HACETTEPE UNIVERSITY DEPARTMENT OF COMPUTER ENGINEERING

BBM434 EMBEDDED SYSTEMS LABORATORY

FINAL PROJECT

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MIDI DRUM KIT WITH TIVA™ LAUNCHPAD

Introduction

In today's world that everythings turned to electronic, humanity want every stuff to be portative and transportable. Increased logistic costs and space limitations are the reasons for motivate designers and engineers to create more portative things by using electronic environment.

Musical industry have one's share of this change and is inarguably becoming more electronic day by day. Almost every today's musical instrument has a simple electronic substructure to modulate even a basic sound signal. This project deals with this topic and is trying to be an alternative to musical industry.

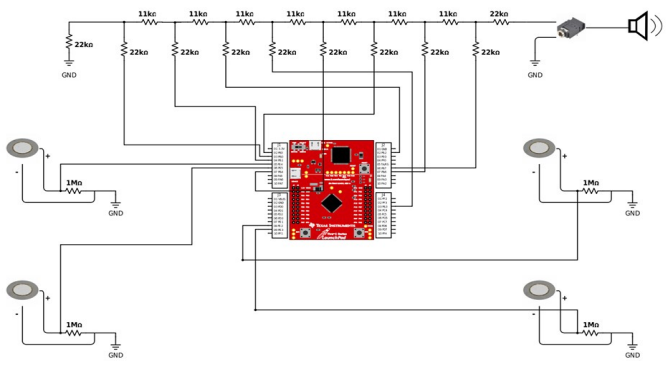
"I want to do album with the sound of the '50s,'60s and '70s. And then have a sound of the future. I said "Wait a second... I know the synthesizer — why don't I use the synthesizer which is the sound of the future?"

Giovanni "Giorgio" Moroder

This project is aimed to implement midi electronic drum kit which generates several realistic drum chords of a traditional drum set. The device perceives pressure from user's to pads and it generates corresponding sound. This drum has simple interface for newbie drummer — the only thing to do is to hit pads and enjoy yourself!

Conclusion

This project was implemented with basic stuffs which everyone can get easily — 4 sensors, 8 CD's (or any stuff that can spread vibration), an output jack, 4 1MΩ and 28 22KΩ resistors. The constructive model of the project is consist of two main parts which are DAC and ADC circuits. ADC reads the pressure of the pads, then DAC generates an output signal with respect to pressed pad.



This project supports multiple pressure to pads. User can hear mixed sound of two different pads pressed at a time. However, it doesn't allow to change the amplitude of the sound in case of pressing different points of the pads.

Methods

In order to understand the implementation of this project, it's needed to comprehend nature of the sound.

Sound exists as varying pressure waves that are created when a physical object moves, vibrating the air next to it. The sound generated by the vibration of the sound source is also provided by the vibrations of the particles in the material environment. These vibrations are called as **sound waves**. Sound waves are often simplified to a description in terms of sinusoidal plane waves, which are characterized by these generic properties:

- Frequency
- Amplitude
- Speed of sound
- Direction

In electronics, it's possbile to manipulate a sound by changing its frequency or amplitute. However, one of the most significant problem is representing sound wave in electronic environment as much realistic as possible. In the environment that everything is represented with binary variables, a basic sine wave is interpreted with Digital Analog Converter (DAC) circuits.

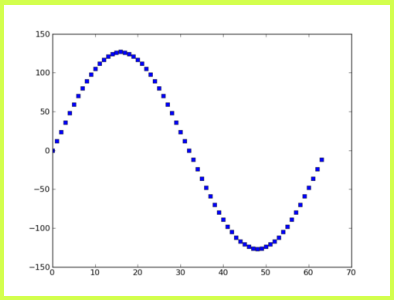


Figure 1. 8-bit representation of a sine wave

In order to represent a sound wave in digital environment, it's necessary to determine the resolution of DAC. This project is based on a DAC with 8-bit resolution to obtain more realistic drum sound. This 8-bit DAC was implemented as a typical R-2R digital converter configuration and its schema is indicated below.

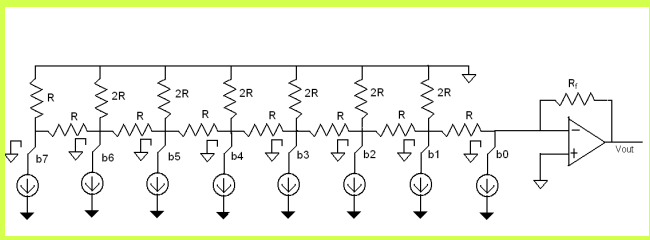
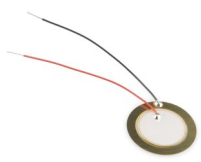


Figure 2. 8-bit R-2R DAC circuit schema

The other significant problem is to take input signals to generate corresponding output signals. To accomplish this challenge, it's used Analog to Digital Converter (ADC) circuits to convert analog signals to digital bits in launch pad. Analog signals can be taken with different sensors. For perceiving the pressure applied over the pads, it's used piezoelectric sensor .



The principle of working of piezo sensor in this project is handling electrical field and potential difference generated by pressing on its piezoelectric material. This voltage variance will be kept via Tiva™ LaunchPad and corresponding sound will be generated.

Video link is available at YouTube