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A Novel Eye-Tracking Device Designed with a Head Gesture Control Module

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Abstract

In this paper a novel eye-tracking device designed which uses tiny CCD cameras to capture the eye image from the screen with the help of a video capture card. In the head gesture control mode, a light source projector is turned on and the CCD camera detects the position of the light source. The locations of the spots on the screen and on the image pupil of the eye image are calculated, compared with the previous point and are subsequently mapped to the point on the screen. The movement increment-coordinate control is also discussed which could improve the ease of use of the computer. We investigate the use of non-rigid head fixation using a helmet that constrains only general head orientation and allows some freedom of movement. Device results simulated with the help of software which achieves excellent timing performance due to the use of live data streaming, instead of the traditionally employed data storage mode for processing analogous eye position data.

Keywords: eye-tracking, head gesture control, data streaming, corneal reflections, eye movement.

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1. Introduction

Following is the way toward estimating either the purpose of look (where one is looking) or the movement of an eye with respect to the head. An eye tracker is a gadget for estimating eye positions and eye development [1-4]. The most comprehensively used current designs are video-based eye trackers [5-8]. A camera revolves around one or the two eyes and records their improvement as the watcher looks kind of lift. Most present eye-trackers use the point of convergence of the understudy and infrared/close infrared non-collimated light to make corneal reflections (CR) [9, 10]. The vector between the understudy centre and the corneal reflections can be used to figure the motivation behind regard on surface or the look course. A clear change procedure of the individual is ordinarily required before using the eye tracker. Two general sorts of infrared/close infrared (otherwise called dynamic light) eye following systems are utilized: splendid student and dull understudy. Their distinction depends on the area of the light source regarding the optics. In the event that the enlightenment is coaxial with the optical way, at that point the eye goes about as a retro reflector as the light reflects off the retina making a splendid understudy impact like red eye. In the event that the light source is counterbalanced from the optical way, at that point the student seems dim on the grounds that the retro reflector from the retina is coordinated far from the camera.

Most essentially, eye following eludes are being used to the estimation of eye movement [11] and it is also utilized for smartphones to avoid the high cost, large equipment and particular eye trackers [12]. All the more deductively, eye following suggests the chronicle of eye position (purpose of look) and development on a 2D screen or in 3D situations in light of the optical following of corneal reflections to survey visual consideration. Additionally, low cost eye tracking has been reviewed to overcome the core issues of high cost equipment by implementing neural networks [13, 14]. Eye tracking was not limited to the learning process; it expedites and improves the performance of robotic controls [15]. The industrial robots were controlled and optimized for the interaction with human [16]. As well as the eye tracking is employed for the betterment of robotic industry, it also became useful in the medical issues. It was deployed for the wheel chair control by using image segmentation [17]. Moreover, this proposed approach will be advantageous for furtherance in the described applications.

Evaluating and reacting to human eye improvement, or eye following, isn't new and the preceding year saw a rising energy for the headway. "Eye following sensors give two principal benefits," says Oscar Werner, VP of the eye following institute Tobii Tech [18, 19]. "Initially, it makes a contraption aware of what the customer is involved with at any given point in time. To a specific degree perhaps soon eye-tracking is a standard component of another time of phones, PCs and work zone setting screens the section for a colossal reassessment of the approach we talk with gadgets—or how they talk with us. "In the earlier year eye-tracking innovation has been stimulated from being a promise innovation being embraced in business items in a wide exhibit of buyer fragments the equal time," Werner says [20]. Moreover, it has been incorporated that common gathering sourcing business focuses, for instance, Amazon Mechanical Turk have enabled the aggregation of greater and broader datasets to get ready affirmation figuring. In any case, any advancement won't create unless it can fulfil specific demands and use cases. Besides, by virtue of eye following, there is in every way no insufficiency.

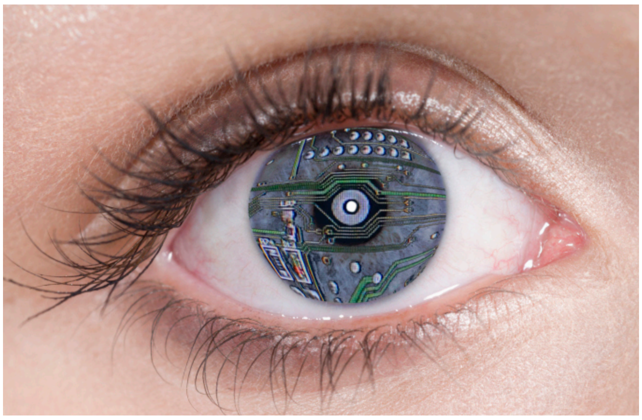


Figure 1. Blue eye with PC circuit board lines

As vision is the most utilized sense among people, having the capacity to track and measure it carefully will greatly affect how we make our goals known to PCs, wittingly or accidentally. The significant work is being done to lessen the cost of costly eye-following hardware, and ideally sooner rather than later free engineers and originators will have the capacity to economically lead their own tests.

This paper presents novel eye-tracking device designed which uses tiny CCD cameras. In the head gesture mode, a light source projector is turned on and the CCD camera detects the position of the light source. The locations of the spots on the screen and on the image pupil of the eye image are calculated, compared with the previous point and are subsequently mapped. We investigate the use of non-rigid head fixation using a helmet that constrains only general head orientation and allows some freedom of movement. Device results simulated with the help of software which achieves high speed due to the use of live data streaming.

2. Technology Background

2.1 Overview of Basic Technology

Eye controlled target framework fundamentally is a procedure to gauge the purpose of look before the development of eye in respect to the top. Most of the vital eyes tracking applications bear sensors with binocular eye-tracker, RGB-D camera, high-frame-rate camera, and visual sensors [21, 22]. In eye framework favourable position to recognize particular point in both space and time. This procedure can be utilized as a part of genuine to control applications with the assistance of eyes. This innovation has taken set year prior, however in the underlying timeframe in the advancement in the ground of eye following the deployment of eye trackers were controlled to the examine tests centre just to look the design of an eye development and it situating, as opposed to utilizing these development as a genuine medium control a human-PC inside association (HCI). Missimer and Betke additionally developed a framework that uses the control of mouse cursor and reproduces the left-snap and right-snap of the mouse by flickering left or right monocular [23]. Eye-tracking is the main strategy in human conduct look into rendering it conceivable to dispassionately gauge and evaluate eye developments continuously [24]. With the development of PC innovation, eye-tracking has been turned into a non-meddling, reasonable, and simple to-utilize device in human conduct examine that permits estimating visual consideration as it dispassionately screens where, when, and what individuals take a gander at. The quality of images is the vital aid towards cloud computing and high resolution imagery which is being observed by quality of experience (QoE) [25, 26] and quality of service (QoS) [27]; the image quality can also be enhance by using optimal feature assessment technique [28, 29] and pre-processing [30-32]. Nevertheless, the performance based on image quality is also enhanced with the help of post-processing [33, 34] and feature merging methods [35-37] .

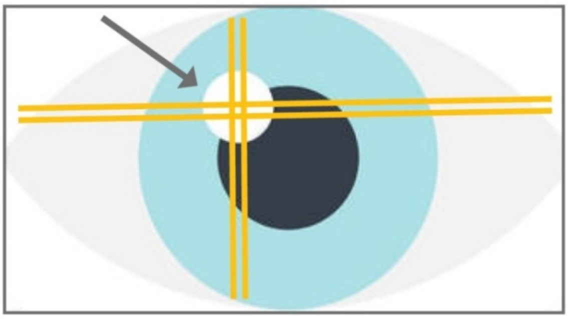
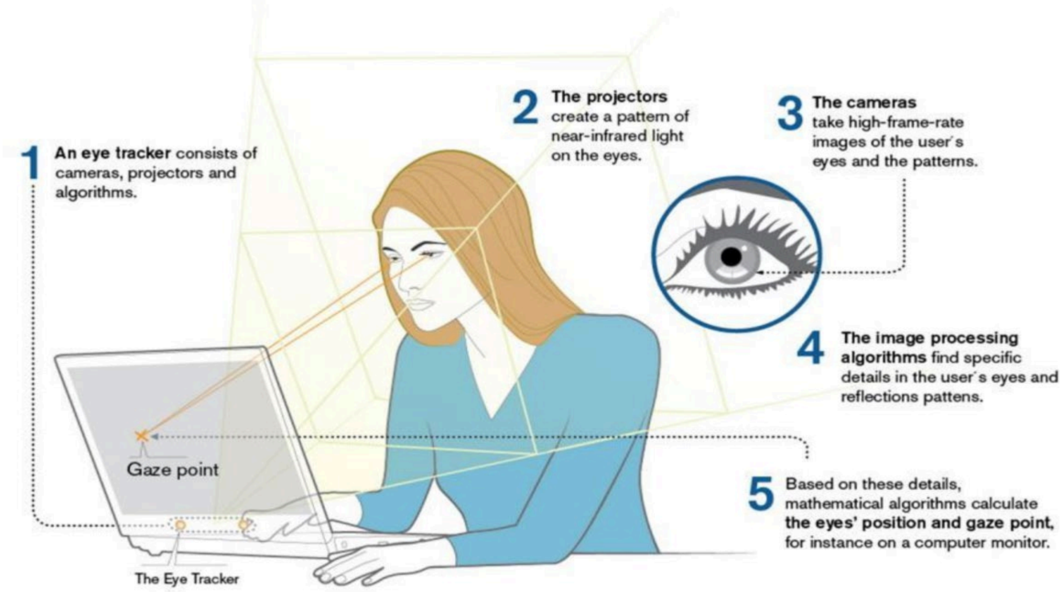


Figure 2. Light is coordinated towards the focal point of the eyes

Close infrared light is coordinated towards the focal point of the eyes; causing noticeable disparity in the cornea which is the external optical component of the eye. While the noticeable range is probably going to produce uncontrolled specular reflection, infrared light isn't detectable by the human eye and along these lines takes into consideration an exact separation between the student and the iris while the light specifically enters the understudy, it just "ricochets off" the iris.

3. Methodology

A helmet-mounted LCD screen, just in front of one eye, that ensures the position of the helmet indicates where the operator is looking. They have a thing that goes over one of the WSO's (Weapons Systems Operator's) eyes, and shows him the view from the night-vision cameras. Sensors in the cockpit keep track of his helmet, and when he is looking through the monocle at the target, with the aiming marks lined up, then there is a nice straight line target-monocle-eye, with the helmet position in a known relationship to the monocle and eye. Then the WSO presses a button to fire weapons, and the aircraft's computers know where to send it. An eye-following head-mounted shows that each eye has a Driven light source (gold-shading metal) in favor of the show focal point, and a camera under the show focal point. To conclude the viewable pathway in world facilitates, the head must be kept in a steady position or its developments must be followed too. In these cases, head bearing is added to eye-in-make a beeline for decide look course.



3.1 System Architecture

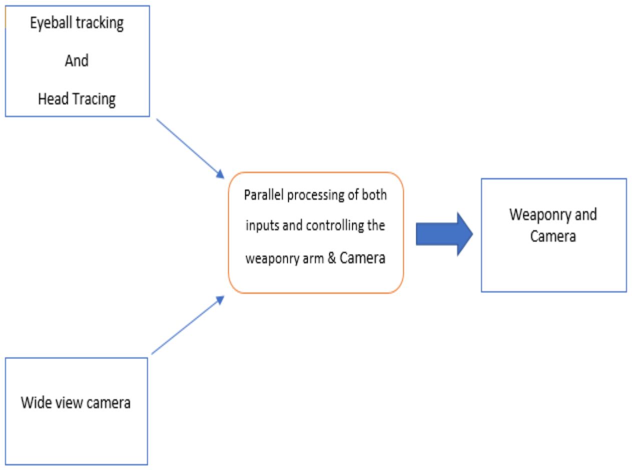


Figure 4. General block diagram of the system

In head turn, we utilize MPU sensor 6050, and it will give us the x, y facilitates these qualities are regularly in points to, help us to choose its position. Sensor ordinarily comprises of at least two sections. Need, they are accelerometer, gyrator, attractive measure and altimeter. The MPU 6050 is a 6 DOF (flexibility) or six-pivot IMU sensor, which implies it gives six yield esteems: three esteems from the speedometer and three from the gyrator. MPU 6050 is a sensor in light of miniaturized scale electro mechanical frameworks (MEMS). Both accelerometer and gyrator are installed in one chip. MPU 6050 speaks with Arduino through I2C convention. The MPU 6050 module has 5V pins, you can interface it to your 5v stick Arduino. If not, you should associate it to 3.3V pins. Next is GND in Arduino connected to GND in MPU 6050. The program that we will keep running here additionally exploits the interfered with Arduino stick. Interface your advanced pins Arduino 2 (intrude on stick 0) to pins stamped INT as MPU 6050. Nearly we have to introduce the I2C lines. To do this, join pins named SDA to MPU 6050 alongside Arduino simple stick 4 (SDA) and stick set apart as SCL on MPU 6050 with Arduino simple stick 5 (SCL).

At that point, Arduino will give these directions to engine and in the outcome engine will turn at the same time. Then again, in programming part Iris following is being happened in camera then this camera design makes of close infrared light on the eye, at that point camera sensor take high-outline rate pictures of the eyes of clients. Also, the picture handling calculations discover particular subtle elements in the client's eyes and reflection based on these data, scientific calculations check the eyes' point and look point, for example on a PC screen.

In this block diagram first we move our head rotation by using MPU 8061 sensor then this sensor is controlled by Arduino programming we find the x, y coordinates of the image which is under the frame and draw the offset of this, then as we move our head rotation then simultaneously rotation of motor will move on the same particular direction.

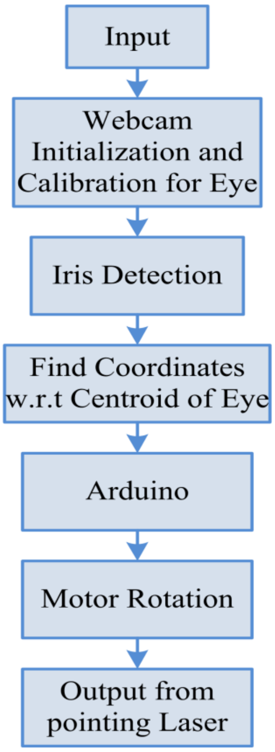


Figure 5. Flow chart of the eye ball tracking system

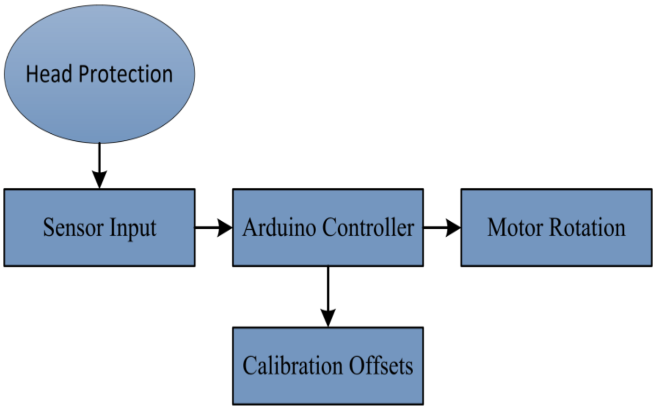


Figure 6. Block diagram of the head rotation system

Input:

The input is taken through a webcam which is mounted on a helmet structure in front of an Eye.

Webcam Initialization:

In Webcam Initialization proper check that a webcam is working properly and set the camera position according to the pilot (which wears the helmet) and also sets the Threshold according to the pilot.

Calibration for eye sample:

In calibration part there is a circle in a screen and a screen which is mounted on a helmet structure. So the circle which is centre on a screen is for 10 seconds and then circle move to the right of the screen for 10 seconds and again circle move to the left of the screen for 10 seconds and then again circle move to the up of the screen for 10 seconds and last the circle move to the down of the screen for 10 seconds so the pilot see the circle with respect to the circle movement and also after 10 seconds in all the steps the message generated OPERATION COMPLETED press ok when a user(which operate the computer) press ok the process continue otherwise process stop. In all the position of the circle we basically collect the maximum values of an eye movement.

Main program started:

We use 2 cameras one for the outer image and other is the iris detection. Cam (1) is the iris detection and cam (2) is from the outer image. In cam(1) first we convert RGB image into gray scale so the processing faster than rotate the image because we rotate the camera and then gray image is convert into black white image and then set the threshold with respect to pilot.

```
PSEUDOCODE
BEGIN
INPUT
    WEBCAM INITIALIZATION
        CALIBRATION FOR EYE SAMPLE
        MAIN PROGRAM STARTED
        IRIS DETECTION
        COORDINATE FIND
        ARDUINO
        MOTOR ROTATION
        POINTING LASER
END
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5. Results and Discussion

A coolest aspect concerning the Apache is its modern device hardware. The Longbow Apache identifies encompassing main powers, air ship and structures utilizing a radar vault attached to the pole. The radar vault utilizes millimetre radio waves that can bring out the state of everything in extend. The radar flag processor analyses these shapes to a database of tank, trucks, other airplane and hardware to distinguish the universal class of every sound target. The PC pinpoints these objectives on the pilot's and heavy armament specialist's show boards.

The pilot and the heavy weapons specialist both utilize for night activities by using night vision sensors. The night vision sensors take a shot at the looking-forward infrared (FLIR) framework, which recognizes the light of infrared discharged by warmed items. The night vision of pilot’s sensor is joined to a turning turret over the nose of Apache. The heavy weapons specialist's sensor of night vision is appended to a different turret on the base of the nose. The subordinate turret additionally bolsters a typical camcorder and a telescope, which the heavy armament specialist utilizes amid the day.

The night vision is transmitted by the PC or picture of video to a little show unit in each pilot's protective cap. The video show extends the picture onto a focal point monocular before the correct eyes of pilot. In the cockpit, infrared sensor track how the pilot position the head protector and hand-off this data to the control of turret framework. Every pilot can point the sensors by essentially moving her or his head! Physically, controls are likewise accessible, obviously.

This proposed technique will additionally utilize the data of a solitary picture to foresee the look with power. We will utilize profound convolutional neural networks (CNNs) to proficiently utilize our vast scale dataset. Note that we incorporate the eyes as individual sections in the system (regardless of whether the face as of now contains them) to give the system a picture of the higher determination eye to help distinguish unobtrusive changes. To benefit as much as possible from the energy of our broad information base, we will build up a bound together prescient extension that enables us to prepare a solitary model utilizing every one of the information. Additionally, subsequent to preparing the common system, we have to think that it’s simple to tweak the system for every gadget and introduction.

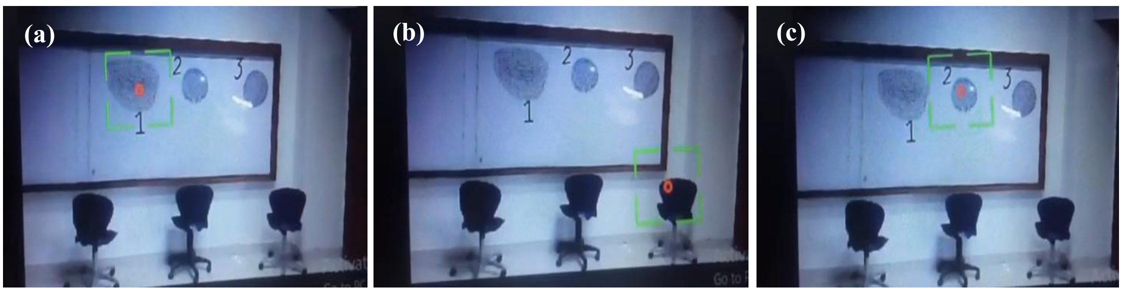

Figure 7. Results of eye ball movement

In Fig. 7 (a, b, c) it is clearly shown that when an Eye ball (iris) move toward right the ROI(region of interference) and also laser move toward right and when an Eye ball (iris) move toward left the ROI(region of interference) and also laser move toward left and vice versa. So the laser follows the position of the Eye ball (iris).

Figure 8. Results of laser movement with respect to head movement

In Fig. 8 (a, b, c), it is shown that when a Head move toward right the laser (which is mount on the top structure) is also move toward right and when a Head move toward left the laser is also move toward left and vice versa. So the laser moves with respect to head.

6. Conclusions

In this paper, the procedure of eye control target system is exhibited in which we collect large data of iris detection. Basically, a helmet mounted with LCD screen along with a DMU sensor and a night vision iris detection monocle, just in front of on eye, that ensures the position of the helmet indicates where the operator is looking. A thing that goes over one of the WSO's (weapons system operator's) eyes shows him the view from the night-vision cameras. The attached sensors keep the track of the head rotation and it happens when the operator is looking through the monocle at the target with the aiming marks lined up then there is a nice straight line target with the helmet position.

To detect the Iris Centre with registered database and propose a system that makes the computer screen scroll as per eye gaze. To find out pixel values and the gradient magnitudes of the input eye, this is exploited to locate the IC. To make an application of the eye Gaze tracking which scrolls the screen with the help of iris without using hands on keyboard.

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