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Eye Faction Along with Glisten Psychiatry Using Human Computer Interface

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Abstract-Eye movement and blink analysis has achieved its peak technology and less expensive. With the availability of high speed processors and inexpensive webcams , more and more people have become interested in real time applications that involve image processing .one of the promising field in artificial intelligence is HCI(Human Computer Interface) which aims to use human features (e.g. face, hands) to interact with the computer. One way to achieve that is to capture the desired feature with a webcam and monitor its action in order to translate it to some events that communicate with the computer With the growth of attention about computer vision, the interest in HCI has increased proportionally. There are different human features and monitoring devices used to achieve HCI. In this project we were interested only in works that involved the use of facial feature Eye and webcam. We notice a large diversity of the facial features are selected and the way are detected and tracked, and the functionality that they presented for the HCI.

Keywords: Human-Computer Interface, Face detection, Eye tracking

I. INTRODUCTION

A. Objective

This system provides a possible new solution for a Human-Computer Interface (HCI) system that can be used for highly disabled people. Besides that, motion information has been exploited as well. The dense motion field describes the motion patterns, in which the eye lid movements can be separated to detect eye blinks. The ability to differentiate the motion related to blinks from the global head motion is essential. Two-step based blink (open and close) detection system requires the tracking algorithms which is capable of handling the appearance change between the open eyes and the closed eyes.

Two interactive particle filters are used, one to track the open eyes and the other to track the closed eyes. Eye detection algorithms can be used to give the initial position of the eyes and the grey prediction algorithm is used for eye tracking and blink detection. For each particle filter, the state variable characterizes the location and size of the eyes.

Introduction to Human Computer Interface :

HCI is the studies of how people interact with computers and to what extent computers are not developed for successful interaction with human being. Researchers choose different facial features: eye pupils, eyebrows, nose tip, lips, eye lid's corners, mouth corners for each of which they provided an explanation to choose that particular one. As its name implies, HCI consists of three parts: the **user**, the **computer itself**, and the **interaction** ways they work together.

B. Motivation

The project has motivated exclusively for physically challenged person .This has attracted many of the public. This provides an easy communication in between user and computer.

C. Problem Statement and Scope

Most existing techniques use two separate steps for eye tracking and blink detection. For eye blink detection systems, there are three types of dynamic information involved: the global motion of eyes (which can be used to infer the head motion), the local motion of eye pupils, and the eye openness/closure. Accordingly, an effective eye tracking algorithm for blink detection needs to satisfy the following constraints:
• Track the global motion of eyes, which is confined by the head motion
• Maintain invariance to local motion of eye pupils
• Classify the closed-eye frames from the open-eye frames
Temporal information is also used by some researchers for blink detection purposes. For example, the image difference between neighboring frames is used to locate the eyes, and the temporal image correlation is used thereafter to determine whether the eyes are open or closed..

II. SYSTEM ANALYSIS

A. Existing System Survey

The goal is to develop computer vision systems that make computers perceptive to a user's natural communicative cues such as gestures, facial expressions, and gaze direction. Such systems are especially relevant for people who cannot use the keyboard or mouse due to severe disabilities. The traditional human-computer interfaces demand good manual dexterity and refined motor control which may be absent or unpredictable for people with certain disabilities.

The primary motivation of this research is to provide an alternative communication tool for people whose motor abilities are extremely limited by conditions ranging from cerebral palsy and traumatic brain injuries to multiple sclerosis. The access to information and enhanced communication that assistive technology provides is both practical and empowering for individuals with disabilities. A robust, accurate algorithm to detect eye blinks, measure their duration, and interpret them in real time to control a non-intrusive interface is proposed for

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computer users with severe disabilities. The existing method employs visual information about the motion of eyelids during a blink and the changing appearance of the eye throughout a blink in order to detect the blink's location and duration. Our system uses various computer vision techniques in addition eye blink motion is used to automatically locate the user's eyes in the video sequence. In particular, candidate motion patterns are compared against a stored model of the properties of actual eye blink motion in order to eliminate motion that is unlikely to have resulted from blinks. The location information gained from the blink motion then offers an opportunity to select an eye template online for further tracking. The correlation between the open eye template and the current eye in the scene reveals the extent of the eyes openness which, together with the complementary motion information obtained from both eye areas, allows us to classify the eye as either open or closed at each frame.

B. Drawbacks

Face detection is normally formulated as a classification problem to separate face patterns from non-face patterns. From the statistical point of view, there are mainly three obstacles for this problem:

- The dimensionality of patterns is usually high.
- The possible number of non-face patterns is extremely large and their distribution is very irregular.
- It may also be difficult to model the probability distribution of face patterns, especially the multi-view face patterns, with a unimodel density function.

The problem of dealing with rotation in depth and it is difficult to detect faces across multiple views. Many researchers addressed this problem by building multiple view-based face detectors, i.e. to divide the view sphere into several small segments and to construct one detector on each segment. Nevertheless, a new problem is normally introduced in these view based approaches: since the pose of a face is unknown before detection, detector should choose to determine if it is a face. A common solution to this problem is to apply all view-based detectors to an input image (or sub-image) and to make a decision based on the one with maximal response.

C. Proposed System

A real-time system which consistently runs at 27- 29 frames per second (fps), is completely non-intrusive and requires no manual initialization, prior face detection, or special lighting is being proposed. The system can reliably classify blinks as voluntary or involuntary based on their duration. The operation is performed by right click using left eye and left click using right eye.

Alternative communication systems for computer users include head-mounted tracking devices, tongue or hand activated switches, sip-and-puff mouth-controlled joysticks, camera-based and electro-oculographic gaze estimators. The goal of introducing eye blink detection functionality in a camera-based system is to provide another point of access for those users who are not capable of controlling motors that the above methods demand. Eye tracking is the focus problem in the researching domain of human-machine interaction and computer vision. So a new eye tracking method is proposed. This method combines the location and detection algorithm with the grey prediction for eye tracking. The Grey Model GM (1,1) model is used to predict the position of moving eye in the next frame, and then this position is taken as the reference point for the searching region of eye.

Experimental results for image sequence of eye maneuvering show that the grey prediction model GM(1,1) can track eye region robustly and correct. The Purpose is to develop computer vision systems that make computers perceptive to a user's natural communicative cues such as gestures, facial expressions, and gaze direction. Such systems are especially relevant for people who cannot use the keyboard or mouse due to severe disabilities. The traditional human-computer interfaces demand good manual dexterity and refined motor control which may be absent or unpredictable for people with certain disabilities.

D. Product Scope

Voluntary long blinks trigger mouse clicks, while involuntary short blinks are ignored. The system enables communication using "blink patterns:" sequences of long and short blinks which are interpreted as semiotic messages. The location of the eyes is determined automatically through the motion of the user's initial blinks. Subsequently, the eye is tracked by correlation across time, and appearance changes are automatically analyzed in order to classify the eye as either open or closed at each frame. No manual initialization, special lighting, or prior face detection is required.

E. Product Perspective

The system employs visual information about the motion of eyelids during a blink and the changing appearance of the eye throughout a blink in order to detect the blink's location and duration. Moreover, the system is designed to initialize itself automatically, and it adjusts to the changes in the user's position in depth. Using the "Blink Link," as the prototype system, a user who is capable of blinking voluntarily can generate mouse clicks through his or her eye blinks in order to operate software applications requiring such input.

F. Product Functions

- Perform motion estimation, skin color detection or background subtraction on input images or an image sequence to locate ROI.
- Exhaustively scan these image regions at different scales;
- For each image patch from the scan, estimate the ‘pose’ (tilt and yaw) using pre-trained pose estimator;
- Choose an appropriate face detector according to the estimated pose to determine if the pattern is a face;
- Refine the results of detection.

G. Constraints

Design is one of the most expensive phases of the operation of computerized system and is often the major problem of a existing system. A large number of problems with the system can usually be traced back to fault input design and method.

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The most critical stage is achieving a successful system and giving confidence on the new system for the users that it will work efficiently. It involves careful planning, investing of the current system, and its constraints on its implementation, design of methods to achieve the change over, and evaluation of the changeover methods. The implementation process begins with preparing a plan for the implementation of the system. According to the plan, the activities has to be carried out, discussion has been made regarding the equipment, resources and how to test the activities**.**

III. METHODOLOGIES

A. SVM (Support Vector Machine)

Two tasks need to be performed for head pose estimation: constructing the pose estimators from face images with known pose information, and applying the estimators to a new face image. The method of SVM regression to construct two pose estimators, one for tilt (elevation) and the other for yaw (azimuth). The input to the pose estimators is the Principal Component Analysis (PCA) vectors of face images. The dimensionality of PCA vectors can be reasonably small in our experiments (20, for example). The output is the pose angles in tilt and yaw. The SVM regression problem can be solved by maximizing,

$$F(x)=\sum_{i=1}^{l}(\alpha_i*-\alpha_i)k(x,x_i)+b \quad (1)$$

where x is the PCA feature vector of a face image, k is the kernel function used in the SVM pose estimator, y_i is the ground-truth pose angle in yaw or tilt of pattern x; C is the upper bound of the Lagrange multipliers a_i and a_{pi} and 1 is the tolerance coefficient. Two pose estimators in the form of ft for tilt and fy for yaw, are constructed. The support vectors (SVs) and patterns with the largest error from the previous iteration have higher priority for selection. The algorithm is stopped when no significant improvement is achieved.

SVM-based face detector can be constructed by maximizing,

$$W(\alpha)=\sum_{i=1}^{l}\alpha_i-1/2\sum_{i,j=1}^{l}\alpha\,\alpha_j y_i y_j k(x_i,x_j) \quad (2)$$

$$\sum_{i=1}^{i}\alpha_i y_i=0 \qquad \text{where } 0\leq\alpha\leq C, \qquad i=1,2,\ldots\ldots\ldots l$$

Where y_i is the label of a training example x_i which takes value 1 for face and 2 for non-face, k is a kernel function, and C is the upper bound of the Lagrange multiplier a_i. For a new pattern x; the trained face detector gives an output.

$$F(x)=\sum_{i=1}^{l}y_i\alpha_i k(x,x_i)+b \quad (3)$$

Where b is the bias. This algorithm is used to find the difference in first frame and second frame to track the eye. The Eigenface method models the probability of face patterns, while the importance of non-face patterns in this method is not significant except when choosing the threshold. On the other hand, an SVM-based face detector makes use of both face and non-face patterns: it estimates the boundary of positive and negative patterns instead of estimating the probabilities. The Eigenface method is computationally efficient but less accurate, while the SVM method is more accurate but slow. The SVM based classifier is computationally more expensive than the Eigenface method, but more accurate. However, since the proportion of the examples in the ambiguous region is relatively small, a significant improvement of the classification speed can be achieved. Furthermore, owing to the fact that the SVM classifier is trained only on the examples in the ambiguous region and not on the whole training set, the SVM classification problem is simplified to some degree. The main advantage of this algorithm is that it is independent from the persons and it does not need to be tuned. Moreover, it provides good results with more than 80% of good detections of drowsy states which can be implemented for physically challenged peoples for operating the PC using Eyes as a primary input device.

B. Grey Prediction Algorithm

A system is called “white” if all the information of the system is known. On the other hand, a system is called “black” if this system does not know anything about it. Thus a grey system is the one which is partially known. The Grey theory is able to deal with indeterminate and incomplete data to analyze and establish the systematic relations and a prediction model.

The Grey prediction has been widely used in studies of social sciences, agriculture, procreation, power consumption and management, as well as other fields. Grey prediction power comes from its ability to predict the future value with only a few data. Grey prediction based on Grey Model (GM) has two basic operations: Accumulated Generating Operation (AGO), Inverse Accumulated Generating Operation (IAGO) and grey modeling. Generally, there are a few types used in the literature,

- GM (1, 1): This represents first-order derivative, containing one input variable,
- Generally used for prediction purposes.
- GM (1, N): This represents first-order derivative, but containing N input variables, for multi-variable analysis.
- GM (O, N): This represents zero-order derivative, containing N input variables, for prediction purposes.

The GM (1, 1) model is the most commonly used model. The first 1 in GM(1,1) means that there is only one variable, and the next 1 means that the first order grey differential equation is used to construct the model. The GM (1, 1) model is used to predict the position of moving eye in the next frame, and then this position is taken as the reference point for the searching region of eye. The efficiency of eye tracking is improved in this way. The grey prediction algorithm based on GM (1, 1) model is as follows: Consider the non-negative data:

$$U^0=[u^{(0)}(1),u^{(0)}(2),u^{(0)}(3),\ldots\ldots,u^{(0)}(n)], \text{ where } n\geq4 \quad (4)$$

Then the GM (1, 1) is:

$$U^{(0)}(k)+aZ^{(1)}(k)=b, \quad k=1,2,3,\ldots\ldots \quad (5)$$

Where “a” is called “develop parameter” and “b” is called “grey input”. The main advantage of this algorithm is that it has the ability to predict the output or the error of the system depending on a small amount of data.

IV. SYSTEM IMPLEMENTATION

A. Motion Analysis

During the first stage of processing, the eyes are automatically located by searching temporally for "blink- like" motion. This module captures the video information in frames. This method analyzes a sequence of the user's involuntary blinks and exploits the redundancy provided by the fact that humans naturally blink regularly. The bi-directional difference image is formed from previous frame image and current frame image for all pixels (i; j) in order to capture both increasing and decreasing brightness changes. The difference image threshold to produce a binary image representing regions of significant change, i.e. motion, in the scene.

Next the image undergoes erosion with a cross- shaped convolution kernel in order to eliminate spurious pixels generated by phenomena such as flickering lights, high-contrast edges, or arbitrary jitter. The changes in the subsequent frames lead to know about whether the object is in motion or not. For example, the sharp contrast along the edge between the face and the hair or shadow on the neck permits only a negligible amount of movement to result in a significant brightness change. Pixel value is used to identify the location here it is termed as i and j.

a) Background Suppression

The background suppression module selects foreground points at each time t by computing the distance, in the RGB color space, between the current frame and the background model, obtaining the difference image, defined for each image point.

b) Blob Analysis and Mining

With the help of 8-connectivity, the system detects all the blobs of connected candidate moving points. It updates the frame information. Blobs with small area are discarded as noise while the rest are validated as actual MVOs (Moving Visual Object).With every MVO the average speed is computed by means of frame-difference. By using threshold values separation is done between a moving MVO and stopped MVO.

c) Background Update

The background model is computed as a statistical combination of a sequence of previous frames and the previously computed background (adaptability). The statistical function used is the median. In order to improve the background update, the system use selectivity, so the background is updated.

B. Color Analysis

The color analysis subsystem are categorized as follows,

a) Skin Detection

To reduce the search area for face detection (increasing the processing speed and decreasing the false detection rate), the system used simple rules to verify if a point belonging to MVO has a skin color or not, using the pixels normalized RGB color space information. Based on the intensity in the RGB color space the skin color is detected.

b) Skin's Blob Mining

A region-based labeling is preformed to compute the connected skin's blobs of skin pixels. Blobs with small area are discarded as noise.

C. Face Analysis

a) Face Detection

The implemented detection subsystem detects frontal faces with small in-plane rotations. Sample faces are stored. They are converted into vector and those values are stored. This face detector corresponds to a cascade of filters that discard non-faces and let faces to pass to the next stage of the cascade.

b) Overlapping Detections Processing

Face windows obtained in the face detection module are processed and fused for determining the size and position of the final detected faces. Overlapping detections were processed for filtering false detections and for merging correct ones.

c) Face Identification

This module was used to filter false detections. This filtering corresponds to an inter-frame operation, while the filtering applied in the Overlapping Detections Processing module to an intra-frame operation. Face detections belonging to consecutive frames were considered to be the same face, by applying the same heuristic used to process overlapping detections. The face images and its corresponding threshold values are stored in a matrix form. The given input frames are also converted into vector and the comparison is made against the stored sample faces vector values if it comes nearly 70% equal then it is considered as a face.

D. Eye Tracking

Relying on motion would make the system extremely intolerant of extra motion due to facial expressions, head movement, or gestures. The user must be allowed to move his or her head with relative freedom if necessary. Following initial localization, a fast eye tracking procedure maintains exact knowledge about the eye's appearance. Thus, the eye may be evaluated for amount of closure at the next stage. As described, the initial blink detection via motion analysis provides very precise information about the eyes positions. Consequently, a simple tracking algorithm suffices to update the region of interest centered on the eye. It tracks out the black part of eye in all the frames.

E. Blink Detection

As the eye closes, it begins to look less and less like an open eye; likewise, it regains its similarity to the open eye slowly as it reopens. However, the apparent correspondence of the two measures would make it redundant to compute. It detects the amount of time the black and white information appears in the eyes. Likewise, processing time may be conserved by tracking and computing the correlation for only one eye.

V. PERFORMANCE EVALUATIONS

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A. Space Complexity

Automatic garbage collection - memory management handled by JVM. Video sequence is stored in buffer and the old frame is replaced by new frame so the memory is not wasted. The frame is stored in the buffer. The primary space is required to process the image that is captured from web camera, detect the face by comparing the stored images, locate the eyes and perform the operations.

B. Time Complexity

Time is the basic requirement to process the voluntary and involuntary blink. Speed will vary depending on the system. Saccade lengths and times as well as their statistical distribution during typical use of a computer. The big advantage of such a method is the high accuracy and nearly unlimited resolution in time. Every eye tracker reports the gaze direction in certain time intervals. For video-based eye trackers the time intervals are determined by the frame rate of the video camera.

C. Efficiency

The most critical stage is achieving a successful system and giving confidence on the new system for the user that it will work efficiently. It involves careful planning, investing of the current system, and its constraints on its implementation.

- The system works for physically challenged humans.
- Every normal human can try the system with eyes.
- System works for both eyes.
- The individuals with or without spectacles can work efficiently.
- Left eyes are user for Right mouse operations.
- Right Eyes are used for Left mouse operations.
- The primary dependency for the system is Logitech Web cam with RGB Encoding.
- JMF – Java Media Framework API is required.
- Perform different operations like single click (right and left click), double click.

D. Issues And Limitations

- Face capturing migration needs to change the providers and the training database
- Plan and sub-plan the modification and changes
- Distance between the human eye and web cam should be in particular distance

VI. RESULTS

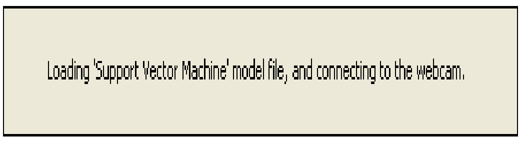

Figure: 1 Loading files

In figure 1 while executing all the files are loaded and connecting the web camera.

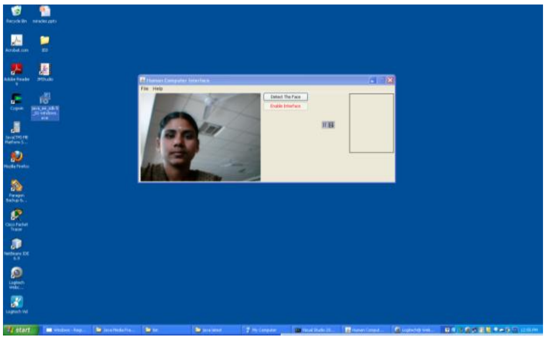

Figure:2 Face captured

In figure 2 ,the face is captured using web camera

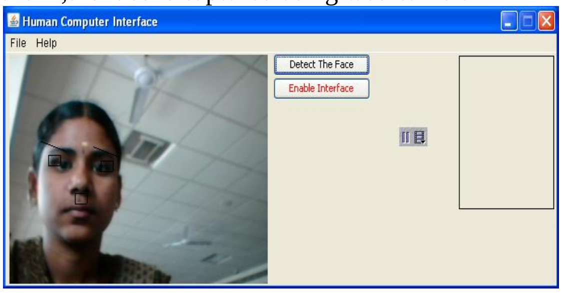

Figure: 3 detect the eye

In figure 3 eye and nose are detected by clicking detect the face button.

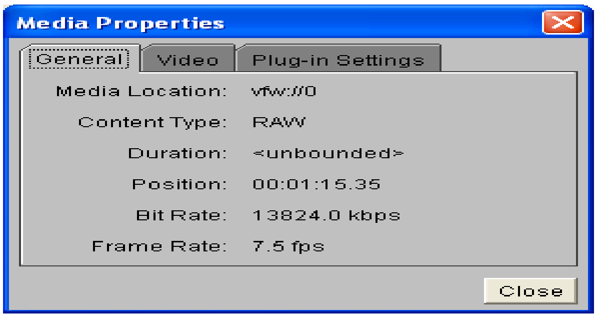

Figure: 4 properties

In figure 4 properties of frame are specified in general tab like location, position of frame, bit rate, content type, and frame rate.

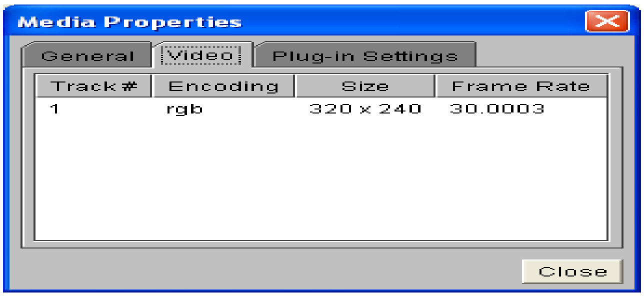

Figure: 5 RGB format

In figure 5 type of encoding is mentioned with size of the frame.

Figure: 6 Enable Interface

In figure 6 when enable interface button is clicked the face is displayed on right side of the screen and can perform the operations.

VII. CONCLUSION

In this project a simultaneous eye tracking and blink detection system is proposed. Two Illumination invariant motion detection algorithms are used for detecting the moving object .The system uses color analysis to detect the human skin color. The SVM algorithm for detecting the human face and the posture of the human face, which in turn works efficiently and automates itself to inactive stage if there is no humans are present before the system .The grey prediction algorithm is used to track the human eye movements and voluntary and involuntary eye blinks. The grey prediction system that gives higher confidence is used to determine the estimated eye location as well as the eye's status (open vs. closed). The algorithm is evaluated using videos collected under different scenarios, of indoor data. Performance is evaluated for the blink detection rate and the tracking accuracy perspective. The system can perform the blink operations, which shows that the proposed algorithm is able to accurately track eye locations and detect blinks.The System can be enhanced with audio interfaced with eye operation, so that the application gets two way inputs. The system can be implemented for control panel activities and enhanced for much interactive application with OSK (on screen keyboard).The system can be implemented in YUV format so it can be used in laptops.

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