MIC PARK & RIDE

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Problem Statement

Parking space has become one of driver's concerns recently since the increasing number of vehicles on the road. Understanding this problem, UW Mobility Innovation Center (MIC) and Sound Transit are working toward creating a system that benefits drivers, especially those who use park & ride facilities.

We create a system as a solution for parking management, improving traffic flow, and reducing pollution. The solution we are working on is a cost-effective smart parking technology configuration that enables more efficient parking management and public information about parking availability.

Requirements

To collect parking data, we have been designed, implemented, and tested three different systems with following requirements:

- Parking Lot Sensor(PLS) System
  - Internet enabled via WiFi with static IP address for remote control
  - Waterproof (IP67)
  - Endure weight up to 4,000lbs
  - Report per space parking occupancy (every 35 seconds)
- Video Analytic System 1: MUST sensor
  - Internet enabled via cellular data
  - Digital camera vision plus IR night vision
  - Real-time vehicle detection
- Video Analytic System 2: Nvidia Jetson Nano and Dome Camera
  - Internet enabled via WiFi with private static IP address for remote control
  - Digital camera vision plus IR night vision
  - Real-time vehicle detection with GPU acceleration

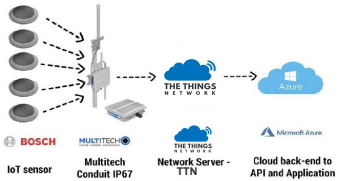
Milestone:

- Installation of sensor system delivered by the previous team
- Connection of sensor data to Azure storage
- Installation of video analytic and machine learning system
- Explore the accuracy of object detection with a non-ideal angle from camera system

Bosch

Hardwares implementation:

- Bosch sensor detects object using two sensor principles with 94% of accuracy.
- Bosch sensor uses LoRa wireless to transmit the signals 10 miles (without obstacles) or 2 miles (with obstacles).
- Multitech conduit Gateway connects to UW WiFi to receive LoRaWAN signals from Bosch sensors and transfer received signals to cloud computation.



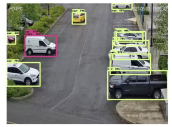
MUST

Hardware Implementation:

- MUST sensor is powered by Ethernet, and using cellular, it can transfer data to local or remote storage.
- MUST sensor collects the pictures from E20 parking lot every 10 seconds. Then, these pictures will be used to feed object detection that is included in the MUST sensor.

Software Implementation:

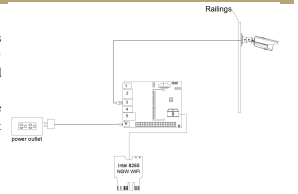
- Using object detection, in the picture, the bounding boxes mean that the software detects the objects with object type and percentage of detection.
- This is not an ideal angle because it has so much occlusion, and cars are overlap on each other, The accuracy is around 60%.



With Jetson Nano

Hardwares implementation:

- Jetson nano kit is an development kit that supports Ubuntu 18.04 and GPU computation. We used it for implementing object detection programming and accelerating computation.
- In our camera system , we use waterproof Dome Camera. This camera is compatible with jetson nano kit and provides night vision with infrared sensor.



Software Implementation:

- Object detection model: Yolo v3 (pretrained with COCO dataset).
- Remote desktop: x11vnc with TightVNC and SSH with PuTTY

Conclusion

- Successfully deploy and test three systems.
- Connected Bosch sensors with multitech conduit gateway and received the data.
- Used Must sensor to collect data from the parking space.
- Finished building camera system with jetson nano kit and implemented Yolov3 on it.

Future Work, References, and Acknowledgments

Future Work:

- Analyze and visualize data from the Bosch sensor
- Collect image data of parking lot and train the customized detection model (i.e. yolov3)
- Analyze different systems' performance in different parking lot scenarios (indoor, outdoor, garage)
- Develop a software for receiving real-time data of the parking lot availability

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