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Artificial Intelligence(AI) Enhanced Eye Tracking System For Tetraplegia Patients

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Abstract

People who are incapable of managing all of their muscles other than their head and eyes. There are some medical conditions, such as Locked in Syndrome, that can induce paralysis or motor speech disorders in persons, which can result in voice or speech impairments. Traditionally, many people can communicate by tracking their movements and blinking their eyes. Communication is important for allowing people of this type to express how they feel and what they need. Using an IOT module and an eye tracking system based on CNN (Convolutional Neural Network), we design a technique of interpersonal communication for a tetraplegic patient in this system. The use of eye blink detection and movement tracking for communication is also possible for quadriplegic patients. With a voice board speaker and this project concept, talks can be delivered while imparting all necessary information. The goal of this research was to develop an IOT module that would enable tetraplegic people to send emergency information to the care team using deep learning and digital image processing. Following the end of the interaction, the technology will be able to flawlessly display the audio signals from the gaze movement.

1. Introduction

Eye tracking technology has considerably developed over the past few years and has become a crucial tool in a number of fields, human-computer interaction, and market research. (An et al.)By detecting the movements of a person's eyes, eye tracking devices can reveal crucial information about that person's visual attention and decision-making processes. The addition of artificial intelligence (AI) to the systems has improved the accuracy, dependability, and adaptability of eye tracking technology. (Benini, De Rossi, et al.)Eye tracking systems augmented by artificial intelligence do, however, have significant challenges. It is challenging to locate high-quality training data for AI systems. Finding the enormous amounts of accurately labeled data required for this can be difficult. (Chiper et al.) AI may be challenging for real-time applications since the methods can be computationally expensive. The objective of this conference paper is to provide a summary of the most current advancements in AI-enhanced eye tracking systems. (Goyal et al.)The study begins by describing the background, context, and applications of eye tracking technology. The aim of the study is to assess the present status of AI enhanced eyetracking systems and their potential for future development. (O Funes, Serrano-Gotarredona, et

al.)

2. Related Works

Users can point at targets more quickly than they can with a computer mouse when using human-computer interaction techniques based on eye-gaze. Using an eye-gaze input approach with brief periods, faster target pointing has been seen. (Vehlen et al.)

The majority of input methods additionally incorporate speech or keyboard input, even though it would be more natural to only make eye contact. (Bissoli et al.) Because of the accidental eye movement that happens during eye-gaze input, this method has a downside in that the cursor will move slightly when you press a key. (Zhang et al.) The pointer accidentally veers off course because it is difficult to concentrate on staring at the target, which reduces precision and focus. Users with eye gaze input devices may grow annoyed when performing difficult tasks, such as choosing items from a menu, which could reduce the accuracy of their pointing. (Fan et al.)

The effectiveness of eye-gaze systems must be improved by ensuring that more natural eye movements can be accurately input. (Zhang et al.) It can be challenging to carry out adjustment functions like to mouse operating functionalities with only natural eye-gaze input, though. Many studies have tried to develop more organic correcting procedures. Keeping the eyes from wandering when focusing on a target will help you stop the pointer from moving. (Fan et al.)

The eye-path tracking device (Nac Image Technologies) monitors eye movements by detecting the reflection of infrared light. (Al-Mamun, Islam, Hoque, et al.) The eye tracker was attached to the system using a connector so that the eye-gaze location could be produced using a rate. (Asifuzzaman et al.)

3. Materials and Methods (Bold, Size 12, Times New Roman font)

A Convolutional Neural Network (ConvNet/CNN) is a Deep Learning algorithm that can take in an input image, assign significance (i.e. weights and biases) to distinct aspects/objects in the image, and be able to distinguish one from the other. (Oudah, Al-Naji, Chahl, et al.) The creation of algorithms that power and will continue to power AI as a whole in the near future relied heavily on CNN's of different architectures, which are readily available. Some of them have been listed below:

- GoogLeNet
- ResNet

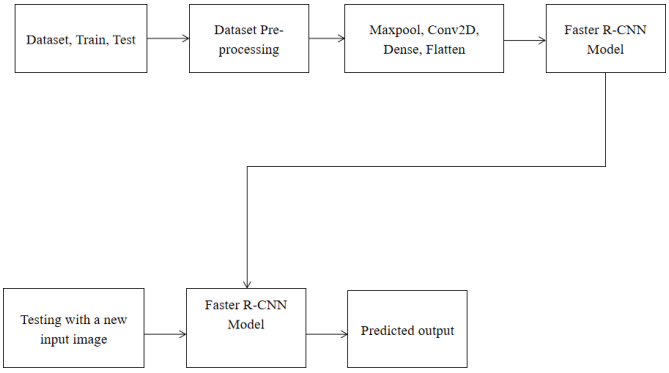

FIGURE 1. Block Diagram

4. Results and Discussion

We have developed an innovative method that uses the Internet of Things module integrated with Convolutional Neural Network based technology to aid individuals with quadriplegia or tetraplegia in communicating effortlessly via eye tracking. This system allows patients to express themselves by detecting blinks and other types of head/eye motion necessary for delivering information quickly without physical interaction.

these people can regain some degree of control over their environment and lives. This may have a substantial positive impact on their quality of life.

It is important to carefully analyze the limitations and inadequacies of AI-enhanced eye tracking systems, such as the need for high-quality training data, the computing burden, and the potential for bias. If they are to be dependable and helpful, AI-enhanced eye tracking systems for people with tetraplegia must carefully address these issues.

For Tetraplegic patients, AI-enhanced eye tracking systems have immense promise, but more research is needed to fully understand their benefits and it is crucial to consider the drawbacks and shortcomings of AI-enhanced eye tracking systems, such as the requirement for high-quality training data, the computational cost, and the possibility of bias. Eye tracking systems for tetraplegics that are augmented by AI must carefully address these challenges if they are to be reliable and effective.

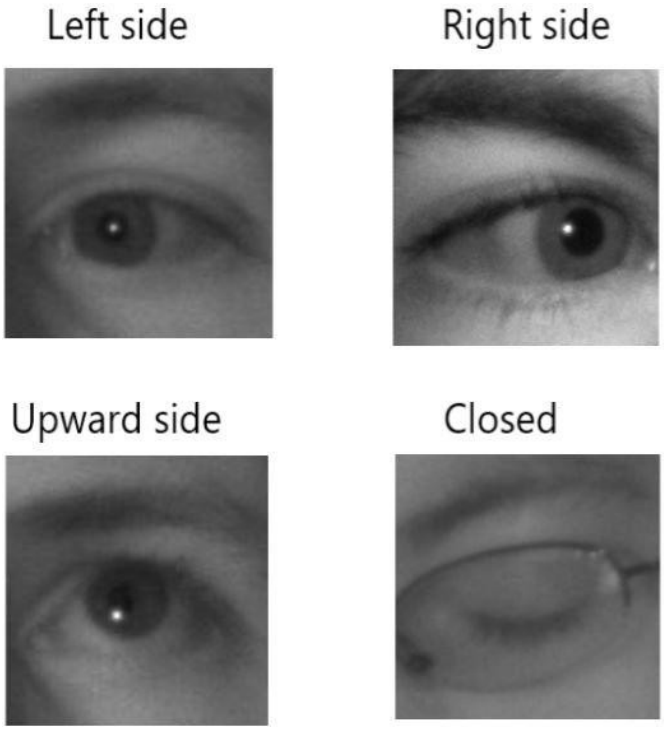

FIGURE 2. Eye Sample

Real-time data collection is possible when the camera is trained on the eye. Eye movement, which is perceived to show the process' conclusion, is the paradigm's key component. The model is trained using a dataset of eyes that contains four classifications. closed eyes, concentrated on the left, focused on the right, focused on the up, focused on the down.

This particular type will question the user three times in a row whether they are blinking to see if they need assistance. The model will automatically recognise that the eyes are closed and blink three times continuously if the eyes are closed and opened three times in a short amount of time.

5. Conclusion

Tetraplegic sufferers may be given new levels of control using eye tracking devices with AI enhancements. By employing eye movements, limitations as well as to develop reliable and effective treatments for this population.

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