ARISES: AN ADVANCED CLINICAL DECISION SUPPORT PLATFORM FOR T1D MANAGEMENT

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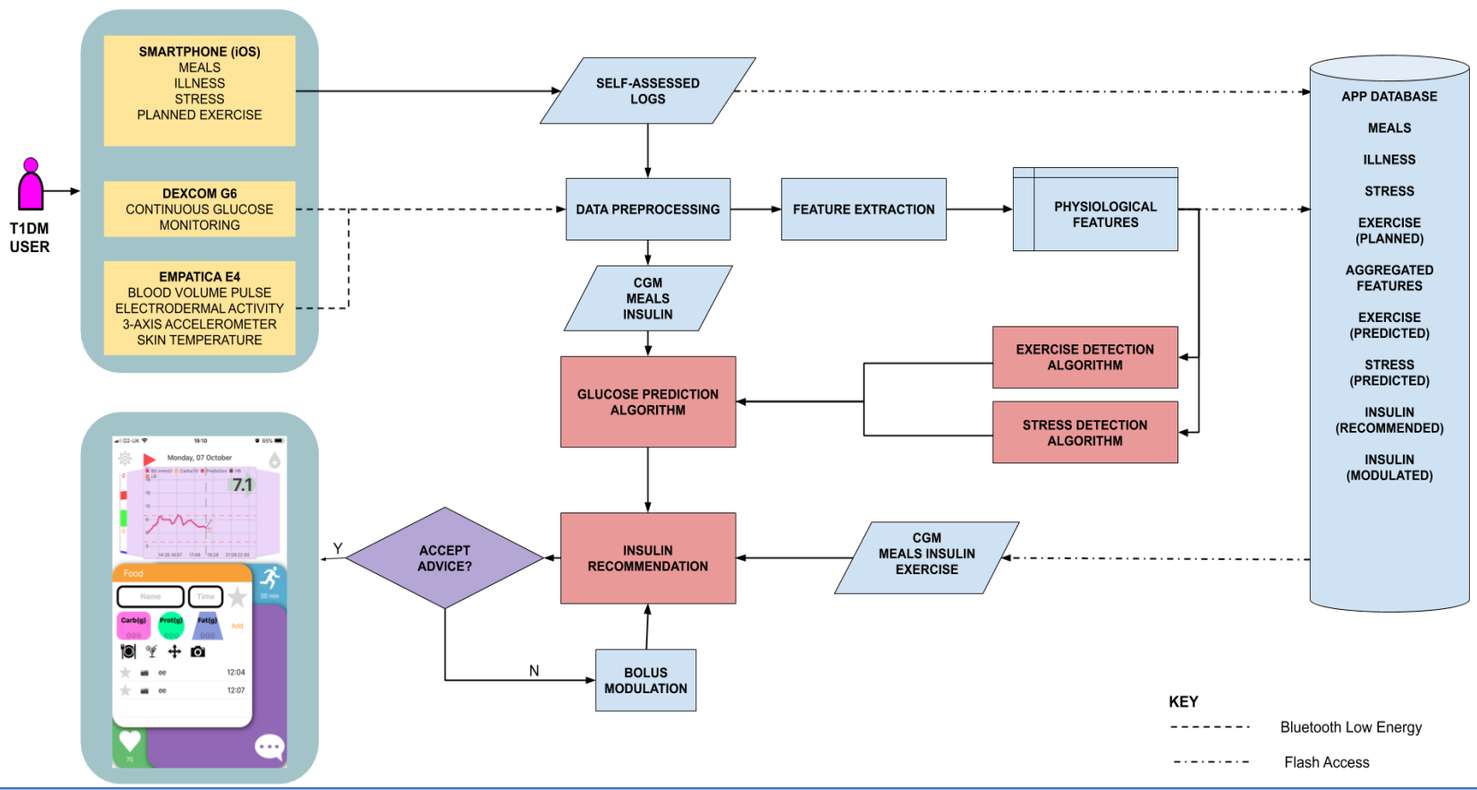
Background

- In daily living, the management of diabetes goes beyond the consideration of meal intake for decisions on actions needed for tight glycaemic control.
- External factors such as stress and exercise also have complex effects on the blood glucose concentration.
- Currently, decision support systems require manual logging of these external factors [1], which require constant attention and can cause diabetes distress, which leads to suboptimal outcomes [2].

Aims

- ARISES (Adaptive, Real-time, Intelligent System to Enhance Self-care of chronic disease) is a mobile platform facilitating a decision support system for people with Type 1 diabetes (T1D) to improve the efficacy of current care and reduce the burden of managing diabetes in daily living.
- We incorporate wearable biosensors to continuously monitor physiological signals from the autonomic system and metabolic system.
- We leverage various machine learning techniques towards improving glucose control and automating detection of external factors.

ARISES System Overview



- The platform is developed on Apple iOS and algorithms implemented using TensorFlow Lite on a smartphone iPhone

Methodology

- ARISES comprises inputs from a Dexcom G6 for CGM, and Empatica E4 for physiological signals.
- This data is wirelessly transmitted to the smartphone, where machine learning algorithms compute relevant information for decisions.
- The system is primarily comprised of the following data-driven submodules:
  1. **GLUCOSE PREDICTION ALGORITHM**: A 3-layer deep learning model composed of dilated recurrent neural networks that forecasts glucose concentration on a 30 minute prediction [3].
  2. **INSULIN RECOMMENDATION ALGORITHM**: A deep deterministic policy gradient model that utilises double dilated recurrent neural networks for recommending meal and correction boluses.
  3. **STRESS DETECTION ALGORITHM**: A 2-layer LSTM neural network for detecting multiple levels of stress intensity [4].
  4. **EXERCISE DETECTION ALGORITHM**: A deep learning model for real time detection of physical activity.

Results and Future Work

- The built-in algorithms have been *in silico* validated and evaluated with retrospective clinical data.

Model	Metric	Result
Glucose Prediction	RMSE	**18.9±2.4 mg/dL**
Insulin Recommendation	Time in range (Time in hypoglycaemia)	**88.3±5.1% (5.3±3.9%)**
Stress Detection	Precision	**0.71±0.12**
Exercise Detection	F1 score	**0.96±0.02**

- The performance of the platform will be evaluated in a randomised cross-over clinical study with 12 participants over 8 weeks.

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