*Instrument tuner*

Product Design Specification

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Version: *1.0*

*04/21/2023*

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# Introduction

## Purpose of The Product

This product can be used to tune a stringed instrument to a specific tuning. Each string can be tuned to a target frequency by following LED indicators that show whether the string’s frequency is too low, too high, or on pitch. This provides a simple way for musicians to tune their instrument without needing to be able to recognize the target note by ear.

# General Overview and Design Guidelines/Approach

## General Product Overview

*This product is designed for the user to tune each string of their instruments one at a time. The user first plays a single string with the microphone close enough to pick up a sufficient audio signal from the instrument. The signal is sampled by the microcontroller, and the approximate frequency of the note is calculated. The frequency in the pre-selected tuning array nearest to the calculated frequency is selected as the target frequency, and the string corresponding to this note is indicated using the LED bar. The LED bar uses a single LED for each string, with the highest string on the right and the lowest string on the left. Finally, the on-board RGB LEDs on the microcontroller are used to indicate whether the calculated frequency is higher than (blue LED), lower than (green LED), or within the frequency tolerance range of the target frequency (red LED).*

## Assumptions / Constraints / Standards

[Describe any general design assumptions / constraints / standards related to any of the project’s design]

# Architecture Design (At least one block diagram is required in this section)

This section outlines the system and hardware architecture design of the system that is being built.

[Describe the system architecture, how the application interacts with other applications. Not necessarily how the application itself works but, how the appropriate data is correctly passed between applications.]

## Hardware Architecture

The microphone amplifies the signal and outputs an analog signal routed to the microcontroller’s opamp input. The microcontroller opamp applies a 2x amplification to the analog signal, and its output is routed to the microcontroller’s ADC. A timer interrupt is used to control the ADC conversion rate, which is set to sample at 4 kHz. The ADC output is saved in software to an array.

## Software Architecture

[Insert any software architecture documents]

## Performance Considerations

[Insert any performance documents]

## SENSORS/aCTUATORS DESCRIPTION (required section)

[Insert any sensors/actuators description]

# System Design

## Use-Cases

[Insert any related project use cases]

## Data Conversions

[Insert any documents describing any necessary data conversions.]

## Application Program Interfaces

[Insert any application program interface documents.]

## User Interface Design

[Insert any user interface design documents or provide a reference to where they are stored.]

## Performance

[Insert any performance documents.]

## Bill of material (BOM) (required section, include only component that are part of your product)

[Insert the list of required components with the cost]

## Calibration and test procedures

[Insert any calibration and/or test procedure]

# Conclusion on (required section)

[Summarize your experience with this project. What challenges you faced, did you mean the specifications, any ways to improve]

Appendix A: References

[Insert the name, version number, description, and physical location of any documents referenced in this document. Add rows to the table as necessary.]

The following table summarizes the documents referenced in this document.

|  |  |  |
| --- | --- | --- |
| **Document Name and Version** | **Description** | **Location** |
| *<Document Name and Version Number>* | *[Provide description of the document]* | *<URL or Network path where document is located>* |

Appendix B: Key Terms

*[Insert terms and definitions used in this document. Add rows to the table as necessary. Follow the link below to for definitions of project management terms and acronyms used in this and other documents.*

*http://www2.cdc.gov/cdcup/library/other/help.htm*

The following table provides definitions for terms relevant to this document.

|  |  |
| --- | --- |
| **Term** | **Definition** |
| *[Insert Term]* | *[Provide definition of the term used in this document.]* |
| *[Insert Term]* | *[Provide definition of the term used in this document.]* |
| *[Insert Term]* | *[Provide definition of the term used in this document.]* |