ENSC 405W Grading Rubric for Project Proposal

Criteria	Details	Marks
Introduction/Background	Introduces basic purpose of the project. Includes clear project background.	**/05%**
Scope	Clearly outlines project scope.	**/05%**
Risks/Benefits	Details both potential risks involved in project and potential benefits from it.	**/10%**
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). [If MS Project is not made available to you, possibly via Imagine, then charts are optional.]	**/10%**
Cost Considerations	Includes a realistic estimate of project costs. Includes potential funding sources. Allows for contingencies.	**/10%**
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.	**/05%**
Correctness/Style	Correct spelling, grammar, and punctuation. Style is clear, concise, coherent.	**/10%**
CEAB Outcomes: Below Standards, Marginal, Meets, Exceeds	11.2 – Cost Considerations: 11.3 – Project Assessment and Scope: 11.4 – Project Risk: 11.5 – Project Planning:	

Version of 26 January 2019 by Craig Scratchley. Updated from Version provided by Steve Whitmore

March 23rd, 2019
Andrew H. Rawicz
School of Engineering Science
Simon Fraser University
V5A 1S6

Re: ENSC 405W Project Proposal for NightEagle

Dear Dr. Rawica and Professor Craig Scratchley,

We have thoroughly prepared EagleVision's Project Proposal of our NightEagle device for review. Our unwavering goal is to create a portable, efficient, and affordable night-vision human and animal detector to alarm drivers, in order to greatly reduce vehicular fatalities during night time. We will combine bleeding-edge Machine Learning technology into an extremely efficient and portable hardware form-factor. The device will take in visual data from an embedded night vision camera and pass the data through our in-house developed AI in order to correctly identify pedestrians under any lighting conditions.

This document will detail a high-level overview of said device from its conceptual implementation. It will showcase the functionalities targeted for proof-of-concept, prototype, or final product, based on the outlined priorities. The appearance and UI prototype will also be rendered in 3D for reference to all technical consultants and investors. Then, the business plan will include a full analysis of the Risks/Benefits, Market/Competition/ Research Rationale, Company Details, Project Planning, and Cost Considerations surrounding the development process of our device.

EagleVision currently consists of three engineering students: John Xing, Billy Luo, and John Zhang, all coming from different engineering divergences to ensure the robustness of the final end product. We would like to thank you for taking the time to review our product and giving valuable feedback.

Sincerely,

John Xing

CEO

Enclosed: Project Proposal for EagleVision's NightEagle

EagleVision™

Project Proposal

for EagleVision's flagship device, the NightEagle

Project team:

John Xing

Billy Luo

John Zhang

Correspondence:

Billy Luo

Email: luosiyal@sfu.ca

Submitted to:	***Issue date:***
Mr. Craig Scratchley: ENSC 405W	Mar 28th, 2019
Dr. Andrew Rawica: ENSC 440	Version 1.0.0
School of Engineering Science, SFU	Confidential content

Executive Summary

In a society of rapidly advancing vehicle safety for passengers, manufacturers continue to consider the safety of pedestrians as an afterthought. EagleVision's flagship device, the NightEagle, aims to offer a solution to this issue at an untapped region of the current industry. The final product, which will be a high-speed night-vision human recognition device, will be broken down into the various components of the business plan, in order to achieve the specifications at a high profitability margin. The end product will be an affordable, highly compact, clean, and easy-to-operate device with a modern user interface and simple installation process (Figure 1).

Figure 1 - Product Design and UI

This document will serve as a high-level exploration of the proposed solution to pedestrian fatalities due to vehicular collisions, especially at night, for high-speed vehicles of all kinds. The various aspects to the development process such as risks and benefits, market competition, project planning and cost considerations will be detailed. EagleVision's mission is to minimize or greatly reduce night-time vehicular collisions with pedestrians by implementing a high-effective yet affordable device, which will recognize pedestrians even in the darkest of circumstances and alert the driver. EagleVision will construct this compact and fully embedded device by combining a high quality night-vision sensors, a micro-PC board, and cutting-edge self-developed machine learning software which reacts in real time. Furthermore, EagleVision's software team will simplify the user-interface so that it can be operated easily while driving and avoid distractions to the driver.

The EagleVision team consists of 3 engineers of the Electronics, Systems, and Computers concentration, and is confident in its diverse skill set to innovate the industry. The team

currently has a working model of the machine learning AI, and the absence of an equivalent mass-market product will guarantee an absolute comparative advantage.

Table of Contents

List of Figures

List of Tables

Glossary

Term	Definition
Opencv Library	An open source coding library containing training datasets for software integration
Machine learning AI	Artificial Intelligence based on repeated training cases of software to recognize visual queues
Night-Vision Device	Conversion to visible light of both visible light and near-infrared using an image intensifier tube, to produce a monochrome feed
Feature descriptor	An algorithm which takes an image and outputs feature descriptors/feature vectors
RPi	Raspberry Pi board
Training Model	The base set of data to be fed into the AI in iterations to eventually produce the desired machine learning capabilities

1 Introduction

One of the core driving factors behind the conception of the NightEagle device is the unfortunate rise of vehicular collisions rates with pedestrians over the years.[2] Although there are traffic lights on almost every major street, there are still many trails and crosswalks without any pedestrian or street lights. As a result, research shows that the overall severity of injuries is tripled on roads without light.[1] Even though certain high-end vehicle brands in modern times incorporate some form of frontal collision detection technology, the general industry is still in its development stages.

EagleVision aims to provide a safer environment for the current traffic ecosystem. The company is committed to enabling all drivers - not only high-end luxury vehicle owners, to drive safely with its patented frontal human detection device. In order to achieve this, the team has identified several potential tools to integrate. On the software side, the team has already developed a working prototype of the machine learning AI and will put it through Through countless iterations of incremental improvements, the AI will become fast and accurate at recognition during no-light situations. In terms of hardware input, a night-vision capable camera will be used to record the video stream and output frame-by-frame bitmaps, so that the software component can detect the faces and bodies in each sample. As for portability and ease of usage, the system will incorporate a Raspberry Pi as the computer at the heart of the device. It is a single-board computer consisting a CPU, GPU, RAM, all relevant ports, power source input, along with various interfaces for connecting other external peripherals.[2] Raspberry Pi gives the development team at EagleVision a powerful set of tools found only on full-sized PCs, but in a minimal size and cost factor.

This document will take the reader through a high level overview of the product and project with a brief exploration into the technical development process. The bulk of the content will be focused on the various business aspects of this venture. The risks and benefits section will explore the potential development and marketing caveats, along with the possible financial and social profits. The market competition section will examine the current competitors to EagleVision and what differentiates our product. The project planning and cost considerations section will be detailed in full to display the schedule and budget we intend to follow, in order to achieve the most efficient agile development cycle. We are confident that the following sections will provide convincing incentives for all potential investors in the automobile safety industry.

2 Project Overview and Scope

2.1 Background

As mentioned earlier, the team is very passionate about reducing the night-time hit-and-run cases, which are on the rise. After surveying the general landscape of vehicular technology, the team concluded that most cars feature only simple general object detection technologies, with only high-end concept self-driving cars incorporating any real pedestrian detection alerts. This document serves as an overview and analysis of the various business specifications of the NightEagle development process, which EagleVision will strictly adhere to during the various production stages. As the core of the device is based around the newly emerging machine learning concept, the team will devote a bulk of the development cycle to ensuring its perfection. As only the top companies in the industry such as Google and Tesla have been able to make a significant impact on the industry, we are dedicated to create our own in-house software which can run at similar capacities, but at a fraction of the cost.

One of the most important requirements for the team is to keep the product compact and portable. As a result, the team will take into consideration the balance between size and power, as the device will also be required to run complex code constantly in real time. As machine learning is an exciting and limitless new form of technology, the EagleVision team will invest heavily into its usage throughout the embedded device and take advantage of its many features and possibilities. In addition, mass production will be available as the onboard software can be duplicated easily, leading to lower costs and higher returns for investors.

2.2 Scope

The engineering prototype and final product will be a small and compact box about 6 inches across diagonally. The front of the device will feature the main camera, intended to be pointed towards the front of the car. In addition, the top of the device will feature an external screen which will be fed information supplied by the software. The team will also incorporate audio or visual alerts to be triggered whenever a pedestrian is detected. The device (Figure 2) will complete all the requirements and specifications outlined in the Proof of Concept and Engineering Prototype sections of the respective documents, and will be ready to be demoed in August 2019.

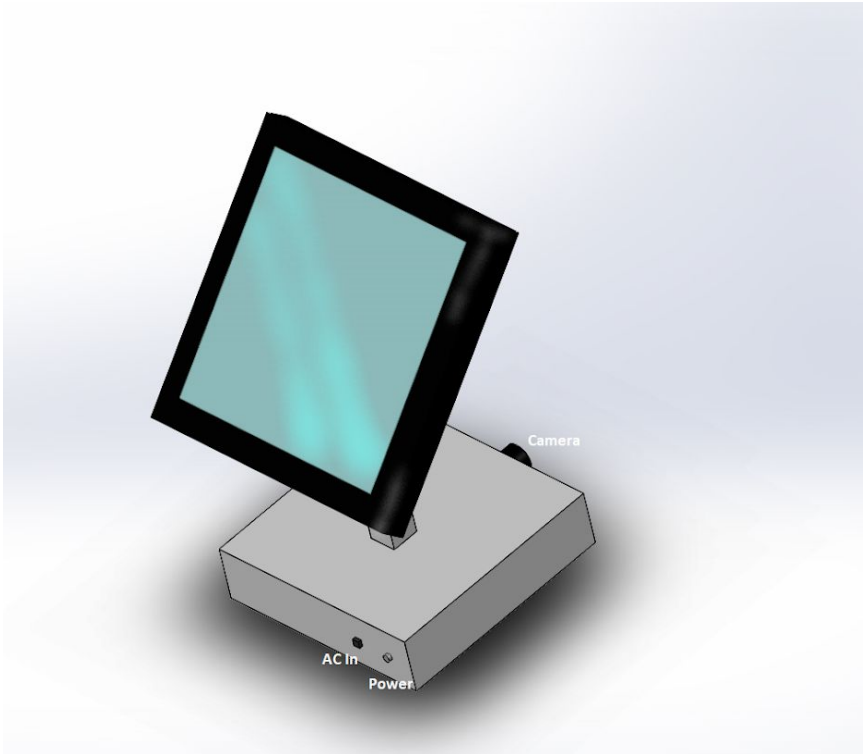

Figure 2: General design of Engineering prototype

Figure 3 displays the system architecture that will be implemented by the team. An indepth look can be found in the Requirements and Design Specifications documents.

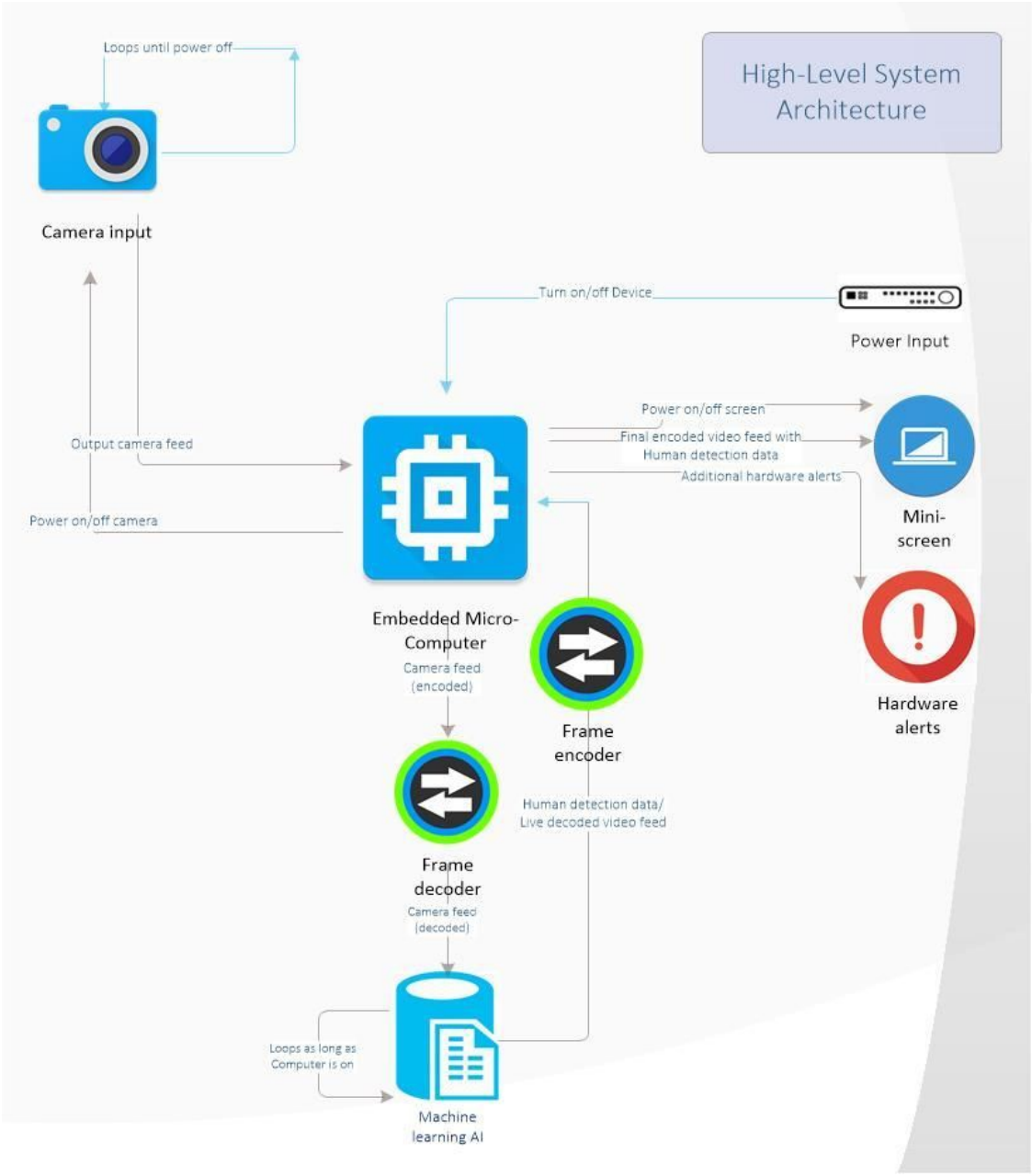

Figure 3 - High-level systems architecture of entire device

2.3 Intended Audience

This report functions as the business and development plan for EagleVision's potential investors and technical consultants. The schedule, cost structure, and implementation process during

ENSC 440 will be followed as outlined. In addition, this document is ready to be evaluated by Professor Craig Scratchley, Dr. Andrew Rawicz, the teaching assistants, as well as potential clients and investors.

3 Project Justification

3.1 Risks

This section will explore the potential risks presented to the various parties involved - the EagleVision team, the investors, and the end users. Overall, the NightEagle is a relatively safe and simple device to operate, so we do not foresee any critical errors. However, all the potential risks are explored in detail and the team's solution to each will be included in this section.

3.1.1 Research and Development Risks

Due to the diverse background of each member on the EagleVision team, we are confident in our ability to deliver on the software, hardware, and systems aspect of the product. In terms of potential software risks, the biggest caveat would be the development cycle of our machine learning AI. As it is a complex block of code that requires thousands of reiterations through testing and training, it could potentially create roadblocks in meeting milestones. In addition, one of the key requirements for embedding the code onto a micro-computer board is that it must be able to run in a low-spec environment. The team will need to reduce the ram consumption of the code in order to ensure speed and reliability once embedded. However, since we already have a working model of the machine learning AI developed in-house, we are confident that the software risks mentioned could be overcome.

Most of the potential hardware construction risks can be eliminated through the usage of third-party casing components for the completed build. In the cases that certain elements will need to be modified. customized, or added, the team has received training to operate the various tools in the machine shop. Thus, the potential risks are relatively insignificant and investors can be assured all negotiated deadlines and conditions will be met.

3.1.2 Setup Process Risks

One of the potential risks come from user error when installing the NightEagle in their vehicle. The main requirement for the alerts to function properly given that all the hardware components are working, is that the camera has a clear view of the road. While clear instructions will be given on the packaging and instruction sheet, there may be users who install the device with incorrect orientations, which will lead to the regular functionalities being unable to be performed. The external screen, however, does provide a view of what the camera sees, so it should be able to reduce this risk for the end user.

3.1.3 Operational Risks

One of the possible operational risks come from the driver being distracted by the device while driving. Since the device features an external touchscreen with visual/audio alerts, the driver may become distracted with the output instead of focusing on the road. With this challenge in mind, the development team will take special measures to implement seamless interactive elements onto the device so that the user can focus on the road and still receive information. For example, the LED-based alerts will be implemented with blue light, which is non-blinding but still noticeable. Audio alerts may be implemented at a later stage, which will eliminate the need to look at the device. Furthermore, the instructions will advice the driver to only look at the screen extensively when they are unsure of the whereabouts of the pedestrian, so that they can slow down their car and observe the screen to see the highlight of the object.

3.1.4 Handling and Usage Risks

The last risk is rather small, and includes any associated risks that comes with handling the physical product. This could include any blunt damage done when incorrectly installing or transporting the device. While the engineering prototype will be boxy in nature, later iterations will feature rounded corners and ergonomic shell design in order to ensure minimum damage even when the user incorrectly handles the product.

3.2 Benefits

The benefits section will detail the various benefits that comes with successful completion of the product, which will balance out and outweigh the aforementioned risks. This section will serve to solidify our potential investor's trust in our company goal, development plan, and profitability. We are optimistic that the general consumer market will also recognize these benefits, and wide adoption of this technology will lead to iterative improvements to the product.

3.2.1 Increased Pedestrian Safety

This is a given, as the main focus of the device is to greatly curb the increase of vehicular fatality rates in recent years. With the successful production and adoption of the NightEagle, one of the biggest benefits will be the reduction of pedestrian fatalities and injuries. The team will work tirelessly to ensure the reliability of the device to detect intended targets and alert the driver.

3.2.2 Untapped Market

By investing in EagleVision, you will be at the forefront of tomorrow's technology. As the company is deeply rooted in machine learning AI, you will be able to operate in a segment of the industry that few companies have succeeded in. As will be explored in the following section,

there are currently a few high-end tech companies who have successfully implemented pedestrian recognition and alert into their vehicles. Meanwhile, most mass market cars have only primitive object proximity alerts, and only work in well-lit areas. Thus, investing in EagleVision will guarantee a step into a fresh market with few competitors.

3.2.3 Contribution to AI Industry

As the EagleVision team is deeply passionate about the prospects of changing the world through AI, we are hoping to contribute to the overall industry through the completion of our product. As machine learning is still a relatively new and undeveloped industry, only a few top companies have been able to make particularly significant impacts with the technology. The launch of the NightEagle device will help pave a path for AI development at a lower cost, helping other smaller companies set foot into the industry. At the same time, since our software is developed in-house, we will still hold an economic comparative advantage.

3.2.4 Increased Police Monitoring Efficiency

One of the alternate uses the team has proposed for the NightEagle device is to be used as a monitoring device for potentially high risk drivers. The team could provide a custom version of the device which will feature an internal memory storage option to record the footage from the camera. If the local police department identifies a driver with previous driving offenses or have had vehicular collisions at night time, they could make it mandatory for the driver to equip a NightEagle in their car. This will help reduce potential costs of keeping dangerous drivers on the road and help provide clear evidence in case of an accident.

4 Market Research

4.1 Market

As the innovation of autonomous vehicles progresses, the advanced driving assistance system(ADAS) has reached great demands for research and development; the field is expected to grow to over 34% over the next eight years. Meanwhile, the CAGR(Compound Annual Growth Rate) will rise to over 14.5% in Asian pacific market from 2017 to 2024. The global market of fully autonomous vehicles will increase to USD 6 billion by 2015.[3] As the figure shows below, the United States, China, and Europe will be the main autonomous vehicle markets in the world, which are expected to reach 5.7 million units, 4.5 million units, and 3 million units in 2035.

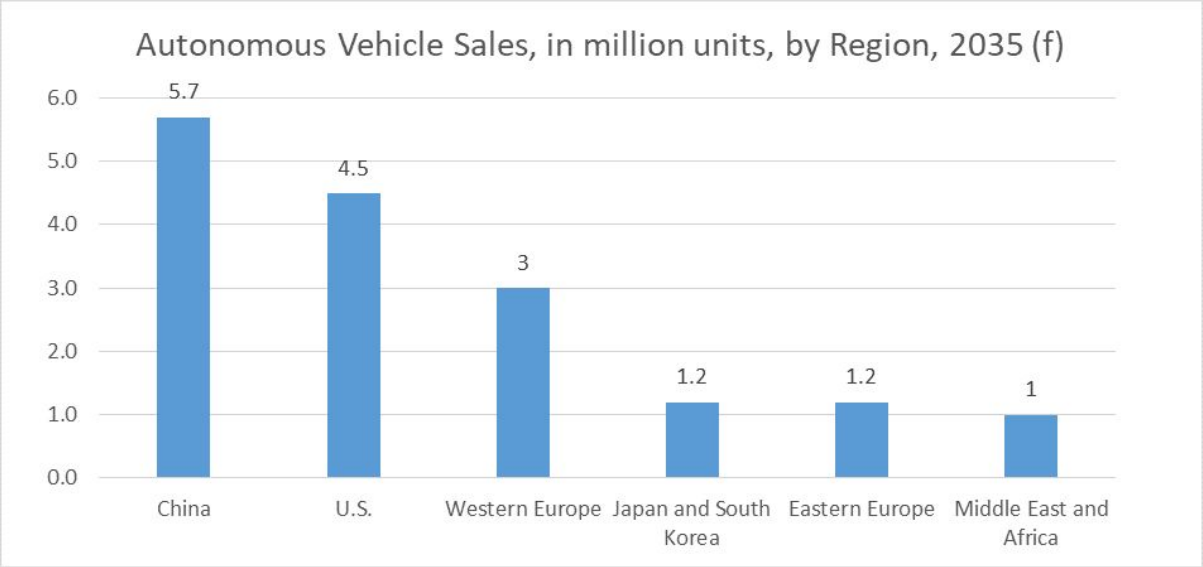

Figure 4: Expected Autonomous Vehicles Market in 2035 [4]

From the Global Market Insights (GMI) research report, the estimated ADAS market will reach to US$65 billion by 2024.[5] From the comparison between 2016 and 2024 in US as indicated below, image sensors will be the highest growth sector of ADAS technologies with over 33% of revenue share over the next eight years. [6]

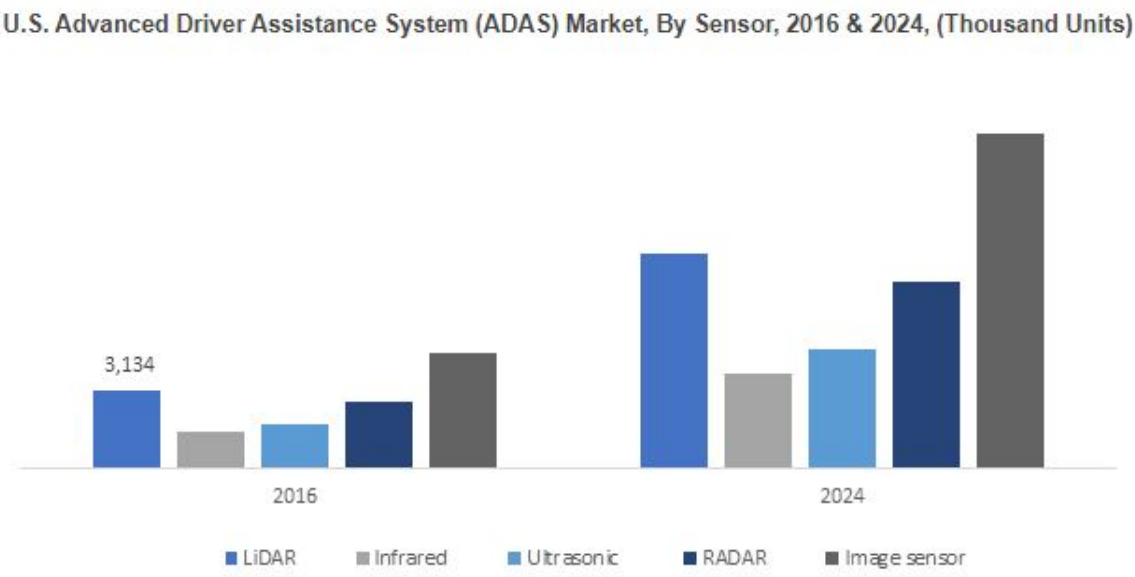

Figure 5: U.S. Advanced Driver Assistance System (ADAS) Market Comparison [7]

As EagleVision's ventures are a part of the ADAS, our investors should be pleased to know that statistics indicate the AI pedestrian detection system market is expected to have over 30% compound annual growth rate (CAGR) during 2018-2023. According to the European Commission for Mobility and Transport, in some of Europe's largest cities, the pedestrian and cyclist traffic makes up between 20-40% of all travel in heavily populated areas and nearly half of the fatalities that occurred were from a vehicle striking a pedestrian. In the United States, this number jumped to a staggering 75%. [8] Thus, pedestrian detection technology will have a huge market space in the future, which will be used in all consumer segments around the world.

4.2 Competition

The market of pedestrian detection system includes several original component manufacturers, such as Mobileye, Delphi, Bosch, TRW, and DENSO. Meanwhile, the majority of the high-end automobiles from Toyota, Volvo, BMW, FLIR, Mercedes, Audi also have this detection technology.[9] The vendor competition in the high-end market is intense, and it will be more cruel in the coming year among providers.

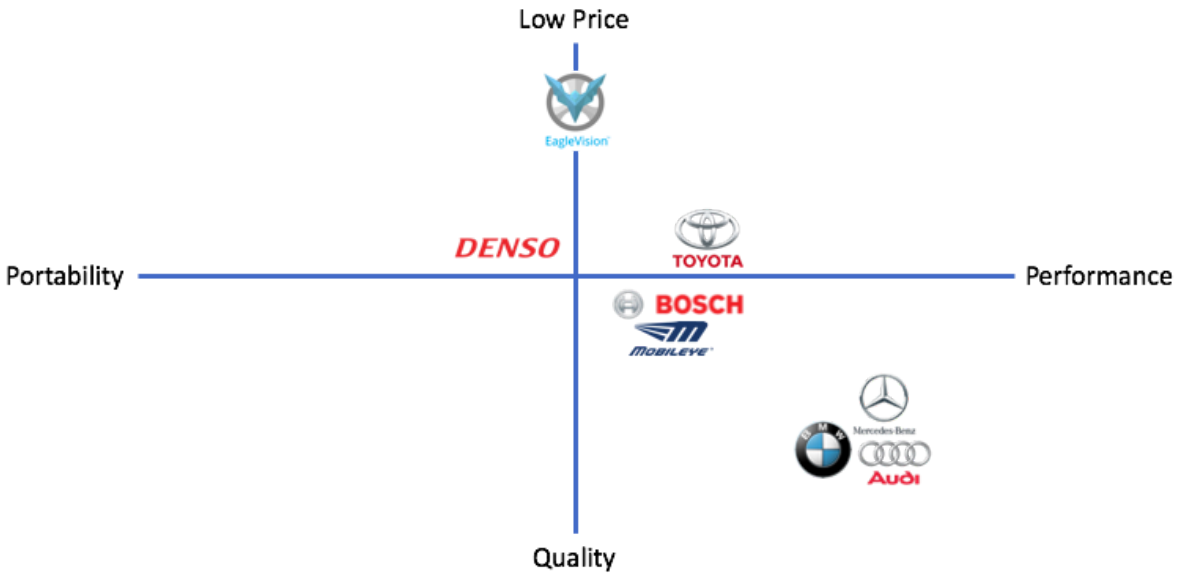

Figure 6: Visual Comparison with other vendors

However, it is still very difficult to integrate the pedestrian detection system into mass-market vehicles due to the high cost of systems and associated components and quality bottlenecks. Even though Audi, BMW, and Benz have great detection systems with high quality and performance, but also comes at a hefty price tag. Certain original equipment providers like Bosch and Mobileye have acceptable quality and performance, but charges a high price for a simple add-on detection device. Mass-market consumers simply cannot obtain such advanced features at an acceptable price on the market. Therefore, NightEagle will aim to provide a high performance detection device, disrupting the market with its quality and affordability.

5 Company Details

EagleVision was formed in January 2019 by founding members John Xing and Billy Luo, and later joined by John Zhang. The team has great interest in machine learning platforms and improving pedestrian safety. The top priority of EagleVision is to successfully fund and produce the first iteration of its flagship device, the NightEagle. The development team is confident that the release of the product will bring about the reduction of pedestrian vehicular collisions and contribute towards lowering costs of development for the machine learning industry.

5.1 The EagleVision Team

John Xing
Chief Executive Officer
5th year
System Engineering
Duties:
System Integration
Software Optimization
Documentation
Graphic Standardization

Middleware Systems Programmer, ICBC, Vancouver BC: April 30th 2018 - Present

- Provisioned and engineered FTP solutions for both internal and external file server configurations to sustain Middleware operations as a service to corporate clients
- Configured and managed access privileges and table values with SQL scripting to fulfill requests from application and operations teams
- Assisted and completed detailed preparations for critical database patching, upgrades, deployments, and reboots to upkeep platforms operation services to various application developers
- Revamped and designed new file server diagrams to create a modern and clean overview of all Gateway, Server Cluster, and Data Centre arrangements

Interests: Piano, drawing, smartphone technology

Billy Luo
Chief Communications Officer
5th year
Computer Engineering
Duties:
Software Engineering
External Communications
UI Design

Junior Software Engineer, Infocube Technology Limited, Vancouver BC: May 2018-Present

- Developed a website for the managed IT services company by using Odoo, HTML, and CSS
- Deployed dedicated servers for multiple games by using shell script on the Linux to lease and create a new kind of business revenue for our company
- Deployed ShadowsocksR (SSR) in our data center to provide the encrypted proxy service for Chinese Internet users to circumvent Internet censorship in mainland China
- Became familiar with the installation and deployment of the data center server with the cloud computing technology

Integrated Management System Development – Software Engineer, Beijing Wiseda Technology Co. Ltd., China May-Dec 2015

- Joined the development team for the whole development process which includes user requirement collecting, designing, developing and testing to develop this Integrated Management Software System
- Designed user interface by using Axure RP and improved it by communicating with users to determine the functionalities and framework of user interface
- Programed user interface by using ZK Studio (a web framework of java in Eclipse) to achieve user interface development
- Trained users with varied technical knowledge to use the software by providing user manuals

Hobbies: Singing, Piano, Basketball, Snooker

John Zhang
Electronics Engineer
5th year
Electronics Engineering
Duties:
Electronic Component Design
System integration

Engineering Intern, FS-Curtis/Fusheng Industrial Company, St. Louis, Missouri, United States: January 2018 - December 2018

- Troubleshot and limitedly launched the GoService Internet of Things (IoT) in North America, analysed the data collected and helped creating the preliminary business model of this new product in the age of Industry 4.0
- Worked cross-functinally with Marketing and Sales to coordinate the special quote process
- Designed the diesel-drive reciprocating air compressor under the supervision of senior engineers
- Investigated the long-lasting problems with the “low oil guard” on the company’s reciprocating air compressors and found the root causes to the problems

Hobbies: Traveling

6 Project Planning

Figure 7 below displays the Gantt Chart of project scheduling and milestones for the ENSC 405W and ENSC 440 period.

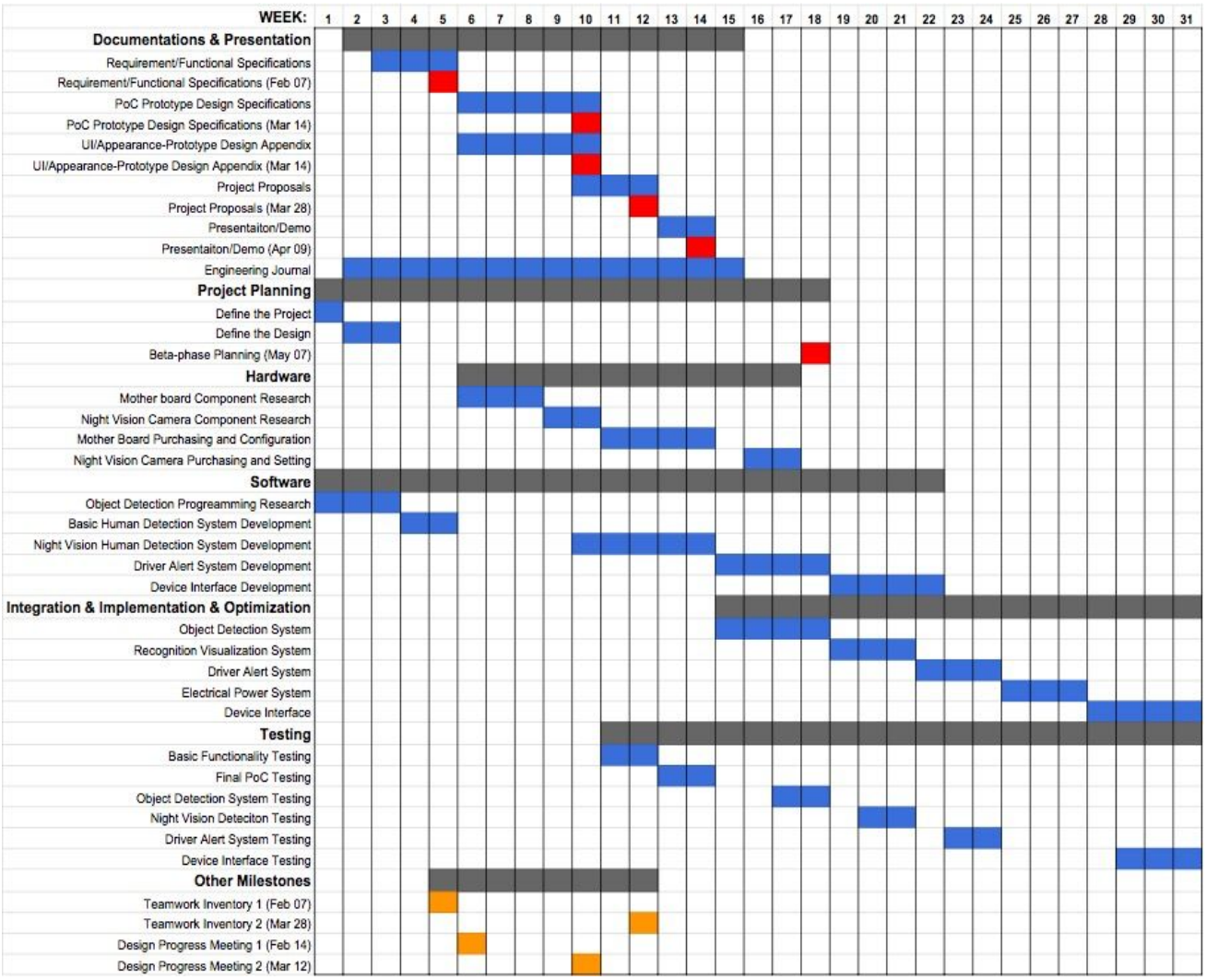

Figure 7: Gantt Chart for Project Scheduling with Milestones

7 Cost Considerations

7.1 Cost Analysis

The preliminary cost breakdown for the NightEagle prototype is shown in Table 1. A 30% contingency is included in the calculation of total cost.

Component	Quantity	Cost (C$/Unit)	Subtotal (C$)
Raspberry Pi	1	46.87	46.87
Night Vision Camera Set	1	34.81	81.68
Touchscreen Display	1	107.07	188.75
Speaker Set	1	16.74	205.49
Li-ion Battery	1	20.02	225.51
USB Power Cord	1	8.02	233.53
Small Electronic Parts (Power Button, Extension Cables, etc.)		10.00	243.53
Custom-made Enclosure Box	1	20.00	263.53
Screen Connector	1	20.00	283.53
	Contingency (30%)	85.06	368.59
	Tax (12%)	44.23	412.82
		Total	412.82

Table 1: Cost Breakdown of Prototype

7.2 Funding

In the prototyping phase of the project, there are several possible sources of funding available in the School of Engineering Science to help offset the expense. Some of the funds are introduced below.

1. The Wighton Engineering Development Fund. This fund is administered by ENSC 440 instructor Andrew Rawicz. It is generally awarded to technologically and economically practical projects aiming to benefit the society. The NightEagle could drastically improve road safety in some areas and will be market feasible, which is why we believe this project would be a competitive candidate to this fund.

2. The Engineering Science Student Endowment Fund (ESSEF). This fund is provided by the Engineering Science Student Society (ESSS) to enrich the educational experience of SFU's undergraduate engineers. The NightEagle project would fall into Category B – Entrepreneurial. Besides the fund, ESSS also manages a parts library of former ESSEF awarded projects. It is possible to take advantage of this parts library to reduce the overall cost of the project.

If the team can not secure any funding, or if the funding is not enough, each team member shall contribute equally to cover the total expense.

8 Conlusion

This document introduced the driving passion behind EagleVision and the business plan that will be followed in order to benefit both the developers and investors. The product overview was detailed, and was followed be a thorough exploration into the Risks/Benefits, Market/Competition/ Research Rationale, Company Details, Project Planning, and Cost Considerations. The team hopes that the ambitious vision behind the project and the full development plan will instill confidence in all investors and potential clients.

Through the different skill sets and attributes of each members in the team, EagleVision strives to create a safer environment for all drivers and pedestrians. The NightEagle device will serve as an affordable and easy-to-access product for any vehicle on the road, ensuring the reduction of night-time vehicular collision fatalities.

EagleVision Inc. plans to finish the proof of concept (PoC) and Appearance Prototype in April 2019, and the final product in August 2019. The team wants to thank Professor Craig Scratchley, Dr. Andrew Rawicz, and the teaching assistants for reviewing the various stages of development and providing us with valuable feedback.

9 References

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