Final Project Proposal

CMPE 3815

AERO Car Simulated Exhaust

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1. Requirements

ID	Requirement	Unit
1	The device shall be capable of getting speed data from an accelerometer	Pass/Fail
2	The device shall convert the speed data to exhaust audio	Pass/Fail
3	The device shall play audio at 1.36 Watts (assuming an 8 Ohm speaker)	Watts
4	The device shall have a reset button that sets the speed to zero	Pass/Fail
5	The device shall use an ESP32 to operate	Pass/Fail

2. Hardware List

- ESP-32 Microcontroller
- Working AERO car
    - Car kits to be used as backup
- Speaker (any 4 to 16 ohms)
- Accelerometer
- Frequency Amplifier (TPA6211T-Q1 Automotive)
- PCB (if time allows)

3. Milestones & Timeline

There are several individual systems that make up the AERO simulated exhaust. The idea is to have an accelerometer that measures the acceleration of the AERO car. From here, this acceleration can be converted to velocity, using the mathematical derivative relationship between the two.

Once the velocity of the car can be understood, it must be converted to a specific pitch of sound that corresponds with the relative velocity. The goal is to additionally add ‘gear shifting’ sounds that one might hear in a regular car.

Once the pitch and frequency of the sound are determined, it must be output to the audio amplifier and then to a speaker. All of this will be managed by an ESP32 microcontroller. Finally, a push button will be implemented that will ‘zero’ the velocity of the car if it is not calibrated correctly.

Task 1: Get familiarized with the ESP32

The first task is to **understand the background information needed to use the ESP32**, as our group members don’t have any prior experience with these microcontrollers. For this reason, there is little intuition around how to write to the ESP32 and how it differs from the usual Arduino boards. This will hopefully be a relatively seamless transition, as with technological resources, this information should be easy to find.

Task 2: Get Accelerometer Reading

Task 3: Send Audio to the Amplifier Chip

The **accelerometer reading** and **sound output to the audio amplifier** are two tasks that can happen in parallel. Due to the size of the group, it makes sense to delegate work in this sort

of way to streamline the design process. These parallel processes will most likely take up a full lab period.

Task 4: Connect Accelerometer Data and Audio

Finally, we will need to **relate the accelerometer reading to the audio output**. This will most likely be the most difficult part of this project. This will take up the majority of the time of the project.

If everything goes smoothly, all of this should be possible during the three lab periods that are available to work with this. If necessary, some time outside of class and lab time might need to be employed, but that is understood and accepted by the team members.

Schedule

November 12, 14, Class periods: Task 1

November 17, Lab period: Tasks 2 & 3

November 19, 21, Class period: Begin Task 4

December 1, Lab period: Finish Task 4, Begin CS Fair Presentation

December 3, Class Period: Finish CS Fair Presentation

December 5, CS Fair: Final Project Presentation

4. Questions

a. Audio Logistics

   i. What audio to use?

   ii. What aspects of the audio should change based on sensor feedback (volume, file played, etc)?

   iii. What role will Bluetooth integration play?