labeled and unlabeled data for training – typically a small amount of labeled data and a large amount of unlabeled data. The systems that use this method are able to considerably improve learning accuracy. Usually, semi-supervised learning is chosen when the acquired labeled data requires skilled and relevant resources in order to train it / learn from it..

Reinforcement machine learning algorithms is a learning method that interacts with its environment by producing actions and discovers errors or rewards. Trial and error search and delayed reward are the most relevant characteristics of reinforcement learning. This method allows machines and software agents to automatically determine the ideal behavior within a specific context in order to maximize its performance. Simple Machine Learning offers the possibility to identify the error early this saves down times and money. Self-learning programs are now also used in the medical field.

2. MATERIALS AND METHODS

Image processing is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it. It is a type of signal processing in

which input is an image and output may be image or characteristics/features associated with that image. But it's very costly depending on the system used, the number of detectors purchased. Also it is time consuming and has lack of qualified professionals as well.
The main limitation is that if the object size is smaller than the pixel size, then it cannot be applied efficiently because then one pixel can contain two or more objects**.** Our proposed method is obtaining the image through data preprocessing, measuring the entropy, separating hand region from images, tracking the hand region and recognizing hand gestures. The convexity defects for the hand contour were calculated using the OpenCV inbuilt function "cvConvexityDefects". The parameters of the convexity defects (start point, end point and depth point) are stored in a sequence of arrays.

A. Haar Cascade Algorithm

Haar Cascade is a machine learning object detection algorithm used to identify objects in an image or video. The algorithm has mainly four stages:

1. Haar Feature Selection
2. Creating Integral Images
3. Adaboost Training
4. Cascading Classifiers

B. Data obtaining

The initial move is to capture the image from camera and to define a region of Interest in the frame, it is important as the image can contain a lot of variables and these variables can result in unwanted results and the data that needs to be processed is reduced to a large extent. To capture the image a web-camera is used that continuously captures frames and is used to get the raw data for processing. The input picture we have here is uint8. The Procured image is RGB and must be processed before the components are separated and acknowledgement is made.

C. Data Pre-Processing

Pre-processing method can be completed 2-steps process:
(a) Segmentation
(b) Morphological filtering

First Process is the Segmentation process. It is done to change over grey-scale picture into the binary picture. That is, one will be hand and another one is background. Algorithm can be Haar Cascade used for this process and Gray scale picture are converted into binary picture having area of interest as the hand and the background.
The two main approaches to segmentation are:

1. Pixel-based or local methods having

a) Edge detection

b) Boundary detection

2. Region-based approach

a) The region merging

b) The region splitting

c) Thresholding method

Thresholding techniques is employed in partitioning the image pixel histogram by using a single threshold technique. We in this project have used Otsu's thresholding technique. HaarCascade thresholding is used to automatically perform cluster-based thresholding. The method assumes there are two classes of pixels following bi modal histogram and then it calculates optimum threshold separating the two classes

D. Background Subtraction

Background subtraction (BS) is a common and widely used technique for generating a foreground mask by using static cameras. As the name suggests, BS calculates the foreground mask performing a subtraction between the current frame and a background model, containing the static part of the scene or, more in general, everything that can be considered as background given the characteristics of the observed scene.

Background modeling consists of two steps Background Initialization and Background Update. In the first step, an initial model of the background is computed, while in the second step that model is updated in order to adapt to possible changes in the scene.

E. Morphological Filtering

After thresholding we have to make sure that there will be no noise is present in image, so we are using morphological filtering Techniques, These Techniques are divided into Dilation, Erosion, Opening and Closing

If the division is not continuous, then there may have some _1s' in the background which is called as background noise, Also, there is a possibility that system generated an error in recognizing gesture this may be termed as gesture noise. If we want flawless contour detection of a gesture, then abovementioned errors should be nullified. A morphological separating (filtering) approach is employed utilizing grouping of dilation (enlargement) and erosion (disintegration) to accomplish a smooth, shut, and finish the contours of a hand motion.

F. Extraction of Features

Pre-prepared or pre-processed picture is accessible to be utilized and different highlights of the resultant picture are removed. Features that can be extracted are Finding Contours, Finding and correcting convex hull and Action.

1.Finding Contours-It implies the direction of hand i.e., regardless of whether the hand is on a horizontal plane or vertically set. Initially, we try to find the orientation by length to width ratio with a presumption that if the hand is vertical ten length of the box bounding them will be more than the width of the same box and, if hand is horizontally placed then width of bounding box is larger than width of the box binding the hand will be more than that of the length of the box.

2. Finding and correcting convex hulls- A hand posture is recognized by its own orientation and by the fact that how many fingers are shown. For getting the aggregate of how many fingers are shown in hand motions that we have to process just area of the finger of the hand that we have in past advance by figuring out and analyzing the centroid.

3. Action:

NUMBER OF FINGERTIPS DETECTED	OPERATIONS PERFORMED
One	Forward
Two	Volume up
Three	Forward
Four	Backward
Five	Close

3. RESULTS AND DISCUSSIONS The vision-based cursor control using hand gesture system was developed in the python language, using the Open CV library. The system was able to control the movement of a Cursor by tracking the user's hand. Cursor functions were performed by using different hand gestures. The system has the potential of being a viable replacement for the computer mouse, however due to the constraints encountered; it cannot completely replace the computer mouse. The major constraint of the system is that it must be operated in a well-lit room. This is the main reason why the system cannot completely replace the computer mouse, since it is very common for computers to be used in outdoor environments with poor lighting condition.

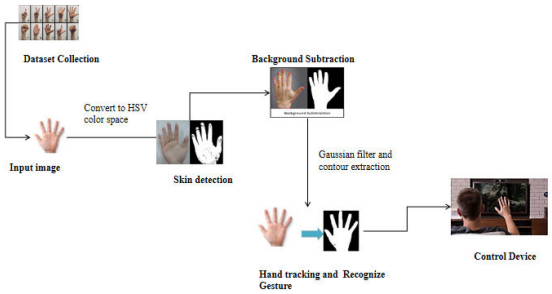


Fig 3.1 System Architecture

The accuracy of the hand gesture recognition could have been improved, if the Template Matching hand gesture recognition method was used with a machine learning classified. Here, what we do is, we just open our script file it will automatically launch a video player. Here we have chosen VLC Media Player. Then script stops execution for predefined time to load the media player. After video file is being played then system invokes the tools that we required to run it for instance- OpenCV, Camera, pyautogui. Now, we are ready to do just sit back and control without using any conventional method.

Fig 3.2 Increasing Volume

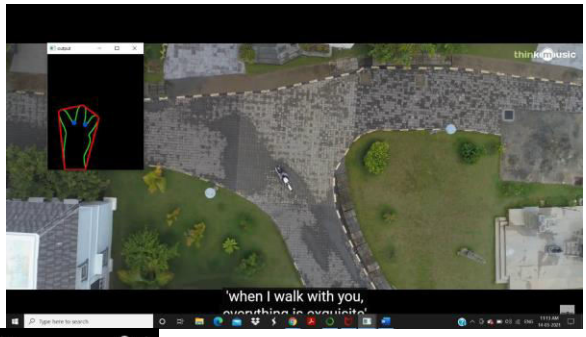
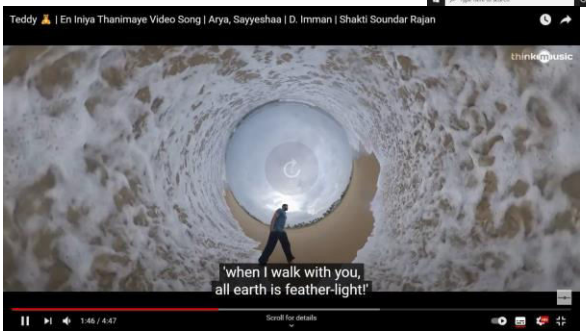


Fig 3.3 Decreasing Volume



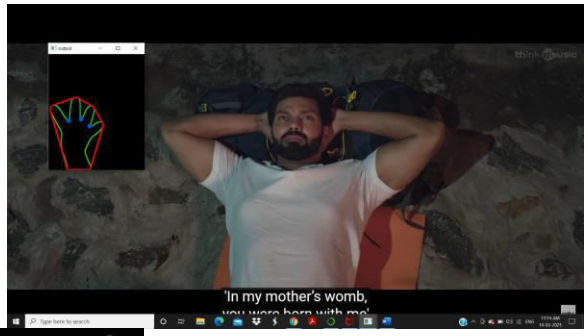


Fig 3.4 Moving Forwards

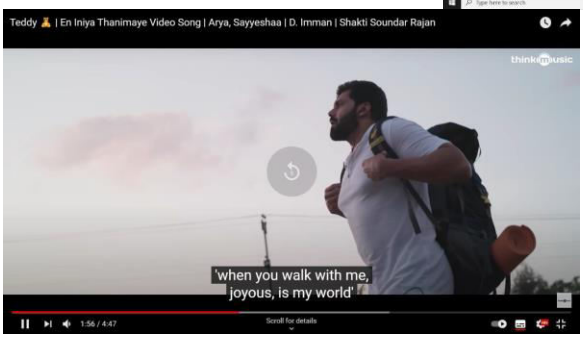


Fig 3.5 Moving Backwards

4. CONCLUSION AND FUTURE ENHANCEMENT

Cursor functions were performed by using different hand gestures. The system has the potential of being a viable replacement for the computer mouse, however due to the constraints encountered; it cannot completely replace the computer mouse. The accuracy of the hand gesture recognition could have been improved, if the Template Matching hand gesture recognition method was used with a machine learning classified. The performance of the software especially hand tracking in the near future. And we also want to decrease the response time of the software for cursor movement so that it can completely be used to replace our conventional mouse. We are also planning to design a hardware implementation for the same in order to improve accuracy and increase the functionality to various domains such as a gaming controller or as a general-purpose computer controller.

Other advanced implementation includes the hand gesture recognition. This method requires the use of a machine learning classifier, which takes a considerably long time to train develop. However, it would have allowed the use of lots more hand gestures which in turn would allow the use of more mouse functions such as zoom in and zoom out. Once the classifier is well trained, the accuracy of the Template Matching method is expected to be better than the

method used in the proposed design. Another novel implementation of this technology would to use the computer to train the visually or hearing impaired.

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