

Perfect Parking A map API parking application: A Literature Review from a Technological Perspective

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# Abstract

This project is a Parking application for academic purpose. The aim of my project is to create a parking system that will replace the outdated systems and to help stop the widespread problem that is parking in our cities. The applications that are used in Limerick City are simply not good enough. So, my goal in this project is to improve the effectiveness of finding parking spaces and to also relieve the stress of the users looking for parking by implementing new and innovative features. I will do this by using an MVC structure and by implementing methods such as map API’s that will show the user exactly where the parking is and by providing locations for them to follow straight to the location. I will also use a parking monitor powered by OpenCV to detect if a parking spot has been filled or made empty. By doing this I feel like it will also help with traffic congestion in the city as people won’t need to keep driving around the block to find a convenient parking space.

# Introduction

Due to an increase in in the number of cars being used in limerick city and other cities in Ireland, finding a solution to car parks has now become vital. The old-fashioned way of parking was that everyone would just leave their cars parked in the streets until they were needed again, this however caused major traffic congestions in towns and cities. Shop owners also got hugely impacted as there wouldn’t be enough room for staff to park no mind the customers looking to go into their shops which was damaging for their business, it is undeniable that car parks are a very important factor in society, by having parking spaces it reduces illegal parking which would have increased congestions on the road and increasing travel time.

It is fair to say that parking back in the 1980s – 1990s wasn’t such a big issue as there wasn’t very many cars on the road as people couldn’t afford to have a car unless they were wealthy, nowadays however it is very hard to find available parking spaces in places such as cities, and of course universities especially during rush hour. Since limerick City is a big city for students to come and study in with there being over 16,000 students attending university of limerick and just under 2000 students in TUS and Mary I, this brings so much more motor vehicles into limerick city which is a city already struggling with car parking. (UL.ie, 2022)

My goal is to try and reduce this issue by building a new innovative parking app and to try to help motorists stop stressing about this parking crisis.

# Application Programming Interface (API)

## What is an API?

An API are a mechanism that allow two software components to communicate with each other using different definitions and protocols. An example of an API would be the bureaus software system which contains the daily weather data, the weather app on your phone would talk to this system using APIs and shows you the daily weather updates on your phone. (What is an API, 2022).

## The History of APIs

Between the years of 2000 and 2002, online commerce and information sharing was just starting to become huge. Companies began to see an opportunity to expand their impact by making their information more accessible and shareable than ever before, these companies being Amazon, eBay, and Salesforce.

In the year 2000 Salesforce finalized and released their first modern API. Within this time eBay and alongside them Amazon also developed their own API which allowed developers access. What this meant was that for the first-time data-sharing was openly accessible for a wide range of customizable uses.

As the years went on many companies started to explore APIs, as this went on the APIs began to grow and software companies realized that APIs were a convenient way to share resources with their developers and to expand their footprint, spark ideas and to accelerate their development.

One of these software companies was Google, with their Google Maps. Google launched its API in 2006 they done this to share the massive amounts of geographical data that they have collected. This being the Google Maps that we know today, being Google Street View, and the Map application on our mobile phone which we use for navigation. (Hawkins, 2020)

## What is a mapping API.

A map API also known as mapping API provides location intelligence for software developers that are developing location-based products or services. It is the base building blocks for location-aware infographics.

A typical Map API have features including geocoding, reverse geocoding, geolocation, directions, and navigation. There are other features such as different types of maps such as terrain or satellite.

Map APIs are a great way for developers to retrieve location data such as proximity details about places, travelling distances and the time it will take between different endpoints. We saw map APIs being used in the pandemic to identify areas that had big spikes in covid cases which would be marked in red on the Covid app. (What is a Mapping API, n.d.)

## What is Directions API

Directions API is a geolocation service that software developers can use to plot routes between different places on a map. The Directions API make it easier for developers to create interactive location-based applications. (Google Maps Platform, n.d.)

## How can I use Directions API

Directions API can play a big part in my application, the reason that I am saying this is because if road users are new or visiting the city and they would need to figure out how to get to this parking lot. Using google Directions API would be a great way of doing this, when the user finds a parking lot, they would like to use they would simply press the parking icon and they would get a prompt to get the directions to the parking and when clicking this it would open up there google maps and show them the fastest way of getting to their location and the time it will take. This will eliminate the road users worry from getting from their location to the parking lot.

# 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 modeling, 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. (TechVidvan, 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 us data that is available as soon as its created and acquired. Rather than being stored, data us forwarded 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. (splunk.com, 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. (bankmycell.com, 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 centers 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.

## The problems I face 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:

* I would have to get permission from APCAO to allow me to place this sensor on their parking premises.
* If I do get permission since the sensor would only be built 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.

# Web Service Frameworks

When I decided to create a web application, I started to do some research on different web Service frameworks to decide what framework I feel would work the best for my application, the frameworks that I carried out research on were:

* Java Spring
* C# asp.NET

## Java Spring Framework

The Spring framework is a great application framework and inversion of control container for the Java platform. It is a great example of high-quality software. Spring provides everything required beyond the java programming language for creating enterprise applications for a wide range of scenarios and architectures. It has been developed for over 17 years (George, 2021).

### Why use Java Spring.

Spring framework helps develop various types of applications using the Java platforms. It provides an extensive level of infrastructure support. Spring also provides the Plain Old Java Objects also known as POJOs mechanisms which developers can easily create the Java SE programming model with the full and partial JAVA EE.

Spring Strives to facilitate the complex and unmanageable enterprise Java application development revolution by offering a framework that incorporates technologies, such as:

* Aspect-oriented Programming
* Dependency Injection
* Plain Old Java Object

The Spring framework also provides plenty of features. It helps the developers to perform the following functions.

* Create a Java method that runs in a database transaction with no help from transaction APIs.
* Create a local Java method that defines a remote procedure with no help from remote APIs.
* Create a local Java method for a management operation with no help from JMX APIs.
* Create a local Java method for a message handler with no help from LMS APIs

(Simplilearn, 2022)

### Advantages and Disadvantages of Spring Framework

Java spring consists of multiple tools to get numerous web app development benefits. When using spring it allows us to not write lengthy code. It is beneficial because it saves developers time and energy. I will now discuss the advantages and disadvantages of the Java Spring framework.

**Advantages**

* **Flexibility:** it offers flexible libraries to assist developers. Users can choose between XML and Java-based annotations regarding configuration. IoC and DI features are also present to provide extensive functionality and features.
* **Consistent configuration:** It helps in providing a consistent way of configuration. It offers a separate configuration for the facilitation of developers.
* **Secure:** the framework offers frequent updates to make our data an apps more secure.
* **Simpler testing:** Developers can perform testing with ease due to this framework. It is possible die to the usage of dependency injection.

**Disadvantages**

* **Complexity:** it is complex to work with Spring. Developers must have more relevant skills and expertise to use this framework.
* **Hard to learn:** if you have little or no experience regarding development, it will be difficult to learn Spring. This is due to the incorporation of the latest programming techniques in this framework.
* **Uses XML:**  lots of XML is needed while developing a Spring app. It can also be problematic for developers.
* **Parallel mechanism:** while using Spring developers can get multiple options. It can be very helpful in some cases, but it can also be confusing. Developers can run into problems when it comes to selecting the right mechanism and can result in wrong decision making. If these mistakes are made it can cause delays in the development of the applications. (Bashir, n.d.).

### Conclusion

From the research that I undertook on the Java Spring Framework it stands as a strong contender for a framework that I will possibly use, I also have experience in this framework which will also be a huge help when it comes to the design stage of the project.

## C# ASP.net

ASP.NET is an open-sourced web framework for building web applications. It is created by Microsoft, version 1.0 was released in 2002 to allow developers to build dynamic web apps. Services and sites. The framework is built to work with the standard HTTP protocol, which is the standard protocol used across all web applications. (Tyler, 2022)

### Why use ASP.NET

There are many reasons why developers should choose to use ASP.NET when developing a website or application. High speed, low cos, and vast language support are among the most significant benefits. ASP.NET is built into the familiar Windows server environment, requiring less setup and configuration than other web development platforms that must be installed and configured separately. The popularity of ASP.NET makes online resources and skilled developers easy to find.

Applications built using ASP.NET can be faster and more efficient than a website that is built using PHP, for example ASP.NET applications are compiled, which means the code is translated into object code, which is then executed. This compilation process takes a small amount of time but happens only once. After compilation, the code can be executed repeatedly by the .NET platform very quickly.

The database type that you would like to use is an important decision that has to be made when developing a web application, when using ASP.NET you have a choice of different databases such as Microsoft SQL server, MySQL, MariaDB to name a few. However MySQL and MariaDB are free and open source but Microsoft SQL Server can require expensive software licenses, there is a free express version which is suitable for a majority of websites.

ASP.NET is written using OOP also known as Object Oriented Programming languages such as C#. OOP provides a framework and patterns for code organization and reuse. C# is a first-class programming language and consistently ranks among the world’s most in demand and most use programming languages.

ASP.NET is developed by the world’s largest software company, Microsoft. Microsoft is heavily invested in their development platforms. Their development community and supporting the software companies use to run these applications. What this means is that there is no need for you to worry about your software becoming obsolete any time soon. (Wiseley, 2018)

### Main advantages of ASP.NET

* The ASP.NET is a web framework is facilitated by a powerful toolkit and designer in the integrated development environment of visual studio. The Drag and Drop sever controls and auto deployment are only a couple of the features this versatile tool offers.
* Lesser code encourages the application to easily manage and effectively maintain.
* These applications have windows authentication which makes the applications more secure.
* In ASP.NET applications, source code and HTML files are together so ASP.NET pages are easy to manage and write. The source code is now being run on the computer. This gives the website a lot od strength and versatility.
* ASP.NET helps in developing robust web applications7

(geeksforgeeks.org, 2021)

### Conclusion

From the research that I undertook for ASP.NET I learned that this framework is very dominant over other frameworks such as the Java Spring. I feel like ASP.NET would be a great framework for building prototype screens for my application because of the drag and drop feature that ASP.NET has within the Visual Studio IDE. This gives me a lot to think about in terms of what framework I should use for developing my application since I have researched two really good frameworks.

# Problem Statement

**Ineffective ways of finding an available parking space which is a waste of time, very fuel consuming and causes traffic jams.**

when road users are looking to find an available parking space they end up wasting time and using a lot of fuel from them driving around the car park or the block multiple times hopping to find a space, on average people spend 17 hours per year driving around looking for parking spaces (Quellmalz, 2021). By developing my app Perfect Parking I’m hoping to make the parking process in college campus and in the city easy and stress free, by doing this I’m hoping to eliminate the time and fuel waste road users encounter while looking for parking.

**Lack of visual parking space availability.**

When road users are driving the visuals of the eye are limited, the vision is blocked by many obstacles such as the cars frame causing blind spots, other cars, trees and much more. With this in mind it can be understood that the road users can find it difficult to spot an available parking space if its in the distance or behind other cars. This has turned into an important problem with road users and as a result they waist time and fuel trying to spot an available space.

**Lack of knowledge of towns or cities.**

Limerick is a city where people migrate to for education or tourism, and with this brings more road users. When people first come to Limerick City, they have to learn the road routes and with this where the parking is. A lot of road users that drive in a new place start to panic and get anxious when they try and find parking. This can cause them to be in the wrong lanes and cause traffic congestion. But with my app it will allow users to plan their route to the parking of their choice and follow directions on the phone to the car park. By doing this that it will keep new road users in the city calm so they can enjoy there holiday or for students teach them the road routes and the best places to park.

# Review Description

From doing research into parking systems, I have realized that there is a lot of existing parking systems that use different strategies and approaches to reach their goals and solve the problems of parking systems.

In this section I will review a few systems that I feel are unique and that have good strengths but that also have some weaknesses.

Graphical user interface, application

Description automatically generated

*Figure 1.0: web parking application to find parking in your area* (APCOA, 2022)

**Brief**

APCOA is a parking application that supports Android mobile, iPhone, and windows OS. APCOA is smart parking application, we use this company in our TUS Moylish campus as of today. The application is very user friendly it allows the user to see how much the parking is per hour and as seen in figure 1.0 above shows in blue there is parking facilities available to cater for disability parking, motor bikes and that the location is secure and safe to park in with controlled gates and surveillance cameras. This changes for different locations that you’re looking to park in. In this application it allows multiple ways to pay, you can prepay by using your debit or credit card, if you’re on Android or IOS you can pay using Google Pay or Apple Pay respectfully. There are also options to pay in cash when you arrive. APCOA claim that they can help you find and pay for parking in seconds.

**Strengths**

From looking at figure 1.0 above we can see that the application uses a Google Map API to equip the user with a map so they can see the exact location of the car park that they would wish to book. With them also showing the parking facilities in the car park this can allow users to plan which car park they can park in depending on if they need disabled parking or motorbike parking and so on.

**Weaknesses**

one of the weaknesses of this application is that it doesn’t show the user if there is parking available in that certain carpark, what this means is that if a user does pre book their parking they are not guaranteed a parking spot on their arrival. This could lead to the user being frustrated on arrival.

**Recommendations**

The limitation mentioned above can be sorted by developing a simple interface that will reduce the number of spaces available when somebody pre books on the app or pays on arrival, by doing this it will limit the number of frustrated users. Another recommendation that I will make about this application would be that the user could get the location of the parking lot and use their Apple or Google maps to take them to that location.

# Conclusion

Since starting my FYP on Perfect Parking and the research that I have undertaken I have learned how important Data and real-time data is, without using this data the application wouldn’t be as user-friendly and would lack information that the users would find useful. Real-time data isn’t the be all and end all of my application, I must be realistic to myself and I know its not possible to create a full-blown scale parking application by myself and have loads of data with loads of information. However, I can try my best by using tools such as Google APIs to supply information for example estimated times of arrivals for user and traffic data. When it comes to building a sensor, it is a brilliant idea but when I weighed up the pros and cons of building the parking sensor there was more disadvantages than advantages as described in heading 4.0 paragraph 4.4 .

In above passages I have discussed and investigated how important parking is in road users’ lives. By building the Perfect Parking application it will make road users lives easier and stress free when it comes to looking for parking. By developing this app, I am also hoping that it will reduce the carbon emissions as it will prevent road users from driving around a car park or city in the hopes of finding a parking spot.

From investigating the issues and importance of parking and how building an application can benefit road users who struggle to find parking, this has allowed me to investigate the most ethical way of continuing with the project from a technological and personal perspective.

I have also learned a lot about two different frameworks these being Java Spring and ASP.NET, this leaves me with a very important decision on which framework I will choose to use as they both have great valuable aspects however, from my research there are also some negatives that will weigh my decision.

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