IPRO 308: Developing an Artificial Pancreas

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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
- Photoacoustic measurement
Questions?