Diabetic health risks, heightened by peripheral neuropathy and glucose fluctuations, lead to complications like foot ulcers and unstable sugar levels. The invasive and uncomfortable nature of current management practices underscores the urgent call for gentler, non-invasive solutions.

Leveraging cutting-edge technology, our solution integrates a sweat-based glucose sensor with pressure sensors to offer a comprehensive health monitoring platform. Powered by ML analytics, it not only facilitates precise glucose control to prevent hyperglycemia and hypoglycemia but also preemptively identifies risks of ulceration. This innovative system revolutionizes diabetes care, emphasizing patient well-being.

WHY I-SOLE?

Current Diabetes Monitoring is:

- stressful
- invasive
- inefficient

- Peripheral neuropathy affects 50% of diabetes cases, leading to complications like hyperglycemia and ulceration.
- 60% of all non-traumatic (diabetic) amputations are preventable with patient data and predictive analysis.
- There is currently no well-known non-invasive solution that integrates both glucose and pressure monitoring.

OBJECTIVE

1. Develop non-invasive hardware fitting within shoe insole form factor
2. Accurately estimate sweat glucose levels and monitor foot pressure values
3. Enable Bluetooth connectivity for data transmission to user's mobile phone

WEB APPLICATION

OBJECTIVE

The web application serves as a dedicated portal tailored to identify our patient's doctors and caregivers, providing streamlined access to key functionalities:

1. Features analytics for tracking patient vitals and predictions, enabling doctors and caregivers to monitor their patients effortlessly.
2. Includes a chat section for patients to discuss vitals with their doctors or caregivers.
3. Integrates a notification system using Twilio for emergency alerts to doctors, caregivers, or family members.

INTEGRATED SOLUTION

BRINGING IT ALL TOGETHER

OBJECTIVE

The mobile app, specifically tailored for patients, serves as an interface with their insole hardware via Bluetooth, ensuring detailed monitoring of glucose and pressure metrics.

1. Leverages Bluetooth connectivity for seamless pairing and real-time data transfer between I-Sole and the mobile app, ensuring uninterrupted metric monitoring.
2. Employs app's offline capabilities to ensure ongoing access to crucial features and data storage, acting as a central hub for hardware, database, and web application integration.

MOBILE APPLICATION

OBJECTIVE

The mobile app provides a comprehensive experience for patients, doctors, and caregivers:

1. Accurately predict hyperglycemia and hypoglycemia
2. Predict the risk of diabetic ulceration

MACHINE LEARNING

OBJECTIVE

Developed a Bi-LSTM model using data from 6 clinical trial participants in the OhioTI DM dataset(s) for precise blood glucose prediction.

ACADEMICALLY SOUND?

1. Accurately predicted 95% hyperglycemia and 92% hypoglycemia Instances for 6 patients data.
2. Achieved an average RMSE of 26.3 and MAPE of 5.2 over 6 patients data.

ACADEMIC VIABILITY

- Reviews confirmed developed algorithm accuracy in translating sweat glucose to blood glucose values.
- Rigorous R&D determined effectiveness of glucose sensor in sweat-based solutions and pressure sensor monitoring points & thresholds.[1][2][3]
- Training features were reduced from 20 to 5 based on gradient boosting analysis of OhioTI DM dataset.[4]
- The BiLSTM architecture was selected for accurate predictions from multiple machine learning models.[5]

FUTURE WORK

- Clinical Validation and Regulatory Approval
- Expand Sensor Capabilities and Integration with Wearable Devices like Basis Peak Ultime Bands

REFERENCES


