

Development of a Portable and User-friendly Intraocular Pressure Monitoring Device

Mihisarani NBGK¹, Minuwari PDN¹, Munasinghe NMAKNN¹, Navodya DR¹, Nethmini MWM¹, Gopura RARC², Warnakula PMT³

¹*Faculty of Medicine, University of Moratuwa*

²*Department of Mechanical Engineering, Faculty of Engineering, University of Moratuwa*

³*Department of Anatomy, Faculty of Medicine, University of Moratuwa*

Introduction - Glaucoma remains one of the leading causes of irreversible blindness worldwide. It is strongly linked to elevated intraocular pressure (IOP), which is the most important modifiable risk factor for its progression. Although Goldmann applanation tonometry is the gold standard for IOP measurement, it requires trained personnel, clinical equipment, and corneal contact. These limitations reduce accessibility for regular monitoring. This study aimed to design a portable, user-friendly, and non-invasive device that allows accurate IOP monitoring in both clinical and home settings.

Methods - A literature review was conducted to identify gaps in existing IOP monitoring technologies. Based on the findings, a model was designed using a Placido disc system projecting monochrome concentric rings onto the cornea. The reflected pattern can be captured by a high-resolution CMOS camera and processed in real-time using a microcontroller. Image processing techniques, including Gaussian smoothing, hybrid edge detection, and sub-pixel polynomial fitting, can be employed to derive corneal curvature with high precision. A validated linear model can estimate IOP variations from curvature changes.

Results - Preliminary testing on simulated and model eyes can be used to confirm the feasibility of accurate curvature detection and real-time processing. The device can achieve non-contact operation, ergonomic portability, and potential for continuous or at-home use.

Discussion - The proposed device can provide a non-invasive, and accessible method for frequent IOP monitoring, addressing key limitations of current tonometry systems. It aligns with emerging trends in teleophthalmology and personalized medicine enabling early progression detection and improved patient compliance. The device can be fabricated and carry out the preliminary testing.