PICK POCKET TUNER

Senior Design I – Divide & Conquer v1.0

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Project Narrative

Participant Identification

The proposal for our Senior Design project is, tentatively, called Pick Pocket Tuner, an automatic guitar tuner that facilitates quick tuning a guitar within a small timeframe. Group number 42 consists of the following members: Lucas Grayford, Paul Grayford, Jamie Henry, and Luis Vargas. The composition of the group by academic major consists of two Electrical Engineering majors, Lucas and Paul, and two Computer Engineering majors, Jamie and Luis. Currently there are no defined sponsors, or financiers to the project beyond the members of Group 42, however the groups are in contact with the College of Music at the University of Central Florida for potential financial support for the project to lessen the financial burden on the group members.

Project Motivation

The main motivation is to assist musicians, specifically guitar players, in tuning their instruments quickly, and accurately in any environment. Usually tuning a guitar, accurately, is a tedious process that can take quite some time away from a musician. When on stage, recording, or just at a jam session, environmental noise is a thing that needs to be accounted for, and a tuner with a ¼-inch input isn't always readily available or the musician needs to tune as they're playing.

Project Description

Through preliminary discussions within Group 42, the Pick Pocket Tuner will include a motor, a screen, buttons, a power switch, a controller, two sensors, and a basic housing to keep it all enclosed. As a method of powering the device, the group is still doing further research to determine if they will be doing replaceable or rechargeable batteries for powering the device. As far as determining the method to find the frequency at which the strings on the guitar are reverberating at is to use two sensors, a microphone, and a vibration sensor. The microphone can be used as a traditional tuner to analyze the frequency at which the strings are vibrating to then adjust the tuning peg.

The method of operation is as follows: the user will take this portable device, and it will have a screen and button interface that would allow the user to interact with the software interface that would give feedback to the user on whether the string is in tune once it is in use. The device will then be placed with the tuning peg device on the tuning peg itself, and the user will strum the desired string to be tuned. The device will then use one, or both, of the sensors within to determine the vibrational frequency and then direct the motor to either adjust the string tension by turning the tuning peg clockwise or counterclockwise. While still being researched further to determine exactly what part to use, a controller of sorts will be the 'brain' of the operation that will take the information from the sensors through UART, SPI, or I2C, and calculate how much power to give the motor and which direction to turn it to accomplish the accurate string tension for the correct string tuning.

A device like this already exists in market, the Roadie3 designed and sold by Band Industries, Inc. This product by Band Industries has been in market since about 2017 and has gone through 3 iterations, and they have a specific device for bass guitars. One of the limitations that this device has is that there is no additional input to verify the accuracy of the string tuning. To bypass this issue, our project will be implemented so that the accuracy is within a ± of 5 cents. Additionally, the choice of motor will be one that allows us to make fine adjustments of the tuning peg to be able to obtain that desired accuracy.

Requirement Specifications	Measurement	Units	Interval
Tune a guitar in a maximum time	3	minutes	±1
String a new guitar in a maximum time	5	minutes	±1
Tune strings to the correct frequency	1	cents	±5
Battery life with respect to strings tuned	100	strings	±15
Max weight	2	pounds	±0.5
Ease-of-use interface with respect to time to select and tune a string	45	seconds	±10
Comfortable, ergonomic and able to fit in one hand	NA		
Ability to tune a guitar to alternative tunings (Drop-D, Drop-C, DADGAD, etc..)	NA		

Stretch Goals

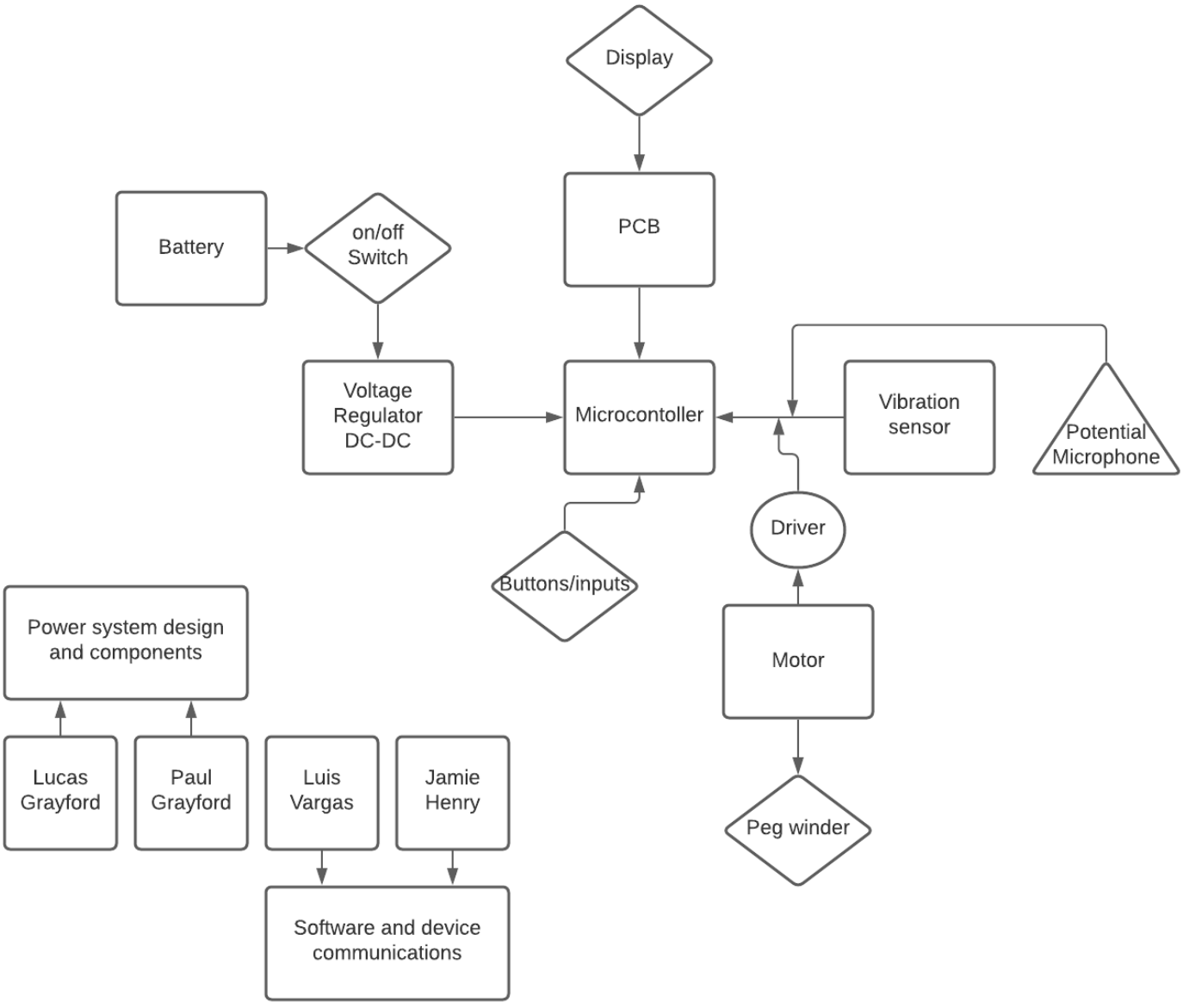
- Ability to tune other stringed instruments like a ukulele or a banjo
- Tune the instrument faster and more accurately

Restrictions and Constraints

- Budget of the project
- Allotting enough time for the project
- Steep learning curves
- Supply chain issues (Difficulty in part acquisition)
- Competition in the market

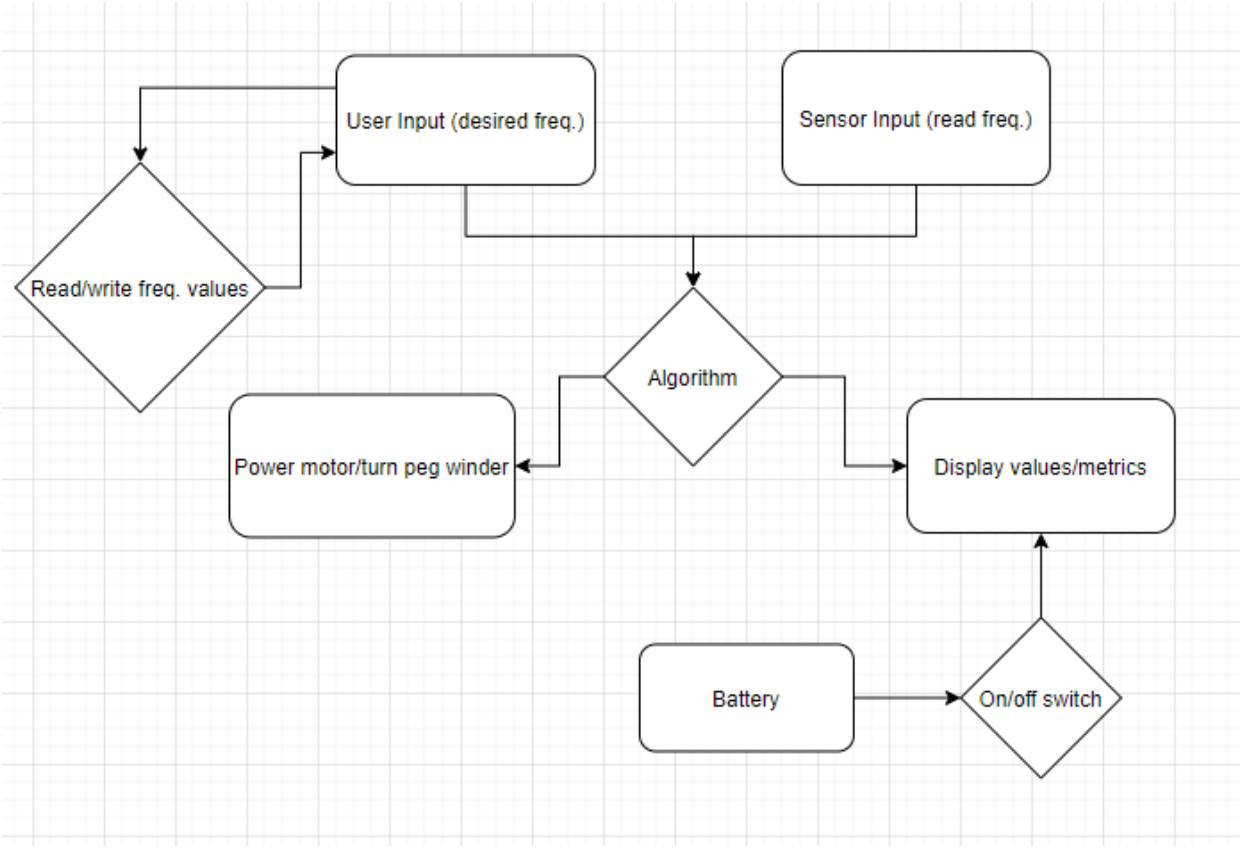
There are no federal restrictions to be aware of while completing the project. We feel these requirements would demonstrate satisfactory engineering qualities on both the software and hardware side of things. Below are flowcharts that show how these requirements will be achieved on both ends of the spectrum.

Hardware Flowchart



Software Flowchart

The main purpose of the software component for the project is to take in inputs from both the user and the sensor. This will provide a created algorithm with the desired string tuning frequency and what frequency the string is current tuned to. This will allow the algorithm to detect the difference between the two frequencies and then turn the motor accordingly to wind the tuning peg to the user desired frequency. The software will also allow the user to save and reuse frequency values. The software will also communicate with the display to show any measured inputs and an interface for easier access to options for the user to select their input.



Project Budget Estimates

For the project budget estimations, we researched most of the components we intend to use for this project. The final table lists roughly how much each component will cost, and how many we will need for the final product. We expect to keep the budget of our final prototype below $100, but the overall budget of the project will be greater because of early prototypes, and testing materials. The table below shows the optimistic cost for the final prototype. This budget will likely be subject to change, especially since we do not have the full design down yet, however we are hopeful about keeping the cost to a minimum.

Components	Quantity	Costs
Battery TBD	1	TBD
Motor	1	$15
Display screen	1	$10-20
DC-DC converter	2	$10 (each)
Vibration sensor	1	TBD
On/off switch	1	$1
buttons/inputs	5	$0.50 (each)
Peg winder head	1	$1
Housing	1	$5
Micro controller	1	$15
Potential microphone (not factored in costs and quantity)	1	$7
PCB	1	TBD
Total	16	$69.50 -$79.50 +TBD costs

Project Milestones

For the project budget estimations, we researched most of the components we intend to use for this project. The final table lists roughly how much each component will cost, and how many we will need for the final product. We expect to keep the budget of our final prototype below $100, but the overall budget of the project will be greater because of early prototypes and testing materials. The table below shows the optimistic cost for the final prototype. This budget will likely be subject to change, especially since we do not have the full design down yet, however we are hopeful about keeping the cost to a minimum.

Project Task	Assignee	Date Started	Date Due	Status
Decide project idea	All	08/27/2021	09/17/2021	Completed
Identify Parts	All	08/27/2021	10/01/2021	In Progress
Final Report Subtasks				
Divide and Conquer v1.0	All	09/07/2021	09/17/2021	In Progress
Divide and conquer v2.0	All	09/17/2021	10/01/2017	TBA
60-page Draft	All	10/01/2021	11/05/2021	TBA
100-page Draft	All	11/05/2021	11/19/2021	TBA
Final Document	All	11/19/2021	12/07/2021	TBA
Final Design Parts				
Motor/Motor Driver	Paul	09/10/2021	10/01/2021	In Progress
Vibration Sensor	Luis	09/10/2021	10/01/2021	In Progress
Display	Jamie	09/10/2021	10/01/2021	In Progress
System Controller	Luis	09/10/2021	10/01/2021	In Progress
Voltage Regulator	Lucas	09/10/2021	10/01/2021	In Progress
Input Buttons	Jamie	09/10/2021	10/01/2021	In Progress
Switch	Lucas	09/10/2021	10/01/2021	In Progress
Battery	Paul	09/10/2021	10/01/2021	In Progress
Housing	Lucas	09/10/2021	10/01/2021	In Progress
PCB	Paul	09/10/2021	10/01/2021	In Progress
End of Semester Design Goals				
Acquisition of Parts				In Progress
Final PCB Design				In Progress
Working Prototype				In Progress