March 31th, 2022

Dr. Mike Hegedus
Simon Fraser University
8888 University Drive
Burnaby, British Columbia, V5A 1S6

RE: ENSC 405W/ENSC 440 Project Proposal for Motorcycle HUD System

Dear Dr. Hegedus,

Please find attached the product proposal for our Motorcycle HUD system, EZhud. Our product's goal is to give motorcycle riders a safe and convenient option for viewing navigation and speed information while on the road. After the simple initial helmet attachment, our solution will guide riders in unknown urban environments while allowing them to keep their eyes towards the road, thus improving their situational awareness.

This proposal contains an overview of our entire product in terms of a business perspective. The product functionalities, project risks, market size, market competition and cost considerations will be extensively analyzed. Furthermore, project milestones and company details will be provided. After reading the full proposal, ClearNav hopes that potential investors will see the clear market opportunity and offer investment.

Our team consists of a diverse set of engineers from the computer, electronic and biomedical concentrations. Our members include Taimoor Ahmed, Muhammad Ahmed Athar, Namsakhi Kumar, Spencer Lall, William Huong and William Xue. Our multifaceted skill sets will allow us to engineer reliable systems and deliver clear documentation.

ClearNav would like to thank you for taking the time to read our product proposal document. If there are any questions or concerns, please do not hesitate to contact me at zjxue@sfu.ca.

Sincerely,

William Xue

William Xue
Chief Executive Officer
ClearNav

Enclosed: Project Proposal for Motorcycle HUD System

Project Proposal

EZhud

Partners:
Spencer Lall
William Xue
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Submitted To:
Dr. Mike Hegedus
ENSC 405W
School of Engineering Science
Simon Fraser University

Issue Date:
March 31, 2022

Abstract

This document outlines an overview of the project and associated market potential in terms of an entrepreneurial perspective. A brief introduction is given for EZhud, a motorcycle HUD system, along with an executive summary. The risks and benefits in terms of the project are also given, as well as an in depth market analysis. The main competitors of our product are examined and the clear differentiators are explained. Gantt charts are presented for the timeline of the project and company partners introduce themselves.

Executive Summary

Unlike in most modern cars, a typical motorcycle is not capable of displaying turn-by-turn navigation directions to the rider while in motion. The lack of a built-in navigation system combined with an awkwardly placed speedometer presents three common problems for almost all motorcyclists today:

1. No built-in turn-by-turn navigation akin to that in a car.
2. To check current speed, riders must glance down at the speedometer which is much more dangerous than in a car and is a common factor for motorcycle accidents [1].
3. No displayed speed-limit information because motorcycles lack a comprehensive infotainment system and display.

There is a need for an affordable product that provides an all-in-one solution to these problems.

The ClearNav company has designed EZhud, a smart heads-up display that attaches to your existing motorcycle helmet to display turn-by-turn navigation, current speed, and speed limit within your peripheral vision. The user will be able to easily program a route into the device from their mobile phone before riding, as well as viewing device battery charge and changing any system settings. EZhud is made with sustainable yet premium materials and is $100-$200 cheaper than the current cheapest competitor in the market.

Three phases of the EZhud product will be completed in 2022 to demonstrate a fully featured product that is reliable and safe.

- **April 12th, 2022:** Proof of Concept product demonstrating a helmet attachable Head's Up Display with real-time navigation and current speed / posted speed-limit detection.
- **August 2022**: Engineering prototype demonstrating a helmet attachable Head's Up Display with near-finished casing and working mobile phone application.
- **August 2022:** Final product available as a consumer product that meets all requirements and engineering standards.

The two biggest players in the motorcycle HUD space are Nuviz Motorcycle HUD and EyeRide HUD, both of which cost around $700. EZhud will solve the problem for much for less while providing a better user interface and better phone compatibility. The estimated cost of the prototype is $550 with the potential for much cheaper options depending on material and scale. ClearNav is actively seeking funding, with partial investment already from the Engineering Science Student Society Endowment Fund and the Wighton Development Fund. Any additional funding will be used to fund R&D to build a more premium product.

The ClearNav team consists of six motivated engineering students with backgrounds in Computer, Electrical, and Biomedical engineering dedicated to providing high-quality Heads-Up Display navigation systems to motorcycle riders in British Columbia. Our team prioritizes safety and reliability, while providing a premium product that is easy and fun to use.

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Glossary

Acronym	Definition
EP	Engineering Prototype
HUD	Heads Up Display
LCOS	Liquid Crystal on Silicon
OIS	Optical Image Stabilization
PoC	Proof-of-Concept
Rider	Motorcycle Rider
RoW	Rest of the World
VHB	Very High Bond

1 Introduction

There are many reasons to join the Motorcycle community, no matter how you got started, ClearNav's aim is to provide motorcycle riders with Clear Navigation, in the hopes of improving road safety for all riders.

Motorcycles are often thought of as exhilarating and cool or even cost effective and fuel efficient [2]. Riding to work can make a commute effortless and the riding community is vibrant with friendly bikers who share similar interests. All of these factors point to a growing community of riders in British Columbia. In 2020, an additional 30,000 Motorcycle licenses were registered with ICBC [3].

However, motorcycles forego many of the luxuries of traditional vehicles. They lack easily visible GPS navigation and convenient speed indicators that car owners are used to. There is no built-in turn-by-turn navigation system and the speedometer is tucked down by your handlebars. Looking down at the speedometer on a motorcycle is much more dangerous than in a car and is a common factor for motorcycle accidents [1]. Not to mention that high intensity vibrations from the engine will damage a handle-bar mounted phone, preventing their use as a GPS [4]. Lastly, riders and drivers alike can often be unaware of the speed limit on traveled roads, partly because motorcycles lack a dedicated infotainment system. Careless speeding can result in costly fines of up to $483 in construction zones [5].

1.1 Project Background

ClearNav's core goal is to bring safe and accessible navigation to motorcycle riders in BC. By designing EZhud, a smart heads-up display that attaches to full-face regulation helmets, ClearNav brings turn-by-turn navigation, speedometer and speed limit information to within the peripheral vision of motorcycle riders.

The full EZhud system is visualized in Figure 1.1 below. Installation of the EZhud system comes in two easy steps, attach the main body of the device to the front right side of your full-face helmet, and the micro-display within the upper edge of your visor, aligning the display with your eyes. Afterwards, users will be able to program navigation routes on their smartphone before the ride, and receive navigation instructions in real-time. Riders will also be able to view their current speed, and a visible prompt, when their speed passes the detected speed limit.

Figure 1.1: EZhud System

1.2 Project Scope

For this project, the main scope will include the research, design, development and testing of an EZhud prototype. Upon completion of the project, the prototype will be able to complete the following tasks:

1. Display real-time turn by turn navigation to Motorcycle riders
2. Display current speed and current speed limit while riding
3. Easily attach to any full-face helmet in an unobtrusive form factor
4. Allow settings changes and route selection via mobile interface

Our product will be able to accomplish the above by incorporating a microprocessor connected to a micro display. The main body of the device will also be detachable to allow riders to remove the product when not in use. In terms of displaying the speed limit, the front facing camera will capture speed limits when it is not already present in the maps database.

By incorporating the system within a single package on the helmet, riders can avoid loose wires dangling whilst riding at highway speeds.

Figure 1.2 below shows the full system overview of the EZhud product and how different components interconnect with each other.

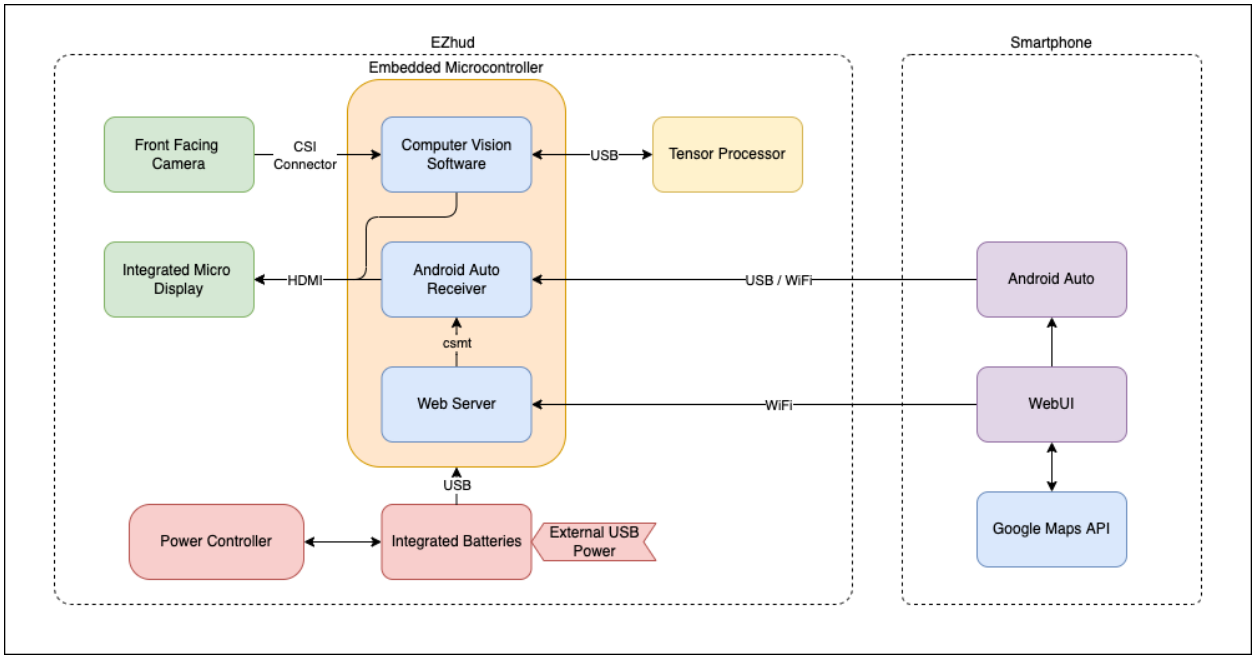


Figure 1.2 EZhud High Level Overview

2 Risks and Benefits

2.1 Risks

As engineers and designers of the EZhud we need to consider the safety hazards posed to end users. EZhud adheres to multiple international engineering standards in addition to ICBC regulations to ensure road safety. As discussed below, primary risks associated with our proposed product, largely relate to its adoption and use in the market.

2.1.1 User Safety

Since EZhud is a heads up display that displays navigation and speed information in front of the user, safety of the rider must be considered. The display should not be directly in front of the rider as it could block the vision and compromise the rider's safety. The display is attached in a way that it does not block the rider's field of view and is easily readable.

2.1.2 Mechanical Issues

The device will be securely attached outside the helmet using VHB tape and a mechanical latch to attach and remove the device when needed. Failure of the latch can result in the device

falling down during a ride which can cause distractions to the rider. To prevent this, the team at ClearNav will test the durability of the latch to make sure the attachment is strong.

2.1.3 Electronics Hazards

For the protection of electronics components of EZhud, battery and other circuitry will be enclosed in a waterproof housing to protect from water, as EZhud is used in an outdoor environment. In order to prevent mishandling and damage to the device, electronic components will be hidden from the user. If there is failure to protect any components, electrical components can be shorted and can result in an electric shock or fire.

2.1.4 Competition

Currently in the market there are already some products available that provide heads up display and navigation. We have a risk to compete with these products in the market. As mentioned in the market competition section below, EZhud's speed limit capture feature, simplicity and the price will distinguish us in the market.

2.2 Benefits

2.2.1 Safety

Riding on a motorcycle can be a very thrilling experience but it also comes with an expense which is the rider's safety. Unlike cars, motorcycle riders are not surrounded by thick metal sheets and steel frames which protects us in case of accidents. Motorcycle accidents can cause serious injuries and sometimes result in fatalities. Motorcyclists only contribute to 3% of the total vehicles insured in Canada, and 16% of fatal accidents involve motorcyclists [6]. Engineers at EZhud are trying to reduce the time the user looks down to the handlebars for speed or phone mounted navigation which could distract the rider and cause accidents. EZhud is a device that mounts onto any full face helmet and gives the rider the step-by-step navigation using Google Maps and also displays the current speed. This would reduce the number of times the rider looks at the information cluster on the bike and hence reduce the chances of getting distracted.

2.2.2 Accessibility

EZhud will be easy to mount on your motorcycle helmet using VHB tape, and will come with a phone application where the users will be able to access the web server to set their navigation route. Any person with a prior knowledge of using a smartphone and google maps would be able to conveniently adapt to EZhud. Since the rider will be wearing gloves, buttons on the EZhud are designed in a way so that it is easy for the rider to locate and press the button while riding. The rider would not need to mount the phone on the handle bar as it can cause internal damage to the phone because of constant vibration from the motorbike.

2.2.3 Limited Competition

There are a few competitors in the market that share the same idea of interest. EZhud will display the current speed using data from Google Maps and will also feature a camera mounted on the front of the device. When the speed limit changes, the camera will detect the sign and display the correct speed limit to the rider. Currently there is no competitor in the market that is implementing speed limit capture along with heads up displays showing route information.

2.2.4 Affordability

We aim to keep the price of EZhud in the $500 - $600 (CAD) range which is lower than our competitors products. We plan to implement an accurate speed limit capture on EZhud. Incase of a speed limit change or a new construction zone the rider could face a speeding ticket since it takes some time for Google Maps to update the speed limit data. Speeding fines for motorcyclists in British Columbia can range from $138 to $483 which could possibly cover the one time cost of the device [7].

3 Market

Our initial target market will be all motorcycle riders in British Columbia. In 2018 there were 800,426 motorcycles registered in Canada and out of these 112,573 were registered in British Columbia [8]. Motorcyclists contributed to 16% of the fatal crashes in 2018 [6]. This reflects that even though motorcyclists contribute to a small percentage of the total vehicle registered but the percentage of fatal crashes are high for them.

Currently motorcyclists use a phone mounted on the handlebar to assist them with navigation since motorcycles don’t have a built in navigation system. As mentioned above, glancing down at the speedometer on a motorcycle is much more dangerous than in a car and is a common factor for motorcycle accidents [1]. Also, many drivers are unaware of the speed limit while driving on unfamiliar roads, exceeding the speed limit can result in hefty fines. In response to the above scenario ClearNav has designed EZhud: a heads up display that attaches to any full face motorcycle helmet to display turn by turn navigation and speed limit.

Figure 3.1 below shows the predicted annual growth for the heads up display market. The growth in the heads up display market is mainly due to the rise in adoption of technology by motorcycle enthusiasts. The figure below predicts that the heads up display market will touch $1,047 Million by the end of 2030 indicating an increase of 30% from 2022 to 2030 [9].

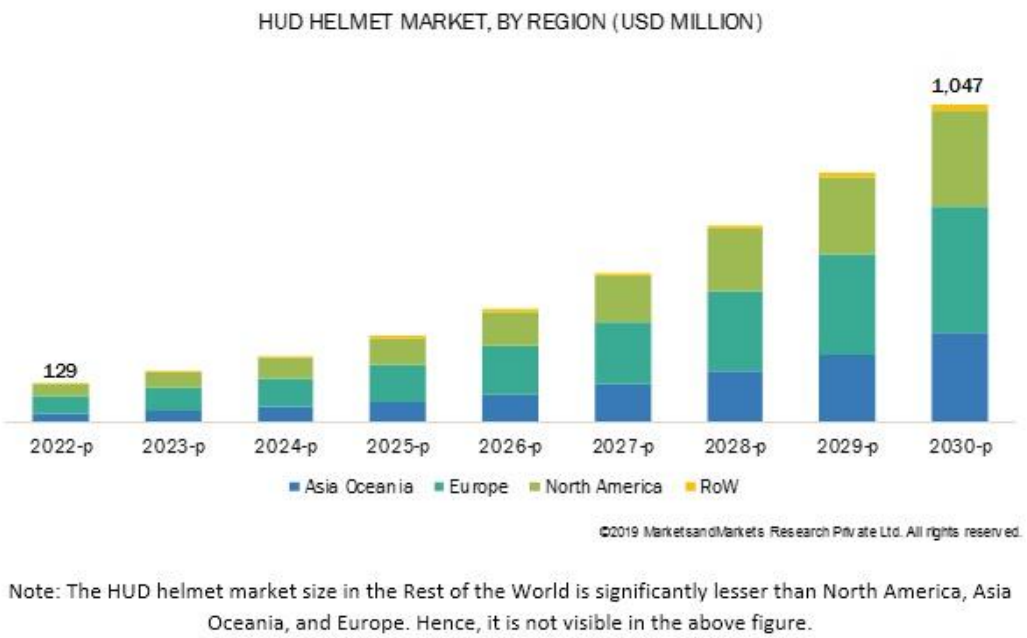


Figure 3.1: Predicted Market Analysis [9]

The demand for EZhud will increase overtime as the target market population continues to grow, leading to the financial motivation to purchase the system.

4 Competition

There are currently some companies who share a similar concept as ours, offering solutions for motorcycle heads up displays. Below we will list some major competitors of EZhud in the market. By researching these companies, we hope to improve on them, learn from their mistakes and succeed where they have failed.

4.1 Nuviz Motorcycle HUD

In 2013, Nuviz was created as a joint project between HOLOEYE Systems, and APX Labs. Nuviz uses an LCOS display to project on the helmet visor and attaches to the helmet using a high-strength adhesive pad. The HUD allows the user to use GPS navigation, record video with a Bike-Mounted 8MP camera, make phone calls and listen to music [10]. All data is generated via a smartphone using Bluetooth with a custom app. In 2013, after finalizing all their design ideas Nuviz started their crowdfunding campaign and finally launched the finished product in 2017. However, after only a span of 2 years the company stopped launching any app updates and by January 2020 the company's software license expired and their website was gone [8]. Their product cost $700 USD, more expensive than other HUDs, however, exact reasons for shutting down are still unknown and we plan to fill the gap left in the market. Their maps are clearly visible on screen, however, customers found it annoying that their maps do not auto scale, thus the users have to zoom in to read tiny street names but then they lose the wider

perspective of their location [11] [12].The Nuviz is designed to be mounted to the right side chin bar but is larger and more bulky than what most riders would prefer [13]. Figure 4.1 below shows the Nuviz HUD product.

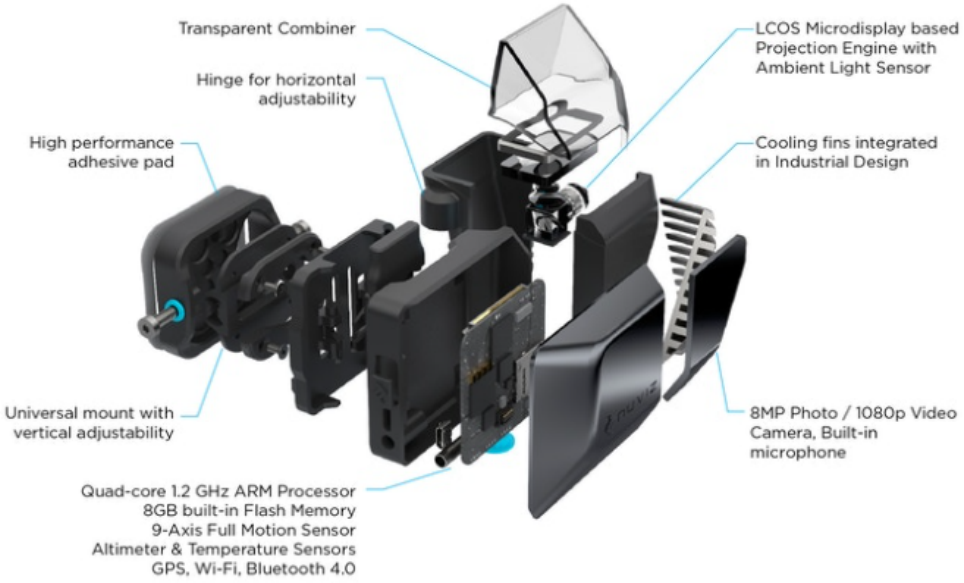


Figure 4.1: Nuviz Ride HUD concept [14]

4.2 EyeRide HUD

Eyelights, a french company created this device that combines head-up display, GPS, hands-free kit and voice command. They started their kickstarter campaign in 2017 and started delivery of the final product from July 2020. EyeRide displays Google maps in your line of sight using the smallest Nano HD OLED technology. It consists of speakers and microphone to enable two way voice communication and enjoy listening to music while riding [15]. EyeRide is available by shipping in the US and Canada but it's more popular in Europe. It's available online on their website for shipping to Canada for $695 CAD + shipping. Although EyeRide consists of many cool features and offers an efficient heads up display with navigation, it does not support the speed limit capture feature that we plan to implement with EZhud. Also, according to feedback from some customers, it only works well with smartphones that have Android 11 or above whereas they advertised it to work well with Android 9 or above [16] [17]. Secondly, we plan to implement EZhud at a much lower price. Figure 4.2 below shows the EyeRide product.

Figure 4.2: EyeRide HUD concept [18]

5 Project Planning

EZhud's development will be split into 3 main stages of development, each with predefined requirements that must be met:

Table 5.1: Product Design Phases

Acronym	Product Design Phase	Description
A	(Alpha Phase) Proof-Of-Concept	Requirements that will be presented during the ENSC 405W demo
B	(Beta Phase) Engineering Prototype	All core components of the product are integrated together and function as a single unit.
C	(Production Phase) Final Product	System meets safety and sustainability standards and fulfills all requirements specified.

5.1 Proof-of-Concept (Alpha Phase)

The Alpha Phase of development will run for the duration of ENSC 405W and deliver a proof-of-concept prototype. The proof-of-concept prototype will implement the core functionality of the product to provide insight into final product characteristics. Additionally the

proof-of-concept will demonstrate that the project is feasible and can be developed by the team. Performance levels may be below acceptable values for the final project, and form/external appearance may be subject to change in later phases.

The following Gantt chart shows the projected schedule for the Alpha Phase of development including estimated task durations and key milestones:

Task Name	Duration	Start	Finish
Ezhud - Proof of Concept (PoC)	**64 days**	**Thu 1/13/22**	**Tue 4/12/22**
1 Project Proposal	**16 days**	**Thu 1/13/22**	**Thu 2/3/22**
1.1 Project Brainstorming	7 days	Thu 1/13/22	Fri 1/21/22
1.2 Project Selection	0 days	Mon 1/24/22	Mon 1/24/22
1.3 Project Proposal Submission	0 days	Thu 1/27/22	Thu 1/27/22
1.4 Project Reevaluation	5 days	Fri 1/28/22	Thu 2/3/22
1.5 Project Proposal Resubmission	0 days	Thu 2/3/22	Thu 2/3/22
2 Requirements Document	**7 days**	**Fri 2/4/22**	**Sun 2/13/22**
2.1 Target User Requirements Research	3 days	Fri 2/4/22	Tue 2/8/22
2.2 Functional and Non-Functional Requirement Definitio	0 days	Fri 2/11/22	Fri 2/11/22
2.3 Requirements Document Submission	0 days	Sun 2/13/22	Sun 2/13/22
3 Progress Meeting #1	**5 days**	**Fri 2/4/22**	**Thu 2/10/22**
3.1 Progress Meeting #1	0 days	Thu 2/10/22	Thu 2/10/22
4 Computer Vision System	**20 days**	**Fri 2/11/22**	**Thu 3/10/22**
4.1 Dataset Creation	17 days	Wed 2/16/22	Thu 3/10/22
4.2 Researching Neural Net Models	9 days	Fri 2/11/22	Wed 2/23/22
4.3 Initial Performance Testing	5 days	Fri 2/25/22	Thu 3/3/22
4.4 Deferring Computer Vision to EP	0 days	Thu 3/10/22	Thu 3/10/22
5 Maps System	**42 days**	**Fri 2/11/22**	**Mon 4/11/22**
5.1 Research Android Auto Head Unit Emulators	11 days	Fri 2/11/22	Fri 2/25/22
5.2 Field Testing Candidates	0 days	Mon 2/28/22	Mon 2/28/22
5.3 Tuning/Customizing Android Auto Head Unit	31 days	Mon 2/28/22	Mon 4/11/22
6 UI Appendix	**7 days**	**Thu 2/24/22**	**Fri 3/4/22**
6.1 UI Appendix Submission	0 days	Fri 3/4/22	Fri 3/4/22
7 Progress Meeting #2	**5 days**	**Sat 3/5/22**	**Thu 3/10/22**
7.1 Progress Meeting #2	0 days	Thu 3/10/22	Thu 3/10/22
8 User Application	**31 days**	**Mon 2/28/22**	**Mon 4/11/22**
8.1 UI Finalized	0 days	Sat 3/5/22	Sat 3/5/22
8.2 Web Server Development	17 days	Sat 3/19/22	Mon 4/11/22
9 Hardware	**36 days**	**Fri 2/4/22**	**Fri 3/25/22**
9.1 Component Research	14 days	Fri 2/4/22	Wed 2/23/22
9.2 Component Selection	15 days	Thu 2/24/22	Wed 3/16/22
9.3 Purchase Components	5 days	Thu 3/17/22	Wed 3/23/22
9.4 Received All Components	0 days	Fri 3/25/22	Fri 3/25/22
10 Design Specification Document	**6 days**	**Mon 3/7/22**	**Sun 3/13/22**
10.1 Design Specification Document Submission	0 days	Sun 3/13/22	Sun 3/13/22
11 Integration	**25 days**	**Tue 3/8/22**	**Mon 4/11/22**
11.1 Software System Integration and Testing	14 days	Tue 3/8/22	Fri 3/25/22
11.2 Full Hardware Integration	0 days	Sun 3/27/22	Sun 3/27/22
11.3 PoC System Integration and Testing	11 days	Mon 3/28/22	Mon 4/11/22
11.4 Proof of Contept Prototype	0 days	Mon 4/11/22	Mon 4/11/22
12 Project Proposal	**10 days**	**Sun 3/20/22**	**Thu 3/31/22**
12.1 Project Proposal Submission	0 days	Thu 3/31/22	Thu 3/31/22
13 Final Presentation	**9 days**	**Thu 3/31/22**	**Tue 4/12/22**
13.1 Poster Presentation	0 days	Tue 4/12/22	Tue 4/12/22
13.2 Video Demo	0 days	Tue 4/12/22	Tue 4/12/22

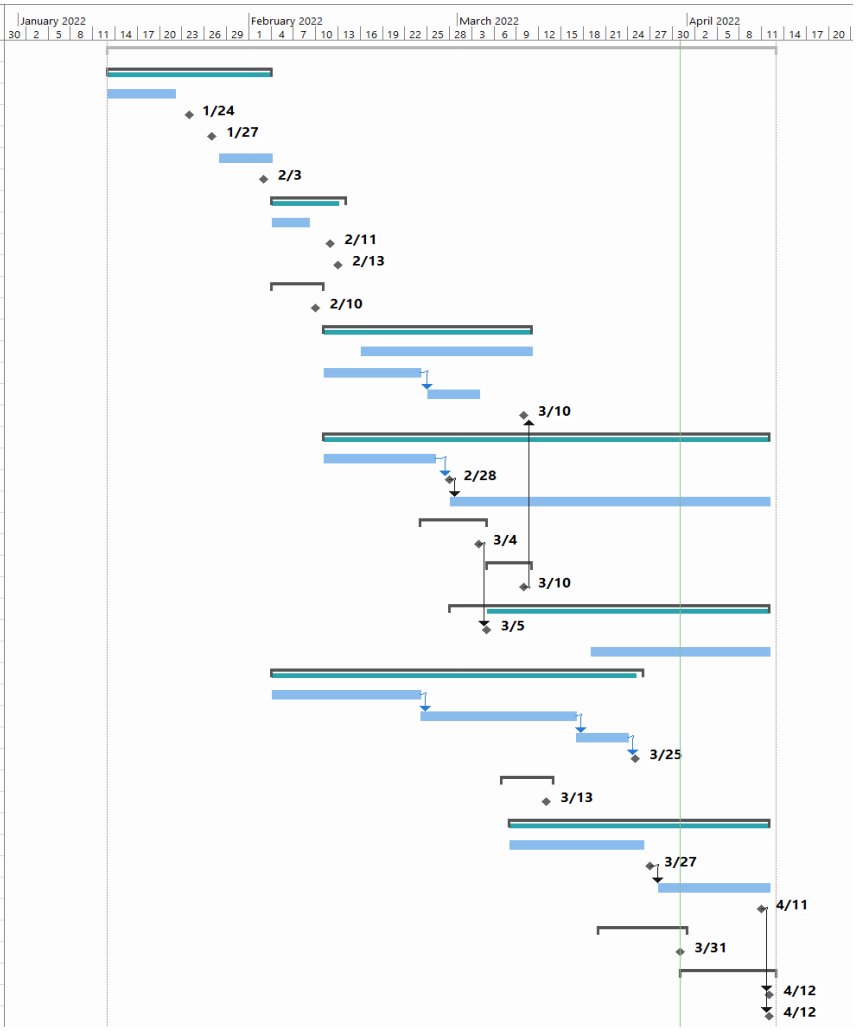


Figure 5.1: EZhud Proof-of-Concept (Alpha) Phase Gantt Chart

5.2 Engineering Prototype (Beta Phase)

The Beta Phase of development will run for the duration of ENSC 440 and deliver an engineering prototype. The engineering prototype will build upon the work done in the Alpha Phase of development. Features and functionality implemented in the Alpha Phase will be refined to meet performance and functional requirements. Additionally, features and functionality

not required for the Alpha Phase but required for final production will be implemented in this phase. Performance and form/external appearance should closely approximate final production.

The following Gantt chart shows the projected schedule for the Beta Phase of development including estimated task durations and key milestones:

Task Name	Duration	Start	Finish
Ezhud - Engineering Prototype (EP)	**86 days**	**Tue 4/19/22**	**Tue 8/16/22**
1 Computer Vision System	**76 days**	**Tue 4/19/22**	**Tue 8/2/22**
1.1 Dataset Creation	46 days	Tue 4/19/22	Tue 6/21/22
1.2 Model Selection	21 days	Tue 4/19/22	Tue 5/17/22
1.3 Model Training and Customization	46 days	Tue 5/17/22	Tue 7/19/22
1.4 Stationary Testing	21 days	Tue 5/31/22	Tue 6/28/22
1.5 In-Motion Field Testing	26 days	Tue 6/28/22	Tue 8/2/22
1.6 Computer Vision Model Complete	0 days	Tue 8/2/22	Tue 8/2/22
2 User Application	**26 days**	**Tue 4/19/22**	**Tue 5/24/22**
2.1 Refine UI	16 days	Tue 4/19/22	Tue 5/10/22
2.2 User App UI Complete	0 days	Tue 5/10/22	Tue 5/10/22
2.3 Implement Back-End Handling of All Settings	26 days	Tue 4/19/22	Tue 5/24/22
2.4 User App and Web Server Complete	0 days	Tue 5/24/22	Tue 5/24/22
3 Hardware	**76 days**	**Tue 4/19/22**	**Tue 8/2/22**
3.1 Iterative Device Shell/Housing Refinement	76 days	Tue 4/19/22	Tue 8/2/22
3.2 Refine Display Mounting Mechanism	21 days	Tue 4/19/22	Tue 5/17/22
3.3 Quick Release Mechanism	21 days	Tue 5/17/22	Tue 6/14/22
3.4 Device Shell/Housing Complete	0 days	Tue 8/2/22	Tue 8/2/22
4 Maps System	**46 days**	**Tue 4/19/22**	**Tue 6/21/22**
4.1 Wireless Android Auto	21 days	Tue 4/19/22	Tue 5/17/22
4.2 Display Computer Vision Speed Limit	25 days	Wed 5/18/22	Tue 6/21/22
4.3 Maps Display Complete	0 days	Tue 6/21/22	Tue 6/21/22
5 Integration and Testing	**86 days**	**Tue 4/19/22**	**Tue 8/16/22**
5.1 Rolling Integration and Regression Testing	65 days	Tue 4/19/22	Mon 7/18/22
5.2 EP Integration and Testing	22 days	Mon 7/18/22	Tue 8/16/22
5.3 Engineering Prototype	0 days	Tue 8/16/22	Tue 8/16/22

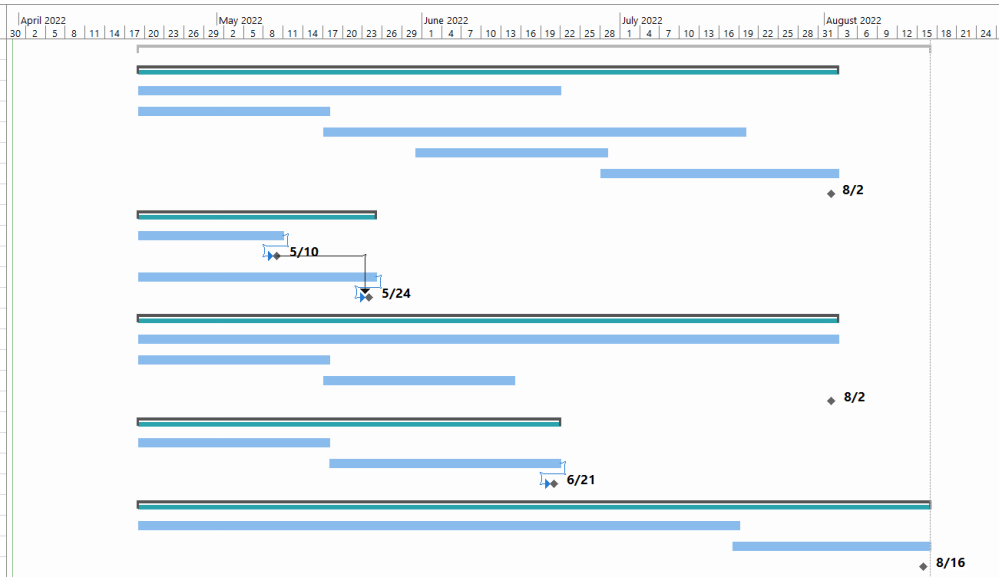


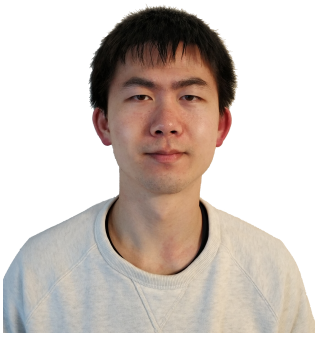
Figure 5.2: EZhud Engineering Prototype (Beta) Phase Gantt Chart

5.3 Final Product (Production Phase)

The Production Phase of development will start after ENSC 440 and will deliver a manufacturing prototype. The manufacturing prototype will implement all functionality required of the final product and be fully optimized and refined, ready for mass manufacturing.

6. Company Details

ClearNav was founded by 6 like-minded engineers in early January 2022. Our team has engineers from Computer, Biomedical and Electronics Engineering backgrounds with every member having a passion to explore technology. EZhud is our first product that provides riders with a heads up display that shows navigation routes and current speed limit of the road. Our team consists of engineers with diverse backgrounds, equal effort was put in by each member to provide expertise on their field of study.

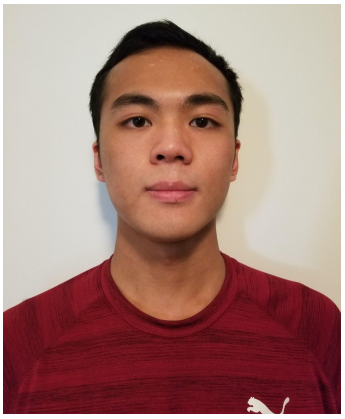


William Xue
zjxue@sfu.ca
Chief Executive Officer

William is currently in his 5th year of computer engineering with strong interests in FPGA programming and deep learning architectures. Having completed co-ops in firmware development at Avigilon, firmware verification at Microchip, and ASIC verification at Intel, William brings a host of knowledge regarding computer architecture and embedded software development. Outside of co-op, William also enjoys tinkering with 3D design, often experimenting with printed designs. William's main contributions will be towards the system integration of EZhud, and any training of deep learning models.

Spencer is a 5th year Computer Engineering student with an interest in AI and embedded systems. He did internships at Tantalus Systems as an Embedded Systems Engineer and at Intel Corp. as a Firmware Engineer. Spencer currently works at Solidigm as a Firmware Engineer. At ClearNav, he is responsible for the front-end user interface design of the mobile application for EZhud and the computer vision for speed limit-detection. Most importantly, he will provide moral support for the team.

Spencer Lall
sslall@sfu.ca
Chief Operations Officer



William Huong
whuong@sfu.ca
Chief Information Officer

William is a senior Computer Engineering student with an interest in processor architecture and deep learning systems. Previous experience includes work terms at Avigilon as a Systems Engineer and Netgear Canada as a Firmware Developer. Experience with low level C/C++ development and general server provisioning and maintenance will be beneficial to the team. At ClearNav he is responsible for the maps, web server back-end, and implementing and maintaining the tech stack. He greatly appreciates the moral support from Spencer.

Namsakhi is a biomedical engineering student with interests in digital image/signal processing, embedded systems, digital design and software programming. Previously she has worked on the Nanomotion project as a research fellow under Dr. Andrew Rawicz at SFU. She also worked as a Product Design Engineer at Microchip Technology Inc where she benchmark power analysis tool flow, pipe-clean flow to analyze expected power estimates and power reductions for a given RTL and stimulus and debug design written in Verilog and SystemVerilog. Namsakhi is contributing in web page development and computer vision for the EZhud project.

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Muhammad Ahmed Athar
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Chief Technology Officer

Ahmed is a 5th year Electronics Engineering student with interest in PCB and product design. Working at Webb Electronics, he gained some valuable experience with hardware design, debugging and testing and also got familiar with 3D design and printing. With over 2 years of sales experience in Telus, Ahmed has developed valuable communication and objection handling skills. Ahmed will contribute in the product development by ensuring smooth functionality of the hardware and electronics design. Ahmed will develop a strategic approach in prospecting to identify new business opportunities.

Taimoor is a 5th year Electronics Engineering student with interests in robotics and VLSI. Previously he has worked at Algo Communications Product LTD as a Quality Assurance Analyst where he tested the company's products and applied his electronics knowledge to rework on PCB’s not performing to their fullest. Taimoor will apply his knowledge of hardware design to make sure all the hardware subsystems function as they are programmed to perform.

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Chief Design Officer

7 Cost Considerations

7.1 Estimated Cost Breakdown

Table 7.1 below shows a breakdown of estimated cost for both proof of concept and engineering prototype. This cost may vary due to supply chain issues regarding the purchase of dedicated electronics.

Table 7.1: Estimated Prototype Cost Breakdown

Type	Component	Quantity	Subtotal (CAD)	Price per unit (CAD)
Hardware	Raspberry Pi 4B	1	$75	$75
	Coral USB Accelerator	1	$75	$75
	Vufine Wearable Display	1	$272.09	$272.09
	Pi Camera Noir Module 2	1	$50.99	$50.99
Electrical	Vidar 3.7V 4400mAh battery	1	$39.99	$39.99
	Adafruit Powerboost 1000C	1	$30	$30
General	VHB Tape (3M Roll)	1	$17.84	$17.84
	USB C cable	3	$12.90	$4.30
	HDMI	2	$14	$7.00
	HDMI Extension	2	$13.29	$6.65
	3D Printing	1	$30	$30
			Total Estimated Tax	$73.06
			Total Estimated Cost	$681.90

7.2 Potential Funding Resources

7.2.1 Engineering Science Student Endowment Fund

The Engineering Science Student Endowment Fund (ESSEF) established by Simon Fraser University in 1997 accepts applications every semester for projects that must fall in one of the following four categories i.e Competition, Entrepreneurial, Class, and Miscellaneous. ClearNav's product, EZhud, satisfies both Entrepreneurial and Class category requirements. As per the

agreement, all equipment and software purchased by ESSEF become the property of the School of Engineering Science and any unused funds must be returned to ESSF [19]

7.2.2 Wighton Development Fund

The Wighton Development Fund is supported by Dr. Andrew Rawicz, faculty member of the School of Engineering Science at Simon Fraser University. Projects that benefit society, for e.g biomedical devices or applications aimed to be designed to assist physically or mentally impaired are prefered for this fund. [20]

7.2.3 Personal Funding

Any remaining costs needed for the project will be distributed equally among the members of ClearNav with an approximate contribution of $150+ by each member.

8 Conclusion

Today, the number of motorcyclists in British Columbia is higher than it has ever been, and only continuing to grow [3]. However, motorcycles are lacking in what are considered basic features of traditional vehicles. In particular, having to look straight down at your handlebars for turn-by-turn GPS navigation and current speed are significant pain points for motorcyclists. To help alleviate these issues, ClearNav intends to bring to market EZhud, a Motorcycle HUD system.

EZhud aims to enhance the safety and awareness of motorcyclists at an affordable price, while minimizing risks involved. With an exponentially growing potential market of nearly every motorcyclist within British Columbia and limited competition from two competitors with smaller featuresets, there is significant potential for growth within this market. To enter this market, development will happen over three phases: Proof-of-Concept, Engineering Prototype, and Final Product. Each phase will build upon the work of the previous one and has a clear goal of what is to be delivered. Cost estimates during each of these phases fit well within budget limits afforded by three primary sources of funding: the Engineering Science Endowment Fund, the Wighton Development Fund, and personal contributions from the team.

The document then further focuses on the target market and predicted annual growth for the heads up display market according to which, the demand for EZhud will increase overtime as the target market population continues to grow, leading to financial progress and hype to purchase the device.

With a wide breadth of skills covering nearly all aspects of this project, the team here at ClearNav is confident in EZhud’s success.

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