ABSTRACT

Hemoglobin (Hb) is an important indicator in assessing a person's health condition because it plays a role in the transportation of oxygen and carbon dioxide in the body. The commonly used hemoglobin measurement methods today are still invasive, requiring blood samples that may cause discomfort, risk of infection, as well as additional time and cost. This study develops a non-invasive hemoglobin measurement device using the MAX30102 sensor combined with a machine learning approach based on a linear regression algorithm. The sensor detects red and infrared (IR) light intensities from the fingertip, which are then used as inputs in the hemoglobin level prediction model. Testing was conducted by evaluating the linear regression model and comparing the measurements from the non-invasive device with those from a standard invasive measurement tool. The regression equation used to estimate hemoglobin levels is $Hb = 0.19118 + 0.02011 \times IR - 0.0030 \times Red$. The evaluation results show that the combination of average IR and Red signals yields the best predictive performance, with an MAE of 0.939, MSE of 1.325, RMSE of 1.151, and a correlation coefficient of 0.643. In addition, the non-invasive device showed an average error of 2.66% compared to the invasive method as the reference. These results demonstrate that the machine learning-based non-invasive device can be an accurate, comfortable, and efficient alternative for hemoglobin monitoring.

Keywords: *Hemoglobin, Linear Regression, Machine Learning, Non-Invasive.*