



ENSC440W/ENSC305W

Post Mortem

Demonstration Date: December 02, 2015

Submitted By	Parkolite Ltd Raj Sidhu, Soudeh Mousavi, Oliver Krajci, Mubaark Sandhu, Azin Navah
Contact	Raj Sidhu School of Engineering Science Simon Fraser University gssidhu@sfu.ca
Submitted to	Steve Whitmore & Andrew Rawicz School of Engineering Science Simon Fraser University
Issue Date	December 02, 2015 Revision 1

Table of Contents

Introduction	3
System Overview	3
Cost	5
Scheduling.....	8
Discussion.....	9
Scope of Work.....	9
Group Dynamics.....	10
Workload Distribution	11
Individual Reflections.....	12
Raj Sidhu – CEO	12
Oliver Krajci – COO.....	13
Mubaarak Sandhu – CTO	14
Soudeh Mousavi – CFO	15
Azin Navah – CMO	16
Conclusion.....	17
Appendix	18
Agendas and Meeting Minutes.....	18

List of Figures

Figure 1 - Electric Circuit for API	4
Figure 2 - Different stages for API in one complete Cycle	5
Figure 3 - Gantt chart.....	8
Figure 4 - Initial Mechanical Design	9
Figure 5 - Alternative Mechanical Design	10

List of Tables

Table 1- Estimated Cost for API	6
Table 2 - Actual Cost for API.....	7
Table 3 - Workload Distribution.....	11

Introduction

In the span of four months ENSC 440 and 305 was able to bring together 5 diverse individuals from different walks of life with various different experiences together. This project has tested our cooperation skills, listening skills and of course our technical skills. In the last four month a group 5 was able to come together to create Parkolite ltd. An innovative company that is progressing towards an alternative way of keeping the public informed about their parking situations in busy metropolitan areas. Essentially this is accomplished via visual feedback that is outputted by the “alternative parking indicator” (API) as different coloured LEDs. Where, green means that a parking spot is available, blue means that the spot is taken, yellow signifies that the spot is about to expire and red denotes the expiration of the parking spot.

In the initial phase of the project IE 305/440 the plan was to construct an alternative parking indicator that caters to free parking areas. For example areas that allow for 2 hours of free parking. This idea came about because of major issue that Raj had gone through in his time at Calgary. His friend’s car was towed on a Friday night as they were preparing to go out. Raj felt that his friend’s car had been unjustly towed. He knew that if his friend had had a fair warning that the parking was about to expire his friend would have surely moved it without ruining a perfect night. So for many months Raj pondered a solution to help people avoid this problem all over Canada. Upon enrollment in ENSC 440/305 Raj found the opportunity to direct a group of five fantastic individuals towards the solution to this problem.

System Overview

The alternative parking indicator as mentioned about is a simple touchless feedback system that shows the user what the status of the parking is via visual feedback. This visual feedback is displayed in four different colours. The overall system is triggered when the AMR sensor detects a change in the magnetic field. This change in the magnetic field is what tells the system to start running its internal code to output the correct colour based on the situation. As seen below the reader can get a grasp as to how the system works.

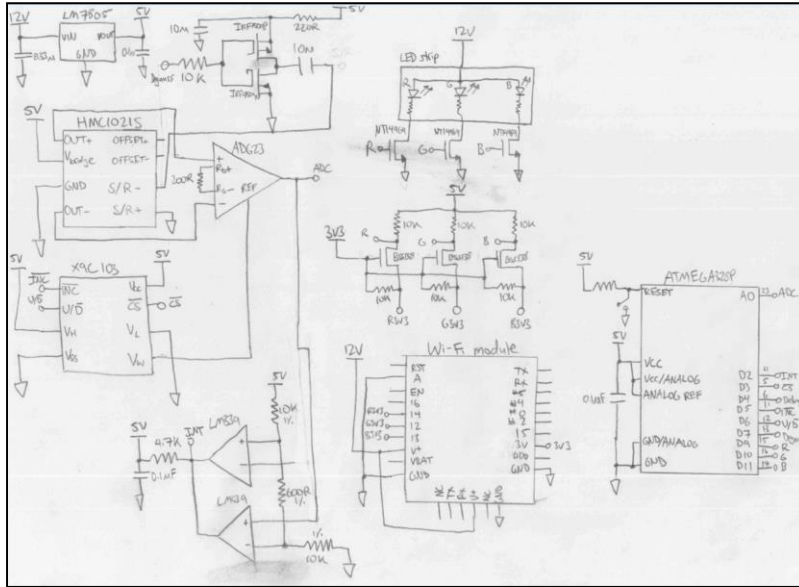


Figure 1 - Electric Circuit for API

As it can be seen in Figure 1 the circuitry is the brains of the entire system. It process the input signal amplifies it and then the ATMEGA 328P chip takes care of signal based on the preprogrammed conditions. The circuit is made up of the following major components:

- AMR Sensor – which detects a change in the magnetic field
- Signal Amplification – which amplifies the signal received from the AMR sensor
- Threshold detection – which determines whether the signal received from the AMR sensor is a vehicle or not by using a window comparator circuit
- Degaussing and charge pump circuit – To degauss the AMR sensor thereby rearranging the dipoles so that a new car can be detected once the previous car has left
- Digital potentiometer – Constantly adjusts the threshold voltage to 2.5V to compensate for any anomalies that may throw the sensing circuit off track
- Regulators – To supply 12V to the LEDs and 5V to the overall circuitry
- ATMEGA 328P microcontroller – To control the whole system through its inputs and outputs
- Level Shifting for Wifi Module – To be able to step the voltage down to 3.3V for the inputs of the wifi module
- RGB LEDs – Provides the visual outputs seen in figure 2

As it can be seen from the description above the circuitry is very intricate and thoroughly thought out. Not only did the circuitry provide us with the desired output, it provided us with the solution to the problem. The following few pictures are what the user can expect to see when they come across one of ParkoLite's API's.

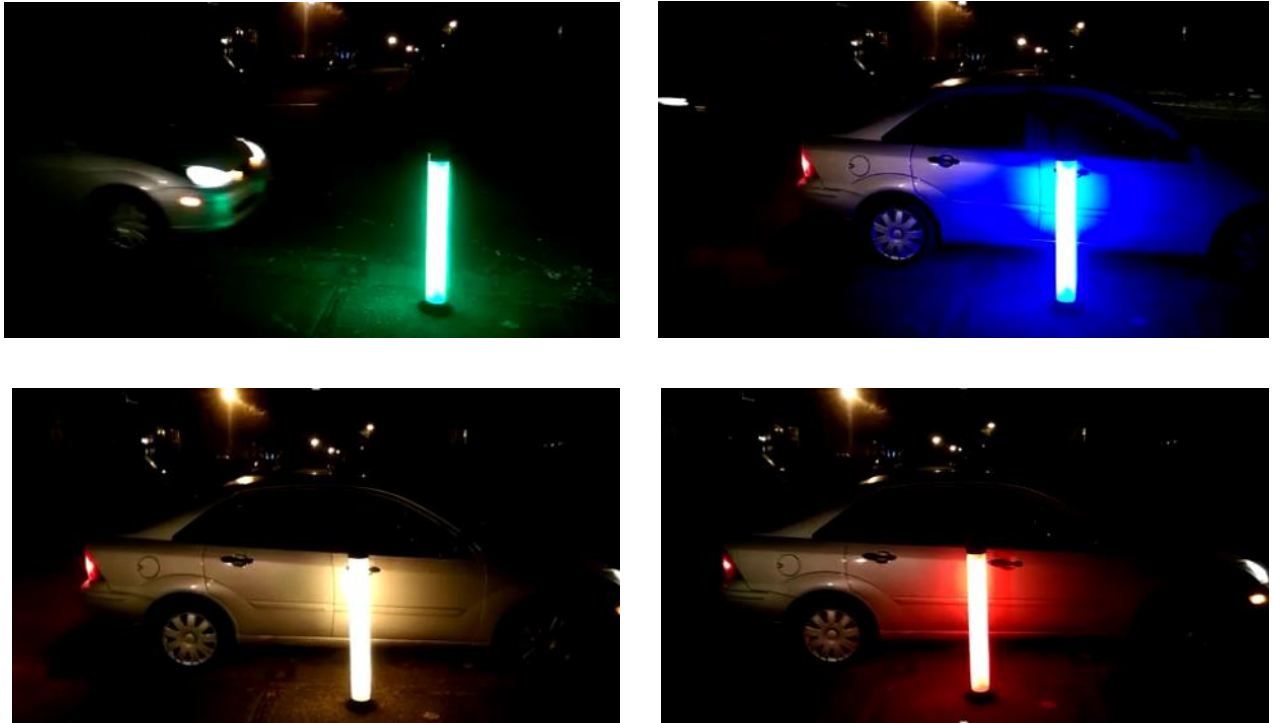


Figure 2 - Different stages for API in one complete Cycle

As it can be seen from figure 2 the API does exactly what had anticipated. Initially when the car approaches the API the user will see the green light (which means he or she can park). Once the car is fully settled into its parking spot the light will indicate to the user that the parking spot has been taken. Once the user approaches parking expiration the light will turn yellow telling the user that parking time allotted for that spot is almost up. Finally once the light turn's red it indicates to the user that the parking spot has expired and it is in his or her best interest to the move the vehicle. Although the final product did what we wanted it too there were several other things that we had to take into consideration when building this prototype like cost

Cost

Although as a group we wanted to build a more refined product we understood that this would have costed us a lot more than we would have wanted it too. Therefore below you will see the estimated cost of \$1,200.00 vs the actual cost of \$492.00. The difference in price is mainly due to changes in material used.

Table 1- Estimated Cost for API

Item	Quantity	Cost Description	ESTIMATED AMOUNTS			Notes
			ORIGINAL Cost of Item	Contingency 30%	TOTAL	
		Materials				
		Electrical/Software materials				
	8	LED's	\$80.00	\$24.00	\$104.00	
	2	120VAC -> 12/5VDC Converter	\$20.00	\$6.00	\$26.00	
	1	Additional Regulators	\$5.00	\$1.50	\$6.50	
	1	Electrical Filters	\$5.00	\$1.50	\$6.50	
	1	Arduino Uno	\$40.00	\$12.00	\$52.00	
	4	ATMEGA328P	\$20.00	\$6.00	\$26.00	
	1	LC Oscillator	\$12.50	\$3.75	\$16.25	
	1	Oscillator Wiring	\$21.00	\$6.30	\$27.30	
	1	Printed Circuit Board	\$80.00	\$24.00	\$104.00	
	2	Relays for switching on/off	\$10.00	\$3.00	\$13.00	
	1	Phase Lock Loop Research	\$10.00	\$3.00	\$13.00	
	1	Wires for Wiring Project	\$25.00	\$7.50	\$32.50	
	3	Shipping electronic equipment	\$25.00	\$7.50	\$32.50	
	2	SMD5050 RGB LED	\$56.00	\$16.80	\$72.80	
	2	Inductive loop sensor	\$60.00	\$18.00	\$78.00	
		Electrical Total	\$469.50	\$140.85	\$610.35	Overall parts may vary
		Mechanical Materials				
	8	2 x 4 wood pieces for prototype	\$3.00	\$0.90	\$3.90	
	3	Cement bag	\$8.00	\$2.40	\$10.40	
	3	6" bolts	\$3.00	\$0.90	\$3.90	
	3	nuts	\$1.50	\$0.45	\$1.95	
	3	washers	\$1.00	\$0.30	\$1.30	
	3	rubber gaskets	\$1.00	\$0.30	\$1.30	
	3	rubber sheeting	\$14.00	\$4.20	\$18.20	
	1	Plastic Casing	\$450.00	\$135.00	\$585.00	
		Mechanical Materials Total	\$481.50	\$144.45	\$625.95	Overall parts may vary
		Total project Cost	\$951.00	\$285.30	\$1,236.30	cost +30% -15% est.
Costs have been discussed and reviewed by all team members						
PREPARED BY		Raj Sidhu	DATE (Y-M-D)			2015-09-18
APPROVED BY		Team	DATE (Y-M-D)			2015-09-20

Although we had estimated the project to cost approximately \$1,236.00 we were only able to secure funding of \$585.00 from the ESSEF. Through group discussion we agreed that it would be best to use more cost effective material to develop this prototype. By doing this we were able to complete the project for approximately \$90.00 less than what our approved budget was. Despite building it for less with less expensive material we did not sacrifice our time line in any way.

Table 2 - Actual Cost for API

Item	Quantity	Cost Description	ACTUAL AMOUNTS	
			Net Price	Total
		Materials		
		Electrical/Software materials		
	1	IC OPAMP INSTR 800KHZ RRO 8SOIC	\$6.07	\$6.07
	1	SENSOR LINEAR MAGN 1 AXIS 8-SOIC	\$11.14	\$11.14
	2	IC DUAL DIFF COMP 8-SOIC	\$0.80	\$1.60
	3	RES SMD 200 OHM 1% 1/4W 1206	\$0.15	\$0.45
	2	MOSFET N-CH 30V 7.3A 8-SOIC	\$1.64	\$3.28
	2	MOSFET P-CH 30V 4.7A 8-SOIC	\$1.86	\$3.72
	2	CAP CER 1UF 16V X7R 1206	\$0.23	\$0.46
	4	CAP CER 0.1UF 50V X7R 1206	\$0.25	\$1.00
	2	AMR SWITCH SENSOR	\$0.79	\$1.58
	1	AMR SWITCH SENSOR	\$0.85	\$0.85
	1	AMR SWITCH SENSOR	\$0.97	\$0.97
	2	IC XDCP 100-TAP 1K EE 8-DIP	\$6.75	\$13.50
	9	TRANS PNP 100V 6A T0020 TIP42C	\$1.25	\$10.71
	3	TRANS PWR NPN MJE3055T	\$1.90	\$5.40
	1	10K OHM 1/4W PKG	\$1.95	\$1.95
	1	1.0K OHM 1/4 PKG	\$1.95	\$1.95
	1	5050 300 LED RGB NONWATERPRO.	\$64.00	\$64.00
	1	ADAFRUIT ESP8266 WIFI MOD	\$9.95	\$9.95
	1	USB TO TTL SERIAL CABLE	\$9.95	\$9.95
	1	IC XDCP 100-TAP 1K EE 8-SOIC	\$8.36	\$8.36
	1	IC REG LDO 5V 1A DPAK	\$0.93	\$0.93
	3	MOSFET N-CH 30V 41A DPAK	\$0.69	\$2.07
	3	MOSFET N-CH 50V 220MA SOT-23	\$0.32	\$0.96
	1	SENSOR LINEAR MAGN 1 AXIS 8-SOIC	\$11.03	\$11.03
	1	IC OPAMP INSTR 800KHZ RRO 8SOIC	\$5.69	\$5.69
	1	IC DUAL DIFF COMP 8-SOIC	\$0.67	\$0.67
	1	IC XDCP 100-TAP 1K EE 8-DIP	\$8.30	\$8.30
	1	MOSFET P-CH 30V 4.7A 8-SOIC	\$1.84	\$1.84
	1	MOSFET N-CH 30V 7.3A 8-SOIC	\$1.62	\$1.62
	3	RES SMD 10K OHM 0.1% 1/8W 1206	\$1.28	\$3.84
	3	RES SMD 200 OHM 0.1% 1/4W 1206	\$1.11	\$3.33
	2	RES SMD 4.7K OHM 5% 1/4W 1206	\$0.15	\$0.30
	3	CAP CER 10UF 25V X5R 1206	\$0.34	\$1.02
	2	CAP CER 0.33UF 25V X7R 1206	\$0.33	\$0.66
	2	CONN HEADER 10POS 0.100 STR 30AU	\$0.79	\$1.58
	1	CONN HEADER 6 POS 2.54	\$0.44	\$0.44
	2	CONN HEADER FEMALE 10POS 0.1" GOLD	\$1.20	\$2.40
	1	CONN HEADER FEMALE 6POS 0.1" GOLD	\$1.00	\$1.00
	1	CONN HEADER FEMALE 14POS 0.1" GOLD	\$1.69	\$1.69
		Electrical Total		\$206.26
		Mechanical Materials		
	1	3X2 BUSHING	\$3.19	\$3.19
	1	TEST CAP 4 IN	\$1.99	\$1.99
	1	4 IN CAP	\$6.49	\$6.49
	1	ABS 2"X3"	\$7.56	\$7.56
	1	SPRAY PAINT	\$9.02	\$9.02
	1	SPONGE KIT	\$9.97	\$9.97
	1	4" CLOSET FLANGE	\$6.19	\$6.19
	1	4X3 CLO FLG	\$10.59	\$10.59
	6	BOLTS	\$0.33	\$1.98
	1	4X8" CLEAR ACRYLLIC PIPE	\$85.08	\$85.08
	1	PE TEST PLUG	\$1.93	\$1.93
	1	PIPE CELLCORE/ABS 1/2X3" BLK	\$13.64	\$13.64
	1	HEX NUT GR#5 1/4-20XEA	\$0.34	\$0.34
	1	CARRIAGE BOLT 1/2"XEA	\$0.74	\$0.74
		Mechanical Total		\$158.71
		Shipping		\$86.49
		GST		\$17.37
		PST		\$24.13
		Total Project Cost		\$492.96

Scheduling

Below you will find the Gantt chart that was initially introduced at the beginning of the term. Our team was extremely efficient at completing assigned tasks therefore the Gantt chart presented at the beginning of the term very closely correlates to how we executed the project right up until the end.

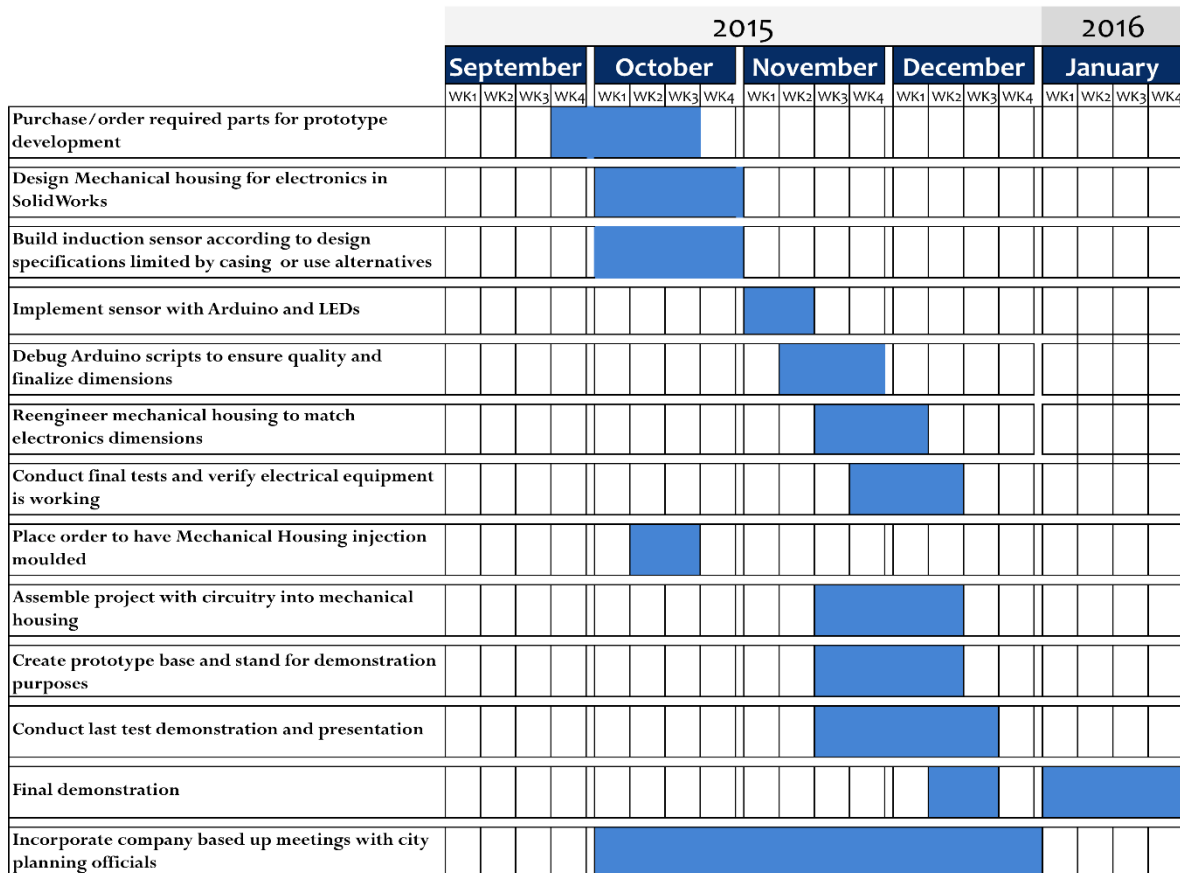


Figure 3 - Gantt chart

The only change in scheduling that occurred was that we had anticipated that the final demonstration was to take place in the third week of December. However due to other time constraints outside of ENSC 440 and 305 it was agreed upon that it would be best to complete our final demonstration in the first week of December. This would require us to make up about three weeks of time throughout the semester. Luckily for us all of our parts arrived on time if not earlier and everything else that we need to complete the API was readily available at the local hardware stores.

The slot of time scheduled in January is for presentations that may take place with the city of Surrey. Early on in the semester Parkolite had contacted the city of Surrey with regards to the idea that we were proposing. They showed a great deal of interest and have requested a prototype demonstration as well.

Another feature left off of the Gantt chart was the potential development of a mobile application to accompany the API. Very late in the semester the team had decided that if there was residual time left over we may look into integrating the API with a mobile application. Luckily we had approximately two weeks at the end of November to begin this process. However, we had not dedicated this as a final deliverable that was to be submitted alongside the API. It was agreed upon that it would be a “nice to have” addition to the project if time permitted. Although, time permitted us to start this part of the project we did not have adequate amount of time to complete it and demonstrate it as an addition to the API.

Discussion

In this section, ParkoLite Ltd. will go over some technical challenges that were overcome through superior collaboration and engineering design. Not only that we will also discuss some scope changes that pushed the API into a different direction than we had initially started.

Scope of Work

At the beginning of the semester the group had finalized the design for the API. It was to be very different from what we had initially thought. Instead of being an upright indicator as seen in figure 2 it was meant to lay flat on the curb. After several meetings and discussions the idea below is what was generated.



Figure 4 - Initial Mechanical Design

However, after dissecting the mechanical design of figure four we came to three very crucial conclusions.

- 1) This design will have restrictive visibility
- 2) This design will be susceptible to extreme weather conditions like snow
- 3) There is a high risk for the curb side design being damaged by careless drivers

These three points were the major deciding factors in proceeding with an alternate design. The alternate design seen below solves issues 1 and 2 however 3 is always unpredictable. All we could do is plan for the worst and hope for the best.



Figure 5 - Alternative Mechanical Design

As it can be seen in figure 5 the alternate design greatly increases user visibility and reduces the chances that snowy conditions will cover the light completely. This intern solved a major design issue for us without sacrificing functionality and usability.

Group Dynamics

Throughout the course of the semester all the team members were responsible for particular areas. We took the strengths of each and every individual team member and made that team member the expert in that area for the duration of the project. We made sure however, all the group members were aware as to how a certain part was being completed so that in case one of the members was unable to make it too a meeting the other members knew what was going on and could evenly distribute the load across the existing members until the other team mate returned. The following is a brief break down as to how the tasks were allocated. We will go into more detail during the workload distribution chart.

- Raj Sidhu – Mechanical/Electrical/Software design
- Oliver Krajci – Electrical / Software Design
- Mubaarak Sandhu – Electrical/Software Design
- Soudeh Mousavi – Software design/financial tracking
- Azin Naveh – Software design/Photoshop expert

When it came to discussing the electrical circuitry Oliver was the person to discuss it with. When it came to finance and cost tracking Soudeh was the expert in the field. Mechanical design was Raj's field and software design was Mubaarak's speciality along with Azin. However, we were all well aware of one another's work and slotted in where help was needed, making the team atmosphere very adaptable and objective oriented.

Workload Distribution

The following table will describe the work load distribution that was taken on by members of the group throughout the semester. We can note in the workload distribution table that the following notation means the following:

- X – Denotes minor involvement or the individual was a floater
- XX – Denotes intermediate involvement or the person was secondary
- XXX – Expert involvement in other words this individual was the primary contact

Table 3 - Workload Distribution

Workload General Overview	Group Members				
	Raj	Oliver	Mobby	Soudeh	Azin
Documentation	XXX	XXX	XXX	XXX	X
Proposal	XXX	XX	XX	XX	X
Design Specifications	XX	XX	XXX	XXX	X
Functional Specifications	XX	XX	XXX	XXX	X
Post Mortem	XXX	XX	XXX	XX	X
Photoshop	X	X	X	X	XXX
Meeting Minutes	XX	X	XX	XXX	X
Financing	XX	X	X	XXX	X
progress report	X	X	XXX	X	X
Electrical	XX	XXX	XX	XX	XX
Circuit design	X	XXX	X	X	XX
sourcing parts	XX	XXX	XX	XX	XX
calculating specific values	XX	XXX	XX	X	X
soldering parts	XX	XXX	XX	XX	XX
debugging design	XXX	XXX	XXX	XXX	XX
reliability testing	XX	XXX	XX	XX	XX
Software	XX	XXX	XX	XX	XX
programming MCU	XX	XXX	XX	XX	X
programming digipot	X	XXX	XXX	XXX	XX
Degaussing function	XX	XXX	XX	X	X
Programming LEDs	XXX	XXX	XX	XX	XX
Android App Programming	X	X	XXX	XXX	X
WiFi Module Programming	XXX	X	X	X	XXX
Programming sensor inputs	X	XXX	X	X	X
Overall computer architecture	XXX	XXX	XX	XX	XX
Mechanical	XXX	X	X	X	X
SolidWorks design	XXX	X	X	X	X
Part selection	XXX	X	X	X	X
overall prototype assembly	XXX	XXX	XX	XX	XX
Mechanical design overview	XXX	XX	XX	XX	XX
mechanical design evaluation	XXX	X	X	X	X
Painting and conditioning	XXX	X	X	X	X

As it can be seen from table 3 the work was distributed very evenly. Whereas it was discussed earlier we had subject experts. This allowed us to allocate responsibilities more efficiently. As listed above electrical was primarily Oliver's strong suit.

Individual Reflections

Raj Sidhu – CEO

This semester has been rewarding in so many different aspects. Starting our meetings while I was in Calgary was just the beginning of a journey that would take us four months and test our team's skills. From technical aptitude to interpersonal capabilities. At our first ever meeting we met via skype. I held this meeting to get all the future group members familiar with one another. I was happy to see that all the group members were cohesive and enthusiastic from day one. This gave me the sense that we had what it took to take this project to completion. I was very optimistic that we could brainstorm solutions to the problems that we had proposed.

Throughout the semester I felt that I went from a student to a future engineer. I learned that although we have the knowledge to implement the things that we did we had to go a step further to implement things that were outside the scope of our education. I felt that this semester tested my learning capabilities. In other words, how quickly could I understand concepts and implement them where they were needed. My back ground in mechanical design and project management also played a role in making the alternative parking indicator spring to life. Although this was a problem that initially affected me throughout the course of the semester I could begin to tell that the team also believed that this was a valid problem and required a solution. This told me that the members were serious about producing a solution to this issue. The positivity was extremely contagious as we pushed each other week after week and praised one another work. I felt that fostering a team climate where people felt free to speak their mind was crucial to our success.

In terms of team cohesiveness it should be a noted fact that there were instances where a team member came across as uncooperative. This team member tried their best to do the work and pursue solutions that were required. However, often times the reactions came across defensive. There were instances where other team mates including myself had issues however we pushed as a group to overcome these issues. Although the issues were not completely resolved they mended to the point where this team mate and the other group members could a working relationship with regards to the project. I could not have asked for more than that, since in the real world often times we have to work with people that may or may not agree with you. But both parties have to be mature enough to look past each other's differences and focus on the tasks at hand.

All in all I feel that this project caused all of the engineers to think critically. It tested their ability to think on their feet and fish for information where necessary. Going forward post 440/305 Parkolite would like to pursue the merits of this idea and see if a company can be erected with this product at the forefront. As discussed with the professors this product would be ideal for cities that are growing. Since mature cities may have difficulty implementing this into their current design. However with that being said Parkolite will look into methods of implementing this idea with

existing infrastructure from the end users. Finally I would like to conclude this post mortem by saying that I have gained potential business partners and even greater than that, a group of friends.

Oliver Krajci – COO

In the past couple years, I have found that I live most happily when I have a technical project that I can work on, and, in that sense, this project was an exceptionally terrific experience given the scope and challenge. Most of my previous technical projects had been completely personal, and so this project was a definite departure from my usual comfort zone.

If I am to speak of what I learned, I definitely did learn a lot, but not in a technical regard; all the skills I needed this semester were ones I had already had from previous projects. Nor do I think I learned much in terms of the complex, yet general "gotchas" that come along with product design, as this was not my first time around the track. What I was entirely unfamiliar with, however, was having somebody else be the leader, as I had readily given up the position to Raj. In that sense, my role in the group was quite different than what I had ever been used to, and thus the ability with which I could contribute directionally was very much a new experience for me. It was this that really caused me to make some new realizations as I was forced to go through the design process from a very different perspective and method than I am used to.

Of greatest shock to me, looking back is the ease with which a group can fall into deceptive group think, and the dangers of optimistic engineering. This is something which I make a deliberate effort to avoid at all costs with my personal projects, but, even so, it was far too easy to find myself rubbing everybody's shoulders as well as my own, telling everyone and myself it would be alright, succumbing to complacency, and finding myself in a panic when things did not go the way we had planned. I am not quite sure, yet, how this can be avoided in the future, but it is definitely eye opening for me. I believe it may pertain to the fact that, when working alone on a project, one is required to doubt oneself at all times, whereas in this case it may have been assumed, even subconsciously, that somebody else would spot the error that you missed.

Regardless, we still completed what we had intended to complete, and I am quite proud of what we accomplished. I am really happy to have had this group design experience, to have practiced my technical skills, but especially I am happy to have fond memories of working with these great individuals. I really did have a fantastic time with this "course", and I look forward to beers with these new friends.

Mubaarak Sandhu – CTO

Since the formation of our group, we have met at least once a week to design, implement and test our *Alternative Parking Indicator (API)*. ENSC 440W was the most important course in my undergraduate degree as we had to think and implement our own ideas. It was unique to not work under the direct management of Profs But instead work under CEO of the company, Raj. It was my pleasure to work under the leadership qualities of raj as he made sure everyone follows the deadlines, which helped us to stay active in last 4 months and not spend the sleepless nights at labs. Also over the past 4 months, API project changed its model but at end it gave me great pleasure and satisfaction that whatever we brain stormed, designed and implemented is finally came to a successful and great project. ENSC 440W also taught me how to implement whatever I learnt through various courses into an actual practical task. I had already done all of my co-ops hence it gave me experience in being a group player and deal with the group-dynamics. Also ENSC 305W taught me the importance of documentation, it is very hard to implement your functions and sell a product if your documents are not well written and does not make any sense.

From the technical point of view I initially contributed in the software aspect of the project. I worked with Arduino microcontroller and it was new to me since I used raspberry Pi on my co-op. I still remember being very happy when I did basic LED task on Arduino with Soudeh. I worked on programming the DigiPot, which was essential to take care of false scenarios of the sensor. With the guidance of Oliver it was successfully completed and integrated with the rest of the code. Another important thing I learnt in this course is the importance of research, some people might find it boring but it is one of the most essential parts of this course during the functional and design phase. One should never start project without a proper research as it might lead to a false start and you end up losing time. I did very detailed research on the sensors at the start of the project; I came to know about different types of sensors and their pros and cons. After discussing with group mates and on advice of Dr Andrew we eventually used AMR sensors. I also offered my help during integration phase and since we finished 2 weeks ahead of schedule, we already started planning on the future of the project and hence me and Soudeh designed very basic app of ParkoLite Ltd., it gave me exposure to the android studio as it was again my first time with android apps, we are still working on it and will integrate it with wifi module after our 440 project.

Overall both these courses taught me how to tackle a real world problem, which in our case was a parking problem since bylaws are very confusing to be understood completely. ENSC 440 taught me how to use all my knowledge and implement it practically through well designed plans and ENSC 305W the importance of documents in an engineering life. At last having sincere and dedicated members for this project, made API fun and enjoyable experience, hence I am proud of being a member of a hard working group.

Soudeh Mousavi – CFO

ENSC 440W has put me on a path of being an actual engineer; it has changed my way of thinking and approaching a problem. It was the most important course of my degree since it was unique and most practical course that I had done in last few years, where I practically applied all my knowledge gained through various classes at SFU. Right from the beginning, I had the opportunity to share my views and ideas with other group members and participate in the base model of the API. I was glad to be the part of dedicated team of engineers who not only provided their technical views but also heard my technical knowledge and let me show my creativity and problem solving skills. With dedication of everyone, we were able to successfully implement our project and I am proud that my knowledge and skills helped my group to achieve the desired results.

My technical experience in this course includes working with a digipot and programming it using arduino. I was new to Arduino since I did not do it before, hence me and Mubaarak did some basic tasks on arduino to get a grip on its functionality. Basically we worked on positioning the wiper of the digital potentiometer to approximately 2.5V. Also I was the CFO of my group, hence I was responsible for arranging all the funds for API product; I filled the ESSEF application and requested for funding. This experience taught me of being responsible and ethical in a group. Apart from that since we finished the product two weeks ahead of schedule, me and Mubaarak started to work on app. We initially started with the app on the emulator but Mubaarak's laptop did not have Intel processor, hence we implemented it on my system. Also Raj gave us working Wi-Fi module with different IP addresses, I connected the nexus phone with the corresponding Wi-Fi addresses and hence was able to learn a lot of stuff on the android app. Lastly I heavily contributed on the documentation which showed me the importance of documentation in this course. ENSC 305W taught me that any product with poor documentation does not live up to the industry standards, therefore it is absolutely essential to deliver the final product with perfect documentation.

Lastly, I am very proud to be the part of very talented engineering team. It was my pleasure to work under the supervision of Raj who treated everyone fairly and followed the deadlines very closely. Also I would like to thank Oliver for his expertise view on every aspect of the project and Mubaarak for being such a good team player while working with him. This course also taught me how to adjust with team members with different personality and one should only focus on their assigned tasks and duties.

Azin Navah – CMO

Similar to all other big projects, the ParkoLite project started with gathering and understanding all the requirements prior to designing the system's architecture. During this phase of the project, my team and I spent a decent amount of time trying to come up with an idea of what the project should be about and after we gained an understanding of what it is that we are trying to do, we started designing the system and writing the documentation which I was involved in to some extent. At that point we were thinking about system overview design and present a graphical representation of what our project would look like. I came up with an idea to create the project overview using Photoshop. In order to be able to work with Photoshop, I started learning how the program worked and how the design should like. After a couple of days of research, I was finally able to create a nice looking design of our system used in a city environment.

When we were assigned our tasks, I was put in charge of creating the software for Digital Potentiometer using the Arduino IDE. My main duty was to program the Potentiometer (Digipot) to get the exact required voltage needed by our sensor which was done by degaussing the magnetic field of our circuit. I also did a lot of research about who our competitors were and what exactly the function of their product is.

The most challenging part of the project for me was working with the Wi-Fi module, esp8266MOD. We were planning to create a mobile application in order to be able to upload the Parkolite current status signal to the cloud and use the mobile application to receive the signal and inform the user. I was in charge of setting up the Wi-Fi module in order for the circuit to be able to communicate with the network using the Arduino IDE. In order to do so, I needed to make an electrical test circuit to see if the state of the Parkolite RGB LEDs can be transmitted through the Wi-Fi module. I had to acquire the required circuitry such as BJTs, Voltage regulators, and resistors from the RP Electronics store. Finally, I made a circuit using the "husstechlabs bi-directional level shifter" schematics to convert the 5 volt signals coming from the pin numbers 9, 10, and 11 of the Arduino micro-controller to 3.3 volt signals using 3.3V and 5V power supplies. After the software code was also implemented, I was able to connect the Wi-Fi module to the Internet and display the RGB LED states

Conclusion

Overall the project was handled and implemented very carefully, our team met most of the deadlines and made sure we are on top of the things. Though there were some design changes in the model of the API, it did not hinder our progress and we were still ahead of schedule. Going into the future, we are definitely thinking of ideas to improve the API. We have already started building an app that will work concurrently with the functionality of the API, hence notifying the user on their parking status. Apart from that we are already in talks with the city of surrey and would love the opportunity to work with them.

Appendix

Agendas and Meeting Minutes

ENSC 440W/305W (Company Name Pending)

AGENDA

September 11, 2015

10:30-12:30PM

Engineering Science Lab 1

Purpose of Meeting: Refine scope of project, discuss the design clarify any questions and assign tasks to members for the development of a proposal. Also, to commence ESSEF application for funding

Items for Discussion:

- What is the project doing get everyone on the same page
- What problem is the project addressing
- What are our designs and alternatives
- Preliminary materials discussion including electrical, mechanical and other materials
- Splitting tasks based on proficiency in designated fields of study and experience
 - Electrical / Software
 - Mechanical and materials
 - Business
- ESSEF application

ENSC 440W/305W (Company Name Pending)

Meeting Minutes

September 11, 2015

10:30-12:30

Engineering Science lab #1

Present: Raj S, Oliver K, Mobby S, Azin A, Soudeh M.

Absent: All members were present

Purpose of Meeting: Refine scope of project, discuss the design clarify any questions and assign tasks to members for the development of a proposal. Also, to commence ESSEF application for funding.

Minutes:

Meeting was agreed upon in social media group. The meeting needed to be held to make sure all group members understood the scope of the project and the direction the team wanted to go.

A. What is the project doing get everyone on the same page

- Everyone agreed the project is being used to color code parking by-laws on the side of the street
- Initially the plan was to work in conjunction with the parking meters however this has been left as a future extension to the project
- The project will use different colors to indicate the different states in which the parking is
 - Green indicates available
 - Yellow about to expire
 - Red Unavailable
 - Blue taken
- An app might also be in the future for this project as resources increase and we can move forward

B. What problem is the project addressing?

- The problem is addressing the need to make street wide parking more efficient
- Not only that to increase traffic efficiency by providing a visual aid to drivers to indicate when parking is available
- This decreases the amount of people pulling over and holding traffic to read traffic by laws the lights simply tell you what you can and cannot do

Discussion: There was some discussion about using diffraction prisms to project the light onto the street. This will allow the drivers to be able to see the light more clearly. This has been added to the scope of the project depending on mechanical design constraints and funding.

Action: Research diffraction prisms to see if they can fit our purpose.

C. What are our designs and alternatives?

- Three designs were created
 - Oliver came up with a block design with spring backing to take any sort of axial loads
 - Also proposed using LED strips and embedding the technology into cavities.
 - Soudeh discussed a design where the apparatus would stretch down to the ground where as in Oliver's design it was suspended half way down the curb
 - Soudeh's design was made for more harsh conditions that can whether ore hard conditions
 - Raj produced the idea that the group supported by bolting the frame onto the curb and having a rubber layer for any force or shock. Electronics would be embedded in cavities. By doing so it would increase material resilience to any outside forces and allows for weather resistivity.

Discussion: Group openly discussed the ideas until everyone came to a consensus to use Raj's design since it used less material but yielded higher strength.

D. Preliminary materials discussion including electrical, mechanical and other materials

- Briefly outlined what will be needed for this project this included
 - Electrical equipment high over view
 - Microcontroller chose to use Arduino due to ease of use and implementation and it fits our purpose also cost effective
 - Mechanical work and materials the different kinds of plastics. Must check CSA specifications

Discussion: We decided that a parts list for the electrical work along with costs will be issued to Raj to gather up total costs and create proposal. All estimates and parts will be within +/-30% contingency. Based on electrical components a mechanical estimate will be made. This will be the bases of our proposal in terms of cost and what parts it is that we want to use.

Action: Research CSA specs and determine material, find out electrical materials needed.

Electrical Estimate will be submitted not later than September 16, 2015 11:59PM

The next meeting was arranged for January 19, 2006 at 10:30-12:30 in the brick house.

E. Splitting tasks & ESSEF

- It was agreed upon that the following people will take care of the tasks listed below
 - Electrical and Software: Oliver, Mobby, Soudeh, Azin
 - Mechanical and Materials: Raj
 - Business aspects: Raj, Soudeh, Mobby
- Soudeh will get started on the ESSEF application and we will find other third party funding if necessary. Raj will support application where needed.

Documentation will be split evenly amongst all group members. Wherever group member needs help support will be provided. Raj will be taking care of the proposal. Mobby, Oliver, Azin will be looking into electrical materials needed.

F. Next Meeting

Next meeting is formally booked for next week Friday 18th 2015 however if a meeting needs to take place prior to that date to hash out more details then it shall be held. Tasks have been split majority communication will take place through email or skype. In person meetings will be done if deemed necessary. There will be between 1 – 4 weekly meetings minimum. Status reports will be done weekly to maintain schedule and timing. Electronics estimates will be received by Sept 16 2015.

ParkoLite Ltd.

AGENDA

September 18, 2015

10:30am -11:30am

Lab1

Purpose of Meeting: To discuss Electronics design

Items for Discussion:

- To discuss a possible Electronics design

ParkoLite Ltd.

MINUTES

September 18, 2015

10:35am -11:20am

Lab1

Present: Raj Sidhu, Soudeh Mousavi, Mobby Sandhu, Oliver Krajci, Azin Navah

Purpose of Meeting: To discuss the possible electronics design

Minutes:

Raj Sidhu called the meeting to order at 10:35 am.

A. Approval of the agenda and minutes of the September 18, 2015 meeting

Minutes were approved as amended:

B. Issue Arising

- How should we detect the change in voltage/frequency/current?
- Placing the sensors, where exactly should sensor be placed on the prototype?
- What type of sensors should we use?

Action: Soudeh Mousavi to look into Phase Lock Loop and how we can use it to detect any changes on either Voltage/Frequency.

C. Updates

- Oliver and Mobby have started brainstorming and they have come up with one design, where mobby explained the high level design to rest of team.
- ESSEF application, Soudeh will finish the application and will send it to Raj for final review. ESSEF presentation is on September 22nd.

D. Next Meeting Date

The next meeting was arranged for October 2, 2015 at 10:30-11:30 in Lab1.

E. Other Business

- We need to make an appointment with Andrew to go over the ideas.
- Proposal documentation is due September 29th.

Meeting was adjourned at 11:20.

ParkoLite Ltd.

AGENDA

October 2, 2015

10:30am -11:15am

Lab1

Purpose of Meeting: To discuss new timelines and to finalize the design

Items for Discussion:

- To finalized the design and set a short time deadlines for Electrical portion

ParkoLite Ltd.

MINUTES

October 2, 2015

10:30am -11:15am

Lab1

Present: Raj Sidhu, Soudeh Mousavi, Mobby Sandhu, Azin Navah

Absent: Oliver Krajci (with regrets)

Purpose of Meeting: To finalized the design and set a short time deadlines for Electrical portion

Minutes:

Raj Sidhu called the meeting to order at 10:30 am.

A. Approval of the agenda and minutes of the October 2, 2015 meeting

Minutes were approved as amended:

B. Issue Arising

Raj Sidhu suggested a new design for the prototype. After discussion amongst members who were present, the design was approved.

The new design will be on a 3 feet tall pole which will be bolted to the sidewalk, the rough design will be provided to Oliver to get a better sense.

Action: Soudeh Mousavi, Mobby Sandhu and Oliver Krajci will test a hall effect sensor to capture an approximate range of object detection. Design will be modified depending on the range of sensor.

C. Next Meeting Date

The next meeting was arranged for October 9, 2015 at 10:30-11:30 in Lab1.

D. Other Business

Soudeh Mousavi will be away on October 18, 2015 for one day.

Action items:

1. Soudeh Mousavi, Mobby Sandhu will be working on algorithm for bylaws' script Saturday October 3 and Sunday October 4, 2015.
2. Electrical team (Soudeh Mousavi, Mobby Sandhu, Oliver Krajci) will provide a sensor profile by Tuesday October 6,2015.
3. Electrical team will be ordering/purchasing electrical parts by Wednesday October 7,2015.

Meeting was adjourned at 11:15.

ParkoLite Ltd.

AGENDA

October 9, 2015

10:30am -11:30am

Lab1

Purpose of Meeting: Weekly Meeting

Items for Discussion:

- Overall Project Progress
 - Electrical
 - Firmware
 - Mechanical
 - Finance

ParkoLite Ltd.

MINUTES

October 9, 2015

10:35am -11:15am

Lab1

Present: Raj Sidhu, Soudeh Mousavi, Mobby Sandhu, Oliver Krajci, Azin Navah

Purpose of Meeting: Weekly Meeting

Minutes:

Raj Sidhu called the meeting to order at 10:35 am.

A. Approval of the agenda and minutes of the October 9, 2015 meeting

Minutes were approved as amended:

B. Issue Arising

- No issue, researches are going well.

C. Updates

- Soudeh will submit APEGBC Team Funding application on October 9th.

D. Next Meeting Date

- The next meeting was arranged for October 16, 2015 at 10:30-11:30 in Lab1.

E. Deadlines

- **Electrical/Circuitry** → for Functional Spec by Oct 11th /Oct 12th
- **Digital Potentiometer** – chip on - needs to be ordered by Oct 13th
- **Software/firmware** → for Functional Spec by Oct 15th (very broad)
- **Mechanical** → for Functional Spec by Oct 14th

Meeting was adjourned at 11:15.

ParkoLite Ltd.

AGENDA

October 16, 2015

10:30am -11:30am

Lab1

Purpose of Meeting: Weekly Meeting

Items for Discussion:

- Overview Circuitry and Electronics

ParkoLite Ltd.

MINUTES

October 16, 2015

10:35am -11:20am

Lab1

Present: Raj Sidhu, Soudeh Mousavi, Mobby Sandhu, Oliver Krajci,

Late : Azin Navah (arrived at 10:55)

Purpose of Meeting: Weekly Meeting

Minutes:

Raj Sidhu called the meeting to order at 10:35 am.

A. Approval of the agenda and minutes of the October 16, 2015 meeting

Minutes were approved as amended:

B. Overall

Oliver has gone through the electronics with the team in order for them to be able to test and eventually adjust the digipot

Action: Mobby and Soudeh will try to make digipot to work and try to adjust the voltage required by circuitry

C. Updates

- Parts have been ordered
- Digipot has arrived and we can start testing it

D. Next Meeting Date

- The next meeting was arranged for November 5, 2015 at 10:30-11:30 in Lab1.

E. Deadlines

Digipot adjustment → Oct 30th

Meeting was adjourned at 11:20.

ParkoLite Ltd.

AGENDA

November 5, 2015

10:30am -11:30am

Lab1

Purpose of Meeting: Update meeting

Items for Discussion:

- Should we consider developing an app?
- How is the progress versus timeline?

ParkoLite Ltd.

MINUTES

November 5, 2015

10:35am -12:00 pm

Lab1

Present: Raj Sidhu, Soudeh Mousavi, Mobby Sandhu, Oliver Krajci, Azin Navah

Purpose of Meeting: Update Meeting

Minutes:

Raj Sidhu called the meeting to order at 10:35 am.

A. Approval of the agenda and minutes of the November 5, 2015 meeting

Minutes were approved as amended:

B. Issue rising

Should we develop an app? And if we did, we need to order a wifi module, PCB is almost done by Oliver. He needs to know how many pins on the wifi chip are being used.

Action: Raj will look into the wifi module

C. Updates

- October 23rd meeting got canceled due to unavailability of members
- PCB is almost done, before order PCB Oliver needs to know the wifi module status
- AMR sensor needs to be shielded since we don't need it to detect ferromagnetic at 360 degrees
- Mechanical part, pipes were bought and frosted by Raj.
- LEDs are very bright even with the frost
- We received our grades for Functional specs

D. Next Meeting Date

- The next meeting was arranged for November 13, 2015 at 10:30-11:30 place of meeting is TBA.

E. Deadlines

Final PCB configuration → November 9th

Wifi module and app → by November 29th if we have a working app it's a go otherwise we are not presenting

Debugging the system → Starting November 17th onwards

Presentation PowerPoint → November 19th start

Rehearsal → November 23rd – 30th

We should meet at 11 am December 2nd , before our demo time

Meeting was adjourned at 12:00 pm .

ParkoLite Ltd.

AGENDA

November 13, 2015

10:30am -11:30am

Skype Meeting

Purpose of Meeting: Update meeting

Items for Discussion:

- Do we have a working prototype?
- Are we still on with an App?

ParkoLite Ltd.

MINUTES

November 13, 2015

10:34am -11:30 am

Skype meeting

Present: Raj Sidhu, Soudeh Mousavi, Mobby Sandhu,

Absent: with regrets Oliver Krajci, Azin Navah

Purpose of Meeting: Update Meeting

Minutes:

Raj Sidhu called the meeting to order at 10:34 am.

A. Approval of the agenda and minutes of the November 13, 2015 meeting

Minutes were approved as amended:

B. Todo

Android APP: Soudeh and Mobby

C. Deadlines

Prototype Finish → Nov 19th

All Electrical Should be finished → Nov 16th

The app should be finished or not → Nov 29th

Debugging day entire day → Nov 20th

PowerPoint Presentation → Starting Nov 20th

We should meet at least 4 times → by December 1st

DEMO DAY → December 2nd

D. Next Meeting Date

- The next meeting was arranged for November 20, 2015 at 10:30-11:30 in LAB1.

Meeting was adjourned at 11:30 am.

ParkoLite Ltd.

AGENDA

November 20, 2015

10:30am -11:30am

Room TBA

Purpose of Meeting: Update meeting

Items for Discussion:

- Where we stand on App?
- How would this App look like?

ParkoLite Ltd.

MINUTES

November 20, 2015

10:40am -11:30 am

ASB 9705

Present: Raj Sidhu, Soudeh Mousavi, Mobby Sandhu, Oliver Krajci, Azin Navah

Purpose of Meeting: Update Meeting

Minutes:

Raj Sidhu called the meeting to order at 10:40 am.

A. Approval of the agenda and minutes of the November 20, 2015 meeting

Minutes were approved as amended:

B. Overview

Raj explained the wifi module and app integration.

Soudeh went through an overview of the app and how would it look like and the basic functionality of it.

C. Deadlines

Deadlines has not been changed since the last meeting, but there is a pressure on working App and wifi module.

Debugging will be placed today in lab1.

D. Next Meeting Date

- The next meeting was arranged for November 27, 2015 at 10:30-11:30 in LAB1.

Meeting was adjourned at 11:30 am.

ParkoLite Ltd.

AGENDA

November 27, 2015

10:30am -11:30am

Lab1

Purpose of Meeting: Update meeting

Items for Discussion:

- Is Wifi Module working?
- Are we able to connect the app to it?
- This is our last official meeting

ParkoLite Ltd.

MINUTES

November 27, 2015

10:40am -11:20 am

Lab1

Present: Raj Sidhu, Soudeh Mousavi, Mobby Sandhu, Oliver Krajci, Azin Navah

Purpose of Meeting: Update Meeting

Minutes:

Raj Sidhu called the meeting to order at 10:40 am.

A. Approval of the agenda and minutes of the November 27, 2015 meeting

Minutes were approved as amended:

B. Overview for November 27th

- **Soudeh , Mobby, Azin** → App and Wifi Modul
- **Oliver** →Power –Battery
- **Raj** → **Cement Base / electrical housing**

C. Deadlines

- App/Wifi module completion to be able to added to test plan → Nov 29th
- Progress Report + test plan → Nov 29th
- Demo day → December 2nd

D. Next Meeting Date

- This was the last official meeting; we will have work meetings and meeting for rehearsal.

Meeting was adjourned at 11:20 am.