Low Cost Vehicle Detection System to Help “Green” UCI Parking

Presented by:

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Overview

- Problem Definition
- Project Description
- Analysis
- Conclusions
- Recommendations
- Future considerations
Problem Definition

- Approximately 17,000 students and faculty commute to UCI
- Need to reduce greenhouse gas emissions by campus traffic
- UCI Parking and Transportation Services (PTS) is looking for ways to reduce the campus’s carbon footprint
Project Description

- Low cost vehicle detection system to measure vehicle occupancy of a parking structure by floor
  - Hybrid system comprised of inductive loop and video detection

- Applied system to the first floor of the Anteater Parking Structure

- Performed analysis and conclusions on system accuracy

- Utilized 45 active ITE student members
Campus Parking Map

Project Location

Major Parking Facilities
Description of System Location

- First detection location is at the structure’s entrance
  - **Temporary loop detectors:** “Blade” Detectors

- First detection location is at the structure’s entrance
  - **Video detector:** Webcam

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Blade Detectors

Cabinet

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Webcam Detector
System Components

Cabinet installed to house equipment

Blade Detectors

Webcam Detector

Cabinet

Router

Laptop

Input file
Candidate Detection Technologies

**Intrusive**
- Magnetometer
- Inductive loops

**Non-Intrusive**
- Infrared
- Video

**Selection Criteria**
- Accuracy
- Costs
- Implementation Restrictions
## Hybrid Detection System

### Blade Detector
- Most accurate
- Reliable
- Vehicle signatures

### Webcam Detector
- Cost-effective
- Accurate with calibration
- Can be installed inside the parking structure
- Does not require traffic cabinet
UCI ITE Developed Software

- Programmed in Java by our chapter
- **CamFilter** interprets Zone Trigger data files
  - Fully automated system
  - Sensitivity calibration
- **BladeFilter** removes false detections from blade detector data
  - Threshold calibration
Analysis of Blade Detectors

- Blade detectors were 98% accurate
- Good vehicle signature (see right)
Analysis of Blade Detectors

- Inaccuracies
  - Tailgating vehicles (shown left)
  - False readings (shown right)

- False readings were removed via BladeFilter
Analysis of the Webcam

- Before calibration, detection accuracy was at 84%.
- Calibration test cases:
  - Excessive speed
  - Tailgating
  - Cars in passing
  - Pedestrians
  - Transitional lighting
- Through iterative calibration, 94% accuracy was achieved.
Analysis of Hybrid System

- After a 5-hour study, the occupancy of the first floor was detected at an accuracy of 98%
Conclusions

- Low cost and accurate monitoring system
- Blade detectors performed well
- A majority of inaccuracies were due to the webcam detector
  - Wireless communications was unreliable
  - Uncontrolled lighting conditions
Breakdown of Materials Used

Total Project Cost - $575
- UROP Grant - $325
- PTS - $250
Recommendations

- Extrapolate our system throughout campus
  - Sawcut permanent loops
  - Install webcams on each floor

- With the current state of our system, the occupancy level needs to be reset every day or two

- Avoid wireless communication

- Investigate further calibration of webcam detector

- Use higher quality cameras and professional video detection software
Future Considerations

- Phone application
  - Displays **live occupancies for each structure by floor**
  - Reduce time to find parking, resulting in lower emissions
Special Thanks

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  - UCI Institute of Transportation Studies
  - Southern California ITE
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Thank you!!

Questions?