



Mindful Health Technologies

providing real-time CHF management
tools for critical care teams



Problem Statement

- Patients with chronic diseases such as CHF and COPD could greatly benefit from remote monitoring while they are outside the hospital. Effective monitoring is challenging in a home setting due to the range limitations of current devices along with issues with patient compliance. This lack of monitoring and communication between the doctor and patient often results in frequent emergency visits to the hospital and readmission of the patient.



Client Requirements

- Automatically collect and transmit patient's blood oxygen saturation data
- Send data over 2G cellular coverage to a cloud database
- Care team members can view data on dashboard web application



Design Constraints

- Resources to efficiently fabricate OEM portion of device
- Learning curve of Web Development



Big Picture

- Improve patient quality of life
- Affordable Care Act- Readmissions Reduction Program
 - Poses a burden to hospital's financial performance
 - Outpatient health management practices are ineffective
 - Readmission could be avoided with better preventative care



Final '1.0' Prototype Summary

- Developed functional 'proof-of-concept' platform
 - Arduino based GSM remote monitoring module
 - Web hosted data visualizations and alerts
- Performed systems integration validation & testing
 - Device-to-Web GSM transmission time
 - Transmission error rate



Final '1.0' Prototype Evaluation

- Device lacks trial-critical features and testing
 - OEM pulse oximetry module failure
 - Current size/form factor does not align with goals
- Software needs expanded functionality for real use
 - Care-team and patient 'network' creation/authentication
 - Separation of GSM receiver processes
 - HIPPA-compliant backend security



2.0 Prototype Dev Strategy

- Implement *pogo* as an all-in-one PCB
 - Credit card size/form factor
 - Secure and test new pulse oximetry module
- Rebuild web software from the ground up
 - Include working care-team and patient networks
 - Support asynchronous GSM I/O in 'worker dyno'
 - Utilize HIPPA-as-a-Service database API



Software Development

Timeline and Goals

- Wireframe and implement Interface
- User Registration/Authentication System
- Design and implement Care Team/Patient data models
- Create splash page for web site
- Implement Data Transmission back-end
- Implement Data Visualization on Dashboard
- Complete integration testing with device



Software Development Testing

- Test Driven Development with Rspec and Cucumber
 - Design system based on failed tests first, then rewrite code to pass them → ensures robust testing suite
- Test for scenarios: User Sign Up, Authorization, etc.
- Test for correct data in visualization
- Perform integration testing with device



Hardware Development

Timeline and Goals

- Order new BCI Digital Micro Pulse Oximeter
- Implement board in *POGO 2.0* with Digital Logic Level Converter
- Complete testing following protocol



Hardware Development Testing

- Pulse oximetry sensor validation
- Sending data through GSM Network
- Full device testing
- Data streaming speed
- Clinical trials in UW Veterans Hospital



Costs

- \$700 budget approved by Qualcomm to buy Masimo OEM pulse oximeter board
 - Divert funds for two \$300 BCI Digital Micro Pulse Oximeter Boards
- \$109 for 3 printed circuit boards (4 layers)
- \$7 ATmega32U4 microcontroller
- \$65 Arduino Mega ADK
- 2 X \$60 SeeedStudio GSM Shield



Other Information

- 3D print encasement with clip
- Will develop user manual to distribute for clinical trials

The image features a vibrant blue background with a subtle pattern of overlapping squares. In the upper right corner, a bright yellow sun is partially visible. A large, light blue pen nib is positioned diagonally across the middle of the frame. Below the pen nib, a dark blue, rounded rectangular banner contains the text "Thank You- Questions?".

Thank You- Questions?