

ABSTRACT

The increasing prevalence of obesity in Indonesia demands a more comprehensive health monitoring system. The current standard, Body Mass Index (BMI), has fundamental limitations because it cannot differentiate between fat and muscle mass, making it less accurate for individual diagnosis. This research aims to design, build, and evaluate an intelligent anthropometric measurement system based on Bioelectrical Impedance Analysis (BIA) integrated with artificial intelligence to provide a more personalized and accurate risk assessment of degenerative diseases.

The developed system consists of an Arduino Mega-based hardware scale prototype that integrates a load cell sensor, a Sharp IR sensor, a BIA circuit, and the "SmartScale" Android application that receives data via Bluetooth. The hardware performance evaluation results, when validated against a reference measuring instrument, showed significant deviation (average error of 12.9%), a finding that highlights the sensitivity of the BIA method to hardware implementation. On the software side, of the three AI models tested, the Deep Neural Network (DNN) model demonstrated the best predictive performance with an accuracy of 88.75%, significantly exceeding the research target of 83%. Parameter significance analysis using the SHAP method further validated the model's clinical relevance by identifying BMI and fat content as the most dominant predictors.

This study successfully demonstrated the feasibility of integrating a BIA anthropometric measurement system with a highly accurate AI prediction model. While the prototype hardware performance showed room for optimization, the prediction system's success in exceeding accuracy targets confirms its potential as a tool for early detection of degenerative disease risk. This system offers a more holistic and accessible approach for the public, offering a superior alternative to conventional BMI-based screening.

Keywords: *Anthropometry, Bioelectrical Impedance Analysis, Artificial Intelligence, Deep Neural Network, Health Prediction*