Comprehensive Design Review

BabyGuard
Wearable & Rich Featured Baby Monitoring and Safety System

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Group Members

Advisor
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Kiran

Yun Shi
What is the Problem?

- Large amount of missing children without instant alert

  According to the National Center for Missing and Exploited Children, roughly 800,000 children are reported missing each year in the United States -- that's roughly 2,000 per day. Of those, there are 115 child "stranger abduction" cases each year, which means the child was taken by an unknown person.


- Lack of tools for timely detecting the body temperature of a baby

- Current products in the market do not have multi-functional features
Current Solutions and Constraints

- **Product A- Wireless Baby Monitor (Vvcare-851)**
  - Monitoring ambient temperature / Bidirectional voice and video interaction
  - *Only works with fixed camera location*

- **Product B- Mini Smart Finder (Digoo DG-KF30)**
  - Wireless locator for kids
  - *Limited features without interaction*
  - *Too small to be carried by baby and may lead to suffocation*

<table>
<thead>
<tr>
<th>Feature</th>
<th>Product A</th>
<th>Product B</th>
<th>BabyGuard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Body Temp.</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Camera</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Distance alarm</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Wearable</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
<tr>
<td>Cost</td>
<td>US$74.33</td>
<td>US$ 4.71</td>
<td>To Be Confirmed</td>
</tr>
</tbody>
</table>


What is BabyGuard?

- Low cost array of wearable sensors collects a baby's body temperature
- Provides real-time feedback and tracks long term physical movement and temperature data
- Uses a home-mounted server to provide interaction between parents and a baby
System Requirements

Wearable Device

➢ Mounted with sensors and connects to Android app or Home Server via BT
➢ Real-time capture for temperature, acceleration and orientations sensor data
➢ Exposes SDK and ports for programming and development

PC

➢ Connects with wearable device to download sensor data
➢ Mounted with camera, speaker, LCD and microphone for interaction

Android App

➢ User interface to monitor and control wearable device
➢ Interacts with Wearable Device/PC to send/receive data from various sensors
Block Diagram

Wearable Device
- Temp. Sensor
- Accel. Sensor
- Gyro Sensor
- Bluetooth on/off

Data Handler/Forwarder
- Temp. Data
- Accel. Data
- Gyro. Data

A/V Encoder
- Video Data
- Audio Data

Camera
- Maurice

Microphone

Data Handler
- Temp. & Activity Data

A/V Decoder
- A/V Data

User Interface & A/V Player & Alarm
- Temp. & Activity Data

PC

Mobile Phone

Bluetooth Connection
Solution Design – PC

Detailed functionality of home server

- Installed inside baby room and connects to wearable device via Bluetooth and to the mobile phone via WIFI.
- Server sends video/audio of baby to parent’s mobile phone through WIFI/Cloud
- Wearable device sends temperature of baby’s body temperature through Bluetooth to board
Solution Design - Wearable

Detailed functionality of wearable device.

- Small and compact device worn on wrist or ankle.
- Connect via Bluetooth to the mobile phone or home server and transmit temperature data of the body temperature periodically (1s) to the mobile app or home server.
- Alarm if Bluetooth connection broken with mobile phone and home server not reachable by *flashing light/sound.*
Solution Design - Wearable

- Temperature Sensor
- Accelerometer Sensor
- Gyroscope Sensor
- On/OFF
- CPU
- Coin Cell Battery
# Hardware Specification Table

<table>
<thead>
<tr>
<th>Wearable Device*</th>
<th>Dimension</th>
<th>– Diameter: 0.94in / 24mm</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>– H: 0.24in / 6mm</td>
</tr>
<tr>
<td>Weight</td>
<td></td>
<td>– 5.6gms</td>
</tr>
<tr>
<td>Connectivity</td>
<td></td>
<td>– Bluetooth LE 4.0 – 2.4Ghz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– Up to 100ft of range – typical 10m</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– Stream sensor Data from 1 Hz to 100 Hz</td>
</tr>
<tr>
<td></td>
<td></td>
<td>– Log sensor Data from 1 Hz to 400 Hz</td>
</tr>
<tr>
<td>Temperature</td>
<td></td>
<td>– -40…85°C Range</td>
</tr>
<tr>
<td>Battery</td>
<td></td>
<td>– 200 – 220mAH CR2032 Coin cell battery</td>
</tr>
<tr>
<td>Home server</td>
<td>Windows PC</td>
<td>Windows 10 OS</td>
</tr>
<tr>
<td>Mobile Device</td>
<td>Android</td>
<td>Android 4 and above</td>
</tr>
</tbody>
</table>

*Specification are from product description chart of Metawear C device
Bluetooth Signal Strength Test (W/O Objection)

*dBm is the power ratio in decibels of the radio power per one milliWatt. A signal of -60dBm is nearly perfect, and -112dBm is call-dropping bad.
Bluetooth Signal Strength Test (With Obstructions)

<table>
<thead>
<tr>
<th>Material</th>
<th>Bluetooth Strength (-dBm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wood</td>
<td>33</td>
</tr>
<tr>
<td>Metal (Alum.)</td>
<td>59</td>
</tr>
<tr>
<td>Glass</td>
<td>54</td>
</tr>
<tr>
<td>Concrete</td>
<td>64</td>
</tr>
</tbody>
</table>
IoT Device Data Accuracy Test - Temperature

![Temperature Graph](image)

- BabyGuard Sensor
IoT Device Data Accuracy Test - Activity

Baby Active Level Indication

![Graph showing Baby Active Level Indication over time. The x-axis represents time in hours from 0:00 to 23:00, and the y-axis represents Relative Motion Amplitude from 0 to 100. The graph indicates peaks and troughs, suggesting active and inactive periods.]

Department of Electrical and Computer Engineering
## IoT Device Battery life Testing

<table>
<thead>
<tr>
<th>Streaming</th>
<th>Battery Lifetime</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Continues</td>
<td>7 days</td>
<td>Realtime streaming to App/PC</td>
</tr>
<tr>
<td>Intermetant</td>
<td>10 days</td>
<td>Connected to device but intermittent data streaming</td>
</tr>
<tr>
<td>Idle</td>
<td>30 days</td>
<td>Connected to App/PC but no streaming</td>
</tr>
</tbody>
</table>
Solution Design – PC Interface

DEVICE

nShi
F8:D3:03:50:5F:FB

→ Devices Information

SESSIONS

nShi 4
2018-10-20T23:16:42.461

→ Received Data
Solution Design – PC Interface

![Graph showing temperature changes over time with a green thermistor line.](image)
Solution Design - Android APP

- Android application designed in Android Studio
- Retrieves real-time data from wearable
- Contains 3 pages
  - Accelerometer
  - Gyro
  - Temperature
Solution Design - Android APP

[Left Image: BabyGuard
Select Device
MetaWear
C6:4E:94:72:C8:C4
-80 dBm

Right Image: Device Information
Manufacturer: BoduGuard Team
Model Number: 1
Serial Number: 000000
Firmware Revision: 1.0.0
Hardware: 0.1
Revision
MAC Address: C6:4E:94:72:C8:C4

Battery Level
Led
RED ON
GREEN ON
BLUE ON
OFF]
Solution Design - Android APP

- **Temperature**
  - Start Sampling
  - Clear
  - Save

- **Accelerometer**
  - Start Sampling
  - Clear
  - Save
  - Acceleration Range: ±2g

- **Gyro**
  - Start Sampling
  - Clear
  - Save
  - Rotation Range: ±125°/s
Proposed CDR Deliverables

- Wearable device connects main server and send temperature data periodically.

- Security implementation for data transmitted between wearable & phone.

- Home server/base station send monitoring image to cloud server.
Distribution of Responsibilities

**Kiran**
- Wearable hardware design
- Wearable device development, interfacing and programming
- Determine technical feasibility of the solution.

**Yun Shi (Jackie)**
- Establish connection detection among wearable and phone
- PC sever interface
- Create mobile app that displays the monitoring status
- Implement a website to illustrate BabyGuard
Thank you

Questions?