EMPRO – Electric Bike Wheel

EMPRO
Your Ride, Electrified

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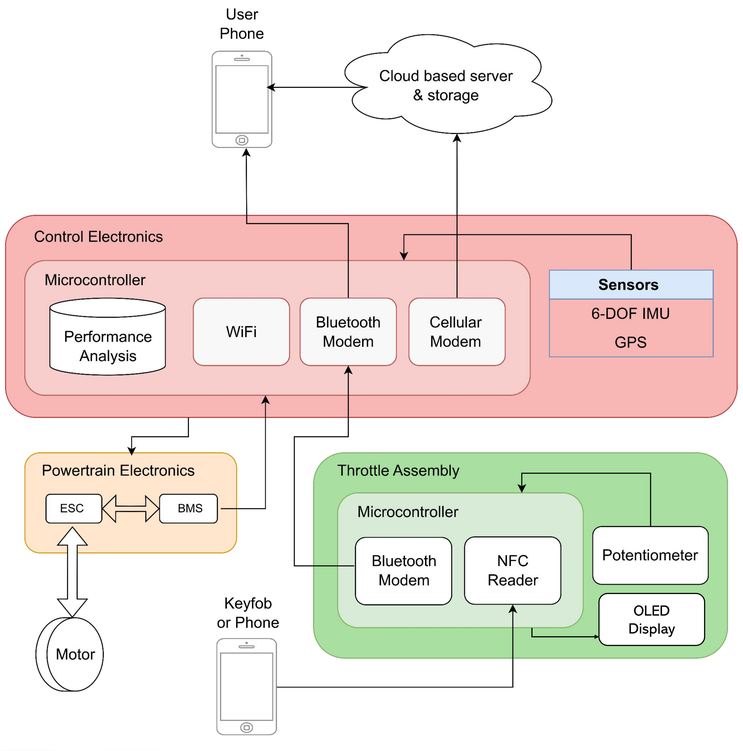
Background

The popularity of electric bikes has surged rapidly over the past 5 years, positioning them as an appealing upgrade from traditional cycling. As a result, we view this as an opportunity to break down entry barriers for E-bike riders and make electric biking accessible to all.

Overview

The Empro E-bike conversion kit is a comprehensive front wheel hub assembly that effectively transforms a standard bicycle into an electric bike. This all-in-one system includes a motor, lithium-ion batteries, and sensors, offering users the benefits of an e-bike at a considerably reduced price. It uses a wireless throttle to control the motor's power output, thereby regulating the bike's speed. Using the onboard sensors, the onboard microcontroller transmits performance metrics to the mobile application, which are subsequently stored on a cloud-based server.

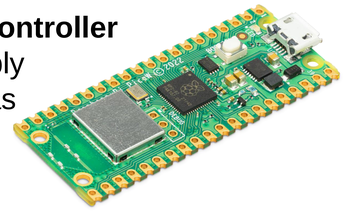
Block Diagram

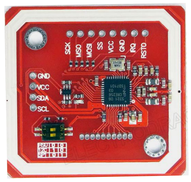


Hardware

Wheel and Throttle Assembly Microcontroller

- The wheel hub and throttle assembly both have a Raspberry Pi Pico W as their control computer



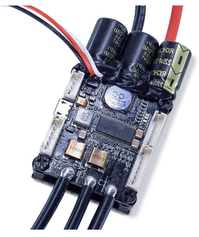


NFC Reader

- A PN532 NFC located in the throttle assembly reads and authenticates the user's key fob to lock and unlock the wheel
- Wakes the throttle from low power mode

Electric Motor

- A Flipsky BLDC 2450W Motor is located in the wheel hub that is sized to fit between the forks of a bike and operate at the voltage/power that our battery is capable of supplying



Electronic Speed Controller

- A VESC 4.12 ESC was chosen to operate at the voltage/power that our motor and battery are capable of taking
- Provides telemetry about motor performance and speed

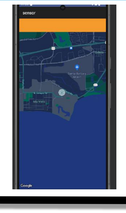
Custom Wheel Assembly Battery Pack

- "18650" Lithium-Ion cells were arranged in a "13s3p" pack configuration (*39x cells*) to get a nominally 48V battery with 444 Wh stored energy

Wheel Battery Pack BMS

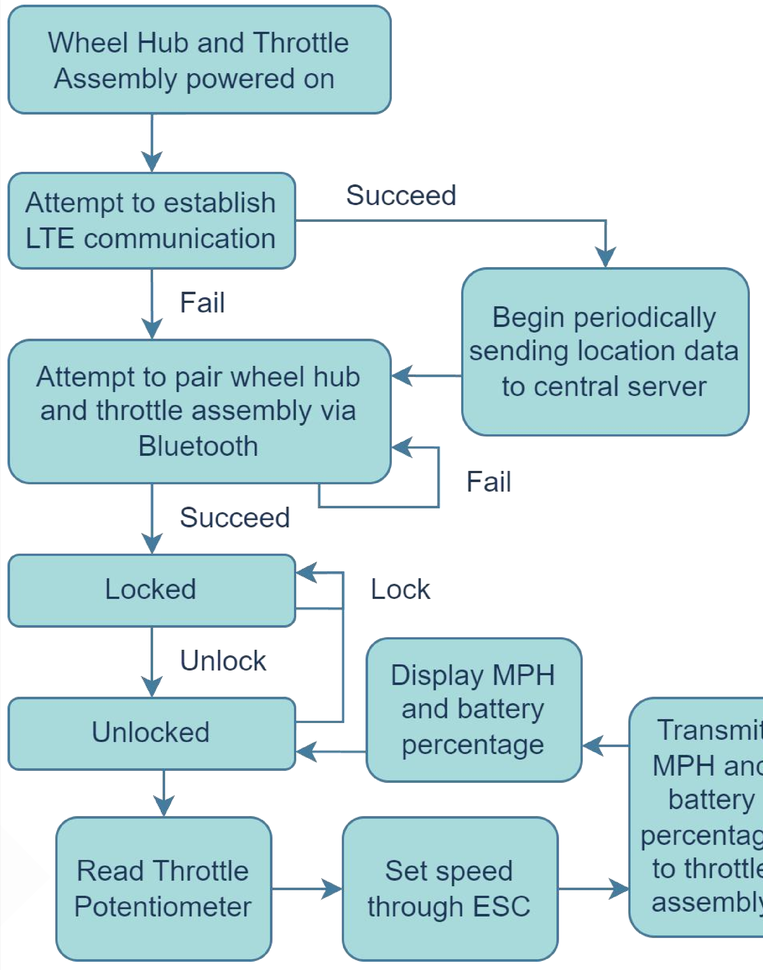
- A JBD Smart 50A BMS was Chosen to operate at the voltage/power that our motor and battery
- Provides telemetry about battery charge state and discharge limits

Mobile Application



- Main purpose: Performance and location tracking
- Deactivates wheel-system from afar
- Helps retrieve stolen bikes

Software Flow



Final Product

Wheel Assembly

Throttle Assembly

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