

Eye Rotation Angle Detection Systems on a contact lens for Augmented Reality

Waseda Univ.¹, °Guo Xingyu¹, Gai Zeyu¹, Saman Azhari¹, Takeo Miyake¹

E-mail: guo-xingyu@moegi.waseda.jp

Eye-tracking technologies are a human-machine interface technique that deciphers user intentions by detecting and decoding eye movements. In the context of augmented reality (AR), smart contact lenses that incorporate eye-tracking ensure that images projected onto the retina move in accordance with the changes in the user's gaze point, thereby maintaining the clarity of the visuals. Here, we developed a low-power eye-tracking system that uses LC resonant circuits and eddy current effects to detect the changes in coupling coefficients between four sensor coils embedded in the glasses and an antenna mounted on the contact lens described in our previous works [1-2] (Figure 1). The system achieves high precision and efficient signal transmission by optimizing impedance matching and resonance principles, with an input return loss of -31.95 dB at 2.76 MHz. The employed system achieves high-precision target positioning with an accuracy of less than 0.01 degrees and a tracking delay of 98.16 milliseconds. The deep learning algorithm developed in this work results in a mean prediction error of 1.82 degrees on the x-axis and 0.7 degrees on the y-axis. The algorithm has low complexity, facilitating deployment on any low-power microcontroller. Overall, the eye-tracking system proposed in this work promises to enrich the methodologies of eye-tracking technology and advance the development of AR-capable smart contact lenses.



Figure 1. Eye tracking system using an electric contact lens

References:

- [1] T. Takamatsu., et.al, *Advanced Materials Technologies*, 8, 2201704, 2023.
- [2] S. Azhari., et.al, *IEEE Sensors Journal*, 23, 7902-7909, 2023.

Acknowledgment:

These research results were obtained from the commissioned research (JPJ012368C08601) by National Institute of Information and Communications Technology (NICT), Japan.