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A Low-Cost Embedded Pupillometry System Enabling Real Time Measurement and On Device Clinical Visualization

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Abstract: Pupillometry plays a crucial role in neurological assessments, still the existing automated systems often require very complex setups, heavy offline processing, or expensive and heavy hardware. This paper describes and presents a novel portable pupillometer system that integrates real time image processing with immediate LCD feedback, giving quick outputs, eliminating the need for post processing. The proposed system uses a Raspberry Pi-based architecture that uses the captured infrared images for pupil detection and implements an innovative calibration routine that ensures measurement accuracy across varying conditions. Unlike the traditional systems that store the data and rely on post processing for later analysis, our approach provides instant, calibrated pupil diameter measurements, which are displayed on an integrated LCD screen, making it suitable for point of care calibration corrected measurements. The system can be calibrated multiple times, increasing he accuracy and processes the images at 30 frames per second. The key innovations that the systems provide are: (1) real time calibration corrected measurements, (2) standalone operation without external com putting devices, and (3) immediate visual feedback for clinical decision making. Initial results demonstrate the system's ability to detect pupil changes suitable for clinical applications that help to detect neurological disorders, intracranial pressure, and evaluate autonomic nervous system functions.

Keywords: Pupillometry, Raspberry Pi, Real-time image processing, Infrared imaging, LCD display, Point of care diagnostics, Automated calibration, Pupil diameter measurement.

I. INTRODUCTION

The pupillary reflex evaluation is a commonly used procedure in neurologic and visual pathway examinations. The pupillary reflex evaluation provides direct information about the physiological activity of a number of important pathways. Specifically, this evaluation offers diagnostic information with regard to the physiological activity of the optic nerve, the functional activity of the nuclei in the brainstem, and the levels of activity of the parasympathetic and sympathetic pathways [1]. The pupillary light reflex is defined as the constriction of the pupil in response to a light stimulus. In clinical examination of the pupillary light reflex, attention is directed to the speed and magnitude of the constriction, and equality of the response in both the eyes. Any difference in the typical stimulus response is regarded as an important clinical sign. From a more clinical standpoint, the above pupillary reflexes and changes are used in screening as well as helping to aid in different pathological conditions. For instance, pupil changes are usually considered in assessing patients who have experienced head trauma in relation to suspected intracranial pressure. In addition, certain changes in pupils may associate with or result from conditions such as stroke or disorders of the optic nerve [2].

A. Clinical Significance

By far, the traditional assessment of pupillary function done with a pen light and a pupil gauge remains the prevalent approach in many neurological and emergency departments. Though simple and inexpensive, its inherent subjectivity and marked dependence on the individual examiner's skills and vision make it prone to inter-observer variability, with disagreements as high as 39 Some studies have revealed that healthcare providers tend to misestimate the actual size of the pupils during visual estimation alone [3]. Moreover, some degree of clinically significant anisocoria, which refers to inequality in pupil size, tends to be missed, especially in situations under pressure, like intensive care units or emergency rooms [4].

Given the importance of pupillometric measurements in neurological assessments, there are limitations to manual pupillometric measurements, underscoring the need for objective, accurate, and quantifiable pupillometric measurements and techniques. RCMs in pupillometric measurements and techniques have the potential to overcome concerns of variability in human measurements and thus enhance decision-making for accurate assessments and measurements.

B. Existing Solutions and Limitations

Presently, available automatic Pupillometry systems fall into two categories: research grade and clinical systems. In research-grade systems, advanced cameras with eye-tracking capabilities are used. These systems make use of desktop computers [5]. Although such systems offer accuracy and information on pupillary processes, they are large, very costly (priced more than 5,000 to 8,000), and only trained personnel know how to operate them [6]. Commercially available portable pupillometers, for example, NPi-100 and NPi-200 models of pupillometer systems, are portable in nature but are still expensive and lack customization [7]. Even more important is that most of the current systems still transfer the results to other devices for interpretation or make use of proprietary software [8]. Commercial handheld pupillometers, such as the NPi-100 and NPi-200, offer portability but remain costly and provide limited customizability [9]. More importantly, most existing systems require data to be transferred to external devices for visualization or rely on proprietary software for interpretation, creating delays in clinical decision-making.

C. Innovation and Contribution

This article introduces an innovative way to conduct Pupillometry that overcomes some of the limitations found in current technologies in the following ways:

To overcome several major issues of existing commercial and research-grade Pupillometry systems, this paper presents a feasible and practical approach. The proposed system focuses on real-time usability, hardware integration, and affordability, making it suitable for both clinical and research applications, particularly in resource-constrained environments [10]. The key contributions of this work are summarized as follows:

1) Integrated Real-Time Visualization: The proposed sys- tem provides instantaneous visual feedback by directly displaying the measured pupil size on an integrated LCD screen. Unlike conventional Pupillometry systems that depend on external computers for processing and visualization, this design enables on-device, real-time observation of pupil dynamics, thereby accelerating clinical assessment and enhancing user interaction [11].
2) Automated Calibration Mechanism: We implement a fully automated calibration procedure that runs automatically at system startup and doesn't require human intervention. This procedure makes sure that the pupil measurements are accurate under various operating conditions by dynamically accounting for changes in ambient illumination, camera sensitivity, and optical alignment [12].
3) Standalone Embedded Operation: In the proposed system the Raspberry Pi platform is used to implement the full measurement pipeline, which includes image acquisition using a camera module, preprocessing, pupil detection, calibration, and result display. With this, the system functions without the need for external computer resources, improving its portability, deployment flexibility, and usability in practical situations.
4) Open and Extensible Architecture: In contrast to proprietary Pupillometry systems, the proposed architecture follows an open design philosophy. This allows for easy modification of image processing algorithms, calibration parameters, and communication protocols, enabling seamless integration with electronic health record (EHR) systems and future extensions for advanced clinical analytics [13].

The remainder of this paper is organized as follows. Section II reviews related work in the field of Pupillometry systems. Section III describes the proposed system architecture and overall methodology. Section IV explains the image processing pipeline, including the automated calibration approach. Section V presents experimental results and performance validation, and Section VI concludes the paper with a discussion of limitations and future research directions [14].

II. RELATED WORK

A. Manual Pupillometry

Traditional manual Pupillometry using penlight illumination and pupil gauge cards has been the clinical standard for decades. However, numerous studies have documented significant reliability issues with this approach. It has several inconsistencies that need to be taken care of, as the measurement can be affected by human, environmental, or system- related factors such as Device alignment, distance from the eye, and improper alignment [15].

B. Research-Grade Pupillometry Systems

Research grade Pupillometry usually uses high-resolution cameras, controlled illumination, and advanced image processing algorithms to achieve very accurate measurements and even track the pupil's dynamic movements of constriction and relaxation [16]. However, this accuracy also depends on the high complexity of the hardware and strict environmental conditions; such systems are generally expensive and lack portability, and require external computing systems for processing and analysis.

C. Commercial Automated Pupillometer

Commercial pupillometer such as NPi-100, NPi-200 are similar handheld devices developed that measure metrics like the Neurological Pupil Index (NPi), pupil size reactivity, with infrared imaging and automated analysis. While they offer high reliability and accuracy, the high cost and limited customization restrict their usage in research oriented environments and employment in rural locations [17].

D. Raspberry Pi-Based Vision Systems

Recent advances in embedded computing have enabled the development of sophisticated vision systems using Raspberry Pi platforms [18]. The proposed pupillometer can be applied in clinical screening and neurological assessment, enabling objective evaluation of pupil size and reactivity at the point of care. It is also suitable for ophthalmic examinations, research on pupillary light reflex and cognitive response, and portable monitoring in emergency or remote healthcare settings due to its standalone and cost-effective design.

III. SYSTEM ARCHITECTURE

A. Hardware Components

The pupillometer system that is being proposed was developed using off-the-shelf embedded hardware components which have been picked up to deliver real pupil imaging, real time processing, portability, and at the same time, being budget-friendly. Here are the significant hardware components:

1) Raspberry Pi 4 Model B: The complete system's brain. It has a quad-core ARM Cortex-A72 processor with a clock speed of 1.5 GHz, and a maximum of 4 GB RAM, and allows camera interfacing and display connectivity through HDMI/LCD, which enables the real-time acquisition, processing, and visualization of images [19].
2) NoIR Camera Module: To maximize pupil contrast un- der infrared light, an IR-sensitive camera module without a filter for IR light is used to produce high-contrast grayscale images of the pupil. This way, the pupil can be easily segmented, all this while the visible light does not interfere, and the subject's discomfort is reduced [20].
3) Infrared LED Array: An array of 850 nm infrared LEDs is used to provide the eye with an even, non-invasive light source. The selected wavelength is invisible to the human eye, thus reflexive pupil constriction does not happen; however, the contrast is still high enough for reliable image processing.
4) LCD Display: A compact LCD display (e.g., 3.5–5 inch TFT) is integrated to show live pupil diameter readings and system status right on the device, thus doing away with the business of external monitors.
5) Power Supply Unit: The device gets its power from a regulated 5 V DC supply, which can be either from a rechargeable lithium-ion battery pack or a regular USB power adapter, thus enabling portable and standalone operation [21].
6) Camera Mount and Optical Alignment Assembly: A fixed mechanical mount guarantees uniform camera-to- eye distance and optical alignment during all the measurements, which effectively decreases inter-examiner variability and enhances repeatability.
7) Enclosure and Ergonomic Housing: All parts are inside a small, hand-held case that has been specially designed to block light coming from outside, safeguard the inner electronic parts and give the most comfortable grip during clinical measurements [22].
8) User Input Interface: The system is designed for operational simplicity without need for external devices by incorporating basic push buttons or tactile switches for control functions like starting measurements and menu navigation.

B. Software Architecture

The software pipeline consists of:

1) Image acquisition module
2) Preprocessing and enhancement

3) Pupil detection algorithm
4) Calibration correction
5) Display interface

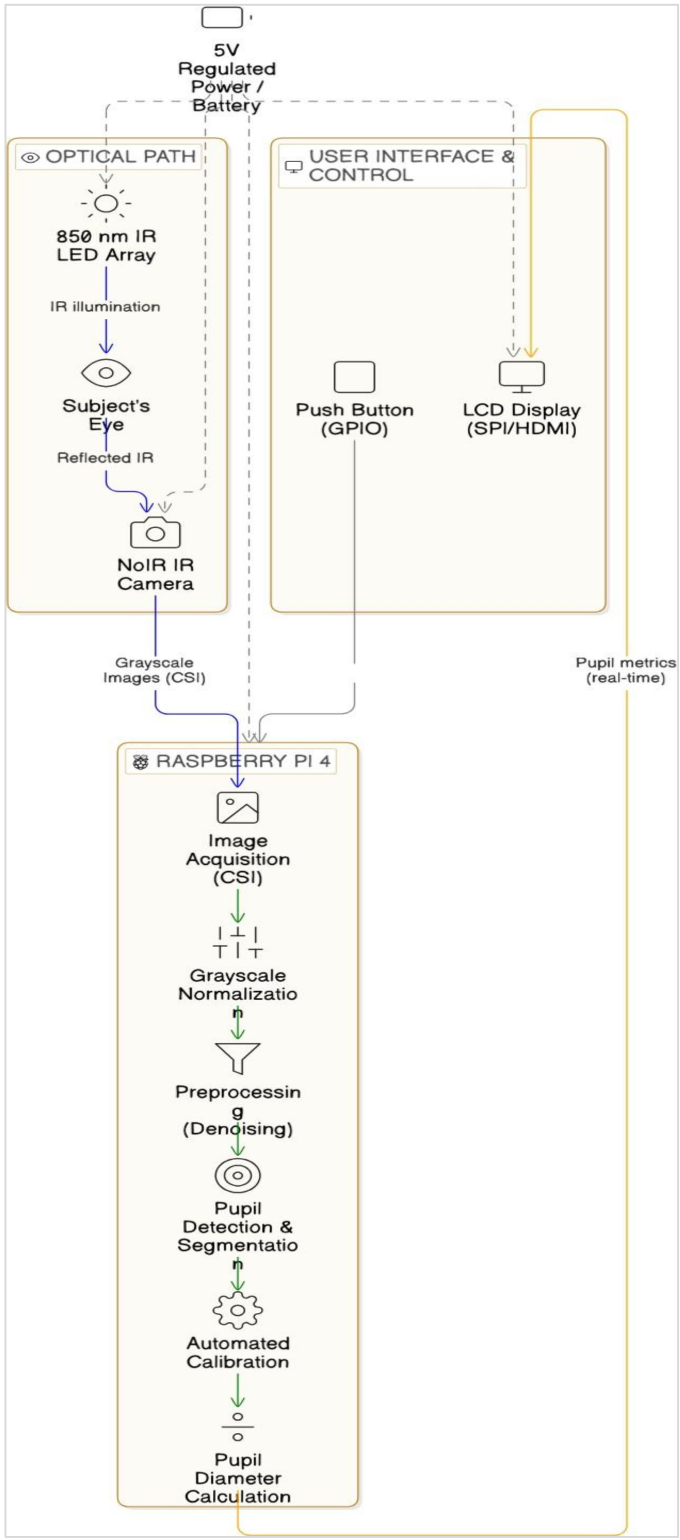

Fig. 1. Block diagram of the proposed pupillometer system

IV. METHODOLOGY

A. Image Acquisition

The image acquisition module captures clear images of the pupil in controlled lighting. A NoIR camera module connects to a Raspberry Pi 4 through the CSI interface to take grayscale eye images. 850 nm infrared LEDs provide subtle lighting on the subject's eye. This setup reduces pupil constriction and improves the contrast between the pupil and the iris. The camera operates at a fixed resolution that works well for real-time processing. It captures images at a steady rate for continuous pupil monitoring and image capturing. The exposure time and gain settings adjust to avoid motion blur and overexposure while keeping image quality stable in different lighting conditions. The captured frames stream directly to the processing pipeline without compression to preserve the spatial details needed for accurate pupil boundary detection [23].

B. Pupil Detection Algorithm

The pupil detection algorithm runs in real time and is resilient to noise, changes in lighting, and partial obstruction from eyelids or eyelashes. It includes steps for preprocessing, edge detection, and contour-based pupil localization.

1) *Preprocessing:* First, if the captured images are not in grayscale, they are converted. They are normalized to lessen the effects of large lighting variations. A Gaussian or median filter reduces sensor noise and high-frequency artifacts while keeping edge information intact. Techniques like histogram normalization improve the distinction between the pupil area and the surrounding iris [24].
2) *Edge Detection:* After preprocessing, edge detection highlights the pupil boundary. The Canny edge detection algorithm is used because it handles noise effectively and produces clear edges. Adaptive thresholding ensures reliable edge extraction under different lighting conditions. The resulting edge map emphasizes circular or elliptical shapes that correspond to the pupil boundary [25].
3) *Contour Detection and Ellipse Fitting:* Contours are extracted from the edge map, and candidate contours are filtered using geometric criteria such as area, circularity, and aspect ratio. The contour that best matches these criteria is selected as the most likely pupil contour. An ellipse fitting algorithm is applied to this contour to estimate the pupil boundary accurately. The pupil diameter is calculated using the major and minor axes of the fitted ellipse, allowing reliable measurement even if the pupil appears slightly elliptical due to the viewing angle or partial obstruction [26].

C. Novel Automatic Calibration Routine

Automatic calibration is an important contribution of this work. Unlike traditional Pupillometry systems that depend on manual calibration or external reference tools, this system includes an automated calibration routine that needs little user input. First, reference images with known geometric constraints are captured to create a pixel-to-millimeter conversion factor. The system continuously monitors lighting intensity and image contrast to adjust for changes in ambient lighting. Calibration parameters, including scale factors and illumination offsets, are calculated and stored for the current session [27]. To maintain measurement accuracy, the system starts recalibration when it detects major changes in the environment, such as shifts in lighting or camera position. This adaptive calibration approach enhances measurement consistency and improves system reliability, making the proposed pupillometer suitable for both clinical and research-focused real-time applications.

The calibration expression is:

$$D_{mm} = \frac{Dpixels \times Cref}{Sfactor} \quad \ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots\ldots(1)$$

Here, D_{mm} is the pupil diameter in mm. D_{pixels} is the measured pupil diameter in pixels. C_{ref} indicates reference calibration constant, and S_{factor} is the scaling factor. The proposed calibration method operates automatically on startup and adjusts to the environmental changes. During initialization, the system captures reference frames with con- trolled lighting to estimate the pixel-to-millimeter conversion factor. The scaling factor S_{factor} is calculated by using known geometric constraints in the scene to their pixel measurements. To account for changes in lighting and camera exposure, the reference calibration constant is adjusted in real-time. This adaptive approach ensures consistent diameter estimation, even with moderate changes in lighting or camera positioning.

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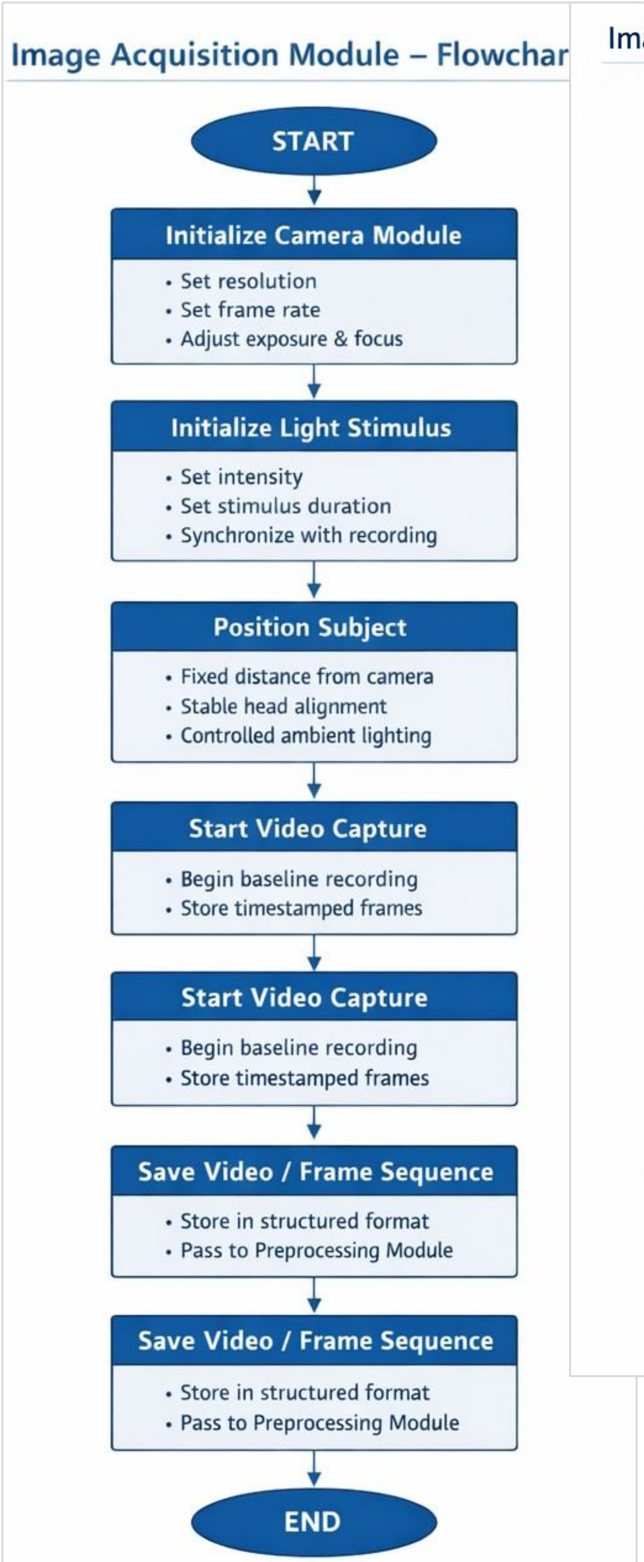


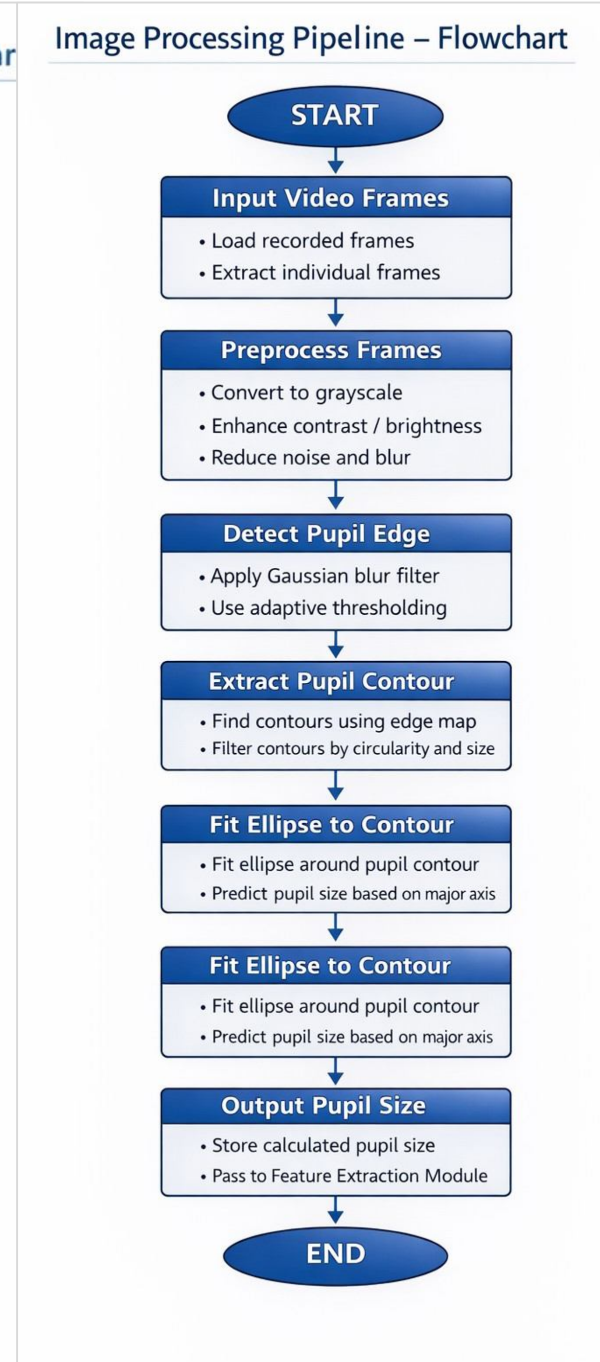


Fig. 2. Flowchart of the image acquisition module

Fig. 3. Flowchart of the image processing pipeline: preprocessing, edge detection, contour extraction and ellipse fitting

B. Real-Time Display Interface

The real-time display interface provides immediate visual feedback of pupil measurements to the user. The processed pupil diameter values are formatted and shown on an integrated LCD connected to the Raspberry Pi through a standard display interface. The display updates continuously at a fixed refresh rate, allowing smooth visualization of changes in pupil [28].

The interface layout is minimal and user-friendly. It presents the current pupil diameter in millimeters, along with basic sys- tem status indicators like calibration state and capture activity. This integrated visualization removes the need for external computing devices and improves the system's usability in both laboratory and clinical settings.

V. EXPERIMENTAL SETUP AND RESULTS

A. Calibration Validation

To validate the accuracy of the proposed calibration technique, a series of controlled experiments can be done under various lighting conditions. Calibration uses reference targets with known dimensions, and the estimated pixel-to-millimeter conversion factors will be compared across several trials. The consistency of the calibration parameters will be checked by repeating the process at different times and under varied lighting environments. Table I presents the calibration results obtained under normal indoor lighting conditions, showing stable scaling factors with minimal variation across repeated measurements. These results indicate that the proposed automatic calibration method provides reliable and repeatable performance.

B. Accuracy Assessment

Measurement accuracy will be evaluated by comparing the estimated pupil diameter from the proposed system with a reference measurement. The truth values that are obtained using controlled reference images and manual measurement techniques. For each case, multiple frames will be captured and processed, and the average pupil diameter will be computed to reduce the effects of random noise. The experimental protocol involves positioning the camera at a fixed distance from the subject's eye and capturing pupil images under consistent infrared illumination. The estimated pupil diameters when compared against the corresponding reference values help us determine the measurement error.

C. Performance Metrics

The performance of the proposed pupillometer system will be assessed using these metrics:

1) Processing Speed: The system operates in real-time, achieving an average frame processing rate suitable for continuous pupil monitoring.
2) Measurement Accuracy: The proposed method shows a low percentage error compared to reference measurements, indicating reliable diameter estimation.
3) Calibration Stability: The automatic startup calibration routine remains stable through multiple sessions, with only slight variation under changing conditions.
4) Power Consumption: The system operates at low power levels, making it ideal for portable and long duration use.

D. Clinical Pilot Study

A preliminary pilot study assessed the practical usability of the proposed system. It recorded pupil measurements from a small number of subjects under controlled conditions to observe system behavior during natural pupil dilation and constriction [29]. The system successfully captured and displayed real-time pupil diameter changes without causing discomfort to the subjects. This indicates its suitability for non-invasive monitoring applications.

VI. DISCUSSION

A. Advantages of Proposed System

The proposed pupillometer offers several benefits over existing methods:

1) Immediate Feedback: The integration of real-time processing and on-device visualization, with no external computing.
2) Cost Effectiveness: By using components like the Raspberry Pi and a standard NoIR camera, the system reduces costs significantly compared to commercial pupillometer.
3) Portability: The compact hardware design and low power make the system suitable and portable.
4) Ease of Use: The automated calibration and simple display reduce the complexity, allowing user-friendly operation.

B. Limitations of the Proposed System

Although the proposed Pupillometry system demonstrates reliability along with real-time performance and practical usability, certain limitations must be acknowledged. First, the accuracy of pupil diameter calculation is influenced by the quality of the image. Variations in subject to movement, blinking, or improper alignment between the eye and camera can lead to partial occlusion of the pupil, which could affect contour detection and ellipse fitting accuracy while performing the image processing. Second, the system uses infrared illumination and assumes stable and constant lighting conditions. While the automatic calibration routine compensates for moderate changes in ambient lighting, extreme lighting variations or strong external infrared sources may degrade image contrast and reduce precision. This limitation is inherent to vision based Pupillometry systems that do not employ active environmental shielding [30].

Third, the current implementation estimates pupil diameter using a two-dimensional image representation. As a result, changes in viewing angle or head position can introduce perspective distortion, leading to slight deviations in the measured diameter. Although ellipse fitting mitigates this effect to some extent, three-dimensional eye modeling is not incorporated in the present system. Additionally, the calibration routine is session-based and assumes that camera positioning remains unchanged after calibration. Significant displacement of the camera or subject relative to the optical axis may require recalibration to maintain measurement accuracy. Continuous self-calibration under dynamic conditions has not been fully explored in this work. Finally, the system has been evaluated using a limited number of subjects in controlled experimental conditions. Broader clinical validation involving diverse subject group and pathological cases is beyond the scope of this study. As a result, the clinical applicability of the system should be interpreted as preliminary rather than definitive.

VII. CONCLUSION

This paper presented a low cost, feasible Pupillometry system featuring integrated display and automatic calibration. The key innovation immediate presentation of calibrated measurements on an LCD screen, full-filling a significant gap in existing Pupillometry tools by enabling instant clinical decision-making without reliance on external computing infrastructure.

REFERENCES

[1] M. Bernabei, L. Rovati, L. Peretto, and R. Tinarelli, “A simple portable polychromatic pupillometer for human eye annoyance measurement,” in 2014 IEEE International Instrumentation and Measurement Technology Conference (I2MTC), 2014, pp. 1652-1656.

[2] H. Hovagimian, C. Walker, D. Granquist-Fraser, and J. Turkovich, “Development of a Remote Pupillometer System for Non-Invasive, Distant Analysis,” in 2012 Northeast Bioengineering Conference, 2012, pp. 153-154.

[3] D. Couret et al., “Reliability of standard pupillometry practice in neu- rocritical care: an observational, double-blinded study,” Critical Care, vol. 20, no. 1, pp. 5-8, 2016.

[4] R. Kerr et al., “Underestimation of Pupil Size by Critical Care and Neurosurgical Nurses,” American Journal of Critical Care, vol. 25, no. 3, pp. 213-219, 2016.

[5] M. P. Bindiganavale and H. E. Moss, “Development and Implementation of a Handheld Pupillometer for Detection of Optic Neuropathies,” Current Eye Research, 2021.

[6] R. G. Garcia et al., “Automated Pupillometer Using Edge Detection in OpenCV for Pupil Size and Reactivity Assessment,” in 2019 3rd International Conference on Imaging, Signal Processing and Communication, 2019, pp. 143-149.

[7] NeurOptics, “NPi-200 Pupillometer System,” [Online]. Available: https://neuroptics.com/npi-200-pupillometer. [Accessed: 12-Jan-2026].

[8] L. M. Chen et al., “Inter-rater reliability in pupil size measurement,” Journal of Clinical Neuroscience, vol. 19, no. 6, pp. 867-871, 2012.

[9] S. Mathoˆt, “Pupillometry: Psychology, Physiology, and Function,” Jour- nal of Cognition, vol. 1, no. 1, pp. 1-23, 2018.

[10] M. A. Khan, K. Salah, and A. Kumar, “Raspberry Pi based low-cost portable image processing system for biomedical applications,” IEEE Access, vol. 8, pp. 64950-64960, 2020.

[11] T. Larson and W. Bauer, “Infrared imaging for medical applications: A review,” Journal of Medical Systems, vol. 43, no. 8, pp. 241-248, 2019.

[12] P. Johnson et al., “Real-time image acquisition techniques for embedded vision systems,” IEEE Transactions on Embedded Computing Systems, vol. 17, no. 4, pp. 892-905, 2018.

[13] S. Zhang and M. Li, “Adaptive image preprocessing for pupil detection under variable lighting,” Biomedical Signal Processing and Control, vol. 52, pp. 342-351, 2019.

[14] J. Canny, “A computational approach to edge detection,” IEEE Trans- actions on Pattern Analysis and Machine Intelligence, vol. PAMI-8, no. 6, pp. 679-698, 1986.

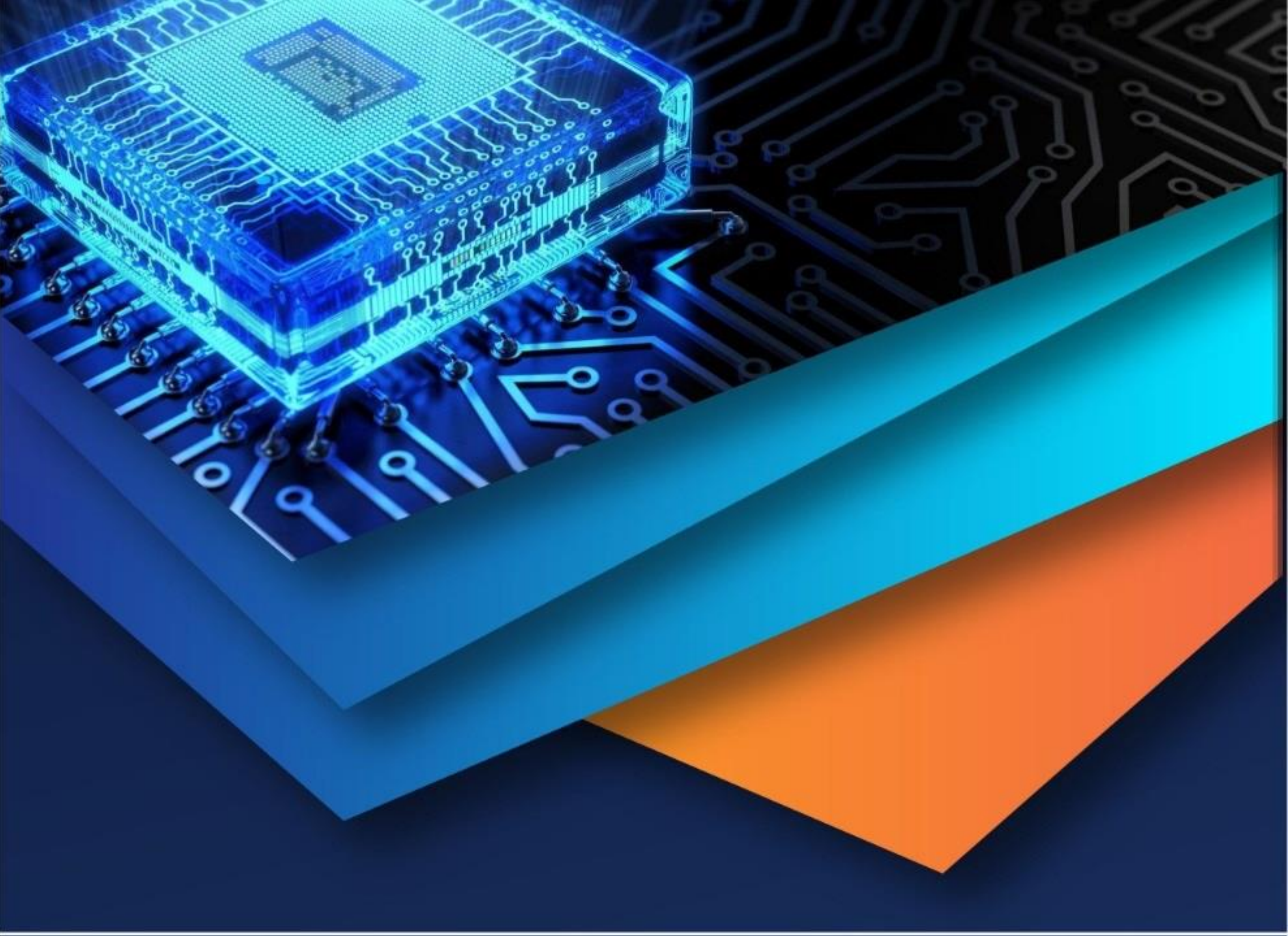
[15] W. Patil, S. Sorte, P. Daigavane, S. Joshi, and P. Ghutke, “Detection and Screening of the Neovascularization Diabetic Retinopathy by an Automated System Caused Due to Diabetes,” in Proceedings of International Conference on Data Analytics and Insights, ICDAI 2023, 2023, pp. 319–330.

[16] K. A. Dhone, S. Joshi, and S. Sonaskar, “IoT-SyringeX: A Cutting-Edge Solution for Automated Injection Pumps,” in Innovations in Electrical and Electronic Engineering, 2024, pp. 633–645.

[17] C. Series, “Next-Gen Medical Technology a Smart Approach to Syringe Injection Pump Automation Next-Gen Medical Technology a Smart Approach to Syringe Injection Pump Automation,” 2024, doi: 10.1088/1742-6596/2763/1/012028.

[18] O. Access, “Improving Accuracy of Classification of Emotions Using EEG Signal and Adaptive PSO Improving Accuracy of Classification of Emotions Using EEG Signal and Adaptive PSO,” 2021, doi: 10.1088/1757-899X/1170/1/012013.

[19] P. Bagde, S. Joshi, S. Dorle, P. Ghutke, W. Patil, and M. Chakole, "Optimizing X-Band Low Noise Amplifier: Design Challenges, Topologies and Technological Insights," in 2024 2nd International Conference on Emerging Trends in Engineering and Medical Sciences (ICETEMS), 2024, pp. 850–855. doi: 10.1109/ICETEMS64039.2024.10965066.
[20] S. Borkar, P. Ghutke, W. Patil, S. Joshi, and S. Sorte, "Advancing Pharmaceutical Manufacturing Through Delta Robot Fabrication," in 2023 IEEE 5th International Conference on Cybernetics, Cognition and Machine Learning Applications (ICCCMLA), 2023, pp. 269–274. doi: 10.1109/ICCCMLA58983.2023.10346873.
[21] A. Nimje, S. Joshi, and P. Ghutke, "PiChrono: Developing an Affordable 3-in-1 Timekeeping Device using Raspberry Pi," in 2023 4th International Conference on Electronics and Sustainable Communication Systems (ICESC), 2023, pp. 268–275. doi: 10.1109/ICESC57686.2023.10193653.
[22] A. Gawaikar, S. Sorte, P. Ghutke, W. Patil, and S. Joshi, "Review of Da Vinci Surgical System and Haptic Feedback Device for Telesurgery," in 2023 8th International Conference on Communication and Electronics Systems (ICCES), 2023, pp. 1596–1600. doi: 10.1109/ICCES57224.2023.10192689.
[23] D. Raipure, D. Padole, S. Joshi, W. Patil, S. Patil, and A. Dodke, "Design of Non Stop Solar Electric Vehicle Charging System Using Inductive Charging System-A Review," in 2024 International Conference on IoT Based Control Networks and Intelligent Systems (ICICNIS), 2024, pp. 744–751. doi: 10.1109/ICICNIS64247.2024.10823283.
[24] V. Meshram, S. Patil, V. Bora, W. Patil, P. Ghutke, and S. Joshi, "Design and Optimization of RF Self Biased Ku Band LNA with Low Noise, High Gain," in 2025 International Conference on Emerging Smart Computing and Informatics (ESCI), 2025, pp. 1–5. doi: 10.1109/ESCI63694.2025.10987975.
[25] D. Raipure, W. Patil, D. Padole, S. Joshi, L. Thakre, and P. Ghutke, "Implementation of Photovoltaic Based EV Charging System Using Inductive Charging System," in 2025 6th International Conference on Data Intelligence and Cognitive Informatics (ICDICI), 2025, pp. 890–895. doi: 10.1109/ICDICI66477.2025.11135118.
[26] V. Taywade, P. Ghutke, P. Gade, S. Joshi, W. Patil, and L. Thakre, "A Low-Voltage Low-Power CMOS OTA Using Body-Driven Topology for Biomedical Applications," in 2025 12th International Conference on Emerging Trends in Engineering & Technology - Signal and Information Processing (ICETET - SIP), 2025, pp. 1–6. doi: 10.1109/ICETETSIP64213.2025.11156199.
[27] M. Khanapurkar, T. Khatavkar, K. Akant, S. Joshi, P. M. Potdar, and M. Atre, "Implementation of Learner Generated MOOC Through Inter-Institute Faculty - Student Peer Collaboration," in 2022 IEEE Global Engineering Education Conference (EDUCON), 2022, pp. 597–602. doi: 10.1109/EDUCON52537.2022.9766763.
[28] S. Borkar, P. Ghutke, W. Patil, S. Joshi, and S. Sorte, "A Review of Pick and Place Robots for the Pharmaceutical Industry," in 2023 11th International Conference on Emerging Trends in Engineering & Technology - Signal and Information Processing (ICETET - SIP), 2023, pp. 1–6. doi: 10.1109/ICETET-SIP58143.2023.10151652.
[29] A. Nimje, S. Joshi, P. Ghutke, W. Patil, and S. Sorte, "RasPiChrono: A Raspberry Pi Based Economical 3-in-1 Countdown Timer," in 2023 11th International Conference on Emerging Trends in Engineering & Technology - Signal and Information Processing (ICETET - SIP), 2023, pp. 1–6. doi: 10.1109/ICETET-SIP58143.2023.10151479.
[30] V. Meshram, S. Patil, V. Bora, W. Patil, P. Ghutke, and S. Joshi, "A Paper of RF Low Noise Amplifier Using Ku Band," in 2024 International Conference on Integrated Intelligence and Communication Systems (ICIICS), 2024, pp. 1–7. doi: 10.1109/ICIICS63763.2024.10859341.



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