Spott

A centralized solution to the issue of parking in urban areas from Team Spott.

Team Members:

	Member #1	Member #2	Member #3
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Tertiary Institution	University of Auckland	University of Auckland	University of Auckland
Degree Major	Chemical Engineering & Commerce	Software Engineering	Media & Sociology
Role in Team	Hardware development & Business model	App development	Market validation and research
Short Bio	Marc's conjoint degree in Chemical Engineering and Commerce gives him the technical expertise needed to develop the hardware needed for the project and the required commerce knowledge to put together a sturdy business plan. His involvement in the Dean's Leadership program also equipped him with the interpersonal and leadership skills needed for the project.	Max's knowledge of software development has been crucial to the advancement of the project: his skills have led to the development of a functioning prototype app for *Spott* which is linked to the Azure service.	Katia's majors in Media and Sociology have contributed essential written communication skills as well as the market research and data to define the issue which *Spott* is committed to solving.

Our team is united by the passion we share for the project. Each of us can relate to the issue underlined by *Spott* and that makes us all the more committed to solving it and creating a better future for commuters throughout New Zealand.

The idea for *Spott* first earned validity when it won the $1000 best app prize at the Velocity 2017 competition.

I- Market Validation

The frustrations linked to finding a car park are shared by all drivers at some stage: for when there are 906,440 registered cars in Auckland alone (as of 2016) and only 3,500 on-street parks in the CBD, parking can be a tedious process which not only wastes time and petrol but also negatively affects our mood and emits excess greenhouse gases into the atmosphere.

We believe that the problem with parking stems from uncertainty: Where can I find a carpark? Will my car fit? Can I be towed for parking here? How much does the cost of this car park compare to other car parks? These are all issues, raised by Auckland residents, which *Spott* parking solutions aims to solve.

Our team conducted market validation through online surveying of 68 respondents. We discovered the following:

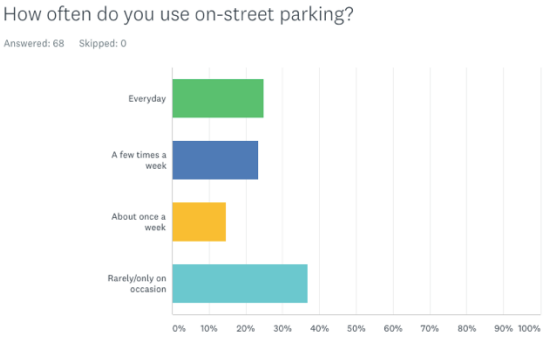

Figure 1: About 50% of people use on-street parking every day or several times a week. This is significant because it indicates that people in urban areas frequently turn to on-street parking and many are likely to become regular users of a service like Spott.

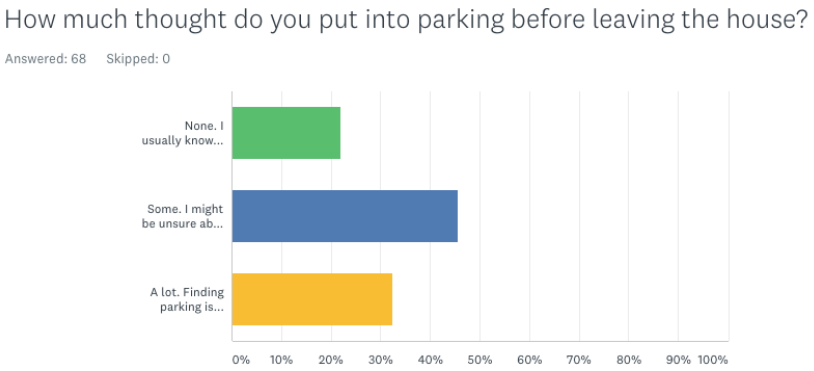

Figure 2: 77% of people reported putting some or a lot of thought into parking before leaving the house. This was due to being unsure about the availability of parking in areas that may be unfamiliar. This figure proves that parking is still a process which requires thought and effort since people do not yet have access to efficient parking services to aid them.

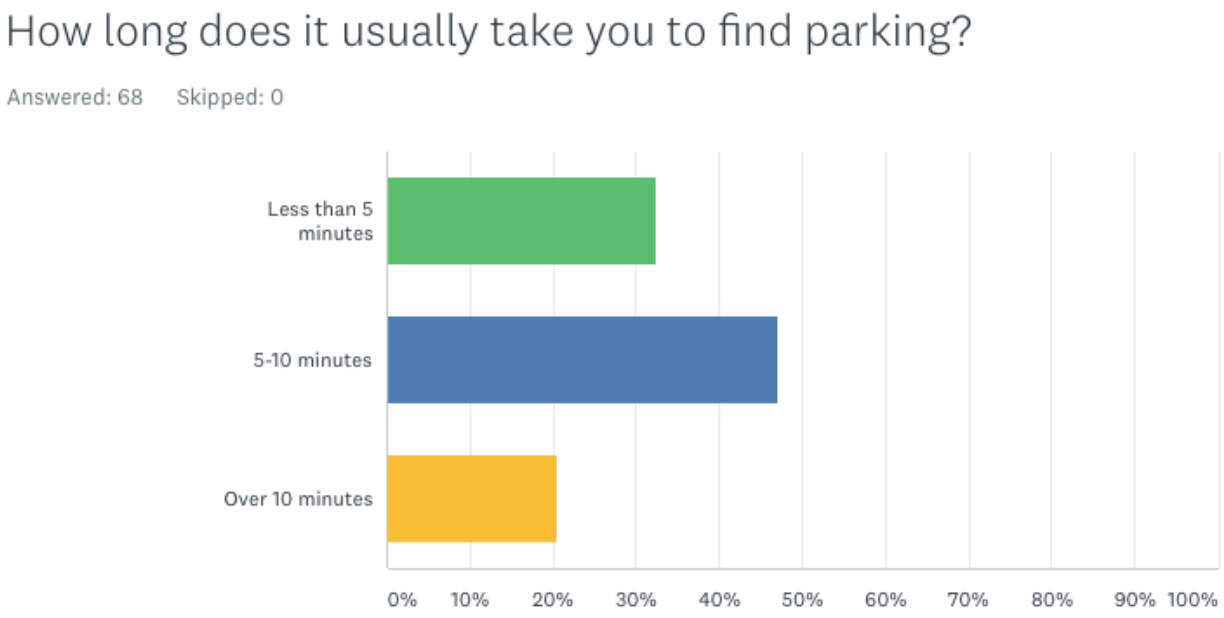

Figure 4: About 50% of people spend 5-10 minutes looking for parking and an additional 20% spend over 10 minutes. This underlines the fact that parking in the current context is time and energy consuming.

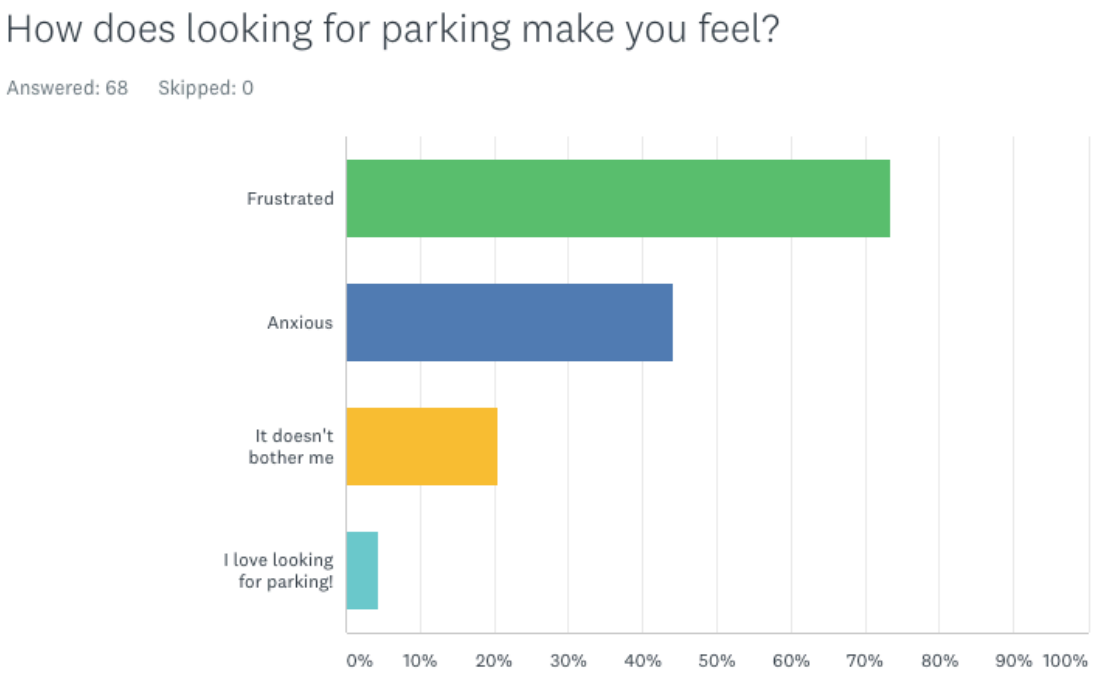

Figure 3: An overwhelming majority (74%) of respondents reported feeling frustrated when looking for parking. 44% also felt anxious. This data indicates that parking affects people's moods and may lead to anger or stress in certain circumstances. The implications for this are huge: according to the journal of Traffic Injury Prevention, between one and two thirds of all motorist injuries are caused by aggressive-driving.

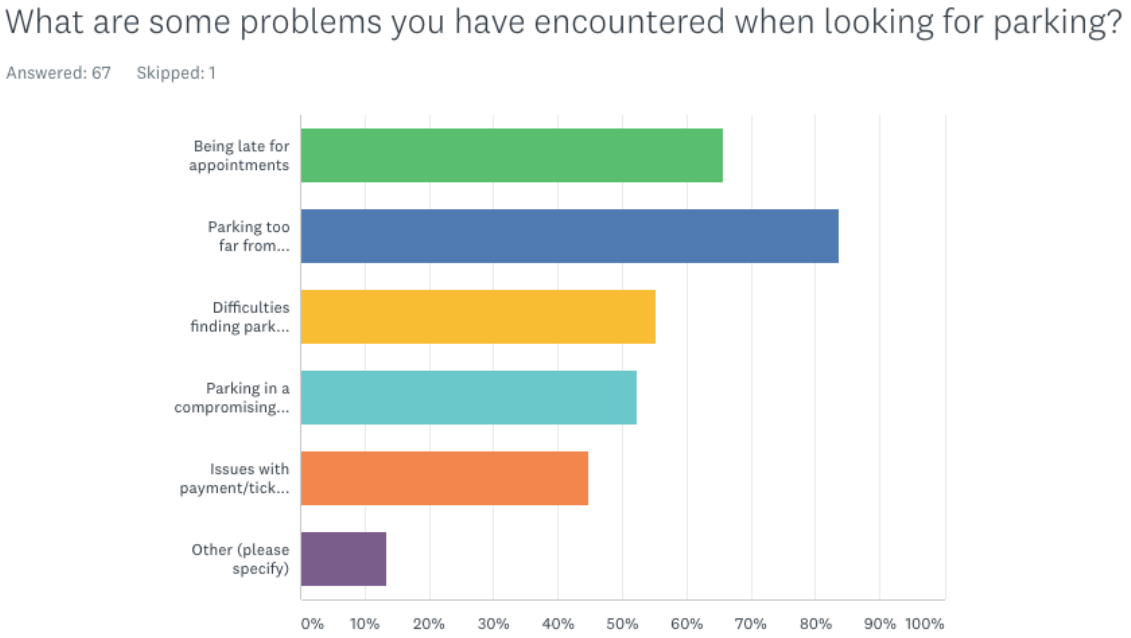

Figure 5: Common issues encountered when looking for parking include:

• Parking too far from destination (84% of people experienced this): Spott rectifies this by presenting the user with the closest available car parks for a given location

• Being late for appointments (66%): Could be avoided through Spott as the user would know exactly where to find parking and how long it would take to get to their destination from there

• Difficulties finding parking when events are happening (55%): This is facilitated by Spott's booking feature

• Parking in a compromising spot (52%): The knowledge of where to park reduces the risk of parking short-term in compromising spots and getting ticketed

• Issues with payment and ticketing machines (45%): The need for ticketing machines is eliminated by Spott's digital payment option

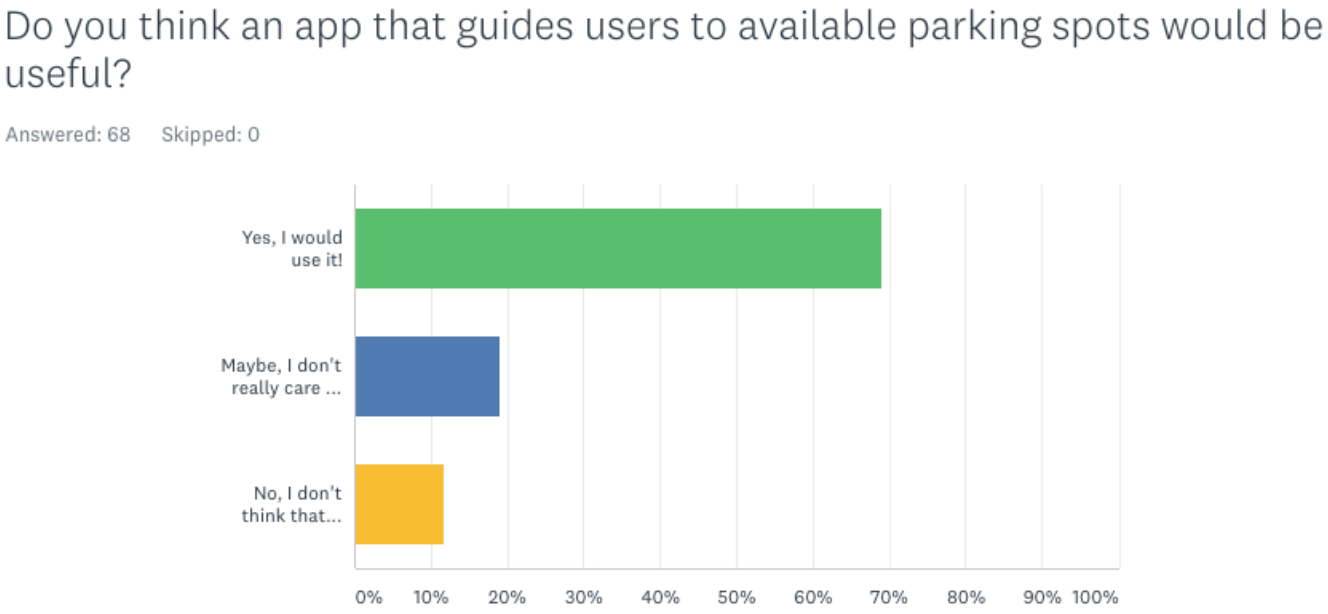

Figure 6: 69% of people stated that they would use an app to help guide users to available parking spots, revealing a tangible demand for Spott's services.

II-Project Summary

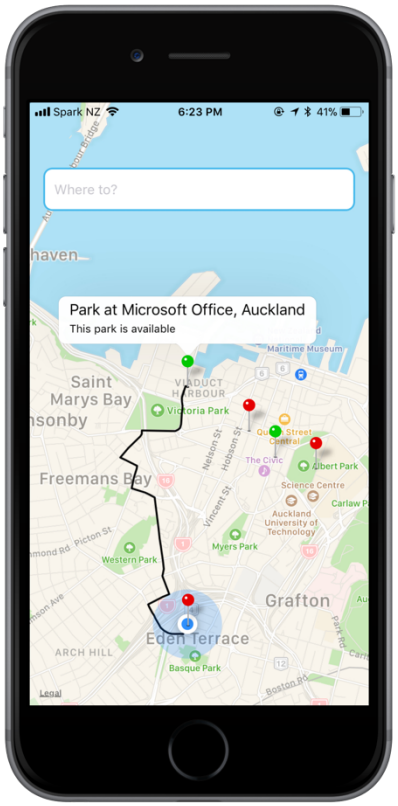

Figure 7: Screenshot of Spott's clean, simple user interface

Spott's Core Features:

Access to real time parking availability data via the *Spott* app

Our system displays the real-time availability of individual, on-street parking spots. We believe this live representation to be crucial to our service as it allows for the user to plan their journey in advance.

Before leaving their location, users simply input their destination. The *Spott* app then utilizes the sensor data, hosted on an azure database, to display all on-street car parks in an easy-to-read, map layout. In our prototype, green pins represent available parks whereas red pins indicate taken parks. The user compares options and selects the one which best suits their needs, according to information specific to each park: including whether it is free or paid parking, price range, times of use, and any other relevant information. The app then navigates the user to the carpark spot.

Pay and manage parking

Upon arriving at the car park, users are given the option to pay through the app using their mobile device. This function eliminates the need for ticketing machines, which are prone to malfunction and inconvenience both consumers and operators. *Spott* thus has the added bonus of reducing the amount of resources invested in the production and maintenance of these machines. Digitizing the payment process in this way also allows users to easily extend the duration of their parking from a distance, avoiding pesky fines and potential towing.

Centralized parking system

We do not envision *Spott* to be a simple logistics tool restricted to motorists. We see *Spott* as an all-in-one solution to the issue of parking. Our Minimum Viable Product focuses on end to end parking for motorists. Parking spots can be identified and navigated to, ensuring there is no uncertainty about the availability and location of parking. Additionally, the scalability of our model lends itself to aiding not only the motorist as a stakeholder but other groups as well, benefiting parking wardens, towing companies and maintenance teams alike. Organisations such as *Auckland Transport* have expressed interest in person-focused projects that aid consumers and reduce their costs. Parking spaces will be utilised more efficiently, increasing revenues. In addition, a *Spot*t app catered to meet parking wardens needs will decrease operating costs for *Auckland Transport*.

The service *Spott* offers would lead to a number of benefits operating both on an individual and social level:

- Users save time, money and fuel by knowing exactly where to park.
- Less confused drivers on the roads leads to improved traffic flow.
- Reduced uncertainty lowers rates of parking-related frustration and anger in drivers, leading to diminished instances of road rage.
- Based on our calculations, using market research data (and the assumption of an average of 2 miles travelled when looking for a parking space), shorter time spent searching for parks would induce an overall net reduction of upwards of 300 tons of CO_2 emissions per year in the Auckland city alone.

III- Technologies/Resources

Our solution combines software with hardware, providing a comprehensive, digital representation of the real world that is highly practical and intuitive.

Our current prototype connects the widely-available *HC-SRO4 ultrasonic sensor* with a *Raspberry Pi 3,* to detect if an object is above the system. Recalling that a sensor will be installed in each car park, a detected object implies that the park has been taken. Running a lightweight, custom python program, the Pi polls the sensor every 5 seconds to perceive whether the park is available and update an azure database accordingly. The *Raspberry Pi* sends a "PATCH" HTTP Request to an Azure-hosted App Service *Easy API*, encapsulating the sensor id and the availability status in a JSON file. The API, recognising the patch request for what it is, hooks into an Azure App Service *Easy Table* and updates the sensor's respective table entry on whether it is available or taken. Each table entry contains a unique id, park coordinates, availability status and extra park-specific details. These extra details will be plugged in when each sensor is installed into its respective park

We decided on the *Raspberry Pi* for its convenience and availability, however for the final product we plan on simplifying the board to erase any unnecessary overhead. This will keep power requirements low and allow for the easier implementation of an off the grid, solar-powered solution. *Marc Lewis* is currently undertaking his Engineering honours project, which focuses on the power requirements of such a device and researching the best applicable solar cell type.

Easy API is used as a primary, secure interface to control the data sent to/from the database. The SQL-based database contains an *Easy Tables* table acting as the persistent storage that allows our mobile application to access real-time data on registered carparks via polling "GET" HTTP Requests. The custom *Easy API* is configured in a way that has allowed for easy integration between our sensor hardware, the database and the mobile application. This has allowed us to produce a working prototype in a short amount of time. The *Microsoft Azure* services we have employed allow for rapid scalability to effortlessly introduce potentially thousands of on-street carparks. The ease with which rows of data representing carparks can be added allows for expansion, which is crucial in providing an up to date, all-encompassing service for our users.

The mobile app reflects the state of each carpark (available or not) and displays this to the user with an intuitive, map interface with which the user can select their carpark of choice and be navigated toward it. Developed using the flexible *React Native* framework, the app is intended to be available for both android and iOS users and is easy to test, deploy and maintain.

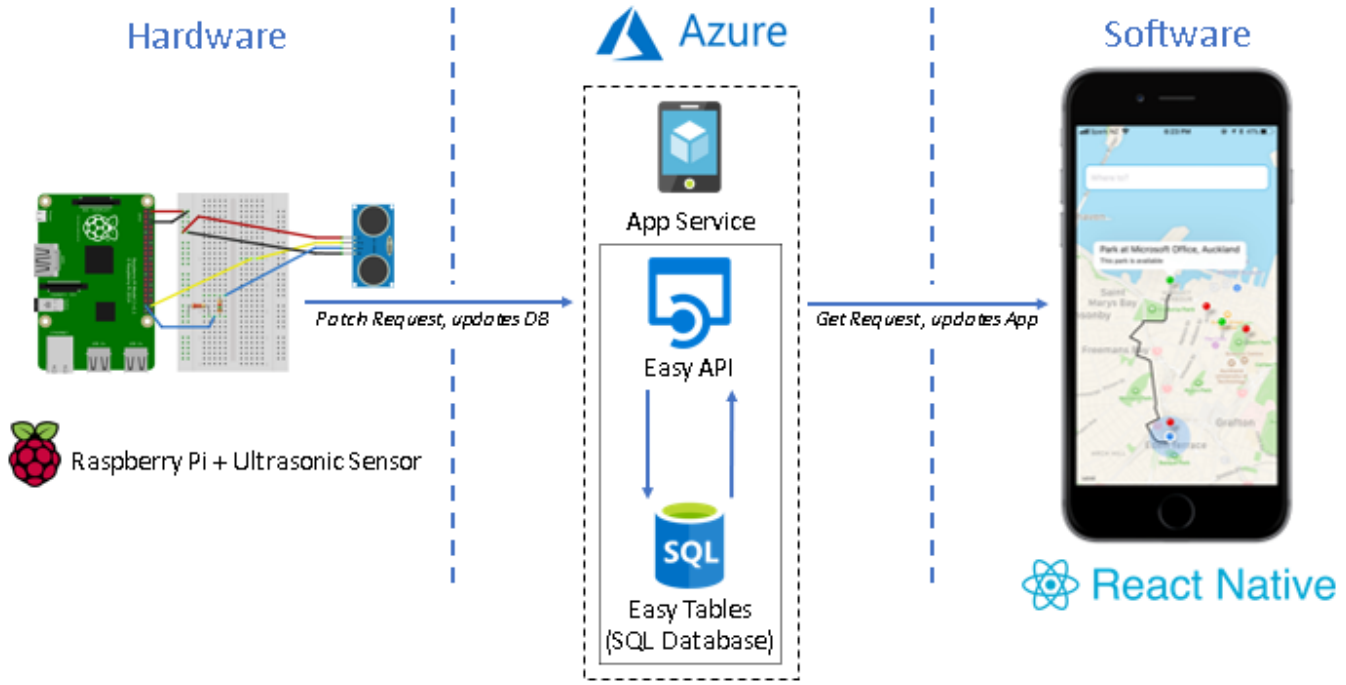

Figure 8: An architecture diagram of the Spott system, with Microsoft Azure as the bridge between our hardware and software components

Inner city infrastructure is forever changing, bringing about roadworks and other capital works that can change the environment a carpark dwells in. Therefore, we have developed the modules with easy installation and easy removal as a priority: *Spott's* modules are simply placed on top of the car park and bolted to the ground, ensuring cheap installation and maintenance costs.

IV- Future developments:

We will continue to develop *Spott* to fit stakeholder needs. Some of our future development goals that expand on our Minimum Viable Product include:

- Booking parking: We believe this to be an extremely powerful asset which guarantees users a seamless, worry-free parking experience. This feature would be especially useful during big events when people often have trouble finding parking in the area. We plan this as a potential feature reserved for the premium version of *Spott*.
- Machine learning: As previously mentioned, market research was conducted by our team in the form of surveys. One respondent outlined a potential risk: if the park a user is being directed towards gets taken whilst on-route, using the app to re-route while driving could pose a safety risk. To address this issue, our team wants to investigate routing algorithms based on a priority list created from the user's preferences (cost, proximity to destination). If the park is taken while on route, the app suggests the next best park and all the user has to do is confirm this choice. We believe this to be a temporary solution whilst the system is still in its early stages of deployment. In the future, when sufficient user-generated data is available, we could implement services like *Azure Machine Learning* and *Stream Analytics* services. Preference data from all users would be catalogued and stream analytics could analyze this data in order for the app to automatically select the preferred carpark.
- Reduced Maintenance Cost: We have evaluated technology such as the *Zigbee* chip, which allows for wireless low energy communication between smart objects. This would allow our sensors to communicate with each other, aiding maintenance of the sensors and providing up to date information on sensors that may be malfunctioning or broken down.

V- Business Viability

Spott is a commercially viable product with the potential to generate income through a number of means:

1. Freemium model:

The free version of the app which allows users to locate and pay for individual on-street parking spots will contain ads used to generate advertising revenue. Users wishing to book parking will need to download the premium version of *Spott* for a small fee, which will also eliminate ads. This is the model used by services such as *Spotify*.

Other versions of the app (e.g. a version for towing companies or for parking enforcement agencies) would come at a cost, most likely on a contractual basis. This makes sense as *Spott* aims to redefine the entire parking management system, including parking enforcement.

2. Commission model:

A second source of revenue can be generated by using a commission model, wherein *Spott* earns a small commission for every transaction completed through the app. This would be granted in accordance with the council who would benefit from the increased traffic flow, revenues and efficiency provided by our service.

Talks with *Roger Jones*, Chief Technology Officer of *Auckland Transport*, will help validate this option in more detail.

3. Data selling:

Spott can gather valuable data which private companies and development agencies could greatly benefit from. This includes estimates on foot traffic based on the areas people park, which carparks are used and how often, allowing the council to judge which specific areas to expand its car parking capacity. Selling this data for company research and analytics purposes will act as an added source of revenue for *Spott*.

Of course, these options will only come into play once the service has been fully developed and operational. To this end, we are exploring funding options and hoping to recruit potential partners and investors to fund initial deployment.

VI- Projected cost:

Our first prototype cost $80 to produce. The solar panel module adds an additional $40 depending on the type of panel used. Therefore in order to roll out across 3000 car parks, we estimate the hardware components to cost somewhere in the order of $360,000. Considering the easy installation of *Spott's* modules, we estimate labour costs to be in the magnitude of $50,000 to install 3000 modules.

This accounts for an estimated initial cost of **$410,000**.

We believe that dominating the Auckland market with the backing of councils and *Auckland Transport* is of paramount importance to achieve this initial goal. At this stage, we have reached out to *Auckland Transport* to obtain support for the project and have been in contact with *Wally Thomas*, Chief Relationships Manager at *Auckland Transport*, as well as *Roger Jones*, Chief Technology Officer at *Auckland Transport* and a member of the *Microsoft* board of executives. They have expressed interest in this project and we have plans in place to meet with these executives to discuss the potential implementation of our solution in and around Auckland.

We are also in discussions with *Ashton Partridge* from *Zinniatek*, a sensor and solar technology manufacturer who works with sensor and solar applications. They have the means to mass produce our modules from their manufacturing facilities in Japan, an invaluable resource for setting up production lines for the hardware.

Spott's business model is sustainable in nature and although we plan to start in Auckland, it has the potential to deploy throughout New Zealand and overseas. This is facilitated by the fact that our technology is easily replicable, installable and scalable, as well as the fact that *Spott* responds to a universal problem.

VII- Competition:

We have evaluated potential competition and feel confident that *Spott* offers a unique service to New Zealanders. Although privately owned car parks such as *Wilson* offer similar services like *ParkMate* to help users locate their parking lots and pay digitally, these do not include on-street parking and lack the efficiency provided by sensor technology able to pinpoint individual parking spots. Other variations include *Parkable* which allows residents to list their empty parking spaces and *Frog Parking* operating in Palmerston North which sells parking sensors to large businesses. These companies provide services related to parking, but are limited to a single or a few components of the parking experience.

Similar services also exist in metropolitan areas overseas, however none have been deployed in New Zealand, which would benefit greatly from a locally developed service catered to the specific needs of its cities.

Spott is distinct from other parking services in New Zealand in that it plans to deploy an end to end model, which guides users to individual carparks unlike any other service on the market. The implementation of our solar technology and its ease of installation makes the modules robust and relatively cheap to install and maintain, meaning that they can last longer than our battery powered competition and perform their function at a lower cost. Also, the ease with which *Microsoft* azure services can be implemented across different platforms makes the service user friendly and secure. Our service focuses on the individual's journey from start to finish, something which Auckland currently lacks.

VIII- Additional information:

- Mobile App Source Code: https://github.com/MGriffith37/Spott
- Please view the accompanying video for a demo of *Spott's* capacities and meet our team!