



September 22, 2008

Dr. Andrew Rawicz

School of Engineering Science
Simon Fraser University
Burnaby, British Columbia
V5A 1S6

Re: ENSC 440 Project Proposal for an Emergency Vehicle Traffic Light Controlling System

Dear Dr. Rawicz:

The attached document, *Proposal for an Emergency Vehicle Traffic Light Controlling System*, outlines our project for ENSC 440. Our development will employ a new traffic light system that will incorporate a response to approaching emergency vehicles. The design is a response to several tragic incidences involving emergency vehicles and civilians colliding within intersections.

The purpose of this proposal is to provide a high level explanation of the project as well as insight into design considerations, budgeting, scheduling and sources of information and funding. Alternative designs are also explored within this document, as well as the need for a technologically advanced product.

ESC is company that is governed by five senior engineering students. Our background in the field is diverse and covers a broad range from software to hardware to mechanical engineering. Ryan Goldade, Leon Chang, Kelvin Liu, Jun Kim and Tae-Hoon Kim have teamed up to bring their various strengths to the table in developing the new advancement in emergency response technology. Please contact Ryan Goldade through e-mail, rgoldade@sfu.ca, if you have any concerns or questions regarding the proposal.

Sincerely,
Ryan Goldade, CEO
Enlightenment Solutions Corporation



ESC

Enlightenment
Solutions
Corporation

Proposal for an Emergency Vehicle Traffic Light Controlling System

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School of Engineering Science
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Executive Summary

“Two people were injured in a crash involving an ambulance near 52nd and Dodge shortly after 7:30 a.m. Sunday, Sept 7th, 2008. Witnesses say a car was southbound with a green light when the eastbound ambulance ran a red light and hit the car.”[1]

When every second counts: for those in urgent need of medical care, law enforcement and other emergency services, a few moments can mean the difference between life and death. According to the ambulance crash log provided by EMSNetwork.org, there were at least 10 ambulance accidents occurred at intersections in the United States in the month of August 2008 [2]. Now imagine the number of worldwide injuries and fatalities from ambulance, police car and fire truck accidents combined together. It becomes obvious that the injuries and deaths associated with emergency vehicle accidents can be dramatically reduced with advancements in today’s technology.

This document proposes a development of an emergency vehicle traffic light controlling system. This system utilizes GPS signal to compute the velocity and location of an emergency vehicle, these data are wirelessly sent to the traffic light that is being approached. The traffic light will make use of the received information and allow easy passage for the emergency vehicle accordingly.

Enlightenment Solutions Corporation (ESC) consists of five fourth-year undergraduate engineering students from Simon Fraser University with industrial experience and technical knowledge in digital/analog electronics, software and firmware design, and wireless technologies.

The project engineering cycle will span a 13-weeks period with the first operational prototype completed by mid December, 2008. The project is tentatively budgeted at CDN\$625 including the cost of research, development, integration and testing of the first prototype, which we expect to obtain from a variety of sources.

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1. Introduction

“2 men die after high-speed crash involving police cruiser” [3].

In the end of October 2007, an RCMP cruiser collided with a Chevrolet Cavalier at the intersection in Burnaby, BC and both the driver and passenger died. The cruiser was displaying flashing lights and sirens, responding to an emergency. Although it is police protocol to be cautious when passing through intersections, such incident can occur at anytime of our daily lives.

BC RoadSense for Drivers states that “Emergency vehicles displaying flashing lights and sirens always have the right of way” [4]. However, emergency vehicles are often forced to sit in traffic or weave through causing delays to their response times to crime scenes or medical emergencies.

Enlightenment Solutions Corporation (ESC) proposes a solution which is to provide traffic light preemption to emergency vehicles in order to reduce emergency vehicle accidents and delay in responses. By installing Emergency Vehicle Traffic Lighting Control (EVTLC) system, the emergency vehicle will be able to control the operation of traffic light.

This proposal includes an overview of the various aspects of EVTLC system, outlines of design considerations, alternative solutions, tentative budget, sources of information, funding, and project schedule with Gantt and milestone charts.

2. System Overview

The overall operation consists of several discrete systems that interact with each other to form the working model of pre-emptive traffic light control. Figure 2.1 highlights the different sub-systems and how the information is communicated through. The on-board GPS system already exists in most emergency vehicles, so the information can be easily transmitted to the traffic light that is being approached. The traffic light must make sense of the information and make a decision on how to control the traffic lights to allow easy passage of the emergency vehicle.

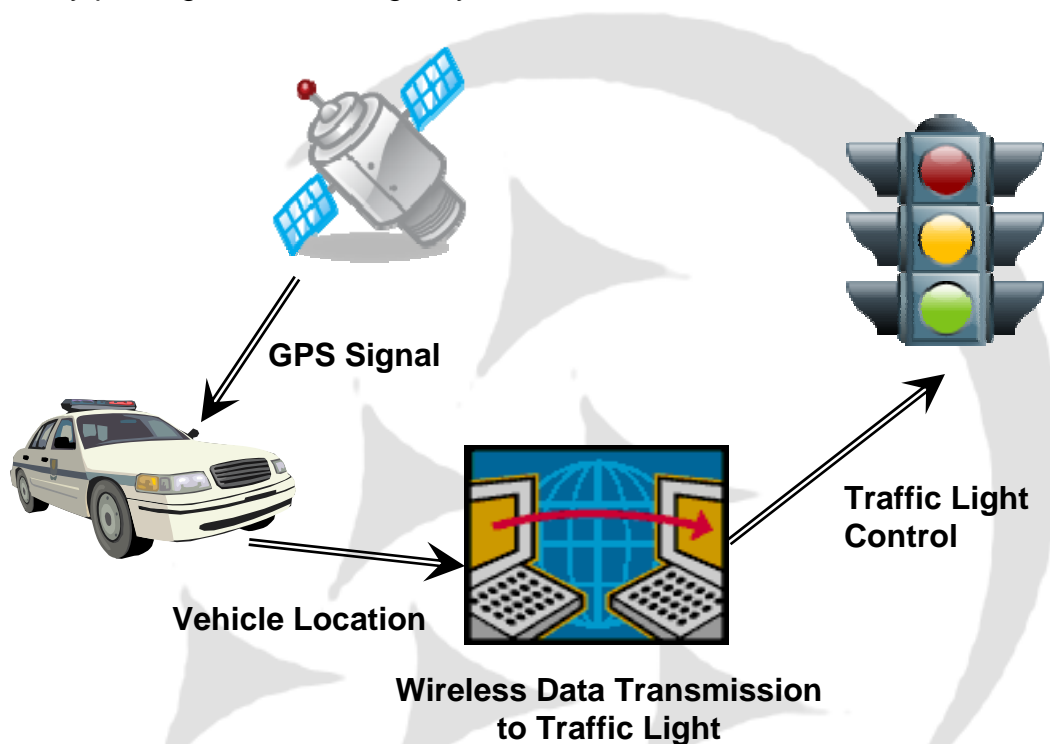


Figure 2.1 Diagram depicting sub-system configurations

The main component will be the traffic light control because it is the backbone of the project. The control will also require the largest amount of computing because it will have to translate the vehicles position and movement into the correct traffic light configuration.

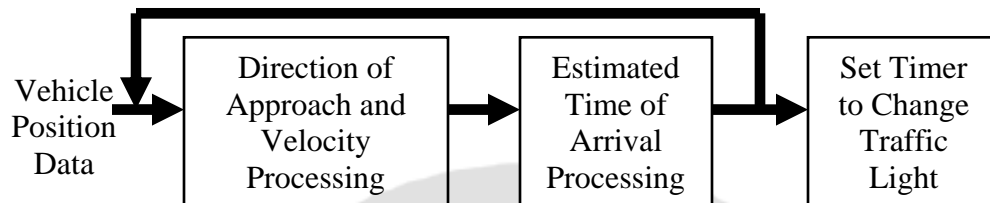


Figure 2.2 Traffic light control information throughput

3. Possible Design Solutions

There has been limited to no advancement in technology to assist the emergency vehicles in recent history. Existing solutions seem inadequate particularly at times of tragic accidents as seen in the recent news.

1. Sirens/Flashing lights

Sirens on fire trucks as well as other emergency service vehicles such as police and paramedic have been around since the early 1900's, replacing the use of bells with the addition of flashing lights relatively recent in history. Sirens and flashing lights are effective only when the driver is vigilant and takes precautions. But with many distractions in today's society from loud music to talking on cell phones, the drivers sometimes fail to notice the approaching emergency vehicles leading from delays to, in extreme cases, accidents that result in fatalities.

2. Public Education

General public education about what to do when an emergency vehicles approaches is taught while studying for a driver's license exam. The idea of pulling over to make way for the emergency vehicles is seen as common sense to most drivers. However, accidents involving emergency vehicles are not caused by inadequate knowledge but simply being unaware and sometimes negligence.

3. GPS navigation and Traffic reports

In recent years, GPS have become common tool for drivers, from directions to avoiding traffic through detours. GPS navigations and traffic report communicated to the emergency vehicles can assist in avoiding high traffic congested routes for faster response. However, this does not necessarily help avoid accidents in clear roads with drivers who are unaware of emergency vehicles approaching an intersection at high speeds.

4. In market traffic light controls

There are currently traffic light controllers on the market that utilize RF or infrared. Controllers using RF generally have short range (20 to 50 feet), using a key chain car remote design. For emergency vehicles in a rush, the range is inadequate to change the light early enough to assist the emergency vehicle. The infrared models have indicated ranges up to 1500 feet. However, infrared requires a relatively clear line of sight to the receiver in order to function. In



both cases, the emergency vehicle operator needs to manually operate the device in order to change the traffic light. The device is not capable of anticipating the approaching emergency vehicle to save valuable time during emergency.

4. Proposed Design Solution

The proposed design solution for the emergency vehicle preemptive traffic control is to have a wireless communication system to relay the vehicles location to the traffic lights controllers. As the vehicle approaches the intersection, the traffic lights will change such that only a green light is given to the direction of the emergency vehicle. This arrangement of traffic lights will hold other vehicles from entering the intersection while clearing out the traffic directly in front of the emergency vehicle. This system will be completely autonomous so that the operator of the vehicle has no responsibility other than to activate the system during an emergency response.

There are several stages in the process of controlling the light which need consideration. The location of the vehicle needs to be determined through the use of a GPS system. The location and also the direction of travel are important in determining where the vehicle is approaching the intersection from. This information can also be used to estimate the time when the vehicle will reach the intersection, so the light can be controlled in a more accurate manner.

The next stage is communicating the GPS information from the vehicle to the traffic control system. In this case, a wireless communication system will be implemented. The idea behind using a radio frequency communication system is that the vehicle will need to be able to communicate the information from several hundred feet away from the intersection. Also in this design, the signal will still be transmitted if there is no direct line of sight with the intersection.

The final stage is implementing a controller to incorporate the signal from the vehicle into a functioning traffic light system. This method would have to keep the normal process of traffic control, but be able to respond when an emergency vehicle approaches. The response not only has to change the traffic pattern, but determine the direction from which the vehicle is approaching. This stage will need sufficient processing power and a well developed algorithm to be able to operate effectively.

5. Sources of Information

The implementation of the EVTLC design will need require a special understanding of traffic control in both an urban and sub-urban setting. Due to the vast complexity of Metro Vancouver's transportation infrastructure, we are able to use this as a road map to developing a safe and effective product. Therefore, our main design information would be obtained through the South Coast British Columbia Transportation Authority (TransLink) and various departments from the City of Vancouver. By incorporating TransLink and emergency services such as the Vancouver Police Department (VPD), British Columbia Ambulance Services (BCAS), and Vancouver Fire & Rescue Services (VFRS), we will be able to effectively analyze a wide spectrum of emergency situations. Since the provincial government is responsible for funding major projects and establishing legislation, they should be consulted as well.

Our main sources for the hardware and software solutions would be through university's faculty members that are in the field of telecommunication and graduate students who are currently working on projects involving RF and GPS technologies. Product sheets, reference manuals, and textbooks would also provide good insights from individual components to overall system integration.

6. Budget and Funding

6.1 Budget

Table 6.1 outlines a tentative budget for the EVTLC system. The project is estimated to cost approximately \$625 to build. The miscellaneous item in the table includes shipping and handling fees, extra parts that we might need, materials used to assemble traffic lights, and standard parts such as: power/voltage regulators, breadboards, resistors, capacitor... etc. Note that the estimated cost of the prototype does not represent the manufacturing cost of the EVTLC system since the development of the first prototype, in general, requires more capital as with the design of any prototype.

Item	Estimated Cost
RF Transmitter/Receiver	\$150
GPS Module	\$300
Car Voltage Regulator	\$25
Miscellaneous	\$150
Total	\$625

Table 6.1: Tentative Budget

6.2 Funding

We are entitled to a fund of \$50 provided from the School of Engineering Science to subsidize for parts and components required in this project. The Engineering Science Student Endowment Fund (ESSEF) is another source of funding for which we are currently applying. The combined funding from the School of Engineering Science and the ESSEF is expected to be sufficient, with the estimation made based upon funding granted to previous projects. Other potential sources of funding are: ICBC, Translink and the federal government. In the case that we are unable to collect sufficient funding to complete the project, our team members agree to bestow the remaining financial cost of the project equally.

7. Project Schedule

A four month roadmap describing the schedule and major deadline dates is demonstrated through a Gantt chart as well as milestone chart in the figures below. Team members will be divided into separate groups to work on individual hardware components simultaneously to ensure shorter implementation duration.

ID	Task Name	Start	Finish	Duration	Sep 2008				Oct 2008				Nov 2008				Dec 2008			
					3/8	7/8	14/8	21/8	28/8	5/9	12/9	19/9	26/9	2/10	9/10	16/10	23/10	30/10	6/11	13/11
1	Research	9/1/2008	10/14/2008	32d	[Gantt bar from 9/1 to 10/14]															
2	Proposal	9/1/2008	9/22/2008	16d	[Gantt bar from 9/1 to 9/22]															
3	Written Progress Report	10/3/2008	10/6/2008	2d	[Gantt bar from 10/3 to 10/6]															
4	Functional Specification	9/22/2008	10/14/2008	17d	[Gantt bar from 9/22 to 10/14]															
5	Design Specification	9/22/2008	11/3/2008	31d	[Gantt bar from 9/22 to 11/3]															
6	Hardware Implementation	10/14/2008	11/20/2008	28d	[Gantt bar from 10/14 to 11/20]															
7	GPS Module	10/14/2008	10/31/2008	14d	[Gantt bar from 10/14 to 10/31]															
8	RF Module	10/14/2008	11/11/2008	21d	[Gantt bar from 10/14 to 11/11]															
9	Traffic Light Control Module	10/14/2008	11/20/2008	28d	[Gantt bar from 10/14 to 11/20]															
10	Software Implementation	10/14/2008	11/20/2008	28d	[Gantt bar from 10/14 to 11/20]															
11	System Integration/ Debugging/Testing	11/11/2008	12/10/2008	22d	[Gantt bar from 11/11 to 12/10]															
12	GPS/RF Module	11/11/2008	12/10/2008	22d	[Gantt bar from 11/11 to 12/10]															
13	Traffic Light Control Module	11/20/2008	12/10/2008	15d	[Gantt bar from 11/20 to 12/10]															
14	Documentation	9/1/2008	12/17/2008	78d	[Gantt bar from 9/1 to 12/17]															

Figure 7.1 Gantt Chart

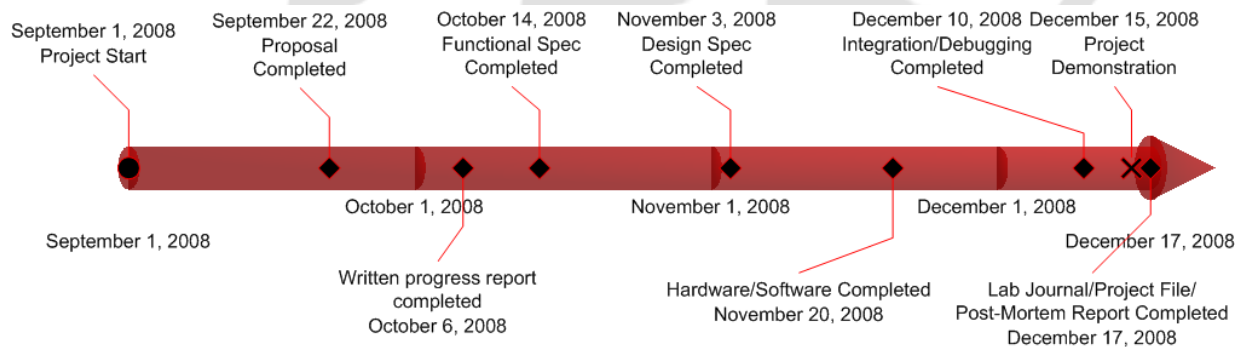


Figure 7.2 Milestone Chart

8. Team Organization

Enlightenment Solutions Corporation (ESC) is composed of five senior engineering students who have worked with one and other throughout the years of studying together and know each other's strengths and weaknesses. Each member can contribute diverse experience from various countries and regions. Due to the large size of the group as well as differences in individual's working environment and experiences, communication and coordination is taken into great consideration.

Ryan Goldade has been elected as the CEO. In this position, Ryan will be the primary group representative for external communications, software implementation, and managing the quality and functionality of the project. Kelvin Liu, as the CFO, will be managing the budget and funding along with system designing process. Tae-Hoon Kim, with the title of CMO, will handle the design of user interface and researching marketability of the project. Leon Chang, will take on the role of CTM will be the primary hardware design and testing engineer. And Jung Jun Kim, as the COO, will be the secondary external contact along with team organization and project requirement coordinator as well as the software implementation.

In order to bring out the best qualities, characteristics, education, and most importantly work experiences of each member, ESC's approach to organization will be adaptive and open. Apart from the weekly general meetings, any member can call for a meeting whenever necessary. All suggestions and opinions will be discussed and tracked for possible future consideration. Progress and problems will be communicated frequently throughout the project to ensure that all the team members are aware of the progress and provide resolution to any problems that individual members may come across.

The tasks will be divided amongst the group according to individual's strength and background as well as personal interest to promote motivation for the expected long hours of work for project of such scale.

Importance of team dynamics is mentioned by other experienced groups. Promoting individual motivation and limiting stress from strict schedules are positive start for creating enthusiastic and bright team environment and dynamics. Understanding the importance of completing this project with good team dynamics will not only lead to successful completion of this project but with pleasant work experience throughout the four months.

9. Company Profile

Ryan Goldade – Chief Executive Officer (CEO)

Ryan Goldade is a control systems engineering student, completing his final year of studies. Ryan has a strong background in leadership from his many SFU student group involvements. Such involvement consists of holding executive positions on the Engineering Science Student Society and the African Caribbean Heritage Student Association. His background in both leadership and technology is an excellent combination for a CEO in the engineering industry.

Kelvin Liu – Chief Financial Officer (CFO)

Kelvin Liu, a fifth-year electronics engineering student at Simon Fraser University, has a wide range of skills including Python scripting, Java, C++ and Visual Basic. He worked as a display developer for Research In Motion, verifying circuits, designing in-house software, and performing flat-panel display reliability tests. Kelvin has also worked for Promate Electronics, a Taiwan-based LCD manufacturer, as an assistant engineer, performing power and optical measurements of displays.

Leon Chang – Chief Technology Officer (CTO)

Leon Chang, a fifth year electronics engineer from the School of Engineering Science at Simon Fraser University. He is an experienced hardware and software tester having a sound knowledge in quality assurance. He has held an international co-op with eCera Semiconductors, from Taiwan, a highly competitive SMD (Surface Mounted Device) quartz crystal and oscillator manufacture. He has also work with Nokia as a R&D hardware engineer responsible for testing its flagship mobile phones from prototypes to pre-releases. While at Nokia, he successfully designed and implemented automated testing equipment control using LabVIEW. For this project, he is responsible for the overall system implementation and functionality.

Tae-Hoon Kim – Chief Marketing Officer (CMO)

Tae-Hoon Kim is a fifth-year electronics engineering student at Simon Fraser University. His engineering abilities reside mainly in the hardware category. Moreover, based on his solid engineering background and academic performance, he has developed extensive expertise through his past work experiences. Examples of this are the conditional access and interactive TV Company, National Data System (NDS) Korea and Microcontroller design Company, VersaChip. These experiences allowed him to gain industry experience and knowledge of set-top box and conditional access systems. His primary responsibilities are to consider design elements of the system and user interface.

Jung Jun Kim – Chief Operating Officer (COO)

Jung Jun Kim is a fifth-year Simon Fraser University electronics engineering student with educational background in hardware and software, and work experiences in management. He worked as an assistant field manager for Chang Jeon Corp. in South Korea assisting the layout and power grid design and installation for KEPCO (Korean Electric Power Corporation). And a full year co-op term at Research In Motion as carrier technical coordinator in the BlackBerry Systems Engineering – CDMA iDEN team, overseeing the certification process of next generation BlackBerry handhelds primarily with Verizon Wireless as well as Telus Mobility and Bell Mobility. He will be working on team dynamics and organization along with software implementations.

10. Conclusion

Most emergency vehicles in the world have no preemption on the operation of traffic lights. When responding to emergencies, these vehicles are at great risk of collisions due to their need to enter intersections during a red light. It is also important that they are able to respond quickly, which can be greatly jeopardized during heavy traffic. We demonstrated in this document that such problems can be enhanced by installing an EVTLC system to the emergency vehicles.

We are dedicated to providing innovative and practical solutions to create a safer community. We at ESC also believe our EVTLC system is the best solution for minimizing emergency vehicle accidents and reducing response delays.

In this document, we proposed the EVTLC system is superior to all other existing solutions. We also presented our potential financial sources, which will make this project possible. Finally, our detailed timeline schedule demonstrates that our product will be completed within the specified time frame.

11. Sources and References

11.1 Sources

- Digi-Key (<http://www.digikey.com/>)
- RP Electronics (Richmond, BC)
- Beeco Sales, Inc. (<http://www.themirt.com/>)
- LIGHTS TO GO (<http://www.trafficlights.com/>)

11.2 References

[1] Omaha Nebraska Local News, “Two Hurt In Car/Ambulance Accident,” *wowt.com*, September 7, 2008. [Online]. Available: <http://www.wowt.com/home/headlines/27974989.html> [Accessed: September 18, 2008]

[2] EMS Network News, “Ambulance Crash Log,” *EMSNetwork.org*, August 1, 2008. [Online]. Available: <http://www.emsnetwork.org/artman2/publish/ambulance-crashes.shtml> [Accessed: September 19, 2008]

[3] CBC News, “2 men die after high-speed crash involving police cruiser,” *cbc.ca*, November 1, 2007. [Online]. Available: <http://www.cbc.ca/canada/british-columbia/story/2007/10/31/bc-burnaby-crash.html>. [Accessed: September 18, 2008]

[4] ICBC, “RoadSense for Drivers,” *icbc.com*, 2008. [Online]. Available: http://www.icbc.com/licensing/lic_utility_resman_drivers.asp. [Accessed: September 18, 2008]