Senior Design Project 1

Brief Specification:

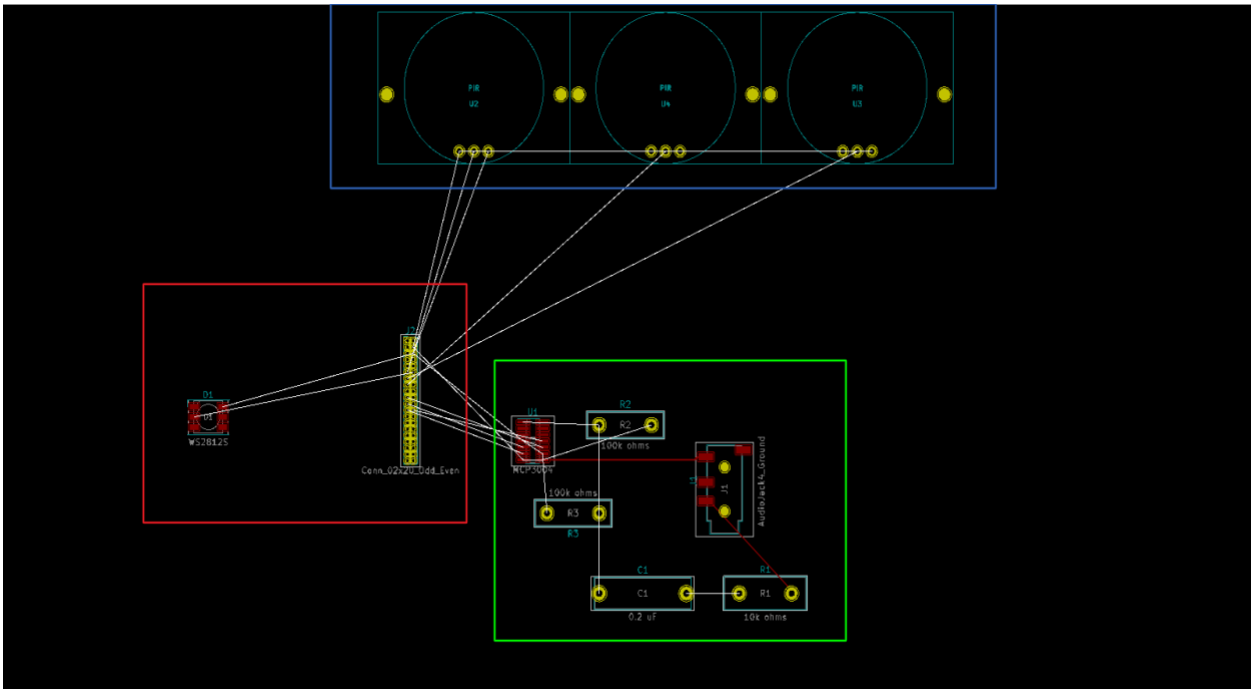
Basic Functionality: Our add-on board is designed to be used such that any custom LED matrix can create unique patterns using one of three various inputs. First, a microphone will be able to take in outside audio inputs and transmit said inputs. Audio inputs can also be provided by the built-in analog audio jack. Finally, three PIR sensors (left, right, center) will allow for heat-based motion to also be registered as inputs. These inputs will be taken by the SBC and sent to the LED matrix.

Power Supply required: Other than the SBC's own power supply, our add-on board will also make use of an external 5V (15A) DC power supply in order to power our LED array.

Current drawn: Our test matrix of 10x10 LEDs will use at most 6A from the 5V power supply when on (60mA per LED). The analog audio input will use a current of 25uA (voltage divider allows us to say 5V/200k ohms = 25uA). Each PIR sensor will use either 50uA when inactive or 65mA when active, which means that with 3 sensors the total current used will range between 150uA and 195mA. Finally, our microphone will use a current of 10uA when inactive and a current ranging between 2 to 10mA when active.

List of GPIO pins/communication buses: On our add-on board, our three PIR sensors use the GPIO 17, 27, and 22 pins from the Raspberry Pi. GPIO 18 is also used as the digital input for our LED array, and GPIO pins 8, 9, 10, and 11 are used by the analog audio input ADC's channel select, MISO, clock, and MOSI respectively

Assembling and using the board:



Shown above is the top copper layer of our board, created using KiCAD. The area in blue indicates the three PIR sensors, the area in green indicates the TRRS audio input and ADC, and finally the area in red indicates the location of LED array (shown by just one WS2812 LED) and the Raspberry Pi. While both the blue and green sections will be soldered to a perfboard, both the Raspberry Pi and LED array will not. Instead they will use simple wiring rather than permanent soldering in relation to the rest of the board.

For further information, see attached schematics.

Installing and using the Software Library:

Several prerequisite libraries should be installed before use. These include the Adafruit NeoPixel library, the Adafruit CircuitPython library, the Adafruit MCP3xxx Library and the wiringPi library.

CircuitPython Installation Instructions:

The Adafruit NeoPixel and MCP3xxx libraries are dependent on Adafruit's CircuitPython library. Adafruit CircuitPython is installed through the Adafruit_Blinka library. After enabling spi and i2c interfacing through the raspi-config tool, enter the following commands into a terminal window:

```
sudo pip3 install RPI.GPIO
sudo pip3 install adafruit-blinka
```

Adafruit NeoPixel and MCP3xxx Library Installation Instructions:

After installing CircuitPython, the NeoPixel and MCP3xxx libraries can be installed through the following commands:

```
sudo pip3 install rpi-ws281x adafruit-circuitpython-neopixel
sudo pip3 install adafruit-circuitpython-mcp3xxx
```

WiringPi Python Installation Instructions:

The WiringPi library must be manually built and installed using python 3 in order to be compatible with the other libraries. The library's prerequisites are first installed using the following:

```
sudo apt-get install python-dev python-setuptools swig wiringpi
```

Then WiringPi is cloned from the git repository and installed using the following:

```
git clone --recursive https://github.com/WiringPi/WiringPi-Python.git
cd WiringPi-Python
sudo python3 setup.py install
```