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January 20th, 2014

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

Re: ENSC 440/305W Project Proposal for an Impaired Driving Prevention System

Dear Dr. Rawicz,

Please find an enclosed copy of our proposal of an impaired driving prevention system. The goal of Alcoshield COMPANY is to eliminate the possibility of driving intoxicated through a robust and vigorous detection scheme.

The proposal document highlights the features of our system and how its integration in society is vital. A thorough analysis of the problem and its solutions are presented along with budget, funding and implementation schedule details.

Our accomplished team of senior engineers who are committed to this project include Moataz Billeh, Ashraf Jerbi, Ritik Looned, Mohammed Naghshineh, and Nima Soroudi. We are excited to be pursuing this topic and hope you share the same enthusiasm. We look forward to your support over the term and if you have any questions or concerns please contact us via email at rlooned@sfu.ca.

Sincerely,

Ritik Looned

Ritik Looned
Chief Executive Officer
Alcoshield

Enclosed: Proposal for an Impaired Driving Prevention System

Proposal for an

IMPAIRED DRIVING PREVENTION SYSTEM

Project Team
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Submitted to
Dr. Andrew Rawicz – ENSC 440
Steve Whitmore – ENSC 305
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January 20, 2014

Executive Summary

Losing a loved one in a car accident is a devastating feeling. It's worse when the accident was caused by unnecessary speeding or reckless driving and it becomes simply unbearable when its caused by impaired driving - especially at a fault of someone else. Over a 1000 people die in such accidents every year which affects an uncountable significant others. It is now time to bring a firm end to such incidents and we at AlcoShield are taking up that challenge with our impaired driving prevention system.

Our innovative idea would prevent the drunk individual from even starting their vehicle let alone getting into an accident. Upon entering their vehicle the driver would be asked to provide a breath sample in the dash mounted breathalyser to confirm that their Blood Alcohol level is within acceptable limits. Failure of the test would terminate the ignition functionality of the vehicle and prevent operation. The individual would thus be forced to explore other modes of the transportation or simply sober up over time.

Although similar products do currently exist in the market, the major flaw they have is the lack of user authentication. They are easily able to be deceived by passengers breathing into them instead of the driver. In stricter systems which implement an authentication scheme, the driver is asked to perform repetitive tests during driving. This is in fact dangerous and distracting which defeats the purpose of the system to make the roads safer. The team of 5 qualified engineers at AlcoShield are proposing to design a robust and advanced authentication scheme with the breathalyser system that would operate in a non-obstructive manner to solve this issue. We present a thorough solution in the proposal that highlights the functionality of the system.

The timeline of the project is approximated to be 13 weeks with explicit milestones. The cost analysis provides a budget in the range of $860 which will ideally be funded by through various sponsors. The engineers involved in the project are committed to making the streets sober and safer and look forward to your support with their design of the SoberJack system.

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1. Introduction and Background

"The main reason why people continue to drive drunk today is because they can"- This statement made by Mother Against Drunk Driving (MADD) president Glynn Birch couldn't be more accurate. There is no denying that impaired driving is an unfortunate prevalent occurrence in today's society. It is estimated that 2,541 individuals were killed in motor vehicle accidents in Canada in 2010 of which at least 1,082 were impairment-related [1]. This approximates to 3 unnecessary deaths every day as a result of poor judgement on someone's part.

Other consequences of non-critical accidents due to intoxicated driving include infrastructure damage and wasteful use of health resources to treat injuries. In 2010, it was estimated that roughly 578 impairment related accidents occurred every day which caused property damage and injuries [1]. The financial implications of these incidents were analyzed in a report prepared for the federal Ministry of Transportation which stated the cost to be over $20.62 billion [2]. One can agree that this a tremendous waste of resources and needs to be resolved immediately.

Current measures in place such as Blood Alcohol Monitoring Stops and hefty fines [3] are obviously insufficient in eradicating this despicable behaviour. These techniques are designed such that their effectiveness only prevails after the deed has been done. Realizing this, we propose a novel preventative measure that catches the drunk driver before they even get a chance to turn on their car.

To elaborate, the project would focus on preventing intoxicated individuals from operating their vehicles by terminating the ignition of the engine if they are suspected to be over the local Blood Alcohol Content (BAC) limit. The system would include a breathalyser to measure the BAC and a method to authenticate the driver. This would ensure a foolproof system and avert any attempts to tamper or cheat the device.

We hope to go in greater detail in the remainder of this document. An overview of the product, current competition in the field, project timeline, and the cost analysis are only a few of the things that we will cover. We appreciate your interest in the project and look forward to your support in making the streets sober and safer.

2. The Scope, Risks and the Benefits

The aim of the project is to design a system which prevents any form of drunk driving while over the legislated legal limits. There are two scenarios which are targeted in our system: the first in which the user is intoxicated and thus are not allowed to operate the vehicle, and the second in which the user is sober and no immediate restrictive action is taken. The entire system would consist of a breathalyser, an ignition kill switch, a driver authentication strategy all of which would be integrated into the vehicle as an aftermarket device. While blood alcohol detection is a relatively simple task with current breathalysers in the market, the 'seller' in our system would be the user authentication feature. We are focused on designing a vigorous system which will ensure that it is the driver who is performing the breath test and not anyone else.

Several implementation methods were considered for the design. One method entailed mounting the breathalyser on the driver's side of the vehicle so that it is inaccessible to other passengers. Further, the device will only activate once the seat belts have been clipped on all seats that are occupied. This ideally prevents any other individuals from performing the test for the driver.

The second method entailed using a camera for facial detection. This strategy is more robust and less likely to be cheated. Common consensus led us to pursue this design. Details of the operations follow below and are summarized in Figure 1.

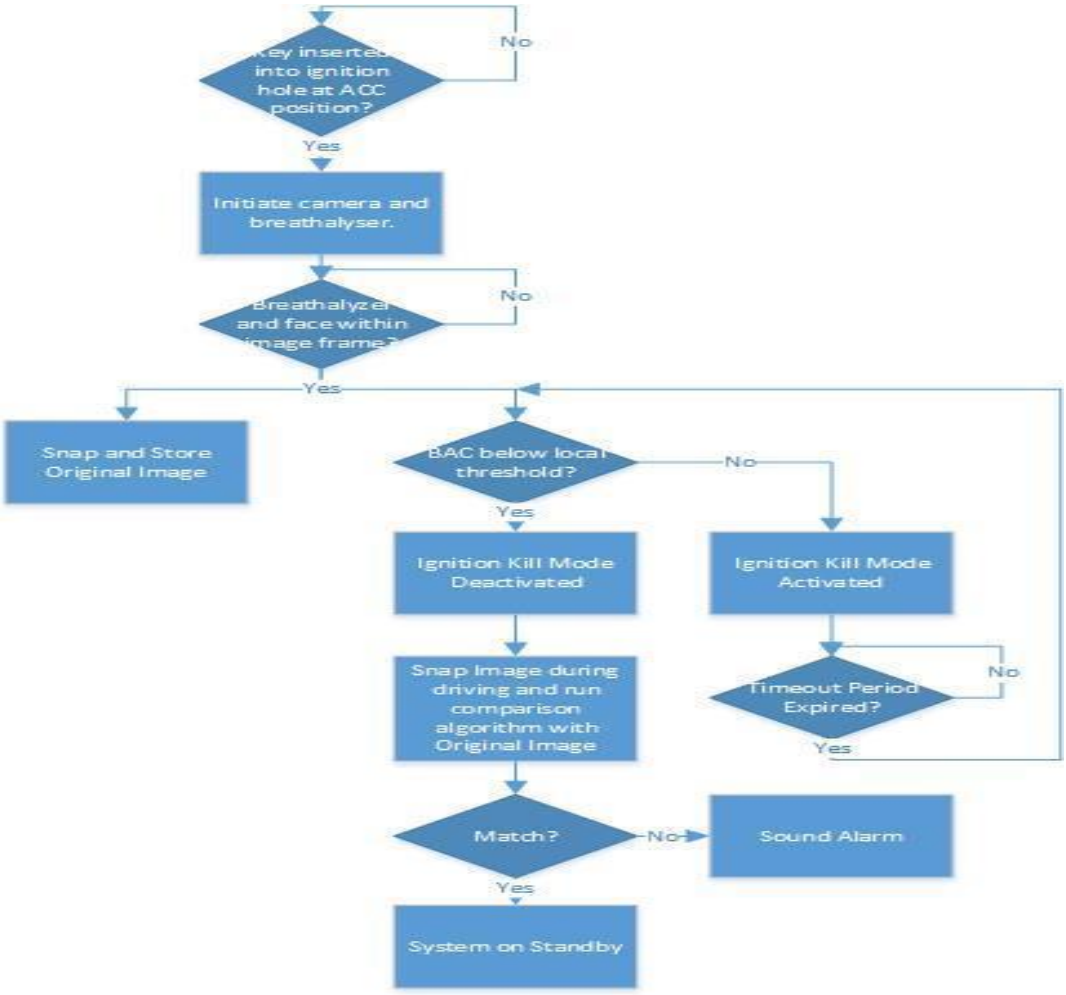

Figure 1. Basic control flow of the system

Scenario 1

Upon entering the vehicle at the driver position, the user has to perform a breathalyser test before they can turn on the engine. If the testers BAC is over the limit, they ignition termination switch is activated and cranking of the engine will not be possible. A timeout period will apply for which the individual must wait before attempting the test again.

Scenario 2

Once the user enters the vehicle in the driver position, they perform a breathalyser test. During this test, an image of their face is captured and stored. The instance of capture will parallel the breathing action to ensure the individual in the image is indeed the person whose BAC is being measured. At a random time interval during early driving, another image will be captured and compared to the original one to ensure the current driver is one who did the breath test. In case of a mismatch, an alarm will be sounded and the driver will be encouraged to pull over and

reinitialize the system.

The highlight of our system is the facial detection and authentication algorithm which is also our biggest risk. Great attention will be required in the image capturing scheme which is necessary for the authentication of the driver to be successful. Two images will need to be compared, one would be the image which is captured when the individual performs the breathalyser test and the second image would be acquired at a random time during the early phase of driving. This would confirm that the individual who performed the breath test in fact the current driver. Cheating the system by asking a friend to do the test while the intoxicated individual drives will not be possible.

The secondary challenge lies in capturing and processing night images. This will further determine the success of the product as it is critical that high classification results are provided through our processing algorithms. False positives are detrimental to the project as they will allow breach of the system and render it useless whereas false negatives will greatly annoy and frustrate the user.

Despite the noticeable technological risks associated with this system, we feel that they are not insurmountable. Realizing that a large amount of effort will be required for the image processing algorithms, we believe that time constraints may be one of the limiting factor on the achievable results. The camera technology which we choose to use may be another contributing factor as the quality of the raw image varies upon devices. Therefore having a reasonable amount of funding to experiment is also critical. Nevertheless, the benefits which will be reaped as a result of this system make it worthwhile to proceed on this venture. The project has the opportunity to directly and positively affect many lives and if not that, at least to create greater awareness of the negative aspects of drunk driving.

To further enhance the functionality of the system (if all proceeds according to plan), we wish to implement a notification scheme to the local authorities upon detection of drunk driving. Wireless transmission of the driver image and car information will be sent to the law enforcement officers who can then take further corrective actions. A more thorough detection system will also target abusers who drink while they drive. They may begin driving sober and pass the breathalyser test but then later start drinking while operating the vehicle. For such individuals, a more rigours system would be in place which would perform periodic BAC checks.

There are many expansion possibilities of this system but given the circumstances, we will be pursing the basic design to cover Scenarios 1 and 2. This alone will put a dent in the intoxicated driving statistics and lead to safer streets.

3. Marketability

Existing solutions

Currently, the ignition interlock device or breath alcohol ignition interlock device (IID and BAIID) requires breath sample before the vehicle starts and at random times after the engine has been started to prevent someone other than the driver from providing a breath sample. This might be disturbing if done frequently while driving and the fact that someone other than the driver can provide the breath samples again would defeat the whole purpose.

Figure 2. Existing breathalyzer system

The Soberjack

Our proposed device, the Soberjack, provides a solution to such problem by integrating a user identification system that checks the identity of the user without the hustle of exhaling into the device many times during the drive. This will be achieved by implementing a real-time image detection system that performs multiple face verifications checks at random times after the engine has been started. This feature would add more usability to the already existing technology. We are also considering other potential solutions like finger-print based identification system.

Targeted clients

Alcoshield technology provides an anti-impaired driving device that could be installed in any vehicle to prevent drivers with prior impaired-driving charges or teenagers that would potentially consume alcohol from driving in an impaired condition. The product is therefore targeting the government and also expandable to the average parent who would occasionally lend his vehicle to his teenage child.

4. Cost and funds

Cost

Table xx explicitly shows the major parts needed to be purchased to develop this system. Please note several breathalyzers are needed to verify the accuracy operations as this plays a critical role in design and functions specification. Several electronic components such as diodes, resistors and capacitors can be borrowed from Engineering Science Student Endowment Fund (ESSEF) Library Parts which is much appreciated.

Equipment List	**Estimated Unit Cost**
Raspberry Pi 8 GB Microcontroller (ESSEF Parts Library)	$ 44.16
Raspberry Pi Camera Module	$ 26.00
Mini 4" PTZ Security Dome Camera Sony CCD	$ 186.49
Relay x 2 - (ESSEF Parts Library)	$ 10.00
Alcomate Premium AL7000 PRO Breathalyzer	$ 129.99
BacTrack Blue Keychain Breathalyzer	$ 52.79
BeagleBone (Credit card Sized Portable computer)	$ 89.00
Blue LED Push Start Ignition Button	$ 19.99
Total Part Cost	**$ 558.42**

Table 1

In addition to above costs, table 2 highlights general costs and unexpected financial situations of this project.

General expected list	**Estimated Cost**
Rent a used car (3days)	$ 40/ day = $120.00
Shipping and handling of Parts	$ 95.00
Electronic components failure	$ 40.00
Contingency	$ 50.00
Total General cost	**$ 305.00**

Table 2

Thus it can be seen the total project cost follows as

Total Part Cost + Total General Cost = $558.42 + 375.00 = 863.42 ± 5%

Funds

For the purpose of this project, there are 3 sources of funding. These are Engineering Science Student Endowment Fund (ESSEF), The Wighton Fund and Engineering Science department. Furthermore, in an effort to decrease costs, the company will possibly use second hand components and materials from past engineering project courses which can reduce our costs by approximately 20% Please note at this point, it is not confirmed the exact amount of fund, however, the company forecast at least 70% of the costs to be covered.

5. Company details

Company profile

Alcoshield Company was established in January 2014 by five enthusiastic Engineering Science students: Ashraf Jerbi (Computer Engineering), Ritik Looned (Biomedical Engineering), Mohammed Naghshineh (Biomedical Engineering), Nima Soroudi (Systems Engineering) and Moataz Billeh (Computer Engineering). All members are in their last study year and each one of them comes equipped with unique experiences and good knowledge which adds more value to the collective assets of the team and ensures proper group dynamics.

Members

Ritik Looned is a fifth year Biomedical Engineering student at Simon Fraser University who is passionate about engineering for the betterment of human society. He brings a broad skill set ranging from a strong foundation in electrical design to expertise in signal and image processing. His extensive experience with PCB design and familiarity with other digital equipment such as oscilloscope, DMMs, and spectrum analyzers makes him an excellent addition to the team. Besides the hardware skills that Ritik presents, he is also confident with several popular software packages such as LabView, MATLAB, and SolidWorks.

Nima Soroudi is a in his fifth year of Systems engineering at Simon Fraser university with 3 cooperative term of work experience at Verathon Medical Canada. Throughout his months, Nima developed a very good understanding of analog circuit design and also troubleshooting and debugging devices from scratch by using the provided schematic and layout. He is experienced using the electronic laboratory equipment's throughout of his previous academic

and industry projects. He is familiar with automated testing design using data acquisition modules in Labview environment. His experience in the industry in addition to his academic knowledge makes him a very efficient and confident hardware engineer.

Mohammad Naghshineh is a 4th year Canadian Biomedical Engineering student at Simon Fraser University (SFU), British Columbia Canada who is very interested, excited and passionate about this project. He has 8 months of experience as a biomedical engineer in a hospital. In addition to that, Mohammad has also completed 4 months of training as a Field Service Engineer for Medical Imaging Devices at Philips Healthcare, thus he is very confident in functions specifications, and component selection and module build of this project. Furthermore, he has designed and implemented several analog, digital and integrated circuits and variety of filters. I am sure he will be an asset to the project with his excellent team work and multi-tasking strategy.

Moataz Billeh Mednini is a 4th year international Computer Engineering student at Simon Fraser University who is passionate about video/image processing applications. Throughout his five terms of internship, he developed a great sense of problem solving and a solid experience programming with C/C++. Moataz is also experienced with digital signal processing, HEVC video coding algorithms, python scripting for software automated testing, hardware design using VHDL, VLSI systems and embedded software. Being exposed to the real world product development cycle, he acquired smart strategies to develop efficient software product designs.

Achraf Jerbi is a fourth year Computer Engineering student at Simon Frasier University. He has finished a three cooperative work experience at 2Iweb and eBrisk Video Inc. In his first work experience, he has been exposed to the web development field. He cooperated with a professional engineering team to develop a dedicated Joomla template as a solution for Iphone and Ipad's graphical interface standard. Ashraf is passionate about video coding as he has learned about different video coding algorithms in his second and third cooperative work experience. He has examined several coding tools in the H.265/HEVC encoder application. He is mostly familiar with C language as well as FPGA programming and python scripting.

6. Schedule and planning

The figure 3 below presents the Gantt chart of our development schedule. As the chart indicates, we are planning to develop all the features discussed earlier throughout this report during a 4 months period. We have tried to come up with a balanced schedule that varies a considerable research and design period as well as realistic estimate to develop the product. Note between that documentation is considered as a continuous task that will be recorded during the development of the product.

	Task	Assigned To	Start	End	Dur	%
	SoberJack Project		1/6/14	4/15/14	72	
1	Project research	AlcoShield members	1/6/14	1/31/14	19	
2	Proposal	AlcoShield members	1/15/14	1/20/14	4	
3	Design specification	Ashraf/Nima/Ritik	2/1/14	2/6/14	4	
4	Functions specification and components selection complete	Moataz/Mohammad	2/7/14	2/17/14	7	
5	Breathalyzer research and design	Nima/Ritik	2/18/14	2/28/14	9	
6	Recognition system research and design	Ashraf/Moataz	2/18/14	2/28/14	9	
7	Ignition lock research	Mohammad	2/18/14	2/28/14	9	
8	Modules build	AlcoShield members	3/1/14	3/22/14	15	
9	Unit testing	AlcoShield members	3/10/14	3/22/14	10	
10	Modules integration	AlcoShield members	3/23/14	4/2/14	8	
11	Final system testing and debugging	AlcoShield members	4/3/14	4/10/14	6	
12	Oral presentation/Demo	AlcoShield members	4/11/14	4/15/14	3	
13	Documentation	AlcoShield members	1/6/14	4/15/14	72	

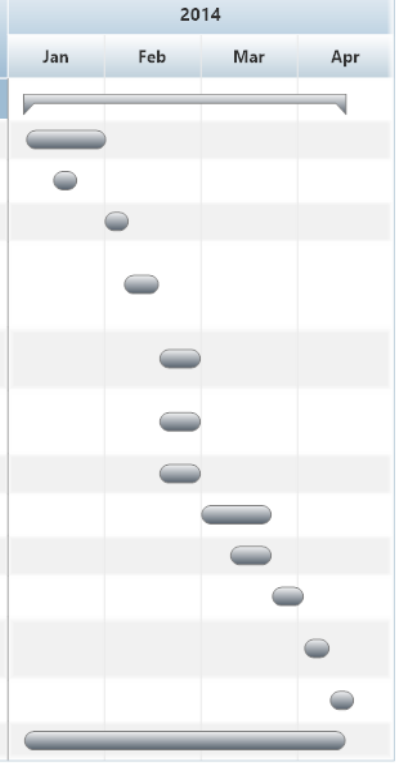

Figure 3. Gantt chart of development schedule

The chart below in figure 4 shows the important milestones and tasks in our project. It highlights the important milestones that we need to meet with respect to its due date to keep track of our progress.

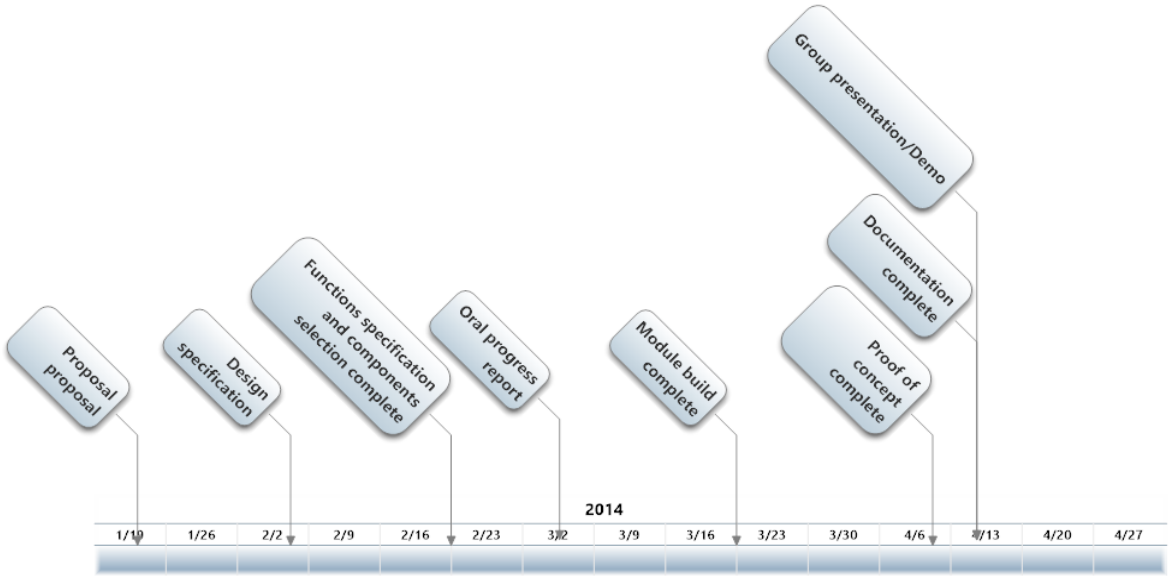

Figure 4. Milestones and tasks

Conclusion

Alcojack device is a forward-thinking device which would save lots of people and public properties based on the statistics of drinking and driving. Our proposed device will not only be used to by government to enforce drivers who has records of drinking and driving; but it will also for parental control for many purposes.

The AlcoShield's team envision is to make the system embedded in the specified vehicle which it will make it marketable for safety and security purposes for government use. Also AlcoSheild will provide this system as a third party application to public which interested users can install on their vehicles. AlcoJack eliminates the possible cheating actions in the current systems in the market by using the face recognition of the user while the user is blowing the breathalyzer.

AlcoSheild sees this device's development as the better and more reliable device in the field. The Soberjack device consists of a digital camera and breathalyzer from another third party and they will be modified to fit in our system. Furthermore, this document highlights our source of information and research materials. In the previous parts the potential funding and budget has been provided, also the proposed timeline has been attached.

References

[1] "The Magnitude of the Alcohol/Drug-Related Crash Problem in Canada: Overview" [Online] Available: http://madd.ca/madd2/en/impaired_driving/impaired_driving_statistics.html

[2] Stephen G.A. Pitel and Robert Solomon, "ESTIMATING THE NUMBER AND COST OF IMPAIRMENT - RELATED TRAFFIC CRASHES IN CANADA: 1999 TO 2010", Western University, April 2013

[3] "Vehicle impoundment for impaired driving" [Online] Available: http://www.icbc.com/driver-licensing/tickets/vehicle-impoundment/impaired-driving

