Winter Design Review

EMPRO

Problem Statement

EBIKES

- Expensive
- Prone to Theft
- Heavy and Bulky

DIY KITS

- Tedious to Install
- Unsafe
- No Servicing

Solution

An Electric Wheel That Transforms Any Bike to An Ebike

1

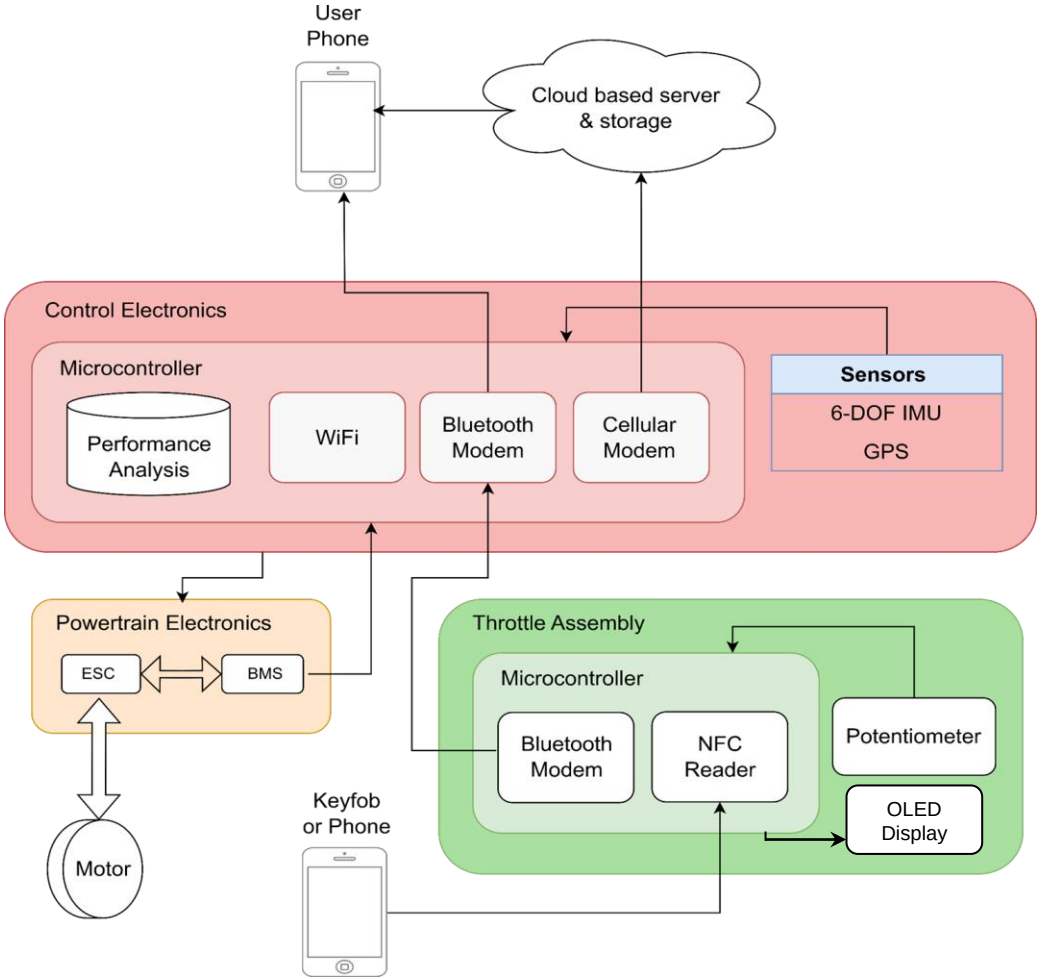
2

3

System Block Diagram

Five Primary Subsystems:

- Mechanical
- Throttle Assembly
- Powertrain Electronics
- Control Electronics
- Smartphone App



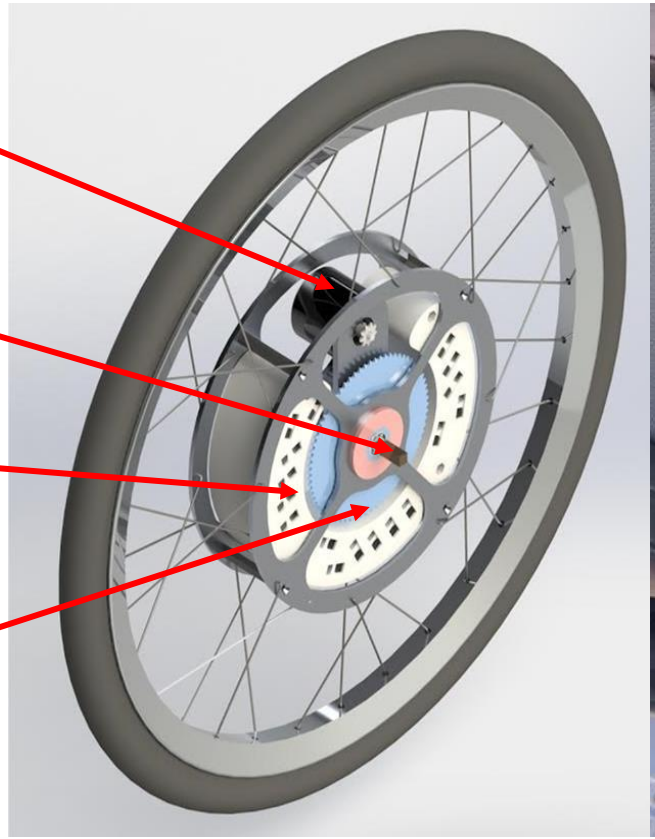
Mechanical

Motor

Axle

Batteries

Electronics
(*behind sprocket*)

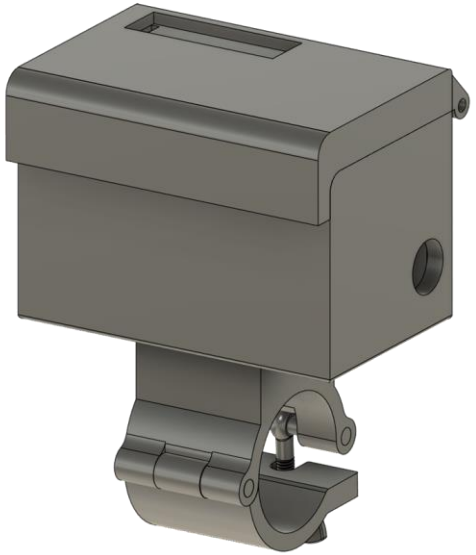


Throttle

Throttle Housing

The throttle activates the wheel and controls its speed.

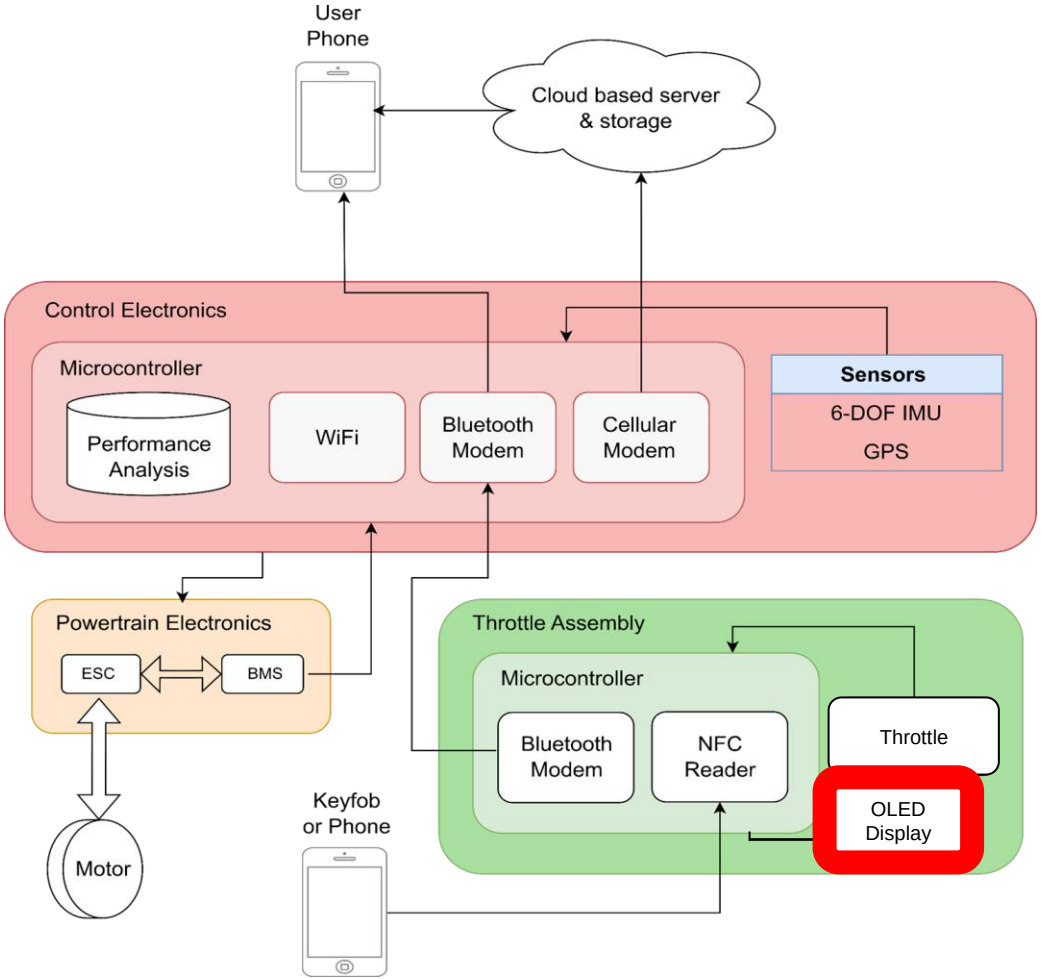
It encloses the throttle MCU, an NFC reader, and slots an OLED display.

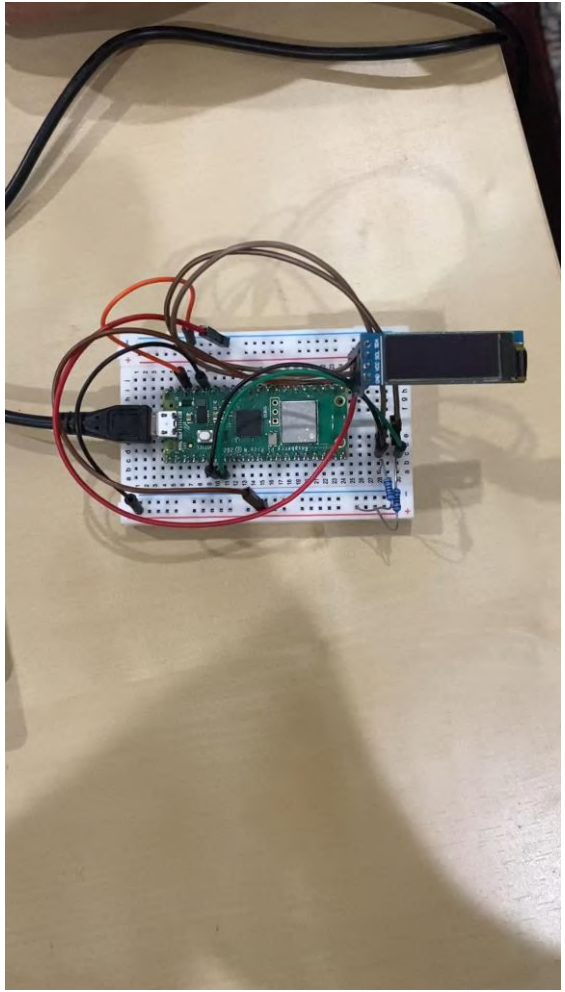


Throttle Housing Demo

Throttle - OLED Reader

The OLED display is used to display the power state and battery percentage of the wheel.

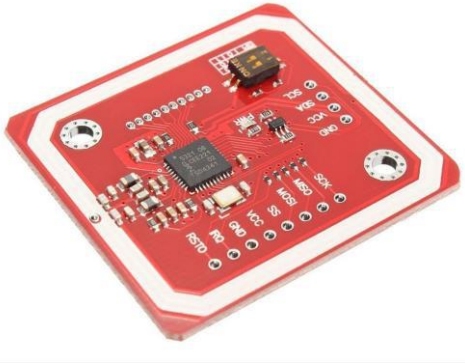


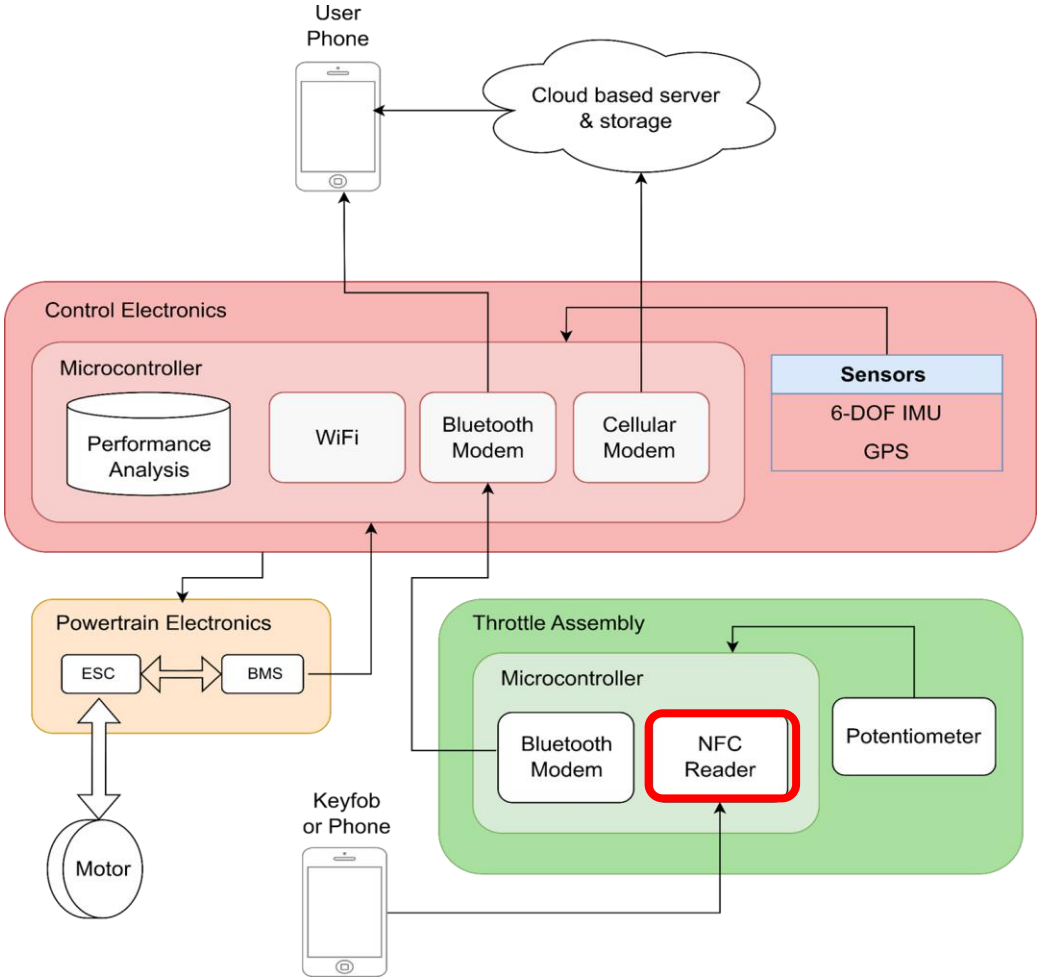


Throttle - NFC Reader

NFC Reader - NXP PN532

Authenticates user to wheel to improve security

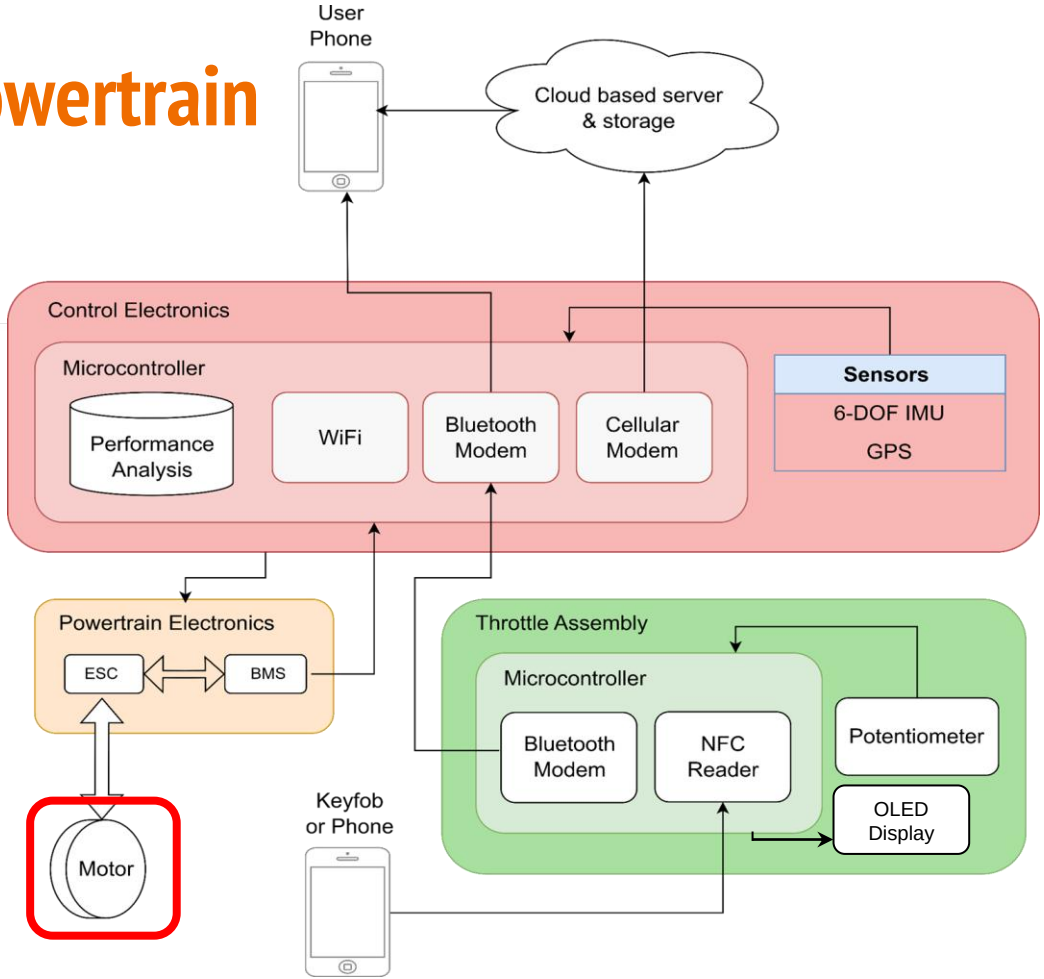




Powertrain

Component Selection - Powertrain

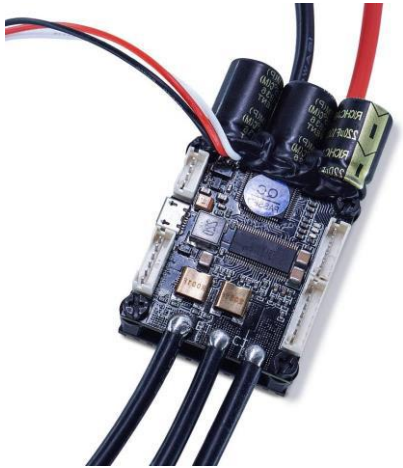
Motor - Flipsky BLDC 2450W

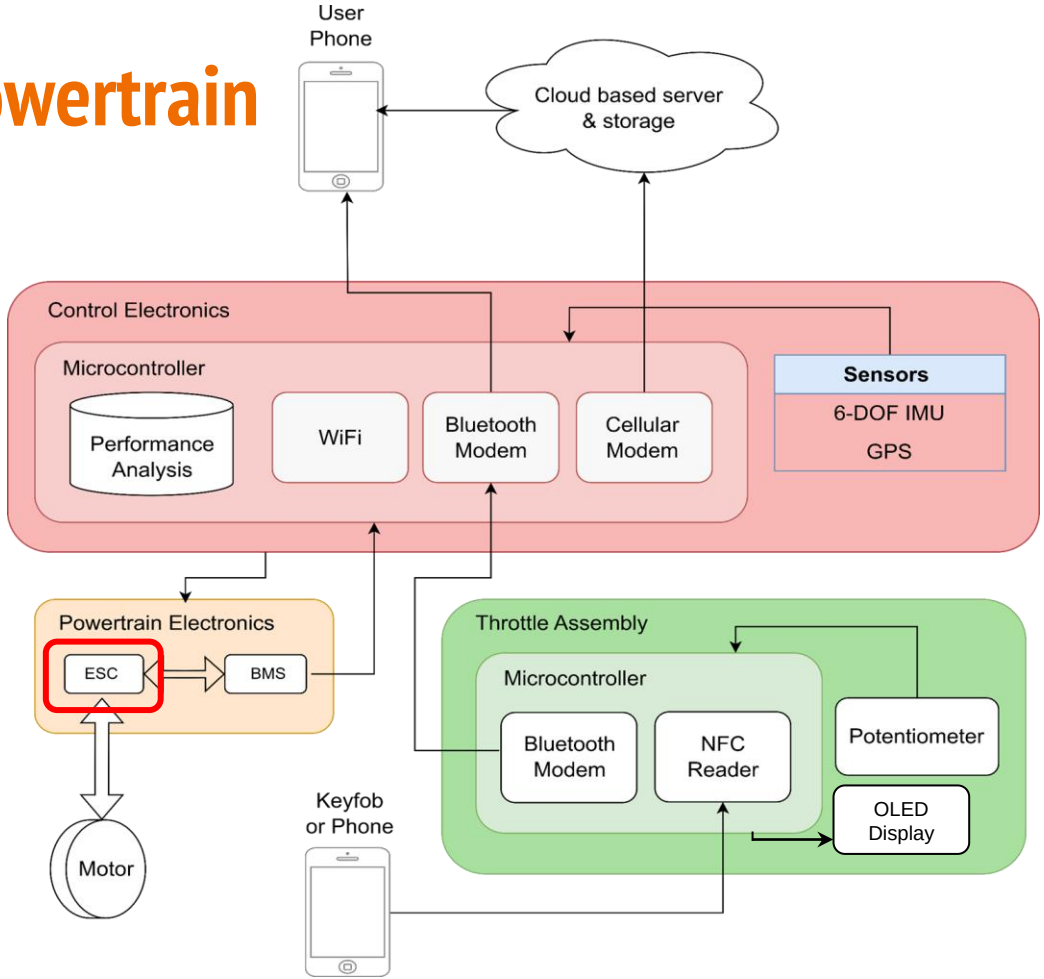


Component Selection - Powertrain

ESC - Flipsky VESC 4.12

- 50A continuous, 150A burst
- UART serial port for command and telemetry

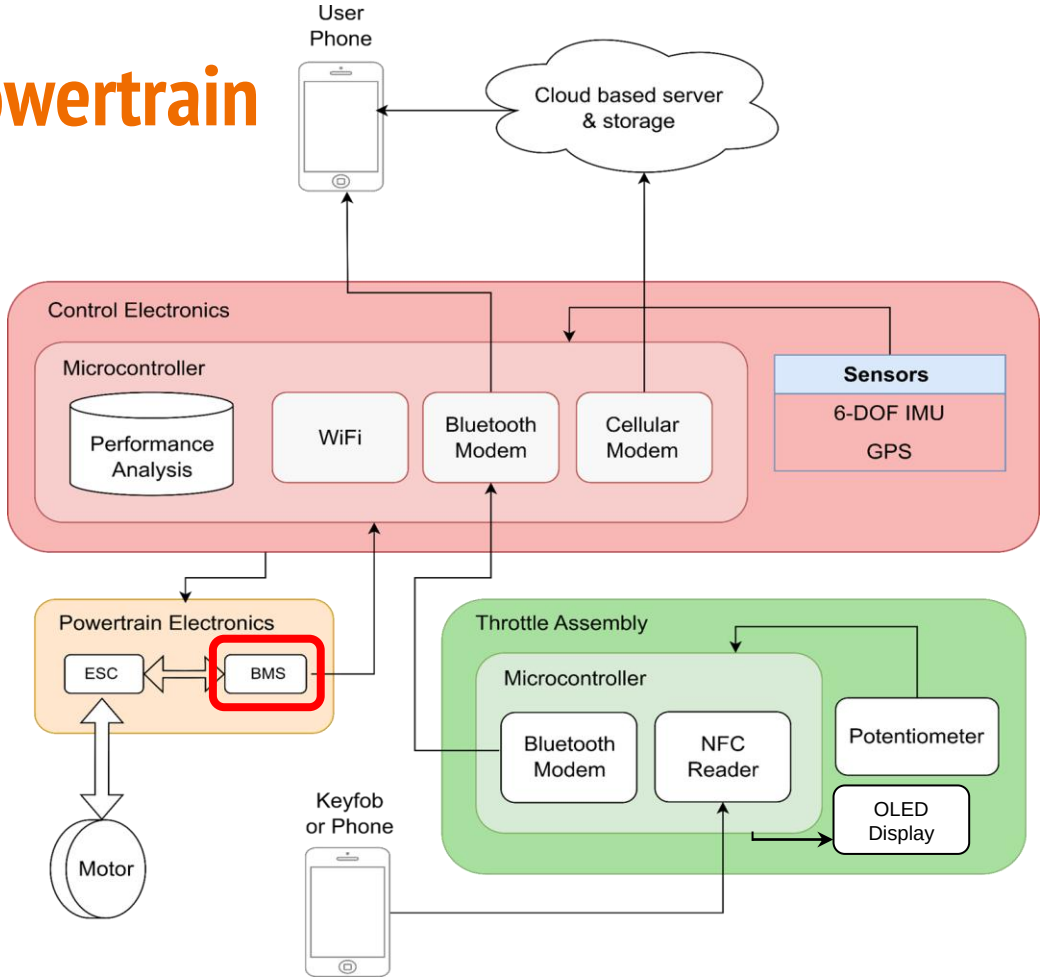




Component Selection - Powertrain

BMS - JBD Smart BMS

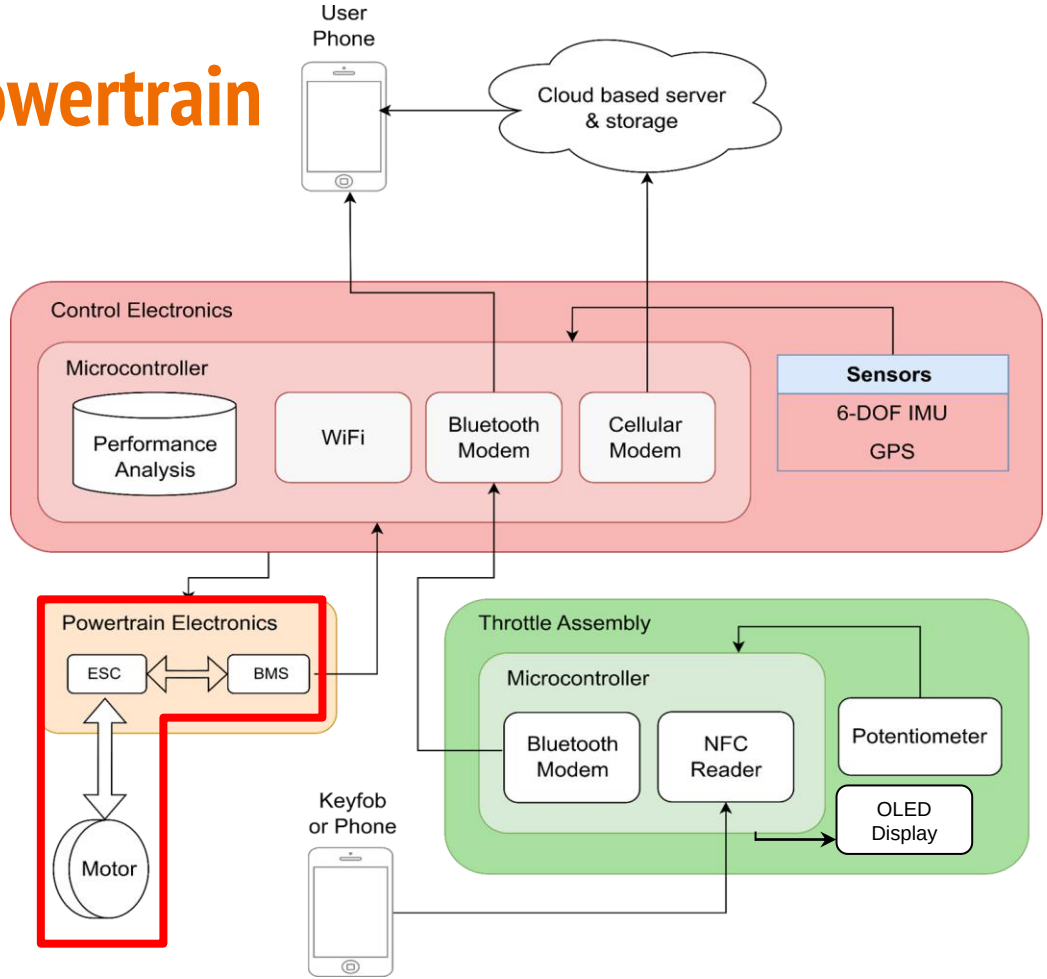
- 50A continuous
- UART serial port for telemetry



Component Selection - Powertrain

Battery - 39x INR18650-30Q

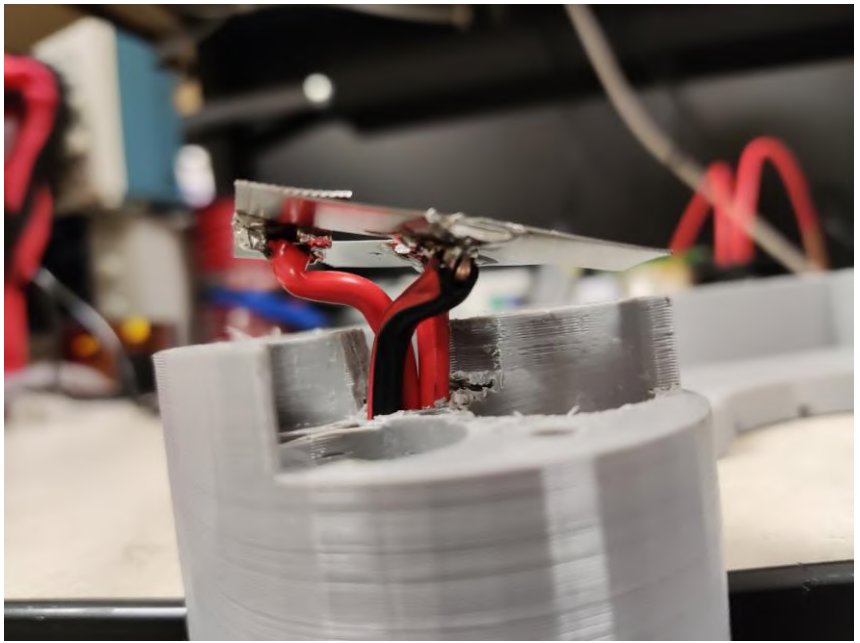
- “13s3p” (*9 Ah / 444 Wh*)
- ~48V (*nominal*) or ~55V (*full*)



Powertrain Progress

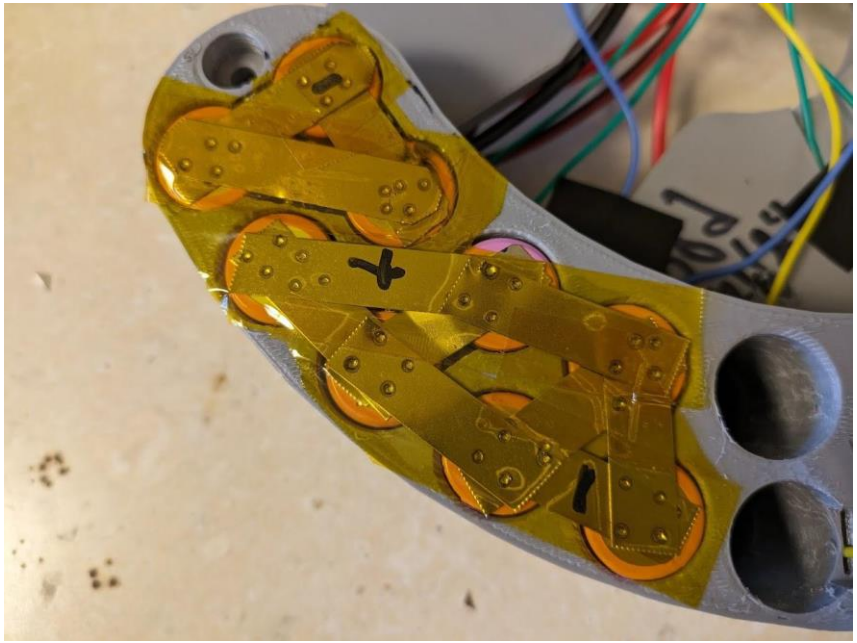
Battery Pack Terminals (*old style soldering*)

Thick-Gauge Wire Routing



Powertrain Progress

Close-Up on Battery Terminals (*3s/13s*)



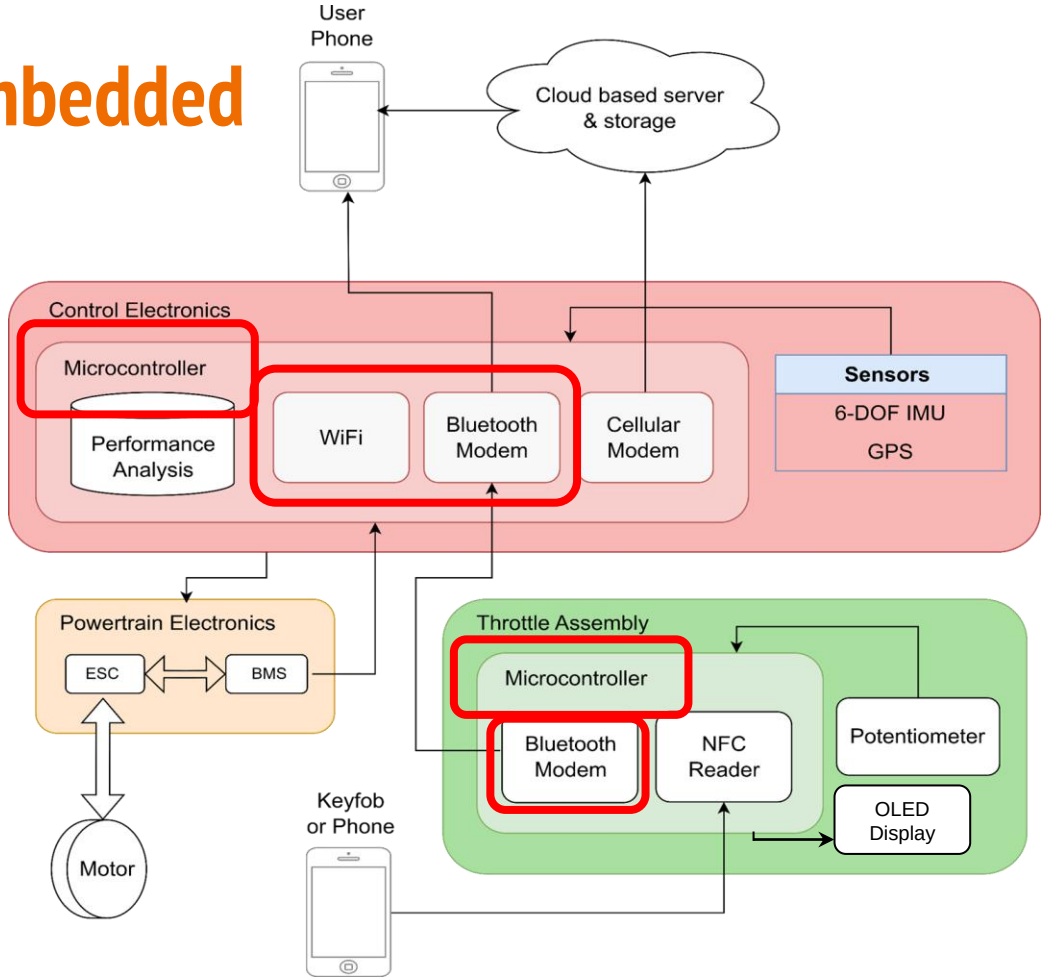
Partially Assembled Pack Connections

Control Electronics

Component Selection - Embedded

Raspberry Pi Pico W

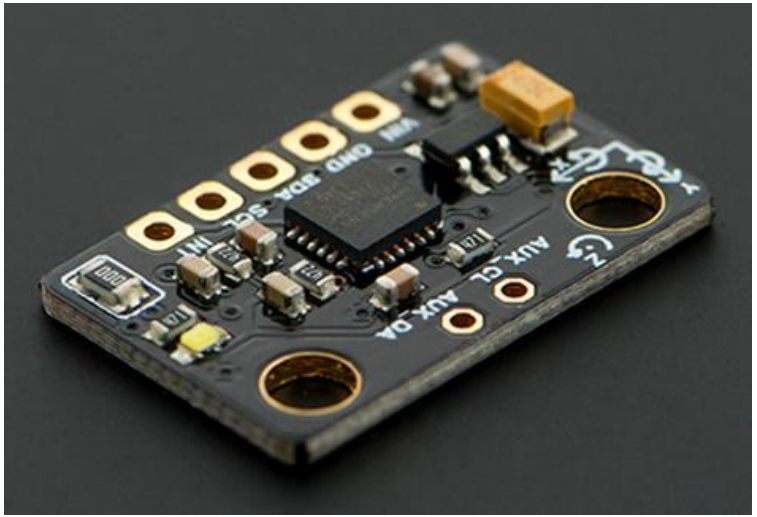
- ARM M0+ MCU
- Integrated BT(LE)/WiFi
- FreeRTOS middleware

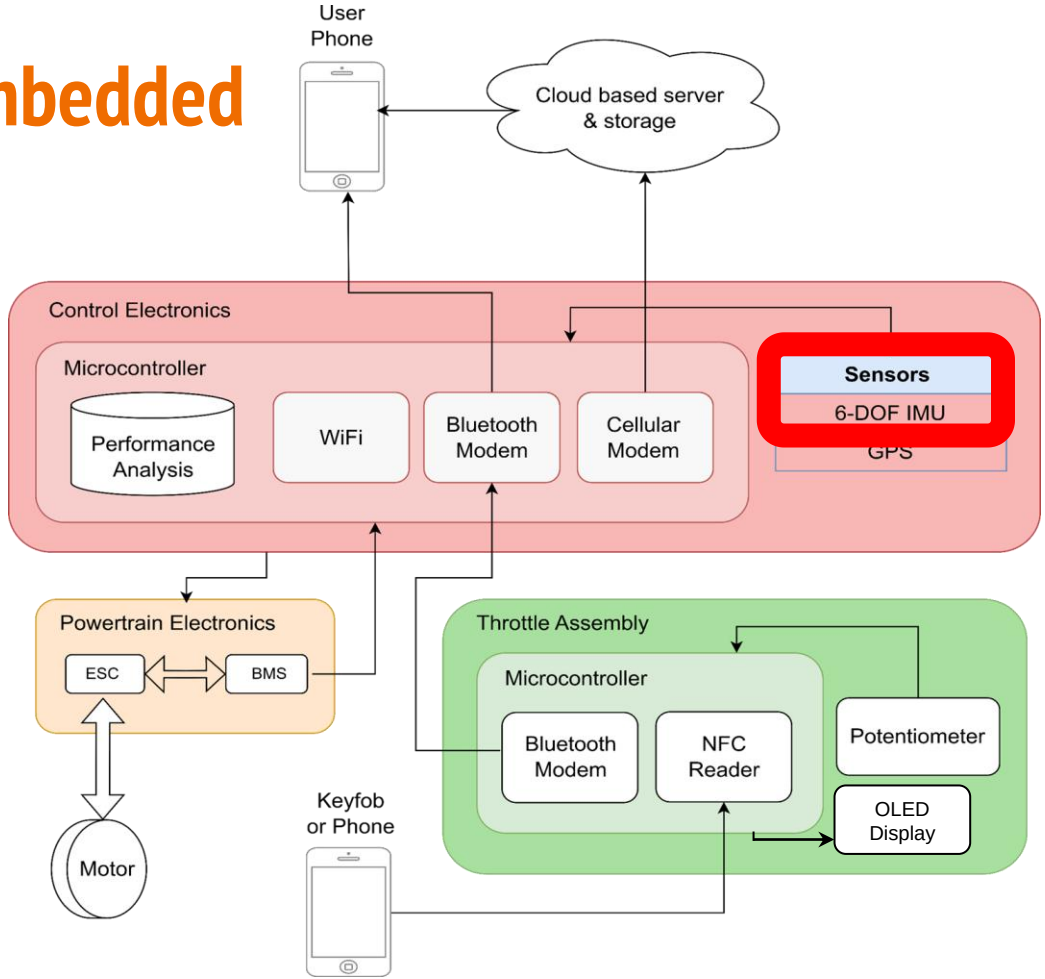


Component Selection - Embedded

IMU - MPU6050

- 6DOF MEMS

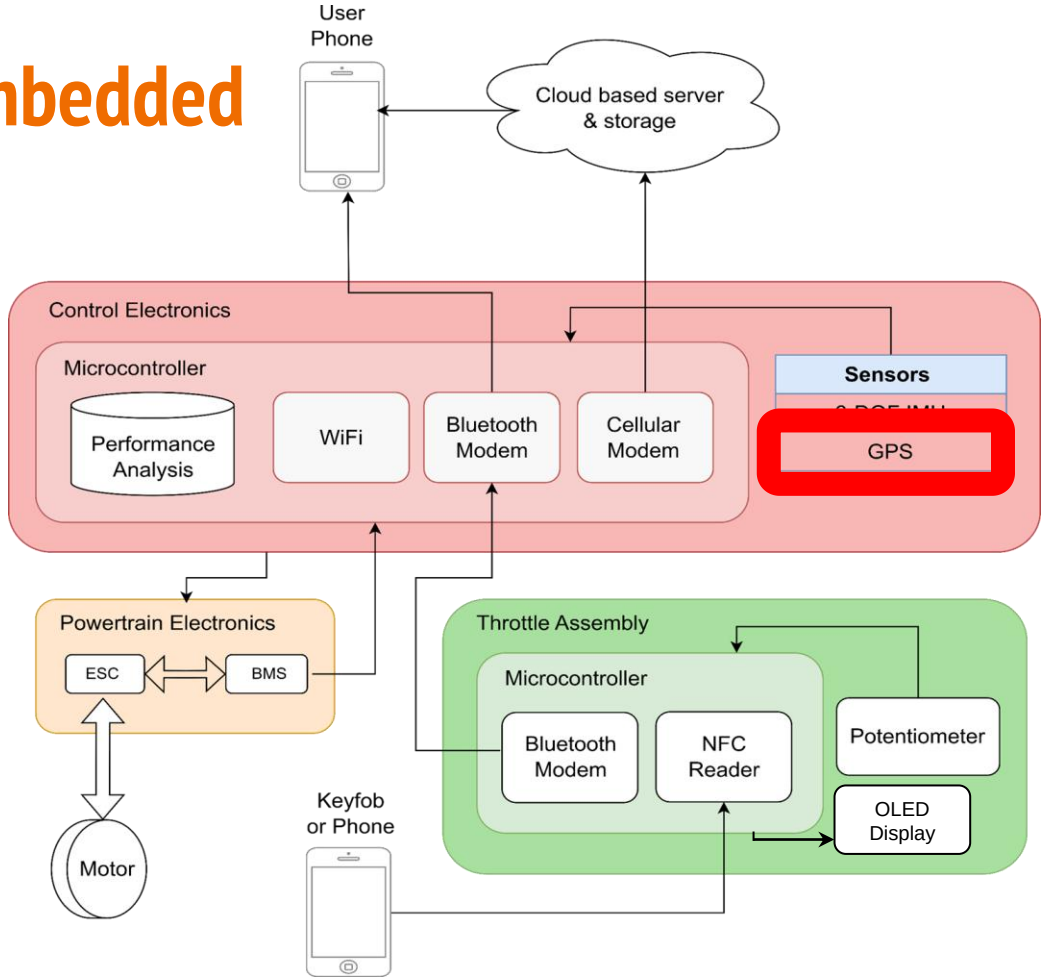




Component Selection - Embedded

GNSS - uBlox SAM-M10Q

- GNSS: all countries' GPS
- Low power receiver



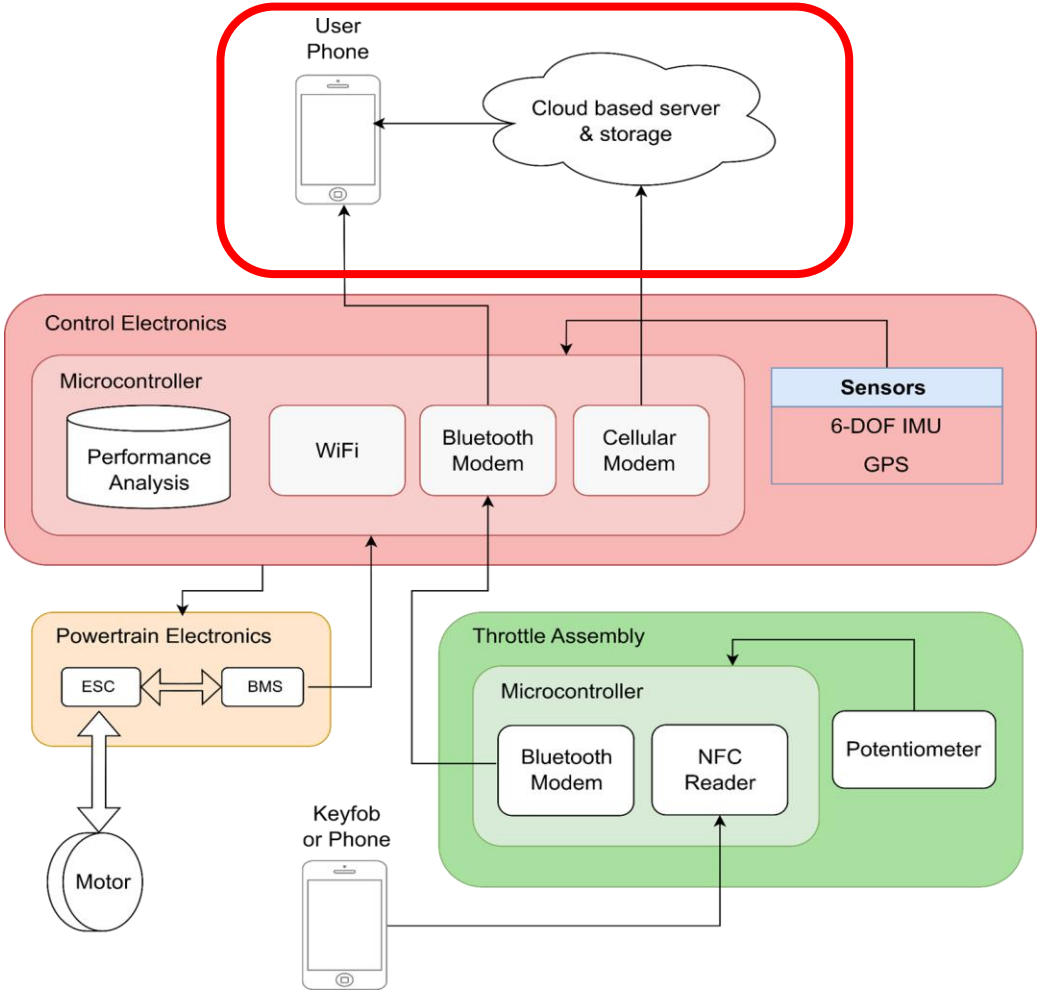
End-to-End Throttle Control

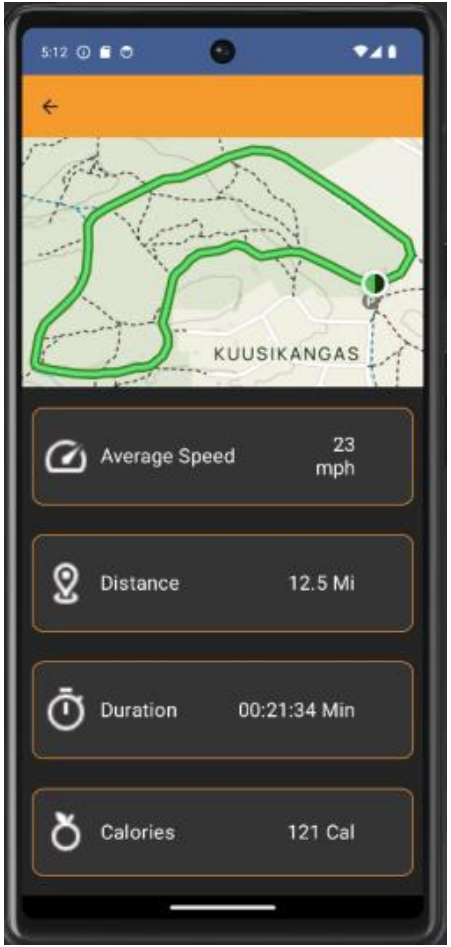
Phone Application

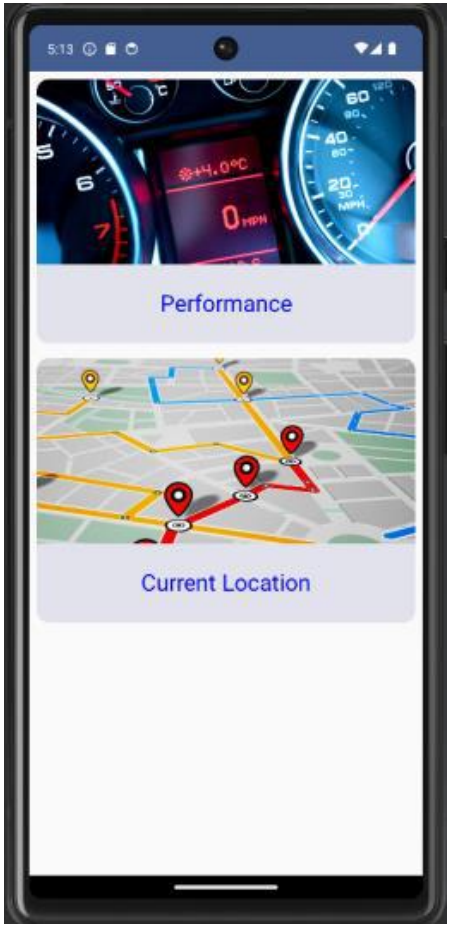
Phone app - Demo

Tracks performance parameters

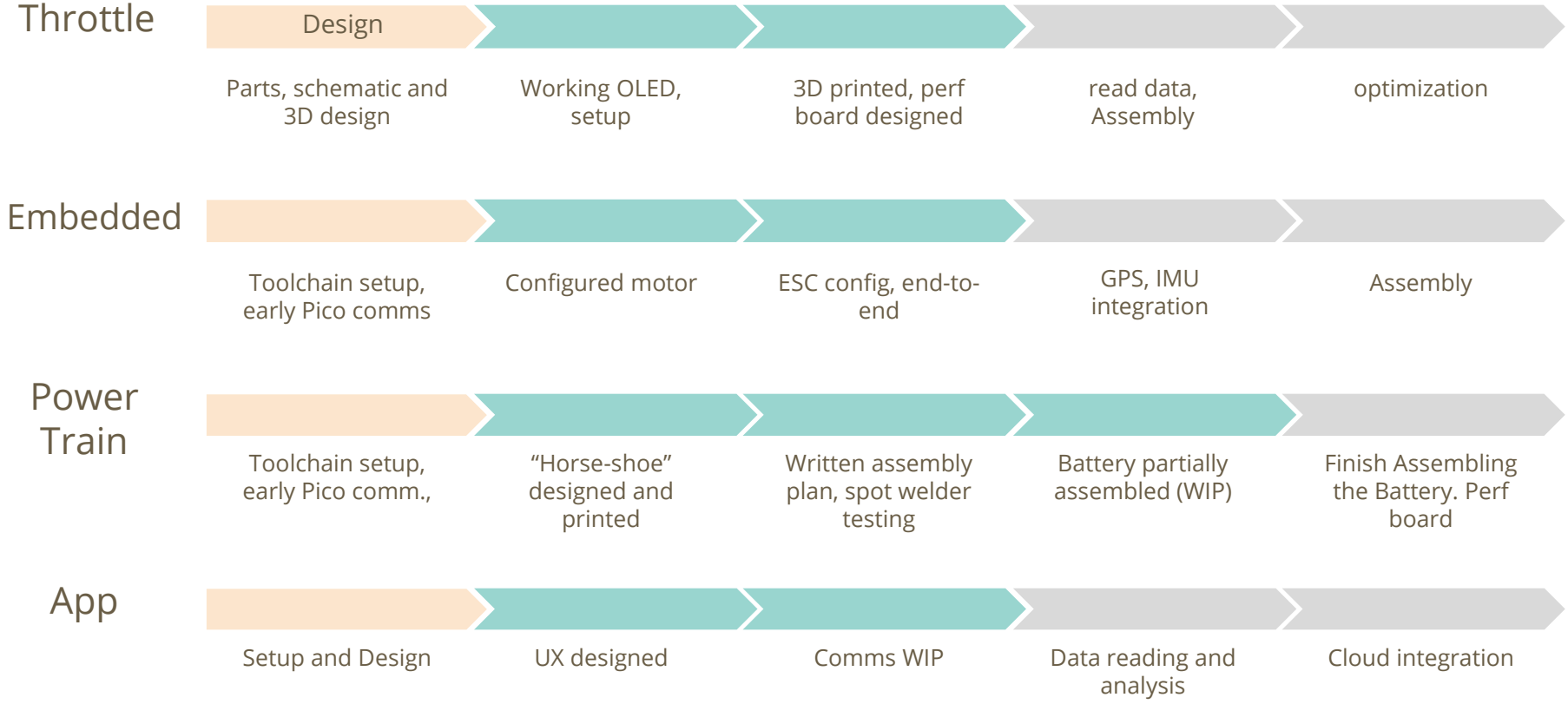
- Speed
- Total Distance
- Duration




5:12
KUUSIKANGAS
Average Speed
23 mph
Distance
12.5 Mi
Duration
00:21:34 Min
Calories
121 Cal


5:13
Performance
Current Location

Current Progress



Thanks to

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