Design of a portable noninvasive Glucometer with clinical accuracy

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The Global Health Network

URL: https://tghncollections.pubpub.org/pub/6kcshy88

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Commercially available home use glucometers are popular everywhere including third world countries like Bangladesh. However, many people do not know the proper disposal method of biomedical waste created by the device. As a result, it leads to biohazard and environmental pollution. Additionally, such devices use an invasive technique which is expensive and painful.

We propose a painless noninvasive Blood-Sugar level detector which is minimalistic hardware that individuals can operate regardless of their skill and knowledge. This device uses a dedicated sensor (OPT101), a light source (infra-red LED light) to collect Photoplethysmography (PPG) data from the fingertip of the subject, and a processor (NodeMCU ESP32) to predict the actual glucose level from PPG information in within few min.

The proposed approach is cheaper, free from infections or health risk.

The complete prototype is developed in three phases: a) development of a proposed hardware that can extract PPG data from a human’s fingertip b) collection of a set of PPG data using proposed hardware and glucose level using a commercially available FDA-approved glucometer from n subjects c) develop a software model and train it with PPG data and actual glucose level. d) deploying this software model (trained) inside the proposed hardware and testing it by the prediction of glucose level from the PPG signal taken from the subject’s fingertip in real-time.

For training the model, we collected 3 readings/subject from 51 people resulting in 191 readings. For validation, it was split in 80:20 %. Various features were extracted from the readings. Our device had an error of 0.866 mmol/l or 15.6mg/dl which is in an acceptable range. The Clark error grid shows model trained with Raw+ALS+Gaussian+First Derivative feature had 70% of the data point on region A, 30% of the data point fell on region B, and no data point in C, D, E. While tests on a fixed subject for two consecutive weeks it could predict the glucose level with an error of 0.4 mmol/l. The device also demonstrated a high level of reproducibility. Our device will help solve the problems involved in invasive processes including the disposal of biomedical wastes.