Introduction

Definitions:

A Parking Lot Management System (PLMS) is an integrated digital platform designed to automate and streamline the management of parking spaces, vehicle entries and exits, and user interactions.

Problem Summary:

Parking inefficiencies result in overbooking, underutilized spaces, and frustration for users. The University of Calgary has faced significant challenges with parking space availability, particularly during peak hours, causing delays and dissatisfaction among students, faculty, and visitors.

Solution Summary:

The proposed PLMS will provide real-time tracking of parking slot availability, automated booking, and efficient fee calculation to enhance the parking experience for all users.

Motivation:

Parking management is a crucial service in urban and institutional settings, where efficient utilization of limited resources can significantly improve user satisfaction and reduce congestion.

Format of the Proposal:

This document outlines the Problem Definition, Proposed Solution, Motivation, Conclusion, and References.

Problem Definition

History of the Problem:

As urban campuses like the University of Calgary expand, the demand for parking exceeds supply. This leads to traffic congestion, delayed parking spot identification, and disputes over space allocation.

Why It's Interesting:

Parking challenges affect thousands of individuals daily, making it a pressing issue with potential for wide-reaching impact.

When and Why It Occurs:

The problem intensifies during academic sessions, events, and peak hours when high demand collides with limited parking availability.

Existing Solutions:

The University uses ticketing systems and physical permits, which lack real-time updates or the ability to reserve spaces in advance.

Improvements Needed:

Integration of real-time slot availability, mobile-friendly user portals, and automated management of parking fees and overstay penalties.

Proposed Solution

Project Achievements:

- Efficient management of parking spaces with real-time updates.
- Simplified booking and payment process for users.
- Enhanced admin capabilities to monitor and optimize parking lot utilization.

Project Deliverables:

Project achievement	Project Output	Product features
Streamlined Management	Admin Dashboard 1	Add, edit, or remove parking slots. Generate reports on parking usage and revenue. Monitor overstay violations with automated alerts.
Improved Accessibility	Customer Portal	View real-time slot availability with filters for preferences. Book parking slots in advance or upon arrival. Pay parking fees online and receive digital receipts.
Optimized Efficiency	Parking Management System	Real-time slot availability. Advanced booking and parking reservation.

Table 1: Project Overview

Additional Features:

- **License Plate Recognition (LPR):** Expedite check-ins and track vehicle exits using stored vehicle information.
- **Overstay Management:** Notify users of impending overstays and allow penalty payments online.
- **Monthly/Seasonal Subscriptions:** Users can purchase long-term parking plans with dedicated slots or discounts.
- **Dynamic Pricing:** Adjust parking rates based on demand (e.g., peak hours vs. off-peak hours).

- **Integration with University Events:** Automatically reserve sections of the parking lot for large events.

Motivation

Why It's Needed:

At the University of Calgary, parking has long been a contentious issue. A better system will reduce frustration, optimize resource utilization, and improve the overall campus experience.

What Makes It Unique:

Incorporates real-time tracking, license plate recognition, and dynamic pricing tailored to the university environment.

Project Contribution:

Enhances parking efficiency, reduces wait times, and provides flexibility to adapt to high-demand scenarios.

Conclusion

Summary:

The Parking Lot Management System addresses critical challenges in parking management, with a specific focus on the University of Calgary's unique needs. It combines real-time updates, automation, and user-friendly design to improve the parking experience.

Estimated Timeline:

- **Feb 3 - Feb 12:**
  - Research and requirement analysis.
  - Database design, including ERD and schema.
  - Docker environment setup.
- **Feb 13 - Mar 12:**
  - Develop backend functionality in PHP (slot booking, payment integration).
  - Create admin dashboard and customer portal interfaces with TailwindCSS.
- **Mar 13 - April 11:**
  - Integrate features like license plate recognition and overstay notifications.
  - Test and deploy using Docker.

References

- City of Calgary. (n.d.). Simplifying parking management. ParkPlus system. https://www.calgaryparking.com/about/parkplus-system.html
- Ive, M. (2023a, September 27). Dynamic pricing: A new revenue stream for parking operations. Rezcomm. https://www.rezcomm.com/resources/blog/reservations/dynamic-pricing-revenue-stream-parking

Summary:

Our Parking Lot Management System (PLMS) is a software system that is designed for the ease of parking transactions at the University of Calgary. It is set to eliminate overbooking, low utilization, and congestion by providing real-time parking availability and automated booking.

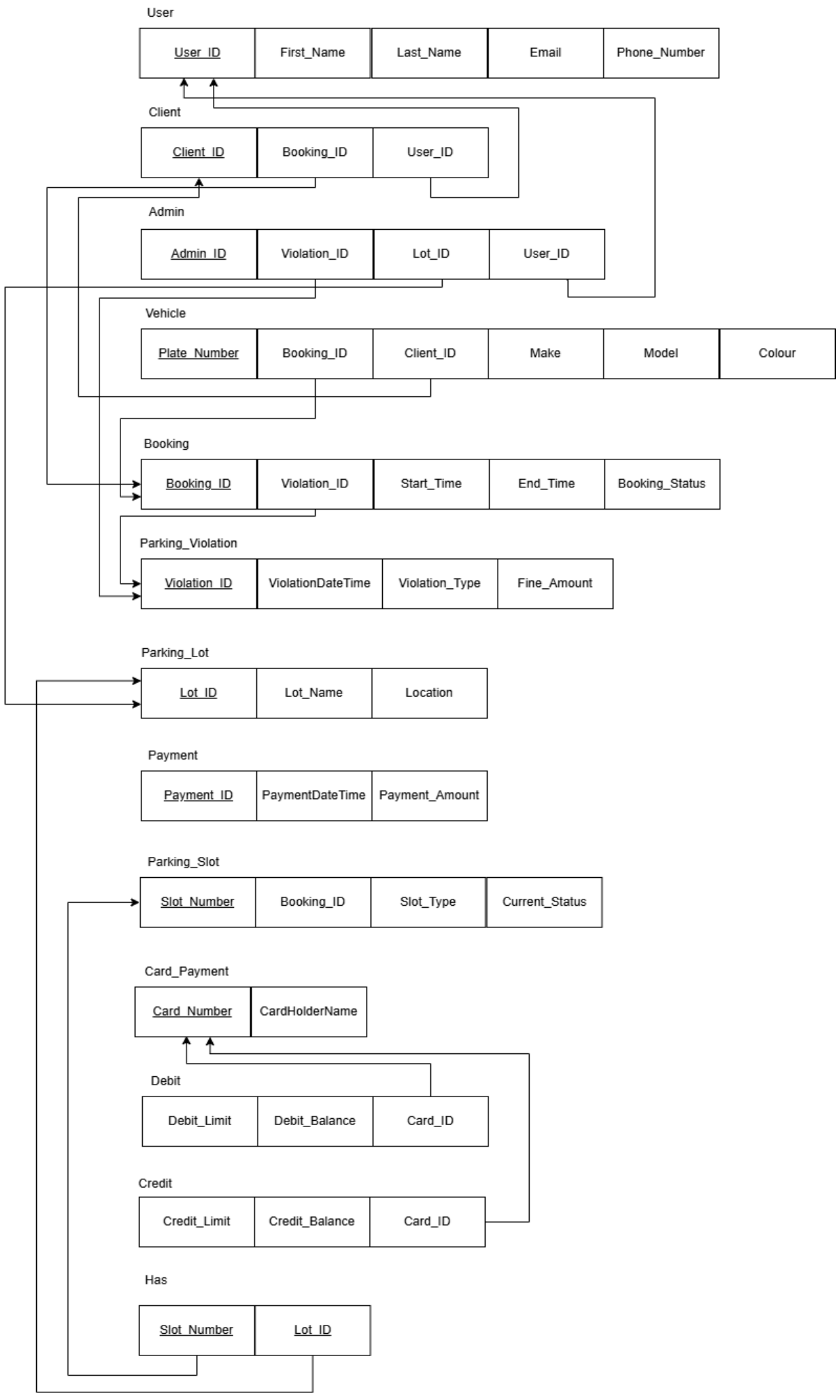
With functionalities like license plate recognition (LPR), dynamic pricing, and overstay management, the system maximizes user satisfaction along with the optimization of resource usage. With a web-based user interface as well as an administrator's interface, PLMS will enhance parking efficiency, reduce waiting time, and impose a better structure for handling parking.

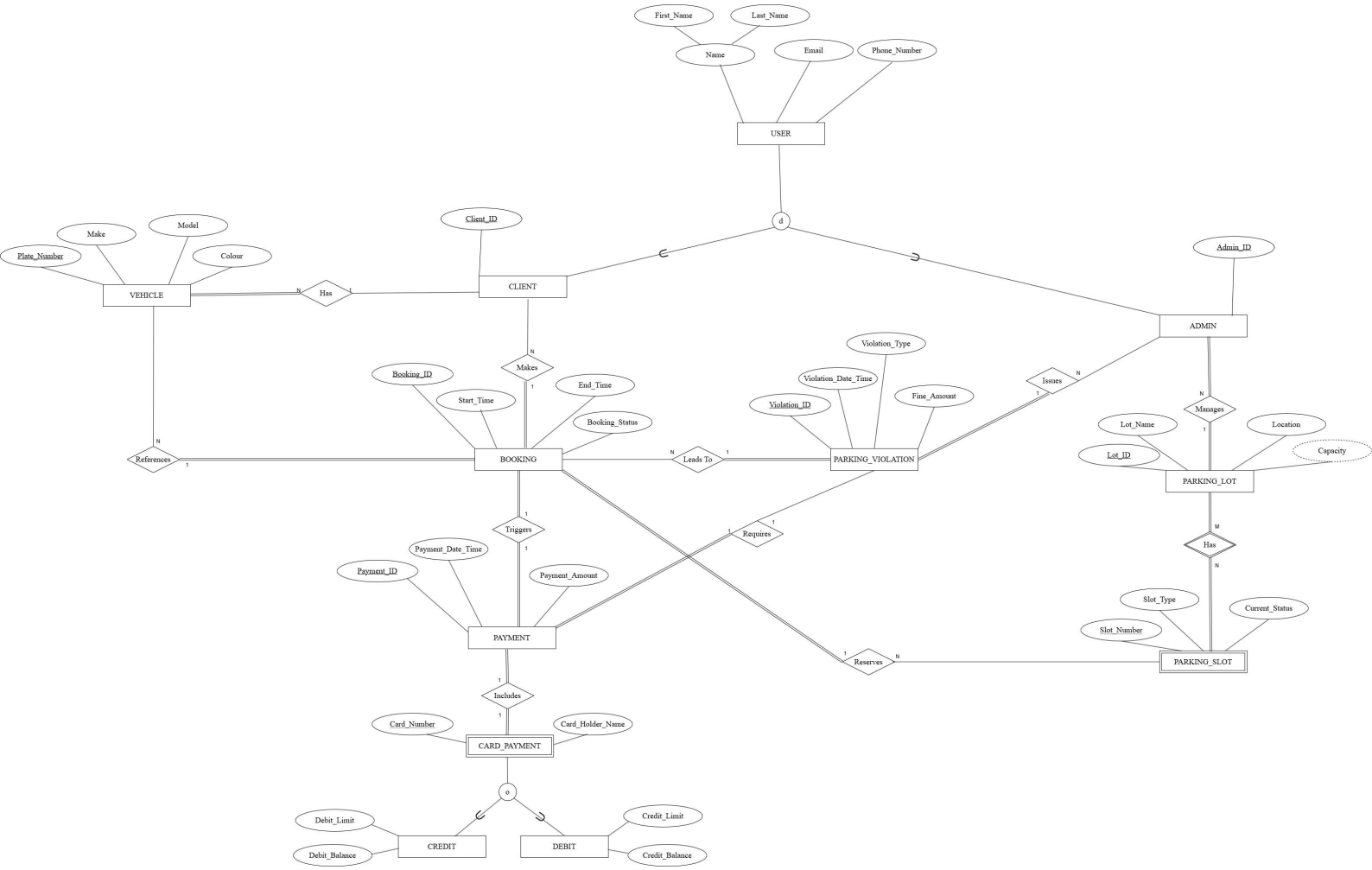
Below we have constructed the corresponding Relational Model (RM) for our EERD diagram which contains the same assumptions.

Our updated EERD with attributes for Debit and Credit is also attached for reference.

Assumptions:

- Admin’s do not park in the lot and simply manage the system
- Admins can manage multiple parking lots and must be assigned a single one
- Clients can make bookings ahead of time
- Clients must register at least one vehicle to make a booking
- Vehicle may or may not be booked by client
- Not all bookings lead to violations
- Parking lot can initially be empty and all parking slots are part of a parking lot
- Each admin must manage at least 1 parking lot
- Parking violations are only issued when a client violates the rules
- System does not support refunds
- Users can only pay using debit or credit card


User
User_ID
First_Name
Last_Name
Email
Phone_Number
Client
Client_ID
Booking_ID
User_ID
Admin
Admin_ID
Violation_ID
Lot_ID
User_ID
Vehicle
Plate_Number
Booking_ID
Client_ID
Make
Model
Colour
Booking
Booking_ID
Violation_ID
Start_Time
End_Time
Booking_Status
Parking_Violation
Violation_ID
ViolationDateTime
Violation_Type
Fine_Amount
Parking_Lot
Lot_ID
Lot_Name
Location
Payment
Payment_ID
PaymentDateTime
Payment_Amount
Parking_Slot
Slot_Number
Booking_ID
Slot_Type
Current_Status
Card_Payment
Card_Number
CardHolderName
Debit
Debit_Limit
Debit_Balance
Card_ID
Credit
Credit_Limit
Credit_Balance
Card_ID
Has
Slot_Number
Lot_ID


First_Name
Last_Name
Name
Email
Phone_Number
USER
d
Client_ID
Admin_ID
Make
Model
Plate_Number
Colour
VEHICLE
Has
CLIENT
ADMIN
Makes
Booking_ID
Start_Time
End_Time
Booking_Status
Violation_Type
Violation_Date_Time
Violation_ID
Fine_Amount
Issues
Manages
Lot_Name
Location
Lot_ID
Capacity
PARKING_LOT
References
BOOKING
Leads To
PARKING_VIOLATION
Triggers
Requires
Payment_Date_Time
Payment_ID
Payment_Amount
PAYMENT
Has
Slot_Type
Current_Status
Slot_Number
PARKING_SLOT
Reserves
Includes
Card_Number
Card_Holder_Name
CARD_PAYMENT
o
Debit_Limit
Debit_Balance
CREDIT
DEBIT
Credit_Limit
Credit_Balance