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IRIS Recognition-Based Wheelchair for Quadriplegia Prone Persons

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ABSTRACT

This abstract presents the concept of an iris recognition-based wheelchair system designed specifically for individuals with quadriplegia, a condition that results in paralysis of all four limbs. The proposed wheelchair aims to enhance the mobility and independence of quadriplegia-prone individuals by utilizing iris recognition technology to facilitate seamless control of the wheelchair's movement.

The system utilizes a non-intrusive iris recognition algorithm to accurately identify the user's iris patterns, which are unique to each individual. By integrating this technology into the wheelchair's control system, the user can navigate the wheelchair by simply focusing their gaze on specific directions or objects within their field of vision. The system captures real-time iris images and processes them using advanced computer vision techniques to determine the intended movement commands.

Through this innovative approach, the wheelchair eliminates the need for physical contact or manual input devices, thereby offering a more natural and intuitive control mechanism for individuals with quadriplegia. The iris recognition-based control system not only enables precise navigation but also provides customizable features such as speed adjustment, obstacle detection, and path planning, ensuring a safe and efficient user experience.

Furthermore, the proposed system incorporates machine learning algorithms to continuously improve the iris recognition accuracy and adapt to individual users' changing eye patterns over time. This adaptive learning capability enhances the system's reliability and ensures consistent and reliable control of the wheelchair.

Keywords :- Quadriplegia, Wheelchair, Adaptive Learning, Iris

I. INTRODUCTION

Quadriplegia is a condition that affects all four limbs, and can make it difficult or impossible for people to control their wheelchairs. Iris recognition is a biometric identification technique that uses the unique patterns of the iris to identify individuals. This technology has been used in a variety of applications, including security systems and access control.[1]

In recent years, there has been growing interest in using iris recognition to control wheelchairs for quadriplegia prone persons. This is because iris recognition is a non-intrusive and accurate biometric identification technique. It is also relatively easy to implement, and can be used with a variety of wheelchairs.

There are a number of advantages to using iris recognition to control wheelchairs for quadriplegia prone persons. First, it is a non-intrusive method of identification. This means that users do not have to wear any special devices or accessories, and they can still control their wheelchairs even if they are wearing gloves or sunglasses.[2]

Second, iris recognition is a very accurate biometric identification technique. This means that there is a very low risk of false positives or false negatives. This is important for wheelchair users, as they need to be able to rely on their wheelchairs to operate safely.

Third, iris recognition is relatively easy to implement. This means that it can be used with a variety of wheelchairs, and it can be integrated into existing wheelchair control systems.

Overall, iris recognition is a promising technology for controlling wheelchairs for quadriplegia prone persons. It is a non-intrusive, accurate, and easy-to-implement biometric identification technique. This makes it a valuable tool for improving the independence and mobility of quadriplegia prone persons.[3]

Here are some additional points that could be included in the abstract:

The benefits of using iris recognition for wheelchair control, such as increased independence and mobility, improved safety, and reduced caregiver burden.

The challenges of implementing iris recognition for wheelchair control, such as the need for high-quality imaging and the need to account for environmental factors.[4]

The future of iris recognition for wheelchair control, such as the potential for using iris recognition to control other assistive devices.

1.1 CHALLENGES OF IMPLEMENTING IRIS RECOGNITION FOR WHEELCHAIR CONTROL

The need for high-quality imaging: Iris recognition requires high-quality images of the iris. This can be difficult to achieve in some environments, such as outdoors or in bright sunlight.

The need to account for environmental factors: Iris recognition can be affected by environmental factors, such as glare, dust, and moisture. This means that it is important to design iris recognition systems that are robust to these factors.[5]

The need for user training: Users will need to be trained on how to use the iris recognition system. This training will need to cover topics such as how to position their head for optimal imaging and how to troubleshoot problems.

1.2 OBJECTIVE

The first phase will involve the development of the iris recognition system. This will include the selection of a suitable camera, the development of the iris recognition algorithm, and the integration of the iris recognition system with the wheelchair control system. The second phase will involve the testing of the iris recognition system. This will involve testing the system in a variety of environments and under a variety of conditions. The third phase will involve the deployment of the iris recognition system. This will involve the integration of the iris recognition system into a commercial wheelchair and the evaluation of the system by users.[6]

II. LITERATURE REVIEWS

Sumedh Kulkarni et al. (2017) proposed help people who are unable to climb stairs or walk i.e. either senior citizens, physically challenged or paralytic people. It is a difficult task for them to climb stairs or walk. Independent mobility is critical for individuals of any age. For such people, this project will bring this convenience. Whenever there is a situation where they wish to climb stairs or move ahead, this wheelchair will efficiently help the user to overcome problems and help them to do such tasks. It is accomplished by controlling the different input mechanism. The user can provide desired input to wheelchair and to the designed special wheel mechanism which will help user to climb the stairs more easily or to move ahead on a straight path thereby overcoming their problems. In this project, it is proposed that this Wheelchair will help different groups of people who are lacking the enough potential to face such problems.

AKM Bahalul Haque et al. (2020) proposed human help 24/7 to proceed onward. They need a wheelchair to move from one place to another as per their need. It would be much easier if the wheelchair needed for their task be automated and controllable by the person himself rather another constant human engagement. In this paper, a design has been proposed considering these facts. The wheelchair will be controlled by voice and gesture. To make the system energy efficient solar power will be used. Along these lines, while moving around all around the battery can be revived effectively. This keen wheelchair is additionally fit for hindrance recognition.

Doshi Siddharth P. et al. (2016) proposed Ubiquitous devices are becoming a part of people’s day-to-day life. Smart devices not only aid to people’s life but also are becoming a crucial part of physically challenged and aged people. The need for safe and independent mobility for the elderly and physical challenged people is of prime concern. The paper deals with creation of a Smart Wheel-Chair (SWC) that mainly focuses on the mentioned issue in a very affordable way and to a greater extent. The Wheel-Chair is controlled by RTOS as its core operating system. It consists of a touch-screen based navigation system along with accident prevention and fall detection. A semi-automatic vision function, heart rate sensors and physiological stress sensors have been integrated. GPRS system is used for location determination and GSM is used to communicate in those cases where certain abnormal events like falling, accident or health issues are trigged. The real-time interaction functions are designed with the motive to make the user operating the wheel-chair completely self-dependent and his interaction with the environment can be like of a normal person .

Nutthanan Wanluk et al. (2016) This project is a smart wheelchair based on eye tracking which is designed for people with locomotor disabilities. The add-on controlled module can be used with any electrical wheelchair. The smart wheel chair consists of four modules including imaging processing module, wheelchair-controlled module, SMS manager module and appliance-controlled module. The image processing module comprises of a webcam installed on the eyeglass and C++ customized image processing software. The captured image which is transmitted to raspberry Pi microcontroller will be processed using OpenCV to derive the 2D direction of eye ball. The coordinate of eyeball movement is then wirelessly transmitted to wheelchair-controlled module to control the movement of wheel chair. The wheelchair-controlled module is two dimensional rotating stages that installed to the joystick of the electrical wheelchair to replace the manual control of the wheelchair. The motion of eyeball is also used as the cursor control on the raspberry Pi screen to control the operation of some equipped appliance and send message to smart phone.

Farwa Jafar et al (2019) Author presents a novel technique to control a wheelchair by using eye movements. Eye controlled chair comprised of an electric wheelchair, a webcam in front of the user's eye capturing eyeball movements with a low-cost Raspberry pi system, serially communicating with Arduino microcontroller to drive wheelchair in the desired direction. The transfer learning approach was adopted instead of traditional image processing techniques, making wheelchair more reliable and accurate. Keras deep learning pre-trained VGG-16 model led us to achieve excellent performance, with very little training dataset. Unlike conventional wheelchairs, presented methodology makes this wheelchair equally suitable for people wearing eye glasses.

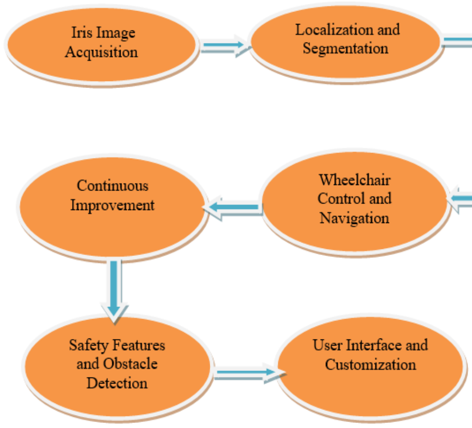
Reshma Abraham et al.(2019) Real time system which enables a person with quadriplegia to control his wheelchair with eye movements. This system is enabled by voice control. Once enabled, it processes consecutive frames from the web cam to detect the direction of eye movement. Consequently, a signal is sent to the Raspberry pi micro-controller, to turn the motors in the desired direction. Detection is done by pupil monitoring using contours. Additionally, it detects Asthenopia, a disease caused by straining of the eye. This is achieved by monitoring the blink rate of the patient. Blink Detection is carried out using two methods. The first method uses a combination of SURF and Harris corner detection while second method uses facial landmarks.

Jatin Sharma et al. (2017) The number of persons who are paralyzed and therefore dependent on others due to loss of self-mobility is growing with the population. Quadriplegia is a form of Paralysis in which you can only move your eyes. Much work has been done to help disabled persons to live independently. Various methods are used for the same and this paper enlists some of the already existing methods along with some addons to improve the existing system. Add-ons include a system, which will be designed using Raspberry Pi and IR Camera Module. OpenCV will be used for image processing and Python is used for programming the Raspberry Pi.

M. VASANTHA LAKSHMI et al (2020), Many people are suffering from the disease called Quadriplegia which means the forelimbs of those people do not work. Some People cannot walk, and they can’t even move because of major accidents. The number of persons suffering from Quadriplegia is increasing with increase in the population of the world. For such people, the main source for movement is the Wheelchair. It is very helpful for the people if those wheel chairs are automated. Some systems have already come into existence such as voice controlled wheel chair, gesture controlled wheel chair. But these systems have some drawbacks as they cannot be used by the persons who cannot move their hands, and voice-controlled systems are vulnerable to noise. Therefore, to overcome those, we propose Eye ball movement Based Wheel chair control system which moves in the desired direction that the person wants to move. Here we are counting the eye blinks. Based on the blinks count we are going to monitor the eye ball movement. We use eye detection, processing of the captured images and interfacing the raspberry pi with motor drivers to control the wheelchair. We also include IR sensors for obstacle detection in left, right, forward direction.

Dianchun Bai et al (2016). Purposed electric wheelchairs on the market mostly were controlled by joystick which required users to operate by hands flexibly. But this wheelchair cound not be used by patients with hand disability or paraplegics. This paper designs an electric wheelchair controlled by eye movements. An eye tracker of Tobii is connected with a electric wheelchair. The eye tracker of Tobii is used to convert eye movement signals into coordinate of gazing points. But these data of gazing points are too diverging to be used directly. Kalman filter algorithm is used to filter data of coordinate and obtain optimal data. By discriminating eye movement-controlled panel area where gazing points is located in, a computer sends appropriate signal to the wheelchair, so as to achieve the goal of moving wheelchair. Thus patients are no longer using hands to control electric wheelchairs.

III. PURPOSED METHODOLOGY



Iris Image Acquisition: The first step in the proposed methodology is to acquire high-quality iris images of the user. This can be achieved using a specialized iris recognition camera or a standard camera equipped with an infrared filter. The user will be positioned at an appropriate distance and instructed to look towards the camera. Multiple images from different angles and under varying lighting conditions may be captured to improve recognition accuracy.

Iris Localization and Segmentation: Once the iris images are acquired, the next step is to locate and segment the iris region accurately. This can be achieved using image processing techniques such as edge detection, Hough transforms, or circular fitting algorithms. The iris region is then isolated from the rest of the image to focus specifically on the iris patterns.

Feature Extraction: In this step, relevant features are extracted from the segmented iris region. Various iris recognition algorithms exist for feature extraction, such as Daugman's algorithm, which utilizes statistical methods to encode the unique patterns present in the iris. Other techniques, such as wavelet transforms or Gabor filters, may also be employed to capture discriminative features.

Iris Recognition and Authentication: The extracted iris features are matched against a pre-registered database of iris templates for recognition and authentication. This involves comparing the extracted features with the stored templates using suitable matching algorithms such as Hamming distance, Euclidean distance, or correlation-based methods. If a match is found, the user's identity is confirmed, and the wheelchair control process continues.

Wheelchair Control and Navigation: Once the user's identity is authenticated, the iris recognition system communicates with the wheelchair control unit to translate the user's gaze direction into appropriate movement commands. The system can utilize a combination of eye tracking techniques, such as gaze estimation and dwell-time analysis, to interpret the user's intentions accurately. These commands control the speed, direction, and other parameters of the wheelchair, enabling smooth and responsive movement.

Adaptive Learning and Continuous Improvement: The proposed system incorporates adaptive learning techniques to improve iris recognition accuracy over time. This involves updating the user's iris templates based on variations observed during different lighting conditions, aging effects, or changes in the iris due to medical conditions. Machine learning algorithms can be employed to adapt the recognition model and enhance its performance for individual users.

Safety Features and Obstacle Detection: To ensure the safety of the user, the wheelchair system can integrate additional features such as obstacle detection and avoidance mechanisms. This may involve using sensors, such as ultrasonic or LiDAR sensors, to detect obstacles in the wheelchair's path and automatically adjust the wheelchair's movement to avoid collisions.

User Interface and Customization: The proposed wheelchair system can provide a user-friendly interface that allows individuals to customize various settings according to their preferences. This includes options for adjusting wheelchair speed, sensitivity of gaze commands, and personalized path planning algorithms.

IV. EXPECTED RESULT ANALYSIS

To annotate the iris, five key landmarks i.e., centre, top, right, bottom, and left are identified. To handle the problem of the different diameters of the irises of different persons, the threshold method was used to check that if the iris diameter and the area selected by the proposed method were the same. After this, the annotation was started. The radius was adjusted to obtain a perfectly aligned circle with the iris. The threshold value was added or subtracted from the centre of the iris. Algorithm 1 shows the steps involved in landmarks annotation.

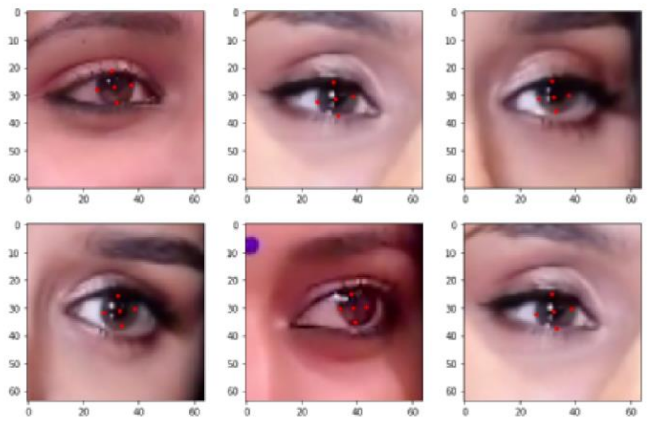


Figure 1. Prediction of iris landmarks of the proposed model.

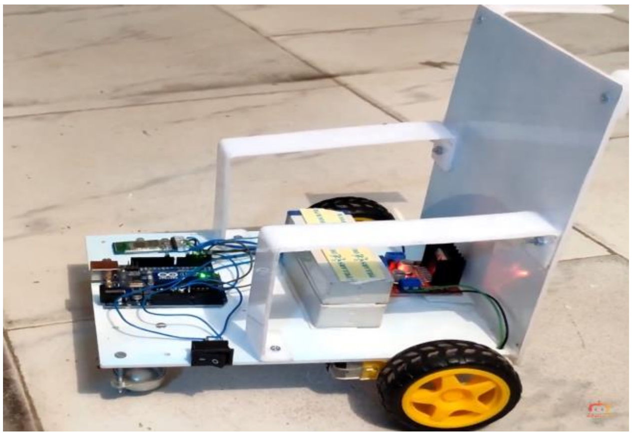


Figure 2 Wheelchair Model

V. conclution and future scope

Iris recognition-based wheelchairs offer a number of advantages over traditional wheelchairs controlled by joysticks or switches. They are more intuitive to use, as they require no physical contact with the wheelchair. This can be especially beneficial for quadriplegic people, who may have limited or no use of their limbs. Iris recognition wheelchairs are also more discreet, as they do not require the user to wear any external devices.

In addition, iris recognition is a very secure biometric authentication method. This means that iris recognition wheelchairs are less likely to be hacked or tampered with than wheelchairs controlled by other methods.

The future scope of iris recognition-based wheelchairs is very promising. As the technology continues to improve, iris recognition wheelchairs will become more affordable and accessible. This will allow more people with disabilities to enjoy the benefits of this innovative technology.

In addition, iris recognition wheelchairs could be further integrated with other assistive technologies. For example, they could be linked to a person's smart home system, so that the wheelchair can automatically move to the desired location. Or, they could be linked to a person's smartphone, so that the wheelchair can be controlled remotely.

The possibilities are endless, and the future of iris recognition-based wheelchairs is very bright.

Here are some specific areas where the technology could be further developed:

Improved accuracy and reliability: The accuracy and reliability of iris recognition technology could be improved by using more advanced algorithms and hardware. This would make iris recognition wheelchairs more reliable and easier to use.

Increased portability: The portability of iris recognition wheelchairs could be increased by making them smaller and lighter. This would make them easier to transport and use in a wider range of settings.

Lower cost: The cost of iris recognition wheelchairs could be lowered by making them more widely available and by using less expensive components. This would make them more affordable for people with disabilities.

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