

**CG4002 Computer Engineering Capstone Project**

2022/2023 Semester 1

**“Laser Tag++”**

**Design Report**

< Think about splitting your team into who will take care of specific components and whether you want subteams, e.g. H/W, comms, S/W. Having a nominal team/subteam lead is also a good idea. Throughout the design report, indicate clearly who will be working on which part of the project individually and who wrote up which sections of the design report. For joint work sections, such as Sections 1 and 2, indicate so.

Each team member should also have a secondary component, this is to mitigate any eventuality like the primary in charge falling sick or dropping the module.>

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Group **XX** | Name | Student # | Primary Component | Secondary  Component |
| Member #1 |  |  | Hw Sensors |  |
| Member #2 |  |  | Hw AI |  |
| Member #3 |  |  | Comms Internal |  |
| Member #4 |  |  | Comms External |  |
| Member #5 |  |  | Sw Visualizer |  |

The main aim of this report is to **explain your ideas and designs.** Make sure the reviewers have enough details to give you feedback and advice.

The report will be graded based on:

1. Quality of information.
2. Quality of design: Clearly thought out, Feasible, Easy to manage etc.

**Section 1 System Functionalities**

Describe the intended system functionalities**.** It is important to let us (the reviewers) have a clear idea of how the system functions from an external viewpoint (i.e. the user viewpoint).

You can use any of the following:

* Use case diagram with use case description
* Feature lists
* User story

Note that you are not limited to the above options.

**Section 2 Overall System Architecture**

Please give:

1. Use a UML deployment diagram or similar to illustrate the high-level system architecture of the intended system. Among other things, indicate clearly:
   1. What do you intend to implement on the Beetle and the Ultra96.
   2. The communication protocol between the Beetles, laptops, Ultra96, evaluation server and phone visualizers.
   3. All hardware components in your design and how they are interfaced with the Beetles and Ultra96.
   4. Software interfaces between the 5 components
2. Description/drawing of the system's intended final form, i.e. as a wearable shirt, vest etc. Try to indicate the placement of the hardware components if possible.
3. The main algorithm for the AR laser tag game. Start with a 4-6 major steps algorithm then, briefly elaborate on how to accomplish each step (e.g., what known algorithm to use, what hardware component plays a part, if machine learning is used, how training data is gathered and used etc.).
   1. If appropriate, give a UML sequence / collaboration diagram.

**Section 3 Hardware Sensors**

Please provide:

1. Clear identification of components/devices (part numbers) and the supporting components required to get them to work, such as resistors and capacitors. Attach/give links to the datasheets.
2. Pin table: Which pins/interfaces of Beetle/Ultra96 will be used, and how the various components/devices are connected to these pins.
3. Schematics: How will you be connecting the various components?
4. Operating voltage level and current drawn by each component/device, and how your design takes care of these requirements.
5. Some idea of the algorithms/libraries you will be using.

**Section 4: Hardware AI**

1. Describe Ultra96 synthesis and simulation setup.
2. Detail what neural network you will be exploring.
3. How will you train and test the model?
4. Detail how the specified neural network model will be realized on the FPGA board.
5. Detail how you will evaluate the design’s timing, power and area with the given dataset.

**Section 5 Internal Communications**

1. Describe how you will be managing task(s) on the Beetles and threads/processes on the laptop.
2. Detail how you will setup and configure the BLE interfaces.
3. Show a detailed protocol on how you intend to coordinate between the Beetles and laptop: Detail the handshaking, packet types, packet format, baud rates.
4. Discuss how you will handle reliability issues , like packet fragmentation and connection drops.

**Section 6 External Communications**

1. Detail how you will communicate between Ultra96 and the evaluation server. Explain when and how secure communication is ensured. Detail the message format, encryption protocol and library APIs you will be using.
2. Detail how you will communicate between laptops and Ultra96. How will you handle tunneling?
   1. Detail the message format
3. Discuss how you will handle concurrency on the laptops or Ultra96.
4. Discuss how you will communicate between Ultra96 and Visualizer.
   1. Detail the message format.

**Section 7 Software Visualizer And Game engine**

1. Describe your user survey and how it helps you arrive at the visualizer design
2. Visualizer design: What data will be displayed, how will you place your phone visualizer, and what design constraints are faced?
3. Visualizer software architecture: What software frameworks and libraries are you using? What are the various modules of your phone visualizer? What data inputs will be streamed to the phone, and how (work with External Comms)?
4. Phone sensors: What sensors will you use and how will you access them?
5. Discuss how you will overlay the scoreboard over the camera feed
6. Discuss how you will enable AR of game actions shown on opponents
7. Game Engine:
   1. Design of the game engine
   2. Details of thread management

**Section 8 Project Management Plan <Only for initial Report ☺>**

Give a brief timeline (weekly will do) of your internal deliverables and milestones. Indicate who will be working on which milestones and deliverables. Try to align with the evaluation timeline to ensure you have enough time to meet all class requirements. A Gantt chart or similar is a good way to summarize your plan.

**Section 9 Societal and Ethical Impact <Only for Final Report ☺>**

This is where you get to dream big and discuss the potential societal implications of your project!

How can your AR laser tag system be generalized to other wearable systems and used for greater societal impact? How will AR wearables impact ethical concerns, for instance, privacy? How can such concerns be balanced?

Go wild! ☺

**References**

Please ensure that you cite and list \*all\* references that helped you in your design here.