IPRO 331 - Non-Invasive Blood Glucose Monitoring
Back Row: Brogan Dexter, Daisy Rathod, Sangeeta Bookseller, Jon Young, Jude Kieltyka.

Front Row: Adeseye Adekeye, Anu Topgi, Shivani Shah, Chad Nishizuka
IPRO 331 - Non-Invasive Blood Glucose Monitoring

- Purpose
- Background
- Design
- Cost Analysis
- Obstacles
- Conclusion
- Recommendations for Future
Diabetes Background

- **Type 1:**
  - “Juvenile Onset”
  - Autoimmune Disease in which immune system attacks the Pancreatic Beta cells which produce insulin
  - Insulin is a hormone used by the body to metabolize glucose
  - Require Regular Insulin Injections
  - Must constantly monitor blood glucose to avoid both hyperglycemia and hypoglycemia.

- **Type 2:**
  - “Adult Onset”
  - Pancreas Still Produces Insulin, but “Insulin Resistance” prevents the body from utilizing it
  - Accounts For 90-95% of all diabetes cases
Hyper and Hypoglycemia

- **Hyperglycemia**
  - Blood glucose is above recommended range
  - Blurry Vision, Excessive Thirst and possible long term effects such as blindness and even early death

- **Hypoglycemia**
  - Blood glucose is below recommended range
  - Possible Medical Emergency
  - “Insulin Shock”
  - Can quickly lead to coma and death
Current Methods

- Require finger pricks for blood
- The blood is then blotted onto test strips
- Test strips are placed in a reader
- Very Cumbersome and stressful, particularly for young children
Invasive Procedure Elimination

Continuous monitoring

Cost Reduction

Eliminate need to restock monitoring supplies
Design Possibilities

- Measurement Medium
  - Interstitial Fluid
  - Blood
  - Saliva

- Medium Extraction
  - Vacuum
  - Ultrasound
  - Iontophoresis
Measurement

Infrared Spectroscopy
  ✓ Near Infrared
  ✓ Far Infrared

Photo-acoustic glucose measurement

Impedance Spectroscopy
Impedance Spectrum

Increasing Concentration of Y

Voltage
Design possibilities

- Cleaning the device
  - Self-cleansing sensors
Interstitial fluid

Ultrasound permeation

Vacuum extraction

Impedance spectroscopy

✓ Resonates Glucose Molecule

✓ Specific Frequency isolation
The vacuum pump then begins its first phase by drawing up any sweat.
Cost Analysis

Equipment Needed

- Ultrasound
  - Transducer
  - Amplifier

- Vacuum Unit
  - Batteries
  - Vacuum Pump

- Cleaning Components
  - Sensors
  - Titanium Oxide Film

- Impedance Spectroscopy
  - Circuit Components
  - Impedance Sensors
Cost Analysis

Current Technology

- Invasive Blood Glucose Monitoring
  - 50 Test Strips: $ 30 (replenish every 25 days or less)
  - 200 Lancets: $ 10 - $ 50 (replenish every 3 months)
  - Testing Apparatus: $ 50 - $ 100 (Lower Level Monitors)
  - Consumable Auto-Sensors (certain machines): ~ $ 70

- Replenishment of Supplies required

- Average Cost per Test: $ 0.70 - $ 0.80
Our Technology

- Non-Invasive Blood Glucose Monitoring

<table>
<thead>
<tr>
<th>Items</th>
<th>Cost Range ($)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultrasound components</td>
<td>25-100</td>
</tr>
<tr>
<td>Vacuum device including batteries</td>
<td>15-20</td>
</tr>
<tr>
<td>Cleaning Components</td>
<td>~ 10</td>
</tr>
<tr>
<td>Impedance Materials</td>
<td>~ 150</td>
</tr>
</tbody>
</table>

- Total Cost Range: $200 to $280
- No replenishing of supplies. **One Time Purchase!**
Obstacles

- Vacuum pressure
- Sweat convolutions
- Concentration Convolutions
- Cleaning measurement chamber
- Who is on the patent?
Future Direction

- Develop Working Prototype
- Obtain patent rights for the idea
- NCIAA biomedical engineering award
- Obtain Sponsorship for further development
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