Remote Patient Monitoring Application for Android

Project Need:

Client Profile (Under NDA) was seeking a remote patient monitoring system, a healthcare domain product. They had an idea of building a product which will integrate seamlessly with advanced electronic healthcare devices and gather patient’s medical information periodically and send it to remote locations for live and analytical monitoring.

The project’s objective was to develop a mobile application which will collect data from electronic devices, display the same and sync the important information to server. A web application was to be developed for displaying the collected information at remote locations.

How we achieved it:

We suggested using native application development for Android based devices and PHP, Zend framework for developing the web application and associated web-services.

We used SCRUM methodology to develop the entire product.

Development Approach:

Instead of traditional Waterfall approach of documenting the requirements and then getting into the software development life cycle, we used Agile SCRUM methodology for faster development:

1. Customer prepared Product backlog with appropriate priorities and assigned a Product Owner to the project.
2. e-Zest formed a team and appointed the SCRUM Master to analyze the Product backlog and conduct Sprint planning.
3. Sprint 1 scope was estimated and finalized and approved by the Product owner.
4. Sprint 1 was then initiated and both Android and Web teams worked together to achieve the end deliverables
5. On completion of Sprint 1, a review session with customer was conducted.
6. Based on the Sprint 1 review feedback and the next priority items in the Product backlog, Sprint 2 scope was estimated and finalized.
7. This process continued for 4 sprints until all the items from the Product backlog were implemented.
8. The product was then released for beta testing.
High Level Architecture

Business Benefits

The developed application allows patients and care takers in the hospitals to monitor the health status of the patient using the easy to understand UI developed for Android application. Alerts, reminders and emergency notifications for vital measurements help doctors to take timely decisions in emergency situations. Doctors can monitor the patient’s status at all the time using the web interface at any remote location as android application keeps syncing the test data using the web services with application server. Web app also works as reporting tool where one can view all the history for the patient’s test performed over the period. High level goal will be achieved when patient’s at remote places can be monitored without physical presence of the specialist professionals at given locations.
Devices Integrated (Phase 1):

1. **FORA d15:**
   The FORA D15b is dual function: blood glucose and blood pressure meter is designed for monitoring blood glucose and blood pressure levels. It has an oversize display with large numbers. The arm cuff adjusts to fit the users arm for comfortable inflation.

   **Device features**
   - Large LCD display and readout.
   - Comfortable arm cuff (9.4" - 13.8" std, optional 12.7" - 17.3").
   - Blood pressure accuracy: ± 2%. Heart rate accuracy: ± 4%
   - 352 test memory sets with date & time.
   - Bluetooth data output capability.
   - Code set by code card included with strips.
   - Keytone warning over 240 mg/dL blood sugar.
   - Requires only 0.7 µL blood sample and 7 seconds to test

   **Used for:**
   - Blood Glucose Measurement
   - Blood Pressure Measurement

2. **Zephyr HxM BT:**

   The HxM™ BT combines Zephyr's patented BioHarness™ smart-fabric heart rate technology used in high-end professional markets, with speed and distance in a small, comfortable consumer device.

   **Device features**
   - Heart Rate range 30 240 BPM
   - Other parameters Heart R-R, Speed, Distance, Strides

   **Used for:**
   - Heart Rate Measurement
   - RR Interval Measurement
High Level Feature list:

Mobile Application:

1. User Authentication
2. Patient’s health monitoring calendar scheduled by doctor
3. Health Monitoring
   - Blood Glucose Measurement
   - Blood Pressure Measurement
   - Heart Rate Measurement
   - RR Interval Measurement
4. Notations (patient experience) while taking measurements
5. Help Section

Web Application (Remote Monitoring):

1. Patient Search
2. Vital Signs (Set thresholds for each measurable parameter)
3. Sessions (details for each parameter measured as per the calendar)
4. Set Calendar for patients
5. Notations (patient’s experience while recording the readings)
6. Graphs
7. Stats
8. Messages (Instructions for patients)
9. Demographics
Mobile UI Screens:

**Authentication**
- Sonia
- Teixeira
- 11-25-1976
- MRN
- Save
- Cancel

**Calendar**
- Heart Rate
  - 11:00:00
  - 11:30:00
  - 11-10-22
- Heart Rate
  - 11:00:00
  - 11:30:00
  - 11-10-21
- Heart Rate
  - 11:00:00
  - 11:30:00
  - 11-10-20
- Heart Rate
  - 11:00:00
  - 11:30:00
  - 11-10-19
- Heart Rate
  - 11:00:00
  - 11:30:00
  - 11-10-18

**Help**
- Getting started
- Additional Features
- Frequently Asked Questions
- Additional Resources
- About HealthMob Inc

**Monitoring Session**
- Sensor: Zephyr HxM
- Status Message: Connected
- Connect
- Show Stats
- Heart Rate: 117 bpm
- Instant Speed: 2.45 mph
- Monitoring
- Stop
- Record Duration: 48 sec

**Monitoring Session**
- Sensor: ForaD15b TaiDoc-BTM
- Status Message: Not Connected
- Read Data
- Show Stats
- Blood Pressure(SYS): 125 mmHg
- Blood Pressure(DIA): 87 mmHg
- Glucose: 000 mg/dL
- Pulse: 90 1/min

**Notes**
- I am inserting a note for me about something, up to 100 characters, this message is 100 characters long.
- Save
- Reset

Contact:
- info@e-zest.net
- www.e-zest.net
Web Portal UI Screens:

1. Patient Search

   **Search for Patient**

   Patient: [Insert MRN or Last, First Name] OR
   Date of Birth: [mm-dd-yyyy] Select Patient from list

   **Hello Dr.Watson**

   Today's date is: **12-20-2011**
   and you have:
   - 700 Monitored Patients
   - 0 Emergency Events
   - 3 Notifications

2. Doctor can set the threshold values to trigger a notification/alert for each patient.
3. Doctor can view sessions recorded & missed as per the schedule with notations.

4. Doctor can set the calendar for each patient. Calendar entries will be synced with mobile client.
5. Note entered by patients while taking measurements.

6. Data obtained from the electronic devices for each measurable parameter during a session.

Select one session on the left to see the corresponding Raw Data.
7. Graphs

Vital Signs | Sessions | Calendar | Notations | Raw Data | Graphs | Stats | Messages | Demographics

**Patient: Joe Doe**

**Patient MRN:** 1235674  
**Monitoring Start Date:** 2011-05-10  
**Monitoring End Date:** Open  
**Current Status:** Active

**Total Scheduled Sessions:** 145  
**Completed Scheduled Sessions:** 4  
**Missed Scheduled Sessions:** 85  
**Patient Recorded Sessions:** 23

Select one or more sessions on the left in order to plot the graph.

![Heart Rate Graph](chart.png)

8. Session Statistics

Vital Signs | Sessions | Calendar | Notations | Raw Data | Graphs | Stats | Messages | Demographics

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<table>
<thead>
<tr>
<th>Session</th>
<th>Date</th>
<th>Start Time</th>
<th>Duration (HH:MM:SS/Readings)</th>
<th>Min. Heart Rate</th>
<th>Max. Heart Rate</th>
<th>Med. Heart Rate</th>
<th>Standard Deviation</th>
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<td>1st</td>
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<td>76</td>
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