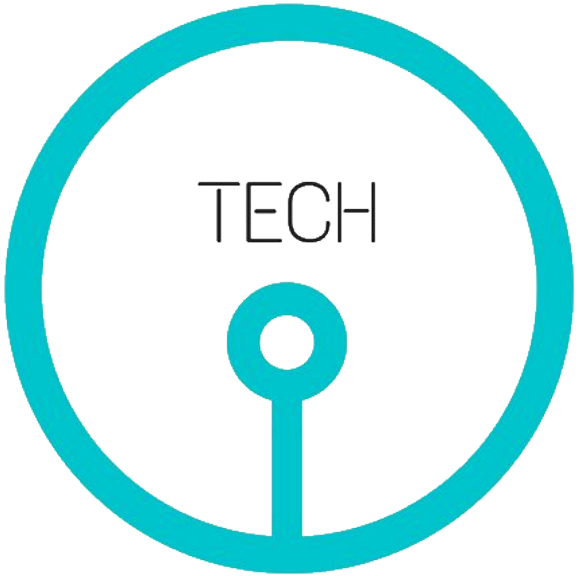
IoTECH*

*Internet of Things Extensible Car Hub

CDR Presentation



The IoTECH Team

Chris Ingerson
CSE

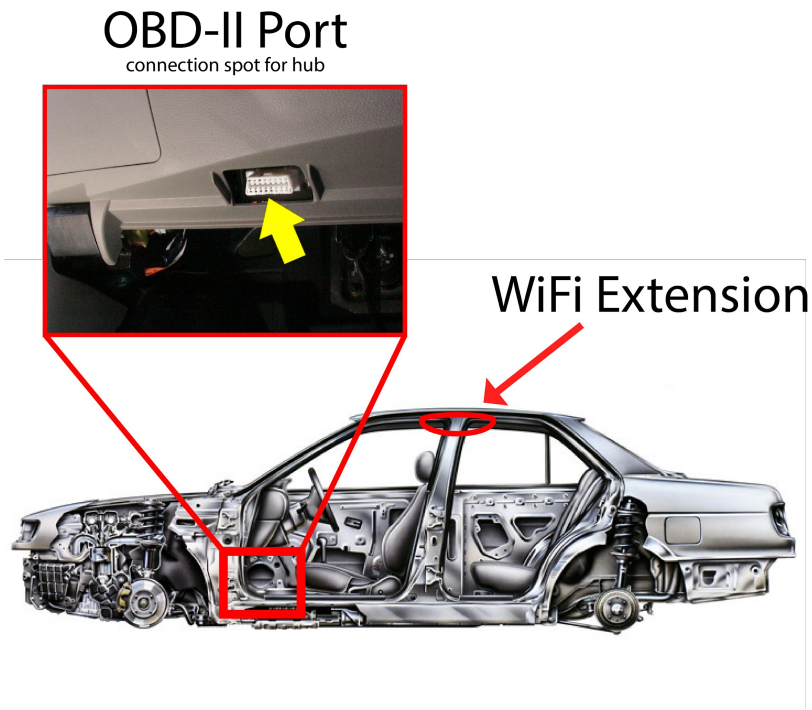
Nick Korniyenko
EE

Nigel Paine
CSE

Raghid Bahnam
EE

Prof. Jay Taneja
Advisor

IoTECH - Problem Statement & Recap



Problem:
Most current IoT devices don’t extend beyond the home with WiFi applications. Very few automotive IoT devices on the market!

- “Smart Hub” - IoT Device
- Interface with OBD-II Port & External Sensors
- 3G/WiFi/Bluetooth data transfer
- Many potential applications

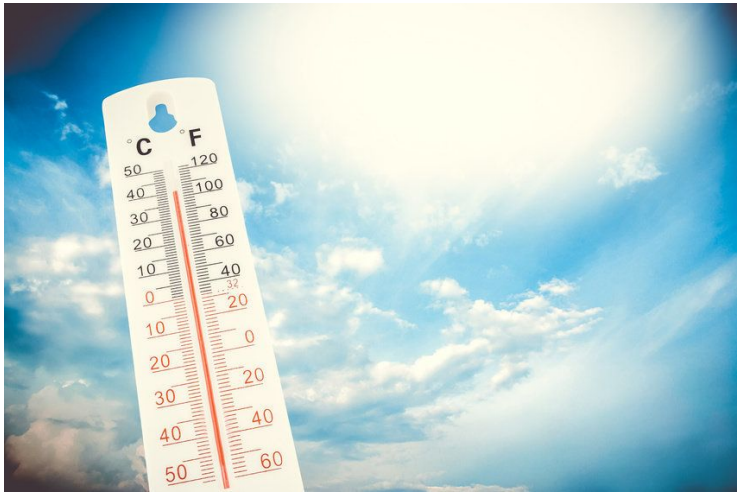
IoT Application: TempAlert

What does it do?

- Sense temperature and motion
- If threshold reached and motion detected, send alert via 3G to server (IFTTT) to user

What’s “In-the-box”?

- PIR Motion Sensor
- Infrared Camera
- Temperature Sensor (OBD & Dedicated)
- Particle Electron (3G)
- Particle Photon
- Bluetooth



Iot Application: SpeedAlert

What does it do?

- Sense vehicle’s speed
- If threshold speed reached, send alert via 3G to server (IFTTT) to user

What’s “In-the-box”?

- OBD-II Data
- Particle Electron (3G)

CDR Deliverables

- ✓ PCB schematic designs finalized
- ✓ Bluetooth/WiFi communication between Hub & Extension
- ✓ Combined Hub & OBD circuits
- ✓ Add 1 more application beyond Temp Alert (i.e. SpeedAlert)

Extras & Goodies

- ✓ Prototype of Extension Enclosure
- ✓ Charging Circuitry

Team Member Contributions

- **Chris**
  - Hub/OBD-II Integration
  - Bluetooth Integration
- **Nick**
  - PCB Design for Extension
  - Added Circuitry to Charge Battery
  - Created Prototype for Extension Box

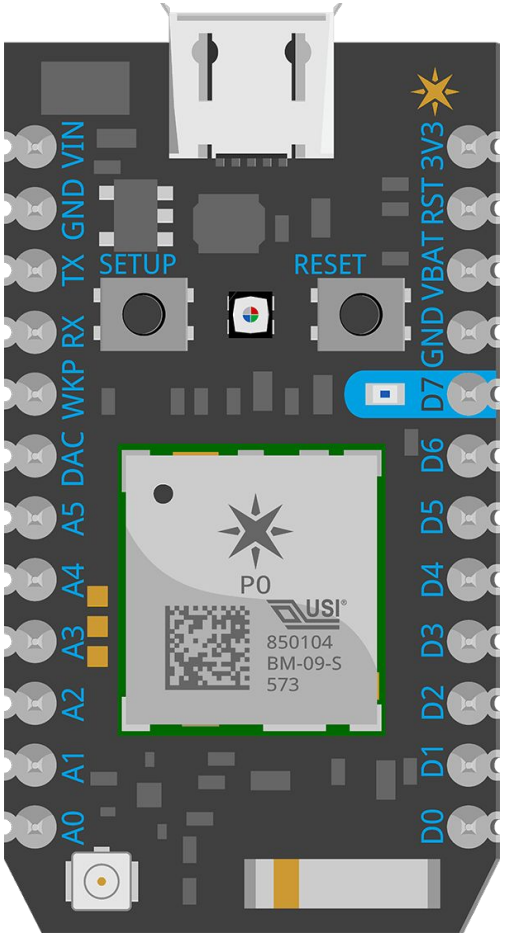
Team Member Contributions

- **Nigel**
  - Extension Integration
  - Bluetooth Integration
- **Raghid**
  - PCB Design for Hub
  - Integrate OBD II with Particle Electron

What Has Changed?

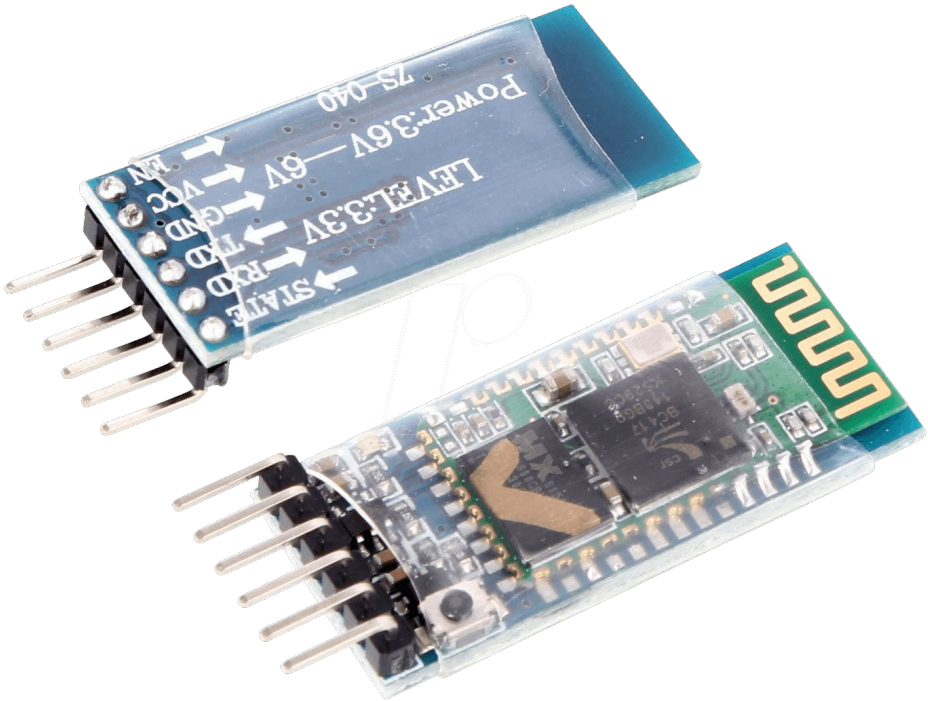
Particle Photon

- Uses Particle IDE
- Broadcom BCM43362 Wi-Fi chip
- 802.11b/g/n Wi-Fi
- STM32F205RGY6 120 Mhz ARM Cortex M3
- 1MB flash, 128KB RAM



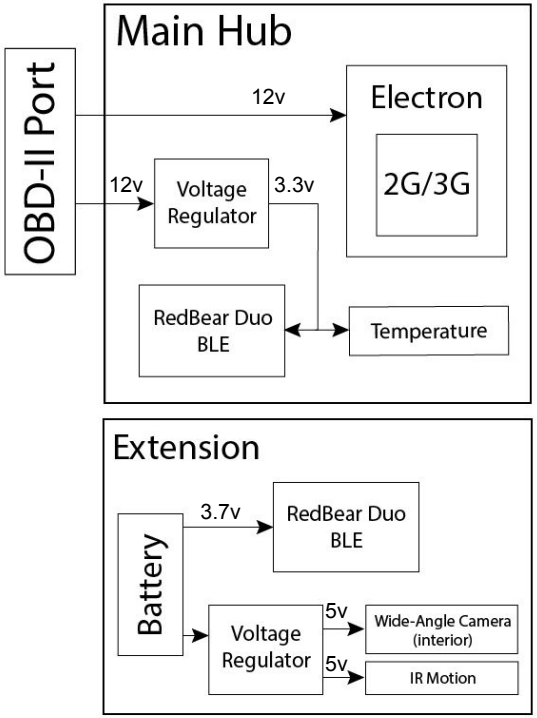
Bluetooth

- Using HC-05 Module
- Hub - Master
- Extension - Slave
- Serial Communication



Block Diagrams - Power

MDR:



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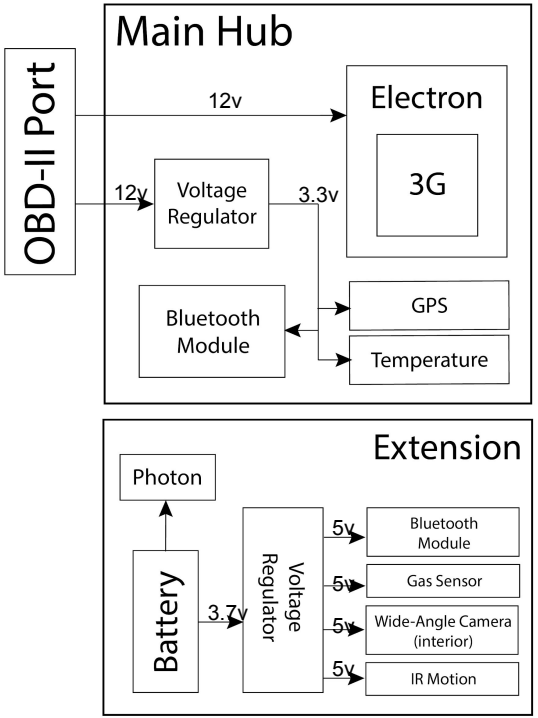
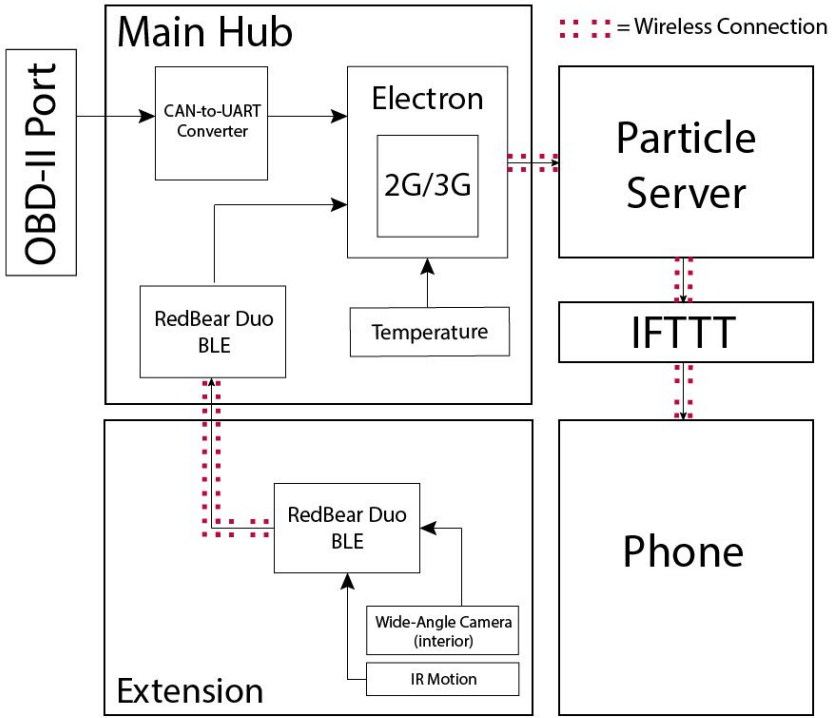
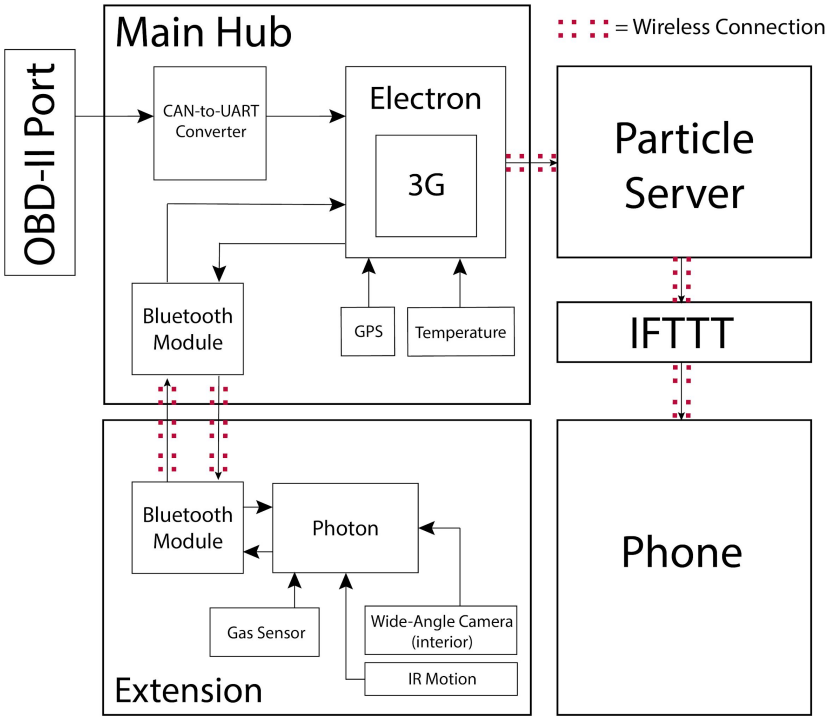


Block Diagrams - Signals

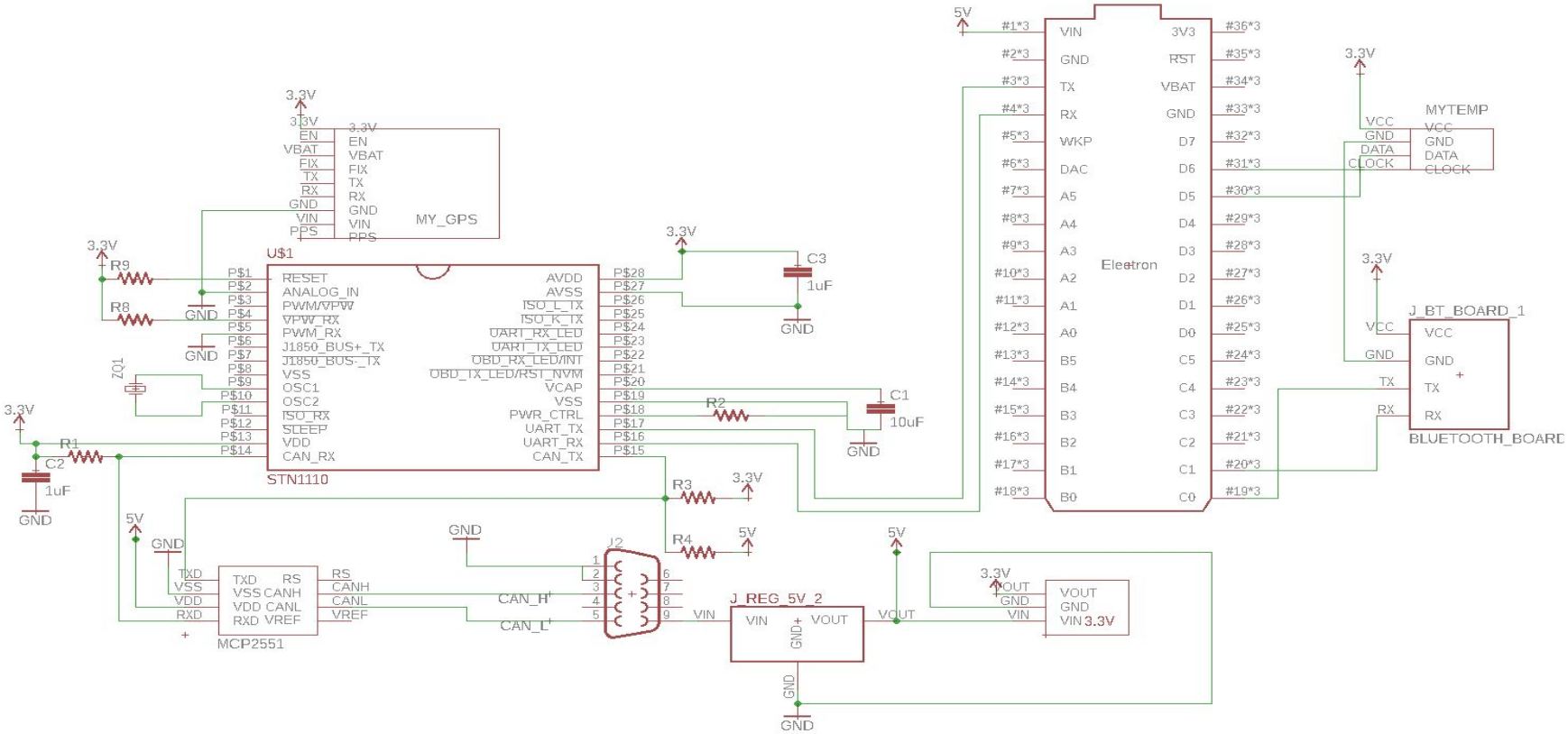
MDR:



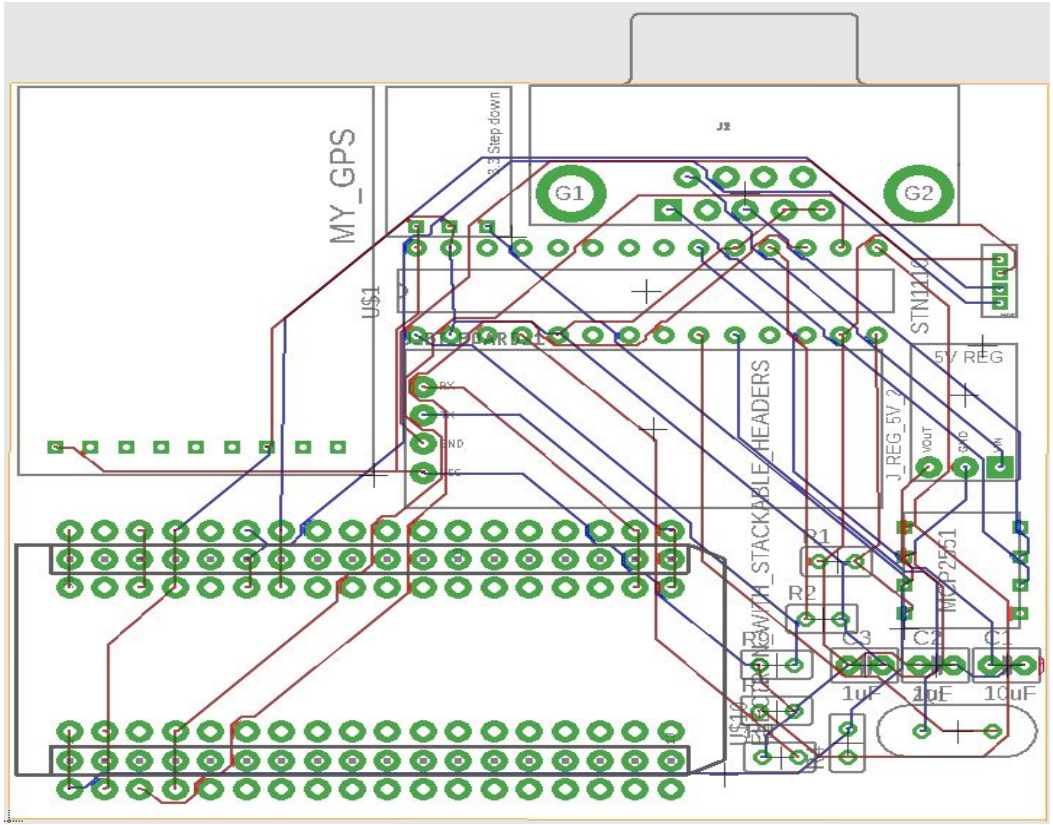
CDR:



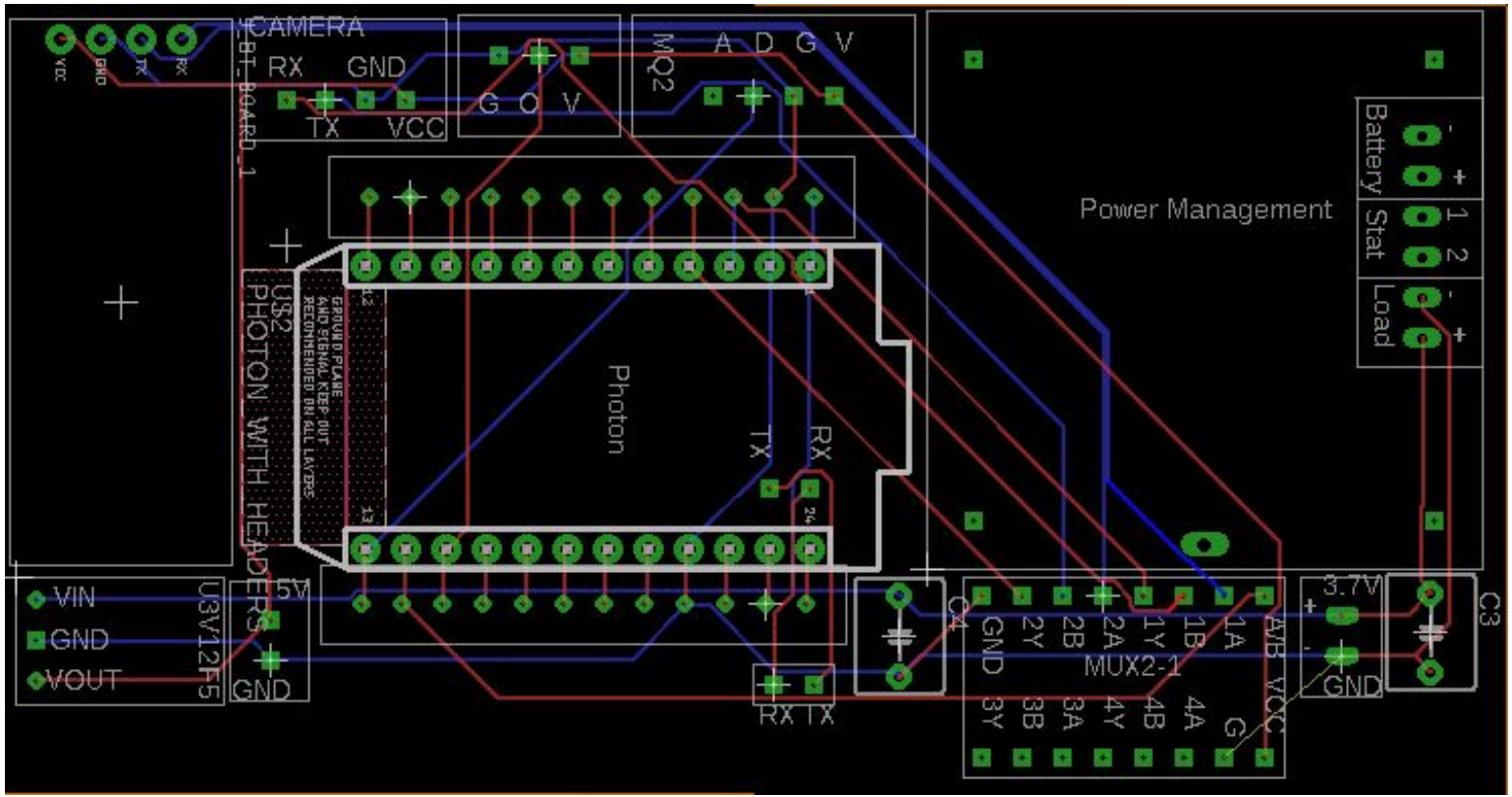
PCB Design


5V
3.3V
VIN
GND
TX
RX
WKP
DAC
A5
A4
A3
A2
A1
A0
B5
B4
B3
B2
B1
B0
3V3
RST
VBAT
GND
D7
D6
D5
D4
D3
D2
D1
D0
C5
C4
C3
C2
C1
C0
Electron
MYTEMP
VCC
GND
DATA
CLOCK
J_BT_BOARD_1
TX
RX
BLUETOOTH_BOARD
MY_GPS
EN
VBAT
FIX
PPS
U$1
RESET
ANALOG_IN
PWM/VPW
VPW_RX
PWM_RX
J1850_BUS+_TX
J1850_BUS-_TX
VSS
OSC1
OSC2
ISO_RX
SLEEP
VDD
CAN_RX
AVDD
AVSS
ISO_L_TX
ISO_K_TX
UART_RX_LED
UART_TX_LED
OBD_RX_LED/INT
OBD_TX_LED/RST_NVM
VCAP
VSS
PWR_CTRL
UART_TX
UART_RX
CAN_TX
STN1110
R1
R2
R3
R4
R8
R9
C1
10uF
C2
1uF
C3
1uF
ZO1
J2
CAN_H
CAN_L
MCP2551
TXD
VSS
VDD
RXD
RS
CANH
CANL
VREF
J_REG_5V_2
VOUT

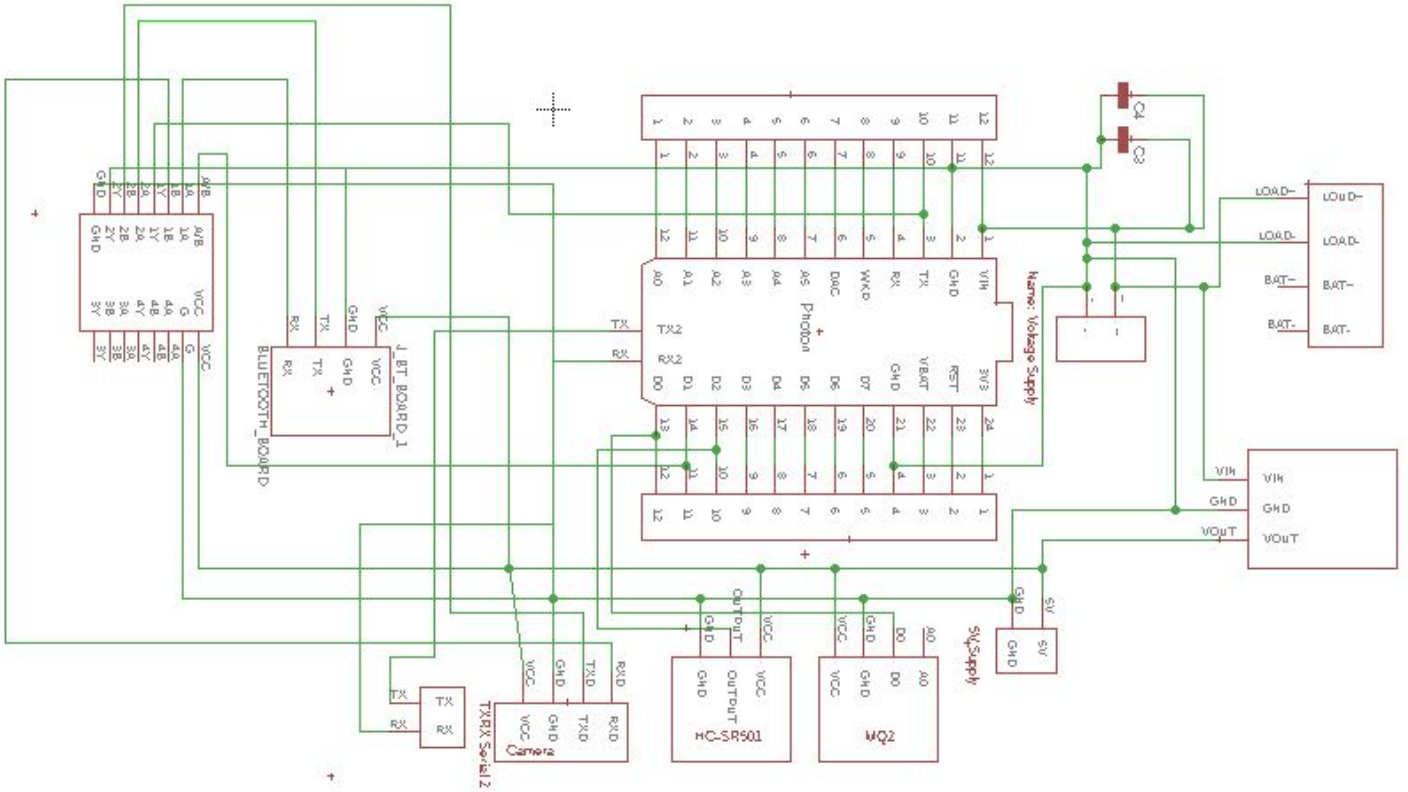
PCB-HUB 2.9"x2.5"



PCB-Extension 2"x4"

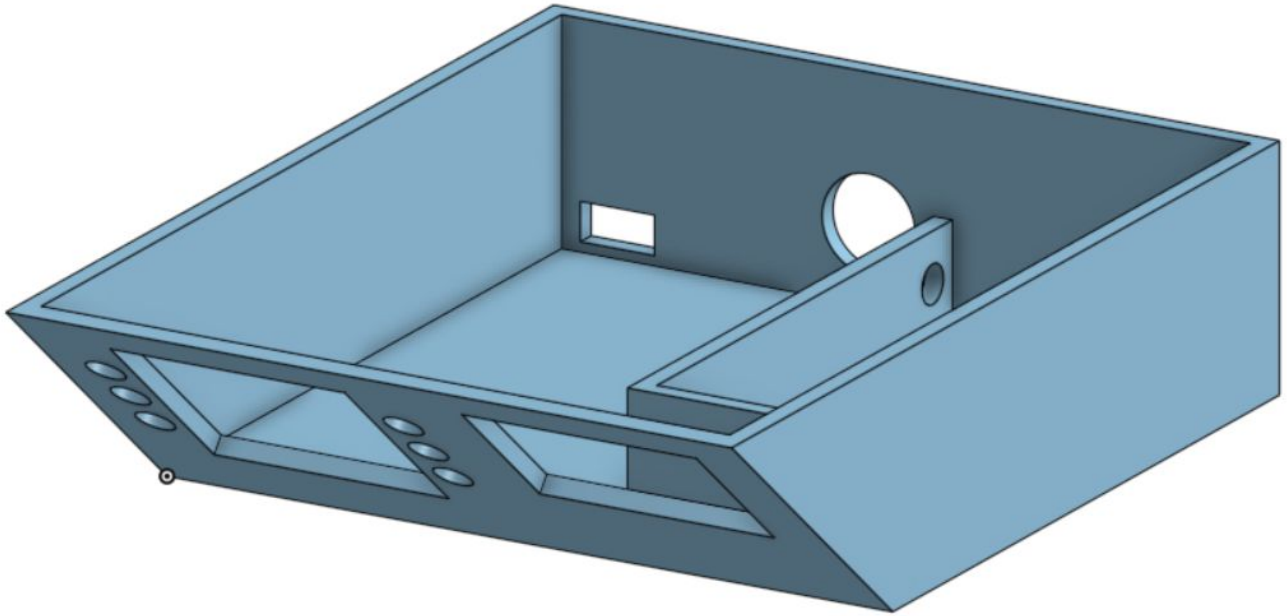


Schematic PCB Extension



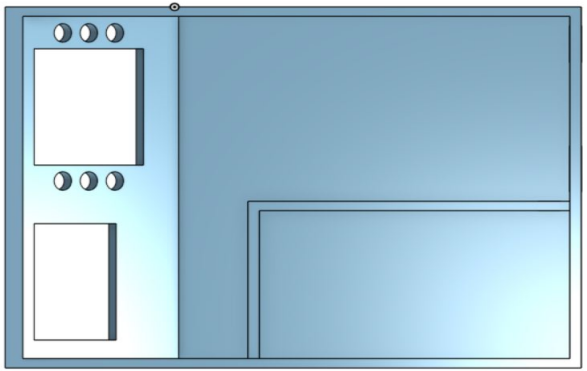
Prototype Ext. Case

Extension Case Prototype

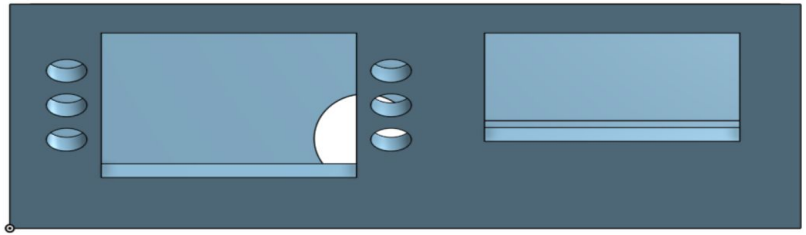


Extension Cover Prototype

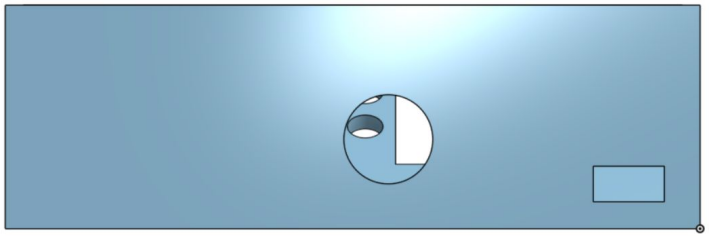
Top:



Front:



Back:



Side:

Bluetooth/SpeedAlert Demo

Speed Detection

- Using OBD-II Data
- When Threshold Reached
- IFTTT sends text message

Final Product!!!

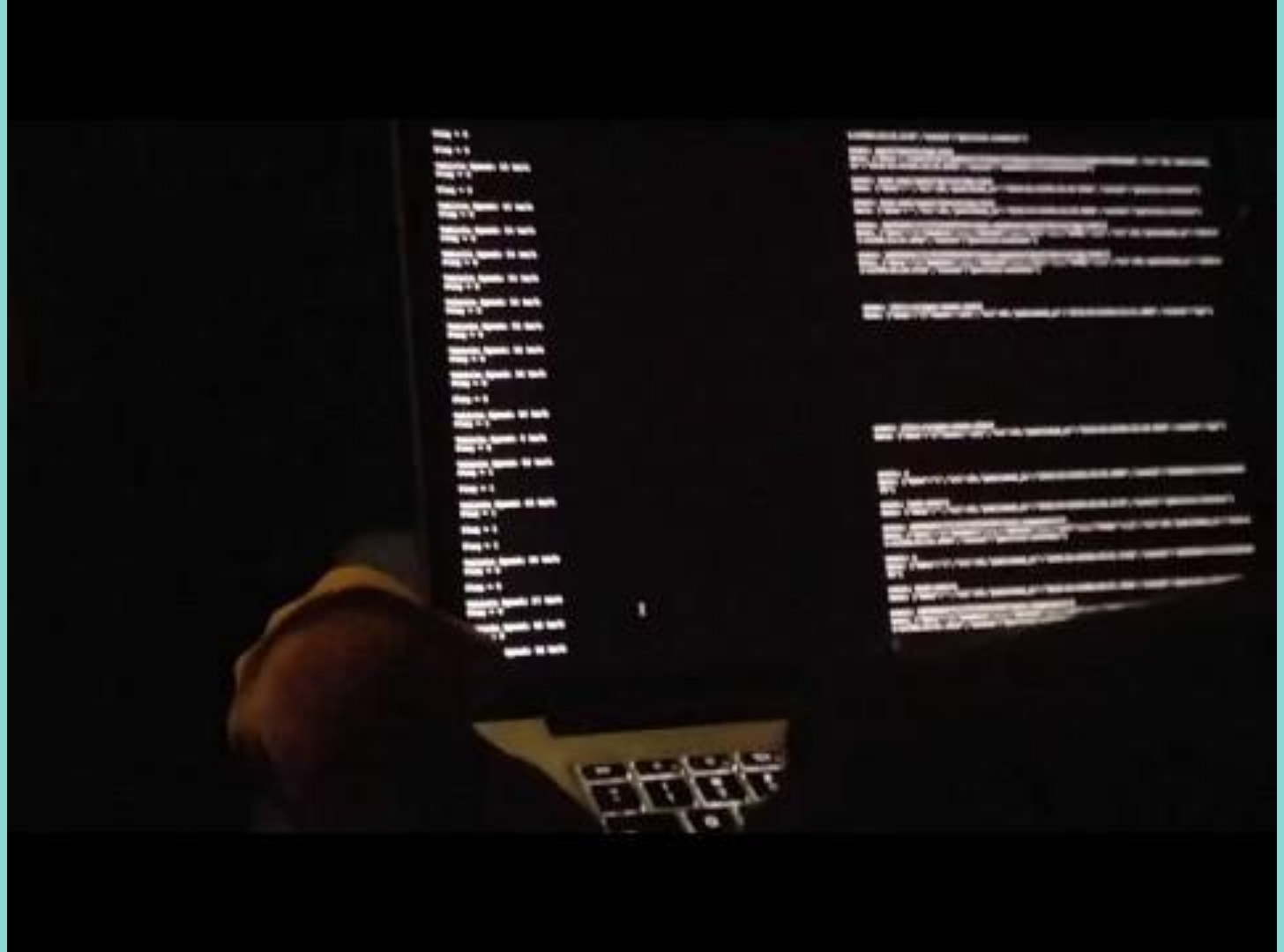
- A Working Android Application
- 2 Fully Working Applications in Unison
- Case for Both Extension and Hub
- Two PCBs (Hub and Extension)

FPR Timeline

New Budget (Raghid)	x				
Complete TempAlert Code (Chris)	x		x		
Complete SpeedAlert Code (Chris)	x		x		
Order PCB (Raghid/Nick)	x				
Solder PCB (Raghid)			x	x	x
Design/Print Enclosure (Nick)			x	x	
Android App (Chris)				x	x
Android App (Nigel)	x		x	x	x
Schedule FPR (Nigel)					x
	3/5	3/12	3/19	4/2	4/9
		SPRING BREAK			

Thank you

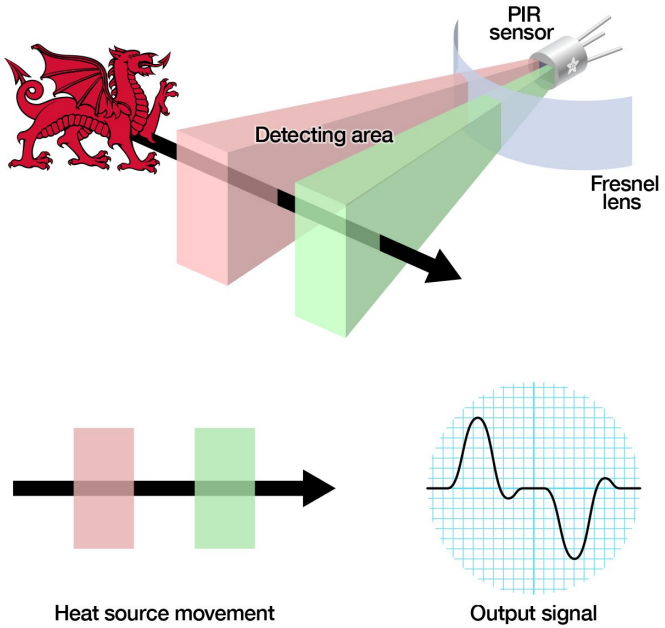
BUT WAIT...



Extra Slides

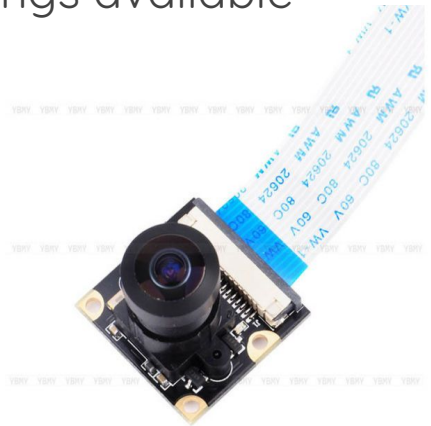
PIR Motion Sensor

- Detects changes in radiation (heat)
- Communicates via analog or digital (high/low)
- Variable sensitivity/delay
- Sense up to 7m away
- 3-4 second delay between firing
- 120 degree sensing range
- Communicate via RedBear Duo
- 3 Pins - Power, Ground, and Signal



Infrared Camera

- Serial communication via UART (TX/RX)
- Baud rate, resolution, and low power settings available
- Can take images in low light settings
- Baudrate: 38400
- Resolution: 320x240
- Returns JPEG (hex data)
- Communicate via RedBear Duo
- Convert hex data to JPEG image using Python



Requirements: Specifications

- **Small and lightweight**
  - Hub: (~100g) (2.5 x 2.5 x 2 in)
  - Extension: (~200 g) (5 x 2.5 x 3 in)
- **Extensible**
  - Ability to expand IoTECH smart hub through hard-wired or wireless connections
- **Modular**
  - Able to interface with multiple sensors

Requirements: Specifications (cont’d)

- **Fast & Reliable**
  - Relay information immediately (i.e. alerts)
  - Make sure alerts are seen by the user
- **Efficient**
  - Car battery life 160-200 hrs (~1 week)
  - Extension battery life 12+ hrs (average)
- **Secure**
  - Ensure that communication between devices are encrypted
  - No vulnerabilities to 3rd parties

Requirements: Input/Output

Inputs:

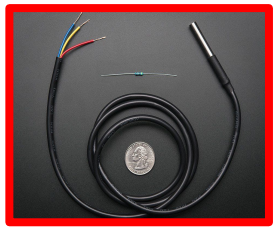
- Power - OBD II (car battery)
- Car Data - OBD II
- Network of external sensors

Output:

- SMS messages & notifications via IFTTT server

IoTECH Hub Integrated

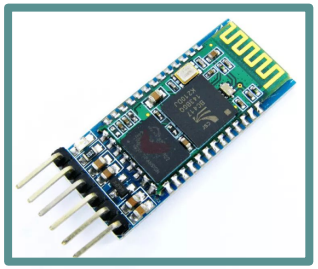
HUB



Temperature/Humidity

OBD-II Port

Communication



Bluetooth

Extension

Wide-Angle Camera

IR Motion Detector

Hardware Budget

https://docs.google.com/spreadsheets/d/1hlk14Tolm_3y21gWLB1YkYPZu6LEQL-wq_8bVloB2G4/edit#gid=0