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Vision based eye blink monitoring system for human computer interaction

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***Abstract*— The main objective of our project is to compensate people who have hand disabilities that prevent them from using the mouse by designing an application that uses facial features (nose tip and eyes) to interact with the Computer. Eyes were used to simulate mouse clicks, so the user can fire their events as the person blinks. Eyes were used to simulate mouse clicks, so the user can fire their events as he blinks. While different devices were used in HCI (e.g. infrared cameras, sensors, microphones) we used an off-the-shelf webcam that affords a moderate resolution and frame rate as the capturing device in order to make the ability of using the program affordable for all individuals. Trying to present an algorithm that distinguishes true eye-blinks from the involuntary ones. It**

detects and tracks the facial features abruptly, thereby fast enough to be applied in real-time. The human face of different races that can be captured with the help of night vision camera that detects the facial features correctly and translates it in to some events which are further used to communicate with the computer.

- **Index Terms**: face tracking, eye blink monitoring, vision based mouse control**.**

I. INTRODUCTION

In the past few years high technology has become more progressed, 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 fields in artificial intelligence is HCI 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.

Face detection has always been a vast research field in the computer vision World, considering that it is the backbone of any application that deals with the human face (e.g. surveillance systems, access control). Researchers did not spare any effort or imagination in inventing and Evolving methods to localize, extract, and verify faces in images. Early methods are dated back to 1970s, where simple heuristics were applied to images taken with certain restrictions (e.g.plain background, Frontal view). In this work we were trying to compensate people who have hand disabilities that prevent them from using the mouse by designing an application that uses facial features (nose tip and eyes) to interact with the computer. The nose tip was selected as the pointing device; the reason behind that

decision is the location and shape of the nose; as it is located in the middle of the face it is more comfortable to use it as the feature that moves the mouse pointer and defines its coordinates, not to mention that it is located on the axis that the face rotates about, so it basically does not change its distinctive convex shape which makes it easier to track as the face moves.

Eyes were used to simulate mouse clicks, so the user can fire their events as blinks. While different devices were used in HCI (e.g. infrared cameras, sensors, microphones) we used an off-the-shelf webcam that affords a moderate resolution and frame rate as the capturing device in order to make the ability of using the program affordable for all individuals. We will try to present an algorithm that distinguishes true eye blinks from involuntary ones, detects and tracks the desired facial features precisely, and fast enough to be applied in real-time.

II. VISION BASED EYE BLINK MONITORING SYSTEM: A STARTING POINT

This chapter describes the background of the research area; where it all started and where it to a great extent still is today. The work presented later in this thesis will however take this further, and go beyond the paradigm that has been dominating the field of human-computer interaction for computer users from the start in the mid eighties. The review below is a point of departure, in order to give the reader an understanding
of the prevalent research focus is an overview of the research area of human-computer interfaces for users, where the main focus areas are described.

A. EYES TRACKING

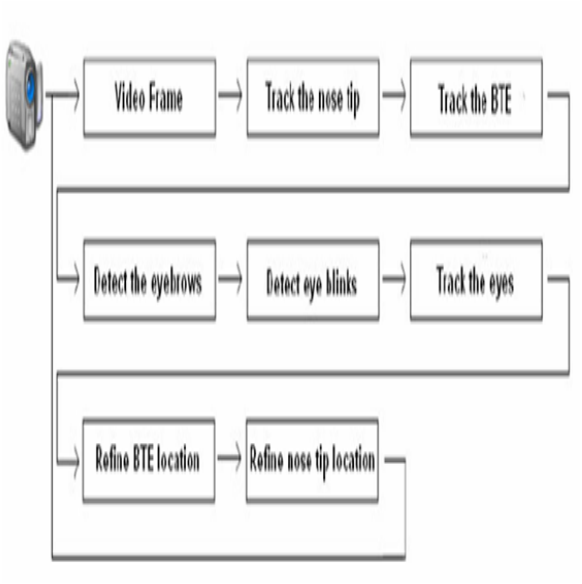
If a left/right blink was detected, the tracking process of the left/right eye will be skipped and its location will be considered as the same one from the previous frame (because blink detection is applied only when the eye is still). Eyes are tracked in a bit different way from tracking the nose tip and the BTE, because these features have a steady state while the eyes are not (e.g. opening, closing, and blinking). To find the eye's new template in the ROI we combined two methods: the first used template matching, the second searched in the ROI for the darkest 5*5 region (because the eye pupil is black), then we used the mean between the two found coordinates as the eye's new location. The problem with the darkest region method was that it picked the eyebrow sometimes as the eye ; here comes the eyebrow detection role where the eye's ROI is placed under the detected eyebrow line to avoid picking it as the eye. Suppose that an eyebrow was picked as the new tracked eye , in the next frame the eyebrow detection region will be taken above the eye's ROI;in his case the region will contain only the forehead (because the region was taken above the false eye which is in fact the eyebrow).

So when eyebrow detection is run for the first time it will not find the eyebrow because threshold the forehead will not give any results, so the eyebrow detection region will be lowered and the detection process will be rerun but this time it will find the eyebrow line, the eye's ROI will be placed beneath it, and the eye tracking process will find the correct eye again

III. OBJECTIVES

Our project aims to present an application that is able of replacing the traditional mouse with the human face as a new way to interact with the computer. Facial features (nose tip and eyes) are detected and tracked in real-time to use their actions as mouse events. We noticed a large diversity of the facial features that were selected, the way they were detected and tracked, and the functionality that they presented for the HCI.

Different detection techniques were applied (e.g. feature based, image based) where the goal was to achieve more accurate results with less processing time. To control the mouse pointer various points were tracked ranging from the middle distance between the eyes, the middle distance between the eyebrows, to the nose tip. To simulate mouse clicks, eye blinks, mouth opening/closing, and Sometimes eyebrow movements were used. The left/right eye blinks fire left/right mouse click events. The only external device that the user needs is a webcam that feeds the program with the video stream.



IV. SOFTWARE DEVELOPMENT PROCESS

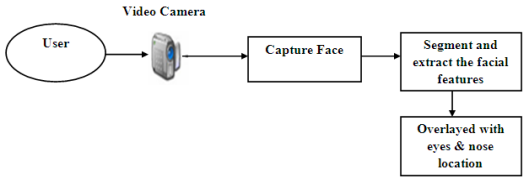
The incremental and iterative development type of development process was chosen since this type of project of interface design is based on usability and heuristic process that cannot be measured precisely with only decision matrixes, only by constant feedback and reevaluation can good results be obtained. Each process must be developed, tested and improved. The basic idea behind iterative enhancement is to develop a software system incrementally, allowing the developer to take advantage of what was being learned during the development of earlier, incremental, deliverable versions of the system. Learning comes from both the development and use of the system, where possible. Key steps in the process were to start with a simple implementation of a subset of the software requirements and iteratively enhance the evolving sequence of versions until the full system is implemented. each iteration, design modifications are made along with adding new functional capabilities (Craig Larman et al., 2003).

V. SYSTEM DESIGN

System design is the process of planning a new system to complement or altogether replace the old system. The purpose of the design phase is the first step in moving from the problem domain to the solution domain. The design of the system is the critical aspect that affects the quality of the software. System design is also called top-level design. The design phase translates the logical aspects of the system into physical aspects of the system.

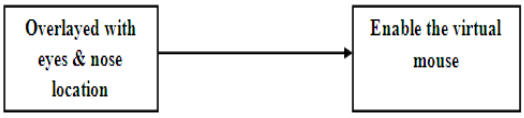
A.Input Design

Input design is the process of converting user-oriented input to computer-based format. The goal of input data design is to make data entry as easy, logical and free from errors as possible. Main screen is designed with Menu bar, Tool box, Property window, Design frame and Code window. The skeleton structure of the form design required by the user is given as the input. Components can be added to the design frame from the Toolbox window and the user required form design can be designed.



B.Output design

The output design was done so that results of processing could be communicated to the users. Output requirements are designed during system analysis. A good starting point for the output design is the Data Flow Diagram (DFD). Human factors educe issues for design involves addressing internal controls to ensure readability.



VI. CONCLUSION

With the growing interest in HCI we are trying to provide an application with the use of facial features and webcams that are robust and precise enough to replace the optical mouse. In this project, a

review categorizing eye tracking systems from numerous angles; from the different methods of detecting and tracking techniques were applied (e.g. feature based, image based) where the goal was to achieve more appropriate results with minimum processing time. We tried to profit from the experience that other researchers gained in the HCI field and added our own ideas to produce an application that is fast, robust, and useable. With the help of face detection algorithm and SVM which are used to cluster the skin samples. Eye Blink monitoring system provides an effective way to interact with the computer which detects and tracks the desired facial features precisely, and fast enough to be applied in real-time. While these methods have been successful in improving eye detection and tracking, there remains significant potential for further developments

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