ENSC 305W/440W Grading Rubric for Project Proposal

Criteria	Details	Marks
Introduction/Background	Introduces basic purpose of the project. Includes clear background for the project.	**/05%**
Scope/Risks/Benefits	Clearly outlines project scope. Details both potential risks involved in project and potential benefits flowing from it.	**/15%**
Market/Competition/ Research Rationale	Describes the market for a commercial project and details the current competition. For a research project, the need for the system or device is outlined and current solutions are detailed.	**/10%**
Company Details	Team has devised a creative company name, product name, and a logo. Outlines relevant skills/expertise of team members.	**/05%**
Project Planning	Details major processes and milestones of the project. Includes Gantt, Milestone, and/or PERT charts as necessary (MS Project).	**/10%**
Cost Considerations	Includes a realistic estimate of project costs. Includes potential funding sources. Allows for contingencies.	**/05%**
Conclusion/References	Summarizes project and motivates readers. Includes references for information from other sources.	**/10%**
Rhetorical Issues	Document is persuasive and could convince a potential investor to consider funding the project. Clearly considers audience expertise and interests.	**/10%**
Presentation/Organization	Document looks like a professional proposal. Ideas follow in a logical manner. Layout and design is attractive.	**/10%**
Format Issues	Includes letter of transmittal, title page, executive summary, table of contents, list of figures and tables, glossary, and references. Pages are numbered, figures and tables are introduced, headings are numbered, etc. References and citations are properly formatted.	**/10%**
Correctness/Style	Correct spelling, grammar, and punctuation. Style is clear concise, and coherent.	**/10%**
Comments		

September 25, 2013

Mike Sjoerdsma
School of Engineering Science
Simon Fraser University
8888 University Drive
Burnaby, BC, V5A 1S6

RE: ENSE 440 Capstone Project Proposal: Easy to Install Car Parking Sensor

Dear Mike Sjoerdsma:

Please find attached the proposal document for our ENSC 440 capstone project. Our objective is to design a car parking sensor that can be easily installed by any lay person. The installation should not require the installer to have any technical knowledge about cars.

The attached proposal gives an introduction to car parking sensors and its market. The proposal will also include a proposed design for our parking sensor along with budget considerations and a project plan. Also included is a description of our company and its personnel.

We are a team of four innovative engineering students. We have an exceptionally strong skillset in electronics design and software development. We also have some mechanical skills as well. The team consists of the following members: Will Zhang, Edmund Mo, HamidReza Haghshenas, and Kenny Lam.

If you have any concerns or questions regarding our proposal, please feel free to contact me by phone or email. Thank you very much for your consideration.

Sincerely,

Kenny Dung Tuan Lam
Chief Executive Officer
Greentree Incorporated
Phone: (778)320-0733
Email: lamdungl@sfu.ca

Enclosure

Unipark-1000

An Easy to Install Vehicle Parking Sensor

ENSC440 Project Proposal
September 20, 2013

Revision 1.1

Title/Name	Signature	Date
Author/Chief Executive Officer Kenny Lam		
Chief Financial Officer Edmund Mo		
Chief Operations Officer Hamidreza Haghshenas		
Chief Technical Officer Will Zhang		

Contents

Introduction

How many times did you have difficulty parking your car? Parking is the most difficult task associated with driving a car. This difficulty results from our inability to accurately judge the distance behind and/or in front of the car. A parking sensor simplifies parking by showing the driver of how much empty space is around the car. The device typically reports the distance to the closest obstacle behind or in front of the car.

There are currently two options available for acquiring a parking sensor. The first is to purchase a new car. Parking sensors come pre-installed in luxury or fully loaded cars. They may also be available as an upgrade option for basic car models. However, purchasing a new car for a parking sensor is ridiculous. The upgrade option is bad as well because the parking sensor is usually bundled with other features which increases the upgrade cost to at least several hundred dollars. Most people would deem this to be too expensive and not really worth it. The second option is to purchase a standalone parking sensor and manually install it into the car. The advantage of this option is that standalone parking sensors can cost as low as $30 (rear parking sensors only). Unfortunately, the standalone sensors are difficult to install for the average person who has limited car knowledge. See Appendix 1 and 2 for typical parking sensor installation instructions. Notice how complicated the instructions are. No lay person would be comfortable with following these instructions. Therefore, the installation would need to be done by a mechanic. According to a local auto shop, installation is $100 just for the rear sensors. So the sensor itself is affordable but the installation cost is high enough to put people off.

We, at SABZ incorporated, have come up with an innovative solution to remove the hindrance cause by a complicated installation process. Our solution will give the average person easy access to parking sensors. We will develop a parking sensor that is affordable and easy to install. The installation process for our device will only take 15 minutes and only require one or two hand tools. We begin our proposal with an introduction to car parking sensors. Then we will discuss the objectives and deliverables of the project, the proposed design, the project plan and the project budget.

Car Parking Sensors

Car parking sensors are designed to measure the distance to the nearest obstacle and relay that information to the driver. Parking becomes a lot easier and safer when the driver knows exactly where obstacles are around the car. The sensors use visual aids such as LED or LCD readouts to indicate object distance. Some sensors use audible beeps to indicate distance with faster beeps meaning closer proximity and a continuous tone meaning a minimal pre-defined distance. Sensors are usually installed on both the back and front of the car but some systems are rear sensors only.

There are many parking sensors available on the market from many different vehicle manufacturers. However, there are only two main types of parking sensors. One type uses ultrasonic sensors while the other uses electromagnetic sensors

Ultrasonic Car Parking Sensors

An ultrasonic system uses the reflection of sound waves off an object to detect the distance. The distance measurement is derived from the echo time. These sensors are usually installed on the bumper as shown in figure 1. The sound waves are in the range of 20 kHz to 40 kHz which is above the level of human hearing.

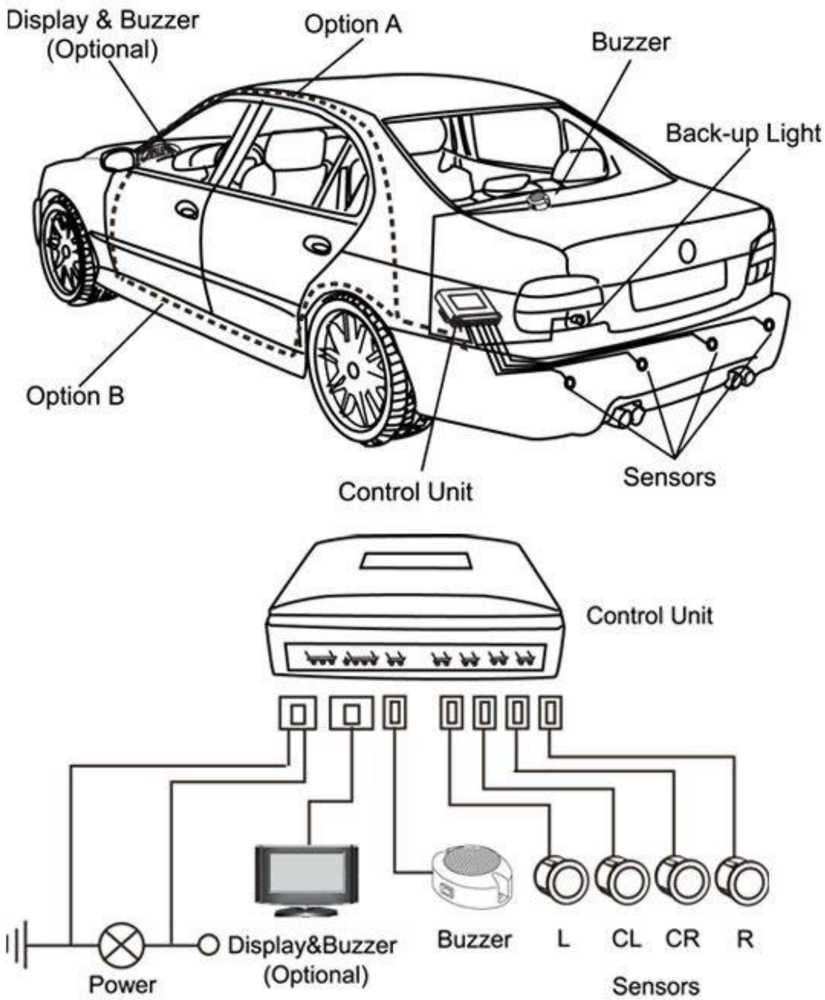


Figure 1: Typical Ultrasonic Parking Sensors Setup. [1]

Ultrasonic sensors offer the following advantages

- Cost effective – systems can cost as low as $30 CND
- Sensors are able to detect objects even if car is stationary.
- Accurate detection of object as far as 4.5m away

The disadvantages are

- The sensors have trouble detecting flat objects because flat objects can be oriented in such a way that their surface reflects sound waves away instead of back to the sensor.
- The system has trouble detecting small objects because they may not reflect enough sound waves back.

- The system has trouble detecting soft objects because they will absorb the sound waves and therefore may not reflect enough sound waves back.
- The distance detection becomes unreliable if the sensors are dirty or out of alignment
- The installation process is complicated because it requires drilling holes in the bumper and running wires inside the car.
- The sensors ruin the original look of the bumper

Electromagnetic Parking Systems

Electromagnetic sensors work by creating an electromagnetic field around the bumper of the car. Objects entering the field will affect a change which is detected and used to calculate the distance of the object.

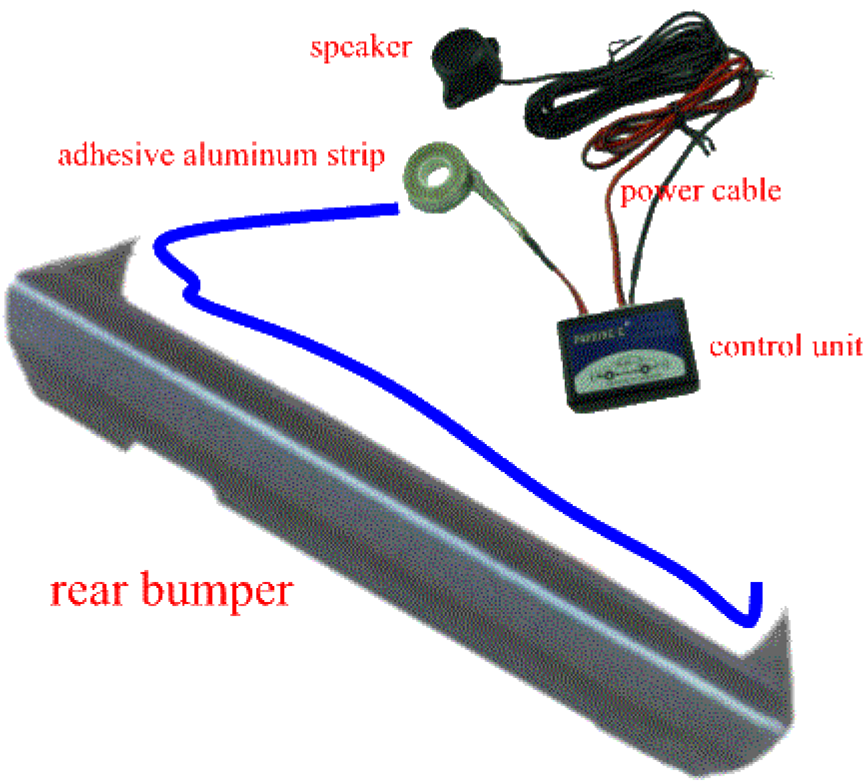


Figure 2: Typical Electromagnetic Parking Sensor Setup

Electromagnetic sensors offer the following advantages:

- The sensor is discretely mounted on the inside of the bumper thus preserving the new factory look of the vehicle
- Does not require any drilling of the bumper
- Electromagnetic sensors are able to detect smaller objects than ultrasonic sensors
- Electromagnetic sensors don't have any dead spots where it can't detect any objects.

However, these sensors have the following disadvantages

- Electromagnetic sensors can only detect the object if the vehicle is moving slowly.
- A bit more pricey than ultrasonic sensors (costs starting at $60)
- Short detection distance of approximately 1m or less depending on model.
- Distance values are not as accurate as with ultrasonic sensors

Design Objectives

There are two essential design objectives to the project. The sensor performance must match or exceed the performance levels of a mid-level car parking sensor. The sensor must be easy to install. To satisfy the performance objective, we will obtain a mid-level car parking sensors and test it against our sensor. Our sensor must be able to detect all objects that the mid-level sensor detects and must report distance values accurate to within 10%. To satisfy the installation objective, a lay person with no technical car knowledge must be able to install the device within fifteen minutes. Also the installation process should not require more than one or two hand tools.

Asides from the essential objectives outlined above, the following are secondary objectives for our project.

- Designing a complete and professional case for the product
- Optimizing the power consumption for maximum battery life

A secondary objective is one that is optional to the project and will be attempted if there is sufficient time. We will likely not have enough time to develop a complete and professional case for our device so we've decided to consider this as a secondary objective. However, we do intend to create a case for our prototype that allows it to be easily installed onto the car. Since the sensor will be battery operated, the final product would benefit greatly from optimizing power consumption for maximum battery life. A rough calculation suggested that we can get around a month's worth of daily usage before the batteries will be low. With power optimization, we could double or triple the battery life. Power optimization has been relegated to a secondary objective because it is not essential to the function of the sensor and we will likely not have enough time to achieve this objective.

We believe that we can get a working prototype that will satisfy the two essential objectives within three months' time. The prototype is deemed to be working if we can easily install it into nine out of ten cars and have it perform as intended.

Proposed Design

The proposed car parking sensor will consist of 3 components. There will be one display module and two sensor modules. One sensor module is for detecting objects at the front of the car and the other is for detecting objects at the back of the car. The two types of modules are described in further detail in the following subsections.

The Display Module

The display module will contain the on/off controls for the sensor and display the distance of obstacles to the driver. To serve its second function, the display module will have an LED display similar to that illustrated in figure 3.

Figure 3: Display Module Concept Picture

In addition to the visual distance display, the module will also contain an audible alarm which will beep more frequently as the obstacle distance decreases. This is a common feature in car parking sensors. Distance information will be retrieved from the front and rear parking sensors via Bluetooth. The on/off controls on the display module will wirelessly activate/deactivate the sensors according to user input. Lastly, to make it easy to install, the module will run off a 9V battery and mount on the dash with double sided foam. A proposed block diagram of the display module is shown in figure 4.

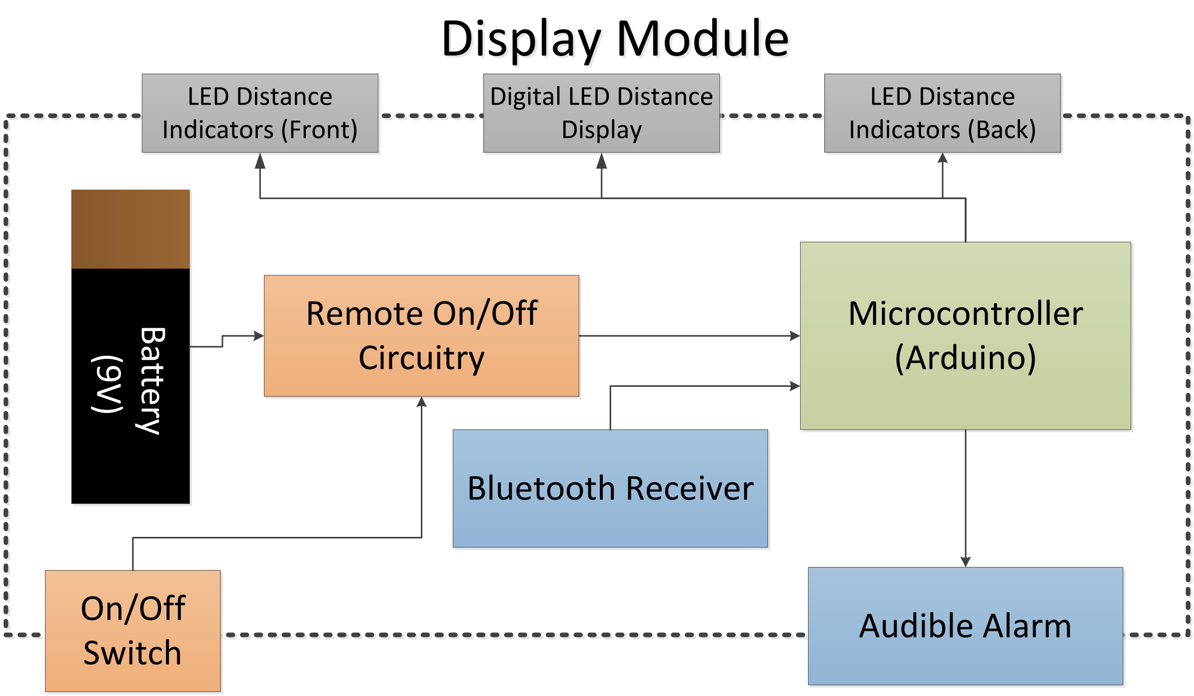


Figure 4: Block Diagram for Display Module

The Sensor Module

The sensor module's sole purpose is to detect obstacles and measure their distance from the car. Our car parking sensors will have two sensor modules. One mounted in the rear of the car and one mounted in the front. The sensor module will use an Arduino microcontroller along with four ultrasonic sensors for obstacle distance detection. This module will have a remote on/off circuitry so that it can be activated/deactivated remotely by the display module. The sensor module will send distance information to the display module via Bluetooth. Like the display module, the sensor module is also battery operated (4X AA). A block diagram of this module is shown in figure 3.

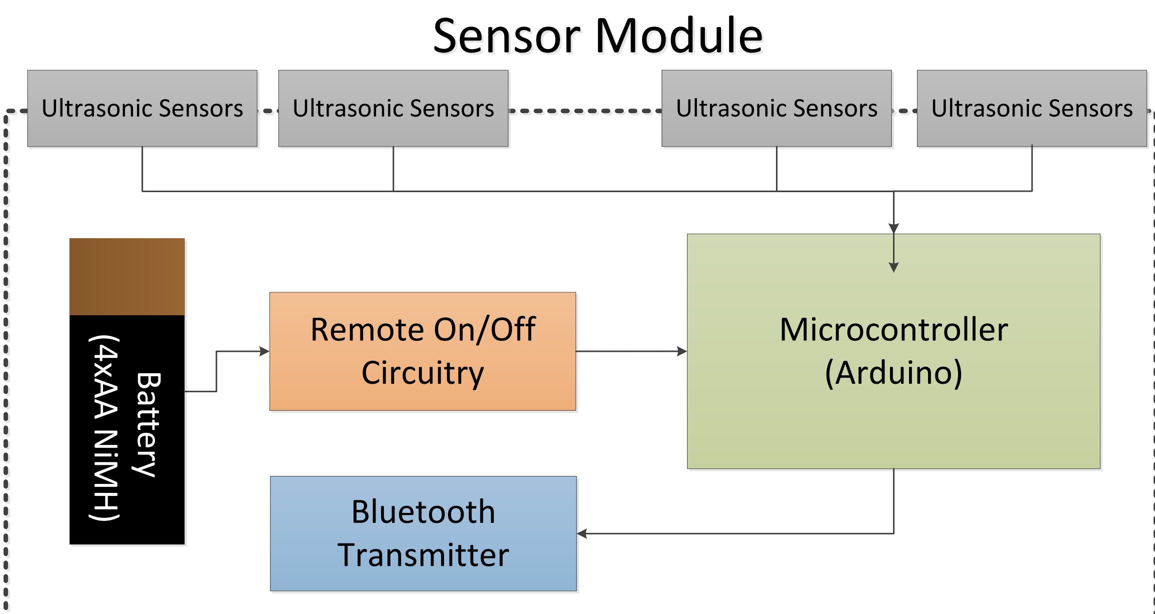


Figure 5: Sensor Module Block Diagram

The electronics for the sensor module will be mounted inside a license plate frame. This frame serves as the housing for the sensor module and should look like what is shown in figure 6. Housing the electronics inside a license plate frame ensures that the sensor is easy to install on any car.

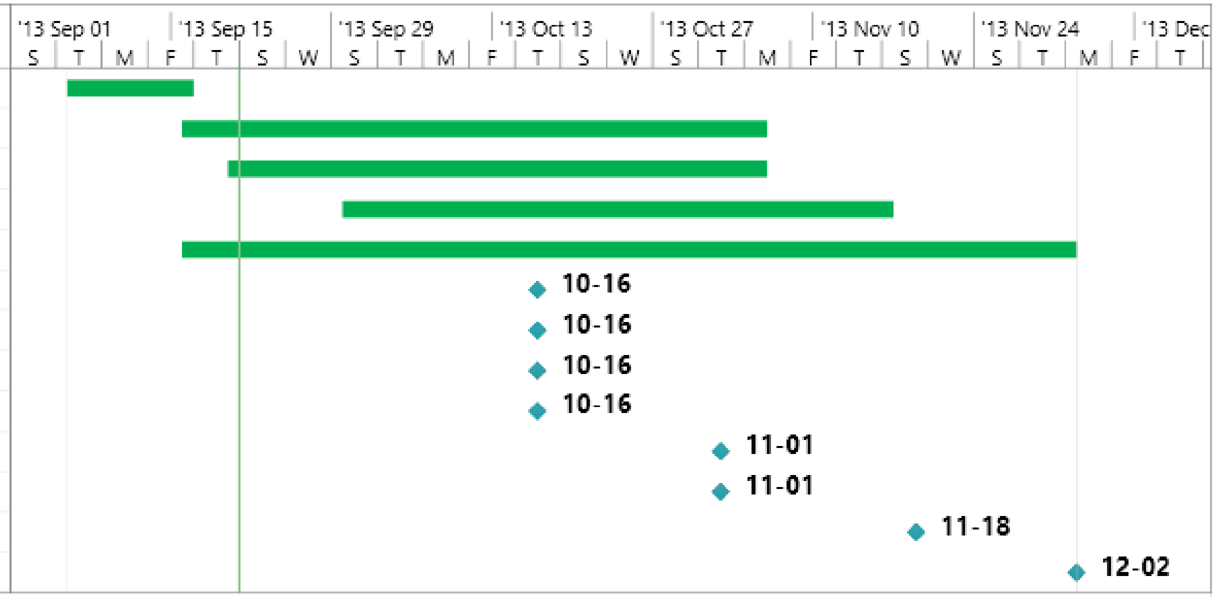
Figure 6: Sensor Module Concept Picture

Project Planning

The following Gantt charts shows the details of the project plan.

Table 1: Project Phases and Milestones

ID	Task Name	Milestone
1	Research Phase	
2	Design Phase	
3	Build Phase	
4	Testing Phase	
5	Documentation	
6	Bluetooth Communication	10-16
7	Remote On/Off Circuitry	10-16
8	Ultrasonic Distance Detection Circuitry	10-16
9	Display LEDs and Audible Alarms	10-16
10	Sensor module prototype	11-01
11	Display module prototype	11-01
12	Working Prototype	11-18
13	Demo	12-02

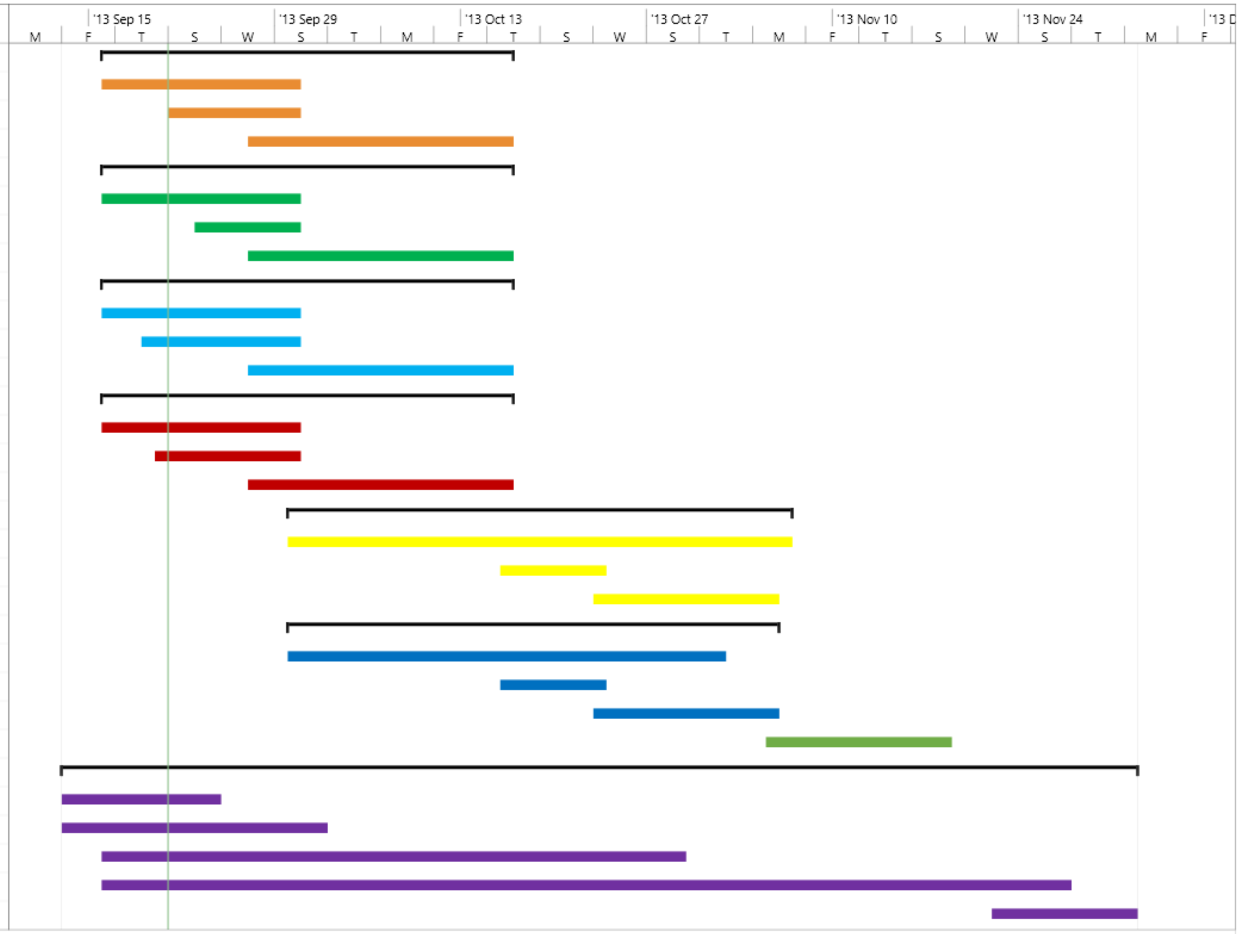


Project: Project2
Date: Sat 13-09-21

Milestone ◆
Summary

Table 2: Gantt Chart for Project Tasks

ID	Task Name	Assigned To
1	**Bluetooth Communication Protocol**	**Kenny**
2	Design	
3	Build	
4	Test	
5	**Remote On/Off Circuitry**	**Will**
6	Design	
7	Build	
8	Test	
9	**Ultrasonic Distance Detection Circuitry**	**Edmund**
10	Design	
11	Build	
12	Test	
13	**Display LEDs and Audible Alarm**	**Hamidreza**
14	Design	
15	Build	
16	Test	
17	**Sensor Module**	**Everyone**
18	Build Casing	
19	Integrate Subcomponents	
20	Test	
21	**Display Module**	**Everyone**
22	Build Casing	
23	Integrate Subcomponents	
24	Test	
25	Test Complete Prototype	Everyone
26	**Documentation**	
27	Proposal Draft to Lucky	Kenny
28	Final Proposal to Mike	Kenny
29	Functional specificatons	Everyone
30	Design specifications	Everyone
31	Written Progress Report	Kenny



Project: gantt chart detailed tas
Date: Sat 13-09-21

Task, Split, Milestone, Summary, Project Summary, Inactive Task, Inactive Milestone, Inactive Summary, Manual Task, Duration-only, Manual Summary Rollup, Manual Summary, Start-only, Finish-only, External Tasks, External Milestone, Deadline, Progress, Manual Progress

Page 1

Company Details

Profile

SABZ Incorporated is small research company consisting of four engineering students. We are based at the SFU Campus in Burnaby, BC. The company was established in August 2013.

The Team

Edmond Mo, Chief Financial Officer

Edmond Mo is a 5^{th} year Electronic Engineering student currently studying at SFU. He was a Software Test Developer COOP at RIM where he designed and ran test cases for part of the QA process of un-release product. He then took the position as a Firmware Development COOP at PMC Sierra where he was actively involved in Firmware Development (e.g. committing bug fixes, and making tools). Through his years of study and experience, Edmond has developed excellent technical skill. He is also competent in writing C/C++, Python, TCL, VHDL, and Verilog.

Hamidreza Haghshenas, Chief Technical Officer

Hamidreza Haghshenas is a 4th year Electronics Engineering student at Simon Fraser University. He is a trained user of Matlab, C++, VHDL, PLC programming, Assembly Language and other object oriented programs. He is also an experienced user of electronic laboratory equipment such as function generators, oscilloscopes, electronic circuits, DMM, and other basic related equipment. During his 8 months co-op in the Electrical Engineering Department of Hezar Aluminum Industries, he worked as a member of the group for Technical Maintenance of Machineries. This experience allowed him to be involved in lot of team work and gain a lot of experiences in solving problems as a member of the group.

Kenny Dung Lam, Chief Executive Officer

Kenny Dung Lam is a 5^{th} year Biomedical Engineering student at SFU Engineering. His core competency is in electronics design and programming. He is also knowledgeable with Java, VHDL and many C-base programming languages. He is also knowledgeable with basic mechanical design and is capable with basic machining operations such as drilling, cutting, bending, and gluing. On a non-technical front, Kenny has developed excellent interpersonal, communication and problem solving skill through his work as a manufacturing engineer for Novadaq Technologies Inc. The job required Kenny to diagnose and fix any product failures that occurred during production. Kenny frequently wrote detailed reports to document the product failures and fixes. At Novadaq, Kenny worked with a multidisciplinary team of engineers, quality assurance personnel, production staff, and operations managers.

Will Zhang, Chief Operations Officer

Zi yue Zhang is a 4th year Electronics Engineering. He is familiar with (X)HTML, CSS,C and C++ languages. He has experience with BJT, MOSFET analysis and analog/digital circuit design. He also has basic knowledge of communication system (AM, FM modulation and demodulation). He is proficient with lab equipment: oscilloscopes, DMMs and function generators. He did one year co-op at BlackBerry. His main focus was on software testing. He can design various test cases which cover most product requirements. He was good at finding the root causes of the defects. He also wrote reports and delivered them to developers and project leads.

Budget

The following tables outline the project budget.

Table 3: Projected Cost for Sensor Module Prototype

Sensor Module			
Description	Estimated Cost/piece	Quantity Required	Subtotal
Microcontroller	$4.00	1	$4.00
Ultrasonic Transducer	$30.00	4	$120.00
Bluetooth Transceiver	$20.00	1	$20.00
Case	$30.00	1	$30.00
Remote on/off circuit	$10.00	1	$10.00
		Total	$184.00

Table 4: Projected Cost for Display Module Prototype

Display Module			
Description	Estimated Cost/piece	Quantity Required	Subtotal
Microcontroller	$30.00	1	$30.00
Display LEDS	$10.00	1	$10.00
Bluetooth Transceiver	$30.00	1	$30.00
Remote on/off circuit	$10.00	1	$10.00
Case	$20.00	1	$20.00
Audible Alarms	$10.00	1	$10.00
		Total	$110.00

Table 5: Project Cost for Parking Sensor Prototype

Complete Prototype Cost			
Description	Estimated Cost/piece	Quantity Required	Subtotal
Sensor Module	$184.00	2	$368.00
Display Module	$110.00	1	$110.00
Reserve Funds	$272.00	1	$272.00
		Total	$750.00

Conclusion

SABZ Inc. is a company dedicated to providing innovative solutions to real world problems. Retail parking sensors are complicated to install and require technical car knowledge thus hindering the average person from using this wonderful tool. Built-in parking sensors are very expensive. Therefore to give people easier access to parking assistance technologies, our parking sensor is designed to be cost effective and easy to install. Installation will take not more than 15 minutes and only require one or two hand tools. We believe our sensor will achieve market success because anyone can afford it, install it, and use it.

Bibliography

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[2] J. Lohrey, "How to Install Rear Parking Sensors," eHow, 29 January 2013. [Online]. Available: http://www.ehow.com/how_5835425_install-rear-parking-sensors.html. [Accessed 19 September 2013].

[3] "Car Features: Parking Sensors," Which?, [Online]. Available: http://www.which.co.uk/cars/choosing-a-car/car-features/parking-systems-explained/parking-sensors/. [Accessed 19 September 2013].

[4] M. Hikita, "An Introduction to Ultrasonic Sensors for Vehicle Parking," New Electronics, 12 May 2010. [Online]. Available: http://www.newelectronics.co.uk/electronics-technology/an-introduction-to-ultrasonic-sensors-for-vehicle-parking/24966/. [Accessed 19 September 2013].

[5] M. Reiciunas, Director, Parking sensors fitted. No drilling required. Invisible from outside. [Film]. Canada: Youtube, 2012.

Appendix 1: Typical Ultrasonic Car Parking Sensor Installation Instructions (Rear Sensors Only) [2]

Required Tools

- Eye protection
- Vehicle owner manual
- Marking pencil
- Measuring tape
- Double-sided tape (may come as part of installation kit)
- Drill
- Drill buffing bit

Procedures

1. Decide on location of sensor units. Measure the length of the bumper and divide the measurement in half or in quarters, depending on whether you will install two or four sensors. Find the center of each half or quarter. Then, consider the shape and curve of the bumper. To work properly, sensors must point straight ahead. Sensors angled up or down will orient to objects in that direction and may not work effectively. Make sure the sensor will sit flush with the bumper in a position approximately 24-inches from the ground. Mark sensor locations with a marking pencil, place a piece of double-sided tape at the location and fix a sensor to each piece of tape.

2. Connect and test sensor placement. Plug sensor wires into the control box. Create a connection between the control box and one of your parking lights. To connect the control box to your parking light, refer to your vehicle owner manual for instructions specific to your vehicle model to access the wiring harness and tap into the parking light. To test, have someone start the car and activate the parking lights. Move objects of varying sizes in and out of the vicinity of the vehicle bumper. Adjust sensor placement if necessary. Once you establish a successful connection, unplug the sensors from the control box and disconnect the car battery to protect against voltage shocks.

3. Install sensors. Using the drill bit that comes with your installation kit, drill the appropriate number of holes, stopping to clean metal shards from the drill area to avoid scratching the bumper. Smooth the area using a drill and drill-buffing bit. Insert a sensor head into each drill hole and pass sensor wires through to the trunk of the vehicle. Plug sensor wires into the control box.

4. Install control box. Most users place the control box in the trunk of the vehicle, under the left or right bulkhead. This will ensure no water can damage the control box unit. Use double-sided tape to secure the control box in place and press firmly.

5. Install warning siren. Since the siren can become quite loud, installing it in the trunk of your vehicle is a good idea. Plug the siren connector into the control box and use double-sided tape to secure in place.
6. Install display unit. Some rear parking sensors include an LCD monitor that you can install on the dashboard of your vehicle. Use double-sided tape to place and secure the monitor and run the wires back through to the location of the control box, and then plug the monitor wire into the control box.

Tips and Warnings

- Be sure to allow enough slack in the connecting wires. Stretched or pinched wires may cause the sensors to fail.
- Do not forget that professional installation is available. If you do not feel comfortable working around wiring or if you feel this project is above your level of expertise, consult a professional.
- Wear eye protection when drilling sensor holes. Metal shards can cause serious injury.
- Rear parking sensors do not replace your eyes and ears. Always look behind and check rear-view mirrors before attempting to back your vehicle.

Appendix 2: Typical Electromagnetic Car Parking Sensor Installation Instructions [3]

Required Tools

- Hand tools
- Instructions for removing bumper
- Break Cleaner
- Cloth or Towel
- Sandpaper (optional)
- Soldering Iron and Solder

Procedures

1. Remove the rear bumper
2. Clean the surface on the inside of the bumper where areal film is going to be attached. Use sand paper to make it quicker. Degrease and remove free dust using brake cleaner (or suitable alternate cleaner)
3. Attach areal film onto inside of bumper. Start from one side and stick the areal film on the bumper all the way across to the other side.
4. Secure end connector of the areal film with double sided tape supplied in the package.
5. Install the control module under the rear light. Make sure the module won't get wet where it is installed.
6. Feed the module connection plug from the inside of the car to the outside where the module is situated.
7. Locate the ground supply of the right side light unit and connect it to the black wire of module plug. Solder together and insulate. Find 12 volt power supply wire to the reverse light bulb and connect it to the red wire of the module plug. Solder together and insulate.
8. Connect module areal lead to areal film connector.
9. Reinstall bumper. Ensure bumper is supported while securing it to vehicle to avoid damage to areal film if bumper falls off by accident.
10. Feed buzzer wire into a suitable car speaker compartment