UNIVERSITY
OF VERMONT

CS2210

SONOGLOW PROJECT

Project by:

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Team: "SonoGlow"
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Introduction

Welcome to the "SonoGlow" Project.

SonoGlow is an RGB LED Matrix Display designed to enhance the music listening experience. This project is designed to seamlessly integrate with Spotify, offering users a unique way to interact with their favorite songs.

SonoGlow is brought to life using a Raspberry Pi, coupled with a Python script that establishes a connection with Spotify's API. Through this integration, the system tracks the currently playing song and retrieves its associated album cover art, which is then displayed dynamically on the LED matrix.

This project offers a new perspective on music appreciation, inviting users to explore their favorite tunes in a novel and captivating manner.

Definitions, Acronyms, and Abbreviations

- **RGB:** Acronym for Red, Green, Blue. It refers to a color model where colors are represented as combinations of these three primary colors. In the context of this project, RGB is used to describe the individual LEDs on the LED matrix panel.

- **GPIO:** Acronym for General-Purpose Input/Output. GPIO pins on the Raspberry Pi allow for digital input and output, making them versatile for connecting to external devices and sensors.

- **API:** Acronym for Application Programming Interface. An API is a set of rules and protocols that allow different software applications to communicate and interact with each other. In this project, the Spotify API is used to access music playback information.

- **IDC:** Acronym for Insulation Displacement Connector. An IDC connector is a type of electrical connector that creates a connection by piercing the insulation of wires without the need for soldering. It's used to connect the ribbon cable to the Adafruit RGB Matrix Bonnet.

- **LED Matrix Panel:** An LED matrix panel is a display composed of an array of individual light-emitting diodes (LEDs) arranged in a grid. Each LED can be independently controlled to create images and patterns.

Project Detail

Project Title: SonoGlow RGB LED Display for Spotify Album Art

Project Description:

The SonoGlow project aims to create an interactive RGB LED matrix display that synchronizes with the user's Spotify music playback to visualize the currently playing song's album artwork. The core components of this project include a Raspberry Pi 4, an Adafruit RGB Matrix Bonnet, and an Adafruit 32x32 matrix panel. The system operates by interfacing with the Spotify API to track the user's active song and then displaying the associated album cover art on the LED matrix panel.

Hardware Components:

Raspberry Pi 4: The Raspberry Pi 4 serves as the central control unit for the project. It runs a Python script responsible for interacting with the Spotify API and managing the LED matrix display.

Adafruit RGB Matrix Bonnet: The bonnet acts as an interface between the Raspberry Pi and the RGB LED matrix panel. It connects to the Raspberry Pi's GPIO header and provides the necessary hardware support for driving the display.

Adafruit RGB LED Matrix Panel (32x32): The LED matrix panel is the visual centerpiece of the project. It features individually addressable RGB LEDs arranged in a grid, displaying the relative song cover art.

Power Supply: To provide 5V power for the Raspberry Pi and LED matrix.

Technical Workflow:

Spotify API Integration: The Python script on the Raspberry Pi establishes a connection to the Spotify API using appropriate authentication. It continuously monitors the user's active track, extracting information about the song title and artist.

Album Art Retrieval: Upon identifying the active song, the script sends a request to the Spotify API to obtain the associated album cover art URL.

Image Processing: The script then downloads the album artwork image from the URL and processes it to fit the dimensions of the LED matrix panel.

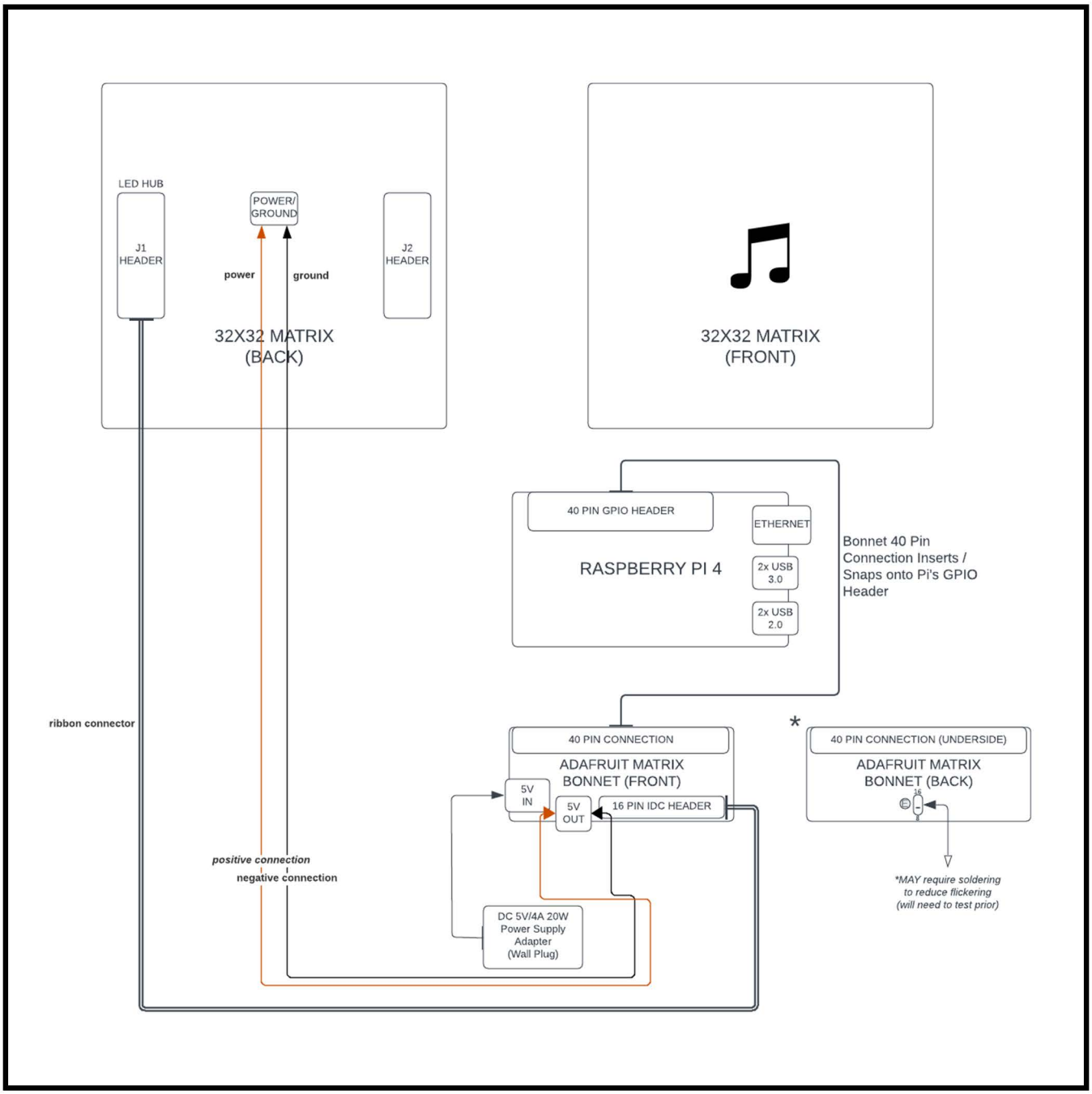
Display Control: Using the Adafruit RGB Matrix Bonnet and associated software libraries, the Raspberry Pi maps the processed album artwork to the LED matrix. It then updates the display in real-time, providing a visual representation of the currently playing song's album cover.

User Interaction: To enhance user interaction, additional features such as play/pause buttons or song title displays will be incorporated into the project. These can be controlled via physical buttons or a web interface.

Project Detail

The SonoGlow RGB LED Display project combines hardware and software components to create an engaging and visually immersive experience for Spotify music enthusiasts. By integrating the Raspberry Pi, Adafruit RGB Matrix Bonnet, and a compatible LED matrix panel, it successfully syncs with Spotify's API to dynamically display album artwork, enhancing the music listening experience. Future enhancements could include additional display modes, advanced interactivity, or integration with other music streaming platforms.

Design Diagram



Project Detail

Mock-up Design:

Budget

Hardware Components:

Raspberry Pi 4: Included prior to project, however worth noting cost. Approximate Cost: $35

Adafruit RGB Matrix Bonnet: Interface between Raspberry Pi and LED matrix. Approximate Cost: $15.

Adafruit RGB LED Matrix Panel (32x32): The primary display component. Approximate Cost: $40

Power Supply: To provide 5V power for the Raspberry Pi and LED matrix. Approximate Cost: $10

Labor:

Research: Time spent on properly researching the components, how they interact with one another and how to construct the project. Estimated Labor Hours: 10 hours.

Assembly: Time spent on physically assembling the components, connecting the parts, and ensuring proper electrical connections. Estimated Labor Hours: 6 hours.

Software Development: Time spent writing and debugging Python scripts for Spotify API integration and LED matrix control. Estimated Labor Hours: 20 hours.

Finalization: Time spent polishing the project to ensure that a fully functional working prototype is prepared and able to present. Estimated Labor Hours: 6 hours.

Reports: Average 2 hours of status updating and scheduling per week. Estimated Labor Hours: 20 hours.

Estimated Project Cost:

The overall estimated project cost is the sum of materials and labor:

Materials: $100.00

Labor:

Project Manager: ~30 hours of researching, scheduling and reports @30$/hr
Lead Developer: ~32 hours of assembly, development and polish @25$/hr

Total Labor Costs: $1,700.00

Overall Cost: $1800.00

Project Plan

Roles: Project Manager / Lead Developer

Role Definitions:
**Seeing as this project is being done with an individual effort, all role definitions and therefore team assignments will befall upon myself.*

Project Manager (Aaron Luciano):

- Leading and Organizing: Primary responsibility is to lead and organize all aspects of the project.
- Timeline Management: Creating and maintaining the project timeline. This involves setting up milestones and deadlines to ensure the project progresses smoothly and stays on track.
- Task Allocation: Allocating tasks to ensure proper and fluid project progression
- Communication: Handling project communications, including keeping stakeholders informed about the project's status and progress.

Lead Developer (Aaron Luciano):

- Technical Leadership: Responsible for the technical aspects of the project.
- Design and Development: In charge of designing and developing the project, which may include coding, architecture, and technical decision-making.
- Quality Assurance: Ensuring the quality of the project's code and its compliance with best practices and standards.
- Problem Solving: Address technical challenges and find solutions to any issues that arise during development.

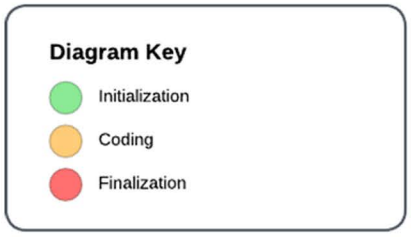
Project Plan

Timeline:

Below, the timeline is listed for milestones and deadlines that need to be achieved along the duration of this project.

There are different phases of this project to ensure enough time flexibility is available to stay on task while being lenient enough for tasks to be finished periodically.

It is constructed in such a way that tasks can be both completed simultaneously as well as individually depending on what the situation requires.



SonoGlow Timeline

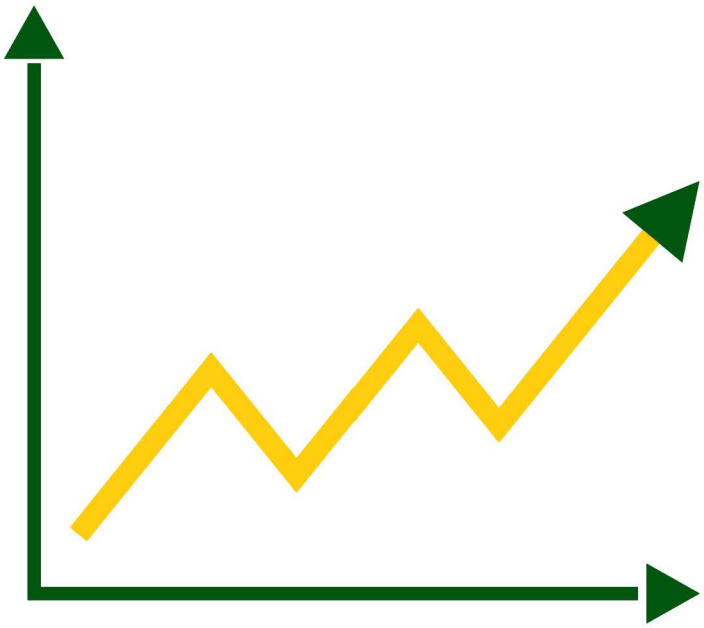
Aaron Luciano | October 11, 2023

	Week 1 10/2	Week 2 10/9	Week 3 10/16	Week 4 10/23	Week 5 10/30	Week 6 11/6	Week 7 11/13	Week 8 11/20	Week 9 11/27	Week 10 12/4
Planning & Research										
Purchase Components										
Experiment with Parts										
Basic Python integration										
API to Pi Script										
Functioning RGB Display										
Testing / Debugging										
Fully Functioning										
Additional Features (tentative)										
Follow Up										

Target Market

Potential Markets:

- **Music Enthusiasts:** This product would appeal to individuals who have a strong passion for music and enjoy visualizing their favorite songs through album cover art. It enhances the music listening experience by adding a visual dimension to the audio.
- **Home Entertainment and Media Enthusiasts:** People who have dedicated spaces for home entertainment systems might find this product attractive. It can be a unique addition to a home theater setup, creating a captivating visual show that complements the music.
- **Art and Design Enthusiasts:** Those interested in digital art, design, or aesthetics could be drawn to the product's ability to showcase album cover art in a dynamic and artistic way. It's not only a functional display but also a form of visual art.
- **Gift Shoppers:** SonoGlow can be an attractive gift option for birthdays, holidays, or special occasions. It's a unique and thoughtful present for music-loving friends and family members.
- **Small Businesses:** Businesses in the hospitality industry, such as coffee shops or small retail stores, could use SonoGlow as an eye-catching display to entertain customers with music-related visuals.
- **Event Planners and DJs:** Professionals in the event and entertainment industry might use SonoGlow to enhance the ambiance at parties, weddings, or DJ performances.



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