

The Problem:

Too much time and effort are spent looking for an open stall in a parking garage. Commuters need a visual indication of the status of a stall before they reach it. Such a system would aid frustration, congestion and tardiness for commuters.

Our Solution

Park - It - CDA is a system for indicating when a parking stall is vacant or full. Vehicles are detected within each individual stall via a redundancy of sensors, and an onboard LED lets the driver know that a stall is open. The LED is diffused with a protruding chamber for day-or-night visibility.

Requirements

- Units must sense/detect the presence of a vehicle
- Units must last for at least a year via battery power
- Units will use a mesh network to communicate with the gateway, as well as each other
- The enclosure must be no larger than 4" X 4" X 4"
- USB access for updates, resets, etc.
- Onboard RGB LED will indicate stall status
- Units must be synchronized and provisioned

Deliverables

- 5 fully functioning prototypes to be deployed in the parking garage in downtown Coeur d' Alene
- An integrated mesh network with a gateway installed at the Innovation den that will receive the stall status of the 5 units
- a simulation that will show an accurate representation of what a full garage deployment would look like

The GSU: Garage Sensor Unit

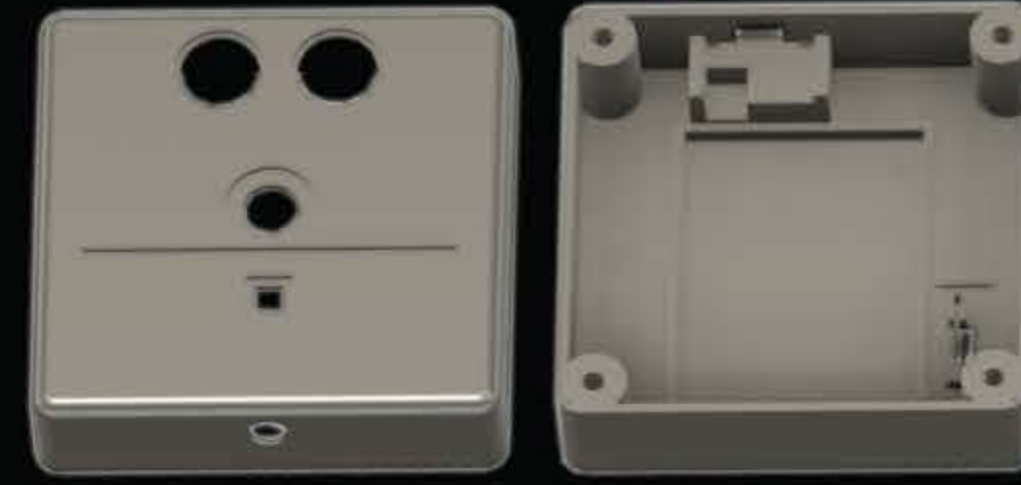
- Uses a PIR sensor to wake the processor when a heat signature is detected below
- Ultrasonic sensor makes 3 distance checks from unit to ground to verify blockage
- Outlying or erroneous results are thrown out in a 2 - to - 1 vote
- The onboard RGB LED is then updated to indicate stall status to commuters
- Stall status is periodically sent to gateway at the Innovation Den via LoRa transmission
- Stalls without GSUs are simulated using real test data from sensors

Components Used

- Adafruit Feather M0 LoRa board
- HC-SR04 ultrasonic sensor
- AM312 PIR sensor
- A single SMD RGB LED
- 868mhz LoRa antenna
- 3500mah Lipo battery
- 18650 Lipo charger
- Latching tactile switch
- DS3231 real-time clock module



Hardware Design



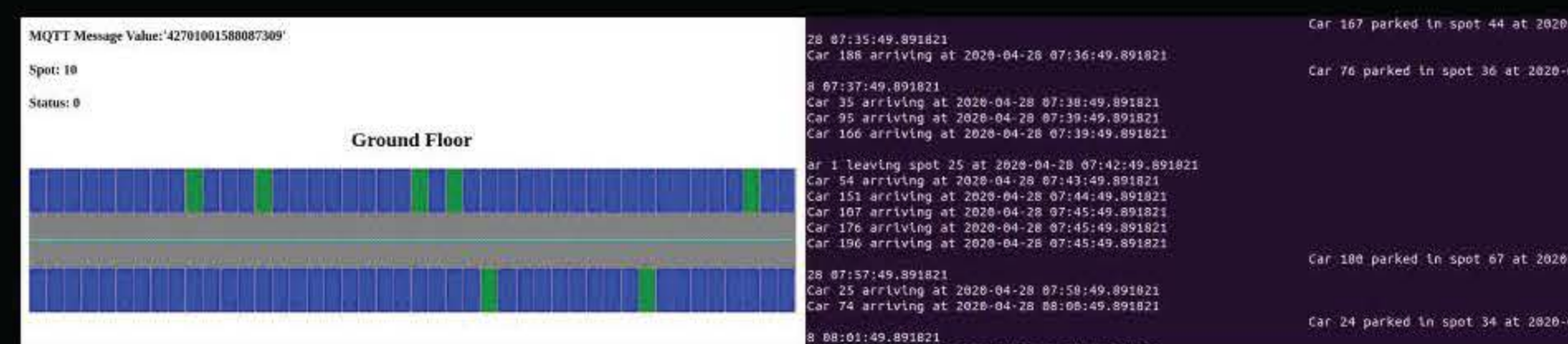
- Enclosure was designed using Fusion360
- Nine other iterations were tested before arriving at this one
- Copper-lined rings were designed and printed to limit the radius of the PIR sensor to prevent false triggers
- Enclosure was printed with 1.75mm PLA and painted black and white
- LED diffuser was designed and printed to give better spread to LED for day-or-night visibility

Mesh Networking



- Units transmit stall status at 900mhz to Dragino LoRa gateway at the Den
- Message packet also includes provisioning number and time stamp
- Units communicate with each other via mesh network to relay messages from all parts of the garage

Simulation

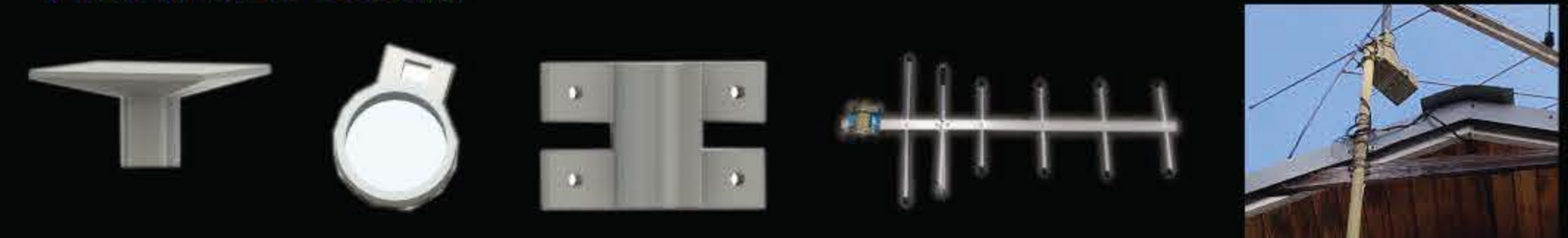


- Simulation runs on a webpage, and is updated via MQTT topics seeded from a Python script, and running on an ESP32
- Simulated data is representative of real world parking habits
- Stall availability is shown per level
- Easily expandable to include more mediums for data collection purposes

Covid-19 and Our Efforts to Communicate While Staying at Home

- Our team exhausted possible means of long-range LoRa communication to test our prototypes during the strict "stay at home" order
- Using makeshift masts from PCV and lumber, we achieved several successful transceived messages
- More data packets were dropped than were received

Hardware Used



- Staying at home meant 3D printing, and building makeshift custom hardware, including a PVC mount for the Yagi antenna, Zip-tie brackets and outfitting a flagpole with a 20' USB cable and power supply
- In the end, the communication was not stable enough for long range message broadcasting, and we have the Units and the gateway in the same location

Final Testing Setup



The Team

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