ABSTRACT

The background of this study stems from the need for a more comfortable, faster, and non-painful method for monitoring blood glucose levels. This research develops a non-invasive blood glucose detection system based on near-infrared (NIR) spectroscopy using wavelengths of 940 and 950 nm. The 940 nm wavelength is selected for its sensitivity to glucose molecules, while 950 nm penetrates deeper into tissue and responds to water content variations, thereby enhancing accuracy. The objectives of this study are to design a system that complies with ISO 15197:2013 accuracy standards, analyze the effect of dual wavelengths on glucose measurement results, and evaluate parameters that influence the accuracy of non-invasive glucose detection.

The developed system consists of a hardware circuit connected to a web-based and local server software interface. The blood glucose prediction model is built using the XGBoost Regressor algorithm, with input features including signals from the PD1 sensor, room temperature, and skin tone. To improve usability, the system is equipped with a web interface that allows users to input their name, skin tone, and room temperature. This data is then sent to the server via a Flask API for processing, and the prediction results are displayed via OLED and the web.

The model was evaluated using cross-validation and showed good performance, with an R^2 score of 0.97, a mean absolute error (MAE) of 1.34 mg/dL, and a mean squared error (MSE) of 33.11. Test results showed that the combination of 940 and 950 nm wavelengths provided higher prediction accuracy compared to using a single wavelength. In addition, parameters such as finger placement, temperature, and skin tone were found to influence the measurement accuracy.

***Keywords**: Diabetes, ESP32, Flask API, blood glucose, infrared, non-invasive, spectroscopy, XGBoost*