INTISARI

PENGEMBANGAN PERANGKAT PENGUKURAN KADAR GLUKOSA DARAH *NON-INVASIVE* DENGAN *NEAR-INFRARED SPECTROSCOPY MULTI-CHANNEL* SENSOR DENGAN MODEL *MACHINE LEARNING*

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Peningkatan prevalensi penyakit tidak menular, khususnya diabetes melitus, menjadi tantangan serius dalam sektor kesehatan Indonesia. Pengukuran kadar glukosa darah secara *non-invasive* menjadi solusi potensial terhadap keterbatasan metode konvensional yang bersifat *invasive* dan kurang nyaman untuk pemantauan jangka panjang. Penelitian ini melakukan pengembangan perangkat *non-invasive* dalam pengukuran kadar glukosa menggunakan sensor *Near-Infrared (NIR) Spectroscopy multi-channel* dengan panjang gelombang 940 nm, sensor OPT101 photodioda serta menggunakan mikrokontroler ESP32 sebagai pemroses. Algoritma *polynomial regression* derajat dua dengan regularisasi *lasso machine learning* dipilih untuk memprediksi dan melihat hubungan antara sensor NIR *spectroscopy* dengan nilai *invasive* kadar glukosa darah. Penelitian ini menggunakan metode eksperimental melalui proses perancangan, pembuatan, kalibrasi, dan validasi terhadap data *invasive* (POCT dan GOD-PAP), serta penerapan ke masyarakat. Hasil kalibrasi menunjukkan performa yang menjanjikan dengan nilai R^2 sebesar 0,99 dan RMSE sebesar 9,33. Serta data prediksi dan validasi berdominasi di area A pada grafik *Clarke Error Grid*. Hasil validasi perangkat nilai R^2 sebesar 0,83 dan RMSE sebesar 19,84. Penelitian ini menunjukkan potensi untuk dikembangkan sebagai perangkat pemantauan glukosa darah *non-invasive* yang tepat dan mudah bagi masyarakat terkhusus penderita diabetes.

Kata kunci : Diabetes, *Non-Invasive, NIR Spectroscopy, Polynomial Regression, Lasso*

ABSTRACT

DEVELOPMENT OF A NON-INVASIVE BLOOD GLUCOSE LEVEL MEASUREMENT DEVICE WITH NEAR-INFRARED SPECTROSCOPY MULTI-CHANNEL SENSOR WITH MACHINE LEARNING MODEL

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The increasing prevalence of non-communicable diseases, particularly diabetes mellitus, poses a serious challenge to Indonesia's healthcare sector. Non-invasive blood glucose measurement offers a potential solution to the limitations of conventional invasive methods, which are uncomfortable for long-term monitoring. This study developed a non-invasive device for measuring glucose levels using a multi-channel Near-Infrared (NIR) Spectroscopy sensor with a wavelength of 940 nm, an OPT101 photodiode sensor, and an ESP32 microcontroller as the processor. A second-degree polynomial regression algorithm with Lasso machine learning regulation was selected to predict and examine the relationship between the NIR spectroscopy sensor and invasive blood glucose levels. This study employed an experimental method through the processes of design, fabrication, calibration, and validation against invasive data (POCT and GOD-PAP), as well as application to the community. Calibration results showed promising performance with an R^2 value of 0.99 and an RMSE of 9.33. Additionally, prediction and validation data dominated the A region on the Clarke Error Grid graph. The device validation results showed an R^2 value of 0.83 and an RMSE of 19.84. This study demonstrates the potential for development as an accurate and user-friendly non-invasive blood glucose monitoring device for the general public, particularly for diabetes patients.

Keywords: Diabete, Non-Invasive, NIR Spectroscopy, Polynomial Regression, Lasso