Pixie Escape Spell Game

ECS511U: INDIVIDUAL PROJECT

DESIGN DECISIONS

The design of the game was inspired by the IR reflector wands recently released at the Wizarding World of Harry Potter. Guests can purchase these wands and look for special plaques on the ground indicating that they can use their wand to interact with the environment. They can then move the wand in a particular pattern corresponding to a spell, which results in a fixed reaction, such as a water fountain turning on or a suit of armor fixing itself.

The "Pixie Escape Spell Game" is a prototype of an IR LED "wand" interacting with an IR sensor/RGB LED pair (sensor package) mounted in the environment (a piece of cardboard). It acts as a proof of concept for increasing spontaneous environmental interaction in theme parks through the aid of sensor packages. This sensor package would allow multiple guests to interact at once, instead of limiting guests to waiting in a line for the spell-casting plaque to become free.

As such the concept of Battleship was modified to be Harry Potter themed. Instead of selecting three adjacent LEDs representing a sunk ship, I chose for three pixies to be placed randomly on the game board. The emphasis of the game is on the user learning and having fun with the wand interactions (choosing LEDs and casting spells) than the game theory of Battleship. I expanded to 16 LEDs so there were enough components to be arranged in a "W" shape for the "wingardium leviosa" spell while still scattering other LEDs around so the "W" wasn't the only presence on the board. RGB LEDs were chosen to enable better visual feedback, e.g. green for hit and red for miss, since there is a lack of a visual display.

Six daisy chained shift registers connected to the PWM pins expand the number of pins, making it possible to connect 16 RGBs (requiring 64 pins). The multiplexer expands the analog input pins allowing 16 IR sensors, as the Arduino natively has only six Analog Input pins.

The serial monitor was almost completely removed. If opened at the beginning of a game it will print the location of the three pixies, but otherwise is unnecessary. The programmer can choose to uncomment some debugging print statements scattered throughout the code to print the raw IR values, etc. This is not normally printed as it slows down the game, since the Arduino is not concurrently listening to all 16 sensors, but has to change the multiplexer's address to each channel in a for loop to gather one data point. Constantly printing values to the serial monitor delays the system too much for the user to interact with the game.

TESTING CONDUCTED

The code was heavily tested before presentation. Hundreds of runs were performed for debugging purposes, as the multitude of sensors and cables meant that moving the system caused wires to come loose. Next steps would include soldering elements onto a PCB to make the system more permanent. The calibration step was run many times during testing to determine if the R, G, and B wires of the LED were properly connected. Raw IR sensor values were also printed out during debugging to ensure they hovered around zero when no IR LED was present. IR values floating around 200-300 means the ground wire was jostled and disconnected.

Testing was also conducted with my flatmates to determine if the interface was intuitive and engaging. Testing also allowed thresholds to be fine-tuned to prevent LEDs from accidentally triggering from the additional ambient light caused by other LEDs turning on, or any increase in noise.

SHORTCOMINGS

Testing revealed some shortcomings of the system.

- IR sensor noise increases as the number of RGB LEDs lit up increases, causing some LEDs to trigger a "guess" even though the user did not select it. This only happened when almost the entire board was lit up, and only occurred once or twice during testing.
- There should be an increased delay between the spell casting mode and guessing mode. The current delay allows users to accidentally trigger LED8, the last in the spell figure, as their next guess because they leave their wand hovered over it after completing the spell.
- The IR sensors and LED are incredibly directional. Though the sensors can be triggered from far away, the user must be pointing the LED within a couple degrees of the sensor's line of sight. Mounting the sensors in small parabolic mirrors could help increase the surface area of the sensing region.
- The vast number of wires makes transport difficult, and some debugging must occur every time it is moved.
- Some users mistake the frosted RGB LED for the IR sensor, placing the IR LED over the RGB LED instead of the sensor. This will not trigger anything.
- Users tended to hold the wand further away from the LED, which was less stable and made it harder for them to properly aim the LED. A wooden prototype would aid this issue.