1. Overview

1.1. Objectives:

The object of this design is to design and build an interactive game with components soldered onto a PCB. Educationally, this will allow us to learn how to interface a sensor with the embedded system in real-time, designing and building a PCB, and developing a game. Our goal is to create a fun interactive game that can be played with hand movements.

1.2. Roles and Responsibilities:

We're designing and building a space-shooter that is controlled using a proximity sensor, therefore you can control the movements of the spaceship using hand motions. The engineers for this project are Tianyun Duan and Tahir Haideri, the client is the TA for EE45L and Dr. Valvano. The two engineers will work together to design the PCB using PCBartist. The two engineers will work on the software and hardware together, assigning specific tasks as needed.

2. Function Description

2.1. Functionality

Overall, this system is a space shooter game controlled by a proximity sensor and a switch. The spaceship alway stay on the left hand side of the screen, and the background will advance horizontally towards the right hand side, and the enemies will come out from the right. There will be different types of enemies, some weak and some strong. And there will be bosses in each chapter as well. The player's spaceship may pick up upgrades along the way and have a higher firepower. The player will also have access to a limited amount of bombs in each chapter.

2.4. Performance

Performance is critical in our system. There are two main measurements that we will take to ensure that we have a satisfactory gaming experience for the players: input delay and frame rate.
First off, we will be using a proximity sensor for input. Since we have not yet received the part, we do not know how long the sampling typically takes. In short, we want the delay between when the user moves his/her hand and when the spaceship actually moves on the screen to be as short as possible. We will use the logic analyzer to check how long the sampling ISR takes to ensure that this delay is within a range.
Secondly, we want the game to be displayed at least at an acceptable frame rate, 20 FPS. This can be easily measured. We can simply use SysTick to count down 1 second, and check how many times the loop was executed (the screen gets updated each time the loop was executed).

2.5. Usability:

The user will interact with the game via a proximity sensor and a switch.
For the proximity sensor, the user would move his/her hand up and down directly above the proximity sensor (facing upward) in order to control the spaceship on the screen to move up and down. The switch will be used for the classic full-screen bomb. Normal bullets will be shot automatically, so there is not switch for that.

3. Deliverables

3.1. Reports

Lab 7:

- Requirements Document
- Schematic - A significant amount of this grade will be on how you plan to debug your board
    - Test points
    - Proper use of the logic analyzer
- Professor's signature on the SCH file - Due with Lab submission along with a copy of the above

Lab 11:

- Testing procedure and testing data
- YouTube video

3.2. Outcomes

Lab 7:

A) Objectives

1-page requirements document

B) Hardware Design

Regular circuit diagram (SCH file)

PCB layout and three printouts (top, bottom and combined)

C) Software Design

Include the requirements document (Preparation a)

D) Measurement Data

Give the estimated current (Procedure d)

Give the estimated cost (Procedure e)

E) Analysis and Discussion

Include a copy of the reviewed SCH/PCB and signed by your professor

Lab 11:

A) Objectives

2-page requirements document

B) Hardware Design

Detailed circuit diagram of the system (from Lab 7)

C) Software Design (no software printout in the report)

Briefly explain how your software works (1/2 page maximum)

D) Measurement Data

Include data as appropriate for your system. Explain how the data was collected.

E) Analysis and Discussion (none). The YouTube video is required

Links to data sheets:

Time of Flight Sensor: https://cdn-learn.adafruit.com/assets/assets/000/037/547/original/en.DM00279086.pdf

Buttons: