The Future of Glucose Monitoring

Lathan Liles
Aditya Sundaresan
Kuang Wei

Mentor: Danielle Guerra
PI: Luke Theogarajan
Diabetes Affects About One in Three People

- Diabetes is a nationwide epidemic
- Diabetes is the result of the inability to break down sugars
- Diabetic patients go through a lot of trouble to acquire and record glucose levels
Ultimate Goal
Quicker, Faster, More Reliable

The Quick Draw

• Android application to analyze glucose readings

• Smart phone memory and processing power

• Bluetooth capability
Overview of Quick Draw

- Electrochemical Sensing Chip
- Microcontroller
- Battery
- Bluetooth Module
Determining Glucose Level

- Glucose reacts with the test strip to generate current
- We can use the current to measure glucose levels
Where the Current Originates

Glucose $\rightarrow$ Gluconolactone

$2e^- \rightarrow \text{Mediator (Ox)} \rightarrow \text{Mediator (Red)}$ to Working Electrode

Oxidation Reaction
Where the Current Originates

\[ \text{Glucose} \xrightarrow{2e^-} \text{Glucuronolactone} \]

- **GOx**
- Mediator (Ox)
- Mediator (Red)
- Working Electrode

**Oxidation Reaction**
Where the Current Originates

Oxidation Reaction

GOx

Mediator (Ox)

Mediator (Red)

2e−

Working Electrode

glucose

gluconolactone
Where the Current Originates

Oxidation Reaction

GOx

glucose

gluconolactone

Mediator (Ox)

Mediator (Red)

Working Electrode

2e⁻
Calibration Process

• Accuracy is vital
• 5 industry standard solutions tested 5 times
• Our program takes rapid measurements of voltage over time
• Maximum voltage is related to glucose concentration
Glucose Oxidation vs. Time

- Maximum Voltage
- Voltage
- Time (s)

- 450 mg/dL
- 345 mg/dL
- 225 mg/dL
- 106 mg/dL
- 40 mg/dL
Glucose Calibration Function

\[ \text{glucose concentration} = \frac{(\text{voltage} - 0.8633)}{0.00185} \]

\[ R^2 \text{ value} = 0.97 \]
Highest Error is 3.9%
Bluetooth Capability

- Bluetooth port sends voltage to Android phones in digital signals
- App that converts voltage readings into glucose levels
- App uses the linear equation
Features of the App

**Take Test:** Wireless connection

**History:** Large memory storage and graphical analysis

**Send Data:** Past measurements can be uploaded and shared through email

**Notifications:** Allows users to set reminder alarms for taking tests

**ICE:** (In Case of Emergency) stores doctor information, emergency contacts & medical conditions
Future Improvements

- Consider effects of temperature, humidity, altitude and heart rate
- Debug the app
- The glucose testing can be optimized on app
Conclusions

• Successfully created linear fit model between voltage and glucose concentration
• \( R^2 \) value shows this correlation is very accurate
• With successful calibration and an Android application...

The Quick Draw will one day become a pocket doctor
Thank You To...

- Mentor- Danielle Guerra
- PI- Professor Luke Theogarajan
- Ofelia Aguirre
- UCSB
- CNSI
- CSEP
- SIMS
- Our RA’s and Super Mentors