**The original plan for prototype that I created (for the Arch)**

**Project Objective**

The purpose of the project is to create an interactive device that changes colors and moves a servo motor based on the distance of an object from an ultrasonic sensor. The device uses RGB LEDs to visually represent distance measurements through color transitions, providing an engaging and educational demonstration of sensor integration with real-time reaction.

**Operational Mechanics**

My project utilizes several components integrated with an Arduino board, including an ultrasonic sensor (HC-SR04), RGB LEDs, and a servo motor. The ultrasonic sensor measures distances by emitting ultrasonic waves and receiving the echo back. The distance measured by the sensor dictates the color displayed by the RGB LEDs and the angle at which the servo motor positions itself. The color transition smoothly changes as the measured distance awyass, making a effect from one color to another.

**Main Components and Setup**

**The key components include:**

Arduino Uno Board: Serves as the central processing unit controlling all other components.

HC-SR04 Ultrasonic Sensor: Measures distances by using ultrasonic sound waves.

RGB LED Module: Displays colors that change based on the distance measured by the ultrasonic sensor.

Servo Motor: Moves in relation to the distance detected, providing a physical response along with the visual feedback.

16-Button Keypad: Allows manual control over the color displayed, enabling interaction beyond automatic sensor readings.

**Encountered Obstacles**

One of the main challenges was managing the smooth transition of colors in response to changing distance readings, ensuring stable readings from the ultrasonic sensor, and integrating multiple components without causing interference. Additionally, debouncing the keypad input to prevent multiple triggers from a single press was a practical issue that needed addressing to enhance the user interaction experience.

**Solutions and Adaptations**

To manage smooth color transitions, I implemented a function that adjusts the color change rate, making transitions appear visually appealing. For stable sensor readings, I added code optimizations to filter out noise. Electrical issues were addressed by carefully wiring and ensuring adequate power supply to all components.

**Potential Enhancements**

Future improvements might include adding connectivity features such as Bluetooth or Wi-Fi to allow remote monitoring and control. Integrating more sensors, like light or temperature sensors, could also provide additional data points for more complex interactions and responses. Enhancing the user interface with a small display could offer direct feedback or instructions to the user, making the device more intuitive.

**Educational Alignment**

The project present with the course objectives by demonstrating practical application of embedded systems, sensor integration, and interactive design. It incorporates fundamental principles of electronics, programming, and mechanical design.