UNCC_WORK Project – Progress Report

Date	Revision	Author	Comments
2021-04-05	A	Zachary Zaleski	Original Document

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1 Objective

The objective of the UNCC_WORK team is to complete a backend communication server scheme that functions to deliver messages to a number of clients concurrently; furthermore, the communication between server and client to be fluid to ensure constant transmission by means of error handling. Moreover, the mobile app will be able collect and display data collected from end user devices such as: the heart rate of the individual, alert notifications, and GPS location implemented from the goggles.

2 Work Completed

The team is currently working on implementing a concurrent backend server-client communication scheme that meets the requirement of 10ms latency across devices. The current implemented multithreaded server implementation is below in Figure 1.

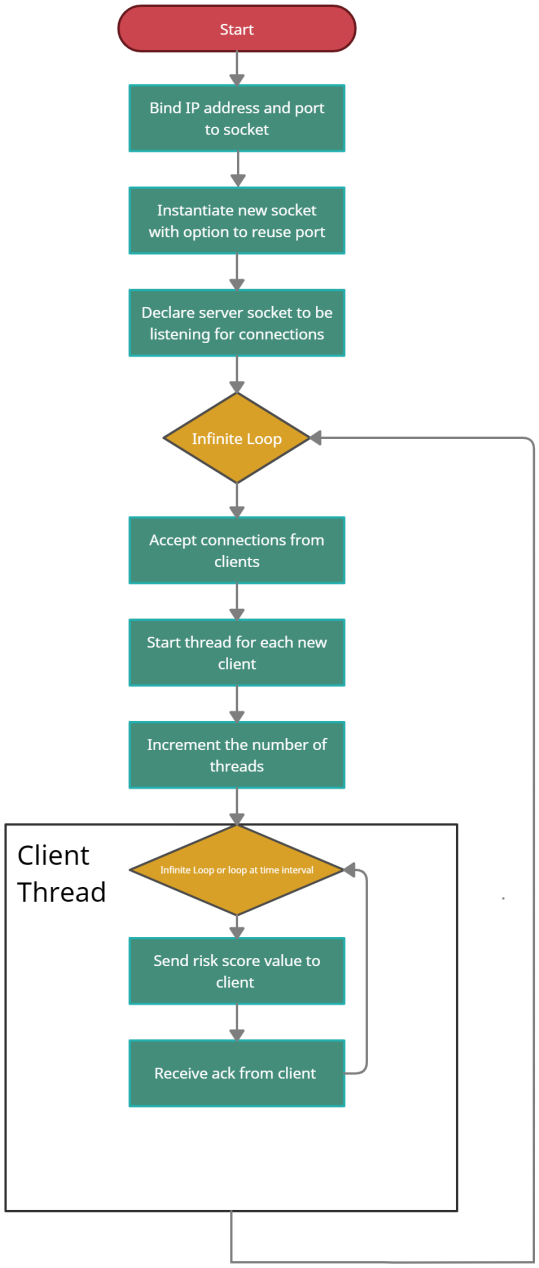

Figure 1: Multi-threaded Server Scheme Option 1

The team implemented a primitive version of Figure 1 with success; however, this implementation requires further research to ensure scalability as error handling of data transmission may not be possible. The general server communication scheme is as in Figure 2 below.

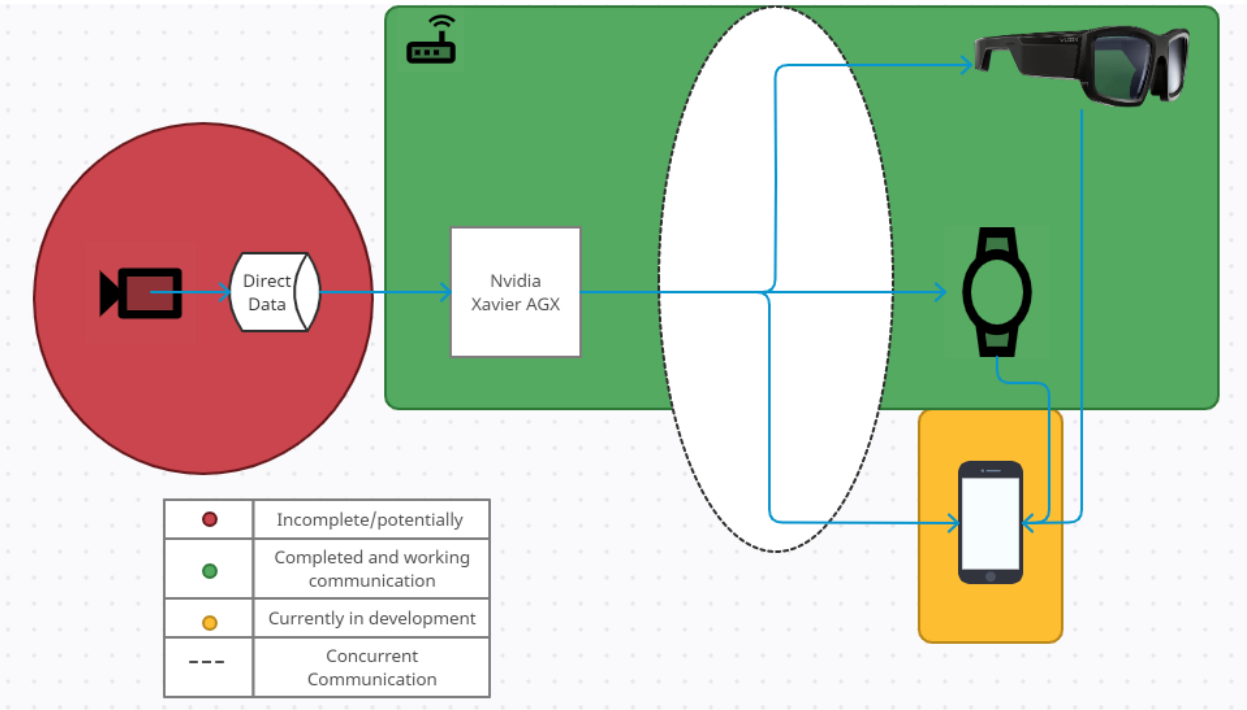

Figure 2: Server Communication Scheme

The figure above is largely an abstracted representation of the communication that will be occurring internally within the system. Figure 3 below shows a concrete definition of the potential system layout in a work zone.

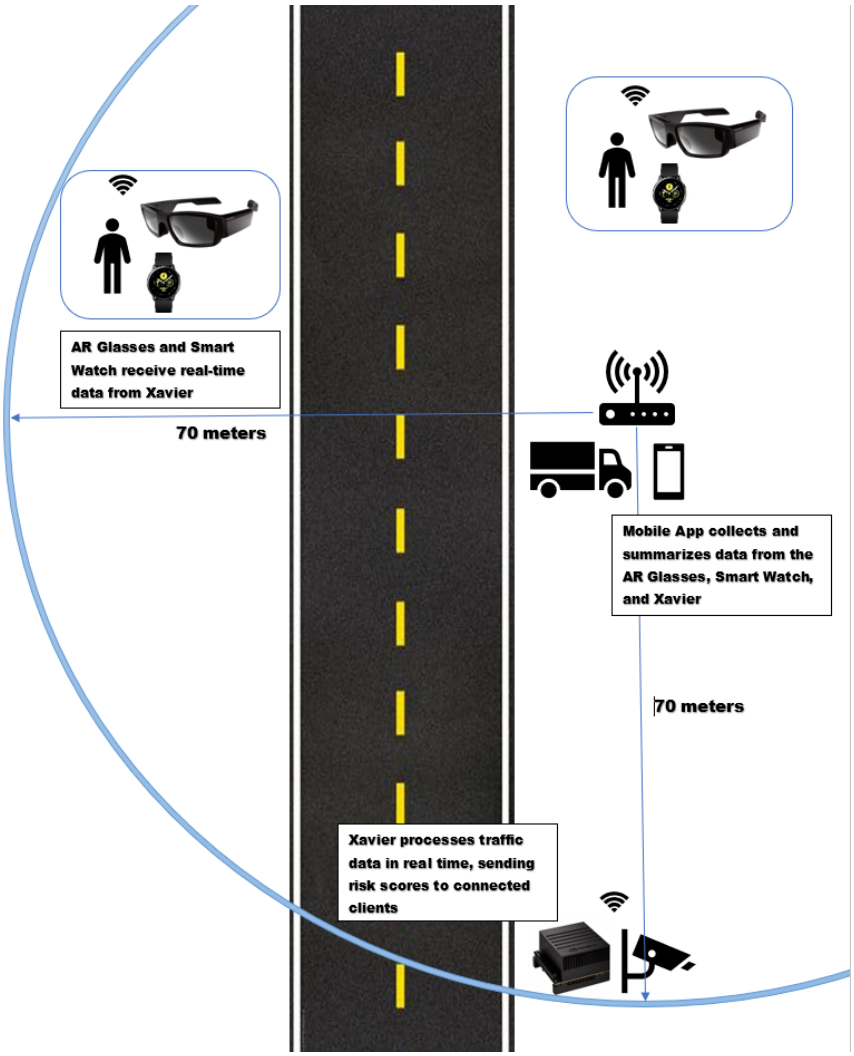

Figure 3: System Overhead

As of now, the team has implemented a single-thread, multi-socket, multi-port server to measure latency between every possible device that is currently available. The flowchart for this server implementation is below. [Figure 4]

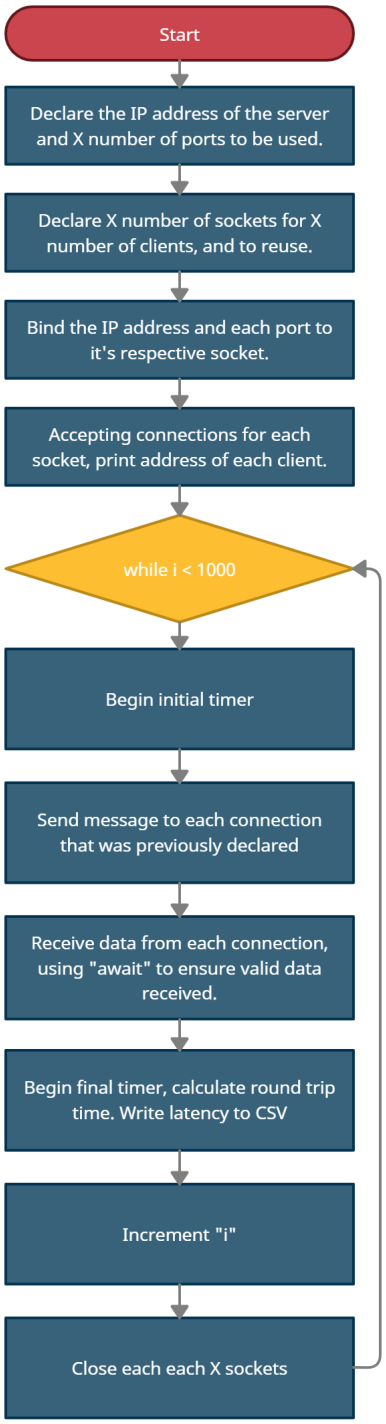

Figure 4: Single-Thread Server Latency Testing Scheme

This represents a one-scale system including: Vuzix Blade goggles, Samsung Galaxy Watch Active 1 watch, and an Android tablet. The communication for the mobile application is currently in development with a generic-frontend UI completed and design of the backend client scheme to communicate with the system is in progress, but will be included in the entire system upon completion.

3 Issues that Need Immediate Assistance

Currently, the UNCC_WORK team has no issues that require interference.

4 Plans for the Remainder of Semester

The focus of the team has shifted to completing the GPS tracking for the mobile application. Current development is successful when latitude and longitude are hard coded, however, accessing that data from the API in real-time has not been completed. A successful tracking application should be available for testing with the multithreaded server by the second week of April.

Moving toward the end of the semester, the team will look to enhance efficiency of the communication system through error handling. Due to much of the testing requiring a trial and error approach, the successful codes need to be cleaned up for future development on this project.

The following remainder of the semester will include further app development, completing a server scheme, and having a scalable, functioning, complete system. The app development will include evolving the user interface of the app. This will include the alert system, heart-rate monitor, and the GPS location linked from the goggles. The mobile application in development will be acting as a digital twin for those involved in the workzone; wherein, the app will aggregate data that has been communicated from the server and other clients. Figure 5 below shows an example of the various functionalities and UI involved with the mobile application.

Figure 5: Application Example

The server scheme will be implemented varying from the single-thread approach that the team has used to measure latency, to a multithreaded, or potentially nested multithreading approach to ensure concurrent message transmission to clients. The multithreading approach should lend greater feasibility to implement connection, data relay, and other error handling for any potential miscommunication within the server. With implementation of said error handling, the server can deliver messages to clients fluidly. Figure 6 is a theorized implementation of a multithreaded server with a send and receive thread nested within the client thread. Ideally, this implementation will lend itself to more sophisticated, inclusive error handling and will be an implementation the team seeks to complete to reach the objective of the project.

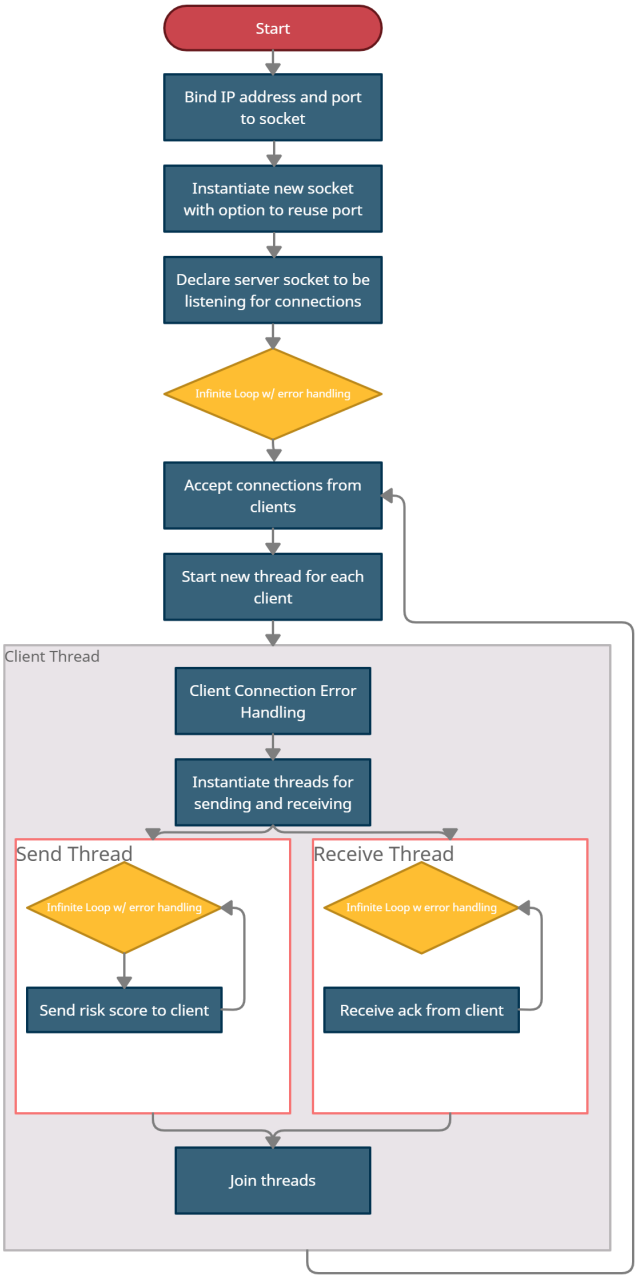

Figure 6: Theorized Multithreaded Server Scheme Option 2

5 Communication with Faculty Mentor and Supporter

The team is in biweekly communication with the faculty mentor, Dr. Tabkhi, by means of Google Meet. Similarly, the team is meeting with Sepehr Sabeti on a weekly basis at minimum to discuss progress. The team works both independently and collaboratively daily to ensure proper progression to deliverable goals of the project.

6 References

1. Jennings, Nathan. “Socket Programming in Python (Guide).” Real Python. Real Python, September 21, 2020. https://realpython.com/python-sockets/.

2. Nicholas, Jennifer. Sending and Receiving Data with Sockets in android, April 16, 2019. https://www.tutorialspoint.com/sending-and-receiving-data-with-sockets-in-android/.

7 Appendices

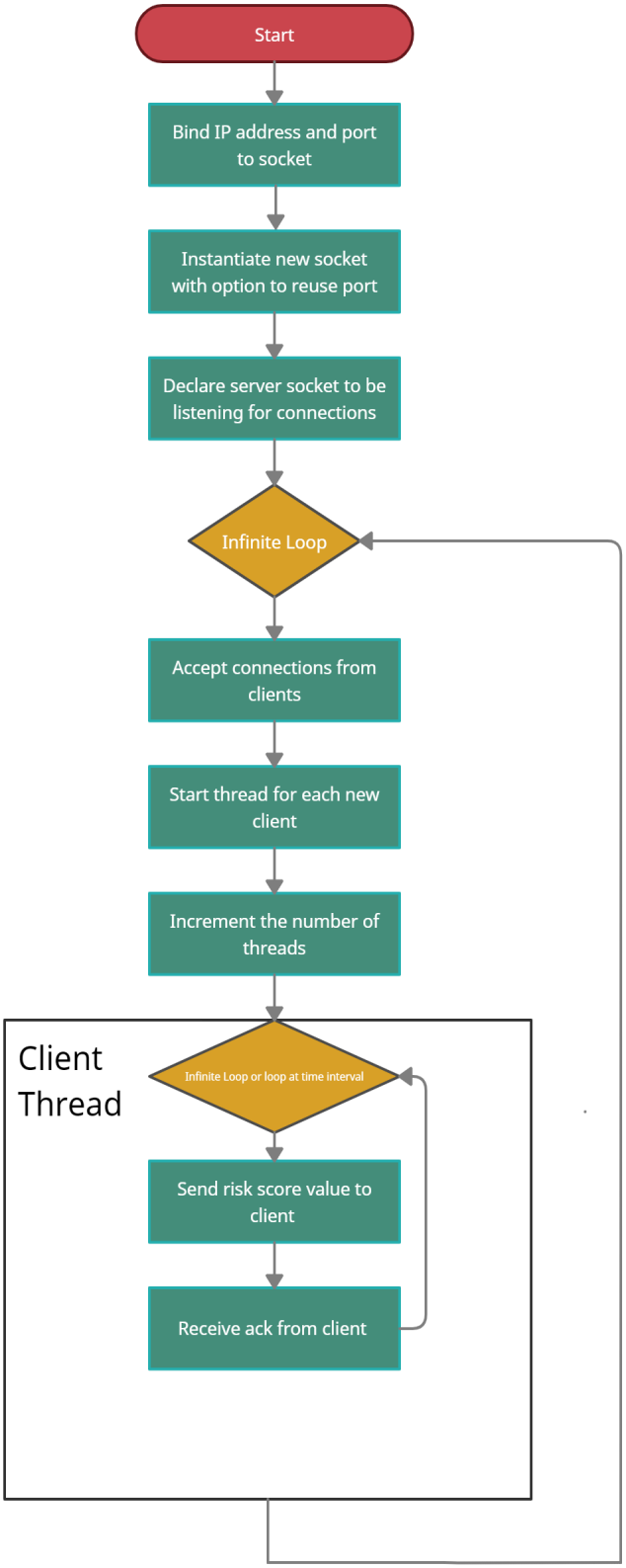

Figure 1: Multi-threaded Server Scheme Option 1

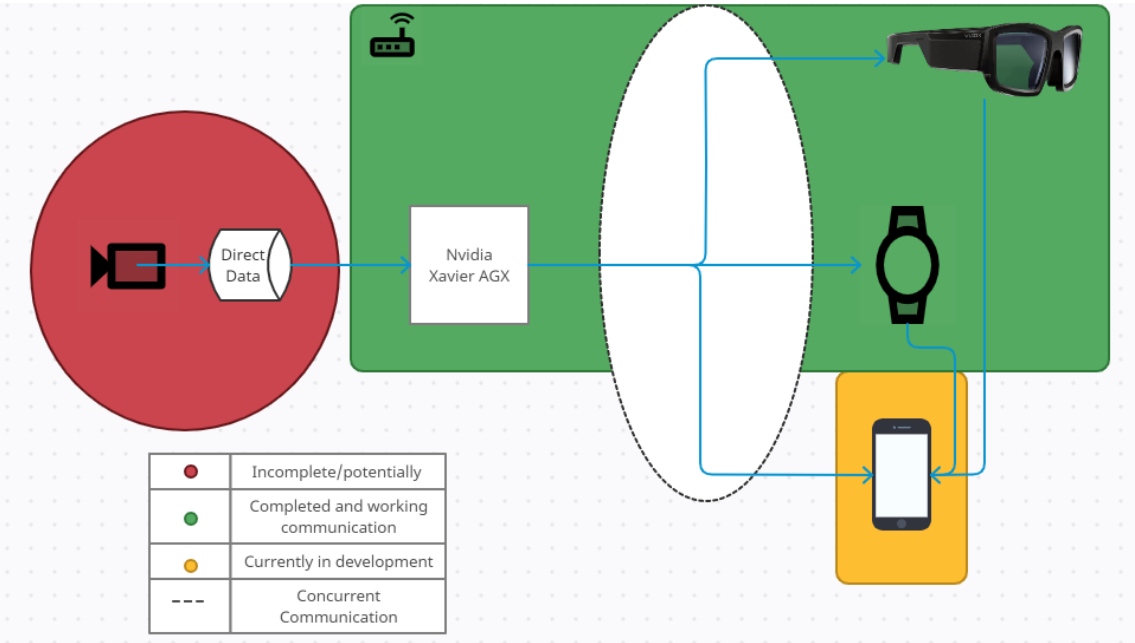

Figure 2: Server Communication Scheme 1

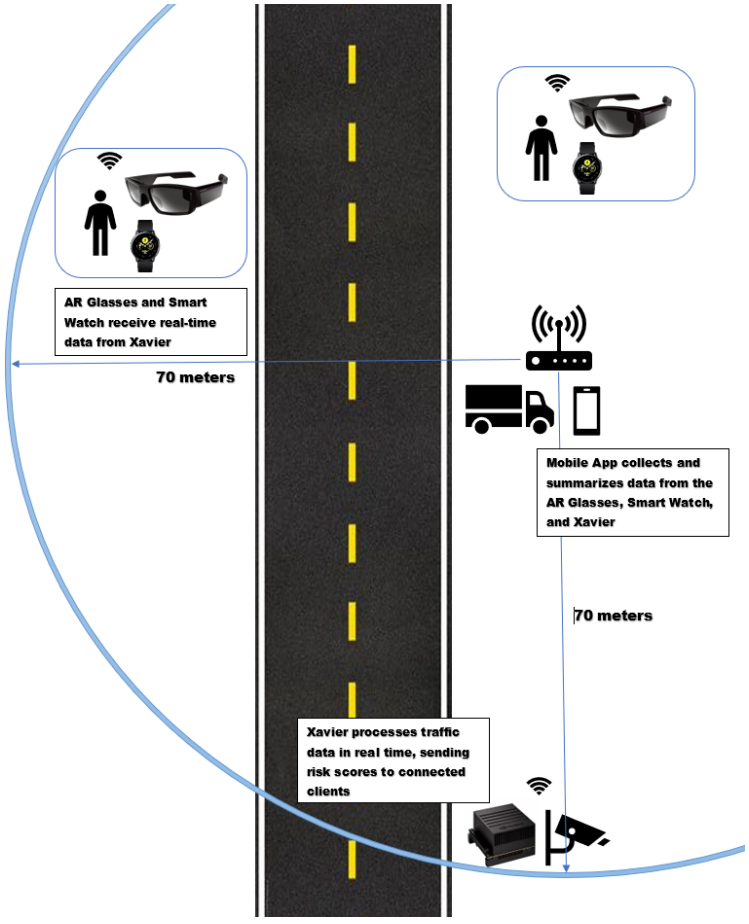

Figure 3: System Overhead

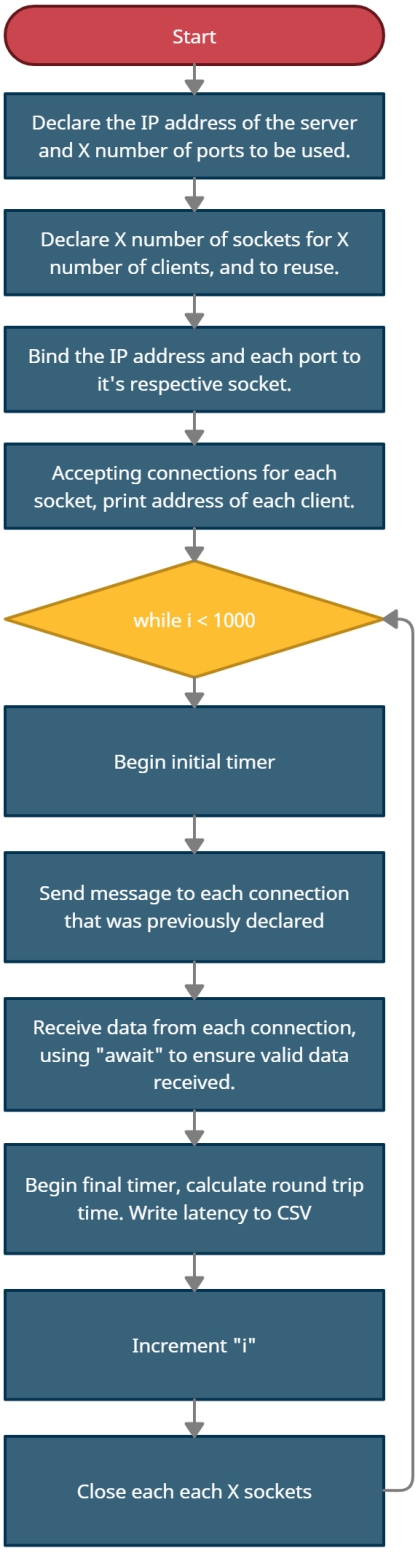

Figure 4: Single-Thread Server Latency Testing Scheme

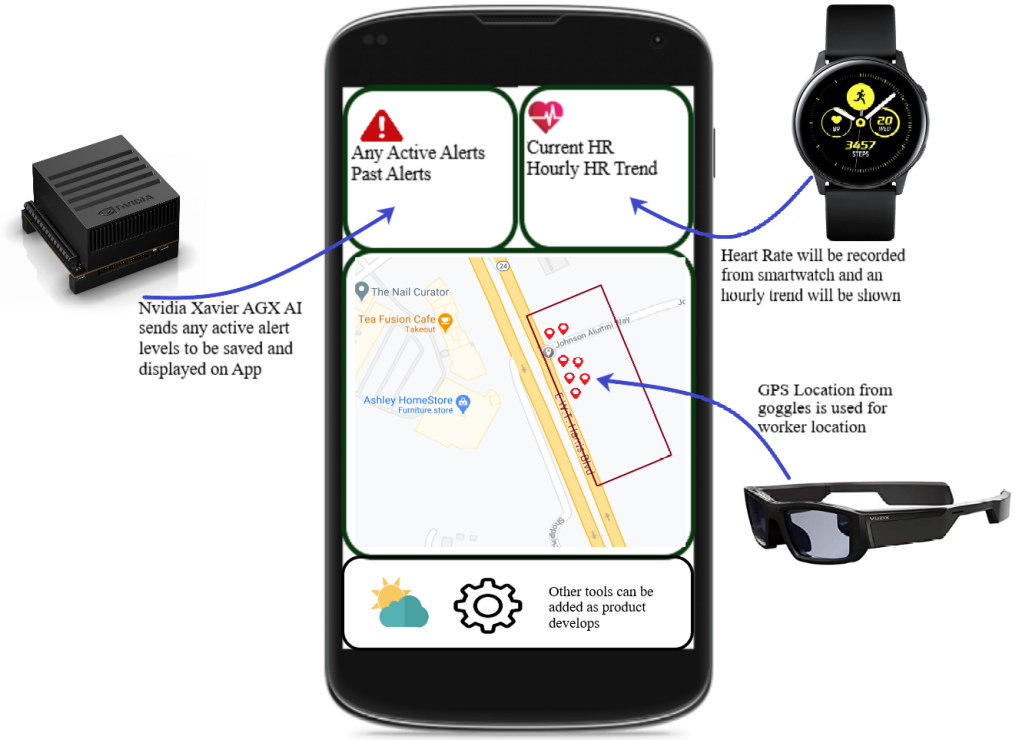

Figure 5: Application Example

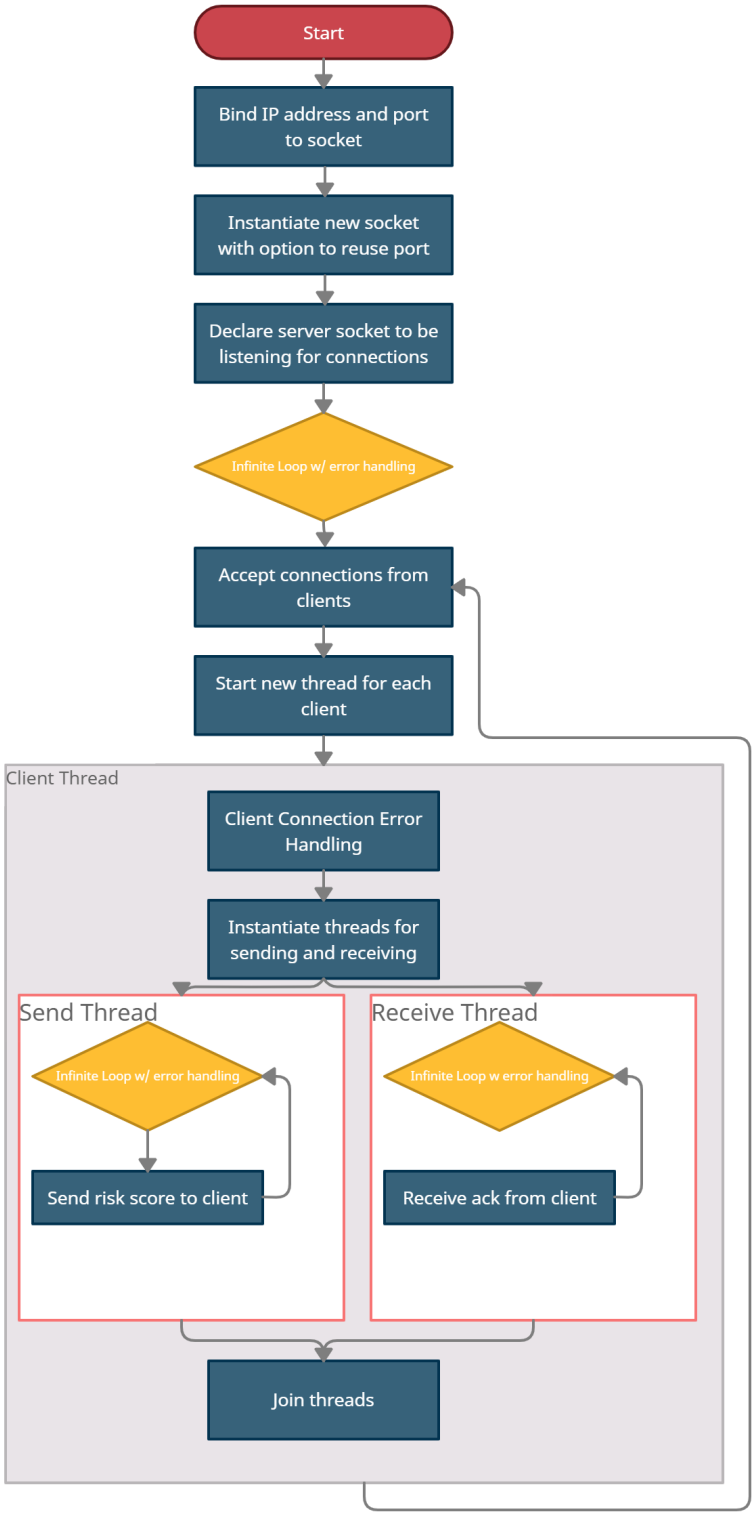

Figure 6: Theorized Multithreaded Server Scheme Option 2

		Project UNCC_WORK SD1	**84 days**	**Mon 9/7/20**	**Thu 12/17/20**		**1**	**121 hrs**	**141**
		Project UNCC_WORK SD2	**85.33 days**	**Wed 1/20/21**	**Fri 5/7/21**		**2**	**111 hrs**	**239**
		Project Management	**85.33 days**	**Wed 1/20/21**	**Fri 5/7/21**		**2.1**	**14 hrs**	**241**
		Revised Final Design Package	0.13 days?	Mon 2/1/21	Mon 2/1/21	Damian Hupka, Duncan Tennant, Nathan Pecoraro, W	DOCUMENT - ADMIN	2 hrs	248
		Project Plan	**85.33 days**	**Wed 1/20/21**	**Fri 5/7/21**		**PLAN**	**5 hrs**	**242**
		Initial Project Plan Updating	0.33 days?	Wed 1/20/21	Wed 1/20/21	Damian Hupka	PLAN	1 hr	240
		Updating Project Plan	0.33 days?	Mon 2/8/21	Mon 2/8/21	Damian Hupka	PLAN	1 hr	263
		Updating Project Plan	0.33 days?	Thu 2/25/21	Thu 2/25/21	Damian Hupka	PLAN	1 hr	283
		Updating Project Plan	0.33 days?	Mon 3/1/21	Mon 3/1/21	Damian Hupka	PLAN	1 hr	284
		Updating Project Plan	0.33 days?	Mon 3/22/21	Mon 3/22/21	Damian Hupka	PLAN	1 hr	290
		Timesheets	**85.33 days**	**Wed 1/20/21**	**Fri 5/7/21**		**2.1.3**	**3 hrs**	**243**
		Timesheet #1	0.07 days?	Mon 2/8/21	Mon 2/8/21	Damian Hupka, Duncan Tennant, Na	DOCUMENT - ADMIN	1 hr	244
		Timesheet #2	0.07 days?	Mon 3/1/21	Mon 3/1/21	Damian Hupka, Duncan Tennant, Na	DOCUMENT - ADMIN	1 hr	282
		Timesheet #3	0.33 days?	Mon 3/22/21	Mon 3/22/21	Zach Zaleski	DOCUMENT - ADMIN	1 hr	289
		Progress Reports	**85.33 days**	**Wed 1/20/21**	**Fri 5/7/21**		**2.1.4**	**4 hrs**	**245**
		Progress Report #1	0.13 days?	Mon 3/1/21	Mon 3/1/21	Damian Hupka, Duncan Tennant, Na	DOCUMENT - ADMIN	2 hrs	246
		Progress Report #2	0.13 days?	Mon 4/5/21	Mon 4/5/21	Damian Hupka, Duncan Tennant, Na	DOCUMENT - ADMIN	2 hrs	299

Figure 7: Project Plan Gantt Chart

		Project Status Review Presentation (PSR)	**41.33 days**	**Wed 1/20/21**	**Sat 3/6/21**		**DESIGN**	**15 hrs**	**249**
		PSR Presentation Preparation	0.27 days?	Thu 2/25/21	Thu 2/25/21	Damian Hupka, Duncan Tennant, Nathan Pecoraro, W	DESIGN	4 hrs	250
		Initial PSR Meeting	0.2 days?	Fri 2/26/21	Fri 2/26/21	Damian Hupka[33%]	DESIGN	1 hr	286
		Various Schematic Design	0.2 days?	Mon 3/1/21	Mon 3/1/21	Damian Hupka, Duncan Tennant, Nathan Pecoraro, W	DESIGN	3 hrs	285
		Re-do PSR Meeting	0.07 days?	Fri 3/5/21	Fri 3/5/21	Damian Hupka, Duncan Tennant, Na	DESIGN	1 hr	288
		Initial Creation of Updated PSR	0.13 days?	Tue 3/2/21	Tue 3/2/21	Damian Hupka, Duncan Tennant, Nathan Pecoraro, W	DESIGN	2 hrs	291
		Updated with feedback PSR	0.27 days?	Fri 3/5/21	Fri 3/5/21	Damian Hupka, Duncan Tennant, Nathan Pecoraro, W	DESIGN	4 hrs	287
		Prototype Review Presentation (PRP)	**1 day?**	**Wed 1/20/21**	**Wed 1/20/21**		**DESIGN**	**0 hrs**	**253**
		<New Task>	1 day?	Wed 1/20/21	Wed 1/20/21		2.3.1	0 hrs	254
		Final Project Report	**85.33 days**	**Wed 1/20/21**	**Fri 5/7/21**		**2.4**	**0 hrs**	**255**
		<New Task>	1 day?	Wed 1/20/21	Wed 1/20/21		2.4.1	0 hrs	256

Figure 8: Project Plan Gantt Chart Continued

		Lab Meetings, Design, and Prototyping	**85.33 days**	**Wed 1/20/21**	**Fri 5/7/21**		**2.5**	**74 hrs**	**257**
		Establishing Github Repository and Flashing New Desktop	0.33 days?	Mon 2/8/21	Mon 2/8/21	Damian Hupka, Nathan Pecoraro	DESIGN	2 hrs	258
		Application Development Research	0.5 days?	Tue 2/2/21	Tue 2/2/21	Duncan Tennant[67%] William	DESIGN	2 hrs	266
		Application "Stories" trimming	0.2 days?	Mon 2/1/21	Mon 2/1/21	Damian Hupka[67%] Duncan	DESIGN	2 hrs	264
		Multithreading Implementatior Research	1 day?	Tue 2/9/21	Tue 2/9/21	Zach Zaleski[83%]	RESEARCH	2.5 hrs	267
		Multi-socket code configuration	0.33 days?	Wed 2/10/21	Wed 2/10/21	Damian Hupka, Duncan Tennant, Nathan Pecoraro,Za	DESIGN	4 hrs	273
		End-User Application Development	1 day?	Wed 1/20/21	Wed 1/20/21	William Clampett	DESIGN	3 hrs	274
		End-User Application Homepage	1 day?	Wed 2/10/21	Wed 2/10/21	Duncan Tennant	DESIGN	3 hrs	269
		End-User Application Development	1 day?	Thu 2/11/21	Thu 2/11/21	William Clampett	DESIGN	3 hrs	272
		Tizen Development and End-User Application Development	0.28 days?	Thu 2/11/21	Thu 2/11/21	Damian Hupka, Nathan Pecoraro, Zach Zaleski	DESIGN	2.5 hrs	271
		2 Socket Server, tizen Development and End-User Application Development	0.61 days?	Fri 2/12/21	Fri 2/12/21	Damian Hupka, Nathan Pecoraro, Zach Zaleski	DESIGN	5.5 hrs	268

Figure 9: Project Plan Gantt Chart Continued

		Outdoor Latency Testing (2 socket)	0.33 days?	Wed 2/17/21	Wed 2/17/21	Damian Hupka, Nathan Pecoraro, Zach Zaleski	DESIGN	3 hrs	279
		Threaded Server Testing	0.33 days?	Sat 2/20/21	Sat 2/20/21	Damian Hupka, Nathan Pecoraro,Za	DESIGN	3 hrs	278
		Testing watch latency and more clients	0.33 days?	Wed 2/24/21	Wed 2/24/21	Damian Hupka, Nathan Pecoraro, Zach Zaleski	DESIGN	3 hrs	277
		Multi-Client Latency Testing	0.44 days?	Thu 2/25/21	Thu 2/25/21	Damian Hupka, Nathan Pecoraro, William Clampett	DESIGN	4 hrs	276
		App. Redesign	0.83 days?	Sun 2/28/21	Sun 2/28/21	Duncan Tennant	DESIGN	2.5 hrs	293
		App. Dev. Discussion with graduate mentor	1 day?	Mon 3/1/21	Mon 3/1/21		DESIGN	1 hr	292
		Finished all latency test scenarios	0.78 days?	Fri 3/12/21	Fri 3/12/21	Damian Hupka, Duncan Tennant, Nathan Pecoraro	DESIGN	7 hrs	295
		Fragment and Importing Map API	0.5 days?	Wed 3/17/21	Wed 3/17/21	Duncan Tennant, William Clampett	DESIGN	3 hrs	296
		Map Working with Emulator	0.67 days?	Thu 3/18/21	Thu 3/18/21	Duncan Tennant, William Clampett	DESIGN	4 hrs	297
		Multithreaded Server Implementatior Work	0.44 days?	Fri 3/19/21	Fri 3/19/21	Damian Hupka, Nathan Pecoraro, Zach Zaleski	DESIGN	4 hrs	298
		Multithreaded Discussion	0.33 days?	Mon 3/29/21	Mon 3/29/21	Damian Hupka, Nathan Pecoraro,Za	DESIGN	3 hrs	302
		Application Development Discussion	0.17 days?	Wed 3/31/21	Wed 3/31/21	Duncan Tennant, William Clampett	DESIGN	1 hr	300
		Application Development Research and Development	0.5 days?	Wed 3/31/21	Wed 3/31/21	Duncan Tennant, William Clampett	DESIGN	3 hrs	301
		Multithreaded Server Development	0.25 days?	Mon 4/5/21	Mon 4/5/21	Damian Hupka, Nathan Pecoraro, William Clampett,Z	DESIGN	3 hrs	305

Figure 10: Project Plan Gantt Chart Continued

		Weekly Meetings	**84.33 days**	**Thu 1/21/21**	**Fri 5/7/21**		**DESIGN**	**8 hrs**	**259**
		Weekly Meeting with Supporter/Grad Mentor	0.2 days?	Thu 1/21/21	Thu 1/21/21	Damian Hupka[33%] Duncan Tennant[33%]	DESIGN	1 hr	260
		Weekly Meeting with Supporter/Grad Mentor	0.2 days?	Fri 1/29/21	Fri 1/29/21	Damian Hupka[33%] Duncan Tennant[33%]	DESIGN	1 hr	261
		Weekly Meeting with Supporter/Grad Mentor	0.2 days?	Fri 2/5/21	Fri 2/5/21	Damian Hupka[33%] Duncan Tennant[33%]	DESIGN	1 hr	262
		Weekly Meeting with Supporter/Grad Mentor	0.2 days?	Fri 2/12/21	Fri 2/12/21	Damian Hupka[33%] Duncan Tennant[33%]	DESIGN	1 hr	280
		Weekly Meeting with Supporter/Grad Mentor	0.07 days?	Fri 2/19/21	Fri 2/19/21	Damian Hupka, Duncan Tennant, Nathan Pecoraro, William Clampett,Z	DESIGN	1 hr	281
		Weekly Meeting with Supporter/Grad Mentor	0.07 days?	Fri 3/19/21	Fri 3/19/21	Damian Hupka, Duncan Tennant, Nathan Pecoraro, William Clampett,Z	DESIGN	1 hr	294
		Weekly Meeting with Supporter/Grad Mentor	0.07 days?	Fri 3/26/21	Fri 3/26/21	Damian Hupka, Duncan Tennant, Nathan Pecoraro, William Clampett,Z	DESIGN	1 hr	303
		Weekly Meeting with Supporter/Grad Mentor	0.07 days?	Fri 4/2/21	Fri 4/2/21	Damian Hupka, Duncan Tennant, Nathan Pecoraro, William Clampett,Z	DESIGN	1 hr	304

Figure 11: Project Plan Gantt Chart Continued