

A MULTIMODAL GAZE-CONTROLLED VIRTUAL KEYBOARD AND MOUSE CURSOR USING OPEN CV

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ABSTRACT

The aim of this paper is to present a system for controlling the cursor position in a computer by human eye movements. Many modules have been developed to help the physical world interact with the digital world. Here we present a novel approach for Human Computer Interaction (HCI) where, we control cursor movement using a real time camera. Some people cannot operate computers because of some illness. The idea of eye controls is of great use to not only for the future of natural input but more importantly to the handicapped and disabled. Moreover implementing a controlling system in it enables them to operate computer without the help of another person. This gadget is most useful for person who can operate cursor by movement of eye. In this project, Camera is used for capturing the image of eye movement. It first detect pupil centre position. Then the different variation on pupil position get different movement of cursor. The Implementation process for Pupil detection is done using Raspberry pi .The Raspberry Pi is a credit card sized single computer or SoC uses ARM1176JZF-S core. SoC, or System on a Chip, is a method of placing all necessary electronics for running a computer on a single chip. Raspberry Pi needs an Operating system to start up. In the aim of cost reduction, the Raspberry Pi omits any on-board non-volatile memory used to store the boot loaders, Linux Kernels and file systems as seen in more traditional embedded systems.

INTRODUCTION

Nowadays personal computer systems are carrying a huge part in our everyday lives as they are used in areas such as work, education and enjoyment. What all these applications have in common is that the use of personal computers is mostly based on the input method via keyboard and mouse. While this is not a problem for a healthy individual, this may be an insurmountable bound for people with limited freedom of movement of their limbs. In these cases, it would be preferable to use input methods, which are based on more abilities of the region such as eye movements. To enable such substitute input methods a system was made which follows a low-price approach to control a mouse cursor on a computer system. The eye tracker is based on images recorded by a mutated webcam to acquire the eye movements. These eye movements are then graphed to a computer screen to position a mouse cursor accordingly. The movement of mouse by automatically adjusting the position of eyesight. Camera is used to capture the image of eye movement. In general, any digital image-processing algorithm consists of three stages: input, processor and output. In the input stage, a camera captures image. It sent to a particular system to focus on a pixel of image that's gives, its output as a processed image. Embedded system is combination of hardware and software. An embedded system can be an independent system or it can be a part of a large system. An embedded system is a microcontroller or microprocessor based system, which is designed to perform a specific task. For example, a fire alarm is an embedded system; it will sense only smoke Python is a high-level language. This means that Python code is written in largely recognizable English, providing the Pi with commands in a manner that is quick to learn and easy to follow. This is in marked contrast to low-level languages, like assembler, which are closer to how the computer thinks but almost impossible for a human to follow without experience.

PROPOSED METHODOLOGY

The figure (a) represents the proposed system, it uses Raspberry Pi board of version 3, and Arm11 processor controls the whole system. This board is connected with Monitor, IR Sensor and SD card. These components are connected by USB adaptors. Raspberry pi is the key element in processing module, which keeps on monitors eye movement by interfacing with USB sensor. Sensor captures the motion of change in the eye movement. IR Sensor will be interface with raspberry pi. Raspberry pi will be using SD card, to install raspbianOs and programming codes.

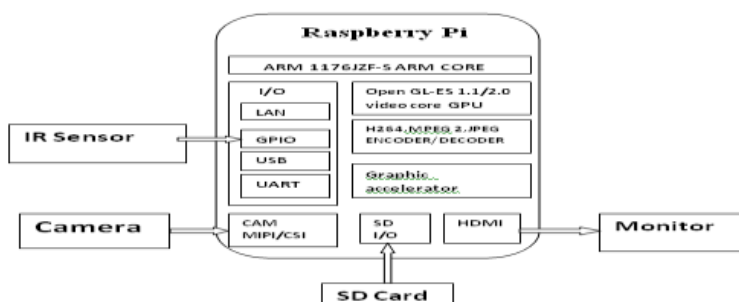


Fig 3.4 Proposed Block Diagram

Figure (a)

1) IR_SENSOR:

The IR Sensor used here is a movement sensor. This IR sensor is connected to the General Purpose I/O port of the raspbianboard, it detects the eye pupil movement and hence makes the camera to start capturing the images. Sensor can cover the range upto 5cm.

2) CAMERA

Once when the sensor detects the movement of eye pupil the camera starts to capture the images and send it into the raspbian board through an USB cable. The camera used here ia an USB web camera of affordable cost. Then the transferred image is processed and monitored out.

3) SD_CARD

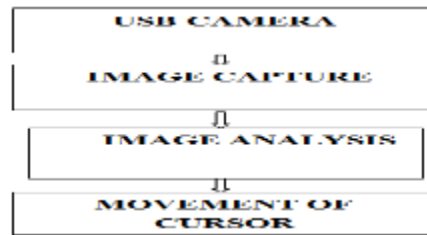
The function of the SD card is to store the Raspbian Jessie operating system module and it stores the program in it. The Raspberry Pi board is activated using Python programming language. The SD card capacity is upto 8GB.

4) MONITOR

The monitor input is got from the HDMI port of the raspberry board. HDMI is a High Definition Multimedia Interface port which is used to monitor the uncompressed video data. The HDMI converts digital image signal into analog signal and gives it to the monitor.

5) SYSTEM APPROACH

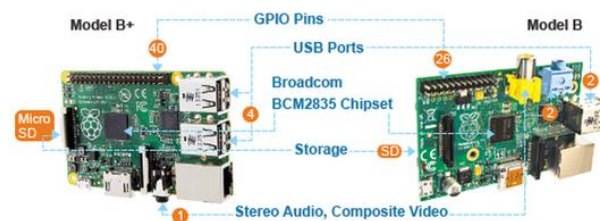
Camera is used to capture the image of eye movement. The pupil centre position of eye is first detected and then the different variation on pupil position is identified to get different movement of cursor. The Implemented process for Pupil detection is performed using Raspberry pi. The pupil reference has the coordinates of (x, y). Raspberry pi will be combine with USB Camera. Raspberry pi will be use SD card, then the install raspbian OS and open cv on raspberry pi. First image will be capture by USB Camera. Focus on eye in image and detect the center position of pupil by opencv code. The figure (b) represents this flow of system approach.



Figure(b)

6) CONNECTING THE KEYBOARD AND MOUSE:

Now we have got our Raspberry Pi's output devices sorted, it has time to think about input. As a bare minimum, we are going to need a keyboard, and for the majority of users, a mouse or trackball is the necessity too. First, some news: if we have got a keyboard and mouse with a PS/2 connector—a round plug with the horseshoe-shaped array of pins—then we are going to have a replacement. The old PS/2 connection has been superseded, and the Raspberry Pi side of the Pi (Figure.3.). If you're using Model B, we can connect the keyboard and mouse directly to these ports. If we are using Model A, we will need to purchase a USB hub in order to connect two USB devices simultaneously. Figure.3. Model B's two USB port A USB hub is a good investment for any Raspberry Pi user: even if we have got a Model B, we should use up both our available ports just connecting our keyboard and mouse, leaving nothing free for additional devices such as an external drive, storage device or joystick. Make sure to buy a powered USB hub: models that are smaller, but lack in the ability to run current hungry devices like CD drives and hard drives. If we want to reduce the number of power sockets in use, connect the Raspberry Pi's USB power lead to the powered USB hub. This way, the Raspberry Pi can draw its power directly from the hub, rather than needing its own dedicated power socket and its mains adapter. This will only work on hubs with a power supply capable of providing 700mA to the Raspberry Pi's USB port, along with power is required by other peripherals. Connecting the keyboard and mouse is as simple as plugging them in to the USB ports, or directly in the case of a Model B or through a USB hub in the case of a Model A. A Note on Storage As we have probably noticed, that Raspberry Pi doesn't have a traditional hard drive. Instead of that it uses a Secure Digital (SD) memory card, a solid-state storage system typically used in the digital camera. Almost any SD card will work with the Raspberry Pi, but it holds the entire operating system, it is necessary for the card to be atleast 2 GB in capacity to store all the required files. SD cards with the operating system preloaded that are available from the official Raspberry Pi Store along with the numerous other sites on the Internet. If we have purchased one of these, or received it in a bundle with your Raspberry Pi, we can simply plug it to the SD card slot at the bottom side of left-hand edge. If not, we need to install an operating system—known as flashing—onto the card before it is ready to go. Some SD cards work better than the others, with some models refusing to work at all the Raspberry Pi. For an up-to-date list of SD card models known to work with the Raspberry Pi, visits the eLinux Wiki page. Expects our peripherals to be connected over the Universal Serial Bus (USB) port. Depending on this we should purchase the Model B+ or Model B, you'll have either one or two USB ports available on the right.

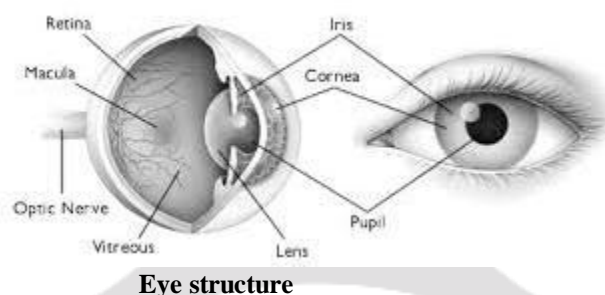


Model of Raspberry pi (B+ and B)

3. SIMULATION RESULTS

Raspberry pi is clubbed with USB Camera. Raspberry pi will be used as SD card, then install Raspbian OS and open CV on Raspberry pi. First image is captured by USB Camera and focus on the eye and detect the center

position of the pupil by open CV code. Take the exact position value of pupil as reference, and then different value of X, Y coordinates will be set for accurate command. Raspberry pi signals are passed by GPIO to transistor circuit. One main aim for Eye Movement controlled cursor is to enable handicap persons to make their life more feasible and to provide them capability and opportunity of independence. The pupil to control the cursor on the screen, the central coordinate of the screen is set as starting point.



Eye structure

This position is used as base for tracing, and First position of the mouse pointer is set as the center of the screen. The moving position of cursor takes the initial position as base. As the pupil moves to one direction, the coordinate of the mouse pointer on screen change as per the action of pupil. When pupils return to the original position, cursor stops moving the starting point and stopping point of the cursor is controlled by movement of the eyes. When the user moves his eyes for a second, then the cursor either starts or stops moving i.e, if the cursor is in moving condition, then after a eye movement, it stops and vice versa. The eye direction arrows are used for testing at the time of demonstration. Beside these arrows, circle is seen in green color. When any obstacle is detected in front of the eyes, this circle becomes red, a buzzer beeps and the cursor stops. This circle does not appear red for natural stopping of the cursor by eye movement. The eye movement and its circuitry required two 1.5 V batteries, three 9V batteries. The camera used, is USB camera, which can be straightly plugged in, and can be used. The camera drivers should be loaded in the system before using.

4. CONCLUSION

This paper is aim for the cursor control using eye ball movement without using the hands we can operate the computers by eye movement. This technology is contracted to replace the conventional computer screen pointing device for the use of physically handicapped persons. The movement of mouse pointer by automatically adjusting the position of eyesight. Without the help of other person they can use the computers and working it. This work can be extended to implement to produce efficient movements to perform the click events and also cover the total mouse function of the system and the total human-computer interface using eye blink. Technology also extended to the eyeball movement and eye blinking to get efficient and accurate result.

Future Enhancement: Human Computer Interfaces has more scope in upcoming days. There are three aspects as far as future enhancements are concerned.

1. Making of user friendly applications by which one can paint, chat and play virtual games.
2. Use of other areas of scalp for EOG acquisition.
3. Make a sophisticated product that can be implemented in fighter jets. Pilot just has to point the target with the eyes and press the trigger when target becomes under the range. It is very nice that the eye movement is more fast and accurate than just the hand movement.

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