Creating a Low-Cost Non-Invasive Blood Glucose Monitoring and Automatic Insulin Injection System With an Artificial Neural Network and Raspberry Pi

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Diabetes mellitus is the ninth leading cause of death worldwide, affecting millions worldwide and likely more due to inefficient testing, and is growing worse every year. The system presented in this research could provide access to essential healthcare to millions worldwide at a low cost and with a non-invasive method. The main way to treat diabetes type I is with blood samples and insulin injections; however, this method is problematic, as current methods of detecting when insulin injections are required can be inaccurate, painful, expensive, wasteful, and intrusive. These methods are expensive, and are reserved for richer countries and individuals. The research goals of this study were to develop (a) a low-cost, non- invasive, and accurate glucometer, and (b) a fully automated insulin injection system. A Raspberry Pi, Pi Camera, laser diode, and servo motor were utilized. The camera and laser diode use laser spectroscopy to determine the concentration of an individual's blood glucose. Deep learning with logistic regression was used to calculate the estimated glucose level of an individual due to its effectiveness in estimating values based on an image. The effects of image count and image resolution on the accuracy of the neural network were investigated. An average accuracy of 90.06% (SD 6.64, n=10) was achieved using multiple high-quality images. The embedded system involves a non-invasive, pain-free, lightweight, and low-cost alternative to the current methods of glucose detection and insulin injection.

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