Final Project Proposal

Year: 2023 Semester: Spring Team: 18 Project: RDNT

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Team Members (#1 is Team Leader):

Member 1: Anurag Numboori Email: anumboor@purdue.edu

Member 2: Graeme Usman Email: gusman@purdue.edu

Member 3: Avik Wadhwa Email: wadhwa13@purdue.edu

Member 4: Kahaan Patel Email: pate1410@purdue.edu

1.0 Project Description:

RDNT is a project that takes an input audio source and runs signal processing algorithms to drive wired LED strips to create a synchronized audio-visual experience. These audio sources are an onboard analog microphone, an AUX-in port, and a Bluetooth signal from our associated Android app. The user will be able to toggle through the 3 modes, with the microphone being the default, by pressing an external button. This mode toggling will be achieved through a multiplexxed circuit that selects the current mode.

The signal processing algorithms that will be used are the FFT algorithm and a 1-D Gaussian filter. The Gaussian filter reduces noise on the input sample and the FFT algorithm uses this noise reduced signal to isolate frequencies. The LED strips will be driven by a message sender that accepts the output of FFT to create patterns on the wired LED strips.

To create patterns we will send PWM signals to the data pin of the LED strips, these patterns and their associated color ranges can be selected by the user using the associated Android app. The microcontroller will read input samples and compute signal processing algorithms to drive the message sender. The LED strips will be powered by a wall adapter from 120V AC to 5V DC. A switching regulator circuit will drop the 5V DC to 3.3V DC for our microcontroller. For demonstration purposes, we will construct an acrylic display.

2.0 Roles and Responsibilities:

1. Anurag Numboori *Team leader – Maintains communication among team members, ensures team is progressing and assists fellow team members in addressing significant issues*

Anurag was able to develop his leadership abilities as Design Lead for his EPICS WRM team as a freshman. He used this experience as Design Lead of a 6-person team to learn powerful skills in compromising and keeping a team focused. He is also interested in software, which he draws from his experience in an internship and many high-level software courses. His interests include Web Development, Computer Security, and Game Design.

1. Graeme Usman *Systems engineer – Responsible for high level functional overview of the system, including the theory of operation, block diagram, and component selection. Ensures components and systems on project work together coherently*

Graeme has had experience working in software and hardware, as well as collaborating with engineers of similar backgrounds. He will be the systems engineer for the team, making sure that all components are integrated properly with each other, while maintaining a high-level view of the overall objective for RDNT.

1. Avik Wadhwa *Hardware engineer – Responsible for design of printed circuit board electrical schematics and layouts, often in charge of circuit board construction and packaging assembly*

Avik is significantly involved with learning more about embedded systems. Throughout his internship at Milwaukee Tool, Avik strived to develop an embedded prototype within project guidelines that are very similar to the scope of this class. He also has experience with developing quick CAD models for prototyping. Avik’s background and passion toward this project makes him a good fit for designing the PCB and developing the packaging assembly.

1. Kahaan Patel *Software Engineer – Responsible for design and implementation of source code. Undertakes functional prototyping efforts early in the semester to mitigate risk in the later stages of the design process*

Kahaan is a pioneering software engineer. He has strong experience in networks and also has experience with building web applications. Kahaan is a fast-learner who believes in rapid prototyping and loves to build software for networked systems, which makes him a great fit for being the Software Engineer for this project.

2.1 Homework Assignment Responsibilities

|  |  |  |  |
| --- | --- | --- | --- |
| *Design Component Homework* | | *Professional Component Homework* | |
| A3-Software Overview | AN | A9-Legal Analysis | AW |
| A4-Electrical Overview | AW | A10-Reliability and Safety Analysis | KP |
| A6-Mechanical Overview | GU | A11-Ethical/Environmental Analysis | AN |
| A8-Software Formalization | KP | A12-User Manual | GU |

3.0 Estimated Budget

|  |  |  |
| --- | --- | --- |
| Category | Description | Total Estimated Cost ($) |
| PCB | The overall cost of printing the schematic | 50 |
| Electronics | Includes:  Microcontroller  Power Distribution Electronics  Bluetooth Modules  LED Drivers | 65 |
| Speakers | Audio Speakers to play music the lights are syncing | 100 |
| LED Array | LEDs we will be using that will visually sync with the music | 60 |
| Acrylic Diffuser  Prototype LED addressable strip | Housing for the LEDs to improve visual appearance | 40 |
| Microphone | For prototype testing of audio I/O | 30 |
| Packaging | Will buy project box or materials to 3D print a box and multiple iterations. | 30 |
| Web Domain | For maintaining archive of project | 50 |
| Total |  | 425 |

4.0 Project Specific Success Criteria

PSSC #1 (Software): The ability to reduce noise on analog inputs through the use of a 1-D Gaussian Filtering algorithm.

PSSC #2 (Software): The ability to control and configure multiple connected LED devices through an in-built Bluetooth module that connects with an Android app through UART.

PSSC #3 (Hardware): The ability to amplify and filter analog input of the microphone using a sequence of operational amplifiers.

PSSC #4 (Hardware): The ability for the user to toggle between input modes by using multiplexxed external controls. These modes will be Microphone (default), AUX-in, and Bluetooth audio.

PSSC #5 (Hardware): The ability to drive multiple WS2812B LED strips with PWM signals and reactively display patterns in response to audio signals.

Stretch Goal #1: The ability to isolate frequencies using the FFT algorithm.

Stretch Goal #2: The ability to regulate power down from 5V DC to 3.3V DC with a switching regulator.

5.0 Sources Cited:

No external works were used to write this report.