July 26th, 2020

Dr. Craig Scratchley,
School of Engineering Science
Simon Fraser University
8888 University Dr.
Burnaby, B.C, V5A 1S6

RE: ENSC 405W/440 Project Proposal for CANnect

Dear Dr. Scatchley,

This Project Proposal document was prepared by CANtech for ENSC 405W/440 as a part of the engineering design process requirements for our CANnect product. CANnect is an open source hardware component and software platform, providing the basis for communication between a user vehicle and their android smartphone device. The CANnect reader interprets vehicle system data and transmits them to our supporting CANnect app via a secure Bluetooth connection.

This document outlines the scope of our project, and a basic overview of the CANnect platform, along with potential risk and benefits. It provides an outline of the market analysis, target market and current competition for CANnect. Further, it includes the project planning, project milestones and cost considerations of the platform.

Our team at CANtech is composed of dedicated engineering students from a range of engineering concentrations including engineering physics, computer and systems engineering. We believe our expertise can be channelled towards making CANnect a successful platform that provides a meaningful solution to automotive applications and encourages a community of knowledge sharing.

Our team at CANtech would like to thank you for taking the time to review our project proposal. Any questions related to our document can be directed to ranjoatc@sfu.ca.

Sincerely,

Ranjoat Kaur Chana

Ranjoat Chana
CCO,
CANtech.

Project Proposal:

CANnect.

Project Team 8:
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1.0.0

Abstract

There are currently 1.2 billion of vehicles on the road all over the world and expect to increase to 2 billion by the year 2035. Thus, automobiles are the essential part of human life, and maintaining the vehicle is as important as driving them. The CANtech company offers a CANnect reader for car drivers to reach into the vehicle system to extract the car information such as vehicle speed, engine temperature, and provides Diagnostic Test Codes (DTC's) to inform current vehicle status on the mobile app.
This document outlines CANtech's proposed CAN Bus reader titled the 'CANtech'. Designed to interface with a car's diagnostics system, the product differentiates from its commercial offerings by being an open-source product and targeted towards car enthusiasts.

The actual 'CANtech' system consists of a reader and an app. The reader will interface with a car's CAN Bus system via an OBD-II connector. It will request for desired parameters from the car and send the data directly to the app via Bluetooth. The app will receive the data, interpret the data and display it to the user in a human-readable text. The data can be viewed either through logs or in real time. Then, the data will be sent to the user interface on the mobile application and the users can view the visualized data through the dashboard. In addition to the dashboard, settings, diagnostics, and map features are also proposed.

For the market analysis, there is a growing trend towards the automotive aftermarket, which the CANnect reader falls under. The target market can be segmented into car enthusiast and non-enthusiasts. There are a wide range of OBD-II readers available on the market for the purposes of vehicle diagnostics. What sets our platform apart is the open source hardware and software components, which allow users to customize the base design.
Our project will be progressed over alpha phase, beta phase, and the production phase and each phase is planned for all issues assigned in the GitLab. Each issue is expected to be finished through each milestone and the estimated cost is demonstrated for each hardware component we are going to use.

The primary cost estimations for alpha and beta are focused on the prototype product which is expected to be $114 for the alpha phase and $48 for the beta phase. Funding is expected to be generated internally as well as externally via the Engineering Science Student Society Endowment Fund and the Wighton Development Fund.

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1 Introduction

The automotive aftermarket size in the US, is expected to grow to more than $680 billion by the year 2024 [1]. A positive trend towards enhancing vehicle efficiency and customization also has come as a result. Some car enthusiasts have expressed their desire to collect as much data about their car as possible. As there is no limit, being able to access their own car's data allows them to hack their cars as they wish. Some want to troubleshoot automotive service codes, some want to use it to avoid costly diagnostics bills, whereas some want to make their cars smarter. It is totally up to their imagination.

As a result, a wide range of OBD-II readers were brought into the market for the purposes of vehicle diagnostics. However, available OBD-II readers in the market as commercial offerings are expensive and not standardized. So, people who want to read information from the car are lacking alternatives. It is also not an open source, so they cannot customize the reader device and software on their own and hence are not flexible.

The purpose of our product CANnect is to target people who are automotive enthusiasts and have knowledge in the related technologies higher than average. However, we are introducing the open-source CAN BUS reader so that the users can customize their devices for their own needs and they are free to share their work to others, which could potentially grow the community of this area.

We are aiming to provide an easy to use, easy to modify device which makes it possible to interact with Toyota vehicles with an android app. From automotive industry professionals, to the everyday car enthusiast, CANnect can be utilized to read and interpret various raw data from a vehicle through a standardized protocol and transmit them to a smartphone app via a Bluetooth connection. CANnect applications include car diagnostic capabilities, such as relaying vital information related to vehicle systems, transmission, battery, engine control, etc. Moreover, CANnect mobile app's map feature will allow identification of the real-world geographic location of the vehicle.

2 Project Overview

2.1 Scope

As a scope of this project, we are developing our product CANnect, starting with the Alpha phase, Beta phase, and finally the production phase and aiming to complete the product over the 8 months period. As the Alpha phase, the prototype of our product utilizing the CAN BUS simulator without actually using the automobile hardware will be demonstrated and this will showcase the skeleton of our project how the system works. As for the Beta phase, we will complete the development of the product and the system should be able to work with the car and the production phased will be followed after. The more detailed product deliverable will be in the following section.

CANnect will only work on vehicles manufactured in America after 2008 as that is when OBD-II made ISO-15765-4 (CAN) a mandatory standard for future OBD-II communication [2]. Furthermore, CANnect will only provide information of the car that is made available through public channels, legislation, engineering standards and reverse-engineering. Lastly, CANnect aims to benefit society by being an open source project and to be easily customisable. As such, all documentation and designs will be published for anyone to view.

2.2 System Overview

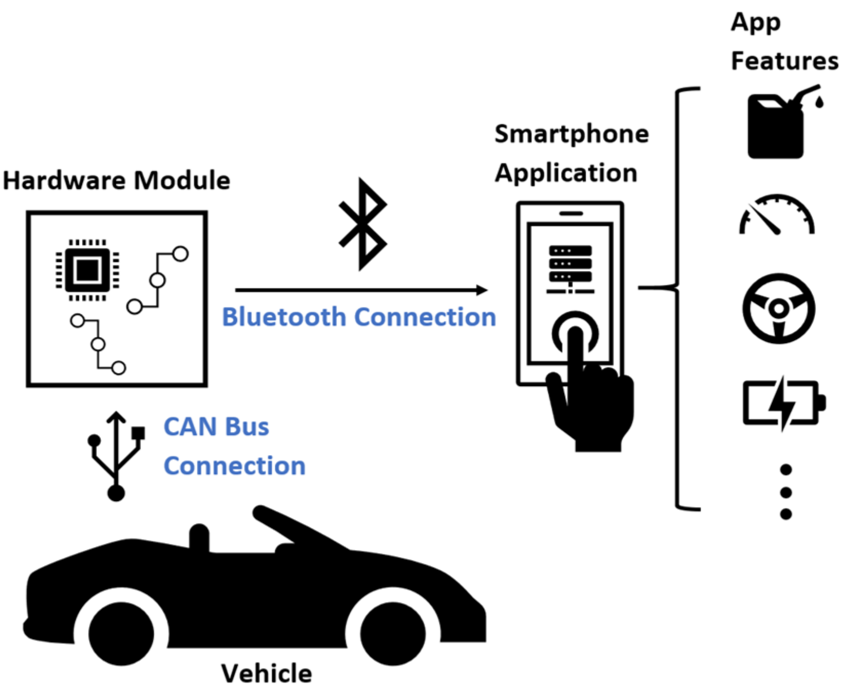


Figure 2-1: General System Overview

The system, as outlined in Figure 2-1, is broken down into two components: the CAN Bus reader and the app. The CAN BUS reader takes the input information from the car and sends it to the mobile application on the Android device via Bluetooth connection for processing.

2.2.1 Reader

The CANnect system consist of the user's smartphone and the reader. The reader is responsible for interacting between the car's CAN Bus system and the user's smartphone. On a car, the reader will connect to an OBD-II port as illustrated in Figure 2-2. By design, the reader only passes the data messages between the car's onboard diagnostic system and the app; it will not interpret any of the data.

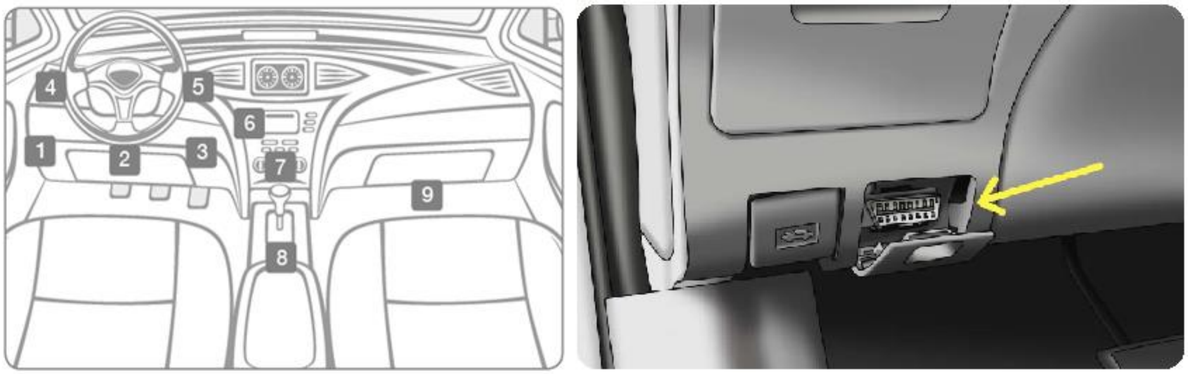


Figure 2-2: Example of a OBD-II Diagnostic Port Location

2.2.2 Software

The CANnect consists of two software components; the software on the microcontroller will extract the data from a data frame and then transmit the serial data from the microcontroller to a smartphone app through a Bluetooth module. Within the app, the data will be processed and displayed to the user, providing meaningful information to the user. With a user-friendly interface, the users will be able to easily interpret the data for their own needs.

2.2.2.1 Mobile Application:

We will focus on developing a native Android app using Java through using the Android Studio SDK as it is the easiest developing environment to work with. It also provides debugging tools and visual layout editors to assist with development.

The smart phone app, CANnect, will allow the user to read DTCs and live sensor data such as oil temperature, engine speed, GPS, fuel rate and speed, etc. It will display the data in 3 different formats:

- tabular form
- linear graph
- dashboard

In addition, the user will be able to locate the car on a map and check the vehicle's diagnostics. The user will be able to access the features mentioned above from the main *Activity* which is an app component that represents a single screen [2.4.3.a]. With the built-in *startActivity*, *onClick* event and event listener methods, the app will launch a new activity according to the user's action. This lifecycle is shown in Figure 2-1.

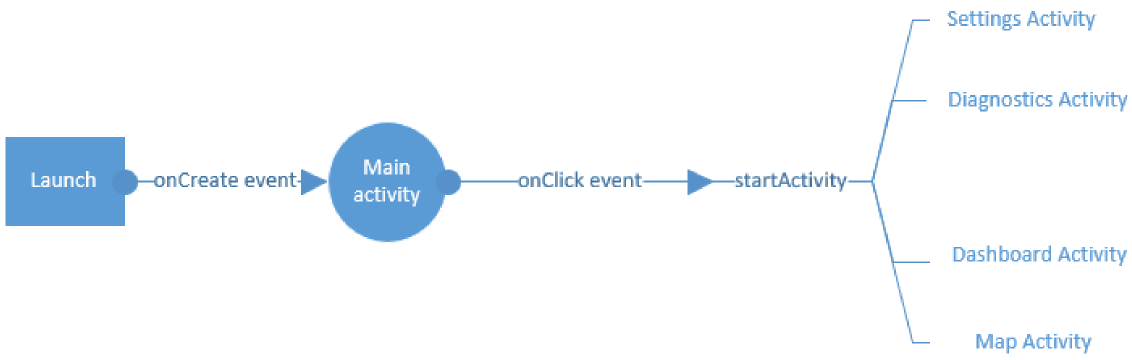


Figure 2-3: Android App Lifecycle

Our proposed UI will be broken down into the following UI specifications which will be similar to Figure 2-4:

- Main Menu: This Main Menu is the starting point of the app and 4 buttons of Setting, Diagnostics, Dashboard, and Map, and the Bluetooth connection button with the connection status will be implemented.
- Settings: The user can configure the app setting from the list of available setting options.
- Diagnostics: The user can select the specific PID and they can press the button and run the diagnostics test and the result will be in the tabular form.
- Dashboard: The user can select the specific parameter from the list of tabs and each parameter from the car will be shown in tables and graphs. The information is updated every 5 seconds.
- Map: The user can enable the GPS through the toggle button and the individual location will be shown on the map.

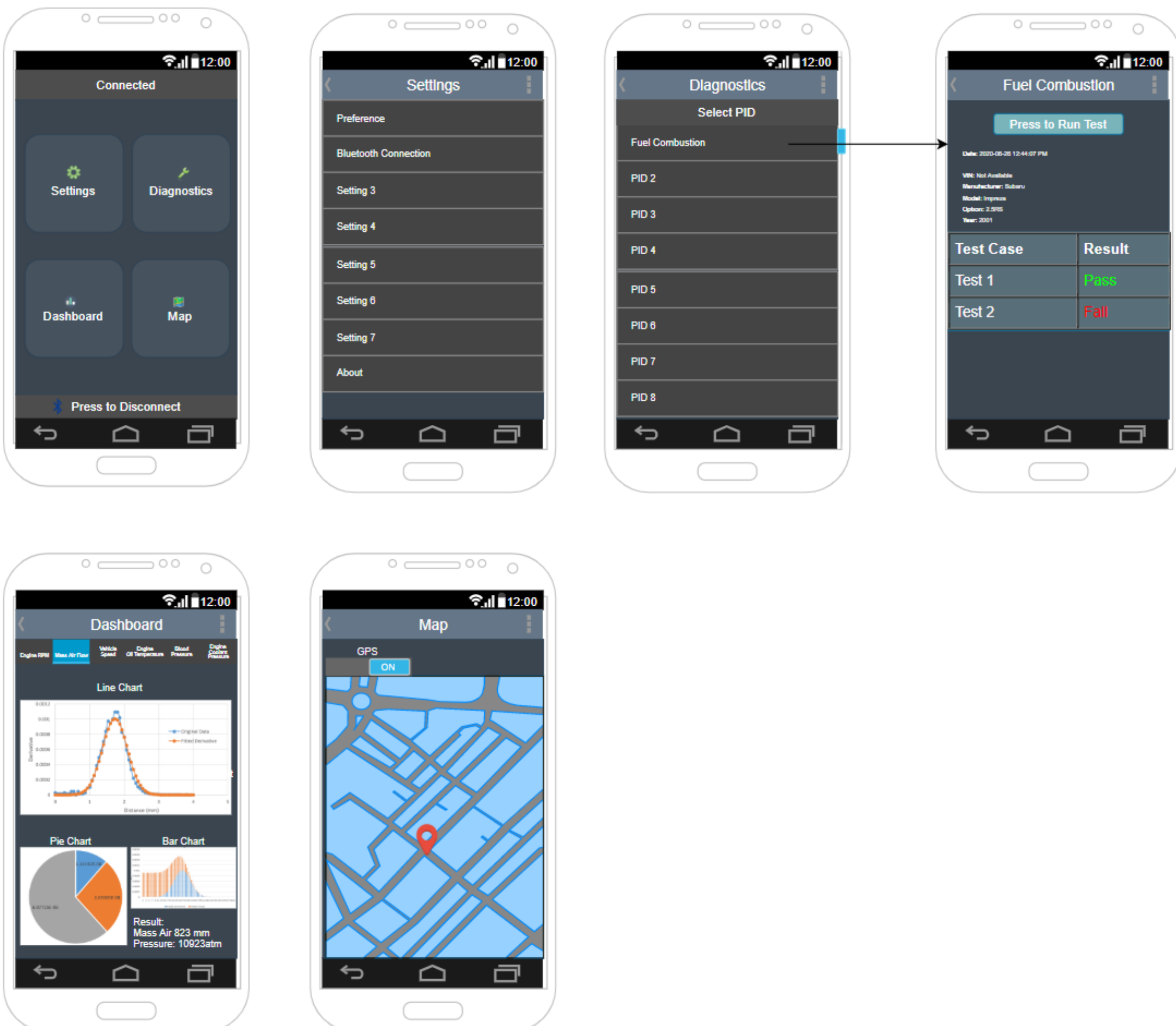


Figure 2-4: Mockups of App Frontend

2.3 Risk

When using CANnect, there may be the possibility that the data provided to the user is not accurate or is out of date. The likelihood of this is however minimal as our product follows the current regulatory standards defined through legislation and is unlikely to change. As well, the focus of car support for only those using CANBUS should minimize incompatibilities. If this were to be the case, it would likely be due to a malfunctioning part on a user’s car that CANnect would likely detect or flag as an error, and the impact caused by CANnect would be minimal as it only requests and reads data. For car-specific changes, these can be reported to CANtech using by sending a log with the data output, car make and what should be expected versus what is actually received to our contact to have it evaluated. Given the open source nature of the product, the community of users can contribute their knowledge to the product.

A concern of car owners when using more advanced devices that directly hook to their car’s CANBUS system are those relating to security and privacy. While such events relating to data leakage and security penetration cannot outright be eliminated and would have serious impact to the car and the user, CANtech takes measures to minimize such events from occurring. On the reader, the device is configured to only request and read data, while the transmission to the phone app is encrypted using federally approved encryption over Bluetooth by default with v4 which the reader supports [3] [4] [5], and the data that is sent contains no personally identifiable information (PII); the data sent only contains the specific diagnostic ID and its value. On the phone app, it will not communicate any PII to any external server without the user's consent and the data collected by the reader will remain on the phone.

Another concern of car owners for similar devices to CANnect is whether they could interrupt and interfere with a car's operation. This safety concern is serious but the likelihood of this is very low as the microcontroller on the Reader is only configured to request and read data, not to write data onto the car's ECU or other components in the car's CAN network. This means that the reader will be configured to use pre-set request functions with diagnostic IDs and other codes being specified on the phone app instead of allowing arbitrary commands to be received on the reader.

There is the possible risk of the reader being a hazard to the user in the form of being an electrical hazard. This would be serious if it were to occur, but this possibility would be minimal as the reader is built primarily with off-the-shelf parts that have basic quality control. In the case of the microcontroller in the Reader (Arduino Uno), they are tested for faulty components and short circuits [6]. As well, CANtech will look into implementing its own quality assurance to mitigate such risks in the production phase.

Upon product release of CANnect to the market, there is a risk for CANtech and stakeholders that the product may not reach its intended audience or the product has a low adoption rate in the market. This would have serious implications for CANtech's livelihood and the ability to support CANnect as well as to meet the needs of its stakeholders given that there are existing solutions in the market means that it is likely this could occur. To ensure product success and visibility, demonstrating CANnect through marketing via advertising, social media and other platforms where car owners are prevalent are avenues to pursue. As well, diversifying by developing partnerships with other car services such as Car2Go and Evo or companies with a fleet of corporate vehicles in addition to developing features that target large scale maintenance and management would establish CANtech's foothold in the car diagnostic device market.

For CANtech and its stakeholders, the risk of a clone being released in the market is high and the impact could affect CANtech's livelihood. Given the open-source nature of the licenses used (MIT and CERN-OHL-P), the source-code is available to all users, meaning that another company could copy and reproduce the product in a proprietary manner, then undercut CANtech. To mitigate such risks, the open-source nature of the product ensures that CANnect can continue to be developed by the community of users. As well if the product were to be released in production, CANtech would also provide differentiating features from just its open-source product such as better consumer support and quality assurance. For users looking for a more stable experience, this would be catered to and in the case of corporate users if such an audience were attracted, this is a priority for them.

Another risk for CANtech and its stakeholders are the development challenges and risks associated with a new product development. Namely, these are those relating to meeting deadlines due to delays due to other commitments of the team, time-constraints, technical challenges, and external factors. There is a moderate change that this could pose a problem given the current health situation surrounding COVID-19 where the use of lab equipment and other tools are restricted. To mitigate this, the team is working remotely where possible, created a project schedule (Gantt chart) and is developing the product using off-the-shelf parts to minimize blockers due to unavailable equipment. As well, the development team is flexible and can adapt to focus on an area of concern should it fall behind.

2.4 Benefits

The main purpose of CANnect reader is to provide an easy to use, easy to modify device which allows car enthusiasts, car hobbyists, and car engineers to interact with Toyota vehicles with an android app. Although there are similar cheap devices available on the market, none of them directly offer source code that can be modified according to user desires.

From the user perspective, the software can be modified to match his/her desire, such as reading from other brands of cars. With Cannect, user can view the raw data message directly from the vehicle which is not possible with any devices on the market. Although our product doesn't offer advice on when to change oil or tires, it will provide information on current status of the car through Diagnostic Test Codes(DTC's) so that the user can have an idea on the current state of the vehicle.

From the shareholder perspective, the initial alpha phase requires some investing, ~ $25 for Arduino Uno alone, the product price will surely decrease with mass production. Although there are numerous similar readers on the current market, the option to view raw CAN/ OBD-II messages and be able to modify source codes is most suitable for user with great interest in adding additional ECU to the vehicles.

3 Market Analysis

The automotive aftermarket size in the US, is expected to grow to more than $680 billion by the year 2024 [1]. The growth is attributed to a tendency for today's consumers to extend the lifetime of their vehicle. There is also a trend towards enhancing vehicle efficiency and customization. Relative to the on-board diagnostics aftermarket in the US, growth is expected to reach 1.5 billion by the end of the same year [7]. The OBD market is growing with increasing vehicle complexities, which require more efficient diagnostic testing solutions. Further promoting remote technologies for real-time vehicle diagnostics to help technician's and vehicle owners' asses the state of their vehicle systems [7]. The expected growth in the automotive aftermarket for professional, DIY and OEM applications show an increasing trend as observed in Figure 3-1 below.

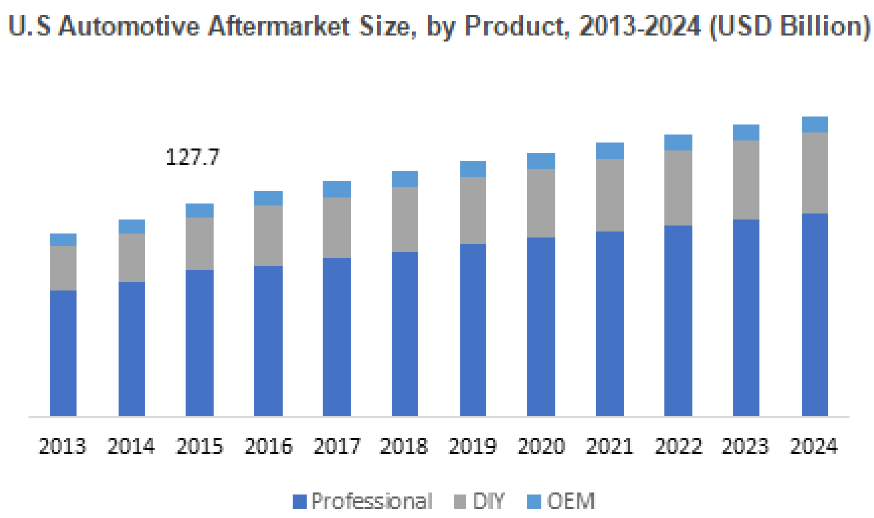


Figure 3-1: US Automotive Aftermarket Projections by Product

The hardware segment contributed 40% to the OBD aftermarket in 2017, as the use of OBD scanners and similar scan tools became more widely adopted [7]. It has also been mandatory for more passenger vehicle manufactures to be OBD compliant, in both the US and China. It is projected that with the age of new smartphone technologies, the ODB remote applications will contribute to 25% of growth in the OBD aftermarket [7]. OBD smartphone applications will allow for remote gathering of vehicle data and easily allow users to monitor vehicle parameters while limiting the dependency on hardware. This will also allow for continuous real-time diagnostics of the vehicle systems status.

3.1 Target Market

The market for aftermarket specialty parts and accessories, including OBD scanners and similar devices, can be segmented into car enthusiasts and non-enthusiasts. In a study conducted by SEMA – a specialty equipment market association for the automobile aftermarket – non-enthusiasts were found to make up 58% of the consumers [1]. The non-enthusiasts either made purchases for vehicle customization, for DIY, or for vehicle accessorizing, for the purposes of maintenance.

Similarly, CANnect falls under the aftermarket for specialty parts and accessories. The target consumers are both car enthusiasts and non-enthusiasts. Enthusiasts are consumers who take an interest in vehicles and vehicle related technologies. Non-enthusiasts may not share those same interests, but still own a vehicle or work in a related profession.

CANnect is also an open-source hardware and software platform, providing consumers with the unique opportunity to customize both the hardware and software components. Open-source software fosters a collaborative development community that is accessible to the public but can also provide businesses with flexibility in solving many problems [8]. Open-source industries are projected to be worth $33 billion by the year 2022 [8]. Our market can thus be expanded to software or hardware developers who fall into the car enthusiast or non-enthusiast segmentation.

3.2 Competition

There are a wide range of OBD-II readers available on the market for the purposes of vehicle diagnostics. According to an online review some of the best OBD scanners include products like the BAFX products 34t5 Bluetooth OBDII, ANCEL AD310 Classic Enhanced Universal, or BlueDriver Bluetooth Professional [9]. Key features of the BAFX scanner are Bluetooth support for windows and android devices, where data can be accessed through 3rd party applications, for vehicles manufactured in 1996 and onwards. The ANCEL scanner supports CAN, the OBD-II protocol and comes with an interactive LCD display for diagnostics reports and monitoring. The BlueDriver scanner is a more expensive scanner that supports iPhones and Androids, allows for live sensor data, and offers an accompanying BlueDriver app [10].

The OpenXC platform offers open source hardware and software, using their OpenXC library for Android or other desktop applications [10]. For Android devices that requires an installation of the OpenXC Enabler, which displays basic UI features. For iOS, the platform provides an app tutorial that assumes users have working knowledge of iOS applications, but also offers a demo application for beginners. The vehicle interface can be reprogrammed with new firmware. Further, for OBD-II support on CAN, they provide the latest firmware release for vehicles sold in the US since 2008, and they include extended support for Ford manufactured vehicles [10].

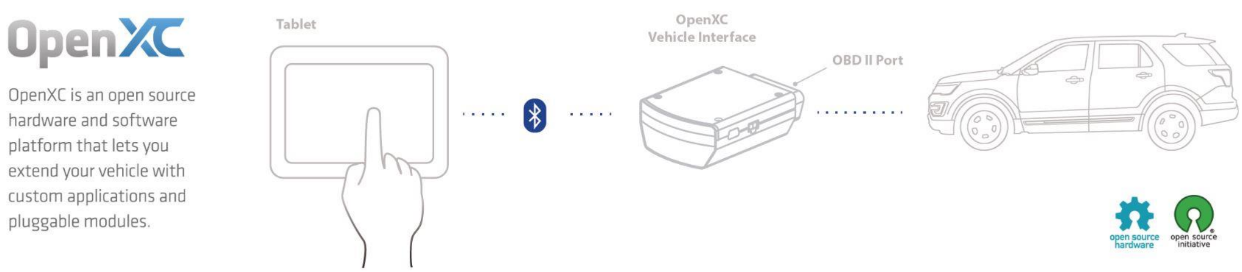


Figure 3-2: OpenXC Hardware and Software Platform

Our CANnect platform is a combination of a CAN Bus reader also compatible with vehicles sold in the US 2008 and onwards and a supporting CANnect app. The CANnect reader is Bluetooth compatible, and offers a supporting app for more thorough diagnostic testing in the base design, it also supports real-time analysis of vehicle systems and is compatible with Android devices.
The CANnect reader not only provides information on DTCs, but also manufacturer specific codes, and access to specific PIDs. The open source aspect of our platform allows for users to build up from our base design for both hardware and software. However, our goal is to make the base design of our product more user-friendly for consumers that may not have a background in development. Our design offers the best features often seen in OBD-II readers/scanners for professional or personal use and encourages collaboration amongst a community of developers, to come up with new solutions for vehicle diagnostics.

3.3 Market Approach

The barriers to entry and considerations of the target market will be used to determine the best approach for entering the market. According to research conducted by SEMA, Figure 3-3 shows the age groups and channels used to purchase aftermarket accessories [1]. It is observed that online and physical channels are the most common among all ages.

WHERE PARTS ARE BOUGHT % OF PART PURCHASES — Source: 2016 SEMA Consumer Market Data

	TOTAL ACCESSORIZERS	AGES 18 - 29	AGES 30 - 39	AGES 40 - 49	AGES 50 - 59	AGES 60+
Online Channels	36%	37%	38%	37%	31%	29%
Physical Channels	52%	51%	52%	51%	55%	54%
Other/Mixed Channels	12%	12%	11%	12%	13%	18%

Figure 3-3: Consumer Ages and Purchase Channels for Aftermarket Accessories

It will be important to have a strong online presence, as most consumers tend to research accessories online before purchase. The most common methods of research include Google or Bing searches, visiting online auto retailer or manufacturer sites, and referencing automotive forums. The open-source aspect of CANnect should further allow for a community of individuals engaged to our product solutions and committed to knowledge sharing. It will also be an opportunity for collaborating with car manufactures for extended support and development. Partnering with manufacturers should further improve the presence of CANnect as a viable solution for vehicle diagnostics in the automotive industry.

In order to be a profitable company, it is important to dictate how the CANnect's hardware and software solutions can be used and choose an appropriate license [8]. The licensing used for the hardware is the CERN Open Hardware License Version 2 [11] and the licensing used for the software is the MIT License [12]. Both outline the detailed policies on modifications or distribution of our source codes or firmware.

4 Company Details

4.1 Choong Jin Ng - Project Lead

Choong Jin is a fifth-year Computer Engineering student and has shown considerable interest in embedded systems and development relating to computer vision, networking and data manipulation. During his time at SKYTRAC Systems, he developed a knack for solving tedious and complicated embedded problems with creative and elegant solutions. Through Team Guardian and the Engineering Science Student Society, he practiced his leadership skills through leading and mentoring team members under his watch. He also developed an interest in understanding how vehicles operate and how they interact with the world. As such, Choong Jin will be responsible for leading the CANnect project and its future success.

4.2 Nicholas Lau - Software Engineer

Nicholas is a fifth-year Computer Engineering student who has gained experience in software engineering, embedded systems and development while leveraging computer architecture. With co-op experience at Transport Canada, he has gained experience with IT infrastructure and business/government process flows and considerations, while his time with Sierra Wireless as a Software Test Engineer in firmware and drivers has given him experience with such software platforms, wireless communication, testing and IoT solutions. For CANnect, he will be working on software for the Reader, the data decoding and the phone app as required.

4.3 Enes Yazici - App Design Engineer

Enes is currently a fifth-year student pursuing an Electronics Engineering degree. His previous work experience includes a software developer role at Binary Stream and software test engineer at Sierra Wireless. He will contribute to the design of the CANnect's Android mobile application with his knowledge and programming experience.

4.4 Takehiro Tanaka - App Design Engineer

Takehiro is a senior Engineering Physics student and throughout the degree, he learned versatile fields from software engineering, hardware/electronics engineering up to theoretical/applied physics including quantum computing. He worked at SFU's Big Data Hub and Ford Motor Company of Canada for Co-op and primarily experienced in data analytics with big data technologies and data visualization with web technologies. For our project, he will be primarily involved in mobile application development. He has a strong interest in data science, machine learning, big data technologies such as Spark and Hadoop, and finally the application of quantum mechanics.

4.5 Win Aung - Hardware Engineer

Win is a fifth-year student who is currently pursuing the degree in Computer Engineering. His previous work experience in PNI Digital Media as QA Analyst will be applied when testing the reader and the app. For the CANnect product, he will be in charge of hardware for the reader, data displaying, and Android app as needed.

4.6 Ranjoat Chana - Systems Engineer, CCO

Ranjoat is a fifth year Systems Engineering student with an interest in robotics and research pertaining to new technological solutions. She had the opportunity to work as a Junior QA Analyst at PNI Digital Media, where she worked closely with a team of developers and QAs to verify retailer services for Azure migration and create automation scripts to test retailer websites. She also gained experience creating test strategy documentation and verify error logs for a retailer photo printing kiosk. For CANnect she will aid in hardware design and research pertaining to the CANnect reader.

5 Project Planning

CANNect will be developed in three distinct stages, with a separate prototype completed at the end of each stage. Table 5-1 identifies the prototype produced at each of the three stages:

Phase	**Phase Description**	**Prototype Demonstration Time**
Zeroth	Research and Planning	N/A
Alpha	Proof of Concept	August 2020
Beta	Engineering Prototype	December 2020
Production	Production Prototype	March 2020

Table 5-1: Phase Description and Outline

5.1 Zeroth Phase

The zeroth phase is a pre-development phase to facilitate planning and research for the CANnect product. For all intents and purposes for engineering, the zeroth phase is a forerunner to the alpha-phase. Figure 5-1displays the planning and research schedule in preparation for alpha-phase.

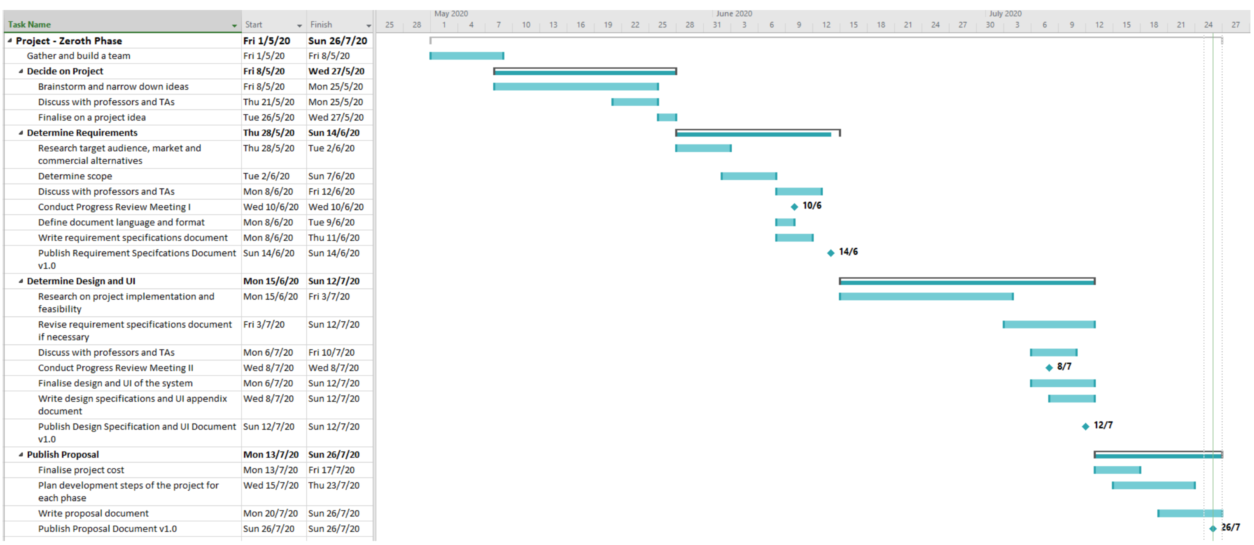


Figure 5-1: Zeroth Phase Schedule

5.2 Alpha Phase

The alpha-phase will be completed at the end of ENSC 405W Summer 2020. The prototype demonstrated by August 2020 during this phase is intended to be a proof-of-concept that demonstrates the feasibility of the core ideas. Although there will be limited functionality, the team intends to reuse most of the hardware and software to aid development for the beta-phase. Figure 5-2 showcases the schedule of development.

The following features will be completed and demonstrated by August 2020:

- The reader shall request for CAN Bus messages from a CAN Bus system, and deliver the answer to the app
- The app shall display the received data messages from the reader in a human readable format to the user in real-time

- The app shall update its values at most every 5 seconds.
- The reader and app shall pair and communicate with each other via Bluetooth

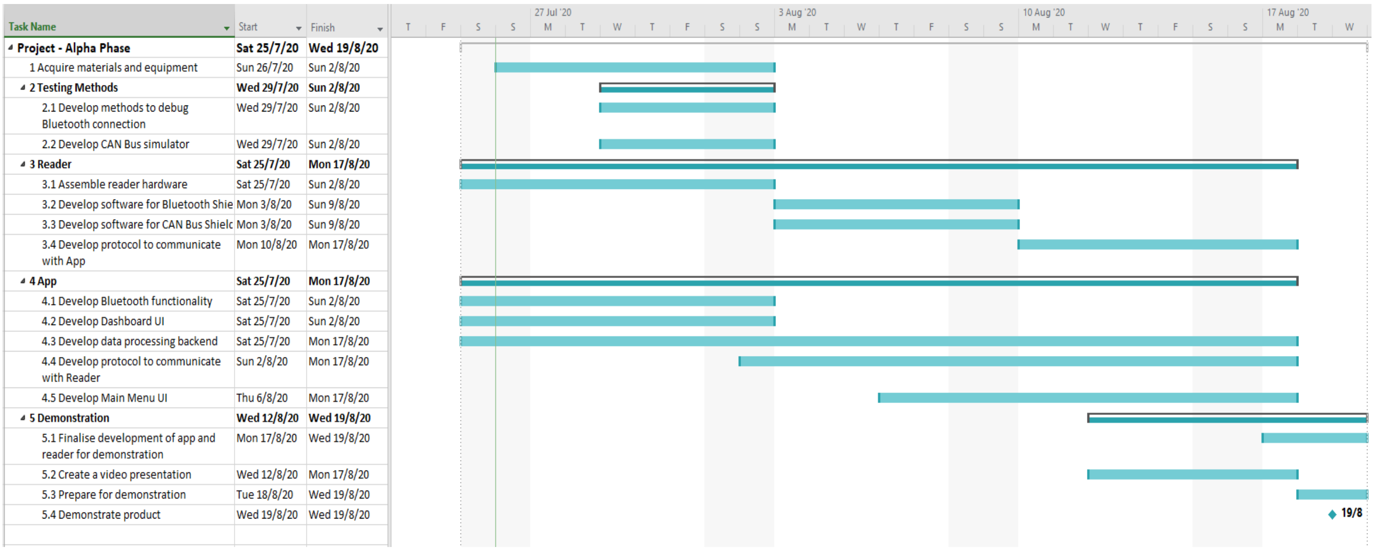
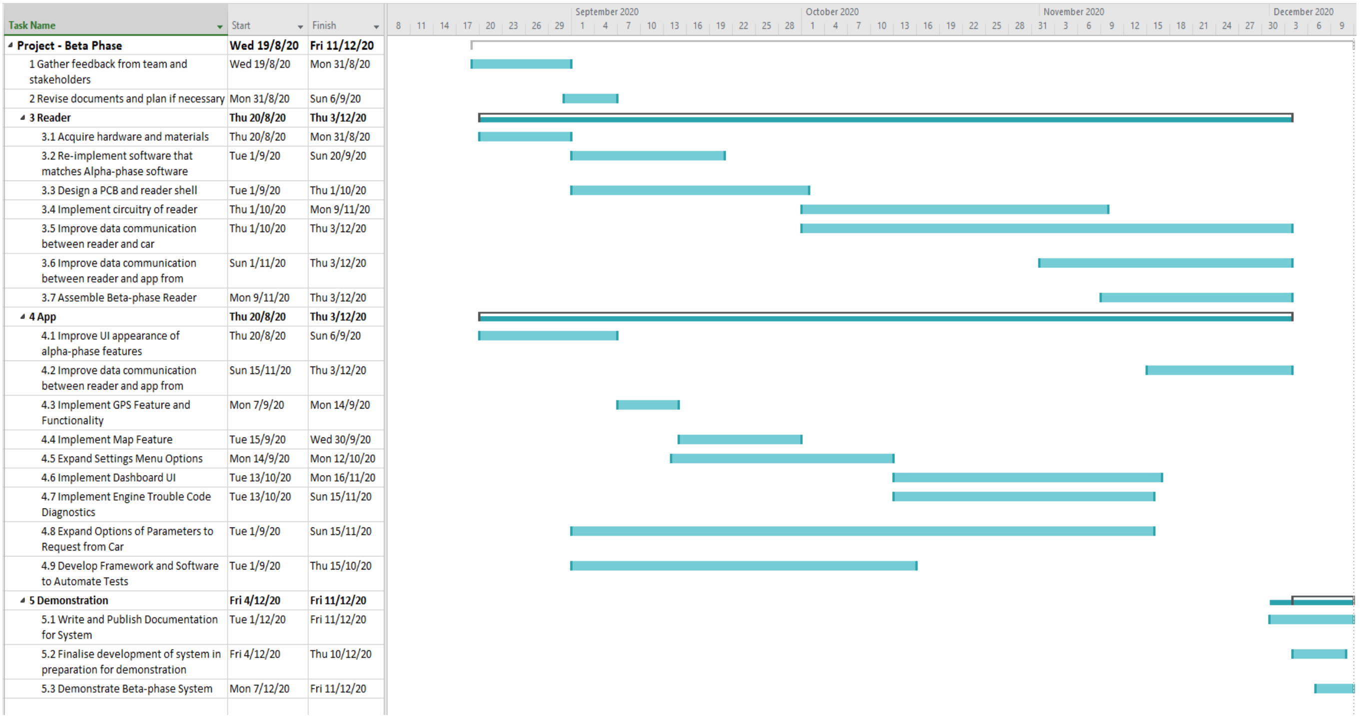


Figure 5-2: Alpha Phase Prototype Schedule

5.3 Beta Phase

The beta-phase will be completed during ENSC 440 Fall 2020. The prototype demonstrated by December 2020 will showcase all intended features that CANtech engineering intends to accomplish. It will also include an appearance prototype of the reader that demonstrates the proposed form users will interact with. Figure X showcases the planned schedule of development and demonstration of the beta-phase prototype.



Task Name	Start	Finish
Project - Beta Phase	**Wed 19/8/20**	**Fri 11/12/20**
1 Gather feedback from team and stakeholders	Wed 19/8/20	Mon 31/8/20
2 Revise documents and plan if necessary	Mon 31/8/20	Sun 6/9/20
3 Reader	**Thu 20/8/20**	**Thu 3/12/20**
3.1 Acquire hardware and materials	Thu 20/8/20	Mon 31/8/20
3.2 Re-implement software that matches Alpha-phase software	Tue 1/9/20	Sun 20/9/20
3.3 Design a PCB and reader shell	Tue 1/9/20	Thu 1/10/20
3.4 Implement circuitry of reader	Thu 1/10/20	Mon 9/11/20
3.5 Improve data communication between reader and car	Thu 1/10/20	Thu 3/12/20
3.6 Improve data communication between reader and app from	Sun 1/11/20	Thu 3/12/20
3.7 Assemble Beta-phase Reader	Mon 9/11/20	Thu 3/12/20
4 App	**Thu 20/8/20**	**Thu 3/12/20**
4.1 Improve UI appearance of alpha-phase features	Thu 20/8/20	Sun 6/9/20
4.2 Improve data communication between reader and app from	Sun 15/11/20	Thu 3/12/20
4.3 Implement GPS Feature and Functionality	Mon 7/9/20	Mon 14/9/20
4.4 Implement Map Feature	Tue 15/9/20	Wed 30/9/20
4.5 Expand Settings Menu Options	Mon 14/9/20	Mon 12/10/20
4.6 Implement Dashboard UI	Tue 13/10/20	Mon 16/11/20
4.7 Implement Engine Trouble Code Diagnostics	Tue 13/10/20	Sun 15/11/20
4.8 Expand Options of Parameters to Request from Car	Tue 1/9/20	Sun 15/11/20
4.9 Develop Framework and Software to Automate Tests	Tue 1/9/20	Thu 15/10/20
5 Demonstration	**Fri 4/12/20**	**Fri 11/12/20**
5.1 Write and Publish Documentation for System	Tue 1/12/20	Fri 11/12/20
5.2 Finalise development of system in preparation for demonstration	Fri 4/12/20	Thu 10/12/20
5.3 Demonstrate Beta-phase System	Mon 7/12/20	Fri 11/12/20

Figure 5-3: Beta Phase Prototype Schedule

Features demonstrated in the prototype, in addition of the features demonstrated in the alpha-phase, are of the following:

- The app shall request any OBD-II legislated parameters from the car via the reader
- The app shall perform engine trouble codes and diagnostics
- The app's user interface shall be user-friendly and easy to navigate
- The app shall have map functionality and include GPS readings from the phone

5.4 Production Phase

During the production phase, the final product will be developed and engineered for mass-production. While all features from both phases will be included, it is expected that the physical characteristics and user interface of the mass-produced product may deviate from previous phases due to decisions to fulfill production requirements. The planning for production phase will be conducted at the end of beta-phase with all key stakeholders and is considered out of scope of this document.

6 Finances

Table 6-1 and Table 6-2 outlines the estimated cost of parts for alpha-phase and beta-phase prototypes respectively. Note that some of the parts used during the alpha-phase will be reused for the beta-phase prototype, and therefore, will not be included again.

Component	Description	Cost (CAD$)
Arduino Uno	Arduino Uno kit containing components needed to make	38

	the microcontroller functional	
CAN Bus Shield	Arduino shield that is able to interface and interact with CAN Bus systems.	38
Bluetooth Shield	Arduino shield responsible for interacting between the app and the rest of the reader	38
Total		114

Table 6-1: Alpha Phase Prototype Estimate Cost

Component	**Description**	**Total Cost (CAD$)**
ESP 32	Main microcontroller that will be responsible for passing messages from the CAN Bus controller (MCP 2515) to the app via its internal Bluetooth connection	5
MCP 2515	CAN Bus controller responsible for talking between the ESP 32 and the car's diagnostic system	10
Colour LEDs	Colour LEDs intended to display status of subsystems of the reader	3
Reader Shell	Shell to encompass the reader for form factor and protection of circuits.	30
Total		48

Table 6-2: Beta Phase Prototype Estimate Cost

At the time of writing, the project will be funded internally within CANtech. To elevate the cost of the project, external funding will be seeked from the following sources:

- Engineering Science Student Society Endowment Fund (ESSEF)
- Wighton Development Fund

6.1 Engineering Science Student Society Endowment Fund

The Engineering Science Student Society Endowment Fund (ESSEF) is a fund managed by the Engineering Science Student Society (ESSS), intending to help finance projects proposed by undergraduate engineering students for projects. Under their categories, CANnect falls under the following categories of interest:

- Category B – Entrepreneurial
- Category C – Class

Acquiring funding from ESSEF should not be difficult due to CANnect's relative low budget and alignment of goals.

6.2 Wighton Development Fund

The Wighton Development Fund is administered by Dr. Andrew Rawicz and is intended to satisfy Wighton's requirement of practicality. Ideal projects is said to benefit society. Because CANnect aims to be open source and intentionally be beneficial to society, the Wighton Development Fund is a promising avenue of additional funding.

7 Conclusion

CANnect is an open source hardware component and software platform, providing the basis for communication between a user vehicle and their android smartphone device.
This document has outlined the scope of our project, providing a basic overview of the CANnect, along with potential risk and benefits. The project cost has been estimated. Moreover, the current market and competitors have been analyzed and concluded that there are no comparable products that exist for CANnect. Project has been planned to complete in 3 stages; alpha, beta and production. The details regarding each stage have been shared in this document.

We believe our expertise can be channelled towards making CANnect a successful platform that provides a meaningful solution to automotive applications and encourages a community of knowledge sharing. Engineers of CANnect hope to contribute their efforts to create a product that will help car enthusiasts to build their own solutions and use for their own needs.

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