Skysong Innovations
Advancing the Arizona State University Knowledge Enterprise

1475 N. Scottsdale Road, Suite 200
Scottsdale, AZ 85287-3538
Phone: 480 884 1996 Fax: 480 884 1984

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Inventors

Hassan Zadeh

Asiful Arefeen

Contact

Jovan Heusser
jovan.heusser@skysonginnovations.com

AI-Based Approaches to Generate Synthetic/Simulated Physiological Signals

Glucose control is an integral component in both preventing and managing diabetes. Without proper control, hyperglycemic and hypoglycemic events can occur, which increase the risks for cardiovascular disease, eye issues, cancer, seizures and more. While continuous glucose monitors are widespread, their lack of computational abilities hinders their utility for behavior change. Additionally, although CGM datasets can be valuable for effective diabetes management, because of annotation effort issues, IRB permissions, under representation of samples, and limited patients, it is difficult to obtain these datasets for creating new and innovative solutions for controlling glucose.

Researchers at Arizona State University have developed two novel AI-based approaches, using wearable sensors and machine learning algorithms, to generate synthetic/simulated physiological signals, such as blood glucose.

The first approach, GlySynth, uses machine learning algorithms with small amounts of labeled training data to synthesize time-series physiological data from contextual information. This model was trained using a small CGM dataset to map artificial CGM signals belonging to new context – i.e. specific meals, medications and health status. While GlySynth is greatly beneficial in diabetes prevention and management, it could also be used to synthesize other time-series physiological data from contextual information. This means it could be used to generate synthetic time-series data for training a neural network.

The second approach, GlySim, is a CGM stimulator that uses multimodal data to not only forecast future glucose readings but also let users examine the impacts of behavior change on glucose response in advance. It creates opportunities for observing food consumption, medication and physical activity to pinpoint factors that cause anomalous events and how to adjust those behaviors to change glucose trajectories.

Potential Applications

- Tools for patients at risk for or having type 1 or type 2 diabetes
  - Enables interventions, such as behavior modifications, to prevent dysglycemia
- Decision support tool for physicians to identify the best course of action for glucose control
- Synthetic data generation for training machine learning models such as neural networks

Benefits and Advantages

- GlySynth
  - Able to perform well on small datasets
  - Creates high quality synthetic data
  - Can potentially reduce the risk of privacy breaches because it does not contain sensitive information
- GlySim
  - Allows users to observe how adjusting behavior changes glucose trajectories
  - Takes data from multimodal information sources
  - Provides a platform for developing and testing novel algorithms and techniques for glucose management without extensive clinical studies

For more information about this opportunity, please see

Arefeen et al - EMIL - 2023

For more information about the inventor(s) and their research, please see

Dr. Ghasemzadeh's departmental webpage