PROJECT PROPOSAL

Smart Parking Management System

All task, no chill

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National Project Management System

Business Projects-IT-Enabled

Definition Phas

Public Works and Government Services Canada

Travaux publics et Services gouvernementaux Canada

Canada

Revision History

Version Number	Description	Date Modified	Author
1.0.0	Finished the Purpose and Background	01/16/2025	Omar Henriquez
1.0.1	Added Problem and opportunity definition for the topics and provide assumption	01/18/2025	Matthew Tsz Hin Yu
1.0.2	Determined the project Constraints and Provide the Risk Considerations	01/18/2025	Wing Yan Kwan
1.0.3	Providing the option analyzation and defining the requirements of the project.	01/19/2025	Dexin Li
1.0.4	Provided the Approvals Sought and Risks of not Proceeding	01/20/2025	Jiyoun Shim
1.0.5	Determined Approval Authorities and Financials	01/20/2025	Ibrahim Umar Sani

Authority Signatures

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1 Purpose

This Statement of Requirement document is a seed funding request for the Smart Parking Management System. This system will transform the parking experience for urban drivers and for parking operators. The system will apply IoT, AI, and cloud-based systems to improve efficiency, decrease congestion, and maximize revenue possibilities.

Parking management is often a point of pain for urban areas. Consequently, drivers commonly waste a lot of time looking for parking places, especially in busy urban settings, making traffic worse, and preventing the revenue of parking operators. This system will be unlike traditional systems that lack real-time availability information, seamless payment integration, or dynamic pricing strategies to optimize space usage.

This project aims to solve these problems by implementing a Smart Parking Management System using IoT sensors, a mobile app, and a cloud backend. This system will ease parking operations, enhancing drivers' experience and help operators use their space effectively. Ultimately, it claims to relieve traffic congestion, decrease carbon emissions, and improve operational profitability.

2 Background

The Parking Problem
As urbanization continues to rise, cities are increasingly struggling with parking inefficiencies. Studies show that as much as 30% of inner-city traffic is made up of drivers looking for a parking space. This not only contributes to the loss of time, which in itself has costs, but also has other significant consequences: more harmful emissions from vehicles, reduced productivity of both the drivers and the businesses that need their services, and lost sources of revenue for municipalities and private operators of parking, who in most cases are surely aware of the importance of such services. These issues are compounded by the lack of real-time parking availability data and outdated payment systems, which cause frustration for drivers and operational inefficiencies for parking lot managers. This extends to other areas like shopping centers, malls and universities as well.

External Drivers
Across the world, policies promoting urban mobility and environmental sustainability are already being implemented by governments and organizations. For instance, the European Green Deal affirms that we cannot wait any longer to make sustainable urban transport a priority, and cities like San Francisco and Amsterdam have begun developing congestion pricing to help combat traffic congestion. This objective is complemented by a Smart Parking Management System that minimizes waiting time and maximizes efficiency of city infrastructure.

A conducive environment for the region's transformation has been created by technological progress. Through innovations in IoT sensors, mobile application development and cloud computing, deploying smart parking solutions is becoming more feasible and cost effective. As a

result, this calls for of evolving from the customary pricing models to additional holistic pricing strategies that will, maximizing the parking lot revenues and operational excellence that are made available through such funds.

Internal Drivers
Operational inefficiency is a critical problem of the parking industry. Parking operators have traditionally relied on old systems that limit their ability to effectively monitor and manage parking spaces. All these antiquated systems result in low visibility of the parking lot usage, incorrect revenue accounting, and high human cost on enforcement and cash collection.

However, in order to automate all these processes an Automated Smart Parking Management System can also be implemented which will not only increase efficiency but also save cost.

Dynamic mechanisms enable operators to monetize higher-demand periods — for instance during big events or busy hours at malls. Moreover, automated payment systems minimize the likelihood of error as well as fraud that is typical in manual transactions which allows enhanced predictability of cash flow.

Customer expectations are shifting as well and present-day consumers expect speed and convenience. Real-time parking data, online booking, and cashless payments are highly convenient, which boosts customer engagement, retention, and satisfaction. Being frictionless and Intuitive is no longer a luxury but is something that is needed especially in the parking experience.

3   Problem/Opportunity Definition

Currently busy areas like downtown are increasingly plagued by inefficient parking, leading to traffic congestion, time waste and environmental problems. Also, the traditional parking system lacks real-time availability information, easy payment methods, which exacerbates the problem.

Our smart parking management system aims to address these problems by using modern technologies such as taking advantage of mobile applications, AI technology to calculate the best parking spot according to fee and distance between the destination. By doing so, it reduces the time drivers spend on searching for parking.

4   Assumption

Our smart parking management system has following assumptions:
- Goal:
  - Our goal for this project is to create a system that addresses the traditional parking inefficiencies by using mobile applications, AI technology.
- Product Scope:
  - The system can be used in various places, including traditional parking areas, shopping malls, universities, etc.

- This product will include a mobile application (frontend and backend) and sensors for parking slots.
- Target Audience
  - The system is designed for drivers who seek efficient parking solutions, and parking lot owners who want to have more control.

5 Constraints

Regarding technological constraints, connecting the sensor or camera and the real-time system will be one of the biggest challenges. To maintain stable connections in multi-level parking structures including underground where the signal strength may be weak.

For hardware constraints, the power supply will be one of them. As the systems will need to support huge amounts of sensors and cameras, it is important to have strong power support. Also, the hardware will face different environmental conditions. The sensors and cameras need to be able to tolerate extreme weather conditions like high/low temperatures, rain, snow, etc.

Another potential constraint will be financial constraints. Regular repair, software updates, technical support, and maintenance are necessary whenever it comes to using technological hardware. Apart from maintenance costs, the set-up cost and initial capital investment of the whole smart parking management system will also be expected to be high.

6 Analysis of Option and Recommendation

Option 1: Partially Automated Parking System

Features:

- Reserved Parking Spots: Provide designated reserved parking spots that users can conveniently reserve online, ensuring they do not need to worry about finding a parking spot.
- Online Reservation on App: Customers are allowed to book a parking spot online.
- Barrier for Reserved Spots: A barrier is used, or staff manually lifts the barrier to prevent unauthorized use of reserved spots.
- Digital Payment and Ticketing: Automated ticket generation for users who book a parking spot online or at the entry point. Multiple payment methods are supported, including cash, cards, and digital wallets.
- Basic Occupancy Monitoring: General availability is displayed on digital boards at parking entrances or central locations. Users manually find parking spaces based on displayed data.

Advantages:

- Provides a platform for users to make reservations online, allowing them to plan ahead.
- Lower development cost and reduced risks, including system failure.

- Lower schedule risk, technical risk, and quality risk, making this option more stable.

  Disadvantages:

- Limited scalability and functionality compared to fully automated systems.
- No real-time navigation assistance is provided.
- Lacks data analysis capabilities to assist users in choosing parking spots effectively.

Option 2: Fully Integrated Smart Parking System (Recommended)

    Features:

- All Features of Partially Automated Parking System
- IoT sensors installed in each parking spot detect availability in real time. Data is sent to a cloud-based backend, providing live updates to users and staff.
- AI Algorithms for Optimized Parking: AI algorithms calculate the best available parking spot based on proximity and pricing.
- Notifications for Upcoming Reservations: Alerts notify users about their upcoming reservations.
- Provide Dynamic Pricing strategy which allows prices to be adjusted dynamically based on demand and time.
- AI-powered cameras monitor activity and detect violations, enhancing security. License plate recognition ensures seamless entry and exit for registered users.

  Advantages:

- Fully automated parking management, reducing labor dependency.
- Real-time data improves decision-making for users.
- Scalable and customizable to suit various parking environments.
- Enhances user experience by providing a more convenient way to find parking spots with navigation and guidance.

  Disadvantages:

- High initial investment in hardware and software development.
- Maintenance of IoT devices and cloud systems incurs ongoing costs.
- A new approach to parking may take time for users to adapt to and achieve market accessibility.

Recommendation: I recommended the fully integrated smart parking system based on its ability to solve key urban parking challenges, including inefficiency on searching parking spots, congestion, and revenue optimization . While the upfront cost is higher, the long-term benefits align with future trends in automation and informatization, improving operational efficiency and user experience.

7   Preliminary Project Requirements

Here are some key requirements that need to be considered:

Real-Time Occupancy Tracking:

● Install IoT sensors in parking lots to monitor availability and update parking status in real time.
● Sensors must be durable and capable of withstanding extreme weather conditions.
● Data from sensors should be sent to a cloud-based backend for live updates and analytics.

Dynamic Pricing System:

● Integration of pricing models that adjust dynamically during peak demand or special events to optimize revenue.
● AI algorithms should support the calculation of optimal pricing based on real-time data.

Automated Payment System:

● Provide multiple payment options, including cards, digital wallets, and subscription plans.
● Ensure secure transactions with end-to-end encryption and real-time payment processing.

Security Features:

● Implement robust data encryption to protect user information.
● Utilize secure APIs for communication between system components.
● Enforce access control mechanisms to limit unauthorized access.
● Regularly apply security updates and patches to maintain system integrity.
● User authentication methods must include:
  ○ Two-Factor Authentication.
  ○ Biometric Authentication.
  ○ Identification via text or email verification.

Mobile Application:

● Develop a user-friendly app with a clearly labeled structure and a well-designed user interface. Key functions include:
  ○ Reserving parking spaces in advance.
  ○ Providing GPS navigation to the nearest available spot using AI technology.
  ○ Managing payments and viewing payment history.
  ○ Offering a Q&A option to provide users a platform for seeking help from customer service.
  ○ Including a guided tutorial to familiarize users with app functionality.

Enhanced Security and Monitoring:

● Integrate AI-powered cameras for activity monitoring and violation detection.

- Employ license plate recognition to ensure seamless entry and exit for registered users.
- Provide real-time notifications for users about reservation status and system updates.

This set of requirements ensures the system meets modern standards of efficiency, user convenience, and security while aligning with the project's long-term goals of scalability and automation.

8 Risk Considerations

High-level risks related to this initiative could include:

- System failure

- Privacy

- Data security

9 Approvals Sought

This Statement of Approval document seeks:

- Approval of the Statement of Requirements:

    We request approval for the scope, objectives, and main features of the Smart Parking Management System. This solution will use IoT sensors, AI-powered algorithms, a simple mobile app and cloud-based technology. Together, these parts are designed to automate parking operations, promote user convenience, and increase operators' revenue.

- Authorization to Prepare Preliminary Project Documentation:

    We ask for authorization to begin the required documentation for Preliminary Project Approval (PPA). This will include feasibility studies, technical requirements, and business cases. The documentation will also address major risks, including system reliability, data privacy, and security measures to make sure the project can meet high performance and safety standards.

- Spending Authority for Seed Funding:

We seek funding approval for $225,000 in the first fiscal year (FY1) and $205,000 in the second fiscal year (FY2), as outlined in Table 10-1. This funding will be allocated as follows:

- ○ City of Toronto : $150,000 annually for FY1 and FY2
- ○ Toronto Parking Authority : $50,000 annually for FY1 and FY2
- ○ Infrastructure Ontario : $25,000 in FY1 and $5,000 in FY2

These funds will cover initial development costs, including permits, IoT sensors, parking meters, mobile app development, installation, integration, and cloud hosting. Table 10-2 gives a detailed spending breakdown.

- Validation to Cover Primary Risk Zones :

  We ask for permission to build solid risk mitigation mechanisms into the project design, such as

  - ○ Ensuring system reliability to avoid operational disruptions.
  - ○ Implementing advanced data security protocols to safeguard user information
  - ○ Addressing privacy concerns and ensuring compliance with applicable regulations.

- Endorsement from Approval Authorities

  The following are the relevant stakeholders and organizations we need for project to be accepted :

  - ○ Toronto Parking Authority
  - ○ City of Toronto
  - ○ Ministry of Transportation Ontario
  - ○ Infrastructure Ontario
  - ○ Additional engagement with daily commuters, visitors, commercial real estate developers, shopping mall parking managers, IoT solution providers, and cloud service providers

- Permission to Enter Strategic Partnership :

  We ask for authorization to collaborate with IoT solution providers, cloud hosting service providers, and other interested parties to make the Smart Parking Management System cost-effective and scalable.

10 Risk(s) of NOT Proceeding

If no action is taken, Toronto, along with stakeholders like the Parking Authority and Infrastructure Ontario could face the significant challenges:

1. **Continued Operational Inefficiencies** : The persistent legacy parking system will lead to poor parking lot utilization, inaccurate revenue tracking, and high labor costs for enforcement and manual payment collection.
2. **Missed Opportunities to Maximize Revenue** : Without implementing the Smart Parking Management System, parking operators risk losing out on the benefits of dynamic pricing models and real-time analytics. These tools are essential for optimizing revenue, especially during peak demand times like major events or busy shopping seasons.
3. **Worsening Traffic Congestion**: Inefficient parking systems force drivers to spend extra time searching for parking spaces, which adds to urban traffic problems. This not only increases frustration but also contributes to higher carbon emissions and environmental harm.
4. **Decreasing Customer Satisfaction** : Today's consumers expect fast, convenient, and seamless experience, including cashless payment options. Failure to provide a user-friendly app that supports real-time parking information and reservation capabilities will erode customer satisfaction and engagement.
5. **Failure to Align with Urban Sustainability Goals** : Governments and organizations are prioritizing sustainable urban mobility solutions. Without this initiative, the City of Toronto risks falling behind in meeting these objectives, as outlined in frameworks like the European Green Deal and similar urban policies.
6. **Rising Maintenance Costs for Outdated Systems** : Continued reliance on legacy systems will lead to increased costs for repairs, replacements, and manual processes. It will eventually place an unnecessary financial burden on parking operators.

Choosing not to move forward with this initiative may leave the City of Toronto and its stakeholders struggling to tackle critical urban challenges, potentially slowing advancement toward modernization, sustainability, and improved user experiences.

11 Approval Authority

Toronto Parking Authority: President & Board of Directors
City of Toronto: General Manager of Transportation Services
Ministry of Transportation Ontario: Minister & Deputy Minister of Transportation
Infrastructure Ontario: President/CEO
City of Toronto – City Council
Commuters: Daily users who require parking for work or errands.
Visitors: Tourists or occasional users seeking convenient parking options.
Commercial Real Estate Developers: Developers who include parking in their buildings and are interested in modernization.
Shopping Mall Parking Managers: Eaton Centre or Yorkdale Mall parking facilities.
IoT Solution Providers

Cloud Service Providers: Organizations like AWS, Microsoft Azure, or Google Cloud to host and manage system data.

12 Financials

Table 10-1 – Source of Seed Funding

#	Source	FY1	FY2
1	City of Toronto	$150,000.00	$150,000.00
2	Toronto Parking Authority	$50,000.00	$50,000.00
3	Infrastructure Ontario	$25,000.00	$5,000.00

Table 10-2 – Spending Breakdown

#	Spending Breakdown	$K
1	Municipal permits, approvals and certifications	25
2	IoT sensors (per sensor)	0.25
3	Parking meters (per meter)	2
4	Mobile app development	50
5	Installation and Integration	250
6	Cloud hosting subscription (annually)	25
Total:		352.25

13 Project Team

The project team consists of the following members.

Table 11-1 – Source of Seed Funding

#	Name	Role	Contact Information
1	Wing Yan Kwan	Cloud Engineer	####@my.yorku.ca
2	Omar Henriquez	IoT Engineer	#####@yorku.ca
3	Dexin Li	Project Team Leader	#####@gmail.com
4	Ibrahim Umar Sani	Cloud Engineer	#####@yorku.ca
5	Jiyoun Shim	Data Analyst	#####@yorku.ca
6	Matthew Tsz Hinn Yu	Software Developer	######@my.yorku.ca