BabyGuard

Wearable & Rich Featured
Baby Monitoring and Safety System

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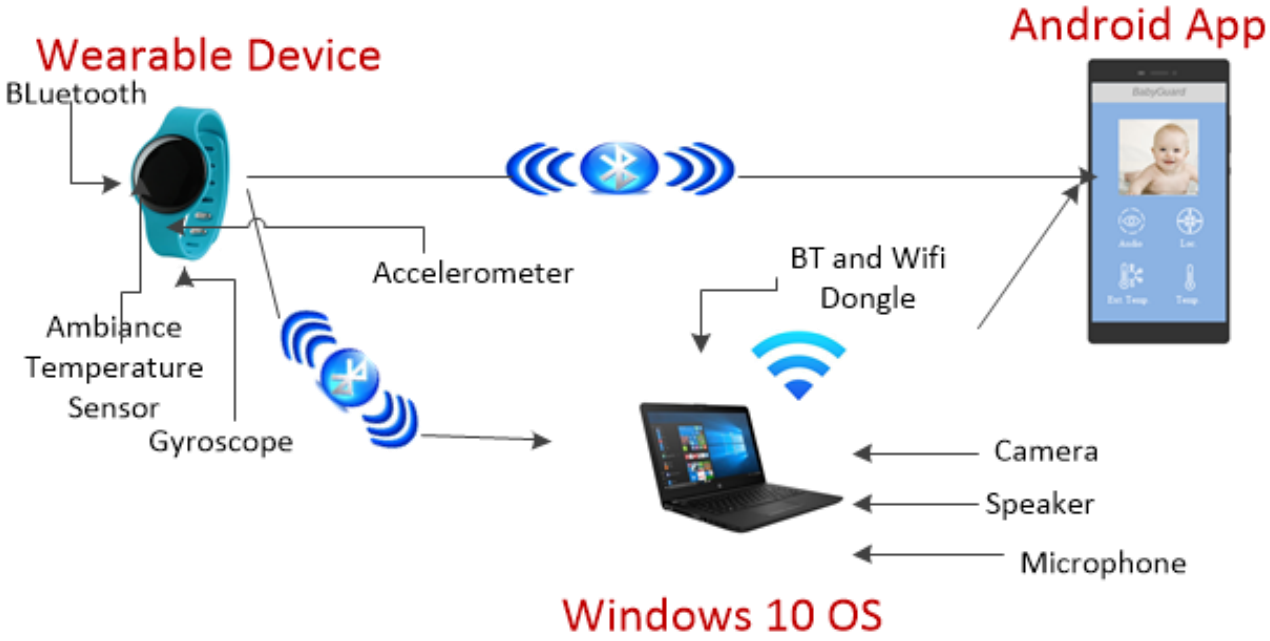
What is the Problem?

- The rate of missing and kidnapping children has become higher in China and the US in recent years
- The tools for detecting the ambient temperature of a baby may not be timely
- Current products in the market do not have multi-functional features that can monitor a baby's physical status using two parties interaction

What is BabyGuard?

- Low cost array of wearable sensors collects a baby's ambient 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

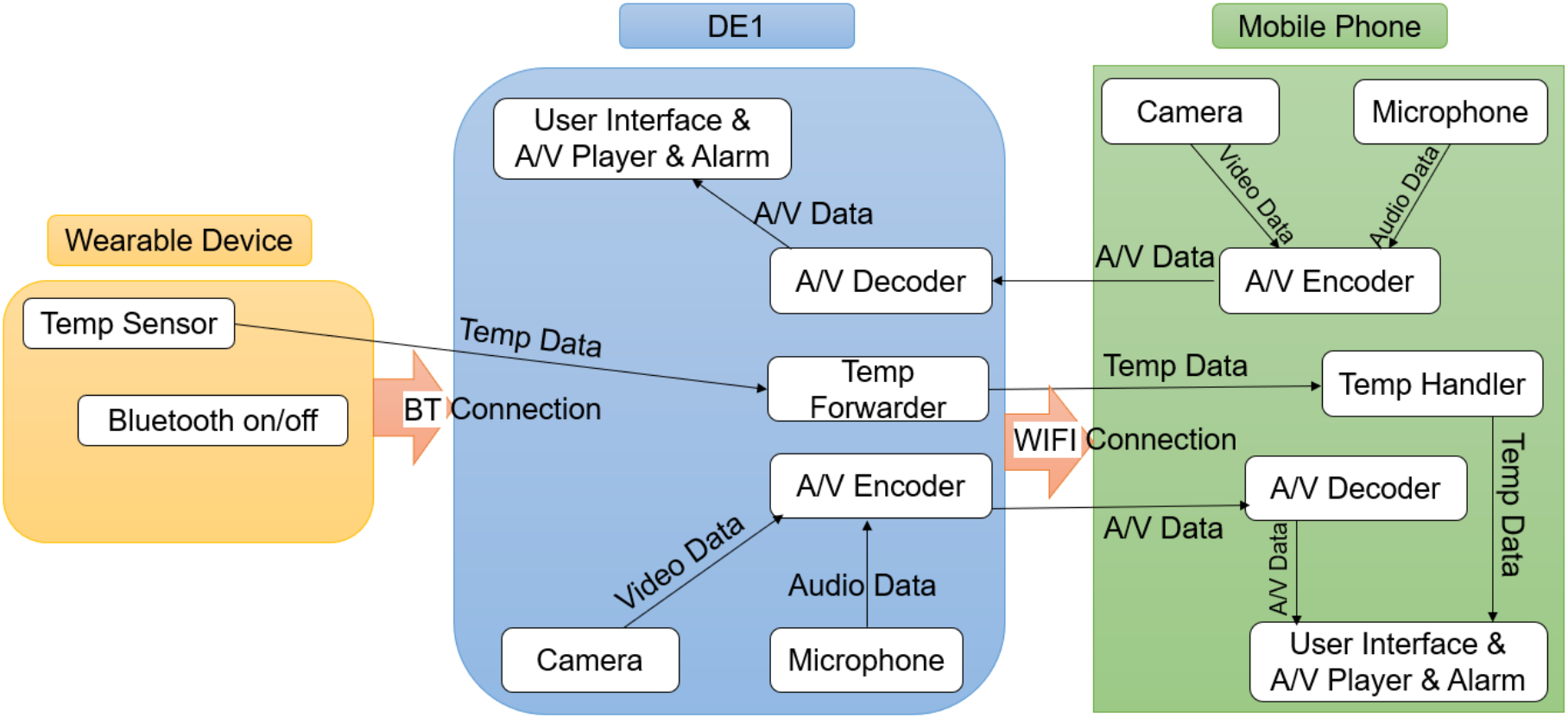
DE1-SOC/PC

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

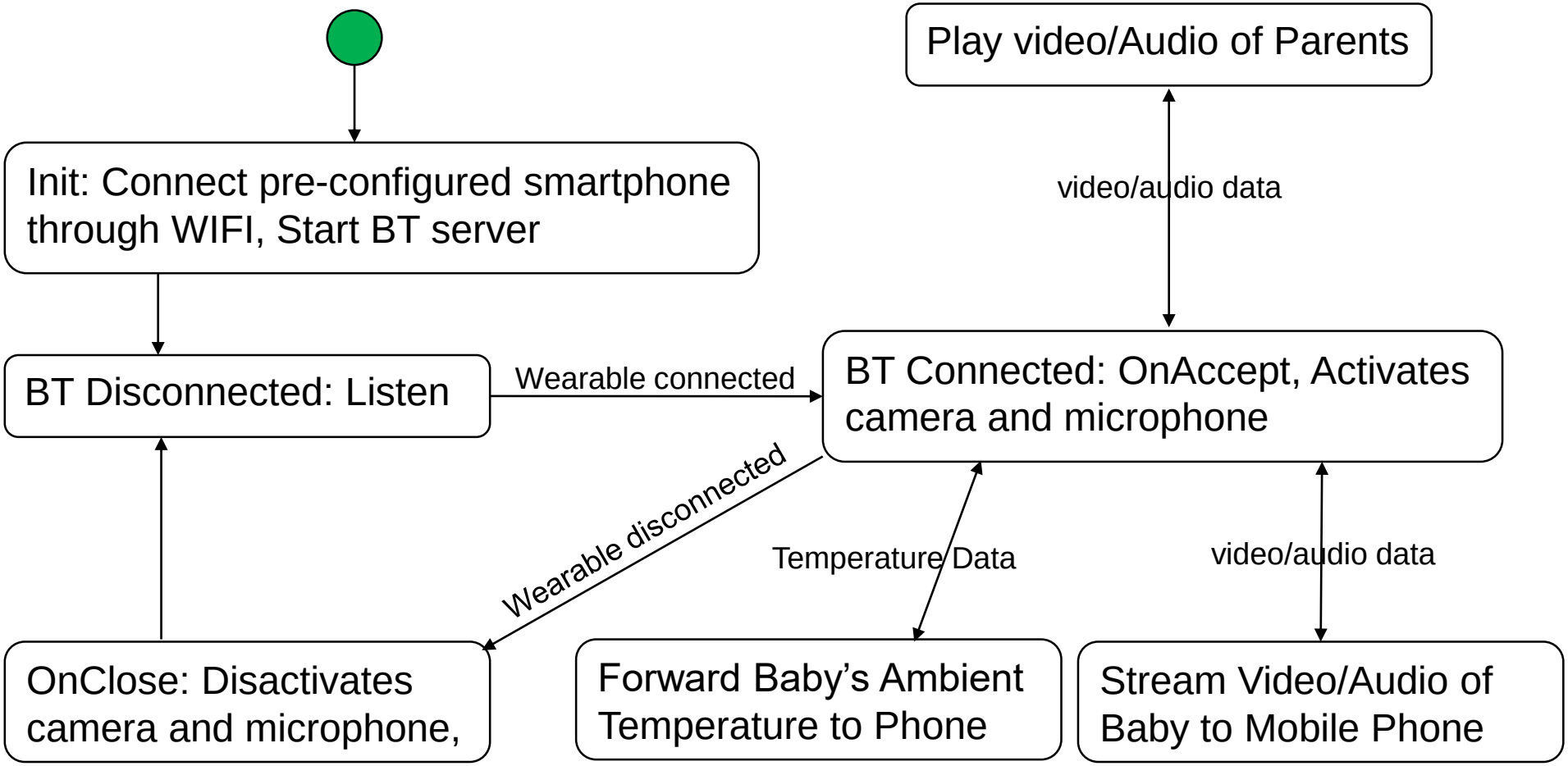
Android App

- User interface to monitor and control wearable device
- Interacts with DE1-SOC/PC to send / receive data from various sensors

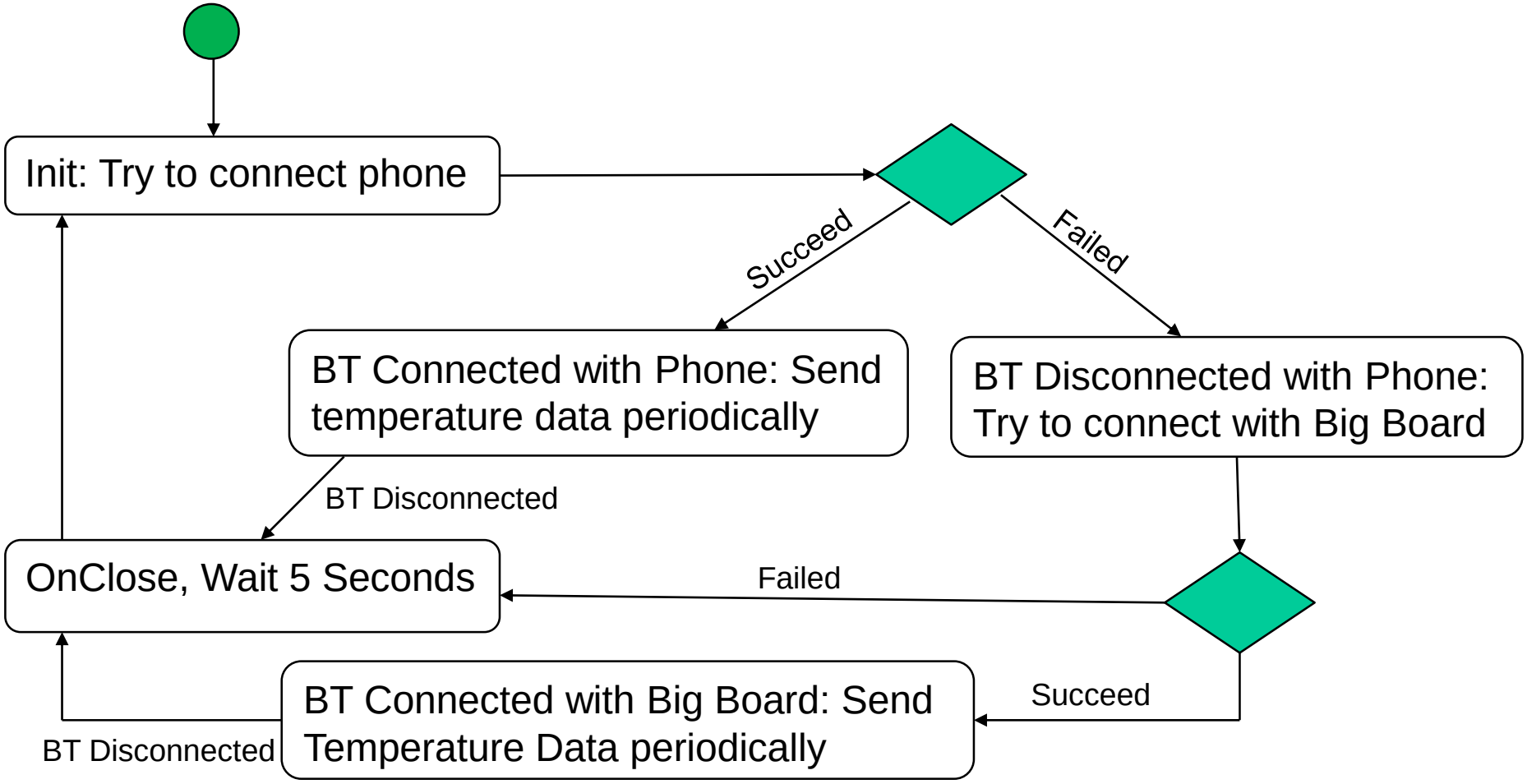
Redesigned Block Diagram



State Chart (DE1)



State Chart (Wearable)



Solution Design – DE1-SOC

Detailed functionality of home server

- Installed inside baby room and connects to wearable device via Bluetooth and to the mobile phone via Wifi.
- Powerful - includes 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 ambient temperature through Bluetooth to board, and the latter forwards information to parent's smartphone through WIFI
- Smartphone sends video/audio of parents to board, which plays on screen and speaker to calm down baby

Solution Design – DE1-SOC

- Camera on DE1 pointing direct to the front
- On connection to the wearable, the DE1 activates its camera and microphone and take video and audio
- On receiving video/audio from parents, the DE1 will play on its screen and speaker
- Extended through USB dongles

Data received by MetaBase App on Win10

	A	B	C	D
1	epoch (ms)	time (08:00)	elapsed (s)	temperature (C)
2	1.52491E+12	2018-04-28T17:46:11.221	0	31.625
3	1.52491E+12	2018-04-28T17:46:12.223	1.002	31.625
4	1.52491E+12	2018-04-28T17:46:13.224	2.003	31.75
5	1.52491E+12	2018-04-28T17:46:14.214	2.993	31.75
6	1.52491E+12	2018-04-28T17:46:15.215	3.994	31.75
7	1.52491E+12	2018-04-28T17:46:16.216	4.995	31.75
8	1.52491E+12	2018-04-28T17:46:17.218	5.997	31.75
9	1.52491E+12	2018-04-28T17:46:18.219	6.998	31.75
10	1.52491E+12	2018-04-28T17:46:19.220	7.999	31.75
11	1.52491E+12	2018-04-28T17:46:20.222	9.001	31.75
12	1.52491E+12	2018-04-28T17:46:21.223	10.002	31.75
13	1.52491E+12	2018-04-28T17:46:22.224	11.003	31.75
14	1.52491E+12	2018-04-28T17:46:23.225	12.004	31.75

MetaWear_Tony_FA73_2018-04-28T1

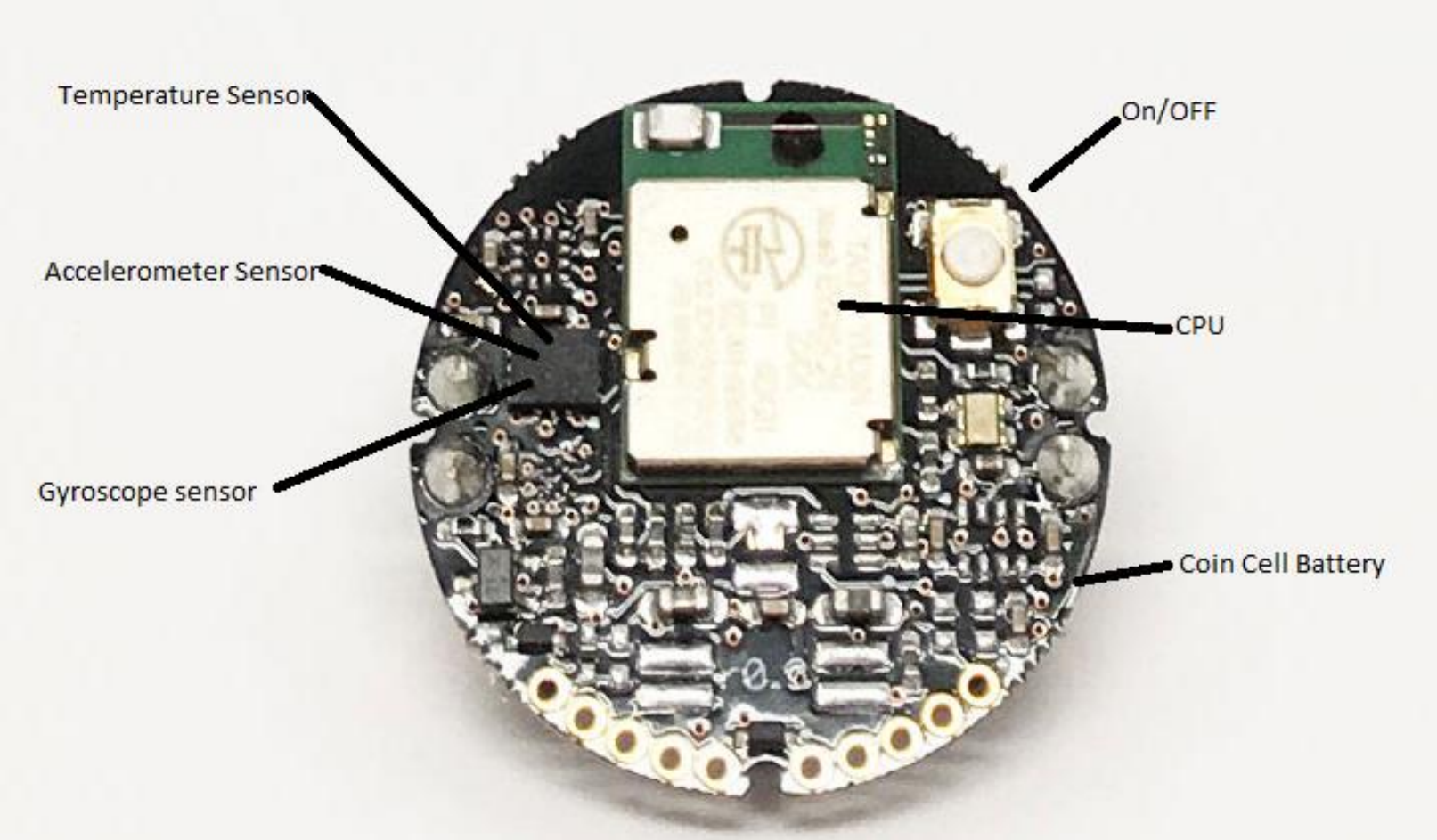
(Using a PC instead of DE1 for MDR)

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 ambient temperature periodically (2s) to the mobile app or home server.
- Sends alert signals to the Andriod app or home server if ambient temperature crosses threshold.
- Sounds alarm if Bluetooth connection broken with mobile phone and home server not reachable by **flashing light/sound*.

Solution Design - Wearable



Hardware Specification Table

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

*Specification are from product description chart of metawear C device

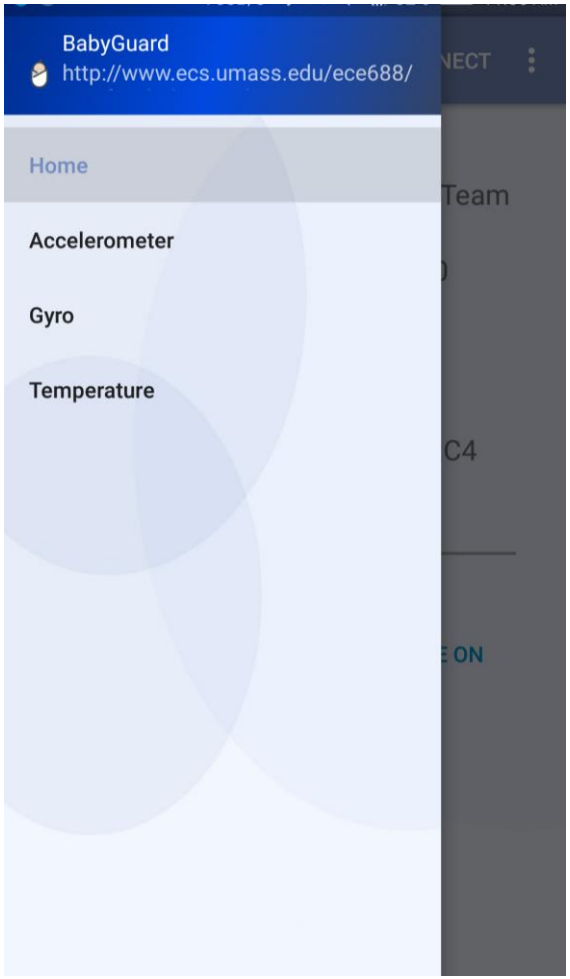
Bluetooth Strength and Battery life Testing

*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.

Distance(m)	Bluetooth Strength	Status	Remark
21	> -90dBm	No	Device disconnects
20	-79dBm	connected	Sensor data Transmission successful
15	-68dBm	connected	Sensor data Transmission successful
10	-50dBm	connected	Sensor data Transmission successful
5	-45dBm	connected	Sensor data Transmission successful
1	-42 bBm	connected	Data Accessible

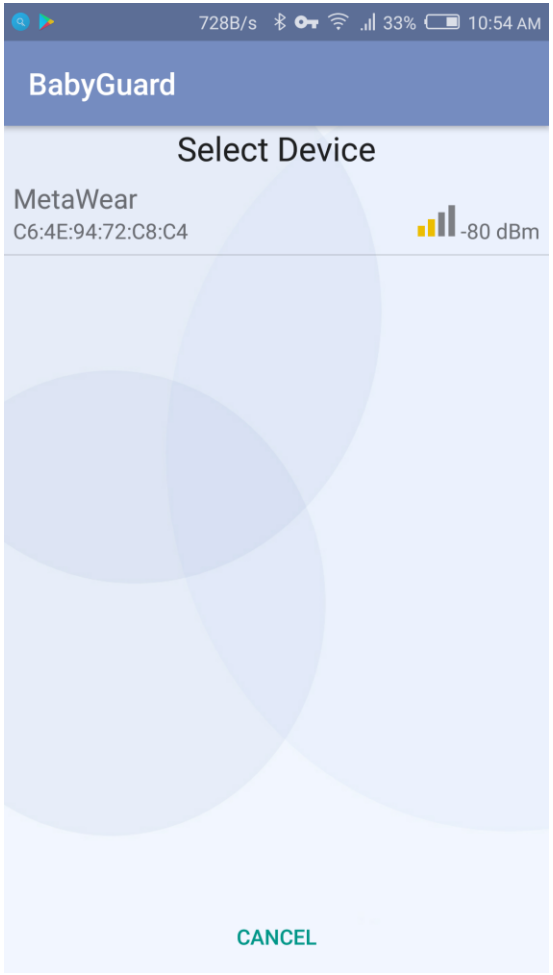
Streaming	Battery Lifetime	Remark
Continues	7days	Realtime streaming to App/PC
Intermetant	10days	Connected to device but intermittent data streaming
Idle	30days	Connected to App/PC but no streaming

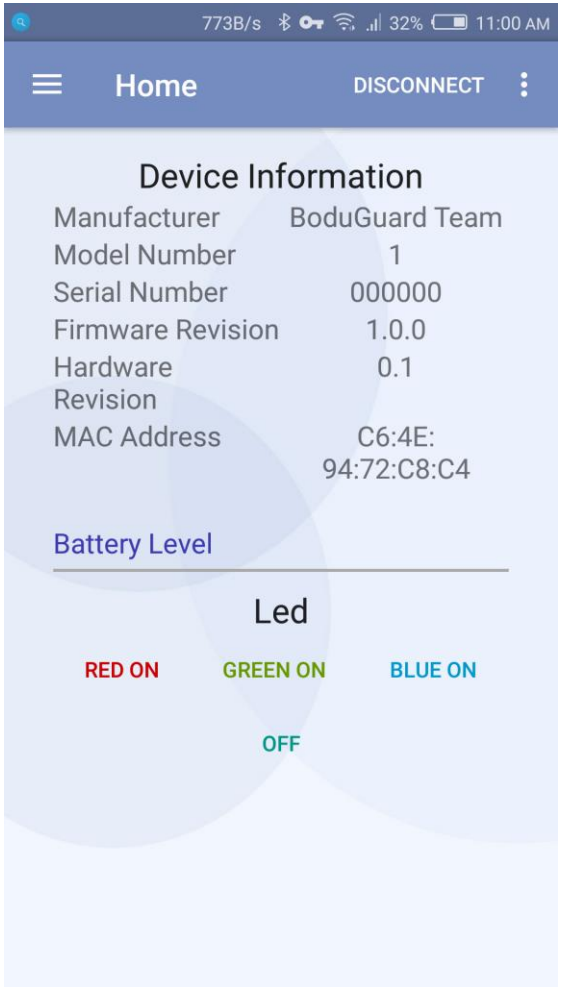
Solution Design - Android APP



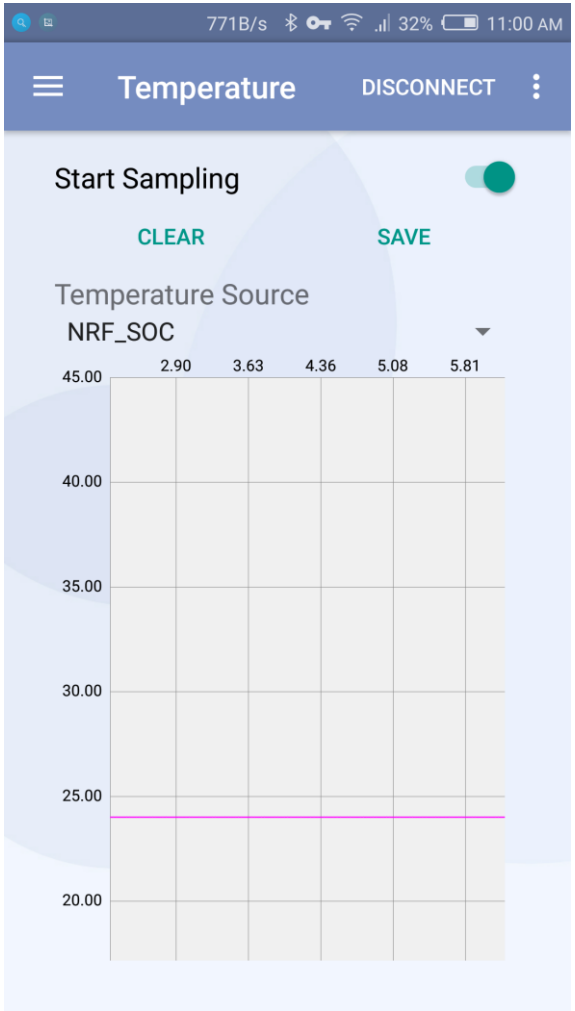
- Android application designed in Android Studio
- Retrieves real-time data from wearable
- Contains 3 pages
  - Accelerometer
  - Gyro
  - Temperature

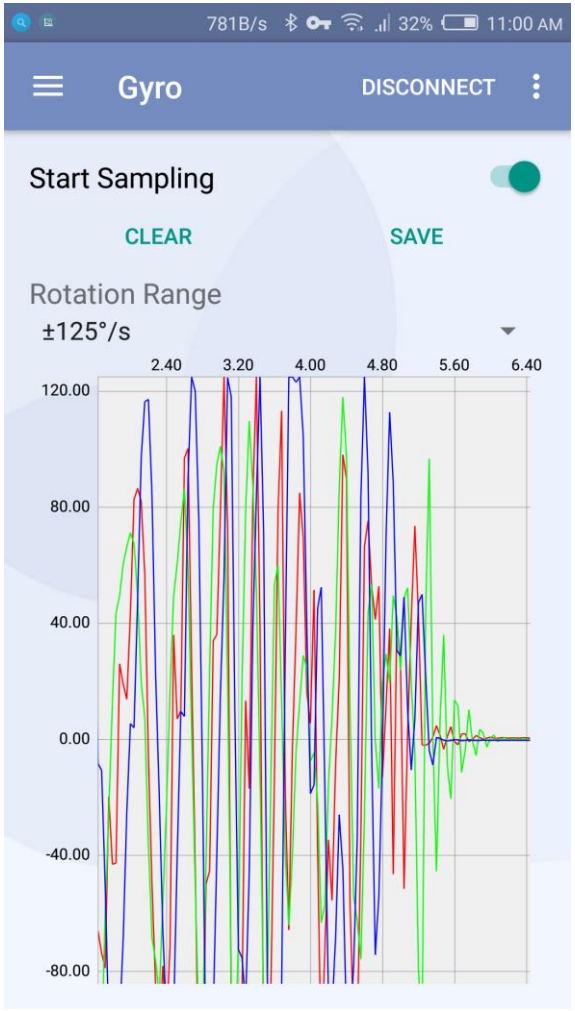
Solution Design - Android APP





Solution Design - Android APP





Proposed MDR Deliverables

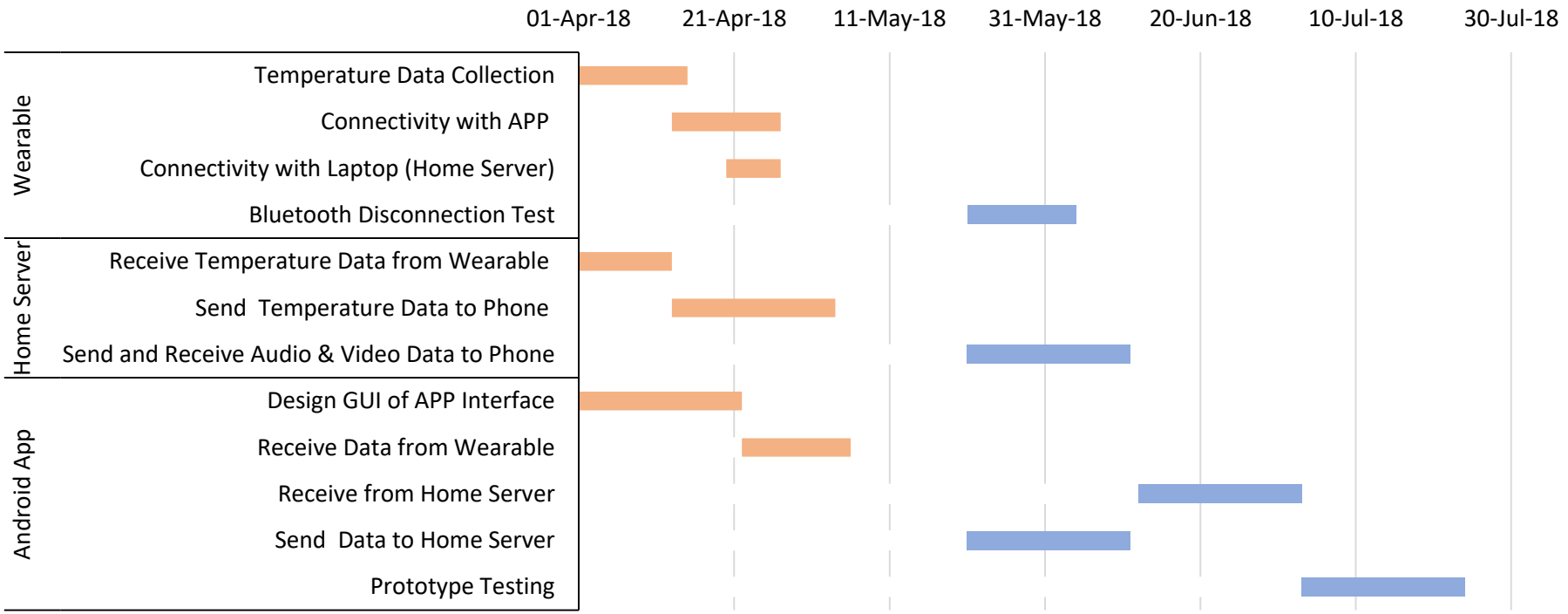
- Establish connection between the wearable and laptop 
- The wearable sends temperature data to laptop 
- The laptop forwards temperature data to Smartphone
- Smartphone shows temperature data in GUI 

In general, we have build a platform which will be able to use as a foundation to implement the rest of our project.

Proposed CDR Deliverables

- Implement notification method when connection is lost between wearable and phone
- 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.
- Phone alarms when ambient temperature above threshold
- Migrate to DE1 from PC

Gantt Chart


01-Apr-18
21-Apr-18
11-May-18
31-May-18
20-Jun-18
10-Jul-18
30-Jul-18
Wearable
Temperature Data Collection
Connectivity with APP
Connectivity with Laptop (Home Server)
Bluetooth Disconnection Test
Home Server
Receive Temperature Data from Wearable
Send Temperature Data to Phone
Send and Receive Audio & Video Data to Phone
Android App
Design GUI of APP Interface
Receive Data from Wearable
Receive from Home Server
Send Data to Home Server
Prototype Testing

Distribution of Responsibilities

Tony

- DE1's BT/WIFI communication with other 2 devices
- Make sure the Bluetooth connection between DE1 and wearable does not raise a false alarm
- DE1 and its camera/microphone/screen/speaker development

Kiran

- Wearable 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

Thank you

Questions?