ABSTRACT

This research aims to develop a non-invasive blood glucose monitoring device using Near Infrared Spectroscopy (NIRS) sensors, named Glucare. The background of this study is based on the high prevalence of diabetes mellitus in Indonesia, where regular blood glucose testing still relies on invasive methods that are uncomfortable for patients. Therefore, there is a need for a more comfortable and effective solution.

The main challenges are designing a device that can provide accurate and real-time results at an affordable cost, and ensuring that this device can be easily implemented for widespread use. The proposed solution involves using the MAX30102 sensor, the ESP32 microcontroller, and the ESPNOW communication protocol to wirelessly transmit data to the cloud, where it will be further processed using machine learning. The implementation of this device includes several key stages: hardware design, data acquisition and reconstruction, and data processing using FFT, Gaussian, and OMP. The resulting data will be stored in Firebase and classified using CatBoost to determine blood glucose levels.

Testing was conducted to evaluate the device's performance, including sensor accuracy, data transmission, the accuracy of data acquisition and reconstruction processes, application usage, and the effectiveness of Machine Learning (ML). The test results show that the device can measure blood glucose levels with an accuracy of up to 90% compared to invasive methods. The data transmission process is real-time, with a delay of less than 2 seconds. The data acquisition and reconstruction process using the compressive sensing method is highly effective, as indicated by parameters such as a high SNR of around 95 dB, MAE of approximately 1.10, MAPE of 0.16%, and low MSE and PRD values of 3.27 and 0.30%, respectively. The ML accuracy of 90% is an excellent figure, and the CPU and RAM usage is very low, below 30%. Therefore, this device is expected to provide a more comfortable and effective solution for diabetes patients to monitor their blood glucose levels.

Keywords: Glucose, Invasive, Non-Invasive, Machine Learning, NIRS.