PARK INC.

Sept 23, 2010

Dr. Andrew Rawicz
School of Engineering Science
Simon Fraser University
Burnaby, BC
V5A 1S6

Re: ENSC 440 Project Proposal for an Automatic Parking System

Dear Dr. Rawicz:

Park Inc. is delighted to have the opportunity to present this proposal for a product that provides an efficient, reliable and convenient solution to parking services, particularly at the SFU campus in Burnaby. The following proposal provides an informational view of the current parking services, our solution to the problem, estimated cost and a brief introduction of the Park Inc. team.

Park Inc. is proud to introduce *Automatic Parking Enforcer (APE)*, which is a device that captures the license plate image with the use of an Infrared camera and converts the image to a series of letters and numbers. The Letters and numbers of each license plate are then matched with an existing database. At this moment, the product is meant to be used in large parking lots, such as the ones at SFU Burnaby. However, in the future we hope to further develop this product for uses in other markets such as security.

Park Inc. consists of five talented and dedicated members, who are eager to apply their knowledge and skills into designing and implementing this product. Our team of engineers includes: Rodin Maroufi, Rosy Johal, Amin Moshgabadi, Yi-Chen Kuo, and Shadi Rohani. Please feel free to contact me with any questions or comments that you may have regarding this proposal by phone at 778.865.2444 or by e-mail at rma12@sfu.ca. Thank you, for your time and consideration.

Sincerely,

Rodin Maroufi

Rodin Maroufi
President and CEO
Park Inc.

Enclosure: *Proposal for an Automatic Parking System*

PARK INC.

Proposal for a

Automatic Parking Enforcer System

Project Team: Rodin Maroufi
Rosy Johal
Amin Moshgabadi
Yi Chen Kuo
Shadi Rohani

Contact Person: Rodin Maroufi
rma12 @sfu.ca

Submitted to: Dr. Andrew Rawicz
Michael Sjoerdsma
School of Engineering Science
Simon Fraser University

Issued Date: September 23, 2010
Revision: 1.1

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EXECUTIVE SUMMARY

"Money never starts an idea. It is always the idea that starts the money."

In keeping with the above quote by Owen Laughlin, the members of Park Inc. have concocted an idea that will replace the way parking lots are manned by a more efficient and cost effective product. Traditionally, parking lots for big campuses require that the driver have a parking permit in order to park. Thus, campus patrol officers are deployed to manually check whether each car parked has the right permit. This can be very time consuming and requires more man power than is needed. Additionally, this method can be quite inconvenient for the drivers because people often interchange their cars and might forget to take their parking permit with them.

To solve this problem, we purpose an automated system that will allow just one campus patrol officer to quickly patrol the parking lot in a car and determine which cars are not authorized to be there. This will eliminate a significant amount of cost overhead for the campus, in terms of less people needed, no longer need to print parking permits etc. The automated system will also be more convenient for the drivers, as they will be able to interchange cars and not worry about forgetting their parking permit.

The basic idea behind *APE* is obtaining the license plates of cars whilst driving and comparing it to a database to see if the driver of the parked car has the necessary parking permit.

In order to make this product, Park Inc. was formed in 2010. Our company consists of five dedicated, innovative and diverse fourth year electronics and systems engineering students. Combined we have proficient skills and knowledge in the areas of: image processing, user interface, digital communication, real time embedded systems, and written and oral communications .All of which, will aid in the design, implementation and marketing of the *APE* system.

To make the *APE* system prototype, the project will be split into four main phases: research, design, implementation, and testing. We have a tentative schedule of when each of the phases will be complete and finish the prototype by December 6, 2010. Additionally, the total cost of making the prototype was determined to be $760, which we expect to obtain from a variety of sources.

PARK INC.

Table of Contents

PARK INC.

1. INTRODUCTION

There are currently 10 parking lots at SFU Burnaby, and as one can imagine patrolling all 10 of these can be a challenge, in terms of the number of people needed, the efficiency and accuracy of the overall system. Additionally, there are over 24,000 students enrolled at SFU and another additional 3000 facility and staff members [1], half of which park their cars at one of the SFU parking lots. Thus, every semester about 15,000 parking permits are issued, this can accumulate to a lot of paper and ink being wasted.

In consideration of all the above factors, we purpose to design and implement an automatic license plate registration system that is efficient, accurate and environmental friendly. The purposed system consists of an Infrared Camera, and a software program with a graphical user interface (GUI). The infrared Camera will be mounted on a patrolling officer's vehicle and will be responsible for retrieving the license plate from the parked vehicle. An infrared camera can be used for this purpose because once light is applied to the vehicle the reflective material used in the production of the license plate will distinguish it from other parts of the vehicle.

The retrieved license plate is than compared to a database, which will consist of license plate numbers of the drivers with parking permits. In accordance, with our product the driver can register more than one license plate number under their permit. Our software will make sure that there are not multiple vehicles under one permit in the parking lot simultaneously.

In this proposal, we will showcase how the *APE* system will be implemented, financed and how the team is organized. Thus, the proposal is split into the following parts: the system overview, sources of information, budget, team organization, and team profiles.

2. SYSTEM OVERVIEW

The *APE* system consists of both hardware and software components. The software component takes a video sequence from the infrared camera as the input, and recognizes the characters from the license plate. After, the characters are acquired and the data is then compared to a given database of registered license plate numbers for a given parking lot. After this, the GUI will display whether or not the particular vehicle has a valid permit. Figure 2.1 represents the basic concept of the system.

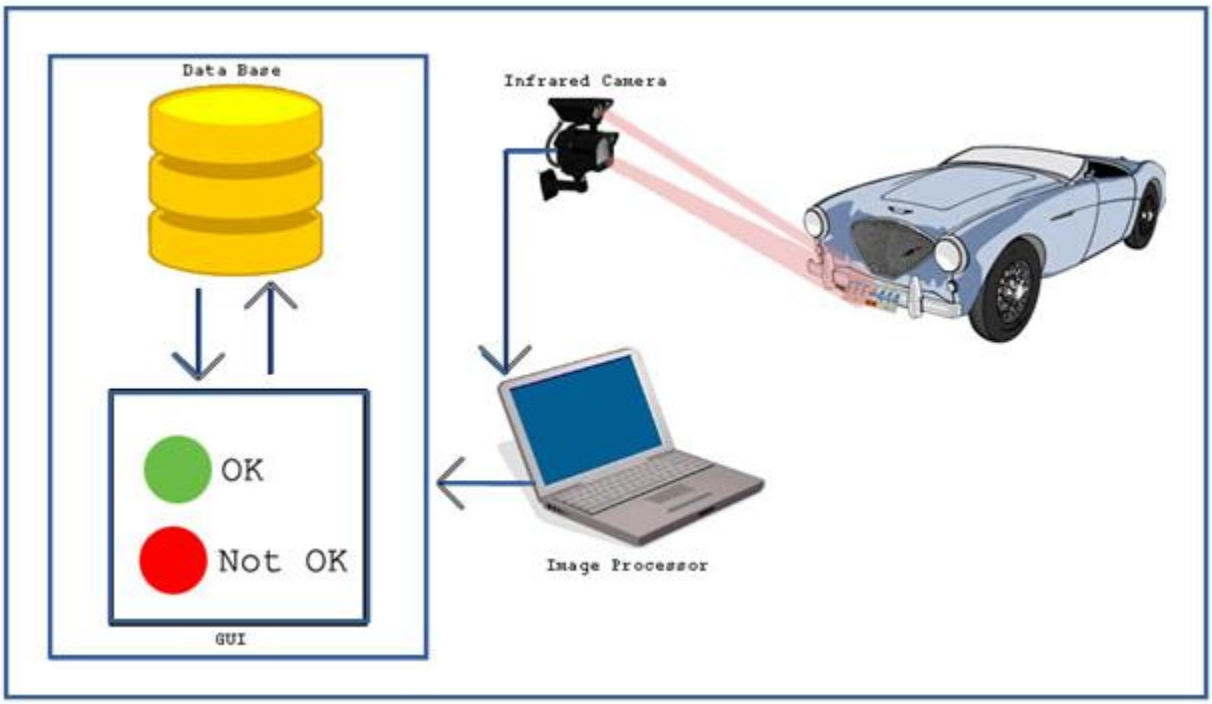

Figure 2.1 Basic Outline of APE System.

The hardware part of the *APE* system consists of: an infrared camera, image processor, communication channel, and data storage unit. The camera will be installed on top of a moving security vehicle. This will enable the camera to take pictures of the parked vehicles, while traveling at a high speed. The pictures are then sent to the image processor. A laptop is used in the security vehicle to process the image, store data, and communicate with the database. As it can be seen the hardware implementation is quite straightforward.

However, the software implementation of the *APE* is very complex and can be divided into three main categories: license plate segmentation, optical character recognition (OCR), and the user interface. Figure 2.2 shows the three main categories of the software program.

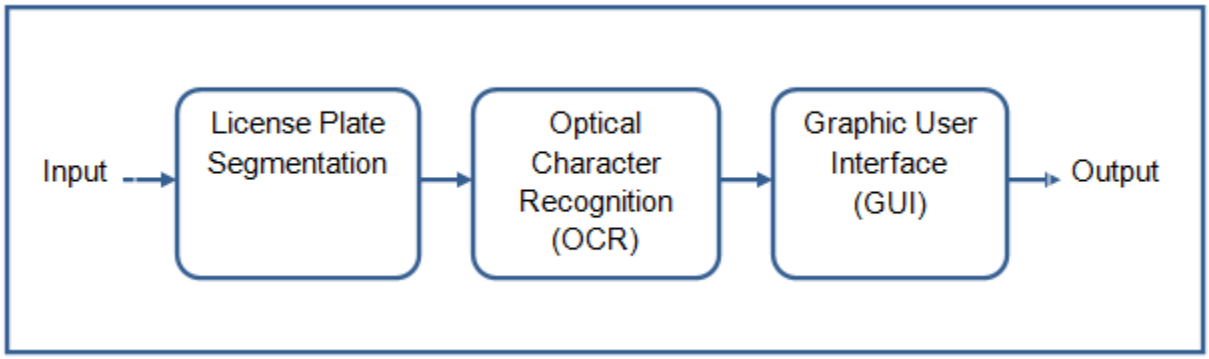

Figure 2.2: The Software Layout of APE

The license plate segmentation consists of sending the picture, taken by the camera, to the image processor and then detecting the part of the picture where the license plate is located and cropping it out from the rest of the image. The cropped picture is then sent to the OCR engine, where the characters on the license plate are recognized. Hence, the OCR engine uses the picture with the characters as the input and it produces a text that can be used in the program as the output. This text is then compared to a database of the vehicles registered under all the parking permits.

Since there are different permit types the data base would be able to differentiate between the different types and store them accordingly. It will also make sure that two vehicles under the same registration are not in the parking lots simultaneously. The Data base and the *APE* software will have to communicate in real time. Thus, a wireless connection is needed.

The result of the comparison is then passed to the GUI via a Wi-Fi connection. The GUI is what the user sees and interacts with while using the product. Thus, it is a important part of the software from a aesthetic and usability point of view.

Figure 2.3 illustrates the logic behind the *APE* system. We have decided to program the software in C because the different parts need to communicate in real – time, and because most of the team members have a high degree of knowledge and experience using C.

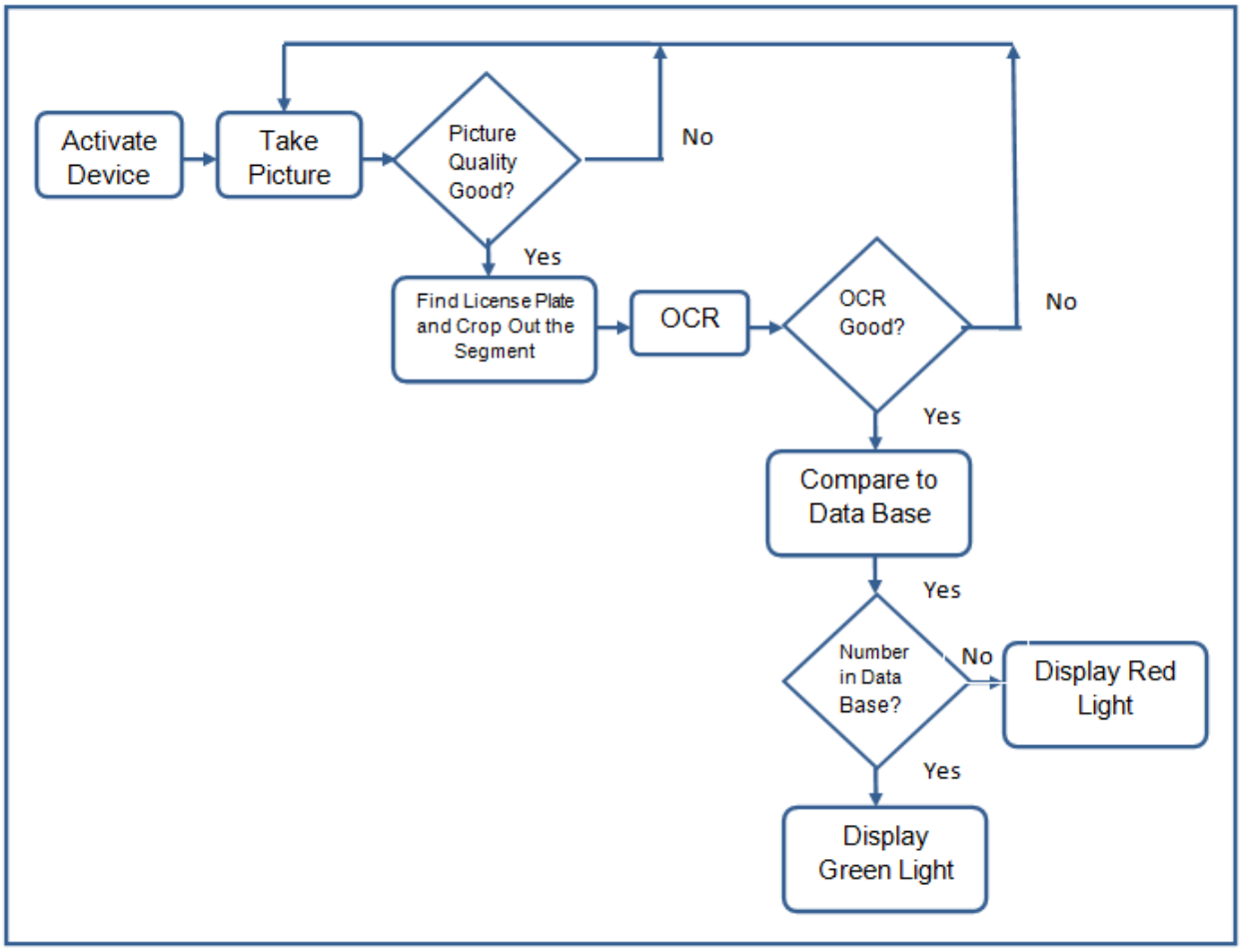

Figure 2.3 Block Diagram of APE System

3. SOURCES OF INFORMATION

We have looked at many sources of information, concerning the various aspects of our product. In relation to the software program, if assistance is needed we plan on contacting Dr. Lesley Shannon, who has taught C to some of our members. There are also many C tutorials online, which will also be consulted. Additionally, if there is a problem in relation to the algorithm used, we will consult a Brno University of Technology article titled "*Algorithmic and Mathematical Principles of Automatic Number Plate Recognition Systems".*

Another important source of information will be the OpenCV documentation, which can be found online. OpenCV is open source code, which will be used in the software component for character recognization. To ensure, that integration of all the software parts is implemented smoothly, a full understanding of the OpenCV code functionality will be required.

Furthermore, a consultation with the SFU parking services was set up to be aware of all the problems APE has to address. As well as all the test scenarios that should be accounted for in the prototype. An additional meeting regarding financing has also been scheduled with SFU parking services.

If assistance is needed in other areas of the product, we will contact the experts in that field, such as the professors in the Faculty of Engineering at SFU. Another, invaluable source of information will be Dr. Andrew Rawicz, who will be supervising the project and hence will guide us in the right direction if need be.

4. BUDGET AND FUNDING

4.1 Budget

Table 4.1 outlines a tentative budget for the APE system developed by Park Inc. All prices include taxes, shipping, as well as a 15% contingency. As it can be seen from Table 4.1, the camera consumes the most part of the total budget. The price of the camera was determined after researching the various types of cameras in the marketplace.

Table 4.1: Tentative Budget

Equipment	Estimated Cost
Infrared Camera	$ 700.00
Camera Bracket	$ 60.00
Total Cost	$ 760.00

4.2 Funding

From the previous section, the cost of the APE prototype was determined to be $760. We have looked at various sources to fund this product. We have already applied for the Engineering Science Student Endowment Fund (ESSEF), and are currently in the process of applying for the Wighton Development Fund. We are also setting up interviews with Simon Fraser University Parking Services to discuss some general parking issues that can be addressed through our product and hope to ask for some financial assistance.

From the previous exchanges, the SFU Parking Services were interested in the product and said that a product, such as APE system, has the potential to be a success Hence, we are fairly confident in securing some funding from them. However, if all the product expenses are not funded we are prepared to use our personal earnings.

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5. SCHEDULE

Table 5.1 shows the Gantt chart of the expected time to be spent on each task in order to complete the APE system.

Table 5.1: Gantt Chart

Task Name	Sept 7	Sept 27	Oct 7	Oct 27	Nov 7	Nov 27	Dec 7	Dec 27
Research								
Proposal								
Functional Specification								
Design Specification								
Process Report								
1st Integration, debugging and testing								
2nd Integration, debugging and testing								
Professional Journal								

Figure 5.1 illustrates the corresponding deadline for each task that has been mentioned in Table 5.1. The milestone chart clearly outlines the completion date for various tasks.

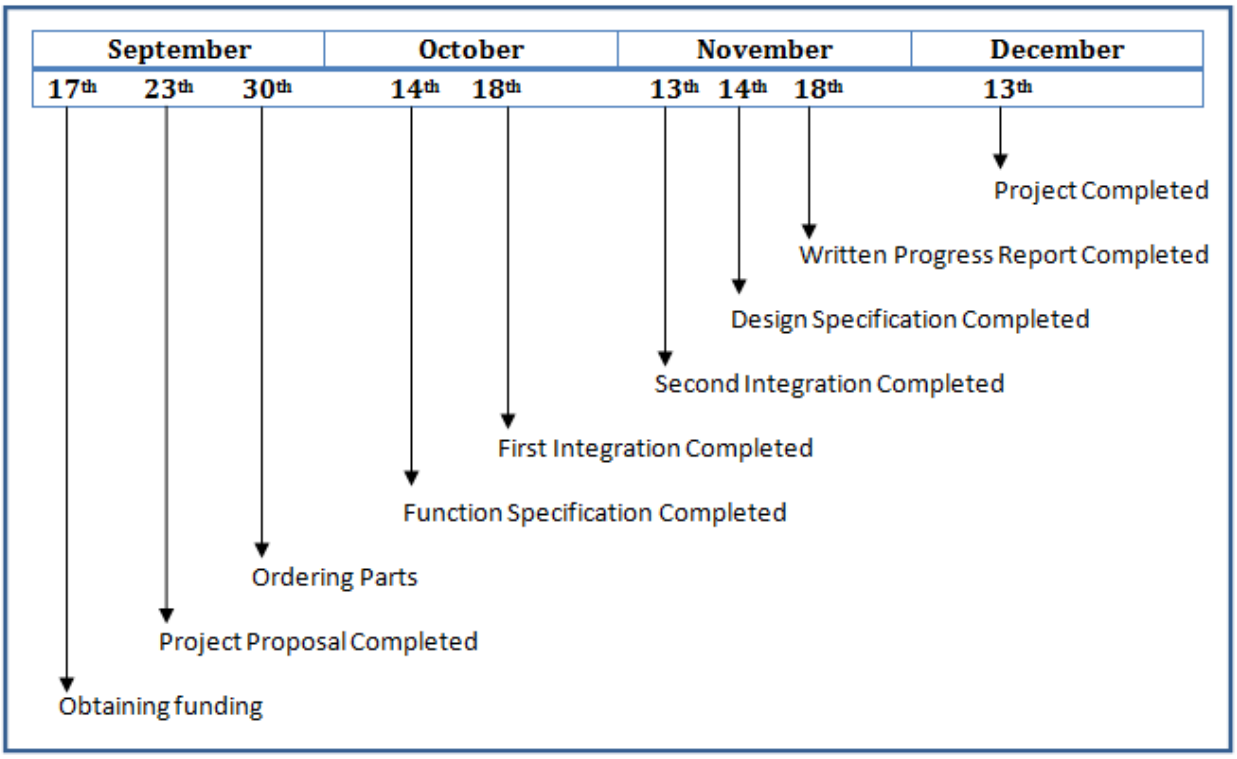

Figure 5.1: Milestone Chart

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6. TEAM ORGANIZATION

Park Inc. was established in Sept 2010, and consists of five members: Rodin Maroufi, Rosy Johal, Amin Moshgabadi, Yi-Chen Kuo, and Shadi Rohani. All of whom, contribute different skill sets to the team, because they all have quite diverse backgrounds. Two of our members, Rodin Maroufi and Amin Moshgabadi, are in the Systems engineering concentration and the other three members, Rosy Johal, Yi-Chen Kuo, and Shadi Rohani, are in the Electronics engineering concentrations at Simon Fraser University.

Park Inc. believes highly in a team oriented environment where all the members are responsible for themselves and accountable to each other. Hence, the CEO is not on a higher level than any other member. But, rather all the members are on the same level. Figure 6.1 illustrates this type of corporate structure. It has created a more open and direct channel for communication as well as trust and mutual respect among each member of the team. Furthermore, all the team members are always motivated to succeed because all the benefits and risks are shared equally.

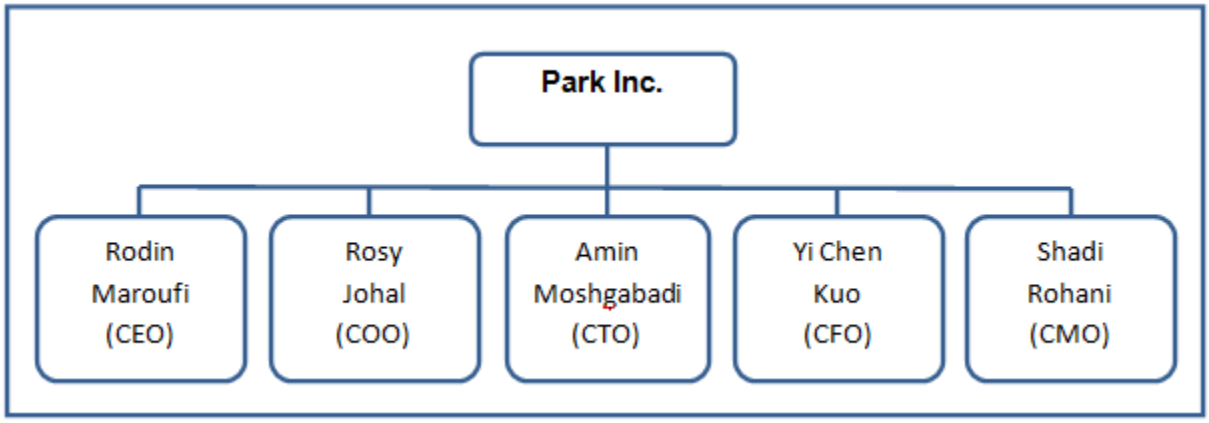

Figure 6.1: Team Organization of Park Inc.

In keeping with the above mentioned corporate structure, the roles of Chief Executive Officer (CEO), Chief Operations Officer (COO), Chief Technical officer (CTO), Chief Financial Officer (CFO), and Chief Market officer (CMO) are filled according to ability and not precedence.

Rodin Maroufi is the CEO, because he has past experience in a leadership role. He is mainly responsible for communicating with all the members and establishing good group dynamics. He will also participate in technical areas such as: image processing and plate segmentation. Rosy Johal is the COO, and is responsible for all the day to day operations of the company. She was

chosen for this role because she has 3 years of experience running a small non-profit organization. She will also participate in designing and implementing the GUI. Amin Moshgabadi is the CTO, due to his past experience in image processing and strong skills in programming with C. Thus, he will mainly focus on the image processing and other software related tasks, Yi-Chen Kuo is the CFO, because she has gathered funds for non-profit organizations in the past. Hence, she will be responsible for our budget and financial stability. She is also responsible for designing and implementing the GUI. Shadi Rohani is the CMO, and is in charge of the bill of materials. She is responsible for contacting companies to find the best parts, in terms of price and quality, needed for the project. She will also be assisting in plate segmentation and image processing.

Furthermore, we believe that team work, excellent communication, and commitment are really critical to our success. Thus, to continue on a successful path, we have arranged meetings twice a week to keep all the members informed of each other's progress and setbacks. Thus, if a problem does occur each member will have input into the next course of action. For professionalism and consistency, each meeting will have a designated speaker, who will record the meeting minutes and, make sure the discussions do not go off topic.

In closing, Park Inc. is organized to enhance team participation and establish good group dynamics while meeting all our milestones. We have full confidence in achieving these goals because most of the members have worked well in the past together. Also, the team is structured in such a manner that all the members can thrive because they will be in an environment that they are comfortable in.

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7. COMPANY PROFILE

Rodin Maroufi - Chief Executive Officer (CEO)

Mr. Maroufi is a fourth year Systems Engineering student at Simon Fraser University. In addition to electronics and programming, which are his main concentrations at school, he has great knowledge of mechanical engineering. Since, he has worked as a design and quality assurance assistance. He also has extensive Knowledge of engineering materials since he has co-op experience testing various metals and polymers for their mechanical and electrical characteristics. He is also comfortable with AutoCad, Solid Works, Labview, C++, Java and VHDL. In addition, he has demonstrated vast leadership abilities in school projects and co-op jobs; which makes him suitable for his position.

Rosy Johal - Chief Operations Officer (COO)

Ms. Johal is a fourth year Electronics Engineering student at Simon Fraser University. She has previously been in charge of operations for a non-profit organization and thus is qualified to oversee the operations of Park Inc. She is also experienced in the following programming languages: C, C++, VHDL and MatLab. However, her areas of expertise are digital communication and design. She is currently on coop with a professor where she is furthering her knowledge in the areas of new age wireless systems and FPGA`s. She will also be working on the user Interface because she has previous experience developing a GUI with C.

Amin Moshgabadi - Chief Technical officer (CTO)

Mr. Moshgabadi is a fifth year Systems Engineering student at Simon Fraser University. He has previous experience with the following programming languages: C, C++, MatLab and JAVA. He is very interested in the image processing field and has worked on similar subjects for the past two years. His previous work experience includes programming and design for RoboWeld, a company that specializes in automation. Also, he has been doing free lance web development for various companies. His software expertise would be a huge assist to the company.

Yi Chen Kuo - Chief Financial Officer (CFO)

Yi-Chen Kuo is a fourth year Electronics Engineering student at Simon Fraser University. During her academic years, she has developed strong programming skills in: MatLab, C and C++. In addition, she is also experienced in computer graphics because she has used SolidWorks and Photoshop. She also has experience in securing funding due to her time working with a non-profit organization at Simon Fraser University. Thus, she will be responsible for securing the funding for the project and working on the user Interface. She was chosen to work on the User Interface because she has strong programming skills.

Shadi Rohani - Chief Market officer (CMO)

Ms. Rohanivadeghani is a fourth year Electronics Engineering student at Simon Fraser University. Over the past year she has worked for one of North America`s Top-10 Electronics Manufacturing Services (EMS) providers. Her experience in Strategic sourcing and her role of Product Cost Engineer makes her the perfect candidate for company's Chief Marketing Officer Position. Her work experience in the industry is an asset to our company's long-term strategic plans. She will be responsible for product development, sales, and marketing communications. She is also coordinating the company's operation in product manufacturing.

8. CONCLUSION

The *APE* system will revolutionize the way parking is patrolled and enforced in large buildings, such as SFU Burnaby. The current system is very archaic; hence, an automated system is long overdue. The *APE* system will cut cost overhead, be more convenient for drivers, as well as security officers and will be more environmental friendly.

The *APE* system is designed by Park Inc. which consists of five Simon Fraser University Engineering students. All of them are very dedicated to bring their vision of an automated parking system to reality. Funding for *APE* will be secured through various different sources including personal assets if need be. If a setback is incurred a solution will be attained by consulting with the many sources of information listed above. In conclusion, the members of Park Inc. are confident that the purposed *APE* system will be a success and be impeccable in quality.

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9. SOURCES AND REFERENCES

[1] Simon Fraser University

Simon Fraser University Parking Services (Burnaby campus)

Ondrej Martinsky. Brno University of Technology.
http://indrasaifudin.files.wordpress.com/2009/10/anpr.pdf