Individual Capstone Assignment

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The project statement is as follows: "All newly manufactured vehicles utilize wireless networks for various vehicle functionalities. Use this technology in automotive raises serious concerns for user privacy and security.

Our goal for this project is to develop a proof of concept via an application that allows the user to select what information they want sent to OEMs (original equipment manufacturers) and insurance companies."

Let's get into how I'm going to use my individual knowledge from my coursework at UC and my co-op jobs in industry to tackle this problem.

Introduction

I'm using this senior design project to utilize skills/knowledge I've accrued throughout my time in college and as practice for a job role I'll be fulfilling in industry. There are the obvious skills that will be practiced, such as programming and problem solving, which in the scope of this project will likely be in the form of Python and Java. In my academic career, the course knowledge I will draw upon the most in the project would be CS-2011 Computer Systems, CS-2023 Python Programming, EECE 3093C Software Engineering, CS-5127 Requirements Engineering, EECE-4029 Operating Systems & Systems Programming, and CS-5130 Advanced Software Engineering. Another course relevant but I have yet to take: CS-4065 Computer Networks and Networked Computing. Systems, Python, Software Eng., and Networking are most relevant to the technical portions to this project: being a solution of creating an application to interface with that has the goals in the project statement. Requirements Eng. and Adv. Software Engineering are for implementing and using effective methods to keep our project organized and ensure it reaches it's goes and to elicit effective communication with our advisor and between my partner and I. Relating to my job experience as a software engineer co-op in automotive, I get to take a deeper look into the various endpoints the system I've worked on previously relates to other systems within the vehicle. All of this knowledge is going to be utilized by my partner to create our project.

UC Class Experience & Co-op Experience

Going more into the classes I've taken and their specific knowledge from them that will be utilized in this project, we'll start with Python Programming (CS-2003) and Intro to Computer Systems (CS-2023). These two provide the specific technical foundational knowledge that will be utilized in this project. From the python course, I don't think this project will utilize that much *advanced* python knowledge such as working with data science. Mostly I imagine it to be the workflow of finding a library and working with that library to implement a specific solution, I imagine this will occur in somewhere in the process of our networking solution. In addition, this class enhanced my knowledge of unit testing which may come into play during the testing phase of our project. Computer systems is important because in developing our application we must keep in mind the resources that are being utilized in our application and how to minimize their impact on hardware performance. This comes down to programming approaches that use memory efficiently and knowing what specific components make up the hardware we're making an application for. SE and Adv. SE (CS-5130), and Requirements Engineering (CS-5127), all delve into how we are going to practice effective techniques and methodologies to create and manage a software project. I would say the two most important lessons from these courses are effective communication and visualizing solutions. One of the first things that is going to be done for this project before a line of code is typed is context diagrams and user workflows for how we imagine the project to be used. Consistent communication is already underworks, also reaching out to experts in networking & security such as professors at UC and people in the automotive to make sure our solution is an effective one has been established and we will be meeting with a lot of these people. Operating Systems (EECE-4029) and Computer Networks & Networked Computing (CS-4065), these will be the main bread and butter of the project. We are working with a specific android implementation so understanding how that specific OS grants elevated privileges and how it allocates hardware resources will be crucial. Also understanding if our project deals with encrypted networks and how to analyzes and label network data are of most importance for this projects goals.

I worked as a software developer at *Siemens Digital Industry Software* for two co-op rotations and I also worked as a software engineer at *Honda R&D Americas, LLC*. At Siemens, it was my first time practicing what I learned outside the classroom in a business environment. At Siemens I Developed C++ algorithm to compress/decompress large files and transfer data across company software products resulting in greater flexibility for customers and developers. I also utilized regular expressions and unit tests in Python script to automate necessary code changes across 20+ files in Simcenter 3D to save developer time. This experience really helped me get a handle on project workflows and enhance my knowledge I previously learned at UC. These skills are important to this project as unit tests may be helpful for the eventual testing phase of this project to test for the testing phase of this project, and understanding how to develop a software solution to a complex problem is also a skill that will be exercised in this project. My work at Honda is more important for this project. The software I worked with during my co-op is going to be the same software I work with for this senior project. What this entails is that I understand I'm going to be working in an Android environment, and I'm either going to

have to utilize the CAN network of the vehicle or find a solution to interface network protocols in the vehicle via software. This is a nice way to jump start my knowledge on how various systems in the vehicle interact with each other, but for the purposes of this project *no inside information will be utilized and all information needed for this project will be found online or with experts outside of Honda.*

Project Motivation and Solution Approaches

Why this project? The answer is threefold: I love cars and automotive, it is a section of the industry that has and always will have so many problems that require well-thought out unique solutions. That paired with my industry experience in co-op at an automotive company made me really want to pursue something that involved cars. Automotive is still in it's early phase of developing software solutions for vehicles, thus I get to get in early and apply my knowledge from UC immediately and be at the forefront of this new development. Secondly, I don't really like insurance companies or user data collection. Doesn't take a lot of research to find a reason to not like insurance company business practices and data collection and privacy is a story as old as time at this point and may be a very fruitless in devour for this project... nevertheless it gives this project a problem to go after and dips into a little bit of a vigilante attitude for me personally. Thirdly, I get to learn more about wireless networking in this project which is something I haven't tackled at UC yet.

The preliminary approach to this project involves a set of specific questions:

- Do we require hardware to implement this project?
- How are we going to test outside of vehicle environment to test and validate our application software?
  The goal is to not use hardware in this project and everything can be done via software. This will require knowledge of the Android operating system and how the various systems of the vehicle interact with each other. If accessing the unit that controls networks can only be done via the CAN network, then use of hardware will be required. Otherwise, if accessible via software, my partner and I are in business as we get to do all of our work via software. Testing will be done in an android emulator with specific apps to monitor network activity and labeling, and to test our UI. The next set of questions pertains to our approach to a solution to regulating the networks of the vehicle:
- Is the data sent by the vehicle encrypted?
- Can an application be installed on the vehicle via web? Or is plugging in our software directly from our devices required?
  If the data sent is encrypted, great! That means this company has taken a step forward to protect information from the vehicle and my partner and I have to find workaround to label and understand the data. If we can install our application via a download from the web...

that's not all that bad but could leave room for bad actors to install software easily that has elevated privilege and can reek havoc on the cars software.

Evaluation

This project will be evaluated on the deliverable of an application that is able to interface with the cars wireless network activity. It will also be determined if we can do this safely with minimal elevated privilege involved. This would be a great step forward the in data privacy problem facing automotive at the moment as these companies are adopting a lot of new technologies either in-house or most likely third party software. I will evaluate my contributions through the networking solution approach and my ability to organize and mange this project effectively. I'm leaving a lot of the interfacing and UI up to my partner as he has a lot more experience in that regard. Objectively, I will be proud of my work if it truly was challenging to implement all of my knowledge from UC classes & co-op and I was able to scedule each specific deliverable and meet subsequent deadlines. Subjectively I will know if I've done a good job if I want to install my application on any vehicle I own in the future.