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IRIS DETECTION FOR ROBOT CONTROL

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ABSTRACT

Statistics suggests that there are around 40 cases per million of quadriplegia every year. Great people like Stephen Hawking have been suffering from thisphenomenon. Quadriplegia is a form of paralysis in which only eyes can move. Our project attempts to make lives of the people suffering from this phenomenon simple by helping them move around on their own and not being a burden on others. In the recent years, drastic improvements have been accomplished in the areas like iris recognition, automated iris segmentation, edge detection, boundary detection etc. Iris recognition is a biometrirecognition technology that utilizes the pattern recognition techniques based on the high-quality images of iris.

The main aim of this paper is to develop an efficient interface to track the iris movement and to use this information to control the direction of robotic vehicle. Interacting with real or virtual objects with help of a human eye is gaining popularity. This paper gives information about morphological operations to detect eyeball movement and how we can use it to move arobot in direction of the line of sight of the user.

1. INTRODUCTION

The iris reveals body constitution, inherent weaknesses, and levels of health and transitions that take place in a person's body according to the way one lives. There is an old saying that the eyes are the window of the soul. They can also be a window to one's health. Like fingerprints or faces, no two irises (the colored part of the eye) are exactly alike. The iris structure is sounique it is now being used for security identification at ATM machines and airports. And for centuries, it has also been used to analyse people's health – past, present and future.

Popularity of the iris biometric grew considerably over the past three years. The problems of processing, encoding Iris texture, and designing iris-based recognition systems have attracted the attention of a large number of research teams. On the other side, the iris biometric has been gaining public acceptance. Modern cameras used for iris acquisition are less intrusive compared to earlier iris scanning devices. Iridology is the science of analysing the delicate structures of the iris of the eye.

Iris is the most reliable biometric in secure transaction proposals. Iris is one the important Biometric Identification technique and also Iris is one of unique identifier of Human then it is stable throughout a life of the person's. In this work a new method to recognition of the eye have been proposed. Edge detection is one of the important modules of any image processing technique. In this work we have proposed the edge detection technique based on Region of Interest (ROI) and also Edge Length (EL) to recognize the Human eye. The performance of the proposed system has been verified and validated with existing problems. This technique is a novel technique to identify the Iris and also the proposed technique shows significant results and compared with the other conventional techniques. Eye tracking is a technique whereby an individual's eye movements are measured so that the researcher knows both where a person is looking at any given time and the sequence in which their eyes are shifting from one location to another. Eye movements can also be captured and used as control signals to enable people to interact with interfaces directly without the need for mouse or keyboard input, which can be a major advantage for certain populations of users such as disabled individuals.

2. LITERATURE SURVEY

Raspberry Pi based complete embedded system for iris recognition:

This paper presents a complete embedded system for iris recognition. The proposed system is based on the Raspberry Pi . The main emphasis has been placed on functionality of the whole recognition process, including hardware and software aspects. A carefully designed infra-red data acquisition enabled efficient iris segmentation an coding. The data processing software is based on the OpenCV library. Selection of the system components and their integration required many experimental tests. The presented guidelines for the construction of the Raspberry Pi based iris recognition system should be valuable when developing next generation systems. The key element of the proper functionality is the correct acquisition of the iris image. In

this paper, the standard Raspberry Pi camera equipped with the telephoto lens and infrared illuminator as well as with theinfrared pass filter acquires the iris images that can be successfully processed. Careful selectionof the software parameters enables a possibility of the high accuracy identification.

Real Time Iris-Based Robot:

This paper proposes a system which aims to design a robot controlled by iris movement. The system is designed using Raspberry Pi and Pi Camera Module which make the system cost effective and stand alone. An Open- Source Computer Vision is integrated on Raspberry Pi for real time image processing. A general-purpose higher-level language, Python is used for programming the Raspberry Pi. The main aim of the system is to recognize iris from an image of eye and find the centroid of the iris. The centroid position is further used to operate the robot in various directions. In this paper, a robotic system is proposed for physically challenged people, which is based on iris movement. An iris detection algorithm is applied to get centroid location of iris. The choice of Canny Edge Detection and Hough Circle

Transform gives correct detection of iris circle and centroid. According to the centroid location obtained from image processing, the control movement can be given to robot. A credit card size computer Raspberry Pi makes this system compact and stands alone.

Comparative Survey of Iris Recognition :

Iris Recognition is one of the most challenging and fastest growing areas in the field of biometrics. This paper focuses about the brief summary of iris recognition system for identification and verification of iris images. This paper also provides the Comparative analysis of various pre- processing approaches. This paper gives the brief summary of Iris recognition system that includes iris detection, feature extraction and classification for identification and verification of iris Images. And also provides the Comparative Study of various pre-processing and feature extraction algorithms for Iris recognition. The

3. IRIS DETECTION FOR ROBOT CONTROL

Obtained by the various algorithms/methods provides better accuracy in terms of their recognition rate.

Recognition of the eye movement direction:

Recently different approaches have been explored for developing a system to track eye movements. This paper can explain recognize any eye movements and be used for controlling of wheelchair, Mouse pointer and so on. It is also suitable for virtual reality purposes.

Iris Movement Detection by Morphological Operations for Robotic Control:

This paper presents a simple yet accurate approach to detect the eyeball movement. The algorithm is fast and efficient enough to detect any kind of movement in the eyeball and can be adjusted to detect movements of specific intensity. The setup is simple and requires only a web camera mounted on a cap worn by the user. I have also presented a simple method to make use of the eyeball movement to control a robot. The approach can also be used to control a computer mouse, in virtual environments to interact with virtual objects, etc. Eye movement detection is an important form of human computer interaction and can be utilized to develop many innovative applications and to interact with the computers in a more natural way. The user has to only look left or right to move the robotic vehicle towards the desired direction. The diagonal motion is achieved when user looks left or right for only small duration of time.

4. METHODOLOGY ADOPTED

Face detection and Eye Tracking:

Open Computer Vision (OpenCV) is being used for the detection of the eye and face. For both eye and face detection, the Haar cascade algorithm is used. Camera modules detect the user's face once the face is detected then by use of the Haar Cascade algorithm finds the location of the eye and it marks the eye region by making use of the Haar Cascade algorithm. Both eyes are detected based on distance.

RGB to Gray Conversion:

Here image colour is convention to cut down delay time in the system. The size of the image frame should be low as possible because the processor cannot process the frames in a runtime condition. Hence, we use RGB to Gray conversion to convert the colour imaged to Gray image.

Features Detection and Blurring Image:

Feature-based techniques have supported the identification and utilization of a bunch of unique features of the human eyes. These techniques identify such local features of the attention and therefore the face which has reduced sensitivity to variations in viewing angles and illumination. The commonly used features for eye localization are corneal reflections, limbus, and dark and bright pupil images. Typically, these techniques first identify and detect the local features; then, they apply a filter to spotlight desired features while suppressing the others or utilize a previous eye shape model to construct an

area contour; and, finally, they apply the classification algorithms to supply the output. Generally, feature-basedtechniques are reported to supply good leads to indoor applications.

Edge Detection:

Corner edge detection and canny edge detection algorithm are being applied to determine soft edges in an image. It allows easy recognition of the circle/rectangle presented in the image in order to set a proper threshold value.

Hough Transform:

The Circle Hough transform method is used for drawing circles on an eye pupil which is a result of edge detection. The circular Hough transform can be employed to deduce the radius and centre coordinates of

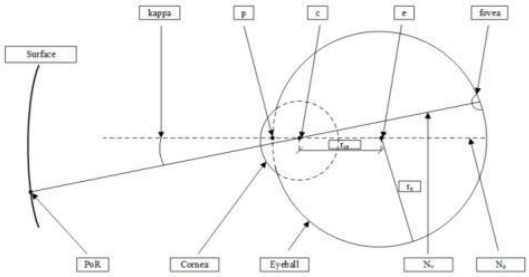
the pupil and iris regions. Images are continuously captured according to eye movements. Circle Hough transform detects the eye pupil movement and draws the circle.

Detection of Iris and Pupil:

The pupil and iris being darker than their surroundings are commonly considered reliable features for eye detection. Our algorithm locates the pupils by searching for two dark areas that fulfil specific anthropometric requirements. Their technique, however, cannot perform wellin different light conditions due to the limitation of the skin-color model. Generally, the use of IR light instead of visible light seems more appropriate for dark region detection. The techniques supported iris and pupil detection require pictures taken from around the eyes or high- resolution images. The majority of the feature-based techniques can't be wont to model closed eyes. In a trial to beat this limitation, a technique was proposed to track the attention s and to retrieve the eye parameters with the assistance of a dual- state (i.e., open or closed) eye model.

Gaze Tracking Approach:

A model-based estimation method is used. Thus, the first thing is the construction of a 3D eye model that resembles human vision and its eye gaze and illustrated in Figure



the cornea centre (c) and the distance between both cornea and eyeball centres (r_{ce}). The optical axis (N_o) is the line that connects the eyeball center (e), the cornea center (c) and the pupil center (p). However, the real gaze direction comes from the visual axis (Nv), which is the line that connects the fovea and the cornea centre and is a deviation of the optical axis (No). That is because the fovea is a small depression in the retina of the eye, where visual acuity is the highest. The angle between these two axes is a fixed angle called kappa, and it is typically represented as a two-dimensional vector [α, β]. It should be noted that there are two different coordinate systems: the camera coordinate system and the head coordinate system. The camera coordinate system has its origin point (0,0,0) at the position of the camera, while the head coordinate system has its origin point (0,0,0) at the centre of the head. This way, the eyeball centre position can be represented in the camera coordinate system (e) or as an offset vector in head coordinates (Vhe).

In order to map a point from one coordinate system to another, the rotation R and translation T of the head relative to the camera coordinate system are required. Thus, the same point in camera coordinates z c and head coordinates system z h are m

The eyeball and the cornea are represented as two spheres intersecting with each other. The main parameters of the eyeball sphere are the eyeball centre (e), the eyeballradius (re), the pupil centre (p) and the fovea. The main parameters of the cornea sphere are

$$\mathbf{NO = P - E / ||P - E||}$$

Once the iris is tracked, then the threshold is set. Threshold A very basic principle is used for the movement detection. The feature point of both the eyes is considered as the reference. The minimum movement of the eye for a valid attempt is considered as threshold. By evaluating the difference, and if the difference is above the threshold in any direction left or right, the corresponding flag is set. If the difference is

less than the threshold value, then there is no need of movement. Sometimes failure in detection occurs due to non-linearity. At such instances a bias can, be given to the eye, which was detected in the previous snapshot. The Block diagram of the proposed system of Iris Edge Detection is shown in Figure 1

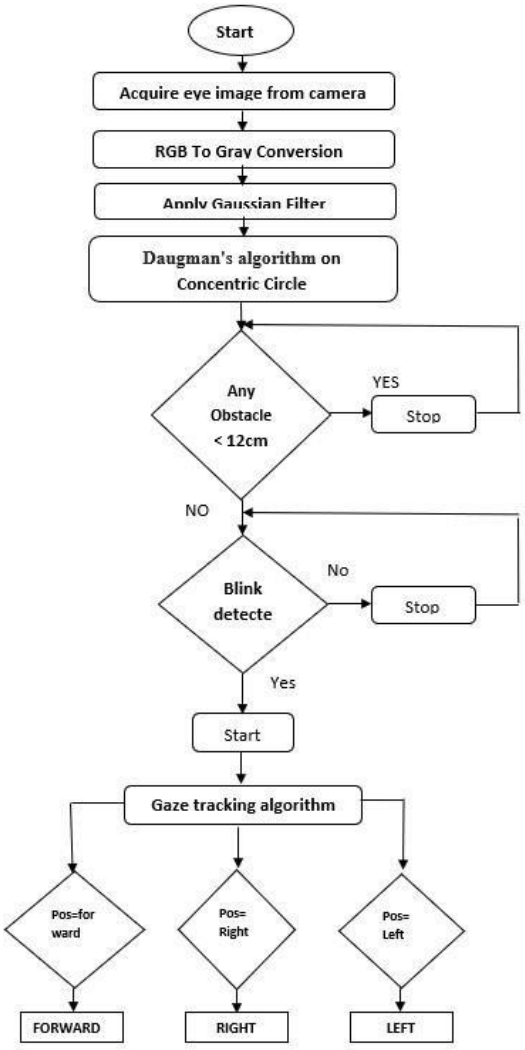


Figure1. Flow Diagram of Proposed Method

Algorithm Implementation:

The prototype of proposed system can be implemented using Raspberry Pi Zero W and an Arduino. Raspberry Pi Zero is a mini computer that plug into any monitor or TV. It has 900 MHz quad-core ARM processor. An OpenCV (Open-Source Computer Vision) library is integrated on Raspberry Pi used for real time image processing. The programming language used to program the Raspberry Pi is Python, which connects the Raspberry Pi with real world. The processed data are then transferred to PI through wireless communication. PI drives the Dc motors according to the data coming from Transmitter.

The block diagram of transmitter of Iris controlled system is as shown in figure 2 The proposed algorithm is initialized on detecting a face from the 5MP Pi camera feed connected to Raspberry pi zero W at the transmitter side.

OpenCV in python has been used for digital image processing to detect Iris commands, we have used a 'haarcascade' of an eye, thereby identifying the eye in the live video window being recorded, and done processing on that part of the image (applying my algorithm only to the subjected eye).

Real time video feed of the Iris was taken as input, and the entire frames are converted to grayscale. Then performed binary thresholding so that the Iris turns completely black and the rest area is completely white. Now fixed 3 points on the frame- left, centre and right. If the person is looking left accordingly it is identified as black. The same thing happens with right. Depending on the position of the eye corresponding command are generated. This code shall be written in the client side (Transmitter). This data(direction) shall be sent wirelessly to the Raspberry pi Zero W.

Transmitter:

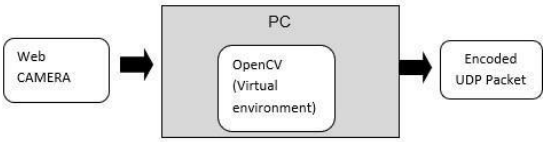


Figure 2 Block diagram of Transmitter

At the receiver section consist of Raspberry Pi connected to Wi-Fi module receives the command, and process the signal to control the direction of the robot. Motor driver circuit drives the motors of the robot. As shown in fig 3

Receiver:

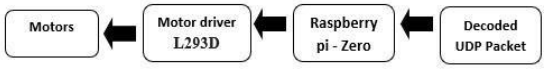


Figure 3 Block diagram of Receiver RESULT

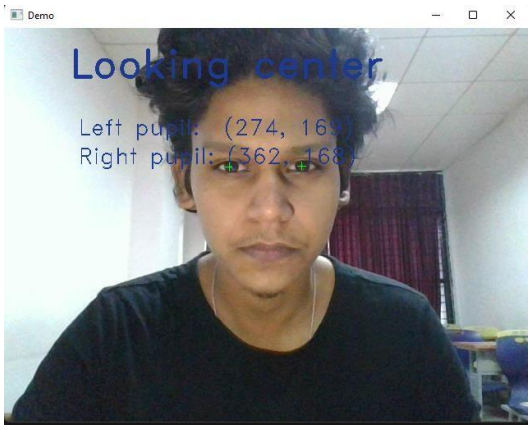


Figure 4 – Looking Center

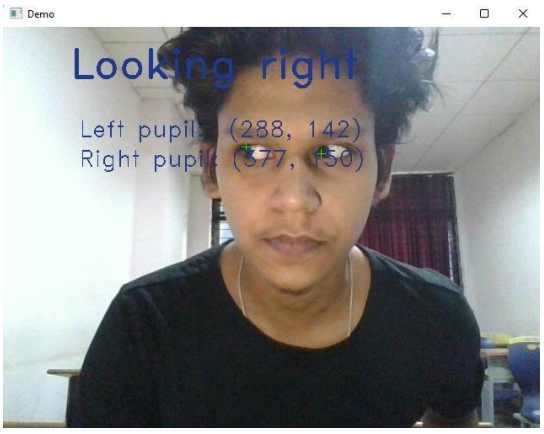


Figure 5 – Looking Right

Figure 6 – Looking Left

Figure 7 – Blinking

Iris position for Forward control of robot: - we can observe that the iris position is at exactly centre position. **Figure 4** shows the binary image of the RGB image. Then this binary image complemented that means white pixels converted into black pixels. When the white portion of the iris is detected at centre column then robotic vehicle moves in forward direction.

Iris position for leftward movement of robot: - we can observe that the iris position is at exactly leftward position. **Figure 6** shows the binary image of the RGB image. Then this binary image complemented that means white pixels converted into black pixels. When white portion of the iris is detected at right column, then robotic vehicle moves in leftward direction.

Iris position for rightward movement of robot: - we can observe that the iris position is at exactly rightward position. **Figure 5** shows the binary image of the RGB image. Then this binary image complemented that means white pixels converted into black pixels. When the white portion of the iris is detected at left column then robotic vehicle moves in rightward direction.

When Iris Is Not Detected (To Stop Movement of Robot) and Blink is Detected: - we can observe that eye is completely closed; hence no iris is detected. **Figure 7** shows the binary image of the RGB image. Then this binary image Complemented that means white pixels converted into black pixels. When white portion of the iris is not detected in image, then robotic vehicle movement is stop.

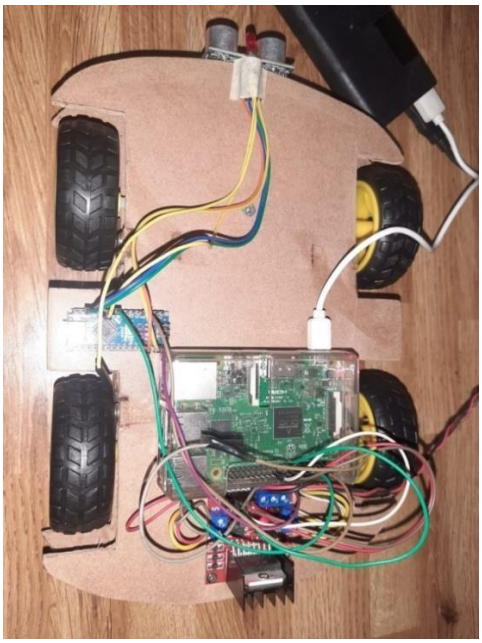


Figure - 8

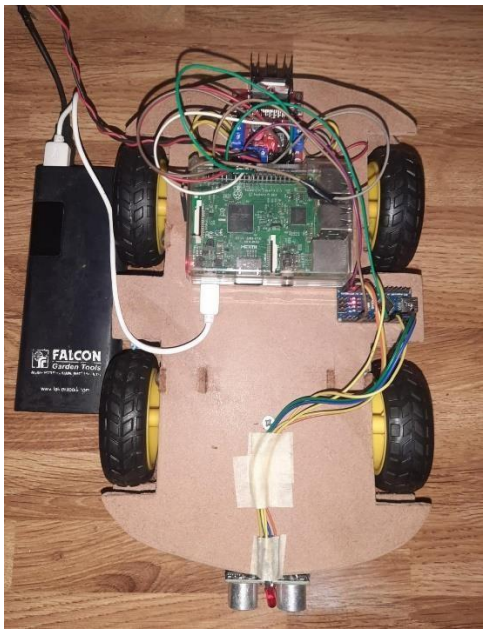


Figure – 9

5. CONCLUSION

In this system we present an innovation in ordinary wheelchair by adding motor type mechanism and making easier and simple wheelchair to handle by using eye motion tracking for physically disabled and paralyzed. The aim of this system is to contribute to the society in our small way by setting out an idea for a system which could actually better the lives of millionsof people across the globe.

The future scope of this system would be to develop a mobile app to manage the wheelchair control. Also introducing home automation in the system would be an added feature of the wheelchair where a disabled person can turn on/off home appliances without getting up from his position.

We have concluded that it can be automatic detect face and eye regions and also iris detection. we have used blob analysis and Hough transform for eye and iris detection resp. Blob analysis is based on skin detection. Blob analysis is very fast way to recognition faces and eye region. And it processing time is fast than other recognitions technique. we proposed an iris detection method using the circular Hough transform that adapts to various eye

positions. Firstly detected the eyes in different position and cropped automatically. Then the positions of irises were detected by circular Hough transform. So I have concluded that Hough transform is very easily implement and also conceptually simple.

In this work performance comparison of three techniques have been investigated Edge detection is one of the important modules of any image processing technique. In this work we have proposed the edge detection technique based on Region of Interest (ROI) and also Edge Length (EL) to recognize the Human eye. The performance of the proposed system has been verified and validated with existing problem. This technique is a novel technique to identify the Iris and also the proposed technique shows significant results and compared with the other conventional techniques and also using this technique we have predicted the cholesterol inside the eye as one of the future extraction.

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