



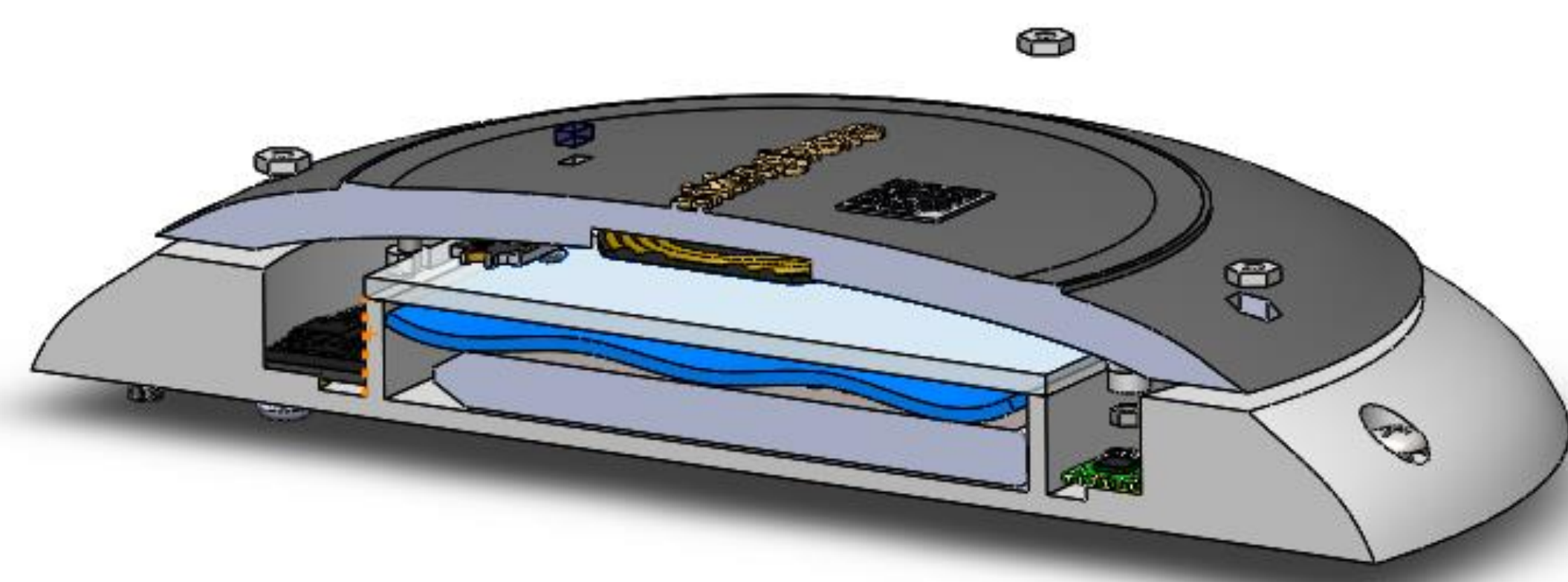
Abstract

Drivers spend too much time in parking lots trying to find an open space. We are aiming to design a smart parking lot to ease the process of finding a parking spot. Using small, low-cost sensors and long-range, low-power transmission, we have developed an affordable solution to this problem. With a cloud database and an easy-to-use mobile accompanying app, Parkingbase makes it easy for users to obtain realtime information on every spot in the parking lot.

Vehicle Detection Unit

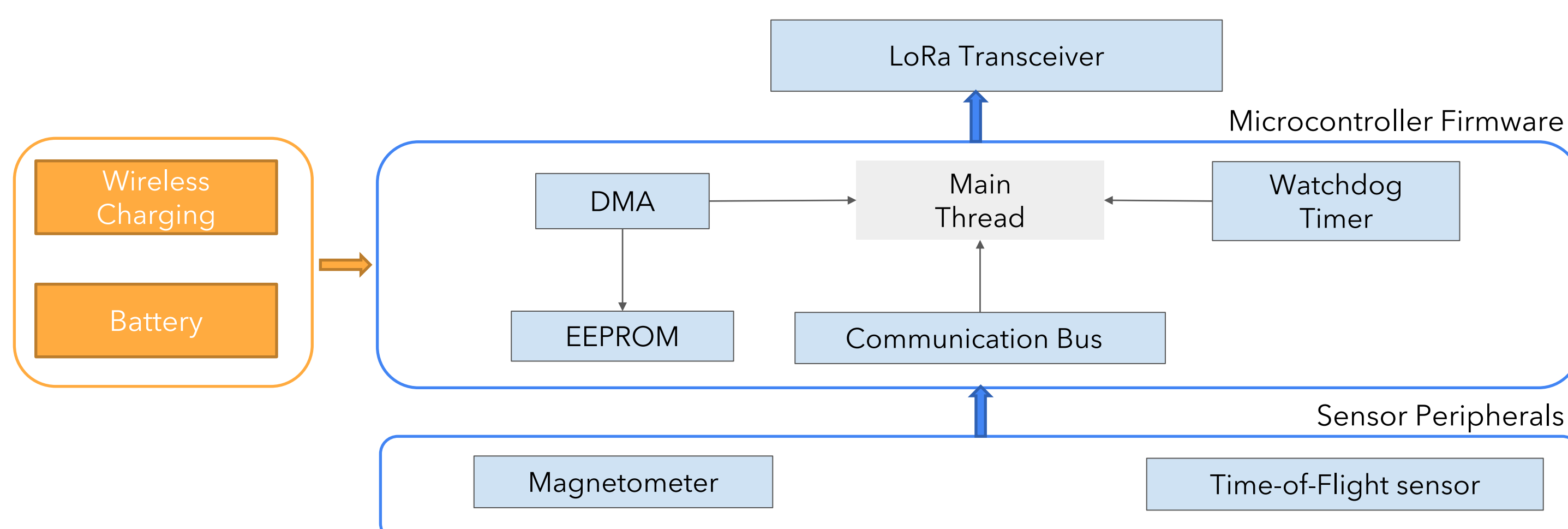
Vehicle Detection Unit

- Ferric Detection on Car Engines
- Lidar Detection on Car Chassis
- Wireless Charging
- Engineering Plastic Cases
- LoRa long-range communication

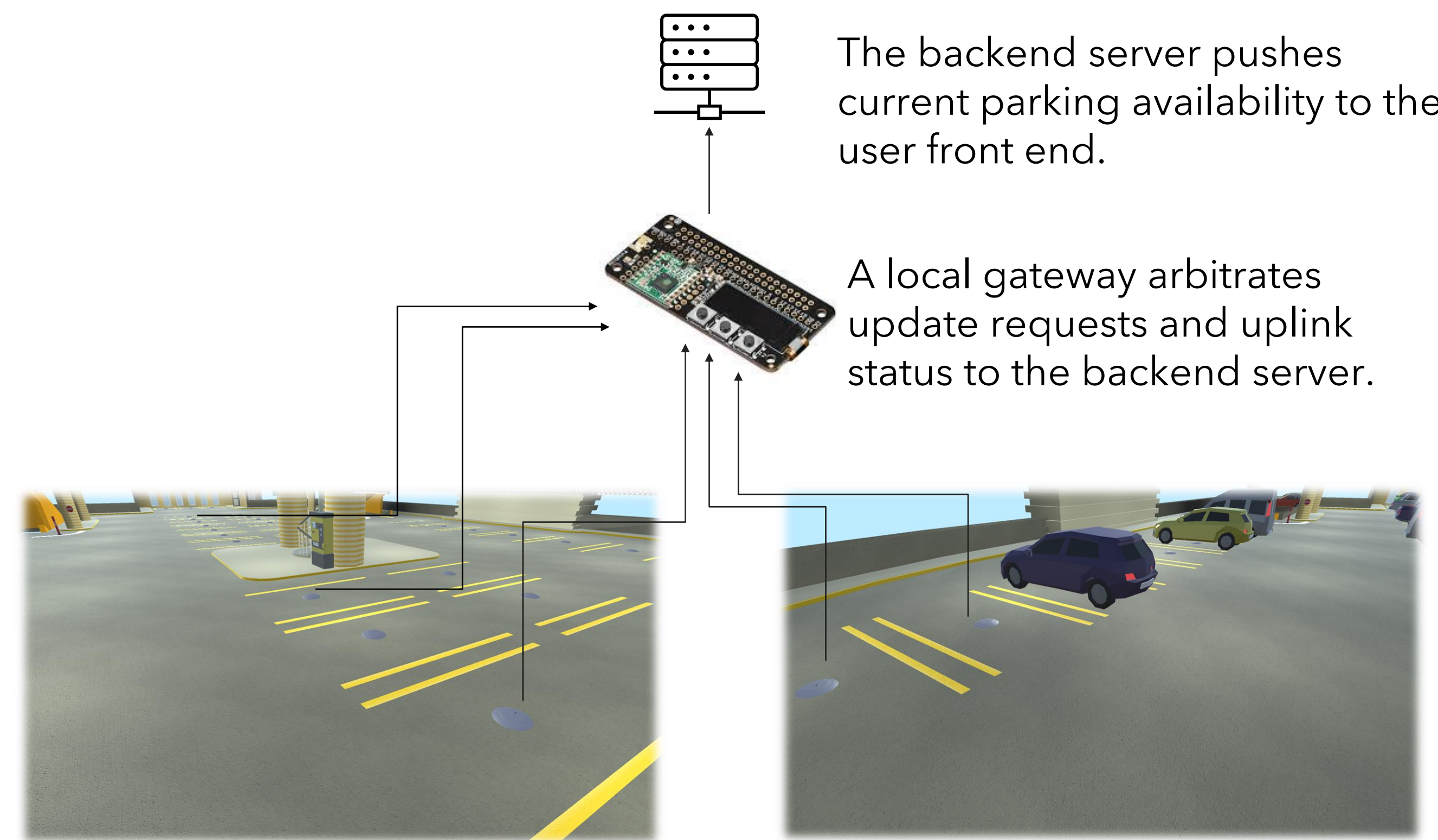


Vehicle Detection Unit Section View

Sensor Unit Block Diagram



Scalability



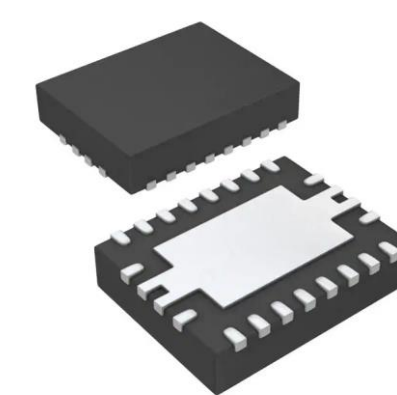
Each parking spot will be installed with a sensor unit.

Key Components



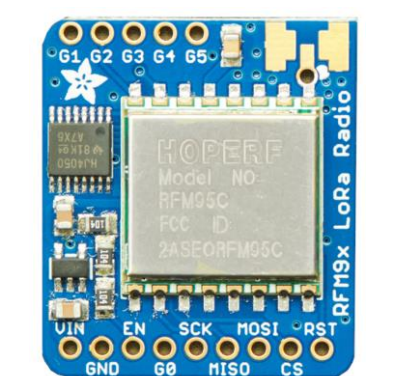
MCU: STM32L053R8

- Low-power consumption
- SPI / I²C / USART interconnect



Wireless Charging: BQ51013B

- WPC v1.2 compliant communication control
- Accurate voltage and current loops
- High-efficiency and low-power dissipation
- Small package size



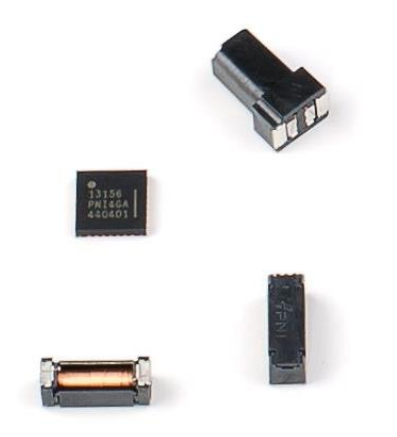
LoRa: SX1276

- LoRa Modem
- Programmable bitrate up to 300kbps
- SPI interface



Lidar (Time-of-Flight): VL53L0X

- Time-of-Flight laser-ranging module
- I²C interface for device control and data transfer
- 940 nm Vertical Cavity Surface-Emitting Laser
- Effective detection range up to 110 cm



Magnetometer: RM3100

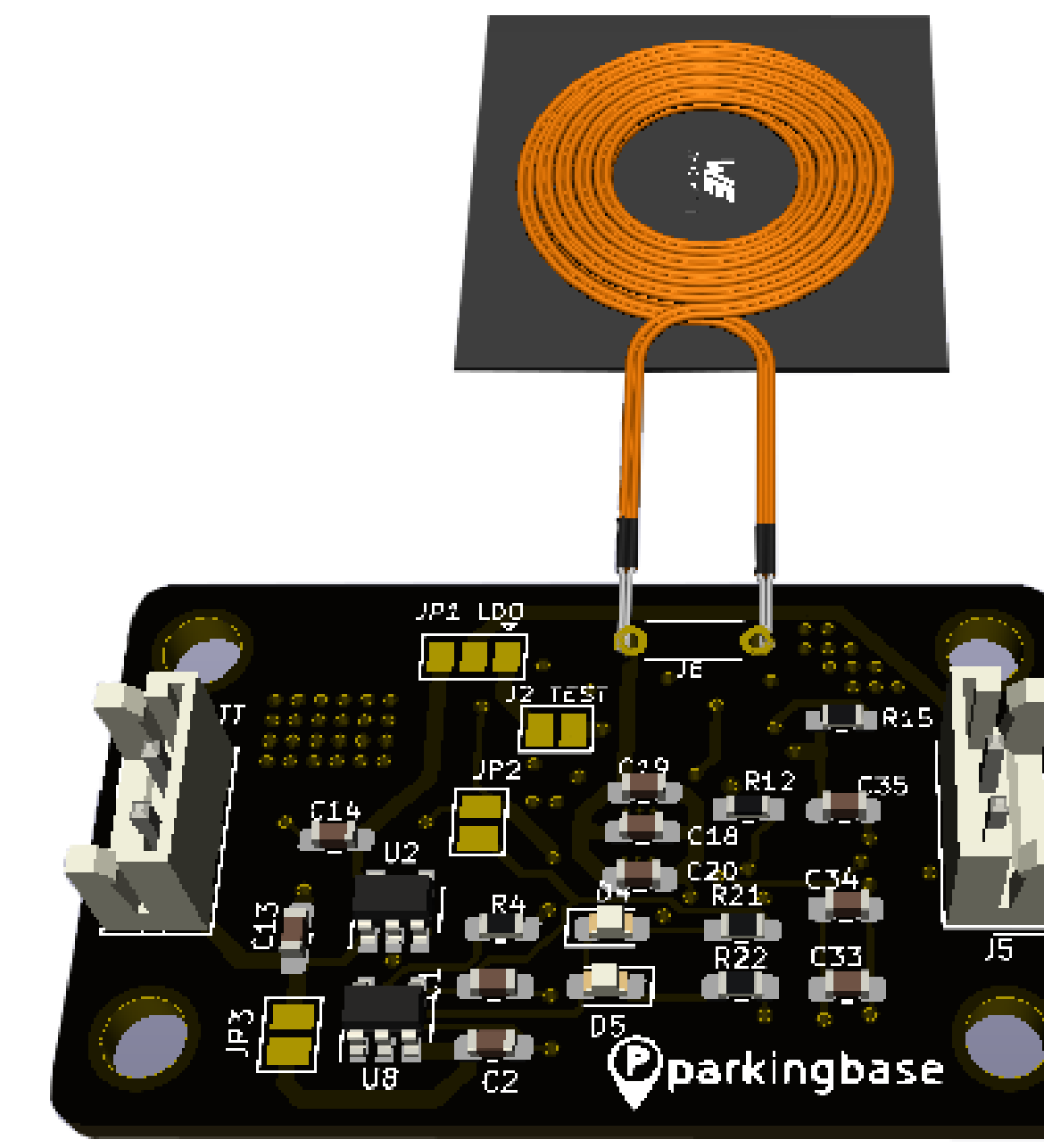
- High-resolution magneto-inductive sensor with 3-axis sampling
- SPI interface



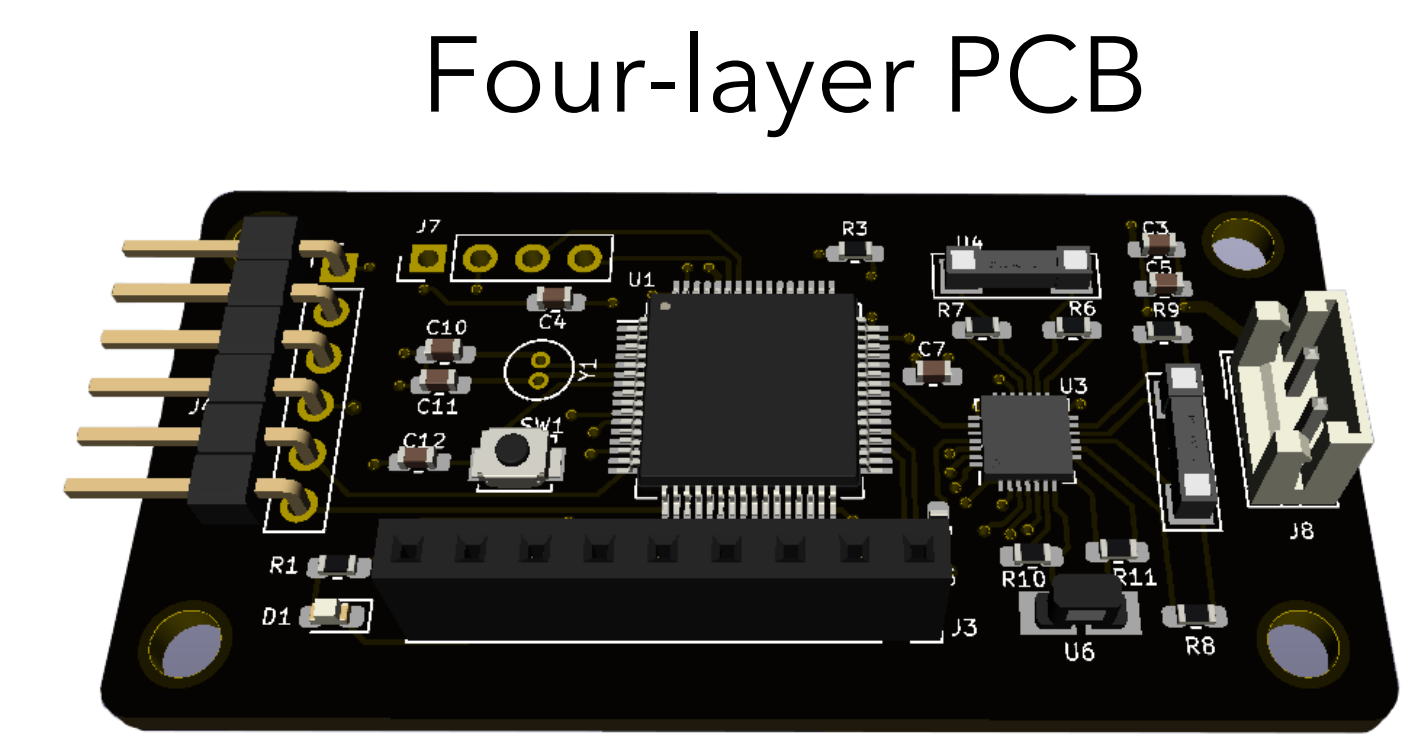
Gateway Unit

- Adafruit LoRa Radio Bonnet with OLED - RFM95W @ 915MHz
- SPI0 Interface for Lora and I²C used for LED display
- RFM9x Adafruit Library used for packet processing
- Connected to REST API server backend

PCB Design



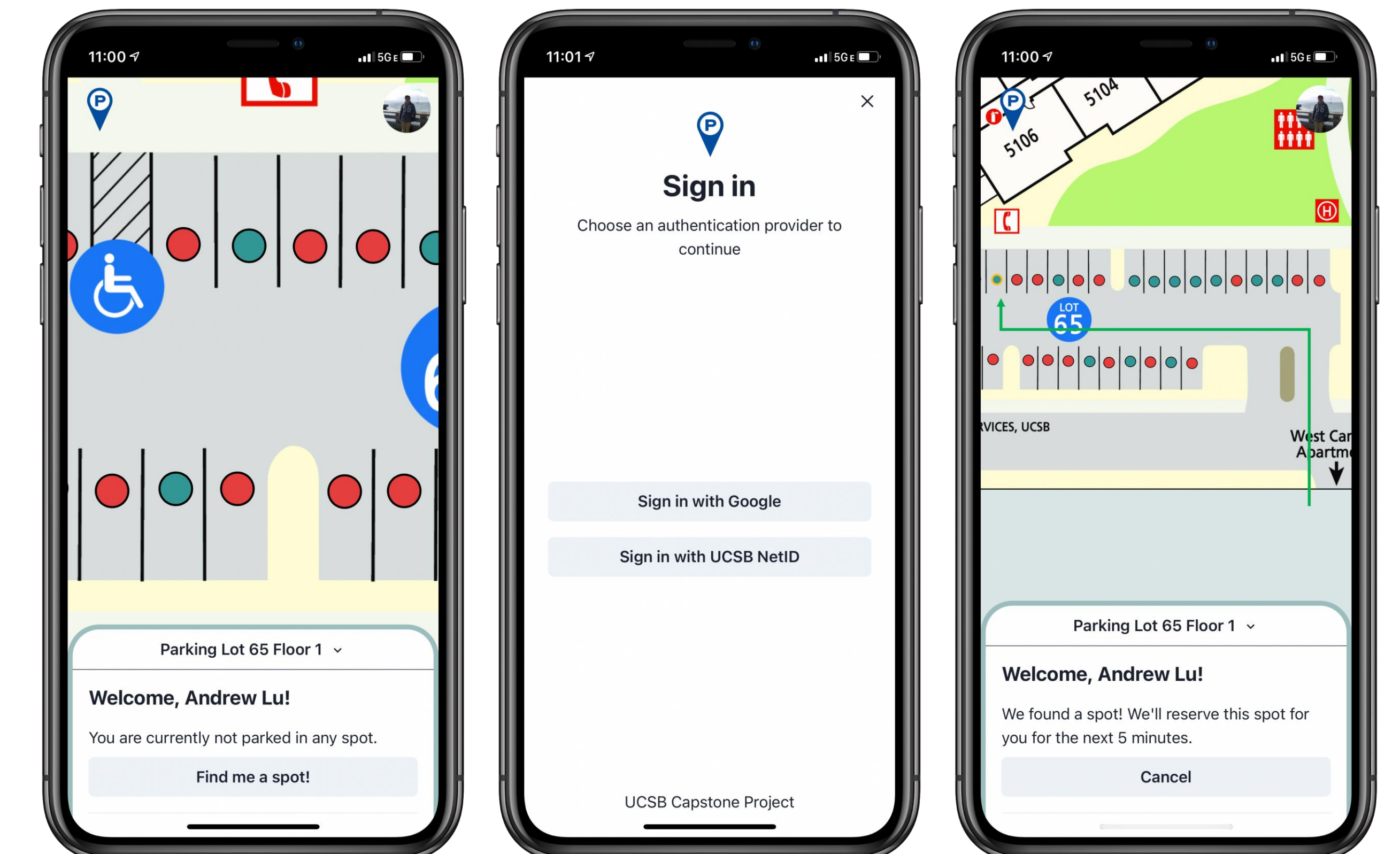
Wireless Charging and Battery Power Management



Four-layer PCB

Vehicle Sensing and LoRa Communication

User Interface



Mobile Web Application

- View the status of all spots within a parking lot
- One click to find and reserve an open parking spot
- App will navigate you to your reserved spot
- Remembers where you parked - view parking history
- Supports Google and UCSB NetID login
- Editor tool for admins to easily view, add, and remove parking sensors

Software Frameworks and Technologies

- Progressive Web Application (PWA)
 - Works on all iOS and Android devices and looks like a native app
- Frontend built using and Chakra UI
- Backend built using Next JS and deployed on Vercel
- Application database built using MongoDB