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Design an Eye Tracking Mouse

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ABSTRACT: **The paper presents the real time system interface between computer and human. This technology is able to replace the traditional mouse with the human face as a new way to interact with computer. The system we described is fast and affordable technique for tracking facial features. By using Six-Segment –Rectangular (SSR)filter, Integral Image and SVM for recognizing the facial features. This system can run at the speed of 30 frames/sec**.

Keyword: Face detection, SSR filter, Integral Image, SVM algorithm, Webcam.

I. INTRODUCTION

The current progression of computer technology has established many different applications in human computer interface. Face detection from images is a very active research area in the computer application. Face and gesture recognition is still remains a challenging and difficult problem to enable a computer to deal with face detection.

The main objective of this paper is to replace the traditional mouse with the human face as a new way to interact with computer. Human face is a dynamic object; it has a high degree of variability and various techniques have been proposed previously.

This technology is intended to be used by physically handicapped/Disabled people who are suffering from a lot of problems in communicating with computer. This technology will help disabled people to communicate through their voluntary movements like eyes and nose movements. People with unadorned disabilities can also benefit from computer access to do their daily jobs like play games and use of internet. This system uses a USB or inbuilt camera to capture and detect the user's face movements. The proposed algorithm tracks the movements of eyes and nose accurately to control the cursor, thus providing an alternative way to access computer mouse.

II. FACE DETECTION

In the recent few years very large amount of research being carried out in the field of face detection. Face detection is a vast research in the computer world.

Face detection techniques are classified into two categories: Feature-based Approach and Image-based Approach [1].

A. Feature-based Approach

In Feature-based Approach we find the facial features (e.g. Nose, eyes etc.)And verify their performance by examining locations and distance from
each other. Feature-based Approach can achieve high speed in face detection. Basically it is known for is pixel accuracy and speed.

B. Image-based Approach

This approach scans the image of interest with a window that looks for faces at all the scales and locations.

By Hjelman's survey the window scanning algorithm is in essence just on exhaustive search of the input images for possible face locations at all scales

III. SSR FILTER

At the beginning, a rectangle is scanned throughout the input image [4]. This rectangle is divided into six segments as shown in fig 2(a).

Fig.1 Six segmented rectangular filter. Average pixel value in each segment are computed and compared with each other to find whether they satisfy certain conditions

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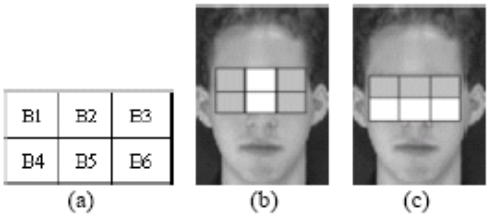

Fig.2Concept of SSR Filter: (a) the proposed rectangular filter divided into six segments. (b) Nose area is brighter than right and left eye area. (c) Eye area is relatively darker than cheekbone area [1].

We denote an average pixel value within a segment Si as Si .Then, when one eye and eyebrow are within S3, we can expect

S1 < S2 and S1 < S6 ……..(1)
S3 < S2 and S3 < S6 …….. (2)

When a point where (1) and (2) are satisfied can be a face candidate. We call this an SSR filter. The proposed SSR filter, which is the rectangle divided into 6 segments as shown in Figure 1, operates by using the concept of bright-dark relation around between-the-Eyes area as explained by Fig.2 (b) and (c). We select Between-the-Eyes as face representative because it is common to most people and easy to find for wide range of face orientation.

The proposed SSR filter is used to detect the Between-the–eyes [BTE] based on two characteristics of face geometry.

i. The nose area is brighter than the right and left eye area.
ii. The eye area (eyes and eyebrows) is relatively darker than the cheekbone area.

When these i and ii characteristics are satisfied, the center of the rectangle can be a candidate for Between-the-eyes.

IV. INTEGRAL IMAGE

The SSR filter is computed by using intermediate representation for image called as "integral image"[2].

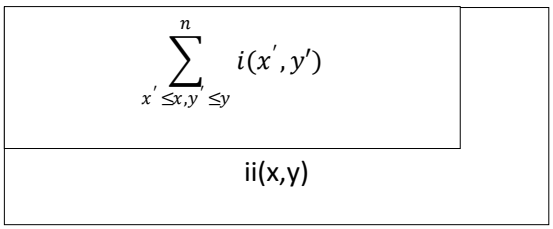

Fig.3 Integral image. (i) Pixel value (ii) Integral image

So, the integral image can be defined as:

$$ii(x,y) = \Sigma\, i(x',y')$$

$$x \le x, y' \le y$$

With the above representation the calculation of SSR filter becomes fast and easy.

The integral image can be computed in one pass over the original image by using following pair of recurrences.

$$s(x,y) = s(x,y-1) + i(x,y) \ldots\ldots\ldots\ldots (3)$$
$$ii(x,y) = ii(x-1,y) + s(x,y) \ldots\ldots\ldots (4)$$

Where, $s(x,y)$ is the cumulative row sum, $s(x,-1) = 0$, and $ii(-1,y) = 0$.

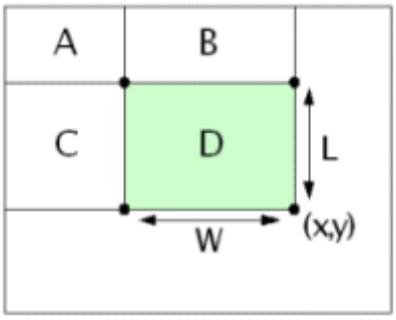

Fig.4 Integral Image[1]

The sum of pixels within rectangle D(sr) can be computed at high speed with four array reference as shown in Fig.4

S_r=(ii(x,y)+(x-W,y-L))-(ii(x-W,y)+ii(x,y-L)) …(5)

V. SUPPORT VECTOR MACHINE

SVM is a maximum margin classifier: In 'learning theory' there is a theorem stating that in order to achieve minimal classification error the hyper plane which separates positive samples from negative ones should be with the maximum margin of the training sample and this is what the SVM is all about. The Samples of data that are closest to the hyper plane are called support vector [4],[7]. The hyper plane is defined by balancing its distance between positive and negative support vectors in order to get the maximum margin of the training data set.

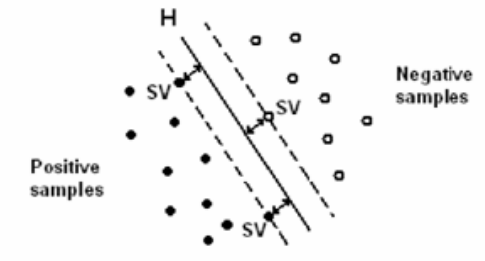

Fig. 5 Hyper plane with the maximal margin.

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A. Training pattern for SVM

To verify the BTE template SVM has been used. Each BTE is computed as: Extract 35pixel wide by 21 high templates, where the distance between the eyes is 23 pixel and they are located on 8th row as shown in Fig.6

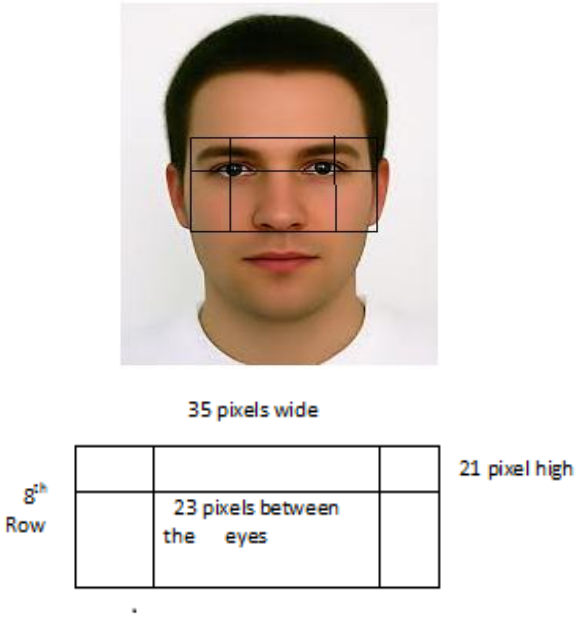

Fig.6 How to extract the training template

The attribute vector is 35 X 21 pixels long of template pixel values in training sample attribute. Minimum two local dark points are extracted from (S1+S3) and (S1+S6) areas of SSR filter for left and right eye candidate. To extract Between-the-eyes template, at the beginning the scale rate (SR) were located by dividing the distance between left and right pupil's candidate with 23, where 23 is the distance between left and right eye in the training template and are aligned in 8th row. Then Extract the template that has size of 35 x SR x 21, where the left and right pupil candidate are align on the 8 x SR row and the distance between them is 23 x SR pixels.

Fig.7 Face pattern for SVM learning

And then scale down the template with SR, so that the template which has size and alignment of the training template is horizontally obtained as shown in Fig.7

B. *Tracking Location*

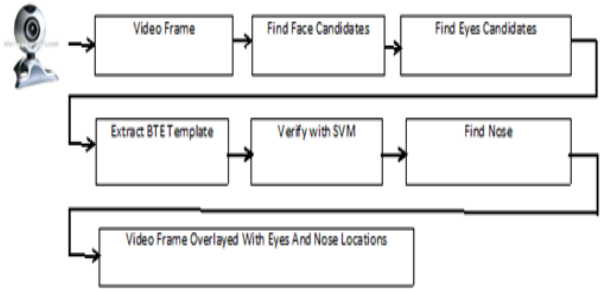

Fig.8 Flow for finding face of candidate[7].

We found the facial features that we need using SSR filter, integral image and SVM algorithm. Using webcam we track the images. The eyes are track to detect the blink which is converted into mouse click. And the nose is track to use for movements of co-ordinates. By using template matching find the location of new co-ordinates.

C. Eye and Nose Tracking

In the pattern of Between-the-eyes, eyes are detected and tracked with updated pattern matching. Then from the captured images appropriate image is selected according to the distance Between-the-eyes. To achieve better eyes tracking result we will using a BTE as a reference point for each frame after locating the BTE and eyes. Using SVM algorithm, SSR filter and Integral image we find the eye pupil [2], [4].For finding the nose we are checking the intensity using integral image. And by using BTE template we find nose bridge, from that we are finding the region of interest that is nose tip as shown Fig.9.

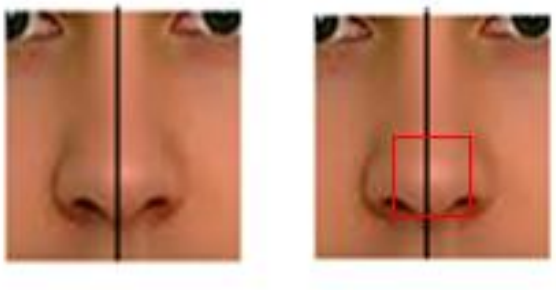

Fig.9 Finding nose tip.

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VI. IMPLEMENTATION

For operating the system we have to follow some protocols. The user has to seat in front of the screen with a USB or inbuilt webcam.

When user run the application, the camera first capture the user's image as per the frame rate 30 frames/sec. Then the facial features to be tracked like eyes, eyebrows and nose etc. Then the applied algorithm and procedures are worked as per described in above section.

A.JMF

The Java Media Framework is a framework for handling streaming media in java program. JMF provides a unified architecture and messaging protocol for managing the acquisition, processing and delivery of time-based media. JMF provides a platform-neural framework for handling multimedia. In our system we are going to use JMF 2.1.1. There are four jar files.

1) JMStudio:

It is an important tool that allows you to playback, capture, store, transmit or receive media. It is a simple player GUI.

2) *JMFRegistry:*

It is a standalone java application you can use to configure JMF. JMFRegistry manages all preferences and plug-ins etc.

3) *JMFCustomizer:*

It is use for creating JAR files that contains only the classes needed by a specific JMF application, which allows developers to ship a smaller application.

4) *JMFinit:*

For initialization of JMF.

VII. APPLICATION

Eye tracking mouse is used in the computer world for interact with computer without touching any physical device. It will used to control computer programs and any computer applications like playing games.

VIII. FUTURE SCOPE

Future work may include improving the robustness against the lighting conditions. By using the highly qualified camera operate the operation to get more accurate result. Adding the scrolling movement (Using nose) Functionality. Also add the speech module which will operated by users mouse and launch on the start of the PC. Also we can add scrolling functionality by using face movements.

IX. CONCLUSION

"Eye Tracking Mouse" is boon for the disable people who are not able to use physical mouse properly. It will gives them a new way to interact with computer world. It opens a new era in computer technology. It is efficient in real time applications which give speed and accuracy of the system.

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