February 08, 2008

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

Re: Ensc 440 Project Functional Specification for a Blind Spot Safety System

Dear Dr. Rawicz,

The attached document provides an overview of our proposed project for ENSC 440. The aim of our project is to implement a blind spot safety system for automobile drivers.

The purpose of this document is to provide high-level specifications to the functionality of our Blind Spot Safety system. The document is meant as a reference containing a framework of design guidelines for the Operations Officer and design engineers. The document does not contain design specifications.

Our company, iChecked Inc., consists of four talented individuals: Aron McKinnon, Elyas Sepasi, Barry Li, and Victor Chan. We believe this team is capable of accomplishing the proposed task in a timely fashion.

If you have any questions or concerns, please do not hesitate to contact us via email at blindspot-440@sfu.ca.

Sincerely,

Aron McKinnon
Chief Executive Officer
iCheck. Inc.

Enclosure: Functional Specification for iChecked Inc. Blind Spot Safety System

Functional Specification for

Blind Spot Safety System

iChecked Inc.

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Submitted to: Dr. Andrew Rawicz – ENSC 440
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Executive Summary

According to the Alliance of Automobile Manufacturers, human errors are the probable cause to 93% of automobile accidents, whereas the environmental factors contribute to only 33%. When was the last time you tried to change lanes and almost got into an accident because someone was in your blind spot and you did not see them? This problem is very widespread and a solution has not been yet made available to the general public. Until now, iChecked Inc. has come up with a revolutionary product that will save lives, reduce the number of accidents, and provides peace of mind to the driver.

The system will include a detection system that will inform drivers if another driver is in their blind spot area with a warning light. This does not eliminate the necessity of shoulder check, but will make the drivers much more aware of the surroundings. So that before changing lanes, with this warning system, driver will be reminded there is a car in the blind spot area.

The size of the automobile industry is huge and growing exponentially, which makes our target market virtually the entire planet. With the price of insurance premiums rising, more drivers will search out alternatives to prevent accidents and thus lower their premiums, which iChecked Inc. provides with the blind spot safety system.

iChecked Inc. was formed by four engineering students from Simon Fraser University. Each member has experience in a wide range of areas, including software and hardware development.

This document guides iChecked designers with regards to the required features and expected level of performance of the device. Though the requirements documented are exhaustive, it is by no means complete, due to the complexity of such systems. We shall continually revise and update the requirements in order to ensure that a satisfactory product is produced.

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1. Introduction

Blind spot safety system is a driver assistant, it will safeguard you when switch lanes and carelessly missed the hazard in your blind spot. Although shoulder check is mandatory in North America, some still ignore or forget to do so, in some country should check is not required. Certain vehicles have interior designs which limit vision and even with a shoulder check changing lanes can still be dangerous and uncertain for the driver. Therefore such system will help the drive avoid hitting other road users when they switch lanes.

The Blind Spot Detection system would consist of a Sensor, Indicator, CPU processor, and wiring. The sensor of the blind spot of the system detects the side of the drivers vehicle, the sensor signal is passed by wires to a CPU processor unit which will process the sensor data and determine if a vehicle is in the blind spot area. The CPU will then send a signal via wires to an indicator to signal to the driver whether or not a vehicle is in fact in the blind spot.

1.1 Scope

This document describes the functional specifications that must be met by the Blind Spot Detection System prototype and the potential production model. The functional requirements for major components of this proof of concept device will be provided. The list of functional requirements for the proof-of-concept model provides the guidelines for our design engineers. Since experience will be gained while developing this device, only a partial set of functional requirements is supplied for the production device. Given that the project is currently under development, the final functional specifications may vary slightly from those provided in this document.

1.2 Intended Audience

The functional specification is intended for use by all members of Ichecked Inc. The team manager should use the functional requirements as a concrete measure of progress throughout the development phase. Design engineers should use this to follow the design goal and implantation. Test engineers should use this document to assist in testing the similarity of function in the actual system with the functionality described in this document. Marketing personnel can use this document to develop advertising materials.

1.3 Convention

The following convention will be used throughout this document for assigning priority to functional specifications:

R[n/priority] Functional specification description.

The functional specification number is denoted by n. The priority is given by A, B, or C and is displayed after the functional specification description. The priority alphabet convention is as follows:

A: Functional specification is required for both the proof of concept, and the final production system.

B: Functional specification is for just the proof of concept.

C : Functional specification is for just the final production system.

1.4 Definition

Blind spot

Even in a time that the mirrors are properly adjusted, there are large areas around a vehicle that drivers are not able to see their mirrors. These spaces are called blind spots. Blind spots are in the sides of the car and at the back of the car and also, below driver's field of vision to the front. The most dangerous blind spots are to the sides of the car. Those are the spots that drivers are supposed to check by doing shoulder check. Depend on the design of each car, small objects like bicycles can be ignored if they are in these spaces around the car.

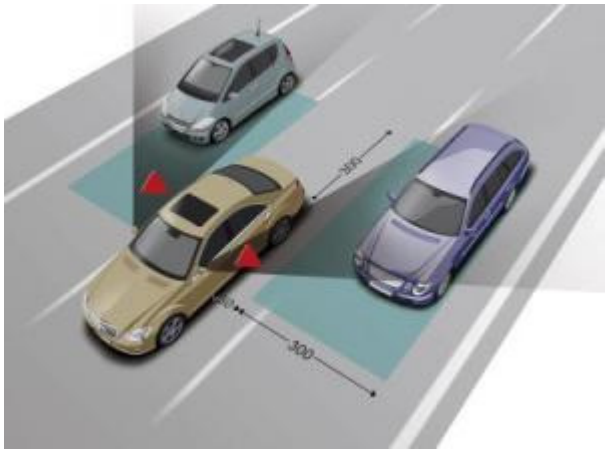

Figure 1-1: Typical Blind Spot of a car

Usually cars have smaller blind spots at the front and at the back and two large blind spots on the sides. The sizes of the blind spots are depended on the size of cars. Therefore, there is no specific range for these spaces around each car. However, with good approximation it can be said that the side blind spots are from 20□ to 90□ from side of the car. Also, it starts from the blind spot of the driver's eyes and go toward the back of the car; blind spot of the driver's eyes is the area that eyes are covering without turning the head around which for a normal eyes is usually from 0□ to 180□ from left to right. To have some approximation about the distance of other cars around the car, it can be say that the closest distance which a car will be in blind spot is around 0.5 meter and the furthest distance from the car is around 3 meters. By furthest distance it is implied the closest- furthest distance since we can go as far as we want and stay in the blind spot. However, after 3 meters it is not a dangerous zone any more.

2. System Requirement

After a vehicle is located in the blind spot, it is recommended to avoid lane changes until the vehicle has passed. The blind spot safety system is a driving assisting system. It will provide more vision and safety than regular mirrors have provided. The intended users are drivers from compact car to truck, and the system would be designed differently for car sizes. [3]

2.1 System Overview

The overall system is consisting of three stages in the block diagram Figure 2-1.

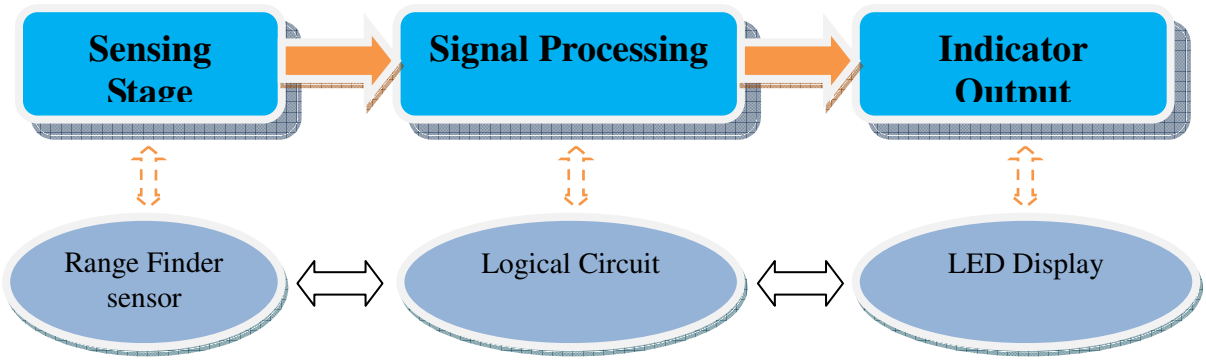

Figure 2-1: Overall Block Diagram

2.2 General Requirements

The specifications stated in this section apply to the overall system.

R[1/C] The Blind Spot Safety System must be waterproof.

R[2/C] The Blind Spot Safety System must be able to perform in the range of -30□c to 50□c.

R[3/C] The Blind Spot Safety System must be able to operate from 35% to 85% relative humidity ranges.

R[4/C] The Blind Spot Safety System should operate properly under normal atmospheric pressure.

R[5/A] The Blind Spot Safety System must be user friendly.

R[6/C] The Blind Spot Safety System must be compatible with different models of cars.

2.3 Physical Requirements

The device should be handheld and portable. To achieve this, the scanning sensors will have to be relatively small.

R[7/C] The Blind Spot Safety System must be easy to install.

R[8/B] The indicator unit of the Blind Spot Safety System shall be easy to mount on or inside side mirrors.

R[9/B]. The Blind Spot Safety System must have a sensor on each side of the vehicle.

2.4 Electrical Requirements

R[10/C] The Blind Spot Safety System shall work with the power generated by the car's battery.

R[11/A]. Voltage required for the Blind Spot Safety System is at max 12V.

2.5 Standards

The production version of iCheck will comply with electronic, electrical and operational standards to ensure safe and reliable usage of the system. The following list encompasses the minimum standards iCheck will adhere to.

R[12/C] The production system will adhere to CSA, CE, ETL and UL standards for consumer electronics

"CSA: Canadian Standards Association

CE: Conformance European (Communaut Europ enne or Conformit Europ enne)

ETL: Originally a mark of ETL Testing Laboratories, now a mark of Intertek Testing Services

UL: Underwriters Laboratories Inc" [4]

2.6 Reliability and Durability

The iCheck devices shall meet the following reliability requirements:

Accuracy: Since iCheck's project is related to the security of drivers on the roads and high ways, the device shall be really accurate. The system will detect and deliver the signals to drivers correctly 99% of the time.

Response Times: iCheck will be used in highways when cars have a high speed. Therefore, The response time for the device to detect the area and process the data and response to the input must be less than a second.

Durability: The expected life span for the device will be more than five years. The stand of sensors and actual sensors will be able to withstand shocks and/or drops from one meter high.

2.7 Safety Requirements

R[13/C] The output devise shall be designed and installed not to block the drivers view and/or confused him.

R[14/A]The enclosure shall have no sharp corners or edges that would pose a danger to the users. The actuator or motor units shall be enclosed to reduce chances of injuries to minimal and to avoid dust or other contaminants that may damage the motors.

R[15/C]All inputs and output ports of our device will be shielded and protected from external static voltage sources. The electrical isolation will be such that there is no risk of electrical shock from our device. All the I/O jacks are industry standards, so they will meet all the safety requirements. [5]

2.8 Usability Requirements

R[16/C] Should be seen clearly within the driving seat.

2.9 Performance Requirements

R[17/A] The response time should be less than 100ms

R[18/C] Should work with the turn signal in any automobile

3. Sensors

The sensors provide the input to the system. They should be able to detect cars and other road users in the blind spot of the adjacent lane. Ideally the sensors can only detect the blind spot in the next lane when the driver active the turn signals. The sensor should be reliable and durable since driving condition varies in different regions.

3.1 General Requirements

R[19/A] The sensing range of the input sensors should be in between 50cm to 350cm.

R[20/C] The sensors must be able to work day and night.

R[21/A] The sensors must be able to cover the blind spot.

R[22/C] The sensors must be able to work under snow and rain condition.

R[23/A] The sensors must be powered by 12 volt or under.

R[24/B] The sensors must output a high low signal between 0-5 volts.

R[25/A] The sensor output signal should be real time.

R[26/A] The delay of the sensors' output signal must be lower than 100ms.

R[27/A] The sensors must output an analog signal.

3.2 Physical Requirements

R[28/C] The sensors must be able to work under below 30 degree Celsius.

R[29/C] The sensors must be able to work above 40 degree Celsius

R[30/C] No dimension of the sensor can be longer than 15cm.

R[31/C] The sensors must be waterproof and shockproof.

4. CPU

This unit act as the brain of the system, it will process the output signal from the sensor then do a logical processing before sending an output signal to the indicator unit.

4.1 General Requirements

R[32/A] The CPU unit processing time should be less than 300ms.

R[33/A] The CPU unit must be powered by 12 volts or less.

R[34/A] The CPU unit must be able to process multiple inputs.

R[35/A] The CPU unit must be able to output an audio signal.

R[36/A] The CPU unit must be able to power the indicator.

4.2 Physical Requirements

R[37/C] The CPU unit must be able to perform below 30 degree Celsius.

R[38/C] The CPU unit must be able to work above 40 degree Celsius.

R[39/C] The CPU unit must be should be shockproof.

5. Indicator

The indicator alerts the user or driver that there are road users in the blind spot when the driver activates the either one of the turn signals.

5.1 General Requirements

R[40/C] The indicator must be able to mount inside the car.

R[41/C] The indicator must be able to alert the user with an audio.

R[42/B] The indicator must be able to alert the user with an led display.

R[43/A] The indicator must not be too distracting when alert is on.

R[44/A] The indicator must not obstruct the window view.

R[45/A] The indicator must not obstruct the side mirror.

5.2 Physical Requirements

R[46/C] The indicator must be no larger than 100 square centimeters.

5.3 Usability Requirements

R[47/A] The indicator user interface must be intuitive and be able to be understood easily by all possible users.

6. Wiring

The interface connects the input and processing and output stages. It should be comply with automobile standards.

6.1 General Requirements

R[48/C] The wiring must follow all automobile electrical installation code.

R[49/C] The wires should be concealable.

R[50/C] The wiring material must follow automobile standards.

6.2 Physical Requirements

R[51/C] The wiring material should be durable.

R[52/C] The wiring material should be adjustable.

R[53/C] The wiring material should be waterproof.

7. User Documentation

R[54/A] All user documentation and technical support information shall be available as online materials.

R[55/A] The user manual shall be written for an audience with minimal technical knowledge.

R[56/A] User documentation shall be provided in official languages of nations where products are distributed.

R[57/A] A detailed installation guide shall be provided for technicians and vendors.

8. Marketing Requirement

R[58/C] The Blind Spot Safety System should have durable packaging.

R[59/C] The Blind Spot Safety System should be flexible and cost-effective.

R[60/C] The Blind Spot Safety System should be marketed to all licensed drivers.

9. User Documentation and Training

R[61/A] The iChecked Blind Spot Detection System is to be installed by certified technicians in the automobile field and therefore technical documentation is needed.

R[62/A] An installation manual shall be included in the Blind Spot Detection System packaging.

R[63/A] A programming guide shall be separately provided to the user upon request.

R[64/A] The manual will be in English, French, and Spanish so as to make it easier to comprehend in all North American countries.

R[65/C] A step-by-step troubleshooting guide shall be incorporated into the instructions booklet.

R[66/C] A regularly updated FAQ, Frequently Asked Questions, section will be available to the user via the website of the company.

R[67/A] A service manual shall be provided upon request at user's expense, in case the party is interested in servicing the device without handing the job over to authorize service personnel.

R[68/A] A "product features" demo and installation video will be uploaded on the company website. The user will also receive a copy on a DVD.

R[69/A] Warranty terms and conditions, as well as all company contact information are to be made available to the user.

R[70/A] An installation manual shall be provided for service personnel.

R[71/C] An electronic version of all documentation shall be provided on the company website.

10. Conclusion

Drivers know that they are required to shoulder check before they merge into neighboring lanes, but the reality is not so. Many people are injured in car crashes involving lane change accidents that may have been prevented with a proper blind spot warning system. iChecked Inc. is determined to minimize these loses through proper design of our blind spot safety system. The potential market is vast and we aim to market directly to all car owners through auto parts dealers such as Canadian Tire.

The schedule and funding section shows our commitment to finish this project on time and on budget. The key to the success of the project lies in its team members with diverse backgrounds and strengths suited to motion detection and computer algorithm design. Our group is comprised of strong programmers and circuit designers. With our current resources and a well defined strategy, we are confident that the project will proceed with success from start to finish.

11. Reference

[1] The Alliance of Automobile Manufacturers, “What Causes Crashes?”, 2009. Available: http://autoalliance.org/index.cfm?objectid=23D1FF5F-1D09-317F-BB7797A26AA6C52F [accessed: Jan 26, 2010]

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[3] International Harmonized Research Activities , “Statement of Principles on the Design of High-Priority Warning Signals for In-Vehicle Intelligent Transport Systems – Draft” 2008. Available: http://www.unece.org/trans/doc/2009/wp29/ITS-17-03e.pdf [accessed: Jan 15, 2010]

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