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AI Based Robust Human computer interaction based head controlled mouse

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ABSTRACT:
Hand-free control for human-computer interface has been very important nowadays. For hand-free solution, to use human body movement tracking in video input and utilize the tracking is an important kind of solution. In this paper, we have presented a hand-free head mouse control based on mouth tracking. We use mouth position interval information between front-frame and the next-frame in video frames of head motion to confirm if a mouth tracking is movement information or command information, once a movement information has been determined, we use a mapping function which is set up by relationship between MMA and screen to map mouth position, then the real mouse position can be got, by this way we can operate mouse cursor in OS. On the other ways, if mouse click command information is determined, we can capture the mouth movement tracking, and then use recognition machine to recognize the tracking to determine which command it is. We have made experiments on Windows XP System to evaluate that our algorithm can represent a good effect for human-computer interface.

INTRODUCTION

With the proceeding of computer science and technology, the usage of computer has brought about significant facilitation in every aspect of the society. However, the common computer input devices are usually designed for normal capable users, instead of elderly and disabled ones. The use of computers requires a mouse, a touchpad, a keyboard or other external devices. Users with upper limbs disabilities are incapable of controlling the mouse or keyboard easily, which makes it extremely difficult for them to use a computer. For common computer users, the long-term usage of conventional input devices causes chronic sore in hands, shoulders or neck, and greatly increases the risk of getting cervical or vertebral spondylosis.

In order to facilitate the disabled to use computers, extensive work has been carried out and two kinds of solutions are presented. The first solution is to use contact-type auxiliary equipment, e.g. infrared sensors and infrared reflector, to detect the user's movements to control a computer. Takami et al. invented a special kind of eyeglasses with three light-emitting diodes. By sitting in front of a computer with the eyeglasses, the user's image will be captured by camera, and the head movements are judged, so as to operate the computer. Evans et al. used infrared light-emitting diodes and photo detectors as auxiliary equipment to determine the user's head position to operate a computer. Chen et al. produced a mouse and a keyboard which can detect infrared signals. These devices use infrared light to achieve positioning and determining whether it is clicked or not, realizing operations of mouse and keyboard by head. Judging eyes gazing direction by measuring the corneal reflex can also be used to operate the computer. Gips et al. used EOG (electrooculographic potential) to detect eyes movements. They designed an EOG-based system that allowed people to control a mouse through moving eyes. The results of such research have been applied in the lives of children. The advantage of contact-type solution is that the detection of movement is accurate. However, the solution requires the user to wear special glasses, sensors or other equipments, which brings inconvenience to the user. The cost of these auxiliary devices is very high which greatly limits their wide usage.

The second solution is non-contact-type, which is to determine the user's action by collecting and analyzing the user's facial images with image processing techniques. Masoomeh and Alireza proposed an algorithm to transfer 2D camera motion information into 3D information to realize mouse operations. Margrit et al. realized mouse operations by tracking the facial features and achieved certain effects. Some other systems detected and analyzed the movement of eyes or mouth to operate the mouse. Compared with the contact-type method, non-contact-type method is easy to use, free of any contacting devices, and with better experience of users. However, this method requires high-quality camera and image processing equipment. The software that suits this system is yet to be perfected until now.

The paper proposed an algorithm to detect the movements of head and mouth and made a simple demo verification. In this paper, we presented a complete head-trace mouse system via webcam, using image processing technology to recognize the movements of head and mouth. Besides, we made a detailed introduction for the functions of the head-trace mouse.

Head Tracking Virtual Mouse is an application that uses the feature classification method to map the mouse pointer on the screen to the movements of head and eye in frames through a camera. The system analyzes the relationship between different combinations of the detected head and eye open and closing action, and then maps them to mouse events on the computer system. Our aim is to use this application mainly for the upper limb disabled who are unable to use the traditional mouse.

LITERARY SURVEY

A review on head based Human Computer Interaction which focuses features such as head

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tracking, face and facial expression recognition, eye tracking, and gesture recognition HCI is presented by Porta (2002) and Turk (2004). Adaptive and intelligent HCI is discussed by Duric et al. (2002) with a review of computer head for human motion analysis and a discussion of techniques for lower arm movement detection, face processing, and gaze analysis. All of these articles agree that approaching the naturalness of human-human interaction plays a central role in the future of HCI and that this objective can be approached by designing adaptive HCI systems that are affective, context-aware and multimodal.

According to Reeves et al. (2004), a multimodal HCI can be an effective means for reducing uncertainty of single-modally sensed data (such as speech or hand motion), thereby improving robustness. Although, the incorporation of all features of human-human interaction into human-computer interaction may be very complex and difficult to achieve, equipping HCI systems with a multimodal setup so that they can approach naturalness, flexibility and robustness of human-human communication will give them the potential to transcend the traditional, cumbersome and rigid mouse/keyboard interaction, and yield a more effective and efficient information- and command-flow between the user and the computer system.

Understanding the situation of a human through head analysis is one of the core technologies in intuitive HCI methods. Ideally, we would like the computer to understand the user in the same way that another human would, simply via visual imagery. We are working on the fundamental science of visually understanding humans through extracting information automatically about the face, facial expressions and hand gestures.

The aim of this study is to emphasis on intelligent interaction between Human and computer using **computer vision**. Our hope is that in the next decade the research community will made significant strides in the science of human-computer interaction and that new

paradigms will emerge which will result in natural interaction between humans, computers and the environment.

Out of all the communication channels through which information can travel, vision provides a lot of information that can be used for the recognition of human actions and gestures which can be analyzed and applied to interaction purposes (Turk and Kolsch, 2004). Specifically when sitting in front of a computer heads and faces can be assumed to be visible to a webcam, a very common input device nowadays. Therefore, it is natural to think of an interface based on head movements, face gestures or facial expressions.

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Architecture

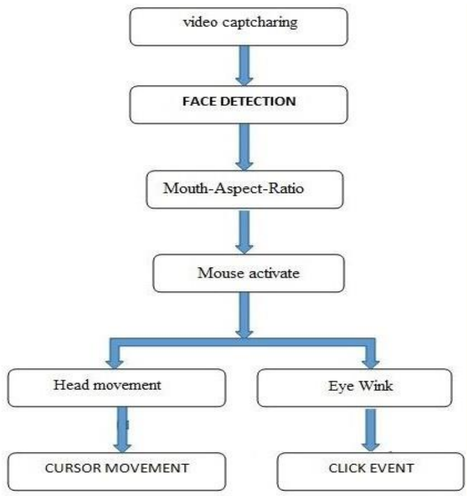

Fig.Architecture diagram

EXISTING SYSTEM:

A vision-based human--computer interface is presented in the paper. The interface detects voluntary eye-blinks and interprets them as control commands. The employed image processing methods include Haar-like features for automatic face detection, and template matching based eye tracking and eye-blink detection. Interface performance was tested by 49 users (of which 12 were with physical disabilities). Test results indicate interface usefulness in offering an alternative mean of communication with computers. The users entered English and Polish text (with average time of less than 12s per character) and were able to browse the Internet. The interface is based on a notebook equipped with a typical web camera and requires no extra light sources. The interface application is available on-line as open-source software.

The previous systems used complex algorithms. They were based on the biometric identification techniques. Some needed to mount devices on the user like Lasers which was not feasible. Hence, our aim is to devise an application that will be cost effective and not be dependent on the biometrics but on the feature classifications of the user. It should use less hardware and simpler algorithms. The objective is to use such a system that will help the upper limb disabled who cannot use the traditional mouse or keyboard.

Disadvantages of Existing System:

The existing system is limited to the biometric identification. To enhance this, we have used the feature classification method.

There are certain problems in existing system as follows:

- Mounting devices: These systems needed a mounted device like lasers or cameras on the user which became tedious.
- Biometric identification: The system used biometric identification for which the users had to register themselves before using the system. It wasn‟t open for all which has been rectified by the proposed application.

- Complex algorithms: The previous systems used many complex algorithms that needed a lot of calculations to be done depending on various markers.

PROPOSED SYSTEM:

Patients with no or limited hand function usually have difficulty in using conventional input devices such as a mouse or a touch screen. Having the ability of manipulating electronic devices can give patients full access to the digital world, thereby increasing their independence and confidence, and enriching their lives. In this study, a hands-free human-computer interface was developed in order to help patients manipulate computers using facial movements. Five facial movement patterns were detected by four electromyography (EMG) sensors, and classified using myoelectric pattern recognition algorithms.

Facial movement patterns were mapped to cursor actions including movements in different directions and click. A typing task and a drawing task were designed in order to assess the interaction performance of the interface in daily use. Ten able-bodied subjects participated in the experiment. In the typing task, the median path efficiency was 80.4%, and the median input rate was 5.9 letters per minute. In the drawing task, the median time to accomplish was 239.9 s. The interface driven by facial EMG achieved high performance, and will be assessed on patients with limited hand functions in the future.

Algorithm presented in this project performs operations deeply centered on predicting the EYElandmarks of a given face. We can accomplish a lot of things using these landmarks. The applications, outcomes and possibilities of EYElandmarks are immense and intriguing. Dlib's prebuilt model, which is essentially an implementation of not only does a fast facedetection but also allows us to accurately predict 68 2D EYElandmarks. Very handy using these predicted landmarks of the face, we can build appropriate features that will further allow us to detect certain actions, like using the eye-aspectratio to detect a blink or a wink, using the mouthaspect-ratio to detect a yawn etc or maybe even a pout. In this project, these actions are programmed as triggers to control the mouse cursor.

PyAutoGUI library was used to control the mouse cursor. For face detection, a machine learning based approach is used, Object detection algorithm proposed in. This technique employs a Haar-features based approach for object detection, which makes the rapid and accurate object detection possible. We defined five motions as the basis of head movements, namely, standard head, head left, head right, head up, and head down, the face which represents the detected head (the head In this project refers to front area of the face), and closing of the eye performs the selected option of left click, right click.

Advantages:

1. Quick response time
2. Customized processing
3. Small memory factor

4. Really helpful for disabled people

IMPLEMENTATION:

The goal of implementation is to make a code which is easy to read and understand. This is the most vital stage in acquiring fruitful programming or a framework and giving the client certainly that the new programming or the framework is functional and gives compelling outcomes. The source code must be clear such that the debugging, testing, modifications can easily done. As they consume a large portion of software budgets. In precise implementation deals with the quality of code, error removal and performance. This phase involves coding styles techniques, standards, and guidelines.

ALGORITHM:

First the system captures images by camera then detects the face area in the images. Let the origin coordinates (0, 0) be at the top left corner in the Figure. And the horizontal and vertical coordinate are noted x and y respectively. The coordinate values are calculated in pixels. The rectangle which frames the face is the detected head area. We calculate the geometric center of the rectangle, and name it as head central coordinates, i.e. (Sx, Sy) .Then we can analyze the specific head movement by time series relationship of the central coordinates.

The algorithm Head move for detection of head movements is described as below

(1) **Initialization:**

User sits up in front of the computer. Let the Head-Trace Mouse run. If the head is detected, the head signals in the first 3 seconds are initialized by statistical methods, and then the head central coordinates (Sx, Sy) of the standard head is calculated.

(2) **Set threshold value**:

Determine the threshold value (Kx, Ky) based on experience.

(3) **Judge the head movements:**

Analyze the images after initialization. The head central coordinates of one image is noted as (Cx, Cy). We compare (Cx, Cy) with (Sx, Sy) to get the following conclusions: If Cx - Sx> Kx, the judgment is that head moves left, abbreviated as left. If Cx - Sx < -Kx, right. If Cy - Sy < -Ky, up. If Cy - Sy> Ky, down. If | Cx - Sx | < Kx and | Cy - Sy | < Ky,standard head. (4) Standard head relocation: If the standard head has been detected in several continuous images, the average value of these head central coordinates will be calculated as the new head central coordinates (Sx, Sy) of the standard head. (5) Go back to step (2) standard head image captured by camera, where the outer rectangular frames the detected standard head. the central point (Sx, Sy) in the rectangular with solid lines, is the central coordinates of the standard head. The solid lines frames rectangular shows the region of head motionless. In the course of system operation, if the head central coordinates are within this region, the head is declared as motionless. If not, an associated movement is ensured. the U, L, D, R parts are the head movement direction, meaning head move up, left,

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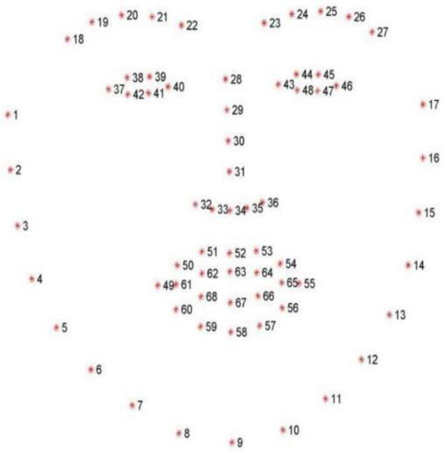
down, right, respectively, as noted in step (3) of Head move algorithm

This project is deeply centered on predicting the EYElandmarks of a given face. We can accomplish a lot of things using these landmarks. From detecting eye-blinks [3] in a video to predicting emotions of the subject. The applications, outcomes and possibilities of EYElandmarks are immense and intriguing. Dlib's prebuilt model, which is essentially an implementation of [4], not only does a fast face-detection but also allows us to accurately predict 68 2D EYElandmarks. Very handy.

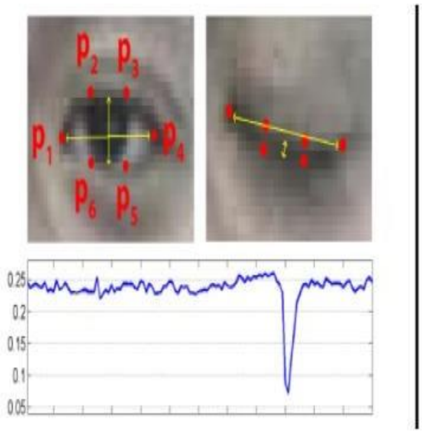


Using these predicted landmarks of the face, we can build appropriate features that will further allow us to detect certain actions, like using the eye-aspect-ratio (more on this below) to detect a blink or a wink, using the mouth-aspect-ratio to detect a yawn etc or maybe even a pout. In this project, these actions are programmed as triggers to control the mouse cursor. PyAutoGUI library was used to control the mouse cursor

10.2 Eye-Aspect-Ratio (EAR)

You will see that Eye-Aspect-Ratio [1] is the simplest and the most elegant feature that takes good advantage of the EYElandmarks. EAR helps us in detecting blinks and winks etc.

You can see that the EAR value drops whenever the eye closes. We can train a simple classifier to detect the drop. However, a normal if condition works just fine. Something like this: if EAR <= SOME_THRESHOLD: EYE_STATUS = 'CLOSE'



$$EAR = \frac{\|p_2 - p_6\| + \|p_3 - p_5\|}{2\|p_1 - p_4\|},$$

Fig. Eye Detection Using OpenCV

This seems complex at first but it is very easy. Let me walk you through the entire process and you will feel the same.

Step 1: Considering our prerequisites, we will require an image, to begin with. Later we need to create a cascade classifier which will eventually give us the features of the face.

Step 2: This step involves making use of OpenCV which will read the image and the features file. So at this point, there are NumPy arrays at the primary data points. All we need to do is to search for

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the row and column values of the face NumPyN dimensional array. This is the array with the face rectangle coordinates.

Step 3: This final step involves displaying the image with the rectangular face box. Screen shots

To run this project double click on „run.bat‟ file to get below webcam screen

In the screen you can see cursor moves based on eye ball movement. Exception will raise and window close if u move cursor close corners of the screen

RESULT:

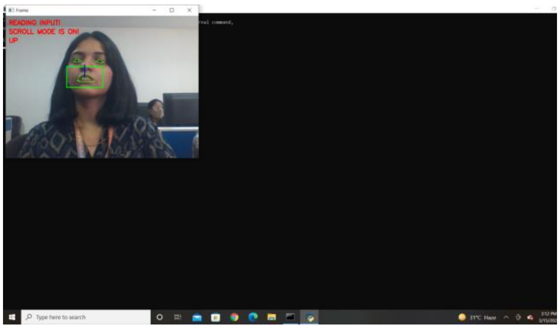

Fig. UP Movement

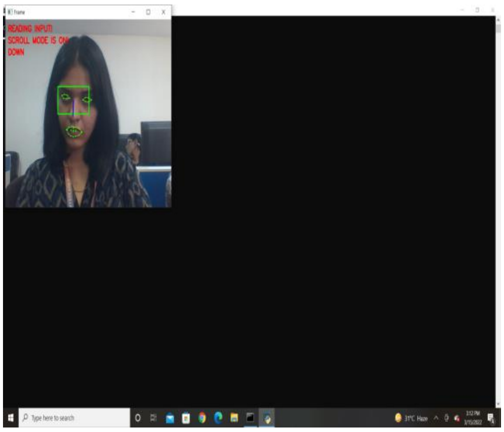

Fig.Down Movement

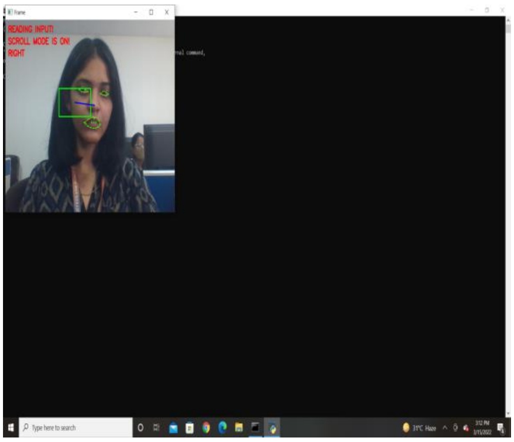

Fig.Right Movement

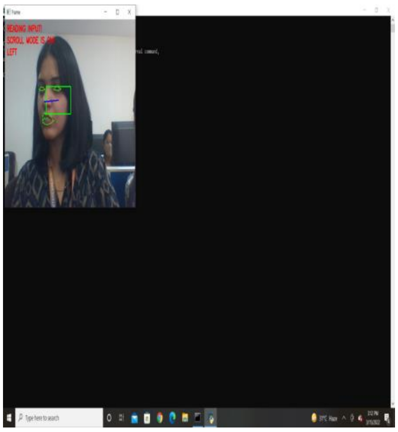

Fig.Left Movement

CONCLUSION AND FUTURE SCOPE:

This paper introduced the principles of a computer-human interaction system based on real-time state-detection of head and mouth. And the head-trace mouse system was designed and implemented. It was proved that this system was capable of performing the majority of an ordinary mouse's operations. With this system, users can operate computers by their head and mouth movements in front of web cameras. This system has been tested by an extensive number of persons and has been widely recognized. The commercial products of this system have been produced.

We have implemented a system to access the mouse pointer on the computer screen using only EYEfeatures. With the use of a camera and python technology, the system architecture is prepared. User is able to view head and eye movements captured through the camera which is displayed on the screen, accordingly the user can move the mouse pointer as needed and also perform various mouse actions. The proposed system is feature based thus allowing any user to use the system without prior registration. This system is especially useful for the upper limb disabled. Currently, we are extending our implementation to support keyboard press technology for the ease of the User to use the Keyboard hands free along with the already existing mouse movements provided by the system. This would then enable the User to access the computer owing to only EYEfeatures and movements without the use of traditional mouse and keyboard i.e Hands free system

The future seems rich for head tracking HCI.The paper demonstrate the various techniques used for implementation of the fusion of head point and speech in real time.The required hardware and modification in the camera according to the requirement for the nose finding and localization. Head tracking technology also needs to be improved to increase the validity and reliability of the recorded data. Head tracking systems need to become cheaper in order to make them a viable usability tool for smaller commercial agencies and research labs.Once head tracking achieve the improvements in the technology ,methodology,and cost it can eye tracker as an input device is far from perfect ,in the sense that a mouse or keyboard is,and that is caused both by the limitations of current equipment and more importantly by the nature of human head movements.

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