Project Report

Project: Musical Instument using 555 timer IC

Course: CSE260

Group No: 02

Section: 11

Group Member:

Tahmid Iqbal (21201701)

Rewana Lorel (20201089)

Ucchas Tarafder (21201088)

Yeasin Fiyaz (21201087)

Name Of The Project: Musical Instument using 555 timer IC

Components Used:

- 555 Timer IC
- Breadboard
- 8 Ohm Speaker
- 7 x Momentary Push Button Switches
- Capacitors: 100nF, 10uF
- Resistors: 8 x 1K, 4.7K
- Few Breadboard Jumper wires
- 9 V Power Supply

Description of the project:

We already know that sound is produced when the speaker diaphragm vibrates. As the amount of vibrations changes, different tones are produced; these tones are commonly referred to as "Notes" in the music world. The vibrations are created by turning on and off repeatedly for as many times as needed. We can also change the resistence settings on a Potentiometer to change the frequency of the output. Instead of utilizing a potentiometer, we will create an arrangement of various resister combinations. Each resistor distant from the first contributes value to the next, increasing the value from the previous ones. As a result, different Notes will be generated for each resister combination

The fequency of the output mentioned befoere depends on how fast the capacitor charges and discharges. For example, if we increase the value of the resistor the capacitor will take more time to charge and discharge, thus reducing the fequency and vice versa.

The frequency can be calculated as

Frequency (F) $= 1.44 / (R1+2\times R2) \times C1$

NB:We have conducted a simulation on proteus software.

NE555 timer IC:

The NE555 timer IC is a popular and versatile integrated circuit that can be used as a timer, oscillator, and flip-flop. In this project, it is used as an astable multivibrator to generate square wave output. It is configured to generate a square wave with a fixed frequency determined by the values of the resistors and capacitors connected to it.

Circuit Diagram: The circuit diagram consists of a 555 Timer IC, seven push button switches, a speaker, capacitors, and resistors. The push button switches are connected to the input pins of the 555 Timer IC, and the output of the IC is connected to the speaker. The capacitors and resistors are used to set the frequency of the output sound/tone. The circuit is powered by a 9V power supply.

Real-Life Implication of the Project:
This project can be used to create an electronic piano at home, which can be a fun activity for music enthusiasts. It can also be used as a learning tool for beginners who are interested in learning to play the piano. The circuit can be modified and expanded to include more buttons and keys to create a full-size electronic keyboard.

Limitations:
The circuit is limited in terms of the number of keys it can produce, as it only has seven push button switches. It also lacks the complex features found in modern electronic pianos, such as touch sensitivity and sustain. Additionally, this project doesn't use potentiometer to get accurate frequencies which would have better musical assurance.

References:

1. Shah, Y. (2016, November 22). Piano Circuit using 555 IC. FreakEngineer. https://freakengineer.com/piano-circuit-using-555-ic/
2. Yashwant, S. (2021). Electric Piano Circuit using 555 IC. Elonics.org. https://elonics.org/electric-piano-circuit-using-555-ic/

Resistors:
Resistors are passive components that resist the flow of current in a circuit. In this project, two resistors with values of 4.7k and 1k are used to determine the frequency of the output.

Capacitors:
Capacitors are passive components that store electrical charge. In this project, two capacitors with values of 100nF and 10uF are used to determine the frequency of the output. The value of the capacitor affects the time it takes for the capacitor to charge and discharge, which in turn affects the frequency of the output.

Usage of Both Capacitors:

The 100nF capacitor is used in the DIY piano project with a 555 timer IC to set the timing of the astable multivibrator circuit. This capacitor is used in conjunction with two resistors to set the frequency of the output waveform generated by the 555 timer IC. The 100nF capacitor is used as a timing capacitor in the astable multivibrator configuration of the 555 timer IC.

On the other hand, the 10uF capacitor is used to couple the output waveform of the 555 timer IC to the speaker. This capacitor acts as a DC-blocking capacitor, allowing only the AC component of the waveform to pass through to the speaker. The 10uF capacitor is larger than the 100nF capacitor and is used to block any DC offset present in the output waveform. This helps to ensure that the speaker does not get damaged due to any DC current flowing through it.

Therefore, both capacitors serve different functions in the circuit, with the 100nF capacitor being used for timing and the 10uF capacitor being used for coupling the output waveform to the speaker.

Process:

100nF capacitor is used to determine the frequency of the output. The value of the capacitor affects the time it takes for the capacitor to charge and discharge, which in turn affects the frequency of the output.

Specifically, the 100nF capacitor is used in conjunction with two resistors (4.7k and 1k) to create an RC time constant. This RC time constant determines the frequency of the output waveform generated by the 555 timer IC.

In the astable multivibrator configuration used in this project, the capacitor charges through the two resistors and discharges through the discharge pin of the 555 timer IC. The frequency of the output waveform is determined by the formula:

Frequency (F) = 1.44 / (R1 + 2*R2) * C

Assuming that the 4.7k resistor is always present in the circuit and the 1k resistor is added in different combinations for each pushbutton, the following frequencies can be obtained:

- Pushbutton 1: 1k resistor added, R1=4.7k and R2=1k
  - Frequency = 1.44 / (4.7k + 2*1k) * 100nF = 1025 Hz
- Pushbutton 2: 1k resistor and another 1k resistor added in series, R1=4.7k and R2=2k
  - Frequency = 1.44 / (4.7k + 2*2k) * 100nF = 728 Hz
- Pushbutton 3: 1k resistor and two 1k resistors added in series, R1=4.7k and R2=3k
  - Frequency = 1.44 / (4.7k + 2*3k) * 100nF = 565 Hz
- Pushbutton 4: 1k resistor and three 1k resistors added in series, R1=4.7k and R2=4k
  - Frequency = 1.44 / (4.7k + 2*4k) * 100nF = 460 Hz
- Pushbutton 5: 1k resistor and four 1k resistors added in series, R1=4.7k and R2=5k
  - Frequency = 1.44 / (4.7k + 2*5k) * 100nF = 390 Hz