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:
  - Packing Lot Sensor (PLS) System
    - Internet enabled via WiFi with static IP address for remote control
    - Waterproof (IP67)
    - Endure weight up to 4,000 Ibs
    - Report per space parking occupancy (every 35 seconds)
  - Video Analytic System 1: MUST sensor
    - Using object detection, in the picture, the bounding boxes mean that the software detects the objects with object type and percentage of detection.
    - MUST sensor collects the pictures from E20 parking lot every 10 seconds.
    - MUST sensor is powered by Ethernet, and using cellular, it can transfer data to local or remote storage.
    - MUST sensor detects object using two sensor principles with 94% of accuracy.
  - Video Analytic System 2: Nvidia Jetson Nano and Dome Camera
    - Using object detection, in the picture, the bounding boxes mean that the software detects the objects with object type and percentage of detection.
    - Using object detection, in the picture, the bounding boxes mean that the software detects the objects with object type and percentage of detection.
    - Internet enabled via WiFi with static IP address for remote control
    - Digital camera vision plus IR night vision
    - Digital camera vision plus IR night vision
    - Real-time vehicle detection with GPU acceleration

Hardware 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.

Software Implementation:

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

Conclusion

- Successfully deployed 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

Acknowledgments

References:

- Bosch, Germany, "parking-lot-sensor-datasheet.".
- Deployments.” 86002216
- Multitech, “IP67 Conduit for Outdoor LoRa® Gateways.”
- "Parking lot vision database.”
- "Parking lot vision database.”