Perfect Parking

An AI Application to Assist Drivers Finding Parking in Busy Cities

Rhys Quilter

K00241356

A Final Year Project submitted as a requirement of the Technological University of Shannon for the degree of Bachelor of Science (Honors) in Software Development.

Supervised by:

John Jennings

Acknowledgments

I would like to thank my supervisor Henry McCoy for helping me to complete my research. In addition, I would like to thank my parents Christopher and Katherine, and my friends Jean, Logan, and Warren for all their support during my time at TUS.

Abstract

This is a sample thesis layout with AI and Software development headings to guide you in developing your thesis. It contains styles, formatting, and a suggested structure with features like headers, footers, page-numbers, Table of contents, Table of figures and managed references.

It is a useful and common practice to put the abstract in Times New Roman 12-point italics. Throughout this document the styles used reflect the styles we suggest you use in your scientific report.

Table of Contents

[Acknowledgments ii](#_Toc132388007)

[Abstract iii](#_Toc132388008)

[Table of Contents iv](#_Toc132388009)

[Table of Figure viii](#_Toc132388010)

[Chapter 1 Introduction 9](#_Toc132388011)

[1.1 The academic objectives 9](#_Toc132388012)

[1.2 Problem Domain? 9](#_Toc132388013)

[1.3 Product title: a solution 9](#_Toc132388014)

[1.4 Objectives 9](#_Toc132388015)

[1.5 The Scope of the solution 9](#_Toc132388016)

[1.6 Report Structure 9](#_Toc132388017)

[Chapter 2 Materials 11](#_Toc132388018)

[2.1 Existing Data 11](#_Toc132388019)

[2.1.0 Others 11](#_Toc132388020)

[2.2 How we can choose 11](#_Toc132388021)

[2.2.1 Machine Learning 11](#_Toc132388022)

[2.3 Conclusion: The Need for a Software Solution 11](#_Toc132388023)

[Chapter 3 Project Management 12](#_Toc132388024)

[3.1 Weekly Meetings 12](#_Toc132388025)

[3.2 Source code management (SCM) 12](#_Toc132388026)

[3.3 Code Style Guide 12](#_Toc132388027)

[3.4 Collaboration Tools 12](#_Toc132388028)

[3.4.1 GitHub 12](#_Toc132388029)

[3.4.2 Microsoft Office Online 12](#_Toc132388030)

[Chapter 4 Data Analytic Methods 13](#_Toc132388031)

[4.1 Artificial Intelligence 13](#_Toc132388032)

[4.2 Categorization 13](#_Toc132388033)

[4.3 Estimation 13](#_Toc132388034)

[4.4 Machine Learning 13](#_Toc132388035)

[4.4.1 Garbage in, likely garbage out 13](#_Toc132388036)

[4.5 Working with Data Structures Object Orientated Programming 13](#_Toc132388037)

[4.6 Examples 13](#_Toc132388038)

[4.7 Conclusion 13](#_Toc132388039)

[Chapter 5 Data Analysis 15](#_Toc132388040)

[5.1 Introduction and focus 15](#_Toc132388041)

[5.2 Academic Aims 15](#_Toc132388042)

[5.2.1 Academic Requirements 15](#_Toc132388043)

[5.3 Functional Requirements 15](#_Toc132388044)

[5.4 Non-Functional Requirements 15](#_Toc132388045)

[5.5 Statistics 15](#_Toc132388046)

[Chapter 6 Results 16](#_Toc132388047)

[6.1 Project Plan: Priorities and Milestones 16](#_Toc132388048)

[6.1.0 The Data Structure 16](#_Toc132388049)

[6.1.1 Populating the System with Data 16](#_Toc132388050)

[6.1.2 Machine Learning 16](#_Toc132388051)

[6.1.3 Testing 16](#_Toc132388052)

[6.1.4 Paths to completion 16](#_Toc132388053)

[6.2 Data Structures 16](#_Toc132388054)

[6.3 System Architecture 16](#_Toc132388055)

[6.3.1 Object Identification 16](#_Toc132388056)

[6.4 Machine Learning 16](#_Toc132388057)

[6.5 Conclusion 16](#_Toc132388058)

[Chapter 7 Implementation 17](#_Toc132388059)

[7.1 Standards and Best Practice 17](#_Toc132388060)

[7.1.1 Object Orientated Programming 17](#_Toc132388061)

[7.1.2 Source Control and versioning 17](#_Toc132388062)

[7.2 Development Environment 17](#_Toc132388063)

[7.3 Tools Used 17](#_Toc132388064)

[Chapter 8 Conclusion and Recommendations 18](#_Toc132388065)

[8.1 Conclusion 18](#_Toc132388066)

[8.2 Recommendations 18](#_Toc132388067)

[References 19](#_Toc132388068)

[Glossary 20](#_Toc132388069)

[Appendix A Reflections 21](#_Toc132388070)

[A.1 Report Structure 21](#_Toc132388071)

[Appendix B Project Management 22](#_Toc132388072)

[B.1 Report Structure 22](#_Toc132388073)

[B.2 Code Style Guide 22](#_Toc132388074)

[B.2.1 Naming conventions 22](#_Toc132388075)

[B.2.2 Avoid magic constant numbers. 22](#_Toc132388076)

[B.2.3 Variable naming 22](#_Toc132388077)

[B.2.4 Methods 22](#_Toc132388078)

[B.2.5 Imports 22](#_Toc132388079)

[B.2.6 Comments 22](#_Toc132388080)

[B.2.7 Documentation 22](#_Toc132388081)

[B.2.8 Classes 22](#_Toc132388082)

[B.2.9 Spacing, Indentation 22](#_Toc132388083)

[B.2.10 Literals 22](#_Toc132388084)

[Appendix C Development Environment 23](#_Toc132388085)

Table of Figure

[Figure 1: School Logo 14](#_Toc132284083)

# Introduction

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs

## The academic objectives

The academic objectives of this project are to study and gain experience working with blah.

The chosen problem used for this study is blah. The proposed blah.

## Problem Domain?

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs

1. Numbered Bullet list.
2. Numbered Bullet list
3. Numbered Bullet item.
   1. Numbered Bullet item.
   2. Numbered Bullet item.
4. Numbered Bullet list

## Product title: a solution

## Objectives

## The Scope of the solution

## Report Structure

This document has cover pages …

An Abstract

TOC and TOF are generated automatically.

The Chapters the following styles

Paragraphs are 12pt Aril Justified with 1.5-line spaces and 6pt before with 3 pt after.

# Literature Review

## Big Data and Realtime Data

### What is big data?

Big data is a combination of structured, semi structured, and unstructured data that is collected by organizations, this data can be mined for information to be used in many projects such as machine learning, predictive modelling, and other analytics applications. Big data is often characterized by the three Vs.

* The large **Volume** of data in many environments.
* The wide **Variety** of data types frequently stored in big data systems.
* The **velocity** at which much of the data is generated, collected, and processed.

These characteristics were first identified in 2001 by Doug Laney, they were then further popularized in 2005 by an analyst at a consulting firm called Meta Group.

Big data doesn’t equate to any specific amount of data, big data deployments often involve terabytes, petabytes or even in some cases exabytes of data that is created and collected over time. (Botelho, n.d.).

### Why is big data important?

Big data importance lies in the fact of how a company utilizes the gathered data. Every company uses its gathered data in its own way, the more a company can gather its data the more the company can grow.

Big data provides valuable insights into customers that companies can use to refine their marketing, advertising, and promotions by doing this they can increase customer engagement and conversion rates. (Anon., n.d.)

Big data is huge in the medical industry, medical researchers can identify disease signs and risk factors, this can help the doctors diagnose illnesses and medical conditions in patients. A combination of data from electronic health records and the web can give healthcare organizations and government agencies up to date information on infectious diseases threats or outbreaks, we have seen this in the past with the pandemic and how the HSE in Ireland were able to monitor the amount of covid – 19 infections per county, and how they were able to create the Covid App with this data. (Botelho, n.d.)

### What is Real Time data

Real time data is data that is available as soon as its created and acquired. Rather than being stored, data is pushed to users as soon as its collected and is immediately available without and delay, this is crucial for supporting live, in the moment decision making. This real time data is a big part of our everyday lives, it powers everything from bank transactions and GPS this was also seen in the many Covid-19 maps that emerged during the pandemic. (Anon., 2021)

We see a lot more of real time data then we think, Google collects endless amounts of real time data and the way they do it is actually very smart, they use a device that 6.6 billion people in the world have and that being smart phones. (Anon., 2022) if people have smart phones, then nearly everyone has the google map application and GPS in their phones. When people sign into google on their phone Google starts creating real time data through the GPS and other apps, for example, when your using Google Maps on your phone it shows loads of data such as the estimated time of arrival to your destination and also if there is any traffic on your route, Google knows this by using real time data from other people that are taking that route and that might be stuck in traffic and this is all taken from the GPS location on smart phones. (Ashish, 2022)

### What is the importance of Real Time data?

Real-Time data is a necessity to stay relevant for today’s business and it needs to be delivered by sophisticated electronic communications tools such as digital signage and data dashboards, to remain appealing to today’s tech savvy workforce from call centres to retailers. (Barnett, 2017)

Real time data is important in many parking applications, these applications use real-time data to show users if there is parking spaces in the carpark which they have selected, this data can be gathered by the carpark having a barrier that counts the amount of cars that go in or the amount of cars that exit, some carparks also have sensors on each of the parking spaces this allows users to see what actual spaces are available, this is the most ideal as it allows people that need disabled parking to see if that type of parking space is available.

### Problems with gathering data.

When tech companies are building applications such as parking applications, they are given a budget by the parking company, and this enables them to put in these parking sensors or put in barriers to gather the real-time data for the users. This is where I face a big problem with gathering this data, since TUS carpark and other car parks in the city is monitored by another parking company called APCOA I am very limited to what data I can gather. Since I’m building this application on a very small scale gathering real-time data is going to be nearly impossible. One solution that I did think of would be to build my own parking space sensor using a raspberry pi and putting this down in a parking space in either my college or in the city, with doing this brings even more problems, these problems being:

* Permission must be sought from APCAO to allow a sensor to be placed on their parking premises.
* If I do get permission since the sensor would only be on a raspberry pi it could easily get damaged or stolen.
* I would only be able to build one sensor for one single parking spot which wouldn’t gather much real-time data for the users.

## Object Recognition and AI

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.

## How we can choose

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.

### Machine Learning

## Conclusion: The Need for a Software Solution

# Project Management

under the headings of (i) sub-topic 1 (cf. 1.1.0), and (ii) sub-topic 2 (cf. 1.1.1)

## Weekly Meetings

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.

## Source code management (SCM)

## Code Style Guide

## Collaboration Tools

### GitHub

### Microsoft Office Online

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.

# Data Analytic Methods

under the headings of (i) sub-topic 1 (cf. 1.1.0), and (ii) sub-topic 2 (cf. 1.1.1)

## Artificial Intelligence

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.

## Categorization

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.

## Estimation

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.

## Machine Learning

### Garbage in, likely garbage out

## Working with Data Structures Object Orientated Programming

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.

## Examples

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.

## Conclusion

This chapter has outlined the …

A picture containing shape

Description automatically generated

Figure 1TUS Logo

Figure 2: School Logo

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.

# Data Analysis

## Introduction and focus

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.

## Academic Aims

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.

* Bullets
* Bullets

### Academic Requirements

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.

## Functional Requirements

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.

## Non-Functional Requirements

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.

## Statistics

# Results

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.

## Project Plan: Priorities and Milestones

### The Data Structure

### Populating the System with Data

### Machine Learning

### Testing

### Paths to completion

## Data Structures

## System Architecture

### Object Identification

## Machine Learning

## Conclusion

This chapter has outlined the …

# Implementation

## Standards and Best Practice

### Object Orientated Programming

### Source Control and versioning

The solutions presented in this chapter are the best practices and patterns of all those tried in various versions throughout the lifecycles of the systems defines in section 1.2.

## Development Environment

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.

## Tools Used

This chapter has outlined the …

# Conclusion and Recommendations

## Conclusion

This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.

## Recommendations

* This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.
* This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.
* This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.
* This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.
* This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.
* This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.
* This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.
* This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs.

References

Anon., 2021. [Online]   
Available at: https://www.splunk.com/en\_us/data-insider/what-is-real-time-data.html

Anon., 2022. [Online]   
Available at: https://www.bankmycell.com/blog/how-many-phones-are-in-the-world

Anon., n.d. [Online]   
Available at: https://techvidvan.com/tutorials/why-big-data/

Ashish, 2022. [Online]   
Available at: https://www.scienceabc.com/innovation/how-does-google-maps-know-about-traffic-conditions.html#:~:text=Google%20Traffic%20works%20by%20crowdsourcing,geographic%20location%20with%20the%20app.

Barnett, M., 2017. [Online]   
Available at: https://www.fourthsource.com/data/importance-real-time-data-five-reasons-need-22014

Botelho, B., n.d. *Big Data.* [Online]   
Available at: https://www.techtarget.com/searchdatamanagement/definition/big-data

Glossary

|  |  |
| --- | --- |
|  |  |
| Term 1 | This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs |
| Term 1 | This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs |
| Term 1 | This chapter will begin by outlining the (cf. 1.1) for the purpose of writing a Report for a Project and outlining paragraphs |

1. Reflections
   1. Report Structure
2. Project Management

"I bring order to chaos" - The Borg Queen, 2373

A few sentences about how the project was managed. A bit about the code, the document, the research, budget and timing, management frameworks and so on.

* 1. Report Structure
  2. Code Style Guide

"This appears to be a region of space that doesn't have many rules. But I believe we can learn something from the events that have unfolded. In a part of space where there are few rules, it's more important than ever that we hold fast to our own." – Captain Janeway, 2372

* + 1. Naming conventions
    2. Avoid magic constant numbers.
    3. Variable naming
    4. Methods
    5. Imports
    6. Comments
    7. Documentation
    8. Classes
    9. Spacing, Indentation
    10. Literals

1. Development Environment