

Capstone Reflections

Throughout the course of this project, I gained knowledge from various observations, outcomes, and trials. A main idea, in this case, presented itself as relaying data between two hardware devices, not originally intended to communicate with one another, in order to achieve an expected, yet somewhat unlikely or surprising outcome. This idea was eventually achieved through drive fueled by learning, a desire for exploration, but mainly through the hope of having fun putting textbook knowledge to the test and implementing simple ideas and designs. I had been fascinated by data transfer across devices, networking, and the simple fact that using a standard, agreed, set of rules, can make two devices successfully “talk” to each other. It furthermore made me believe that what a simple device or two can do with information received from many different sources, can open up a world of unlimited fun and possibilities.

Through the development of our capstone project I learned the basics of the C++ programming language. I learned the fundamental differences between the User Datagram Protocol (UDP), and the Transmission Control Protocol (TCP), such being that UDP is a datagram stream with no requirement of a “listener” at the end of its pipe stream, while TCP requires a host and a client, both of which must acknowledge the transfer and arrival of packets sent among them. Furthermore, a great skill learned by this project was deeper perspective on and usage of software development kits (SDKs), particularly the NAO Humanoid Robot SDK. Working with this development framework allowed me to better understand the relationship between a programmer and a user of that programmer’s tools. Working with the NAO SDK further allowed me to find out and become familiar with the MAKE and CMAKE build systems, both of which I now use consistently on personal projects.

All of these learned tools and insights were used in our project to write a program for a NAO Humanoid Robot using its C++ SDK in order to control it, and implement data transfer and between the NAO’s camera and a Windows machine, an Oculus Rift providing data to such Windows machine, and a Mac, and such Mac and the NAO itself.

Some challenges faced along the way came in the form of understanding the SDK for the NAO Humanoid Robots. We had chosen from the planning stages of our project, to use the C++ SDK for this robot as it would provide more than the necessary functionality we were looking for, such as movement control, and video streaming. What we did not foresee was a guide lacking in detail, incomplete steps, inconsistent examples, and outdated / deprecated SDK functions. A most memorable moment from these happenings occurred when I realized that the set-up wizard that the SDK used in order to resolve paths between a program and the SDK and link binary objects into executables when compiling programs made with the SDK, was in essence broken. Particularly, it had a few cases of poor taste in code structure, causing certain functions to loop indefinitely, and various settings to not be set properly. We also encountered outdated software, libraries, and a plethora of other setbacks that ended

up costing us months worth of time to resolve (luckily we began preparing for all of this a semester in advance).

A few things I would do differently include possibly waiting for SDKs, from the same company, aimed at programming languages other than C++ to mature enough to the point where we would be able to use them for the entirety of the project, set aside more time for planning and sketching (my teammate and I kind of jumped at experimentation and software writing earlier on than we should have), and checking to make sure that all of the equipment that would be possibly required by such a project is either easily obtainable, or already at hand (we went with our instincts from the very beginning, hoping a Mac would be more than enough to achieve the entire project, only to find out later that we would need (and be lucky enough to have) a Windows machine, a router, and an unimaginable amount of ethernet cables, along with said Mac).

Overall, this project has given me confidence to pursue more complex projects, it has taught me that a simple way of achieving a large, or seemingly unattainable goal, is to break it into smaller, more achievable tasks, until it eventually is reached. It has taught me that it is very much possible to learn on your own even more than what one can learn just through lectures, and has taught me the value of perseverance, even when all seems lost, or a roadblock seems impassable.