A20-236 **APPLICATION GROUP**

作品名稱

應用於青光眼照護之智慧型隱形眼鏡

Smart Contact Lens for
Glaucoma Monitoring Application

隊伍名稱

交大優視 Smart Lens, New Vision

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作品摘要

青光眼是全世界目前造成眼睛失明最主要原因之一，其中眼壓異常波動而引起之視神經損傷則是罹患青光眼最危險的機轉。目前商用眼壓計雖準確度高，不過受限於量測機制，僅能量測病患當下的眼壓值。以診斷與治療觀點而言，對於青光眼的治療僅依靠在醫院測量到單一眼壓值並不足以作為治療的參考標準，而是必須了解病患在日常生活活動對眼壓所造成的影響，並針對這些因素導致的眼壓值變化即時給予適合的治療，才能有效防止青光眼症狀的惡化。

依此，為了在不影響人類正常生活前提下偵測眼壓，其系統設計重點需包含方便攜帶、即時且長時間連續量測且量測時不會對眼睛造成不適…等。鑒於以上的想法，本團隊開發一應用於長時間眼壓監控之智慧型隱形眼鏡系統，如圖 1 所示，為了使用者的舒適度及實用性做為考量，將會有二個主要的模組，分別是：

具有無線傳輸能力的隱形眼鏡式眼壓感測系統
（Smart Contact Lens System，SCLS）：
感測系統將嵌入三維曲面軟式隱形眼鏡上，而感測系統包含「眼壓感測器」、「感測系統晶片」與「傳能 / 訊號天線」。感測系統之電源供應將由接收外部傳能天線轉換取得，進而達到無線眼壓感測的目的。此設計提供了眼壓監控者使用上的便利性，達到不受行為動作影響的量測方式。

外部眼壓訊號讀取器
（Intraocular Pressure Reader，IOP Reader）：
外部讀取系統主要是作為訊號讀取與能量傳輸，當感測系統端將眼壓感測訊號發送出後，將由眼鏡型眼壓訊號讀取系統進行訊號接收及轉換為後端電路可以處理之訊號。使用眼鏡做為讀取系統的裝置，減少無線傳輸距離，有效降低系統所需之收發訊號功率。

本團隊提出之應用於青光眼照護之智慧型隱形眼鏡，期望在不影響患者正常生活前提下長時間且連續的偵測眼壓。本團隊以微機電技術製作出高解析度眼壓感測器，對壓力變化擁有良好的響應速度與靈敏度；高解析度感測晶片，可解析至 0.5 mmHg 壓力變化，並可以在特定範圍內做調整以補償感測器的誤差偏移；無線傳輸採用 RFID 技術架構，可以有效地降低能量的需求，減少電磁波在眼球表面上的能量累積（SAR）；以商用規格之隱形眼鏡材料與模具進行封裝，含水、透氧且柔軟、舒適、適合長時間配戴。

圖 1. 應用於青光眼照護之智慧型隱形眼鏡系統架構

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- **研究領域：**微機電系統、生醫系統晶片、機電系統整合

Abstract

Glaucoma is currently the leading cause of blindness in the world. High intraocular pressure is one of the important and dangerous factors for glaucoma. Currently, commercial tonometers are highly accurate and safe, but limited by the measurement mechanism, only the patient's current intraocular pressure can be measured. However, the treatment of glaucoma cannot only rely on the intraocular pressure measured in the hospital. It is important to understand the impact of various daily activities of the patient on the intraocular pressure. And give proper treatment to the abnormal intraocular pressure value caused by daily life behaviors to prevent the deterioration of glaucoma symptoms effectively.

Therefore, in order to monitor intraocular pressure without affecting the normal life, the system design should include portability and long-term continuous monitoring and no discomfort to the eyes during measurement ... etc. In order to consider the user's comfort and practicality, there will be two major design concepts, namely:

Smart Contact Lens System, SCLS:
The sensing system will be embedded in the soft contact lens. The sensing system will include Intraocular pressure sensing components, sensing chips and transmission antennas. The power supply of the sensing system will be converted from the received external RF power signals to achieve the purpose of sensing. This design provides a convenient measurement method that is not affected by behavior and actions.

Intraocular Pressure Reader, IOP Reader:
The external reading system is mainly used for signal reading and energy transmission. When the Smart Contact Lens System transmit the intraocular pressure signal, the glasses-type intraocular pressure reading system will receive the signal and convert it into a back-end circuit that can be processed. Use glasses as a device for reading the system, reduce the wireless transmission distance, and effectively reduce the power of the transceiver signal required by the system.

We proposed the smart contact lens for glaucoma care. Expect long-term and continuous monitor intraocular pressure without affecting human normal life. The capacitive intraocular pressure sensor made by micro-electromechanical technology, which has good response speed and sensitivity to pressure changes; the sensor chip has high resolution and can be adjusted within a specific range to compensate for the deviation of the sensor. The wireless transmission adopts RFID technology architecture, which can effectively reduce the energy demand and reduce the accumulated on the surface of the eyeball by radio waves; Smart Contact Lens System is packaged by commercial specifications of contact lens materials and molds. It has suitable water-containing, oxygen-permeable, and comfortable for long-term wear.

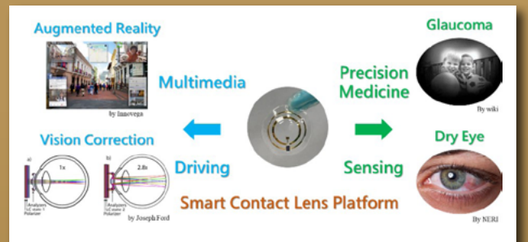

Fig. 2 Future applications of smart contact lenses