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| University of New Mexico • National Association of Anorexia Nervosa and  Associated Disorders | | **Final Project** **Report**  **FPGA Videogame** |
|  | **Intermediate Logic Design**  Professor: Jim, Plusquellic  Student: Montoya, Zachary  Submitted: December 15th, 2022 | |
| Albuquerque, NM | | |

# Summary

This report is to summarize the work carried out for the final project for ECE338 Intermediate Logic Design, a video game implemented on the Xilinx Zybo Z7-10A SoC written in VHDL. A revision yielding strong elements of the games vision was achieved that features a vibrant border, multiple module instantiated asteroids, a realistic space cruiser that is capable of 2-dimensional travel through outer space that can fire a realistic missile cluster! A revision history was included within the Weekly Update Tracker toward the end of this report to capture the progress of this project.

# Discussion

This project truly was a wonderful learning experience with VHDL and I whole heartly agree with the remarks given that most of the learning occurs within the last three weeks of the semester where the focus is on this. I was able to tune my iteration speed on this project by being generating revisions to the VHDL faster using a windows computer versus my OSX machine and I felt this greatly enhanced my learning experience.

The largest hurdle was to separate the asteroids and paddle into different modules, I latter found that the issue resided from a problem I accidentally created with my HDMI driver when moving the project around ironically. After this I was able to generate the missiles which are quite interesting because they update state with the ship, including velocity and ROM orientation. In addition, the missiles also capture the orientation of the ship during firing. This was an interesting task because there were several iterations where the missiles would either change orientation after fired when the ship changed orientation or would relaunch into a different direction when the ship changed orientation and fire button was pressed. These bugs were resolved using the classical ready and start signals between the spaceship and the missile, the missile would only issue ready once it has reached the boundary of the screen only allowing for one shot to be fired at a time.

Per recommendation a text module was beginning to be implemented to capture a score along with a counter of when the missiles contact the asteroids or when the asteroids contact the ship. The core of this interaction would also have been a collider which was also not implemented but nonfunctioning attempts were made to track the boundary positions of the entities using ports.

# Conclusion

Ultimately, in the same breath I personally recognize this project implementation as successful and am proud of the work created especially given the time and resources, but also wish there was more time perfect the functionality of this game.

**Weekly Update Tracker**

The purpose of this section is to provide regular updates, occurring every Wednesday, describing what has been worked on and what features were added to the game. Because this report is cumulative, the current updates will be added on top of the previous week’s updates to form a reverse chronological order the features and revisions made. The authors responsible for the revisions created where included in the respective revision number. See Table 1 below.

Table 1 - Weekly Update Tracker

| **Date: 12-07-22** | **Revision Number: 4** |
| --- | --- |
| **Title: Multiple Asteroid Instantiations via modules, missiles, ship ROM, and the beginnings of text** | |
| **Authors: Zachary Montoya** | |
| The objective of this revision was to finalize the game including all the options committed to during the initial project proposal. This however was not possible given the time and resource constraints, as this group project migrated into a solo effort. I am however incredibly proud to provide an update that the scope of this final revision does include multiple asteroid instantiations via modules, missiles, a newly improved orientation dependent ship ROM, and the foundation for a text score. Given that these updates are too large to include within snippets of figures it is recommended that the reviewer of this document reference the attachments include with this document. | |

| **Date: 12-07-22** | **Revision Number: 3** |
| --- | --- |
| **Title: Walls, 2D Ship Movement, multiple asteroids** | |
| **Authors: Zachary Montoya** | |
| The objective of this revision is to add (1) walls for the game to interact within, (2) 2D dimensional ship movement that has independent button control, and (3) multiple asteroids. However multiple asteroids were only able to be implemented within one file not multiple modules that are instantiated via a master controller this is still in progress.  Figure 1 – Additional game boundaries    Figure 2 – Modified constraints to accommodate the new btns    Figure 3 – Additional game boundaries | |

| **Date: 11-30-22** | **Revision Number: 2** |
| --- | --- |
| **Title: Asteroid Element Size Increase and Horizontal Logic of the Paddle** | |
| **Authors: Anindya Bal and Zachary Montoya** | |
| The objective for this revision was to: (1) increase the dimensions of previously modified asteroid element, (2) improve the asteroid element’s visual design, (3) include horizontal movement to the paddle. This third objective is motivated by a larger goal of turning the paddle into a spaceship used for destroying asteroids! These three minor objectives were met. See images below of some of the core code changes to implement these objectives:  Figure 4 - Lines 54 of pong\_graph\_st.vhd file    Figure 5 – 16x16 BALL ROM in the pong\_graph\_st.vhd file    Figure 6 – Paddle Movement Requests in the pong\_graph\_st.vhd file | |

| **Date: 11-23-22** | **Revision Number: 1** |
| --- | --- |
| **Title: ROM Mask Manipulation** | |
| **Authors: Zachary Montoya** | |
| The objective for this revision was to modify the shape of the ROM mask to change the shape of the outputted image. This is usefully to provide a variety of different shapes for the BALL element to display during the code execution. Note that the ROM mask map and associated BALL element was left at its original 8x8 dimensions, and the mask map was changed so the ball would visibly appear as an asteroid.  Figure 7 – 8x8 BALL ROM in the pong\_graph\_st.vhd file | |

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| Date: | 11-21-22 |
| Subject: | ECE595/ECE338 Intermediate Logic Design Project Request |

Dear Professor Plusquellic,

The purpose of this memorandum is to submit a formal request for the ECE595/ECE338 Intermediate Logic Design Project Description for your consideration. The video game implemented in VHDL selected for submission is the default game: ALIEN CONTROLLED ASTEROIDS with ALL options selected.

The options our team is seeking to include in our game’s implementation is as follows:

1. Optional: Firing operations may also involve firing ‘cluster bombs’ that destroy all asteroids within a fixed radius (you should limit how often a user to use cluster bombs).
2. Optional: An alien spaceship can be added that is under control of a second player
3. Optional: The number of asteroids can increase in number and speed as the game progresses
4. Optional: Asteroids can gravitate automatically toward the space ship
5. Optional: Asteroids can be directed by an alien, which is controlled by a second player
6. Optional: You can add additional space ships after the user destroys a fixed number of asteroids.

We are confident that although this is not a novel game topic that a successful implementation shall yield full marks for the project assignment.

Kind regards,

Anindya Bal

Zachary Montoya