gPod

Blood Glucose Meter

Team 2
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Sponsored by the Rehabilitation Engineering Research Center
Introduction

- gPod Blood Glucose Meter
  - Lower cost alternative to commercially available meters.
  - All-in-one package
    - For the visually impaired
    - For patients with motor control disabilities
Patient Need

- 18.2 million American diabetics
- 5th leading cause of death in U.S.
- No cure
- Leading cause in new blindness in adults 20-74 years old
- Annually 12,000-24,000 diabetics loose sight
Economic Costs

- 1 out of every 10 health care dollars spent
- Annual per capita health care expenditure $13,243
- Diabetes market $132 billion/year industry
Available Products

- Accu-Chek Advantage
  - Portable
  - 26 second results
  - 4 uL blood sample
  - No alternative site testing
  - Snap-in code key calibration
  - Large legible display
  - Cost: $65
Available Products

- OneTouch Ultra by Lifescan
  - Portable
  - 5 second results
  - 1 uL blood sample
  - Multiple site testing
  - Large legible display
  - Cost: $75
Available Products

- Voicemate by Accu-Chek
  - Portable
  - 26 second results
  - 4 uL blood sample
  - Snap-in code key calibration
  - Step-by-step voice instructions
  - Modular
  - Cost: $570
#5997817 Electrochemical biosensor test strip – December 7, 1999 - Crismore, et al.

- Electrochemical biosensor
- Capillary test chamber
Design 1

- Amperometric Test Strips
- Speech Module
- Serial communication
Design 2

- Near IR spectroscopy
- Speech Chip
- Vial Scanner
- USB communication

![Graph showing absorbance vs. wavelength with peaks at 2.12 μm, 2.27 μm, and 2.32 μm for 5 mM glucose with 1 mm path length.]
Design 3

- Colorimetric Test Strips
- Speech Chip
- USB communication
- Vial Scanner
Optimal Design

- OneTouch Ultra Test Strips
- Speech Chip
- USB communication
- Insulin Vial Scanner
Block Diagram
Glucose Test Circuit

\[ V_1 = \frac{V(R_1)(R_2)}{(R_1+R_2)} \]

\[ V_2 = -I_2 \times R_3 \]

\[ V_3 = -I_3 \times R_4 \]

\[ I_1 = \frac{V_1}{(R_1+R_2)} \]
Glucose-Current Relationship

Glucose Concentration vs. Current @ time = 4 sec
LCD Screen

- Viewing area: 52x33.5 mm
- Backlight: White EL
- Parallel Data
Speech Chip

- Text-to-Speech Synthesizer
- Natural sounding speech
- Variable pitch and speed
Vial Scanner

- FDA requires barcode of NDN on all insulin vials
- Connects to meter through USB port
- Identifies type of insulin and concentration
Microprocessor

- PIC16F874A by Microchip
- Controls LCD, speech chip, USB, glucose test circuit
- Programmed using Hi-Tech C and MPLabIDE
User Interface

- Insert test strip
- Add blood
- Testing
- Display results both visually and auditory
- Display errors (if occurs)
- Auto-shutoff after 1 minute
## Estimated Costs

<table>
<thead>
<tr>
<th>Part</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microprocessor</td>
<td>$7.00</td>
</tr>
<tr>
<td>Winbond WTS701 (Speech Chip)</td>
<td>$32.00</td>
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<tr>
<td>LCD Screen</td>
<td>$26.00</td>
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<tr>
<td>Circuit Boards (2.8”x 3.5”)</td>
<td>$17.00 each</td>
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<td></td>
<td>$51.00 for 3</td>
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<tr>
<td>Case(s)</td>
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<td>Other components</td>
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<td><strong>Total</strong></td>
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<table>
<thead>
<tr>
<th>Part</th>
<th>Cost</th>
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<tbody>
<tr>
<td>Barcode Reader</td>
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<tr>
<td>Circuit Board</td>
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<tr>
<td>Case</td>
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<td>Other Components</td>
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<td><strong>Total</strong></td>
<td><strong>$119.00</strong></td>
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## Timeline

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<tr>
<th>Project</th>
<th>Duration</th>
<th>Starts</th>
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<tbody>
<tr>
<td>Prototype Glucose Circuit</td>
<td>2 weeks</td>
<td>Jan 17-31</td>
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<tr>
<td>Test Glucose Circuit</td>
<td>3 weeks</td>
<td>Feb 1-March 3</td>
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<tr>
<td>Prototype LCD Circuit</td>
<td>2 weeks</td>
<td>Jan 17-31</td>
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<tr>
<td>Test LCD Circuit</td>
<td>3 weeks</td>
<td>Feb 1-March 3</td>
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<tr>
<td>Prototype Speech Circuit</td>
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<td>Jan 17-31</td>
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<tr>
<td>Test Speech Circuit</td>
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<td>Feb 1-March 3</td>
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<tr>
<td>Prototype Vial Scanner</td>
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<td>March 13-22</td>
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<tr>
<td>Test Vial Scanner</td>
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<td>Systems Integration</td>
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<td>March 3-April 3</td>
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<tr>
<td>Final testing</td>
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<td>April 3-28</td>
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Conclusion

- Portable size
- Lower cost
- User-friendly interface
- Easy to read display
- Audible output
- Insulin Vial Identification
Any Questions?