BabyGuard

Wearable & Rich Featured
Baby Monitoring and Safety System

March 8, 2018
What is the Problem?

This child, now 8 years old, never knew his real parents. He was a victim of kidnapping at only 1 year old after only 10 seconds of negligence by his parents.

Children missing/kidnapped each year

–200,000 kidnapped in China

–800,000 missing in the USA

Now thanks to IoT, BabyGuard can provide an alarm, at the most critical moment.

It will cover other dangers surrounding our children
What is the Problem? (Cont.)

- Burnt when playing fire
- Heatstroke when left alone in car in summer
- Fever
- Parent and baby cannot see/hear each other when far apart (Anxiety)
Current Solution and Constrain

- **Product A - Wireless Baby Monitor (Vvcare-851)**
  - Monitoring Ambient’s Temperature / Bidirectional voice and video interaction
  - *Only works according to fixed camera location*

- **Product B - Mini Smart Finder (Digoo DG-KF30)**
  - Wireless Anti-Lost Locator for Kids
  - *Limited Feature without interaction*
  - *Too small to be carried by baby and may lead to suffocate*

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

The solution (BabyGuard) includes a small wearable and a Server.

- Wearable device connects and sends temperature data to mobile phone if connected, if not then checks connection with main server if not found then alarms.
- Wearable device connects main server and send temperature data periodically.
- Home server/base station connects to mobile app if available through Wifi and send gathered data.
Our Solution (Cont’d)

Wearable Device

- Bluetooth
- Ambiance Temperature Sensor
- Body Temperature Sensor

DE01-SOC

- Camera
- Speaker
- Microphone

Android App

- BT and WiFi Dongle
  - Ext. Temp
  - Temp
System Requirements - The Wearable

- The small wearable must have Bluetooth, and be pre-paired with smartphone(s) and DE1-SOC(s)
- The small wearable will connect a pre-paired smartphone if within 10 meters
- When the small wearable loses BT connection to all its pre-paired devices, alarms: Smartphone and the wearable both beep, and flash light on mobile app and with warning message
- Send temperature of baby’s body & ambient to paired device (phone or DE1) every 2 seconds
- Smartphone alarms if baby’s body temperature exceeds threshold 38 Celsius degree, or baby’s ambient temperature exceeds 45 Celsius degree
- A small wearable can be worn on wrist
- Can be enclosed in a sleeve or covering so cannot be poked or swallowed

* Exact Numbers TBD
System Requirements - The DE1-SOC

- Can be fixed at home (one DE1 for one room)
- If the small wearable is not connected with phone, will connect the DE1 through Bluetooth within 10 meters
- On connection of the wearable, the DE1 will activate its camera/microphone and take video/audio, and connect pre-configured smartphone through WIFI
- DE1 will stream video/audio of baby to parent’s smartphone in real-time
- The DE1 will forward temperature of baby’s body & ambient to smartphone
- On parent’s pressing on a button/menu on Smartphone, the phone will send real-time video/audio of parents to DE1
- The DE1 has screen/speaker, and will play received video/audio of parents
Solution Design

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 transmits temperature data of the baby/ambience periodically (2s) to the mobile app or home server.
- Sends panic signals if baby or ambient temperature crosses threshold to the android app or home server.
- Alarms if Bluetooth connection broken with mobile phone and home server not reachable by *flashing light/sound.*

*Searching for devices with LED or Speaker*
Solution Design (Cont’d)

Detailed functionality of wearable device.

3-Axis Geomagnetic Field Sensor
BR1225 Battery Holder (back)
6-Axis Inertial Measurement Unit
Integrated Environmental Unit (Pressure, Temperature, Humidity)
Bluetooth Smart SoC DA14583 Dialog Semiconductor
On/Off switch
Connector to Programming Interface Board
Solution Design (cont.)

Detailed functionality of home server

- Installed inside baby room and connects to wearable device via Bluetooth and to the mobile phone via WiFi.
- Powerful with BT/WIFI/camera/microphone/screen/speaker
- When the wearable device connects the home server through Bluetooth, the server knows the baby is in this room, and activates its camera/microphone
- Server sends video/audio of baby to parent’s smartphone (for example in other room/office) through WIFI
- Wearable device sends temperature of baby’s body & ambient through Bluetooth to board, and the latter forwards to parent’s smartphone through WIFI
- Smartphone sends video/audio of parents to board, which plays on screen and speaker to calm down baby
Argument for Feasibility

Proposed solution
- solves conflict between wearable and rich features
- through dividing into following 2 parts

Wearable device
- Small and comfortable to wear
- Fewer sensors, needs smaller battery
- Safe with fewer sensors ruggedly attached and no loose ending parts
- Yet provides vital features: prevent baby missing or burnt/heatstroke

Home Server
- Interactive and always connected system
- Powerful, cover most features of other competitors
- can be extended to many new fancy ideas
● BT will transfer a dozen of bytes of temperature data every 2 seconds
● WIFI will transfer video @ 2.4Mb/s, and audio @ 128Kb/s for HD.
Hardware Selection

Below hardware components needed for the project.

**Wearable device**
Smart wearable wireless temperature sensor ➔ DigiKey Low Energy Bluetooth IoT sensor device.

**Home server / base station**
Powerful computer board DE01-SOC
Camera, microphone, speaker, LCD display, Bluetooth and Wifi dongle.

**Android mobile phone**
Sensors

Wearable device
- Temperature sensors
- Bluetooth connector

Home Server
- Camera
- Microphone
- Speaker
- LCD display
- Bluetooth/Wifi connectors
Camera/Audio/Video/Speaker on DE1

- Camera on DE1 pointing direct to the front

- On connection of the wearable, the DE1 will activate its camera/microphone and take video/audio

- On receiving video/audio from parents, the DE1 will play on its screen and speaker

- Extended through USB dangles
APP User Interface

- Android Application for Phone
- Display and/or Track Baby’s Location
- 2-way Audio and Video Interaction via Phone
- Real-Time Interaction by Using Built-In Camera
- Allow for Notification of Body and Ambient Temperature
Challenges

**Wearable device**
- Miniaturizing the devices as small and compact as possible and water proofing.
- Error correction and distinguishing temperature sensor data before forwarding.
- Self issue detection like failure of any components and sensors.
- Auto Bluetooth connection priority first to home server and then to mobile phone.

**Home Server**
- Provide reliable connections between wearable and mobile device.
- Efficiently gather requested data and forward to mobile phone.
- Self issue detection like failure of any components and sensors.
- Powerful to multitask and respond efficiently.
## Estimated Costs

<table>
<thead>
<tr>
<th>Item</th>
<th>Estimated Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluetooth Dongles</td>
<td>¥ 100</td>
</tr>
<tr>
<td>Temp. Sensor</td>
<td>¥ 60</td>
</tr>
<tr>
<td>DigiKey Low Energy Bluetooth</td>
<td>¥ 200</td>
</tr>
<tr>
<td>DE-1 Board</td>
<td>Provided</td>
</tr>
<tr>
<td>Video Sensor</td>
<td>¥ 25</td>
</tr>
<tr>
<td>Audio Sensor</td>
<td>¥ 50</td>
</tr>
<tr>
<td>Android Device</td>
<td>¥ 2000 (Testing Purpose)</td>
</tr>
<tr>
<td><strong>TOTAL COST</strong></td>
<td>¥ 435 (US$70)</td>
</tr>
</tbody>
</table>
**Distribution of Responsibilities**

**Tony**
- DE1’s BT/WIFI communication with other 2 devices
- Make sure the Bluetooth connection between DE1 and wearable doesn’t raise a false alarm
- DE1 and its camera/microphone/screen/speaker development

**Kiran**
- Work on Hardware design
- Wearable device development, interfacing and programing
- Determine technical feasibility of the solution.

**Yun Shi (Jackie)**
- Establish connection detection among DE-1 board, wearable and phone
- Create mobile app that displays the monitoring status
- Implement a website to illustrate BabyGuard
Goals of MDR

- Establish connection between the wearable and laptop
- The wearable sends temperature data to laptop
- The laptop forwards temperature data to Smartphone
- Smartphone shows temperature data in GUI

(We use a laptop instead of the DE1 to ease development for MDR demo)