VIRTUAL KEYBOARD USING EYE BLINKING

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Abstract –
Verbal communication consider as the primary mode of interaction for most individuals, yet certain situations may inhibit its use. This prompts the exploration of alternative communication methods. This paper introduces a novel solution to the problem: a virtual keyboard system using eye blink detection for input. Utilizing a webcam, the system identifies eye blinks via facial feature points, specifically the "68 points" method. By employing a blend of machine learning algorithms and image processing techniques such as Histogram Of Oriented Gradients (HoG) and Convolutional Neural Network (CNN), the system achieves real-time and accurate eye blink detection. The user interface of the virtual keyboard is intuitively designed, enabling users to input text seamlessly without physical keyboards or additional devices. Moreover, an eye blink serves as the functional equivalent of the "Enter" key. Evaluation of the system utilizing a diverse dataset demonstrates its robustness across varying lighting conditions and user profiles. The proposed system holds promise for applications in assistive technology, virtual reality, and human-computer interaction. Key terms: Virtual Keyboard, Eye Blink Detection, OpenCV, Python, dlib library, Human-Computer Interaction (HCI).

I. INTRODUCTION

This research paper presents the creation of a virtual keyboard system which introduces a novel input method: eye blink detection. The primary aim is to develop a system that is not only effective but also intuitive and easy to use. The potential applications of such a system are broad, spanning across various fields including assistive technology, virtual reality, and human-computer interaction.

One notable aspect of this virtual keyboard system is its adaptability to environments where conventional input devices like physical keyboards may not be feasible or safe to use. For instance, in high-risk environments such as nuclear power plants, where the potential for contamination is significant, utilizing traditional input devices can pose challenges or even risks to the operators. In such scenarios, the implementation of a virtual keyboard system utilizing eye blink detection could prove immensely beneficial. By eliminating the need for physical contact with input devices, the risk of contamination can be significantly reduced. Additionally, the system's reliance on eye blink detection ensures that operators can interact with the interface without compromising their safety or the integrity of the environment. Thus, by offering a safer and more practical alternative to traditional input methods, the proposed virtual keyboard system has the potential to greatly enhance operational efficiency and safety in critical environments like nuclear power plants.

Motivation

Traditional input devices like keyboards and mice have long served as the cornerstone of computer interaction. However, these tools present significant challenges for individuals with motor disabilities or injuries, limiting their accessibility to technology. Moreover, in environments such as virtual reality hazardous workplaces, where the use of traditional input devices is impractical or risky, alternative methods areessential.

Eye blink detection emerges as a promising solution, capitalizing on the natural movements of users' eyes to offer a non-intrusive and intuitive input mechanism. This research paper is motivated by the need to explore the potential of eye blink detection as a viable input method for virtual keyboards. The objective is to develop a robust system capable of accurately detecting eye blinks and translating them into text input. Such a system holds immense promise across various domains, including assistive technology, virtual reality, and hazardous workplace environments. By enhancing accessibility and usability for a diverse range of users, this technology has the potential to significantly improve their quality of life and efficiency in interacting with digital interfaces.

The pursuit of eye blink detection as an input method underscores a crucial shift towards inclusive design practices and innovative technological solutions. By leveraging the inherent capabilities of users' eyes, this approach eliminates barriers to access for individuals with motor impairments and offers a seamless interface in challenging environments. Beyond its immediate applications in assistive technology and workplace safety, the proposed system opens doors to enhanced user experiences across diverse technological landscapes. Its integration into virtual reality environments, for instance, could revolutionize immersive interactions by providing a natural and intuitive means of control. Similarly, its adoption in hazardous workplaces could mitigate risks associated with traditional input devices, safeguarding the well-being of workers while maintaining operational efficiency. Overall, the exploration of eye blink detection as an input method represents a significant step towards creating more inclusive, adaptable, and user- centric technological solutions that cater to the diverse needs of individuals across various contexts.

II. LITERATURE SURVEY

1) Mohamed Ezzat. In [1]. Introducing Blink-To-Live, an innovative mobile app tailored to empower individuals with speech impairments who rely on eye movements for communication. This groundbreaking application harnesses advanced computer vision algorithms alongside a customized Blink-To-Speak language framework to interpret a wide array of eye gestures. Through the camera embedded in smartphones, both patients and caregivers gain seamless access to monitor the subtle eye movements of users. These gestures are then translated into practical commands for daily interactions, enabling users to effectively express their emotions and needs. The app displays the synthesized eye-based speech in real-time on the phone screen, providing an immediate and intuitive channel of communication. While currently offering an accessible and cost-efficient solution, Blink-To-Live is poised for future advancements that hold the potential to redefine this technology landscape.

2) Dinesh Kumar. In [2], The incorporation of eye- controlled interfaces into computer systems stands as a revolutionary leap forward, particularly for those with disabilities. Through meticulous development, it has been proven that computer cursors can be guided solely by the movement of one's eyes, eliminating the necessity for manual input. This advancement holds tremendous potential for individuals with disabilities, offering a transformative method of engaging with computers. By leveraging facial expressions, specifically eye and mouth movements, users can effortlessly navigate virtual keyboards and cursor positions without external assistance. Powered by sophisticated algorithms like the Haar classifier, the technology accurately detects and isolates facial regions such as the eyes and mouth. This facilitates hands-free interaction between humans and computers, marking a significant stride towards inclusivity and accessibility in the digital domain.

3) Aya Marshaha. The research in [3], This endeavor marks a significant stride forward in enhancing the quality of life for individuals with motor disabilities by introducing an innovative writing tool reliant solely on eye movements, thereby circumventing the necessity for limb engagement. Central to the system's design is its user-friendly interface, which demonstrated an impressively short learning curve in initial trials. While the preliminary results showcased notable accuracy, the project remains a work in progress, laying the groundwork for future advancements. A key focus for enhancement lies in minimizing writing time, potentially through the adoption of quicker typing techniques. This might involve integrating a recommender system or exploring the utilization of higher resolution cameras to expand the number of available keys on the screen. Real- world testing with target users is paramount, as their feedback holds invaluable insights essential for honing and optimizing the keyboard's functionality.

4) Rajan Ghimire. In this research [4], Individuals facing physical disabilities encounter significant

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obstacles in their daily routines, particularly in utilizing information technology. Mundane tasks that many take for granted become complex due to limited mobility, impeding their full engagement in essential activities, such as education. In today's digital era, where access to information is paramount, there arises a pressing need to bridge the gap between individuals with physical challenges and computer technology. Addressing this imperative, this research focuses on the development of an 'Eye-Controlled Virtual Keyboard.' Acknowledging the importance of tailoring technology to meet the unique requirements of physically impaired individuals, this virtual keyboard emerges as a crucial solution, empowering them to communicate effectively with computers.

III. SYSTEM ARCHITECTURE

METHODOLOGY

A. Histogram of Oriented Gradients For face detection, the HOG (Histogram of Oriented Gradients) point descriptor employs the direct machine literacy method SVM. HOG is a straightforward yet crucial point description. extensively used for bus, face, fruit, and other item recognition in addition to face detection. Because HOG uses raw intensity distributions and edge directions to characterize item forms, it is reliable for object detection. HOG struggles to identify unknown faces. Step 1: To begin using HOG, the goal is to split the image into tiny connected cells. Step 2: Examine each cell's histogram. Step 3: Compile all the histograms into a point vector, which is a histogram made up of all the little histograms unique to each face.

A. System Architecture:

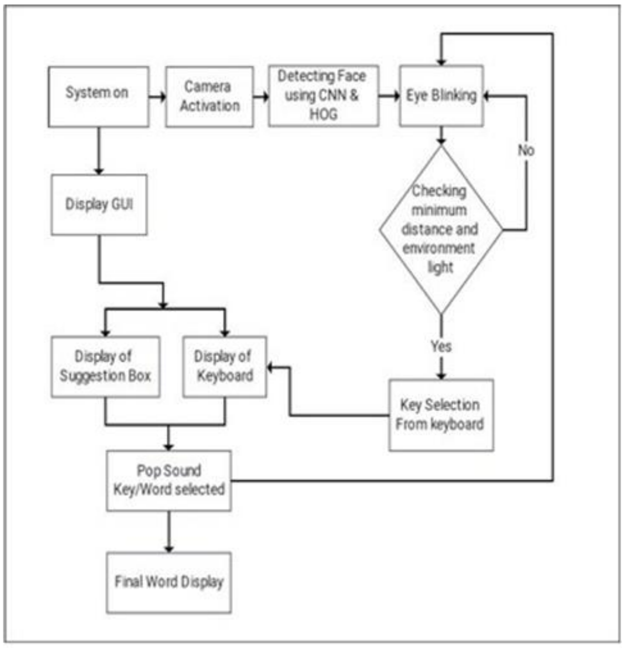

Fig. 1. System Architecture

B. Convolutional Neural Network While HOG-oriented sensors are not particularly good at this, CNNs (Convolutional Neural Networks) are a class of deep networks that are highly good at odd-angle edges. A CNN-based face detection function in Dlib keeps the trained model in the ".dat" file after being trained on millions of photos. Advantages: 1. Face identification using CNN is highly accurate and capable of locating unknown faces.

2. It utilises the CPU but utilises the GPU more quickly. 3.It is veritably easy to use

IV. WORKING

For every second's worth of frames:

1. All 68 facial landmark coordinates are found using the Dlib frontal face detector, and the coordinates are then transformed into a NumPy array.
2. Provide the array's index 36, 37, 38, 39, 40, and 41 to 2 gaze for an eye and detecting the blinking

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of eye. the crop eye() function, which uses it to crop the left eye's image based on the coordinates of the corresponding landmarks.
3. Use the same indexes 42, 43, 44, 45, 46, and 47 to obtain a cropped image of the right eye.
4. The two models for blink detection and gaze detection are given the cropped eyes images. The eyes' openness percentage is predicted by a blink detection model, and the eyes' gaze is predicted by a gaze detection model. User may be looking to the left, right, or center.
5. Eye blinks are used to enter text into a certain keyboard column, and eye gazing is utilized to change the keyboard's active column.

A. Software Quality Attributes

- Dependability: Users can rely on the system at any given time since it operates independently of internet connectivity. All data is stored locally, ensuring consistent accessibility.
- Manageability: The project's different iterations are easily manageable. Developers find it straightforward to incorporate new code into the existing system and adapt it for additional features or emerging technologies. Maintenance is cost- effective and straightforward, enabling easy bug fixes and program updates.
- Testability: The system is designed with a clear separation of components, making testing straightforward. By dividing the system into OpenCV for screen operations and camera eye detection, testing becomes more manageable.
- Adaptability: The system exhibits flexibility, capable of seamless integration with other systems as needed.
- Accuracy: By employing efficient algorithms for path and motion planning, the system minimizes errors, ensuring correctness in operations.
- User-Friendliness: The interface should be intuitive and user- friendly, enabling anyone to navigate it effortlessly and complete tasks error-free.
- Efficiency: The system should update information on the user interface swiftly, ensuring optimal performance and minimal waiting times for users.

B. Software Dependencies

- OpenCV 3.2.0: This open-source library, accessible online, serves as a cornerstone for computer vision and machine learning applications. It provides essential building blocks for various computer vision tasks.
- dlib: A Python library specializing in face detection and recognition, offering robust functionalities in these domains.

C. Hardware Specifications

The system necessitates three key hardware components:

- Operating System (OS): Compatible with Windows 7 and newer versions, as well as various Linux-based and MAC OS platforms.
- Camera Module: An essential component trained specifically for capturing eye movements, generating gaze direction, and detecting eye blinks.
- Display: Required to showcase the system's interface and provide visual feedback to the user

For every frame within a second:
1. Utilizing the Dlib frontal face detector, the system identifies and extracts the coordinates of all 68 facial landmarks, converting them into a numpy array.
2. The crop_eye() function is then employed, accepting the coordinates of the 36th to 41st facial landmarks to obtain a cropped image of the left eye.
3. Similarly, coordinates from the 42nd to 47th facial landmarks are passed to the crop_eye() function to acquire a cropped image of the right eye.

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4. These cropped eye images are subsequently fed into two distinct models: the blink detection model and the gaze detection model. The blink detection model evaluates the degree of eye openness, while the gaze detection model determines the direction of the user's gaze—whether left, right, or center.
5. Eye blinks are interpreted to navigate within specific columns of the virtual keyboard, while eye gaze is utilized to shift the active column accordingly.

V. CALCULATIONS

To create our blink sensor, we're utilizing a measure called the eye aspect ratio, introduced by Soukupová and Cech in 2016. Unlike traditional methods that rely on identifying the disappearance of the white area around the eyes to detect blinks, this method is more sophisticated. It involves calculating the ratio of certain distances between facial landmarks around the eyes.
Imagine starting at the left corner of each eye and measuring specific distances between facial landmarks. This ratio captures the relationship between these distances. When the eye is fully open, the ratio is large and remains relatively constant over time. However, when a blink occurs, the ratio drops close to zero and then increases again afterward.
In simpler terms, the eye aspect ratio provides a quick, accurate, and easy way to detect blinks by analyzing the relationship between facial landmarks around the eyes. It's a more elegant solution compared to traditional methods and is based on the rate of distances between these landmarks.

VI. RESULT

A virtual keyboard operated through eye blinks holds promise as an inclusive input method, particularly beneficial for individuals facing motor impairments or disabilities. This system functions by displaying keys on a screen, allowing users to select a key simply by blinking their eyes.
To ensure the system's accuracy and dependability, it's crucial for the eye blink detection to distinguish between deliberate and unintentional blinks. Moreover, adjusting the duration of key flashes is important to provide users with sufficient time to make their selections.
The effectiveness of this virtual keyboard hinges on the user's ability to control their eye movements and the precise calibration of the eye blink detection system. Ultimately, it offers a potential avenue for a broader range of individuals to engage with digital devices in a more inclusive manner.

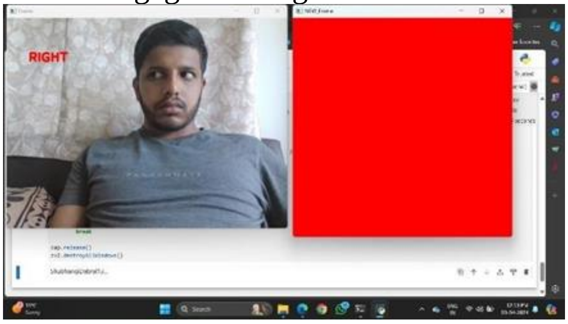

Fig .1 Detecting right side

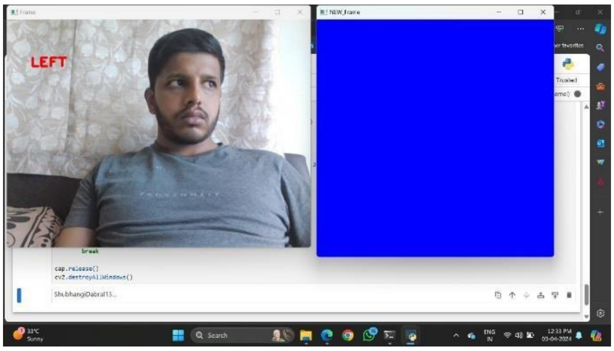

Fig. 2 Detecting left side

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Fig. 3 keyboard


Fig. 4 White Board

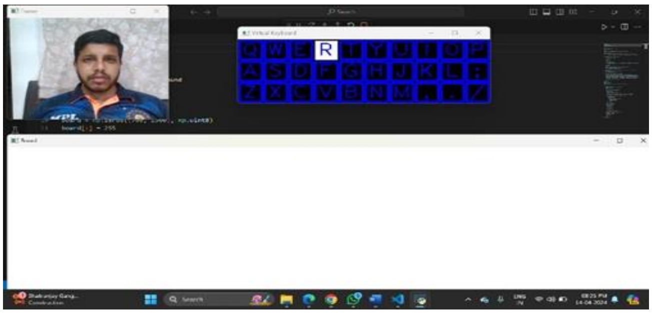
Fig. 5 User Interface

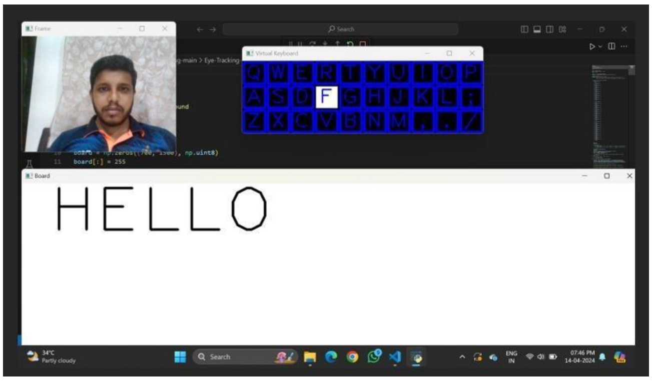

Fig.6 Typing Words

VII. CONCLUSION

For individuals lacking physical abilities beyond eye movement, this proposed method introduces a transformative aspect to their lives. Through the utilization of this device, those with such conditions can now type without the need to physically engage with a keyboard. This significantly reduces the effort typically required for typing and opens up possibilities for disabled or paralyzed individuals to communicate via typing. Undoubtedly, this approach stands to become a dependable and invaluable tool, offering blessings to countless individuals.

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