University of Central Florida

Initial Project & Group Identification

Divide & Conquer V.1

Leith Rabah

Stefan Gonzalez

Carson Warner

Anja Frohock

1. Group & Project Description

Group 25	**Major**	**Area of Interest**
Leith Rabah	Computer Engineering	Software Engineering
Carson Warner	Computer Engineering	Hardware Engineering
Anja Frohock	Electrical Engineering	Circuit Design
Stefan Gonzalez	Electrical Engineering	Electrical Design

Project Title	**Customers**	**Sponsors**
Frequency based instrumental lights	-Musicians -Schools -Performance Venues	Dr. Richard Leinecker

2. Project Narrative Description

What we desire from the project is an interactive system that turns on LEDs at the notion of an instrument playing, each instrument will generate its own distinct response based on the notes/keys played. The current instruments that will be desired are the flute, piano, acoustic guitar, and drum set. Each instrument will have its own distinct logistical challenges in which the input and output would be varying. This product was desired by our sponsor Dr. Leinecker for the need of interactive instruments with current day technology; furthermore his main request is just for the flute instrument to be designed and made. The complexity of the project will increase with the involvement of more instruments, the portability of the interactive system, and the intensity of the LEDs responses based on the volume and pitch. The Sponsor wants the system to display light intensities based on the individual instrument's wave response when played at different frequencies. The project is estimated to be relatively low cost, portable, low power, and easy to use. Dr. Leinecker agreed to be flexible on design and output of the product. On the market there is no public version of the product, hence the need for it. The use of

Raspberry Pi, specifically Pi4, will be treated as the brain of the project based on the recommendation of the Sponsor. The project will have the potential to raise the quality of performances and experience of playing the instruments. Having the responsive lights to only be turned on or on a certain color when played correctly, acting as a visual aid for both the user and the observers. This visual aid can be beneficial to those that lack the skills to interpret perfect pitch or even to those that lack the ability to hear. This aspect of the design could also gain the attention of other sponsors but as of now our main focus is to complete just the desires of Dr. Leinecker. Our group took interest in this project for its applications of embedded systems, coding, circuit designing, wave frequencies, and fabrication. In which this project will involve the use of existing hardware, matching devices together, manual construction and designing of devices, and possibly 3D-Printing for parts. In hopes to keep the project relatively low-cost the project will be made with the integration of the UCF Innovation Lab, for their equipment mainly. The materials and components will be sponsored by Dr. Leinecker, though the budget's limit has not been discussed in depth yet. Currently the group will be consulting with Dr. Leinecker once a week or every 2 weeks depending on his availability. The meetings with him will involve making the product for his desired design and seeing how flexible he can be as problems will be found when actually fabricating the project.

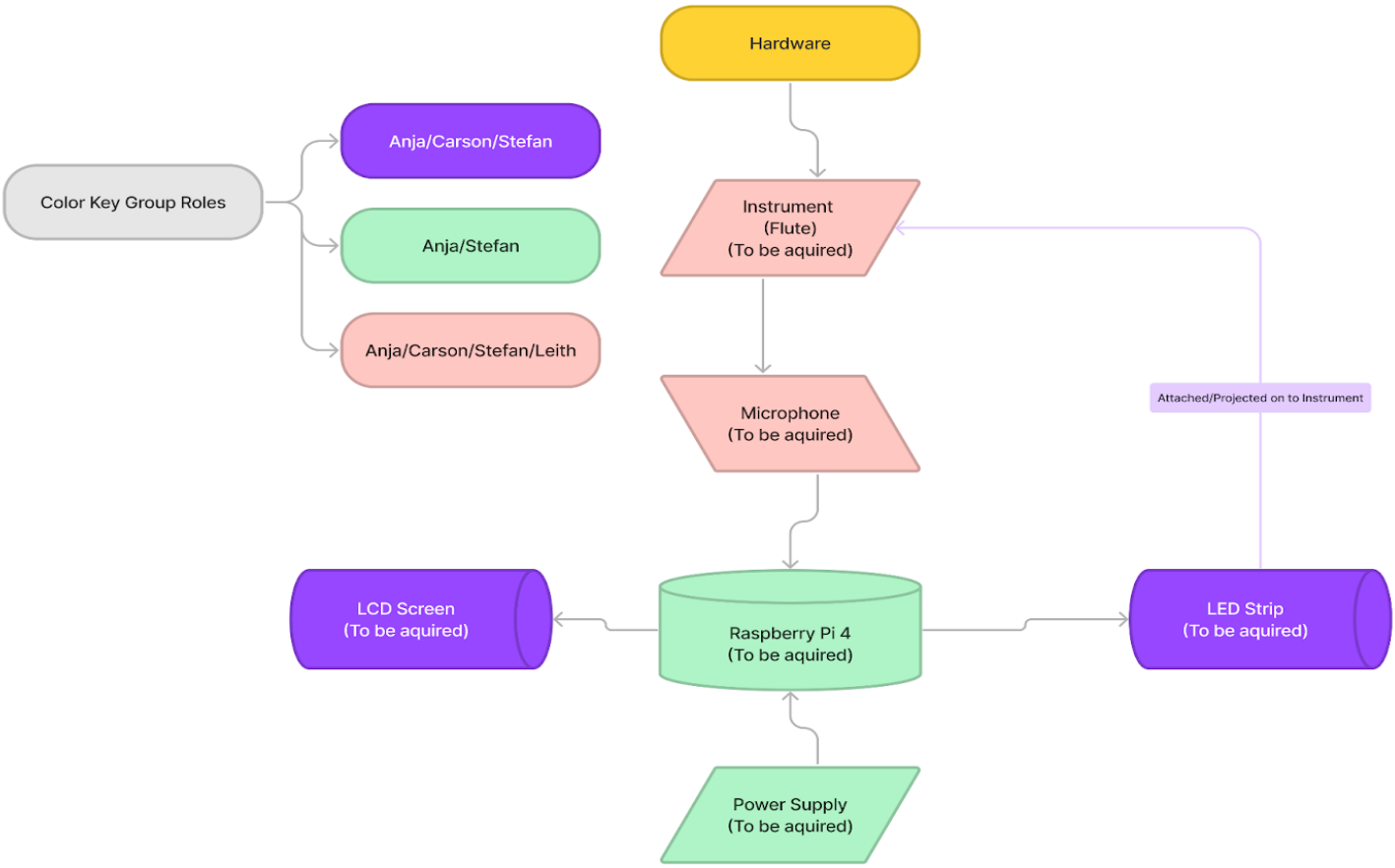
3. Requirements & Specifications

The requested constraints and specifications of the project by the consumer include an LCD screen that would be able to select themes and alternate forms of power such as an attached battery pack/power supply power efficiency will be required to enable portability for extended periods of time. This would also have to include a bluetooth module to control the LEDs. Another would be an LED light strip or laser projected light to illuminate the desired instrument which reacts to tone, pitch, and volume from the desired instrument. This has to be done via a microphone attached near the bell of the instrument or connected through line level if the

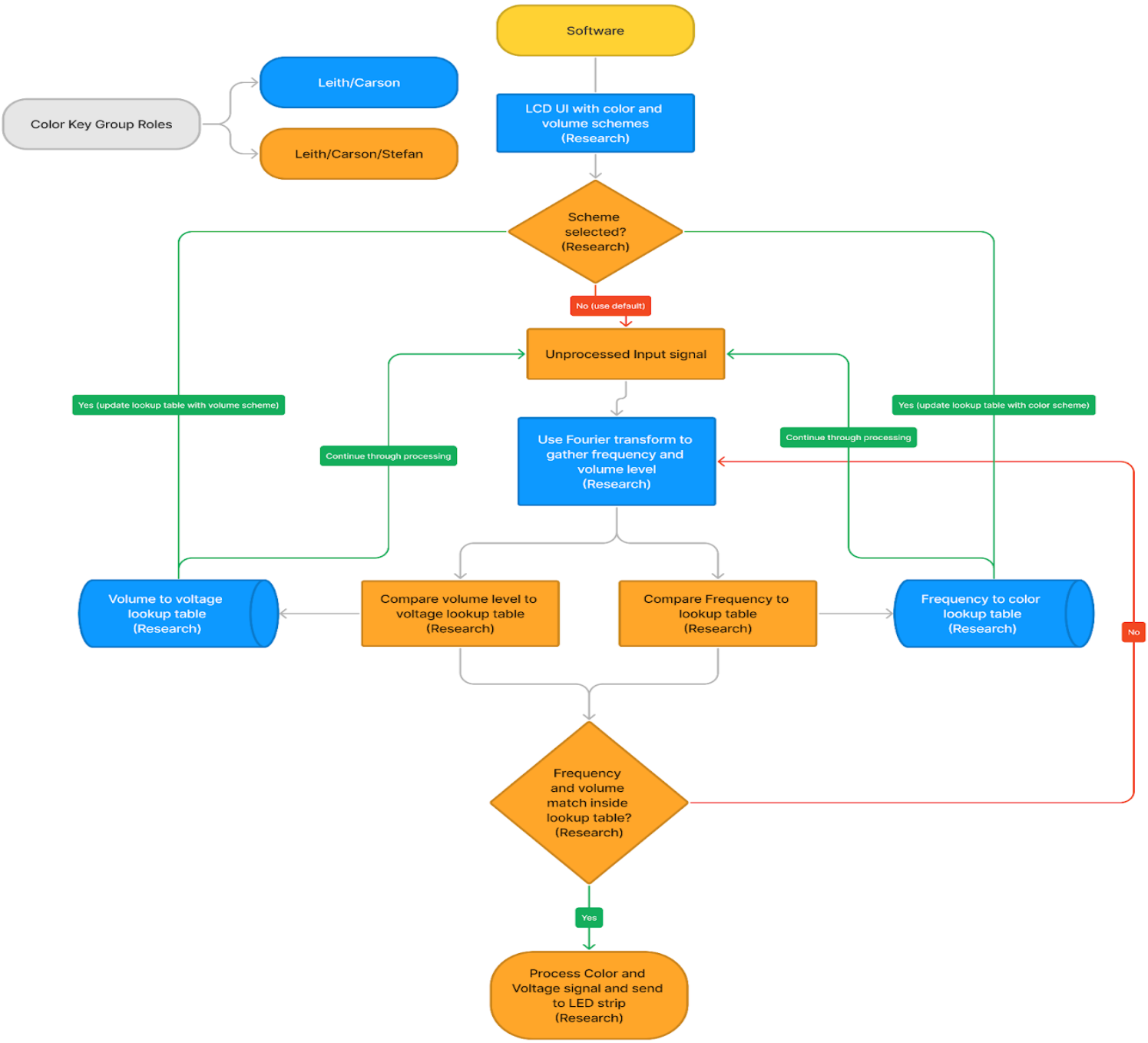
instrument is electronic and provides its own sound to avoid microphone interference. Another option would be to have a mic stand and attach a line from it to the musician to power and control the LEDs. However, that would display more of a challenge when trying to pick up the sound of only the instrument with the LEDs. The project and all software involved must run off of a Raspberry pi 4 or an Nvidia Jetson and use a USB standard interface to be able to connect with a computer.

4. Project Block Diagram

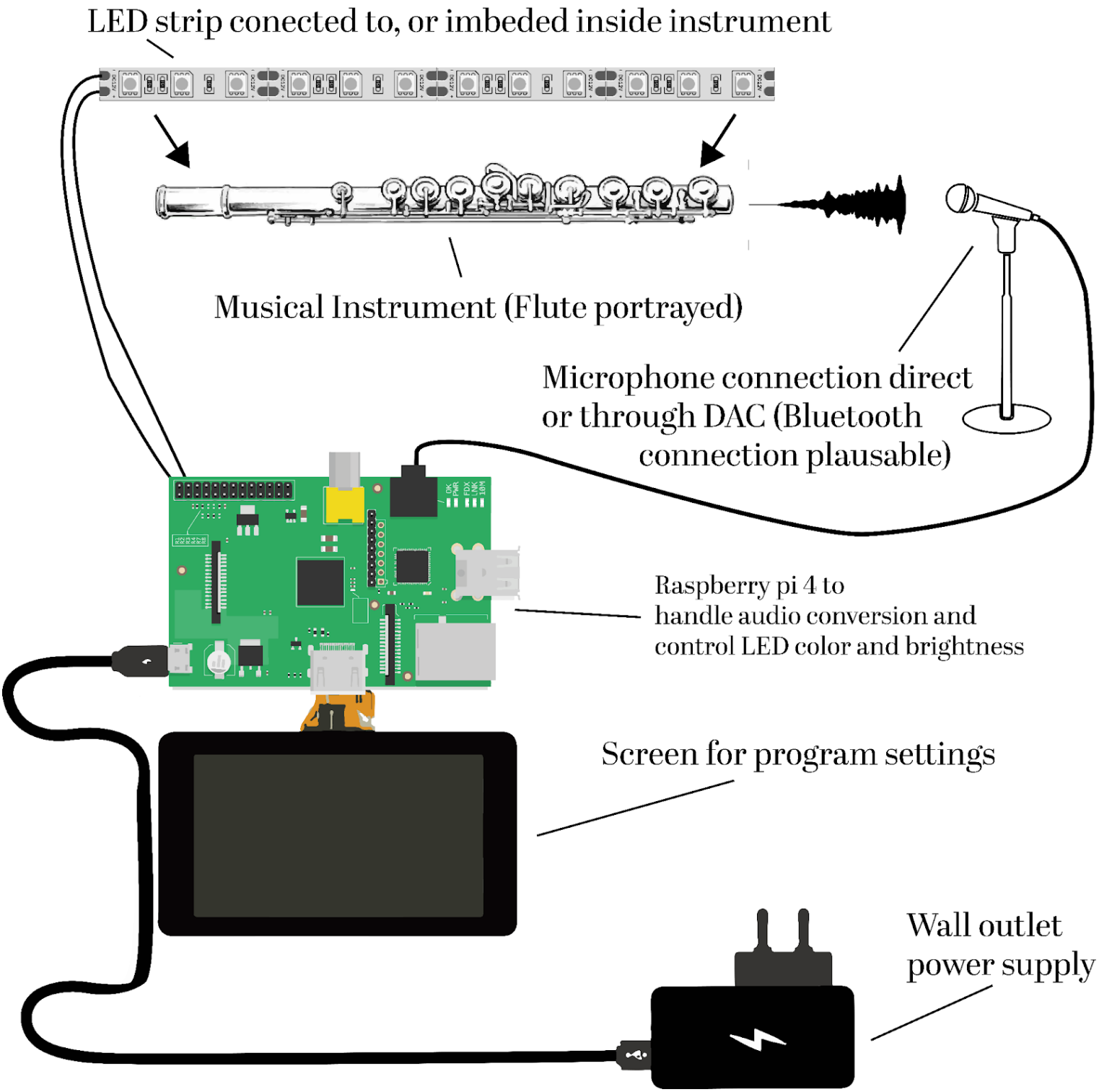
Hardware:



Software:


Software
Leith/Carson
Color Key Group Roles
Leith/Carson/Stefan
LCD UI with color and volume schemes (Research)
Scheme selected? (Research)
No (use default)
Unprocessed Input signal
Yes (update lookup table with volume scheme)
Continue through processing
Use Fourier transform to gather frequency and volume level (Research)
Continue through processing
Yes (update lookup table with color scheme)
Volume to voltage lookup table (Research)
Compare volume level to voltage lookup table (Research)
Compare Frequency to lookup table (Research)
Frequency to color lookup table (Research)
No
Frequency and volume match inside lookup table? (Research)
Yes
Process Color and Voltage signal and send to LED strip (Research)

Illustrative Prototype:



5. Project Budget

Part	Cost Estimate	Description
Microphone	$25-$88	Shotgun microphone to pick up music being played, price varies by size and quality
LED Strip	$7-$15	RGB LED strip to light up the flute
LCD Screen	$29-$80	LCD display to apply different light modes and settings
Microcontroller	$107-$297	The lower estimate would be the Raspberry Pi 4, the higher estimate is the NVIDIA Jetson
Battery	$17	3.7V Lithium Ion rechargeable battery
Charging board	$6	Prevents overcharging of the battery
Bluetooth Module	$10	Allows the LEDs to be controlled by the microcontroller wirelessly
Total	$178-$490	

6. Initial project milestone for both semesters

Initially, for the first semester, the primary milestone is to have a finalized design for the project. We plan to have all parts and design specifications finalized by the end of the semester along with our final report so that we do not need to spend time in the next semester ironing out any design flaws; allowing us to focus on building the actual project. We have a secondary goal of meeting specific deadlines for the paper that we placed upon ourselves in an attempt to finish the report ahead of schedule in order to begin building the project before the first semester comes to a close.

Milestone	Deadline
General Idea	09/16/2022
Part & Design Research	TBD
Parts Testing	TBD
30 Page Draft Complete	10/15/2022
60 Page Draft Complete	11/04/2022
90 Page Draft Complete	11/15/2022
100 Page Draft Complete	11/18/2022
120 Page Draft Complete	11/31/2022
Final Report	12/06/2022
Begin Building	TBD

HARD DEADLINE — SOFT DEADLINE

The primary milestone for next semester is to have the two main features of the project functioning properly. These features are RGB lights that adjust their color according to the frequency of the sound being read in and brightness that adjusts according to the volume. There is a secondary milestone of creating an interactive app to create prebuilt light settings for the instruments and making the entire project more innovative than the initial idea (such as the implementation of robot vision to project the light on the instruments) through constant communications as we work on the project.

Milestone	Deadline
First Feature Functional	TBD
Second Feature Functional	TBD
Both Features Polished	TBD

App Rough Draft	TBD
App Functional	TBD
Project Complete	TBD

HARD DEADLINE — SOFT DEADLINE