v1.0

Final Project Proposal

Year: 2024 **Semester:** Spring **Team:** 1 **Project:** Dungeon Crawler Board
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Team Members (#1 is Team Leader):
Member 1: Landon Carre **Email:** lcarre@purdue.edu
Member 2: Jackson Luna-McCrocklin **Email:** jlunamcc@purdue.edu
Member 3: Grace Whitaker **Email:** gwhitake@purdue.edu
Member 4: Neil Brown **Email:** brow1950@purdue.edu

1.0 Project Description:

The Interactive Dungeon Crawler is an electronic game board that visualizes and simulates the dungeon crawler experience commonly seen in role-playing games such as Dungeons and Dragons. The board will feature a 16-by-16 hex-based 2D map, a 4-by-4 keypad, a 2.2 inch LCD, a USB port, and a power cord. The 2D map will serve as the playing area of the board, using LEDs to represent obstacles, characters, and chests, as well as possible movements, combat, and vision. The board will use 16 WS2812B LED strips, each connected to its own GPIO pin. The LEDs will be controlled using DMA and PWM. Underneath each hex on the board will be a Hall Effect sensor to detect character position and movement. The sensors will be connected via 16 I2C I/O expanders: one for each of the rows. The character tokens will have magnets attached to interact with the sensors. The 4-by-4 keypad will be used to input dice rolls and select actions. The keypad will be connected using a GPIO matrix. The LCD will display character information and status, as well as prompts for the players and DM to respond to in order to facilitate gameplay. Character information and status will include health, gold, and enemies killed. The prompts will show available actions and ask for dice rolls. The USB will be used to port over initial map and character information from a computer. A separate application will be used to customize maps, place characters, and input character information. The microcontroller will parse the information from the USB and load the information onto the game board's map, as well as provide the starting stats for all characters to be used in the gameplay code. The gameplay will be turn-based and will use object-oriented class systems to define hexes, players, and monsters. Pathing algorithms will be used to simulate possible character movements, actual movements, and field of view. The fighting will consist of melee combat, where players and monsters must be adjacent in order to engage. Gameplay ends when all enemies have been eliminated and all chests have been looted, or all players have been eliminated. The board will be powered via an outlet using 5V 8A of power.

2.0 Team Member Expertise and Team Roles and Responsibilities:

2.1 Team Member Expertise:

Landon Carre: Has gained experience during internships at NSWC Crane in Indiana and Micron in Germany. At NSWC Crane a tool was made in python extracting design parameters for different integrated circuits. This required both software design as well as in-depth study of simplified circuitry. Through Micron experience was gained optimizing characterization scripts

in python for DRAM memory chips. Debugging and reverse engineering large software projects were large areas of focus. Opportunities were also given to understand high-level software testing on DRAM hardware architecture. Due to working with a wide variety of people and having a broad collection of experiences it was decided that Landon is fit to be the team leader.

Jackson Luna-McCrocklin: Has experience in embedded C programming on an STM32, circuit design, hardware component interfacing, and LCD graphics design all from his ECE 36200 course project. He also has some experience in wood and metal working and CAD from personal projects. With his knowledge, Jackson is best fitted as the Hardware Lead.

Grace Whitaker: Has experience with website building and networks using PHP, HTML, and JavaScript. She also has experience in previous internships with GitHub and GitLab for collaborating and planning projects on software teams. She also has some CAD (SolidWorks), 3D Printing, circuit design, embedded programming and hardware experience from personal projects and previous classes. Due to her experience with a wide range of software languages and working in several professional software teams, Grace is best fitted as the Software Lead.

Neil Brown: Has experience in a wide range of software focused applications including embedded C programming in ECE 36200, control software for robotics and AI software in python. Neil has also developed APIs for a Node.js package manager which developed skills in JavaScript, Python, and GCP. Also has adequate experience debugging hardware using lab equipment like power supplies and oscilloscopes. Due to his combination of software and hardware experience Neil is best fitted to be the Systems Lead.

2.2 Team Roles and Responsibilities:

Role	Team Member
Team Lead	Landon Carre
Systems Lead	Neil Brown
Hardware Lead	Jackson Luna-McCrocklin
Software Lead	Grace Whitaker

Figure 1. Team Roles

3.0 Homework Assignment Responsibilities

Design Component Report		***Professional Component Report***	
A3-Software Overview	Landon Carre	A9-Legal Analysis	Landon Carre
A4-Electrical Overview	Neil Brown	A10-Reliability and Safety Analysis	Neil Brown
A6-Mechanical Overview	Jackson Luna-McCrocklin	A11-Ethical/Environmental Analysis	Grace Whitaker
A8-Software Formalization	Grace Whitaker	A12-User Manual	Jackson Luna-McCrocklin

Figure 2. Assignment Responsibilities

4.0 Estimated Budget

Mechanical	Estimated Cost
Frame	$50
Hex Dividers and Board Top	$20
Electrical	
Microcontroller	$30
Hall Effect Sensors	$15
LEDS	$120
LCD	$10
SD Card	$20
Power Adapter	$20
PCB	$50
Miscellaneous Electronics	$50
Total Budget	**$385**

Figure 3. Estimated Budget

The budget is broken into two categories, mechanical and electrical. The mechanical systems are the physical attributes of the board not related to any software or electrical systems. The electrical systems are the various devices and sensors that will need to be installed and wired. Purdue's budget for ECE 47700 is estimated to cover the project's entire cost.

5.0 Project Specific Design Requirements

The following are the five PSDRs for the Dungeon Crawler Board:

1. PSDR #1 (Software): An ability to simulate a turn-based combat game involving pathing algorithms and object-oriented class systems.
2. PSDR #2 (Software): An ability to customize maps and characters on a computer via a Unity-based application.
3. PSDR #3 (Hardware): An ability to control rows of LED strips with DMA and PWM on microcontroller GPIO pins.
4. PSDR #4 (Hardware): An ability to control an array of Hall Effect sensors with I2C I/O expanders on a microcontroller.
5. PSDR #5 (Hardware): An ability to port information from a computer to a microcontroller via USB OTG.

6. Extra PSDR #1: An ability to store multiple preloaded maps on an SD card using SPI.
7. Extra PSDR #2: An ability to simulate ranged combat using line of sight algorithms, expanding the object-oriented class systems.