IPRO 308: Developing an Artificial Pancreas

William Wakeman
Anju Saseendran
Allen Klug
Adam Kuuspalu
Adam Smith
In Soek Sin
Olufemi Sonoiki

Diabetes: inhibiting a Lifestyle

- Diabetes: A metabolic disorder that limits the production or response of insulin which allows glucose to enter the tissues of the body.
- Glucose is the primary fuel source for our body.
- 21 million Americans have diabetes*
- Two major types of diabetes :
- Type 1 ~ 5 - 10% of all cases of diabetes
- Type 2 >90%
- People with diabetes must watch and regulate their diet, general health (BP, cholesterol), eyes, kidney, feet and constantly measure their insulin levels.
- Current Treatment for Type 1: Insulin injection or pumps, restricted diet, and the observation of insulin levels everyday.

*American diabetes association

Prior Work in Previous Semesters :

- **Closed-Loop:**
- Porcine Skin limitations

  -loss of tensile strength and elasticity
- Paper cone speakers

  -Too delicate to handle load and fluids of prototype
- Ultrasound through a Vacuum

  -dampened effect

- **Measurement:**
- AC Impedance:

  - Interstitial fluid was used as a dielectric measuring phase shift.

  -Range of instruments unable to determine resonance frequency
- Oxidation:

  -measured voltage spike at various glucose concentrations

  -Produced no discernable results

Current Team Approach and Methods

- **Closed-Loop**

  -Verification of Skin pore enlargement

  -Redesign of extraction prototype

  -Extract interstitial fluid

- **Measurement**
  - **Focus on glucose measurement by EIS**

  -Current problems

  -Plan of action

  -Potential Alternatives

Skin Pore Enlargement

- Reduce Skin Thickness
- Observe Pig Skin before and After Sonophoresis

Possible Obstacles and Alternatives

- Identification of Skin Pores after Sonophoresis
- Stereo Image Optical Topometer

Extraction Device

- Redesigning of Previous IPRO Group's Prototype
  - Division of Prototype into two Separate devices
    - Ultrasound Device
    - Vacuum Device

Measurement

Problems

- Learning how to operate the Autolab PGSTAT30
- Finding the resonance of glucose over interference

Plan

- Confirm the resonant frequency of water using the autolab
- Find the resonant frequency of glucose using the same process
- Find a relation between glucose concentration and impedance.

Alternatives

- NMR
- Photoacustic measurement

Questions?