gPod

Accessible Blood Glucose Monitor Interface

Team 2
Matthew Bularzik, David Price, Michael Rivera

Sponsored by the Rehabilitation Engineering Research Center
People with diabetes must check their blood glucose levels several times daily with a portable meter. Diabetes can cause visual impairment, which can make using these meters a difficult process. Talking meters are available, but are not designed for simple operation.

Objective:
- Design a portable, reliable, low-cost blood glucose meter.
- Effectively communicate instructions and measurements visually and audibly.
- Consider the use of insulin vials and the identification of their contents.
Patients

- The meter must be designed to meet the following patient’s conditions:
  - Partial hearing loss
  - Parkinson’s disease
  - Slight to moderate tremors
  - Limited use of extremities
  - Blindness
Diabetes

- 14.6 million cases in America
- 5th leading cause of death
- Leading cause of blindness in adults 20-74
- 12,000-24,000 new cases of blindness annually
- No cure

Source: www.CDC.gov
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
gPod Prototype

- Accurate Glucose Measurements
- Clear, Loud, Voice Output
- Barcode Scanner to Identify Insulin
Electronics

- Glucose Circuit
  - Filter
  - Trigger
- Speech Module
- User Interface
- Microprocessor
- Barcode Scanner
Glucose Filter

![Diagram of glucose filter circuit with resistors and capacitors labeled with values such as 10k, 56k, 47n, 100n, 22k, 2.2k, and 1u.](image)
Glucose Trigger
How does a glucose measurement work?

- Blood sample applied to sample well of test strip.
- Glucose oxidase reacts with glucose producing a current.
- Current converted to voltage.
- Voltage reading taken during linear phase of curve (2 seconds after sample applied).
- Voltage and glucose concentration have a linear relationship.
Speech Module

- Text-to-speech conversion
- RS-232 Communication
- Voice output for instructions and measurements
Microprocessor

- A/D conversion
- LCD control
- Speech control
- Barcode scanner
- Communication
Microprocessor

- MPLab
- Hi-Tech PICC compiler
- Programmed in C++
Barcode Scanner

- Scan National Drug Code Barcode
- Identify Type of Insulin
- Output type on LCD and by voice
- Took a OneTouch Ultra reading every 10 trials.
- Applied a known solution to gPod glucose meter.
- FDA requires an accuracy of +/- 20% difference.
- Examining the averages, the gPod and OneTouch Ultra are comparable in accuracy.
PCB Schematic

- Microprocessor
PCB Schematic

- SP03 Speech Module
- MAX232
PCB Schematic

Character LCD Screen
PCB Schematic

- Glucose Measurement
- Glucose Filter
PCB Schematic

- Trigger
- XOR Gate
PCB Schematic

- Power Input
- +/-5 Voltage Regulators
PCB Layout

Back – Facing into the case
PCB Layout

Front - Facing out of the case
Case Design

- OKW Handheld Enclosure
  - 9V Battery Slot
  - Display Window
  - PCB Mounts
Case Design

- Case Outside
  - Power Switch
  - Vial Scanning Switch
  - Vial Scanner Port
Case Design

- Case Outside
  - Test Strip Slot
  - Speaker Holes
  - Battery Compartment
Case Design

- Inside Casing
  - PCB Mounting
  - LCD Placement
  - Speech Module
Carrying Case

- Case can hold:
  - gPod
  - Test Strips
  - Lancets
  - Samplers
  - Insulin Vials
  - Control Solutions
  - Barcode Scanner
  - Spare Batteries
  - Log Book
  - User’s Manual
# Budget – gPod Cost

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<td>Character LCD</td>
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## Budget - Development

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Conclusion

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