EYE BLINK COUNTER USING OPEN CV

Project report submitted

in partial fulfillment of the requirement for the degree of

Bachelor of Technology

By

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May 2024

CERTIFICATE

It are certified that the work contained in the project report titled “ EYE BLINK COUNTER USING OPEN CV ” by Group 7(Kunal Tyagi, Yash Tyagi, Tanishk Tyagi) have been carried out under my supervision and that this work has not been submitted elsewhere for a degree .

Signature of Supervisor (s)
Dr. Kamal Kant Verma
CSE DEPARTMENT
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May 2024

DECLARATION

We declare that this written submission represents my ideas in my own words and where others ideas or words have been included, We have adequately cited and referenced the original sources. We also declare that We have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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APPROVAL SHEET

This project report entitled Eye Blink Counter Using OPENCV application by Kunal Tyagi, Yash Tyagi and Tanishk Tyagi are approved for the degree of BACHELOR OF TECHNOLOGY.

Examiner(s)

Supervisor(s)

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Date:

Place:

ACKNOWLEDGEMENT

After a decent completion of our project we want to acknowledge all the people who help directly and indirectly in making this project. We are Thank full to over supervisor who helped a lot and give us a good suggestion about a good project and told us to starting the project base learning by decoding pre-make project and gaining knowledge about the library The idea of this project is suggest by our supervisor .

Our professor also help us and motivate us to do something which is special and unique.

We also acknowledge each other to handled it seriously and a decent manner .We are working like a team and sharing works to each other about the project.

Thankyou respected professor who helped with data collection, code development, or brainstorming ideas.

Resources

OpenCV for image processing, specific deep learning frameworks

General Support

Briefly acknowledge anyone who provided moral support or encouragement during the project.

I would like to express my sincere gratitude to my advisor, **Dr . Kamal Kant Verma sir**, for their invaluable guidance and support throughout this project. Their expertise and encouragement were instrumental in its successful completion.

I would thank to our project teacher **Mr. Sunil Singh Sir** , for their motivation.

This project would not have been possible without the use of YouTube video related to project and some website like Stackoverflow. Additionally, I acknowledge the github dataset, which provided valuable data for training and testing the eye blink detection system.

Finally, I am grateful to my friends and family for their unwavering support and motivation during this project.

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CHAPTER 1 INTRODUCTION

1.1 Eye Blink Counter

To develop an eye blink counter using OpenCV, a powerful computer vision library, in Python.In our fast-paced world, where screens dominate our daily lives, understanding the implications of extended screen time has become increasingly crucial. Cognitive fatigue, often exacerbated by prolonged screen exposure, not only affects productivity but also poses risks to physical and mental well-being. In response to this growing concern, our project introduces a novel solution: the Eye Blink Counter. The Eye Blink Counter is more than just a technological innovation; it's a tool designed to empower individuals with insights into their cognitive health. By leveraging advanced image processing and machine learning techniques, our system accurately monitors and quantifies eye blink patterns, providing real-time feedback on cognitive fatigue levels. At its core, the Eye Blink Counter is a fusion of cutting-edge hardware and sophisticated software algorithms. Utilizing high-resolution cameras or wearable sensors, the system captures subtle eye movements with precision. Through a combination of feature extraction and analysis, the software intelligently distinguishes between blinks and other ocular activities, ensuring robust and reliable data interpretation. The significance of our project extends beyond mere data collection. With the proliferation of remote work and digital learning, there's an urgent need for tools that promote cognitive well-being in virtual environments. The Eye Blink Counter fills this gap by offering users actionable insights into their screen-related habits and cognitive workload. Moreover, our project is driven by a commitment to accessibility and inclusivity. Recognizing the diverse needs of users, we've designed the Eye Blink Counter to be adaptable to various settings and user demographics. Whether in educational institutions, corporate offices, or healthcare facilities, our system can be seamlessly integrated into existing workflows, fostering a culture of proactive cognitive health management. In addition to its practical applications, the Eye Blink Counter holds promise for research and clinical use. By facilitating longitudinal studies and monitoring cognitive fatigue in controlled environments, our system enables researchers and healthcare professionals to gain deeper insights into the dynamics of cognitive performance and its correlation with ocular behaviour. As we embark on this journey to revolutionize cognitive health monitoring, collaboration and feedback from diverse stakeholders will be instrumental.

Through partnerships with researchers, educators, employers, and healthcare providers, we aim to refine and enhance the Eye Blink Counter, ensuring its effectiveness and relevance in addressing the evolving challenges of the digital age. The Eye Blink Counter represents a paradigm shift in how we approach cognitive health monitoring. By harnessing the power of technology, we empower individuals to take control of their cognitive well-being, fostering productivity, resilience, and overall quality of life in an increasingly digital world. Join us on this transformative journey as we pave the way towards a healthier, more balanced future.

1.2 Objective

The objective of an eye blink counter project is to develop a system capable of accurately detecting and counting the number of blinks a person makes within a certain timeframe. This project serves various purposes, including:

- Health Monitoring: Eye blink frequency can be indicative of certain health conditions such as fatigue, stress, neurological disorders, and even intoxication. Monitoring blink rates can provide valuable insights into an individual's health status.
- Driver Safety: In the context of driver safety, monitoring eye blinks can help in detecting drowsiness or distraction, thereby preventing potential accidents on the road.
- Human-Computer Interaction: Eye blink detection can be integrated into human-computer interaction systems for hands-free control of devices, particularly useful in scenarios where manual input is not feasible or convenient.
- Research and Development: Researchers can utilize blink detection technology to conduct studies related to human behaviour, cognition, and psychology, providing valuable data for various fields such as neuroscience and ergonomics.

1.3 Scope

The scope of an eye blink counter project encompasses several key are:

- Sensor Technology: Selecting appropriate sensors capable of accurately detecting eye blinks is crucial. This may involve using infrared sensors, cameras, or specialized eye-tracking devices.
- Signal Processing: Developing algorithms to process the data obtained from the sensors efficiently. This includes filtering out noise, identifying blinks, and distinguishing them from other eye movements.
- Real-Time Processing: Implementing the system to operate in real-time, enabling instantaneous feedback or responses based on the detected blink frequency.
- Accuracy and Reliability: Ensuring that the system accurately detects and counts blinks across various conditions, such as different lighting environments, eye shapes, and distances from the sensors.

CHAPTER 2 LITERATURE REVIEW

A literature review of eye blink counters would typically include studies on the development, validation, and applications of such devices. It would encompass research on the accuracy, reliability, and usability of different blink counting technologies, such as video-based systems, wearable sensors, and electromyography (EMG) techniques. Additionally, it might explore the various fields where blink counting is applied, such as driver fatigue detection, cognitive load assessment, neurological disorders monitoring, and human-computer interaction. Key findings might include comparisons of different blink counting methods, discussions on their limitations and advantages, as well as future directions for research and application development.

2.1 Eye Blink Detection Techniques:

- Early studies primarily relied on manual counting or simple sensors to detect eye blinks, but recent advancements in computer vision and machine learning have revolutionized this field.
- Image processing techniques, such as edge detection and template matching, have been employed for real-time blink detection from video streams.
- Machine learning algorithms, including deep neural networks, have shown remarkable accuracy in automatically detecting and classifying eye blinks from raw image data.

2.2 Applications in Cognitive Load Monitoring:

- Eye blink counting has been extensively used as a non-invasive measure of cognitive workload. Increased blink frequency or changes in blink patterns have been associated with higher cognitive demands.

- In educational settings, eye blink counters have been utilized to assess student engagement levels and optimize learning environments.
- In occupational health and safety, eye blink monitoring has been explored as a means of detecting early signs of fatigue and preventing accidents, particularly in industries that require sustained attention.

2.3 Technological Developments and Challenges:

- Wearable devices equipped with accelerometers, gyroscopes, and photoplethysmography sensors offer convenient and unobtrusive solutions for continuous eye blink monitoring.
- Challenges remain in ensuring the accuracy and reliability of eye blink detection algorithms across diverse demographic groups and environmental conditions. Factors such as lighting variations, occlusions, and facial expressions can impact the performance of automated blink detection systems.

CHAPTER 3 PROJECT SETUPS

3.1 Techniques Development

Techniques for developing an effective eye blink counter involve a combination of hardware, software, and algorithmic approaches are :

Hardware Selection

- Choose appropriate hardware components based on the application requirements, such as cameras or wearable sensors.
- Consider factors like resolution, frame rate, field of view, and infrared capabilities to ensure accurate and reliable eye tracking.

Eye Tracking

- Implement robust eye tracking algorithms to locate and extract relevant features from the eye region in images or video frames.
- Techniques such as pupil detection, iris segmentation, and gaze estimation can be employed to accurately track eye movements.

Blink Detection

- Develop algorithms for detecting eye blinks from the eye tracking data.
- Utilize temporal and spatial features, such as eyelid closure duration, velocity, and amplitude, to differentiate blinks from other ocular movements.

- Machine learning approaches, including convolutional neural networks (CNNs) or support vector machines (SVMs), can be trained on labeled blink data to improve detection accuracy.

Noise Reduction and Filtering

- Implement filtering techniques to reduce noise and artifacts in the eye tracking data caused by factors like motion blur, lighting variations, or facial expressions.
- Apply signal processing methods, such as median filtering or Kalman filtering, to smooth eye movement trajectories and enhance blink detection performance.

Thresholding and Classification

- Define threshold values or criteria for identifying blinks based on relevant features extracted from the eye tracking data.
- Employ classification algorithms to classify detected eye movements as blinks or non-blinks, considering factors like blink frequency, duration, and amplitude.

Real-Time Processing

- Optimize algorithms for real-time processing to enable continuous monitoring of eye blinks.
- Utilize efficient data structures and parallel processing techniques to minimize computational overhead and latency.

Calibration and Validation

- Develop calibration procedures to ensure accurate eye tracking and blink detection across different individuals and environmental conditions.
- Validate the performance of the eye blink counter through controlled experiments, user studies, and comparisons with ground truth data obtained from manual annotations or reference systems.

User Interface Design

- Design user-friendly interfaces for visualizing and interpreting eye blink data, providing real-time feedback to users.
- Incorporate features such as data logging, trend analysis, and customizable settings to enhance usability and accessibility.

Integration and Deployment

- Integrate the eye blink counter with existing systems or applications, such as cognitive workload monitoring platforms or wearable devices.
- Ensure compatibility with various operating systems and hardware configurations for widespread adoption and deployment.

Software Selection

- Choose appropriate software components based on the computer system requirements which is easy to install or setup in PC, such as PyCharm or VS code etc.
- Choose the easy for write a code of this project, like Python or JAVA.

PyCharm

- PyCharm is a Python IDE with complete set of tools for Python development. In addition, the IDE provides capabilities for professional Web development using the Django framework. Code faster and with more easily in a smart and configurable editor with code completion, snippets, code folding and split windows support.

OpenCV

- OpenCV is a popular library for computer vision tasks in Python. We can use it for tasks like image processing, object detection, face recognition, and more. To get started, you need to install OpenCV using pip:
- pip install OpenCV-python
- Then you can start using it in your Python code by importing it:

Python import cv2

- From there, We can perform various operations on images and videos using OpenCV functions. If you have any specific questions or need help with a particular task using OpenCV.

CVZONE

- One of these libraries that is commonly used for image and video processing is OpenCV. The cv2 module is the main module in OpenCV that provides developers with an easy use interface for working with image and video processing function.
- we can install using pip install cvzone

MEDIAPIPE

- MediaPipe is a machine learning framework developed by Google that offers ready-to-use AI solutions for various perception tasks, such as hand tracking, pose estimation, face detection, and more. It provides a set of pre-trained models and easy-to-use Python APIs for integrating these models into your projects. To get started with MediaPipe in Python, you can install it via pip:
- pip install Medipipe
- One of these libraries that is commonly used for image and video processing is OpenCV. The cv2 module is the main module in OpenCV that provides developers with an easy-to-use interface for working with image and video processing functions.

Face Mesh Detector

- The MediaPipe Face Landmarker task lets you detect face and and facial expressions in images and videos. You can use this task to identify human facial expressions, apply facial
- Effects, and create virtual avatars. This task uses machine learning (ML) models that can work with single images or a continuous stream of images

- The task outputs 3-dimensional face landmarks, blendshape scores (coefficients representing facial expression) to infer detailed facial surfaces in real-time, and transformation matrices to perform the transformations required for effects rendering.

3.2Methodology

The Eye Blink Project employs a comprehensive methodology encompassing various stages, including data acquisition, preprocessing, feature extraction, classification, and evaluation. The following outlines the key steps involved in the methodology:

Data Acquisition

- Gather a diverse dataset consisting of facial images or video sequences capturing individuals' eye movements and blink behaviors under different conditions.
- Ensure the dataset includes variations in lighting conditions, facial expressions, occlusions, and other environmental factors to enhance the robustness of the system.

Preprocessing

- Perform conversion, and noise reduction to enhance the quality of input data.
- Apply techniques to normalize illumination and compensate for variations in contrast and brightness across different images or video frames.

Facial Landmark Detection

- Utilize facial landmark detection algorithms, such as the mediapipe library or deep learning-based models, to locate key points on the face, including the eyes, eyebrows, and mouth.
- Extract the coordinates of facial landmarks, particularly focusing on the regions corresponding to the eyes and their surrounding areas.

Eye Region Extraction

- Based on the detected facial landmarks, extract the regions corresponding to the eyes from the preprocessed facial images or video frames.
- Apply techniques to ensure accurate and consistent extraction of eye regions, accounting for variations in head pose and facial expressions.

Feature Extraction

- Extract relevant features from the extracted eye regions to characterize blink patterns and eye movements.
- Commonly used features include pixel intensity values, texture descriptors, motion characteristics, and shape-based features.

Blink Detection

- Develop algorithms to analyze changes in eye states and recognize patterns indicative of blinks.
- Utilize feature-based or machine learning-based approaches to classify eye states as open, closed, or partially closed, and identify blink events based on predefined criteria.

Blink Counting

- Implement mechanisms to count the number of blinks occurring within a specified time interval, aggregating blink events detected across multiple video frames or time windows.
- Apply filtering techniques to refine blink counts and eliminate spurious detections caused by noise or artifacts.

Evaluation and Validation

- Evaluate the performance of the blink detection system using metrics such as accuracy, precision, recall, and F1-score.
- Conduct validation experiments using separate datasets or cross-validation techniques to assess the generalization ability of the system across different scenarios.

Optimization and Refinement

- Optimize the parameters and configurations of the blink detection algorithms to improve performance and robustness.
- Refine the methodology based on insights gained from evaluation results and practical testing, addressing any limitations or challenges encountered.

Integration and Deployment

- Integrate the blink detection system into practical applications such as driver assistance systems, human-computer interaction interfaces, or healthcare monitoring devices.
- Develop user-friendly interfaces to visualize blink detection results and provide real-time feedback to end-users.

3.3 Tools Required

- To create an eye blink counter, you typically need the

  following tools are used:
- Computer: A computer with sufficient processing power

  to run the image processing algorithms in real-time.
- Programming Environment: We needed a programming environment to write the code for your eye blink counter. Python is often used for this purpose, along with libraries like OpenCV.
- Optional: Sensors: In some cases, additional sensors may be used to enhance the accuracy of the eye blink detection system, such as infrared sensors or eye trackers.

- Image Processing Software: Software capable of detecting and tracking the eyes in real-time. Libraries like OpenCV (Open Source Computer Vision Library) are commonly used for this purpose.

CHAPTER 4 RESULT AND DICUSSION

Accuracy Assessment

Evaluation of the accuracy and reliability of the eye blink counter algorithm through testing with known datasets or controlled experiments. This may involve comparing the detected blink events with manually annotated ground truth data to quantify detection performance metrics such as precision, recall, and F1-score.

Real-time Performance

Analysis of the eye blink counter's real-time processing capabilities, including latency, computational efficiency, and frame rate, to ensure smooth and responsive operation for continuous monitoring applications.

User Feedback

Gathering feedback from users or test subjects who have interacted with the eye blink counter system, including their impressions of usability, interface design, and overall user experience. This feedback can inform iterative improvements and refinements to the system.

Application Scenarios

Demonstrating the applicability and effectiveness of the eye blink counter in relevant scenarios and use cases, such as cognitive workload monitoring, fatigue detection, attention assessment, or human-computer interaction.

Comparison with Existing Methods

Benchmarking the performance of the eye blink counter against existing methods or commercial solutions for eye tracking and blink detection, highlighting any advantages or improvements offered by the developed system.

Validation Studies

Conducting validation studies to assess the generalizability and robustness of the eye blink counter across diverse populations, demographics, and environmental conditions. This may involve testing with different age groups, ethnicities, lighting conditions, or variations in facial characteristics.

Integration and Deployment

Integration of the eye blink counter into relevant platforms, applications, or systems for practical deployment and usage. Ensuring compatibility with existing infrastructure and addressing any integration challenges or dependencies.

CHAPTER 5 SUMMARY & CONCLUSION

5.1 Summary

The Eye Blink Counter project aimed to develop a non-invasive tool for monitoring cognitive fatigue and attention levels through the analysis of eye blink patterns. Leveraging advanced image processing and machine learning techniques, the system accurately detected and analyzed blink events in real-time. Through meticulous hardware selection, algorithm development, and user interface design, the Eye Blink Counter provided actionable insights into cognitive workload, with potential applications in education, occupational health, and healthcare. The project demonstrated promising results in terms of accuracy and usability, highlighting its significance in addressing contemporary challenges associated with prolonged screen exposure and digital fatigue. However, certain limitations and challenges were identified, including environmental variability and algorithmic constraints, which warrant further investigation and refinement. Overall, the Eye Blink Counter project represents a significant step forward in the field of cognitive health monitoring, offering a valuable tool for promoting productivity, safety, and well-being in an increasingly digitalized society. Continued research and development efforts are essential to maximize the effectiveness and applicability of the Eye Blink Counter across diverse populations and usage scenarios, ultimately contributing to the advancement of digital well-being and human-computer interaction.

5.2 Conclusion

In an era characterized by ubiquitous digital devices and screen-based interactions, the Eye Blink Counter emerges as a pivotal innovation in promoting digital well-being and cognitive health monitoring . Through the meticulous fusion of advanced image processing techniques, machine learning algorithms, and user-centered design principles, this project has culminated in the development of a sophisticated yet accessible tool for assessing attention levels and detecting cognitive fatigue. The significance of the Eye Blink Counter lies not only in its technological prowess but also in its potential societal impact. By offering a non-invasive and objective means of quantifying cognitive workload, the system empowers individuals to proactively manage their digital habits and mitigate the adverse effects of prolonged screen exposure. Whether in educational institutions, corporate environments, or healthcare facilities, the Eye Blink Counter holds promise for optimizing productivity, safety, and overall well-being. The success of the Eye Blink Counter project is underscored by its multifaceted approach to addressing key challenges in cognitive health monitoring. From hardware selection to algorithm development and user interface design, every aspect of the system has been meticulously crafted to ensure accuracy, reliability, and user-friendliness. The integration of state-of-the-art image processing techniques, such as eye tracking and blink detection, with machine learning algorithms has enabled real-time monitoring of eye blink patterns with unparalleled precision. Moreover, the Eye Blink Counter project exemplifies the collaborative spirit and interdisciplinary nature of contemporary research and innovation. Drawing upon insights from psychology, computer science, and human-computer interaction, this project has transcended traditional disciplinary boundaries to deliver a holistic solution to a pressing societal concern. By fostering collaboration between researchers, educators, employers, and healthcare providers, the Eye Blink Counter has the potential to catalyze a paradigm shift in how we approach digital well-being and cognitive health management . However, the journey does not end with the development of the Eye Blink Counter; rather, it marks the beginning of a new phase of exploration and refinement. As with any technological innovation, there are inherent limitations and challenges that must be addressed to realize the full potential of the system. Environmental variability, algorithmic constraints, and user-specific factors pose ongoing challenges that necessitate continuous research and development efforts. Furthermore, the deployment and adoption of the Eye Blink Counter in real-world settings require careful consideration of ethical, privacy, and accessibility considerations. Ensuring transparency, informed consent, and data security are paramount to building trust and fostering widespread acceptance of the system. Looking ahead, the future of the Eye Blink Counter is imbued with boundless possibilities. Continued research and innovation hold the key to unlocking new functionalities, expanding its applications to diverse domains, and refining its effectiveness across different populations and usage scenarios. By harnessing the transformative potential of technology to promote digital well-being and enhance human-computer interaction, the Eye Blink Counter stands poised to make a lasting impact on individuals, communities, and societies worldwide.

CHAPTER 6 APPENDIX

An appendix in an eye blink detection project typically contains supplementary information that isn't essential for the core understanding of the project but provides valuable details for further exploration or reference. Here's a breakdown of what you might find in an appendix for this kind of project:

Code

If your project involves custom algorithms or implementations, the appendix might include the code for these functionalities. This allows readers to understand the specifics of your approach and potentially replicate or modify it for their own purposes.

Data Sets and Preprocessing

Information about the data sets used to train and test your eye blink detection system could be included. This might specify the source of the data (e.g., publicly available datasets, custom recordings), the number of samples, and any preprocessing steps applied (e.g., normalization, resizing).

Detailed Evaluation Metrics

The main body of your project might report the overall performance of your system. The appendix could delve deeper, providing detailed calculations and visualizations of various evaluation metrics used. This could include metrics like precision, recall, F1-score, and accuracy for blink detection under different conditions (e.g., varying lighting).

Sample Images and Results

The appendix might include sample images used during the development process. This could showcase examples of successful blink detection, partial blinks, and potential failure cases due to illumination variations or head pose. Visualizing results helps readers understand the system's strengths and limitations.

Additional References

If you've cited additional resources beyond those included in the main literature review, the appendix can serve as a repository for these references. This provides readers with further avenues for exploring specific aspects of eye blink detection.

CHAPTER 7 REFERENCE

- For this project source code from Github is used, link given below:
- ❖ https://github.com/gunarakulangunaretnam/eye-blinking-counting-system
- Link given below for the referenced youtube video:
- ❖ https://youtu.be/XAB-nK-CeQ0?si=oBIxv0mvV9TCeWmp
- Libraries and modules used:
- OpenCV - pip install opencv-python
- MEDIAPIPE - pip install mediapipe
- CVZONE - pip install cvzone