January 19, 2014

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

Re: ENSC 440 Project Proposal for a Bicycle Smart Helmet

Dear Dr. Rawicz,

Please accept the following document as a proposal for our Smart Helmet project. We aim to design and implement a bicycle helmet that makes biking a safer and more enjoyable experience for the community. Our design consists of a helmet with mainly break and turn signals that help bikers announce their presence and intentions to other road users.

The purpose of this proposal is to present an overview and an introduction to our product, some design considerations, preliminary budget and funding sources as well as major project milestones and intended team organization.

Cycle Bright Solutions consists of five determined and talented 4th year engineering students. Wael Jendli, Chakaveh Ahmadizade, Ahmed Medhioub, Ibrahim Appiah. If you have any questions, or concerns about our proposal, please feel free to contact Ahmed Medhioub at 778-829-7307 or by email at amedhiou@sfu.ca.

Sincerely,

Wael Jendli

Wael Jendli
Chief Executive Officer
Cycle Bright Solutions

Enclosure: Proposal for a Bicycle Smart Helmet

Cycle Bright Solutions.

Proposal for

Proposal for a Bicycle Smart Helmet

Project Team	Chakaveh Ahmadizade Arta Ahrabi Ibrahim Appiah Wael Jendli Ahmed Medhioub
Contact Person	Ahmed Medhioub amedhiou@sfu.ca
Submitted to	Dr. Andrew Rawicz - ENSC 440 Steve Whitmore - ENSC 305 School of Engineering Science Simon Fraser University
Issued Date	January 19, 2014
Revision	1.1

Executive Summary

With an increasing awareness of the dangers of global warming and with an attempt to save our suffering planet and avoid the increase in oil prices, the number of cyclists in Vancouver increased by about 180% over the last decade [3]. Taking that into considerations, road users had to cope with the huge flow of daily bikers which resulted in an increase in the number of road incidents where cyclists were involved. Indeed, cyclists were involved in 1400 incidents on average per year over the last year with 100% injuries according to ICBC [4].

Most of those accidents were the consequence of miscommunication between cyclists and other road users especially when turning or changing lanes [5]. Indeed, cyclists need to use hand signals while keeping the other hand on the handle which makes it hard to keep a straight line.

To prevent a continuous increase in such incidents, different parties tried over and over again to find a definitive solution such as glowing gloves or wired turn signals. Those solutions require the cyclist to either wear a glove at all time or undertake some modifications of the bike.

Thus, the objective of our project is to provide cyclists with a safer and more enjoyable riding experience through our smart helmet. Considering the fact that wearing a helmet is enforced by a provincial law [6], we are designing and implementing turn signals and brake lights at the back of the helmet that can be triggered wirelessly without taking the hands off the handle. To make the helmet more attractive, it will have Bluetooth capabilities and the ability to connect it to your phone our music device without breaching the laws or putting the safety of the cyclists at risk. The helmet could be used as well for other purposes such as skate boarding or roller users.

Cycle Bright Solutions consists of five talented students coming from different engineering streams with the motivation and the energy to take this project from an idea, to a full design and implementation. We believe that our team has all what it takes to make this vision come true and help decrease the number of road incidents and encourage more people to use bicycles and help save more energy.

The present document will cover the engineering cycle of the product from research, design to implementation of the proof of concept. This cycle will span the 13 weeks of the spring's 2014 term, with a projected budget of $750 obtained from different funding sources.

Table of Contents

List of figures and tables

1. Introduction

Vancouver is one of the top 10 bike friendly cities in North America. According to city of Vancouver “Cycling is one of the cleanest and most energy efficient forms of transportation, and the number of people choosing to cycle continues to grow, year after year. Much of this growth is due to the City of Vancouver's support for green transportation initiatives to make roads safer and more comfortable for cyclists and pedestrians”[1]. However, safety is one of the most important issues affecting this target audience. A study conducted in 1999 showed that each year, in the US, approximately 900 people die from injuries due to bicycle crashes and over 500,000 people are treated in emergency departments. By far the greatest risk posed to bicyclists is the head injury, comprising of two-thirds of hospital admissions, making helmets a quintessential accessory for riders. [2]

We at Cycle Bright Solutions believe that the current helmets can greatly benefit from the advancements of technology, and our objective is to answer this problem through the creation of a smart helmet. We aim to create a helmet which will increase the safety of riders by making it easier for cars and cyclists to communicate with each other. The conventional hand signals are inadequate at best and downright dangerous at worst. They require the cyclist to remove one hand from the handle bar to perform awkward hand motions that might throw them off balance and even then, they may be not even be feasible at times due to variety of factors such as grade or conditions of the road. Furthermore, these hand signals can be hard to see in low light conditions. To address these issues, the Cycle Bright Solutions’ helmets will feature an RGB LED panel at the back of the helmet that can display left/right signals as well as brake lights to warn the other cars in a timely fashion that is noticeable at any time of day without requiring the rider to remove their hands from the handlebar.

The Cycle Bright Solution offers an exclusive and unique product that will provide several useful and features to outdoor-sport enthusiasts such as signalling, Bluetooth capabilities and geo-location services. The helmet involves the incorporation of many different components, which will be integrated within the assigned time.

This proposal outlines the product of Cycle Bright Solutions, along with design solutions, projected budget, project scheduling and other necessary information.

2. System Overview

Our proposed design consists mainly of three subsystems:

- The triggering circuit from where the cyclist can express their intention to turn on the right or left signals, or to turn them off. A brake sensor, can detect when the cyclist hit the break and sends it the microcontroller along with any turn signals commands.
- A microcontroller unit, to receive the sent signals, decode them and correctly turn the according lights on.
- Multicoloured LED array to correctly display the signals
- One sided-Bluetooth speaker built in the helmet that can be synced with any Bluetooth equipped devices

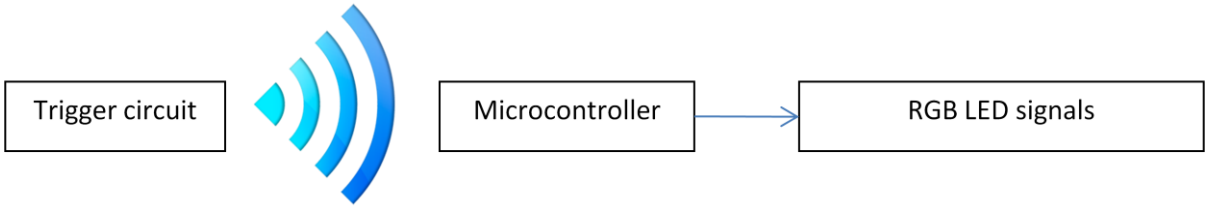


Figure 1: Smart Helmet System Block Diagram

A sample concept design made by Balázs Filczer can be illustrated to further explain our vision:

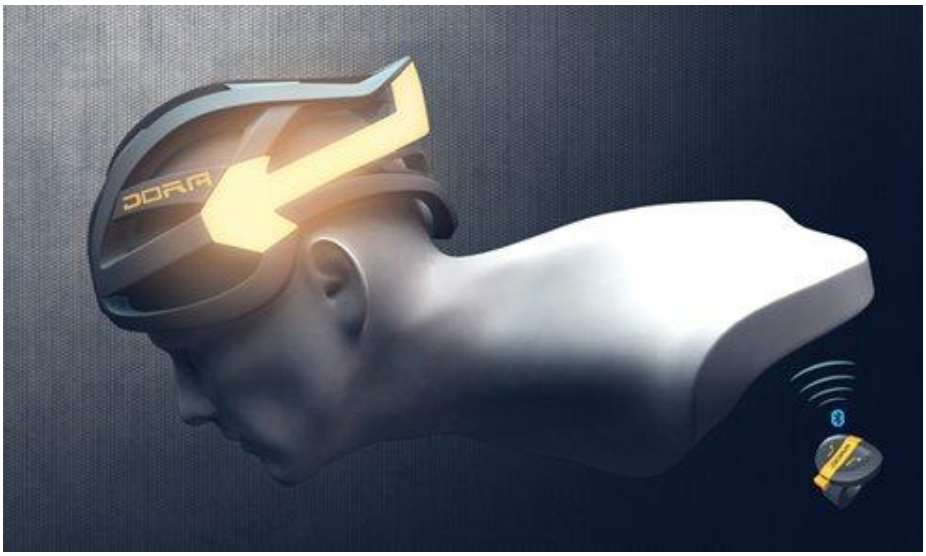


Figure 2: Concept Helmet proposed by Filczer [7]

As Yanko Design says, “Um… why doesn’t this already exist? It’s just… plain… genius. What do you think? Is this a design you'd look twice at if you were in the market for a new helmet?” [7]

3. Possible Design Solutions

A market research for available solutions to solve our proposed problem outlined these potential and available solutions:

3.1 Rear Turn Signals:

While this device is available in the market, it needs the cyclist to buy an extra device and wire it to the back of the car which will seem too cumbersome for those who choose cycling to save extra money and avoid the complications of owning a car. In addition, by being attached to the rear of the bike, those lights could be easily confused with the usual flashing lights and couldn't be seen by all road users.

Figure 3: Proposed rear turn signals

3.2 Glowing gloves:

Even though this device is still under design and implementation, it doesn't solve totally the risks of getting into accident since the cyclist needs to keep a hand on the handle while signalling with the other hand which makes it hard to keep a straight line [8].

Figure 4: Proposed glowing gloves

3.3 Jacket with turn signals (Hobbyist Project):

While this could be an original cheap solution to implement turn signals, it requires the cyclist to always wear the same jacket over all seasons and all weathers.

Figure 5: Proposed Jacket implementation of turn signals

4. Proposed Design Solution

Our proposed solution is to build a smart helmet that features turn signals and brake lights that can triggered wirelessly from within the handle while keeping both hands on the handle. The smart helmet features Bluetooth capabilities and some geo-location services. Thus, the cyclist by just buying our smart helmet will have a safer and more enjoyable ride. In fact, there is no need to buy extra accessories like gloves and jackets that can be only worn in certain seasons and weather conditions. By buying a helmet that is required by law, the cyclist will experience the advantages of a standard helmet and turn/brake signals.

In contrast with the available rear turn signal, the Smart Helmet solution doesn't require extra wiring due to the fact that the triggering circuit can be easily attached to the handle. By being waterproof, the Smart Helmet guarantees a safer at all seasons and at all weather conditions. By proposing one-sided Bluetooth speaker, the Smart Helmet provides the cyclists with the ability listen to their favourite songs while biking to work or riding for fun without being endangered when wearing headphones. In addition, by being built-in the helmet, the Bluetooth speaker will provide a better sound quality without the noise generated from the neighbouring wind.

The main constraints in implementing this project are the tight schedule and the availability of the funds. In addition, in some provinces and some countries, wearing a helmet is enforced by law only for small children or under age teenagers. Thus, we need to make our helmet attractive and affordable to at least attract the people who are looking for added features such as the Bluetooth. Taking the above constraints into consideration, we will be able to build a simple proof of concept that features the main functionalities of our Smart Helmet.

With more funding a wider time span, we will be able to prototype and design the helmet from scratch to take into consideration all the features intended and their layout/integration. Thus, this helmet could be extended to be used in skateboarding, rollers and some other extreme sports.

5. Source of Information

In order to research and decompose our deign challenges many sources will be used such as: textbooks, electronic forums and reference to similar implementations or subsystems of our design.
In addition, SFU engineering faculty will be a valuable resource when it comes to feasibility advice and circuit verification.
We will try to work as a group and teach each other since we all come from different background with different and valuable co-op experiences.

6. Budget and Funding

6.1 Budget Break-down

The table below lists the components needed for the project as well as their estimated cost over- estimated by 15%. In addition, 20% were added to the total cost, to cover tax and shipping. Some necessary components like a visor and a face guard were grouped together in accessories to simplify the cost report. Other materials might be bought later in order to add further features like high visibility strips and more, these costs were taken in consideration in the Miscellaneous section.

Equipment Needed	Cost
Helmet	$100
Helmet Accessories	$55
2 Microcontroller boards	$60 / each
2 Bluetooth Modules	$30 / each
LED arrays and strips	$85
Miscellaneous	$200
Total	$620
Total + Tax & shipping	$744

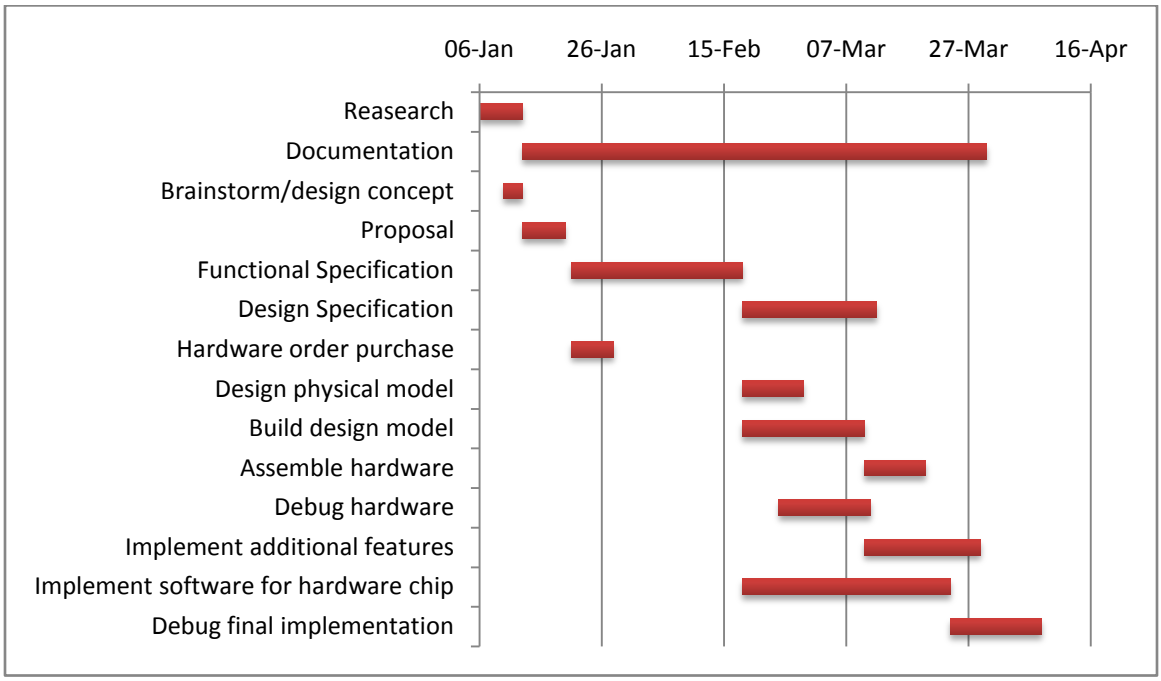
Table 1:Projected Budget breakdown

6.2 Funding Resources

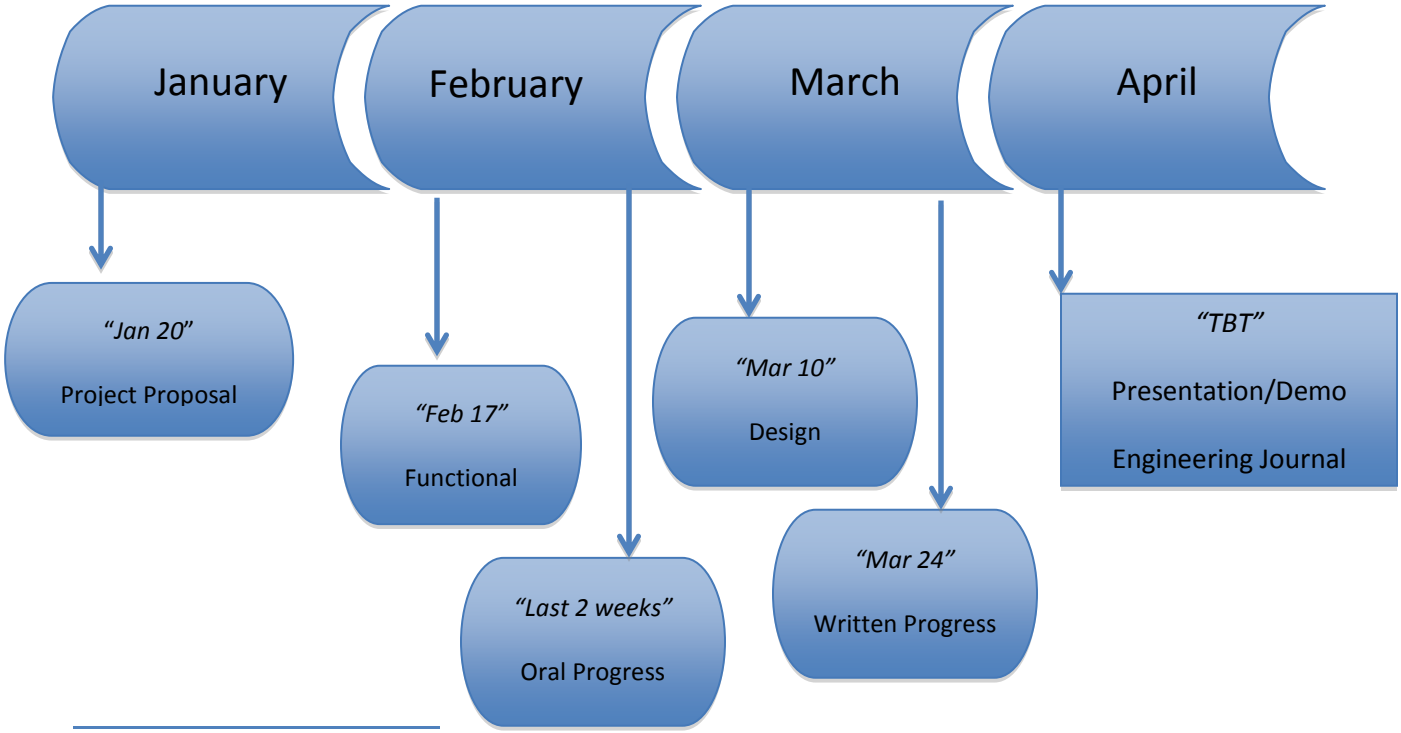
As our main source of funding, we are getting ready to present our proposal to the Engineering Science Society in order to get the approval for ESSEF funding. We have also approached other student association such as SFU IEEE Student Branch and they agreed to help with some electrical parts if they are available in their stock. Other sources of funding are being considered if the previously mentioned sources were not able to help and we are particularly looking at the Wighton Fund. In case the amount collected from these sources was insufficient to cover the totality of the expenses of the project, our team members have agreed to share the remaining of the costs equally.

7. Schedule

Below is a detailed Gantt chart displaying an overall timeline of our entire project, although research is specified on the chart as 7 days it is continuous throughout the whole project



Below is a milestone chart highlighting the important dates of the project:



8. Team Organization

Our Cycle Bright Solutions team is structured in a way that allows every member to take on a management role as well as a technical role. This arrangement allows a fairly equal distribution of tasks as well as a better, more effective interaction between individuals. The management responsibilities are organized in the following manner: Wael Jendli acting as the Chief Executive Officer (CEO) supervising and managing the general aspects of the project. Chakaveh Ahmadizade who is the Chief Operating Officer (COO) is responsible for monitor the daily progress of all the different tasks. Ahmed Medhioub acting as the Chief Financial Officer (CFO) whose job is to manage all financial issues from funding to equipment purchases. Acting as a Chief Technology Officer (CTO) is Arta Ahrabi and her role is to constantly investigate and advice on the technical solutions to be used in the project.Last but not least, our Chief Information Officer (CIO) who is responsible of the information technology and advising as well on technical matters.

All of the team members have great industry technical training in various fields such as embedded software development, firmware engineering, web and app development, hardware and communication protocols. Thus for the Technical distribution of roles, each member would take on both development and testing tasks .For Some particular features of the project, teams of two or more persons will be formed in order to accelerate the development and/or testing process.

To make sure that work is in constant progress and insure better team dynamics we have decided to go with an agile project management plan. All members report on daily basis the progress of the work assigned as well as blockers or other concerns posted on Skype group conversation. Also, a weekly one to two hour meeting is organised using a doodle poll to make sure all members are available. Dropbox is utilised for document sharing along with holding backups to developed source code and scripts.

This project represents a unique opportunity to our team members as it allows us to apply the concepts and theory we have accumulated throughout our journey as engineering students. We all strong believers in focused teamwork, devotion and dedication to be the keys to successfully complete this project with all of its aspects meeting the deadlines agreed upon.

9. Company Profile

Wael Jendli - Chief Executive Officer (CEO)
Wael is a 4th year computer engineering student. He has experience programming in C++ and Java. Through his last co-op position he was involved in the design cycles of BlackBerry devices. He was involved in different engineering projects, leading some of them and participating as a key team member in others. He is always eager to learn about new technologies and take up the challenge to the next level.

Chakaveh Ahmadizade- Chief Operations Officer (COO)
Chakaveh is a fourth year Computer engineering student at Simon Fraser University. She has completed a technical coop term at Invoke Media as iOS application developer. She has experience in C++, C#, Objective-C and VHDL. She is interested in micro fabrication and has clean room experience fabricating microelectronic devices on silicon wafer as a course project. She gained experience in hardware design as a result of taking electronics and design courses. She is a self-driven individual who has also worked in teams for various school and work projects.

Ahmed Medhioub- Chie Financial Officer (CFO)
Ahmed is a third year Computer engineering student with experience in Hardware SoC and embedded system design. He had my co-op in the Smart Router OS Infrastructure at Ericsson Inc and that helped me gain great skills in embedded C coding and software design. He also had the pleasure of teaching an IEEE arm micro-controller workshop in the fall of 2013 that was sponsored by Engenuics Technologies. Throughout his course projects he has developed great understanding to FPGA design and used it in various applications such as Audio systems and Bio-medical devices. He had the chance to work with tow great SFU professors, Dr. Ash Parameswaran and Dr. Lesley Shannon. These research opportunities helped further enhance not only his technical but also his soft skills.

Arta Ahrabi - Chief Technology Officer (CTO)
Arta is a passionate and creative individual who uses her work and academic experience in Electronics Engineering to create fresh design solutions. Currently is her last year of her degree, Arta has developed many critical skills ranging from real-time and embedded system programming in assembly and C to analog circuit design. Her experience includes a strong emphasis on digital circuits, with particular experience in logic design. As a member of Cycle Bright Solutions' team, Arta will provide an invaluable alternative perspective towards feasibility.

Ibrahim Appiah - Chief Informational Officer (CIO)
Ibrahim is a 4th year Systems engineer at Simon Fraser, however, he began his studies at SFU as a biomedical engineer, where he worked at the BC Cancer Agency, working on image processing sequencers, web server, and database servers. Also has over 6 years of graphic/web design experience, working for Sankofa Webtech, where he created designed and managed multiple small business websites.

10. Conclusion

Cycle Bright Solutions is committed to providing an effective solution to improve the safety of cyclists. Our team is excited to propose the first Cycle Bright Solutions' product, the Smart Helmet. This product will introduce a safer way to communicate between cyclists and other vehicles and reduce the percentage of accidents.

Among the wide range of helmets already available on the market, our approach for this smart helmet is relatively inexpensive, safe and comfortable to use (fully integrated into the helmet, wireless and semi-autonomous) and we hope that it will kick-start a whole new generation of helmets.

We have outlined the overview of the project, which includes the proposed design, research budgets & funding, time schedule and sources of information. Our team believes that we will be able to achieve our goals within the given timeframe.

11. References

[1] “Cycling in Vancouver.” Internet: http://vancouver.ca/streets-transportation/biking-and-cyclists.aspx , 28 Feb 2013, [14 Jan 2014].

[2] Thompson DC, Rivara F, Thompson R. Helmets for preventing head and facial injuries in bicyclists. Cochrane Database of Systematic Reviews 1999, Issue 4. Art. No.: CD001855. DOI: 10.1002/14651858.CD001855.

[3] “Cycling in Canada”. Internet: http://en.wikipedia.org/wiki/Cycling_in_Canada, 10 Jan 2014, [19 Jan 2014]

[4] “Quick Statistics”. Internet: http://www.icbc.com/about-ICBC/Newsroom/quick-statistics.pdf, September 2013, [19 Jan 2014]

[5] “What are the dangers in term of cycling safety?”. Internet: http://www.sharetheroad.ca/what-are-the-dangers-in-terms-of-cycling-safety--p128277, [19 Jan 2014]

[6] “Cycling safety tips and regulations”. Internet: http://vancouver.ca/streets-transportation/cycling-safety-tips-and-regulations.aspx, 20 Septembre 2013, [20 Jan 2014]

[7] “The ultimate helmet has embedded turn signal lights”. Internet: http://www.treehugger.com/gadgets/ultimate-bike-helmet-has-embedded-turn-signal-lights.html, 5 March 2013, [20 Jan 2014]

[8] “Cycling and traffic skills”. Internet: http://www.bikesense.bc.ca/ch4.htm, [20 Jan 2014]

