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Automatic Home Controlling System for Paralyzed Patient using Eye Gestures

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ABSTRACT: The system revolutionizes the lives of paralyzed individuals by harnessing the power of eye-tracking technology for seamless control of home appliances. Utilizing OpenCV for robust and real-time eye tracking, the system enables patients to effortlessly interact with their surroundings by focusing on predefined patterns or commands. A user-friendly interface facilitates the establishment of a connection between eye movements and various household devices, including lights, fans, and entertainment systems. This innovative solution empowers individuals with limited mobility to regain independence, simplifying the management of daily routines and living spaces through intuitive gaze-based commands. By providing a novel avenue for communication and control, the system offers paralyzed patients a renewed sense of autonomy, convenience, and improved quality of life.

KEYWORDS: Paralysis, Eye-tracking technology, OpenCV, Predefined Patterns or Commands, Household Devices, Gaze-based control.

I. INTRODUCTION

Paralysis is a loss of muscle function in a part of the body. It can be localized or generalized, partial or complete, and temporary or permanent. Paralysis can affect any part of your body at any time in your life. If you experience it, you probably won't feel pain in the affected areas. Currently, no cure for paralysis exists. However, depending on the cause and type of the issue, some people experience partial or complete recovery. Temporary paralysis, such as that caused by Bell's palsy or stroke, may resolve on its own without medical treatment. Also, when paralysis results from a spinal cord injury or chronic neurological condition, a person may recover partial muscle control.

Although rehabilitation does not cure paralysis completely, it can help prevent symptoms from worsening. The proposed system signifies a paradigm shift in empowering paralyzed individuals through the integration of eye-tracking technology for seamless control of household appliances. In an era marked by technological advancements aimed at enhancing the quality of life, this project specifically addresses the unique needs of paralyzed patients, providing a comprehensive solution to facilitate their interaction with the surrounding environment.

The proposed system is designed to empower paralyzed patients with a means to control their home appliances effortlessly through eye tracking technology. It leverages OpenCV for robust and real-time eye tracking, allowing patients to interact with their environment by focusing their gaze on specific predefined patterns or commands. Through a user-friendly interface, patients can establish a connection between their eye movements and various household devices, such as lights, fans, and entertainment systems. By implementing this innovative system, individuals with limited mobility can regain a sense of independence and convenience as they manage their daily routines and living spaces simply by directing their gaze.

The primary objective of this project is to revolutionize the lives of paralyzed individuals by developing a system that leverages eye-tracking technology for seamless control of home appliances. The focus is on utilizing OpenCV for robust and real-time eye tracking, enabling patients to interact effortlessly with their surroundings through predefined patterns or commands. The ultimate goal is to empower individuals with limited mobility, providing them with a renewed sense of autonomy and improved their overall quality of life by simplifying the management of daily routines and living spaces through intuitive gaze-based commands.

II. LITERATURE SURVEY

A literature survey is the key step in the software development process. Before developing the tool it is necessary to determine the time factor, economy, and company strength. This chapter presents previous studies done in the field of Automatic Home Appliances Controlling Systems using Eye Gestures during critical conditions. It deals with background studies in the field of technology applications.

Praveena Narayanan, Sri Harsha. N et al. [1] (2022) discussed about **“A Generic Algorithm for Controlling an Eyeball-based Cursor System”** proposed a specific humancomputer interaction system
Sivasangari.A et al.[2] (2020) explained about **“Eyeball based Cursor Movement Control”** they introduced an individual Human computer interference system.

Marwa Tharwat et al. [3] (2022) discussed about **“Eye-Controlled Wheelchair”** A powered wheelchair is a mobility device for moderate or severe physical disabilities or chronic disorders.

Rani. V Udaya, S Poojasree et al. [4] (2022) explained about **“An IOT Driven Eyeball And Gesture-Controlled Smart Wheelchair System for Disabled Person”** The area of smart homes has evolved with goal of restoring the capacity of physically disabled people, aged, and others with limited mobility to accomplish critical every day activities by giving sufficient help via current technology devices.

Dhanasekar J,Guru Aravindh K B et al. [5] (2023) discussed about **“System Cursor Control Using Human Eyeball Movement”** This paper aims to develop a system for controlling the computer cursor using the movement of the users 2019s eyeballs, providing a hands-free alternative to the traditional mouse.

Vandana Khare et al. [6] (2019) explained about **“Cursor Control Using Eye Ball Movement”** A few people and groups are not able to operate the computer because of their illnesses. In this scenario, it is more sound, to introduce a method of computer operation, which is easily accessible, even considering the disabilities of the differently abled. **Osama Mazhar et al [7] (2015)** discussed about **“A realtime webcam based Eye Ball Tracking System using MATLAB”** Eye Ball Tracking System is a device which is intended to assist patients that cannot perform any voluntary tasks related to daily life.

S.N.Shivappriya et al [8] (2021) **“Intelligent Eyeball Movement Controlled Wheelchair”** For people who are physically disabled, wheelchairs play a significant role.

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S.N.Shivappriya et al [8] (2021) **“Intelligent Eyeball Movement Controlled Wheelchair”**For people who are physically disabled, wheelchairs play a significant role. **Maheswari R et al [9] (2022)** **“Voice Control and Eyeball Movement Operated Wheelchair”** Physically disabled persons rely heavily on rehabilitative mobility aids.

Adarsh Rajesh et al. [10] (2017) **“Eyeball gesture controlled automatic wheelchair using deep learning”** Traditional wheelchair control is very difficult for people suffering from quadriplegia and are hence, mostly restricted to their beds.

III. BLOCK DIAGRAM

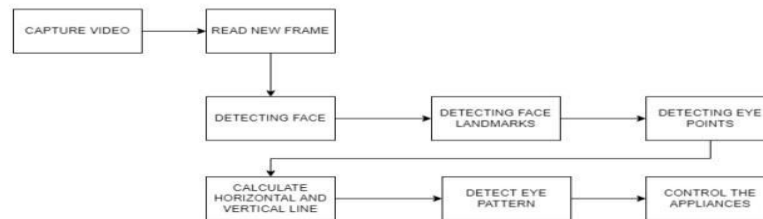


Fig – 3.1 Block Diagram

The block diagram fig-3.1, outlines a sequential process for a system likely involving facial recognition and eye-tracking technology. It begins with capturing a video stream, followed by the extraction of individual frames. The system then proceeds to detect faces within these frames and identifies key facial landmarks, particularly focusing on the eyes. Subsequently, it calculates horizontal and vertical lines based on the position of the detected eyes. Eye patterns or movements are then analyzed to determine the user's gaze direction or intention. Finally, based on this analysis, the system triggers actions to control appliances. This process suggests the development of a sophisticated interface allowing users to interact with appliances through eye-ball movements, potentially enabling hands-free operation. Such technology could find applications in various fields, including assistive technology for individuals with mobility impairments or as a futuristic control mechanism for smart homes and devices.

IV. METHODOLOGY

INTRODUCTION TO METHODOLOGY:

The methodology for implementing the proposed eye-tracking system aims to empower paralyzed individuals by leveraging advanced computer vision techniques for controlling home appliances. This intricate process involves several key steps, each contributing to the accurate and responsive analysis of user eye movements.

VIDEO CAPTURE AND FRAME EXTRACTION:

The initial phase focuses on video capture, where real-time footage of the user's face is obtained through a camera. This video stream serves as the foundation for subsequent processing. Frame extraction is then performed, processing the captured video frame by frame. This real-time extraction is crucial for ensuring the system's prompt response to the user's gaze.

FACE DETECTION:

Following frame extraction, the attention shifts to face detection. OpenCV's face detection algorithms are employed to identify and isolate the user's face within each frame. This step is pivotal, as accurate face detection forms the basis for subsequent eye-tracking analysis.

EYE DETECTION THROUGH FACE LANDMARKS:

Once the face is successfully identified, the methodology progresses to eye detection through face landmarks. Facial landmark detection algorithms are applied to identify key points on the face, including those corresponding to the eyes. These landmarks serve as crucial reference points for precise eye-tracking.

EYE POINT DETECTION:

The subsequent step involves detecting specific eye points within each eye. Algorithms are engaged to pinpoint the key features, such as the corners and the center.

The precise localization of these points is essential for accurately calculating the horizontal and vertical positions of the eyes.

CALCULATION OF HORIZONTAL AND VERTICAL EYE POSITIONS:

The calculation of horizontal and vertical eye positions is a crucial intermediary step in the methodology. Through the analysis of the relative positions of the identified eye points, the system determines the orientation of the user's gaze within the frame. This quantitative data forms the foundation for subsequent pattern recognition.

PATTERN RECOGNITION AND ANALYSIS:

The final phase involves the analysis of eye patterns to discern specific user actions, such as blinks or directional gazes. For blink detection, the system monitors changes in eye openness over time, identifying instances of rapid closure and reopening. Directional gaze detection involves analyzing the movement patterns of the eyes to determine whether the user is looking to the left or right.

USER INTENT CLASSIFICATION:

The culmination of these analyses results in the classification of user intent. The system distinguishes between blinks and directional gazes, enabling it to send corresponding control signals to home appliances. A blink may signify a general command, while left or right gazes could be associated with specific appliance control commands.

SYSTEM INTEGRATION AND INDEPENDENCE:

The detailed methodology underscores the intricate process involved in implementing the proposed eye-tracking system. The integration of advanced computer vision techniques, particularly leveraging OpenCV, facilitates the translation of subtle eye movements into meaningful control signals. This empowers paralyzed individuals to manage their living spaces effortlessly and independently, contributing to an improved quality of life.

The conversion to gray level simplifies subsequent processing, and the Appliance Control module interprets patterns related to blinks and pupil position, enabling the seamless operation of household appliances based on the subject's eye behavior. This integrated approach provides individuals with limited mobility a novel and intuitive means of controlling their living environment through precise gazebased commands.

V. CONCLUSION

In conclusion, the presented eye-tracking system, developed with Python 3.7, Thonny IDE, and leveraging OpenCV and Gaze Tracking, stands as a promising solution for enhancing the autonomy of paralyzed individuals in home environments. By interpreting subtle eye movements, the software enables intuitive control of household appliances, contributing to an improved quality of life for users with limited mobility. The successful integration of computer vision technologies underscores the potential for assistive systems that prioritize accessibility and user-friendly interfaces.

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