

noBS, The non-Invasive Blood Sugar Monitoring System

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Project Overview

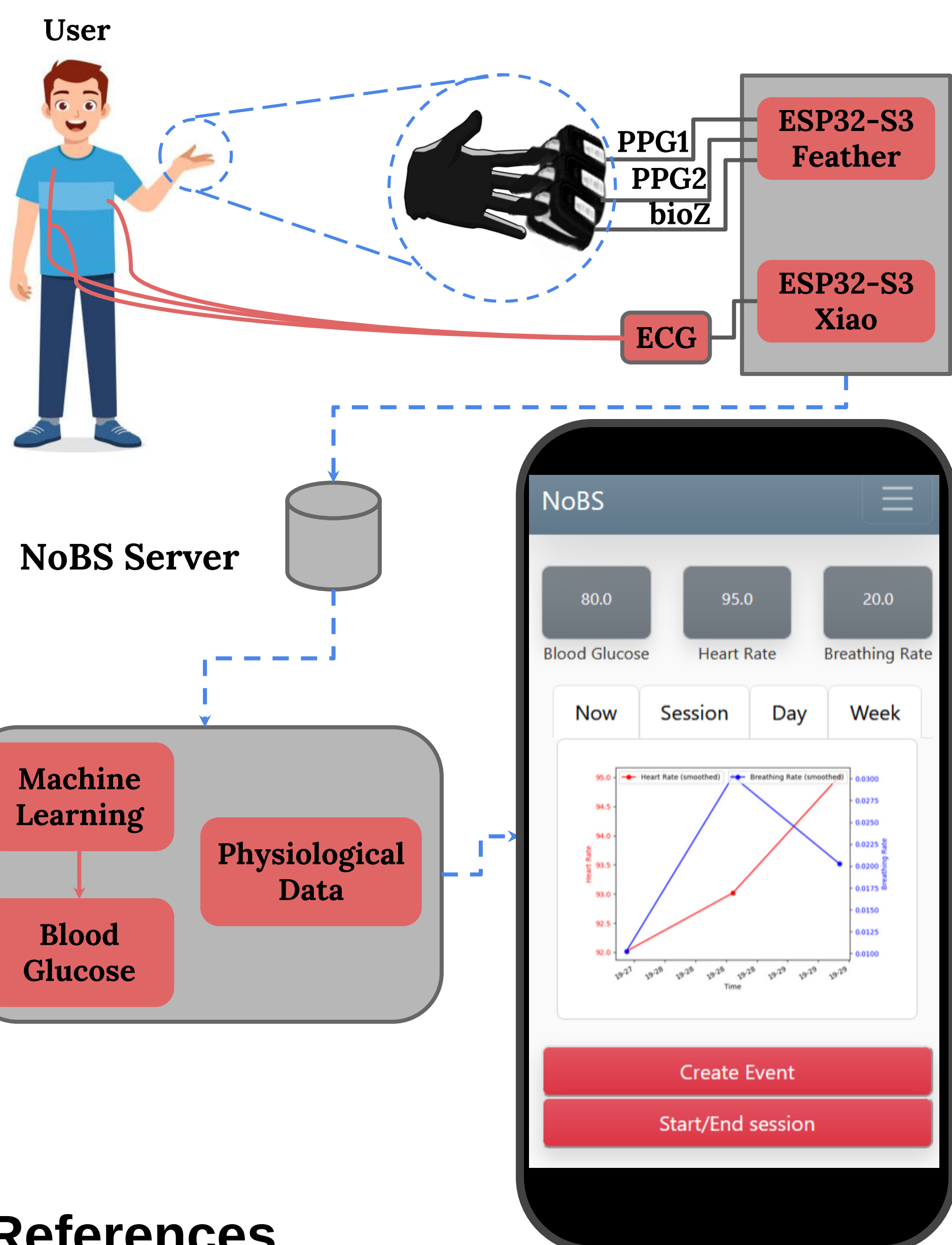
At present, there is no way to measure blood glucose without invasive methods. NoBS is a noninvasive monitor capable of detecting blood glucose using a combination of bioimpedance(BioZ) analysis, multi-wavelength spectroscopy(mPPG), and a machine learning model. NoBS aims for painless glucose monitoring with the following primary requirements:

- noBS shall assess blood glucose non-invasively.
- noBS shall use multiwavelength PPG (mPPG) and bioimpedance analysis to assess blood glucose.
- noBS shall send data to a server and make the data accessible to the user via a web application.

The Background

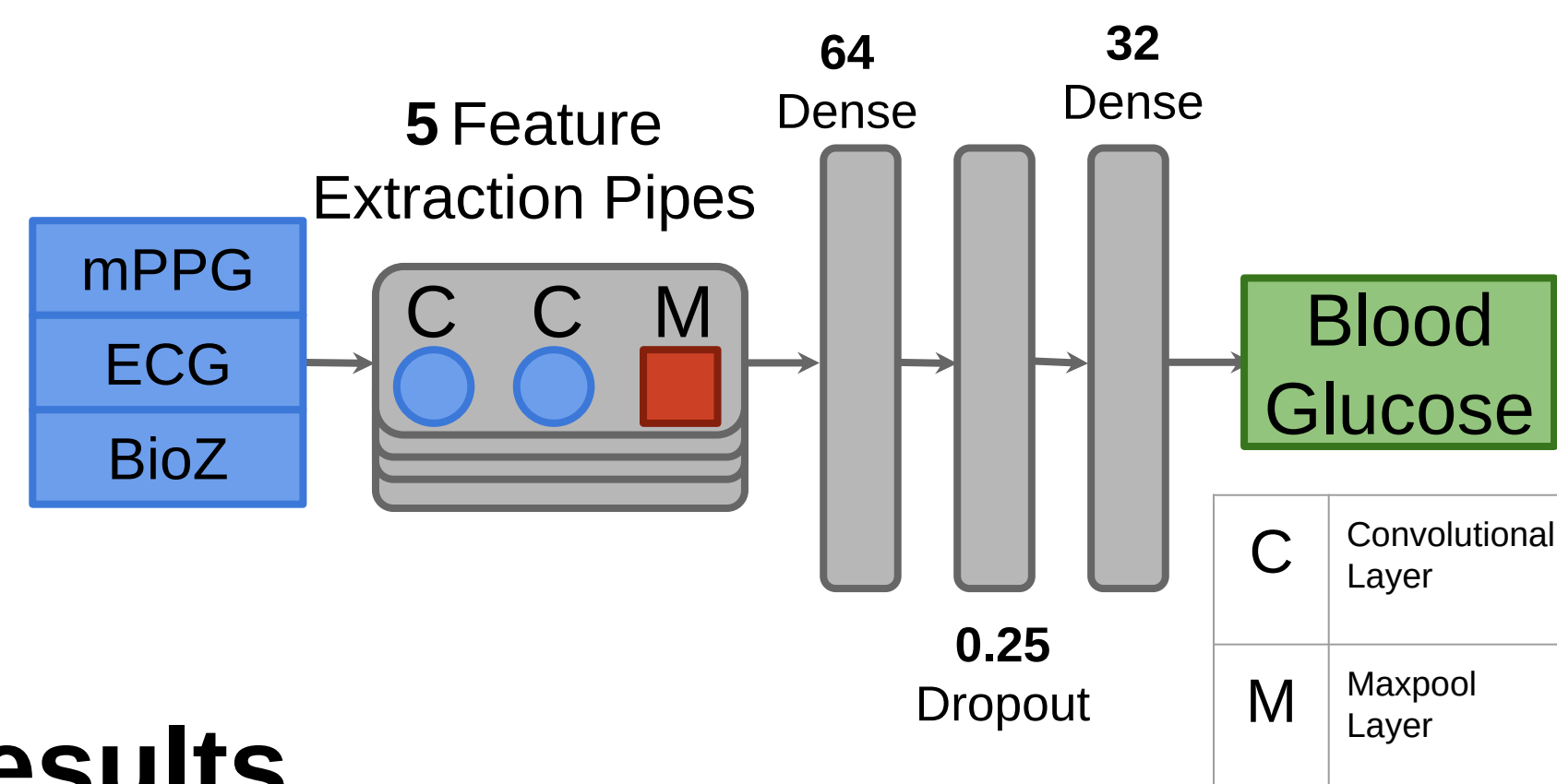
- Cases of *Diabetes Mellitus* are rising globally, expected to reach 690 million by 2045 [1].
- Recent research suggests that blood glucose can be measured within 6.62_{RMSE} using only mPPG and a ML model [2], but with a small dataset.
- Diabetics must use invasive or minimally invasive methods to determine their current blood sugar level [1].

Proposed Solution Diagram



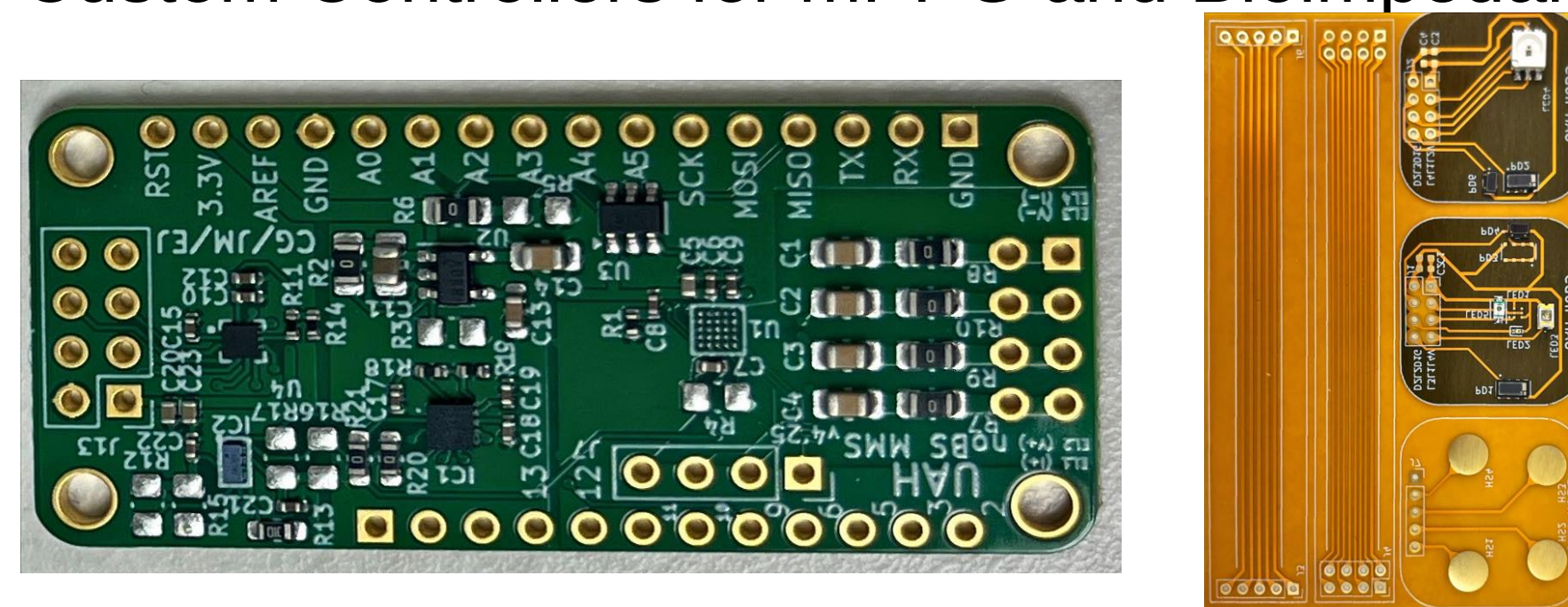
Deep Learning Architecture

- Deep Learning, three phase design:
 - Convolutional module for feature extraction
 - Dropout to prevent overfitting
 - Dense to assess Blood Glucose
- Hyperparameter Tuning:
 - Vary Number of layers and dimensions of each phase
 - On top of Train & Test set, Dev set for final evaluation

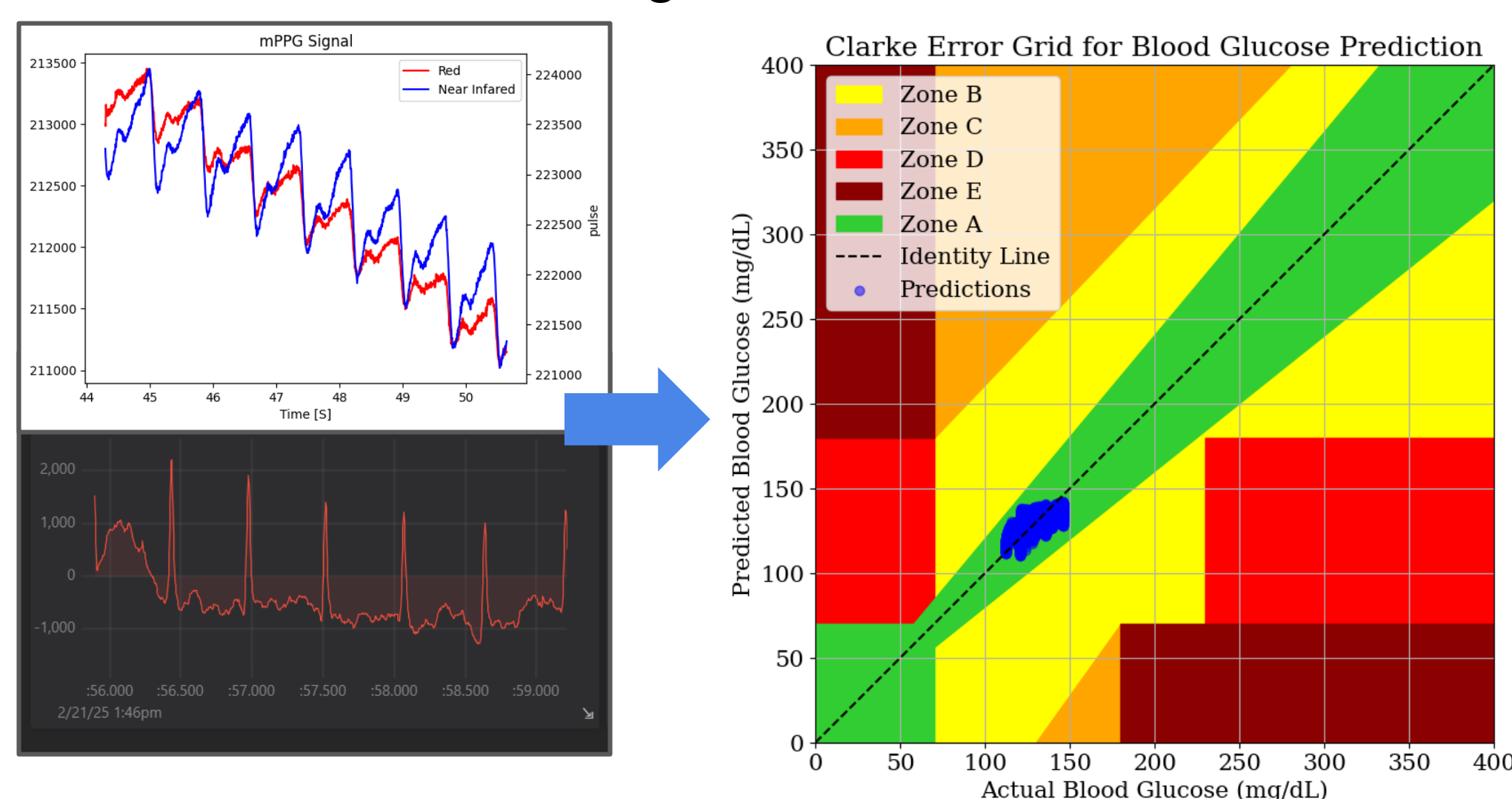


Results

- Custom Controllers for mPPG and Bioimpedance



- Blood Glucose Using a ML Model with < 8% Error



- Custom Mobile Application and Server

Conclusions

- Non-invasive blood glucose monitoring is very important but still unresolved issue
- A very promising solution for non invasive monitoring
- Near real-time blood glucose assessment
- Future work
 - an end-to-end ML model might be used for other monitoring applications (blood pressure, stress...)
 - Wearable continuous monitoring

Acknowledgement

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References

- [1] B. Alsunaidi, M. Althobaiti, M. Tamal, W. Albaker, I. Al-Naib, "A Review of Non-Invasive Optical Systems for Continuous Blood Glucose Monitoring". *Sensors*. <https://pmc.ncbi.nlm.nih.gov/articles/PMC8537963/>
- [2] C.-T. Yen, U.-H. Chen, G.-C. Wang, and Z.-X. Chen, "Non-Invasive Blood Glucose Estimation System Based on a Neural Network with Dual-Wavelength Photoplethysmography and Bioelectrical Impedance Measuring," *Sensors*, vol. 22, no. 12, p. 4452, Jun. 2022, doi: 10.3390/s22124452.