Minimum Features

- Gesture Directions Drawn on Monitor - Scott
    - Graphics - Game display on the VGA monitor that streams the sequence of gestures (represented as arrows) that the user must perform
    - This will be fallback for the laser vector graphics plotter Scott has developed in case we cannot successfully utilize it with the laser galvos, though there are multiple of sets of galvos to use in the lab including Weston's and Gim's.
- Gesture recognition using NTSC camera and Green Gloves - James
    - Centroid Localization - Extract images from the NTSC camera, identify all green pixels, and compute the centroid locations for both the left and right hands. Plot locations of these centroids on VGA monitor.
    - Gesture Identification - Convert centroid trajectories into 8 known gestures and a flag that is asserted when no gesture is correctly detected. Indicate current measured gesture with number on hex display.
- Sound effect overlay on music for correct and incorrect gestures - James
    - Play music during the game and add sound effects for correct and incorrect gestures. These could consist of a simple 1 second horn sound for an incorrect gesture and harp for correct gesture (stored in BRAM).
- Music playing and speaker system- James
    - Use flash memory to store music to be played during the game.
- Game logic to handle gesture transition - Scott
    - Game Logic - Handles transition of gestures and takes into account timing to see if a gesture is completed within a reasonable duration
    - Sound Logic - Signals the sound system to overlay effects for different gestures
    - Galvanometer Control Logic - Signals to control the voltages that control the mirrors of the laser galvanometer. In addition there is an on-off flag to turn on and off the laser as different vector shapes are drawn in the vector shape buffer.

Expected Features

- Galvanometer Circuitry - Scott
    - Circuitry to control laser galvanometer to position the laser.
    - The laser will be turned on and off to allow separate vector shapes to be drawn without having false connections.
- Add UI menu for user control drawn by laser galvanometer - Scott and James
    - Game Menu - Allow user to select different settings of the game (e.g. song) using menu drawn by the laser galvo
    - Allow the user to navigate the menu and start the game by doing sequence of appropriate "tutorial" gestures.
- Gesture directions drawn by laser galvanometer - Scott
    - Game Gesture - Current gestures (represented as arrows) will be drawn alongside a box surrounding the current gesture to be performed.

- All items listed in Minimum

Stretch Features

- Add music composition feature (e.g. 2D musical grid) - James and Scott
    - Music composition mode can potentially consist of two separate types of play. One type of play could be typing on a “laser” keyboard to play different notes or instruments. The user would move virtual hands over the different keys to trigger the sounds.
    - Another option would be to have the laser trace and “remember” the paths of the hands and draw a spiral, and convert those two spirals into notes. The spiral would be stored in a BRAM which would gradually “forget” the last moves, creating a cool vanishing effect as the user “conducts” more moves. A simple mechanism to turn the spirals into sound would be to compute the rate of change the position and use that to control the “volume” of each individual sine wave generated from each hand motion. The curvature of the path in turn could be used to control the frequency. Combining these two together would allow the user to combine two different frequencies at two different amplitudes together by just moving their hands. Correlating the volume to motion would also encourage the user to move their hands at all, so that there’s never an appropriate long term game-play situation which doesn’t involve motion.
- Add bonus game e.g. pong (or bouncing score screen) - James and Scott
    - Vector graphics code has the ability to offset sprites in controllable way, so it would be easy to update the position of the vector sprites frame by frame.
    - This type of functionality may also be extended to a simple score screen at the end of the game, where the user’s “score” is plotted out of 100. The score could bounce around the boundaries of the screen for a fun effect.