Requirements Specification for Dynamic Parking Signage Project

ELEC 491 Capstone Design Project

Team PL-89

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Glossary

IP	*Ingress Protection*
SEEDS	*Social Ecological Economic Development Studies*
UBC	*University of British Columbia*
UBC PAS	*UBC Parking and Access Services*
VIP	*Very Important Person*

1. Executive Summary

UBC Parking and Access Services(UBC PAS) foresees an increase in short-term parking demand on campus, and envisioned a solution using dynamic parking signage. In 2018, a capstone team was tasked with producing a prototype as proof of concept. This year, our team is tasked with improving this legacy prototype, and integrating new ideas to the project.

This document defines the acknowledged items between UBC PAS and the 2019-2020 Dynamic Parking Signage capstone team, including the context and goals of the project, the domain of the final product(s), and the functional and non-functional requirements for said product(s). These define the scope and specifications of the project and are the basis for the design decisions for the product.

Upon completion of this project, UBC PAS will receive two functional prototypes, source codes and relevant documents of the prototype - including a user manual to help develop the system further.

2. Context and Background

UBC SEEDS is an organization on campus that aims to find sustainable solutions to modern problems. Their purpose is to connect UBC students with UBC staff, faculty, and operations to advance sustainability ideas, using the UBC campus as a living laboratory.

UBC Parking Access Services is responsible for regulating and managing campus parking and access to university buildings. The goal of UBC PAS is to provide convenient, affordable and personalized parking options to the UBC community through innovative and sustainable technologies. The client believes that the parking experience is vital to all positive experiences on campus as the parking lot is usually the first and last thing people see on campus. UBC PAS foresees an increase in short-term parking due to an increase in deliveries and ride-hailing services in Vancouver which is the main motivation for this project.

This project was made possible by the UBC SEEDS program, for bringing together students and organizations for interdisciplinary partnerships to advance sustainability ideas. The goal is to enhance vehicle users' parking experiences through sustainable technology - motivated by the following three considerations:

- Safety: Lack of parking space causes drivers to resort to illegal curbside parking, which compromises circulation of other vehicles and pedestrians on campus[1]. This increased congestion results in higher chance of accidents and casualties [2][3].
- Economical: Maximizing parking stall usage could reduce congestion levels on campus roads, thus reducing wastage of resources [4].
- Ethical: Verifying the vacancy of disability stalls situated close to building entrances and ensuring the capacity of disability stalls exceeds the legal requirement.

The dynamic parking sign is a continuation project, building on previous years' research and progress.

3. Domain

The final product is part of the smart parking management sector, as the dynamic parking sign will provide management resources for UBC PAS to automate parking space usage, and create an overseeing network for parking on campus. The product is a custom project presented by UBC PAS to help alleviate parking at the UBC campus. The primary use of the parking signs would be for building parking, lots, and curbside parking (not including parkades). By the end of this project, two prototypes will be deployed to verify the practicality of the design.

The capstone team will be providing two signs capable of displaying stall restrictions controlled by UBC PAS. Since the project is a continuation, the team is improving upon the design presented at the start of the project. Our capstone team will be delivering a finalized sign that will be the foundation for a manufactured product, a management system, a user guide, and a developer manual to assist future developers in this project.

4. Goals

UBC PAS's main goal for this project is to design a product, dynamic parking display, that can be manufactured, as a sustainable solution to relieve parking issues on campus and explore new technologies to improve services.

The objectives are to have:

- Parking stall restriction flexibility
- Reduction in unused parking stalls
- cost-efficient manufactuability
- User-friendly management system

By the completion of the Dynamic Parking Signage project, UBC PAS can work to improve upon the parking experience on the UBC campus. Parking is often the first and last thing people accessing the university experiences, and UBC PAS wants to create a positive experience for each user.

5. Use Cases

The following use-cases are a demonstration of the capabilities of the parking sign we are producing for UBC Parking:

1. The signs will guarantee one stall at each building designated disability parking only. When the stall is occupied, the next available stall will be changed to disability parking. Meanwhile, other stalls will be set to the user's preference (i.e. displaying temporary parking for pick up/drop-offs, deliveries, and parking).

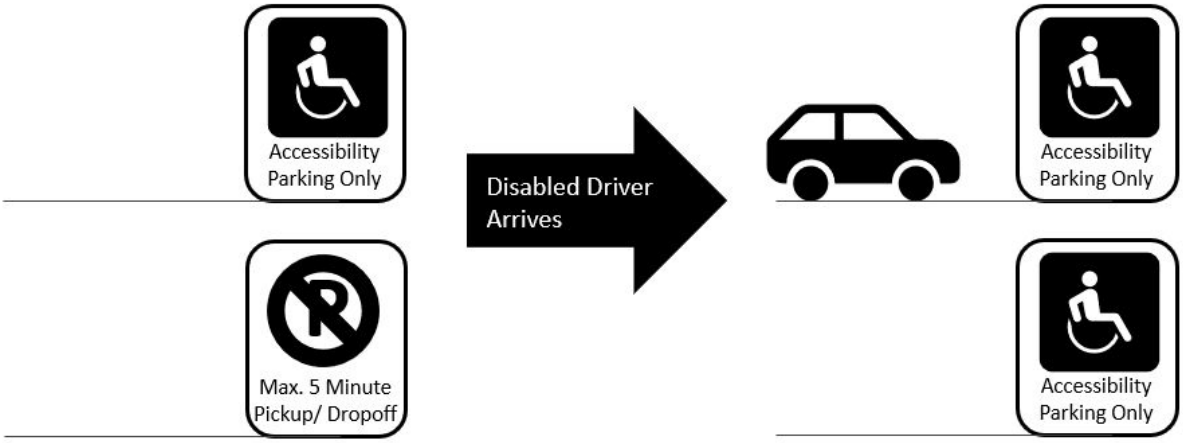

Figure 1. Example of Use Case 1 - Guaranteed Accessibility Parking

2. Change the sign depending on a schedule. Having the sign display parking restrictions during scheduled times throughout the day (i.e. displaying “daycare pick up/drop off,” during peak hours (morning and afternoons) and having “5-minute parking,” during the other days).

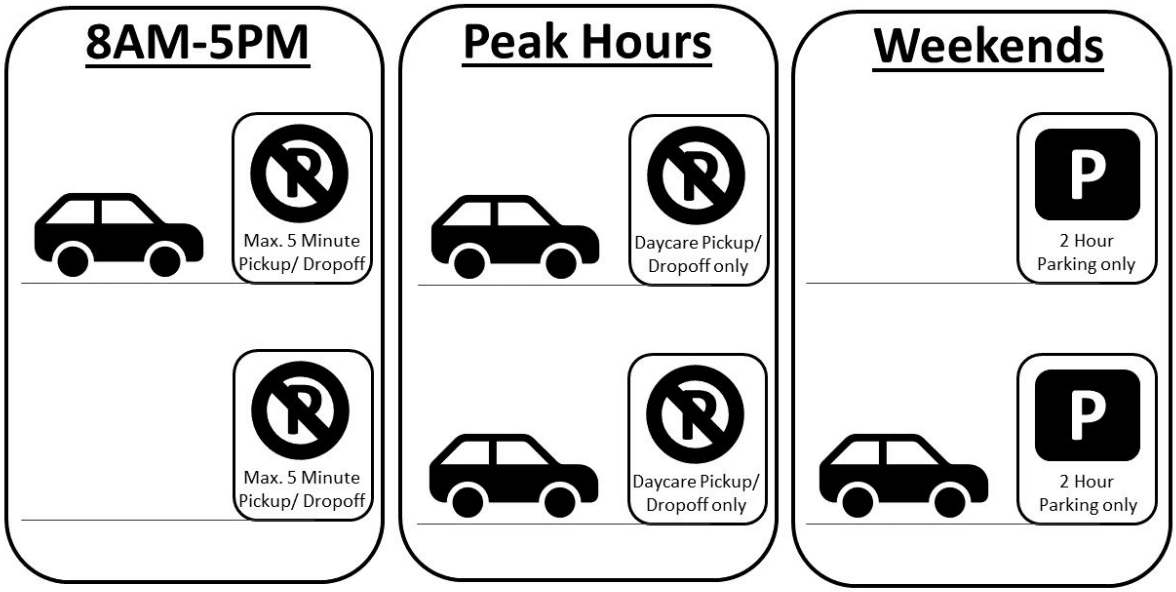

Figure 2. Example of Use Case 2 - Sign Changes Based on Schedule

3. Can modify the sign for special parking. Allowing the user the ability to modify the sign to display stall restriction depending on special events and designated parking (i.e. parking for events, VIP parking, and no parking).

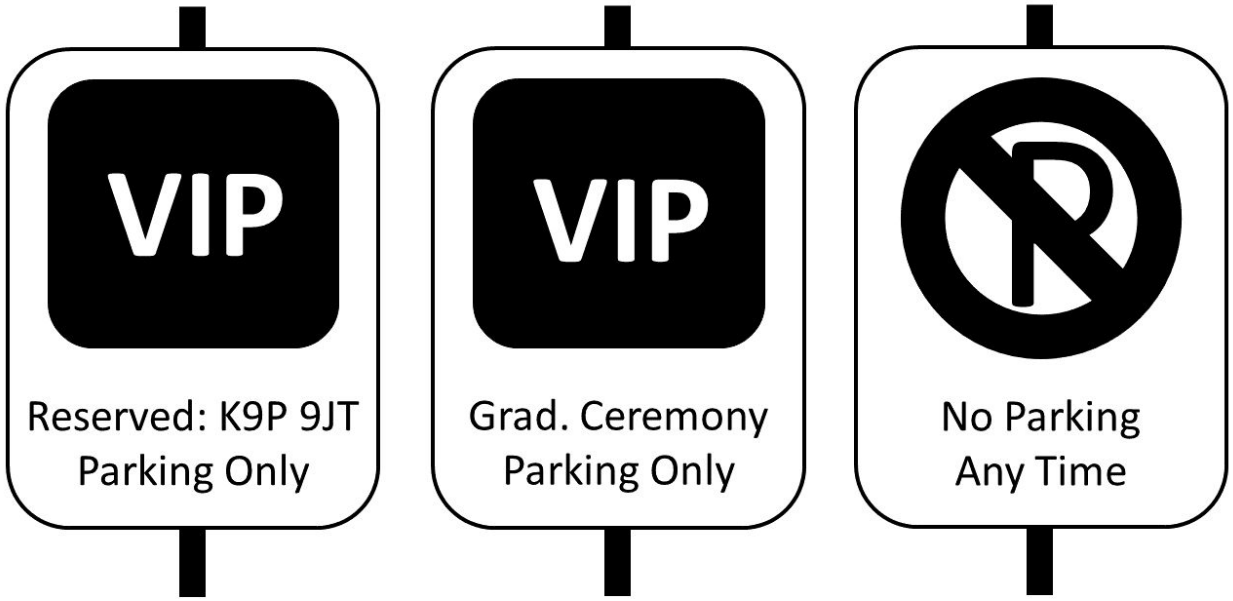

Figure 3. Example of Use Case 3 - Signs for Special Parking

Each of the use cases was presented by UBC Parking as examples of how the sign would be operated. The use cases are the motivation of the functional and non-functional requirements - with respect to constraints given by UBC Parking.

6. Requirements

This section lists the requirements and constraints agreed upon with the capstone team and the clients, which will be the rationale for all project design decisions. These requirements will be presented as functional and non-functional requirements for the desired behaviour and desired performance respectively. This section also gives a list of use cases and constraints given by the client.

6.1 Functional Requirements

FR1 Management of stall parking protocols based on parking occupancy
FR2 Programmable device to control display
FR3 Sign remains visible and readable in all conditions

6.2 Non-Functional Requirements

NFR1 Self-powered, lasting for at least two weeks - including low light and night conditions
NFR2 Change signage within two minutes of an update
NFR3 Sign must be visible from 2 meters away throughout the day
NFR4 Weatherproof enclosure with a rating IP65 or higher
NFR5 Must be durable to survive outdoors with many potentially destructive elements (falling branches, birds flying into a sign, ball hitting a sign, debris from construction)

6.3 Constraints

C1 Uses solar power as part of the self-powering system
C2 Thickness of the enclosure should not exceed 2 inches and a reduced solar panel size
C3 Wireless communication between sign and management system

7. References

[1] B. S. Bezerra, G. G. Manzato, S. V. de Mello, A. S. Peixoto, and M. C. Batistao, “Framework for Infrastructure Risk Analysis to Pedestrians in a University Campus Parking,” *Theoretical and Empirical Researches in Urban Management*, vol. 14, no. 2, pp. 59–71, May 2019.

[2] A. E. Retallack and B. Ostendorf, “Current Understanding of the Effects of Congestion on Traffic Accidents,” *Environmental Research and Public Health*, vol. 16, no. 18, Sep. 2019.

[3] D. A. Hennessy and D. L. Wiesenthal, “Traffic Congestion, Driver Stress, and Driver Aggression,” *Aggressive Behavior*, vol. 25, no. 6, pp. 409–423, Jan. 1999.

[4] P. Christidis and N. I. Rivas, “Measuring Road Congestion,” *Joint Research Centre*, pp. 1–28, 2012.