Question 1: Introduction

The theme I decided on is "Marvel Superheroes" it is inspired by the many superheroes that are in films, games and comics. Targeting superhero fans of all ages, this experience plans on giving them a chance to step into the role of their favorite characters. Rather than just idly watching those heroes through a screen, they will be given a chance to become them, users will be able to strike poses, test their quick reflexes and even use their voice as weapons, each triggering different effects through interactive technology. I wanted each concept to be inspired by different heroes so that users can have a sense of familiarity with it and enjoy it more from a superhero lover's perspective, they each have different sensors to make the experience fun and interesting for everyone, no matter young or old. Using a mix of sensors from motion sensors to touch sensors and finally sound sensors, making users be able to summon lightning with a Thor-like pose, dash through reflex challenges like speedster Quicksilver, or defeat Dr Doom with the power of their voice which is inspired by Banshee.

Question 2: Concepts

Concept 1: Hero Pose Activation

Technical Perspective:

This concept uses two sensors, the Microsoft Kinect sensor and camera with gesture recognition software such as OpenCV for more accuracy in analyzing the gesture. The kinect sensor is used for full body tracking, capturing arm movements and posture, it is good for identifying gestures and movements like raising a fist in the air to simulate thor summoning lighting powers using his hammer. This will work alongside the camera with gesture recognition software that will detect more specific gestures needed to activate the effects on screen like Spiderman's web shooting gesture. Once a gesture has been identified, the application used, like Unity will then trigger a visual effect on a connected screen.

User Interaction:

The user will stand in front of the screen and adjust themselves so that their whole body can be seen by the camera and kinetic sensor, on the side of the screens there are specific superhero poses they can try out. The user will then pick which one they want

to start off with, for example raising their palm outwards towards the screen like Iron Man where the system will detect it and activate the matching effects, such as repulsor blasts firing from their hand on the display. Different poses will activate different hero powers, giving users the thrill of becoming a superhero. The variety of poses also encourages users to try them all to see the different effects and abilities they each trigger.

Concept 2: Speedster Reflex Run

Technical Explanation:

This concept uses two sensors, the Light Sensor (Adafruit Light Sensor TSL2591) to detect when a player approaches the panel, triggering the game when the sensor registers a drop in brightness. SparkFun Capacitive Touch Sensors are placed behind light-up pads, detecting changes once touched. An Arduino microcontroller controls the sequence, randomly lighting one pad at a time once a signal is given from the light sensors, it will then signal for the pad to light up. When a pad lights up, the system waits for a touch within a set time (1 second). When the sensor registers a touch, it will send signals to a 7-segment LED display, where it will increase the score using numbers. This repeats until the timer ends, after then the final score is displayed before the system resets.

User Interaction:

The user will first step up to the wall panel, their shadow casting over the touch pads, starting the game. When a light flashes on a pad, they must tap it as quickly as possible with their finger with the goal of hitting as many flashing pads as they can with limited time. A successful hit adds a point to their score, shown above them on a digital display. The lights will keep appearing until the time runs out, lights will stop appearing and the users can see their final scores on the digital display above them, they can then decide if they want to try again to beat their score or move on.

Concept 3: Sound Showdown

Technical perspective:

This concept uses two sensors, a proximity sensor (HC-SR04 Ultrasonic Sensor) and a sound sensor (Adafruit Electret Microphone Breakout). The HC-SR04 is used to detect when a person is within a set distance (1–1.5 meters) of the display wall. The

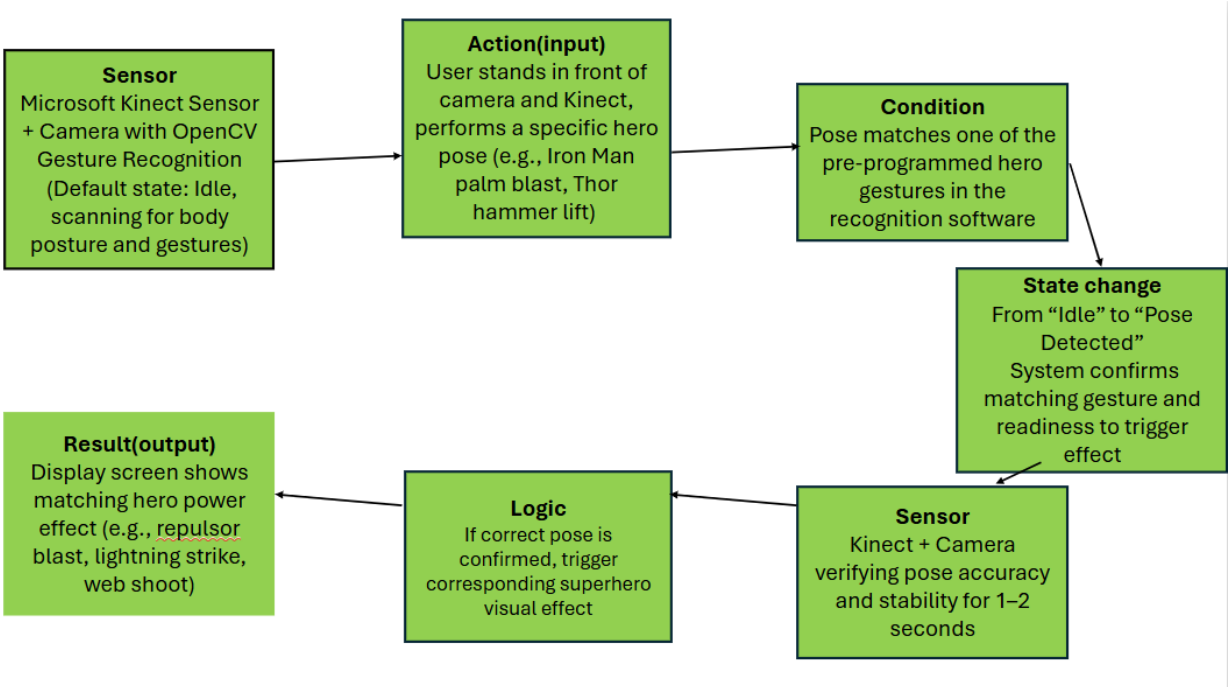
microphone sensor will become active and start to pick up sound from volume levels, sending the data over to a microcontroller (such as an Arduino), which will pick up the loudness and maps it visually onto a vertical sound bar meter on the screen with horizontal line across the bar shows the target volume threshold, next to a projection mapping of the villain on the wall using TouchDesigner. If the microphone detects that the set volume (sustained loudness for 10 seconds) has been met, the system triggers a win animation onto the wall.

User interaction:

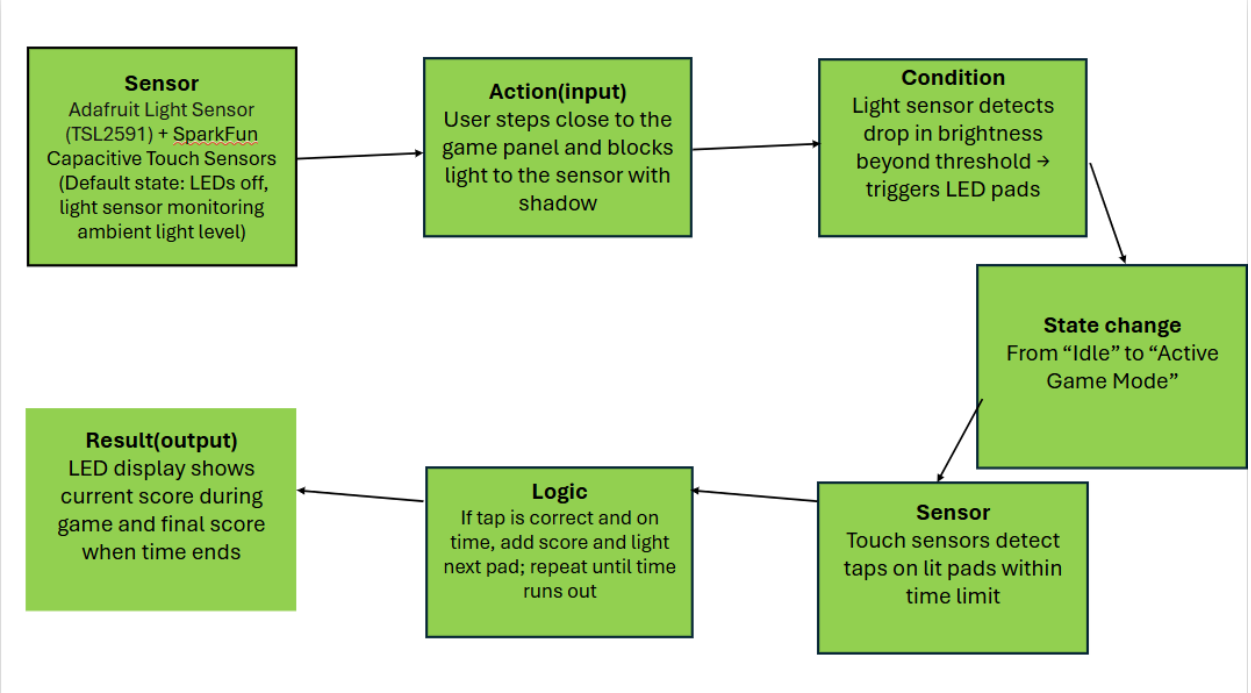
The user first approaches the screen with a projected image of a villain, automatically getting detected by the proximity sensor. Once they're close enough, the screen activates, and they see a vertical sound level bar with a goal line. The user will then be prompted to defeat Dr Doom on screen by making loud noise, such as yelling, cheering, or singing for 10 seconds. As they make noise, the sound bar fills up in real time and if the participants have reached the set loudness they needed to make, the screen will then show the villain getting defeated by their power. If the user fails, Dr Doom will taunt them on screen and asks the user to try again

Question 3: Flow charts

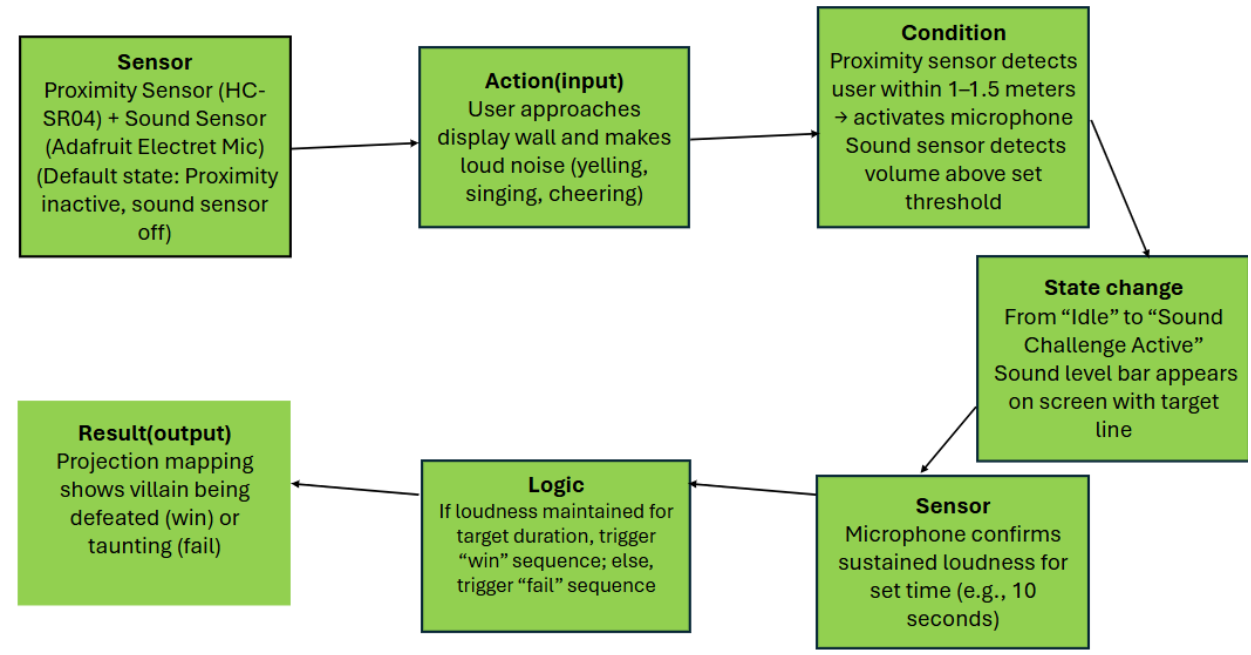
Concept 1



Concept 2



Concept 3



Question 4: References

Technical References for Concept 1

- GitHub: Gesture detection with Kinect + Unity3D
  A practical sample repository demonstrating how to capture skeleton data and define custom gesture detection in Unity using Kinect sensors.
  URL: https://github.com/viggin/GestureDetect GitHub
- Blog: Implementing Kinect gestures – Vangos Pterneas
  A written tutorial walking through gesture recognition fundamentals using Kinect and Unity, with C# code examples.
  URL: https://pterneas.com/2014/01/27/implementing-kinect-gestures/ Pterneas
- YouTube Video Tutorial: Custom Gesture Recognition with the Kinect in Unity
  A visual walkthrough of recording, defining, and detecting custom gestures using Kinect in Unity.
  URL: https://www.youtube.com/watch?v=E9cZHStQcYM YouTube
- Hand Detection Tracking in Python using OpenCV
  Tutorial on real-time hand gesture recognition with OpenCV, explaining hand landmarks and their use in gesture detection.
  https://gautamaditee.medium.com/hand-recognition-using-opencv-a7b109941c88

Technical References for Concept 2

1. Light Sensor (Adafruit TSL2591)

- Adafruit TSL2591 High Dynamic Range Digital Light Sensor – Wiring & Test
  Description: Official guide from Adafruit explaining how to wire the sensor, install libraries via Arduino Library Manager, and run test code including setting gain and integration time.
  URL: https://learn.adafruit.com/adafruit-tsl2591/wiring-and-test Adafruit Learning System
- Interfacing TSL2591 Ambient Light Level Sensor with Arduino
  Description: Step-by-step tutorial showing wiring to Arduino, reading lux values via serial monitor or LCD, and using programmable interrupts. Great for detecting when a player steps in front.
  URL: https://simple-circuit.com/interfacing-tsl2591-light-sensor-module-with-arduino/ Simple Circuit

2. Capacitive Touch Sensor (SparkFun AT42QT101X)

- AT42QT101X Capacitive Touch Breakout Hookup Guide – SparkFun
  Description: Comprehensive tutorial for hooking up the AT42QT1010 to Arduino including wiring diagrams, basic example code, and instructions on mounting custom touch pads.
  URL: https://learn.sparkfun.com/tutorials/at42qt101x-capacitive-touch-breakout-hookup-guide/all

Technical References for Concept 3

1. Proximity Sensor (HC-SR04 Ultrasonic Sensor)

- Ultrasonic Sensor HC-SR04 and Arduino – Complete Guide
  Description: A well-detailed tutorial covering sensor operation, wiring diagrams, Arduino code, and technical explanations of distance measurement mechanics.
  URL: https://howtomechatronics.com/tutorials/arduino/ultrasonic-sensor-hc-sr04/ How To Mechatronics
- Title: Complete Guide for Ultrasonic Sensor HC-SR04 with Arduino
  Description: Offers a schematic diagram, sensor specs (range, resolution), and a sample Arduino sketch—perfect for beginners and quick deployment.
  URL: https://randomnerdtutorials.com/complete-guide-for-ultrasonic-sensor-hc-sr04/ Random Nerd Tutorials

2. Sound Sensor (Microphone Module for Loudness Detection)

- Guide for Microphone Sound Sensor with Arduino | Random Nerd Tutorials
  Description: Explains how to connect a sound sensor module to Arduino, with guidance on wiring, analog/digital pin usage, and example code that outputs sound detection results.
  URL: https://randomnerdtutorials.com/guide-for-microphone-sound-sensor-with-arduino Random Nerd Tutorials
- How to Use a Microphone Sound Sensor with Arduino
  Description: A simple, step-by-step guide to setting up sound detection using a sensor, how to configure sensitivity, and how to read noises.

URL: https://arduinoexpert.com/blog/how-to-use-a-microphone-sound-sensor-with-arduino/ arduinoexpert.com

Question 5: Reflection

Working on this concept, I learnt about how many different types of sensors there are that are used in interactions, from motion sensors and gesture recognition to proximity, light, and sound sensors. These were all new to me, since before, whenever I go to experiences, I do not really think about what kind of sensors they used for them, and I was surprised by how many sensors there are that can be used in interactions. For example, motion sensors can detect full body movements, while gesture recognition ones focus more on hand and finger actions which provides more accuracy. Proximity sensors are used to tell if there are people near, creating instant feedback without needing a button, same goes for light sensors. I also realised that sound sensors can be used creatively, such as triggering reactions based on claps or voice commands. Exploring these technologies made me appreciate how much thought goes into making these systems interactive for people and how important sensors are in making each experience.