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Paper Title: Non-invasive Optical Blood Glucose Measuring System using Regression Models

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Abstract

Diabetes is one of the chronic diseases with an increasing number of patients every year. Therefore, blood glucose level (BGL) is an essential health information for diagnosis and management of diabetes. Commonly, the BGL is usually measured invasively by taking blood samples, which can cause pain or discomfort to the patients. Our paper aims to design and develop a low-cost, low-computational non-invasive blood glucose measuring system using optical technique.

The proposed system consists of a hardware for measuring photoplethysmogram (PPG). The PPG signal is subsequently analyzed to estimate the corresponding BGL, which is sent wirelessly to be stored in a database and displayed on an Android application. The application recommends the appropriate dosage of insulin injection based on the type of users and their diets. The report of historical blood glucose levels in the database can also be generated for further medical examination.

Three PPG features, namely peak-to-peak amplitude, maximum amplitude, and standard deviation of signal amplitude, have the strongest correlations to the BGL.

We investigate three regression models for estimating the BGL from these PPG parameters. The robustness of the system is assessed using cross validations. The average root mean squares error (RMSE) for three-fold cross-validations are 17.38, 16.76, and 16.39 mg/dL for simple linear regression, principal component regression, and partial least squares regression, respectively. The RMSEs from leave-one-out cross validation are approximately 12 mg/dL, with partial least squares regression model having the best accuracy. Furthermore, the results from Clarke Error Grid Analysis indicate that the system can be implemented with any of the three models for practical usage.