

BBM434 Embedded Systems Laboratory Project Proposal

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1. Introduction

1.1. Overview

Purpose of this project is creating an easy to use a guitar for the people who do not know how to play classical guitar. Our digital guitar will have 8 buttons for each note and a proximity sensor instead of strings. Using these buttons and proximity sensor, sounds will be created for the corresponding notes. The volume will be getting high when the user's hand vertically getting closer to the sensor. Therefore, it will give the impression that a user is actually hitting the string of a guitar.

1.2. Outline

This proposal contains information about the hardware structure of the project. Hardware schematic, descriptions of the components will be explained in detail. In addition to that, the software layer of the project, timeline, responsibilities and budget will be explained.

2. Organization

2.1. Hardware System

There will be eight buttons as inputs for this system. Each of these buttons corresponds to a note. Notes will be generated for 8-bit DAC using sine wave.

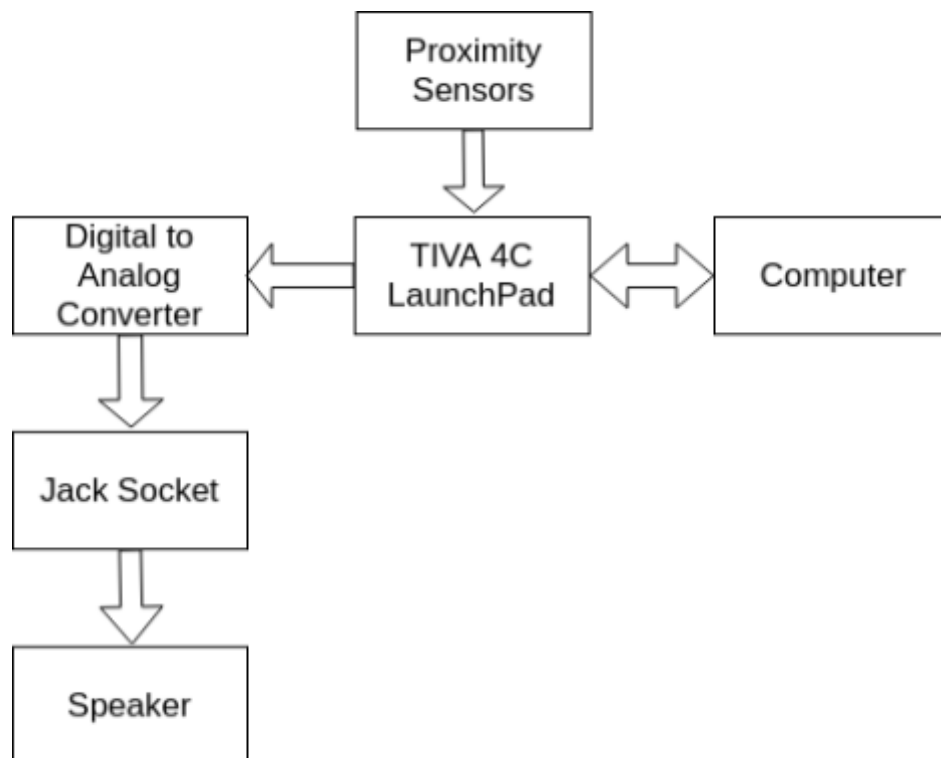


Figure 1- Hardware Schematic

After clicking a button, the proximity sensor will be active and amplitudes will be adjusted according to distance. After converting the digital signals to analog signals, sound will be heard from the speakers.

2.1.1. Ultrasonic Ranging Module HC-SR04



Figure 2 - HC-SR04

The guitar that will be created during this project will be played by moving the hand. The amplitude of the sound wave will be higher or lower according to the position of the hand. Therefore, proximity of the player's hand to the guitar is an important variable. Using HC-SR04 sensor, proximity can be measured.

Some of the features of this sensor:

- Working Current: 15mA
- Working Frequency: 40Hz
- Max Range: 4m
- Min Range: 2cm
- Measuring Angle: 15 degree

[HC-SR04 Datasheet](#)

2.1.2. DAC0808 - Digital to Analog Converter

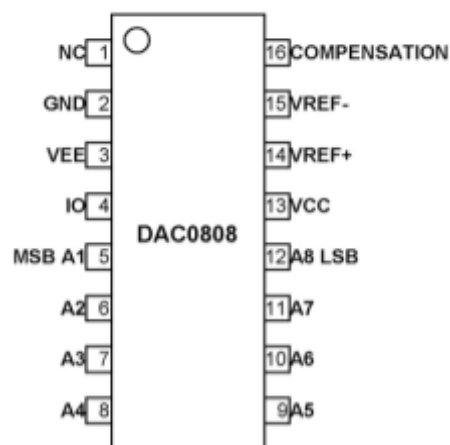


Figure 3 - DAC0808

The DAC0808 is an 8-bit monolithic digital-to-analog converter. Digital to Analog Converters are necessary for this project because the digital signals that are created by the software should be converted to analog signals which are necessary to have sounds.

[DAC0808 Datasheet](#)

2.1.3. Jack Socket 3pin 3.5mm



Figure 4 - Jack Socket

A jack socket is a fixed electrical connector with one or more receptacles for a movable plug, also known as a jack plug. Connecting the plug to the socket allows a user to complete an electrical connection for the purpose of conducting sound, powering a device, or performing other activities.

In this project, this socket will be used to get an output signal.

2.1.4. D78-45 10W 8R 78mm Speaker



Figure 5 - Speaker

Speakers will be used to get good quality sound as output.

2.1.5. Tact Switch Buttons with Caps



Figure 6 - Tact Switch with Caps

8 switch buttons will be used and these 8 buttons will be programmed to output Do, Re, Mi, Fa and other notes respectively. The audio frequency corresponding to each button and the SysTick value that will generate this frequency are measured.

2.1.6. Tiva 4C LaunchPad and USB Cable

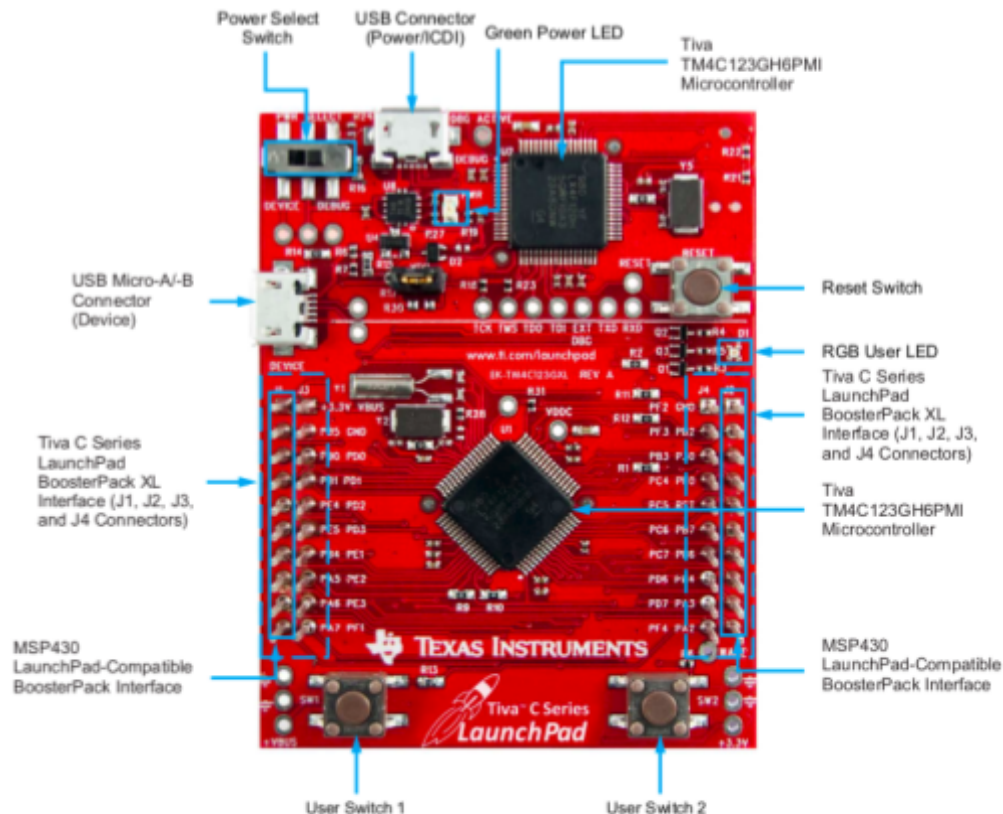


Figure 7 - Texas Instruments Tiva™ C Series EK-TM4C123GXL

The LaunchPad that will be used in this project is Texas Instruments Tiva™ C Series EK-TM4C123GXL.

[User's Manual Link](#)

2.1.7. Breadboards

A breadboard used to connect types of equipment for transmitting voltage to our system.

2.1.8. Resistors

Resistors help control the flow of current in a circuit.

2.1.9. Plexiglass or Lego

Surround the electric circuit with one of these materials for a better look and to ensure good performance to the user.

Our current idea is to use Legos to surround circuit. However, if we cannot do it with legos, plexiglasses will be used.

2.2. Software Layer

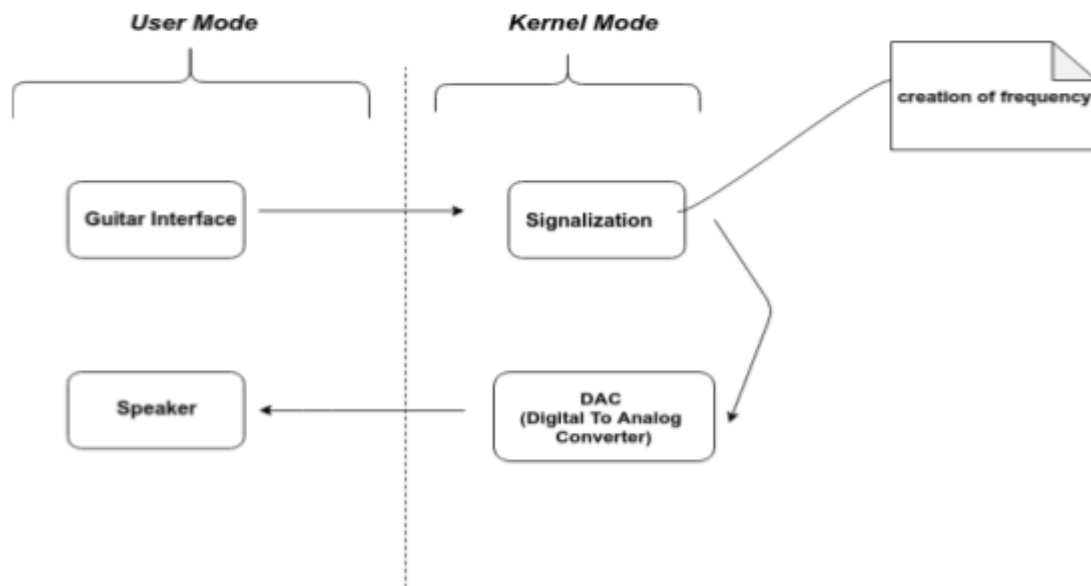


Figure 8 - software architecture schematic

As you can see from the Figure 8, some of the modules of the system are in the user space, and the others are in the kernel space. User space is a space that contains hardware interfaces which are used by the user to be able to perform some actions such as pressing a button on the guitar. Kernel space which cannot be directly reachable to the user is about generating digital signals and converting them to analog signals. After obtaining analog signals, sound can be heard from speakers which is also in the user space.

3. Timeline and Responsibilities

3.1. Timeline

From now on, we have six weeks until the term ends. Since it is the first time that we are doing such a big project, the hardware implementation of the system might be difficult for us. Next 3 weeks, we are planning to finish building the hardware system. Following 2 weeks, programming the sensor and generating signals will be done. Last week, we are planning to make our guitar beautiful. We will cover it up with a nice surface.

3.2. Responsibilities

Both person will work on building the circuits and appearance of the guitar. In addition to these, each person will focus on some critical issues of the project.

3.2.1. Onur Cankur

Connecting the proximity sensor and learning how to program it.

3.2.2. Merve Müge Deliktaş

Connecting the DAC and jack socket to get sound as output.

Responsibilities might be shared during the project in order to complete the project on time.

4. Budget

- Texas Instruments Tiva™ C Series EK-TM4C123GXL - 100 TL
- Resistors - Uncertain(Maximum 3 TL)
- 8 Switches - 2.5 TL
- Stereo Jack 3pin 3.5mm - 3 TL
- Breadboard - 10 TL
- Wires - 6 TL
- Ultrasonic Ranging Module HC-SR04 - 6 TL
- DAC0808 - 12 TL
- D78-45 10W 8R 78mm Speaker - 8 TL

A summary is approximately: 150.5 TL