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Personalized Continuous Glucose Monitoring System for Diabetes Self-Management

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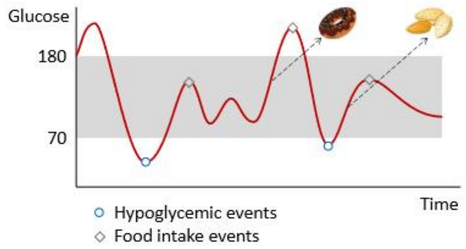
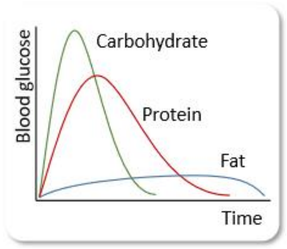
Introduction

Motivation

- 30M Americans suffer from diabetes and 84M are pre-diabetic
- It is important to minimize excess glucose levels, understand potential hypoglycemic events and be able to log diet and provide just-in-time alerts and interventions.





Significance

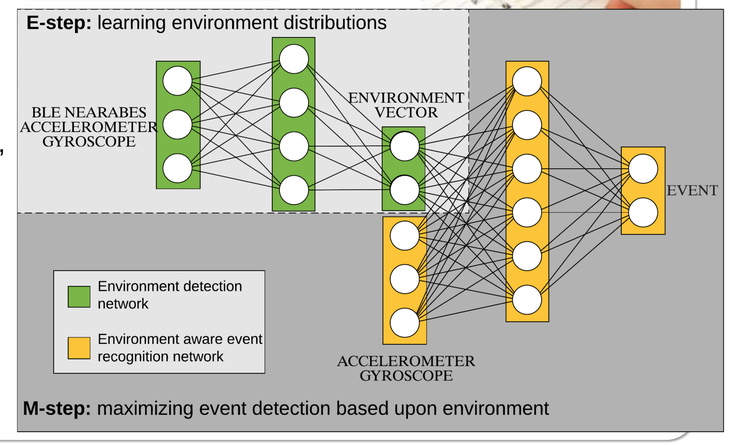
- Automated just-in-time monitoring requires strict control of diet and exercise
- While exercise tracking exists, current diet monitoring solutions remain impractical or creates user burden, often with abundant manual logging necessary.
- Understanding the context and changes to potential alerts requires burdensome data collection.

Existing solutions

- A number of automated sensing systems have been investigated to aid in diet monitoring, including acoustic sensing, photography-based logging, and automated computer vision techniques
- They still remain cumbersome in wearing, burdensome in logging, or inaccurate in estimation [1]
- A solution is needed that can log nutrition information in an automated fashion without requiring excess user logging

Continuous Glucose Monitoring: An Opportunity

- Continuous glucose monitors (CGM) can measure the post prandial glucose response (PPGR) to any food eaten
- PPGR is known to be impacted by the macronutrient composition of meals (carbohydrates, proteins, and fats) [2]
- An increase in carbohydrates quantity in a meal increases the amplitude of the glucose response



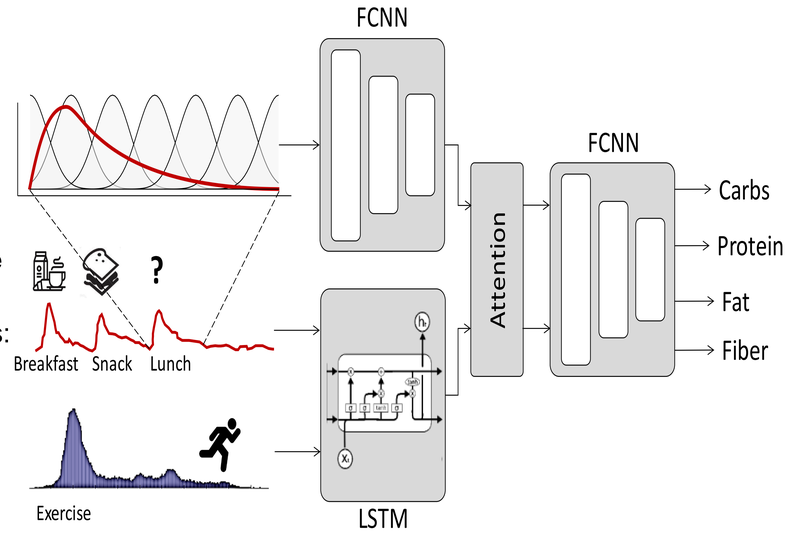
Methods

Human Subjects Studies

- This study was approved under IRB numbers 2019-0793 and 2018-0998.

Proposed Study

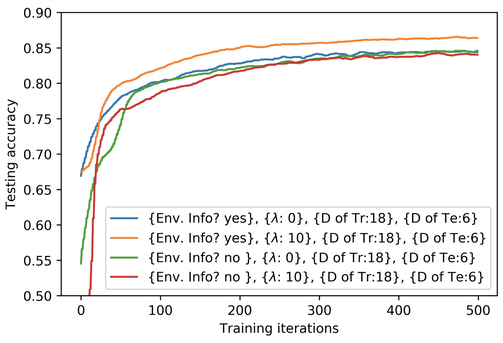
- We break this study into two discrete components.
- The first study aims to use wearable sensors and determine:
  Activity (and Energy Expenditure)
  Eating
  Sleeping
  Working
- These will provide context for an individual's energy expenditure
- The second study involves logging all meals and macronutrients:
  Users will log all meals
  All exercise
  All sleep
  All sedentary/work
  All travel
- We will then develop an attention-based method to track macronutrients automatically, based upon prior meals, activity, context, and post-prandial glucose response.



Experiment and Results

Preliminary Observation

- We are able to estimate actions, eating, and context using minimal user labels.
- We see 15% increase in eating detection activity with less than 20 user labels.
- This will provide a data collection base for our macronutrient data collection study



Discussion

- **We have a data collection platform that accurately tracks user context and detection of eating. This will allow us to properly segment meals and provide context to automate diet monitoring through our second user subject study.**

Reference

[1] Solis, Roger, et al. "A human-centered wearable sensing platform with intelligent automated data annotation capabilities." Proceedings of the International Conference on Internet of Things Design and Implementation. ACM, 2019.
[2] Zeevi D et al. Personalized nutrition by prediction of glycemic responses. Cell, 2015 163(5): 1079-1094