

Overview

In this project, I will build a working tuner that musicians can use to tune their instruments. This will involve the use of the STM32L476 Discovery Board, along with a microphone, LCD character screen, and on-board joystick buttons. The peripherals will communicate with the microcontroller using SPI and I2S, and the joystick buttons will trigger an interrupt that will allow the musician to change which note to tune.

Goal

The main goal of this project is to build a working tuner. This can be split into the following parts:

1. Using a microphone to detect the frequency of a pitch being played by a musician
2. Displaying information about how in tune the pitch is on an LCD screen

As an additional goal, I may implement a speaker system to output selected notes in tune. This would allow the musician to listen to and play a given note on their instrument in order to match the tuning of the instrument to the pitch given by the speaker.

Purpose

The purpose of a tuner is to allow musicians to tune their instruments. If an instrument such as a guitar undergoes large temperature changes prior to or while being played, this may cause the guitar strings to go out of tune. Wind instruments such as flutes, which require reassembly prior to being played, may face fluctuations in tuning due to minute changes in the assembly process (e.g. how far the head joint or mouthpiece is pushed into the body of the instrument) or other environmental factors. A tuner will listen to the tuning note a musician plays and tell the musician whether that note is sharp or flat. The musician can then adjust their instrument according to the pitch information given by the tuner.

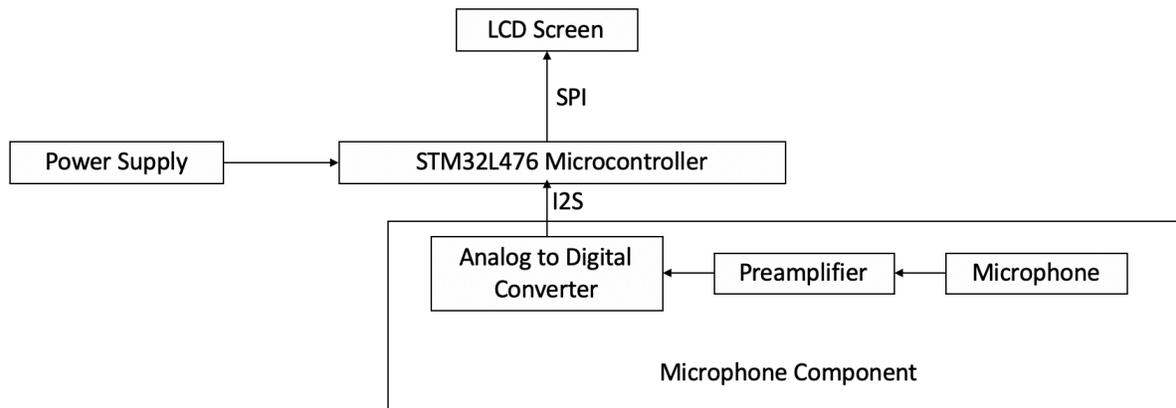
Peripherals

- Microphone and corresponding circuitry (ADC, preamplifier)
- LCD character screen
- Joystick buttons (on-board)

Serial Interface Protocols

- I2S: The microphone will communicate with the microcontroller using the I2S protocol
- SPI: The microcontroller will communicate with the LCD using the SPI protocol

Block Diagram



Responsibility

As the sole member of my group, I will be responsible for the entirety of this project. This includes

- Obtaining necessary hardware
- Writing software for communication, pitch calculation, and frequency detection

Software Structure

The software will use an infinite while loop to get data from the microphone. If the microphone picks up a frequency, the software will calculate how out of tune the pitch is by comparing the detected frequency to a specific frequency corresponding to an in-tune note. The information will then be displayed on the LCD screen. The tuner will tune one pitch at a time, meaning that the compared frequency will remain the same, even if the musician plays a different note. In order to change which note to tune, the musician will press a joystick button on the STM32L476 Discovery Board. This will trigger an interrupt, which will change the compared frequency and allow the musician to tune a different note. The while loop will be written in a main.c file, while the SPI and I2S initialization and communication functions will be written in separate files.

Project Website

<https://sites.google.com/view/vivian-ross-final-project/home>