

# EMBEDDED SYSTEMS

## LAB PROJECT

COE17B010

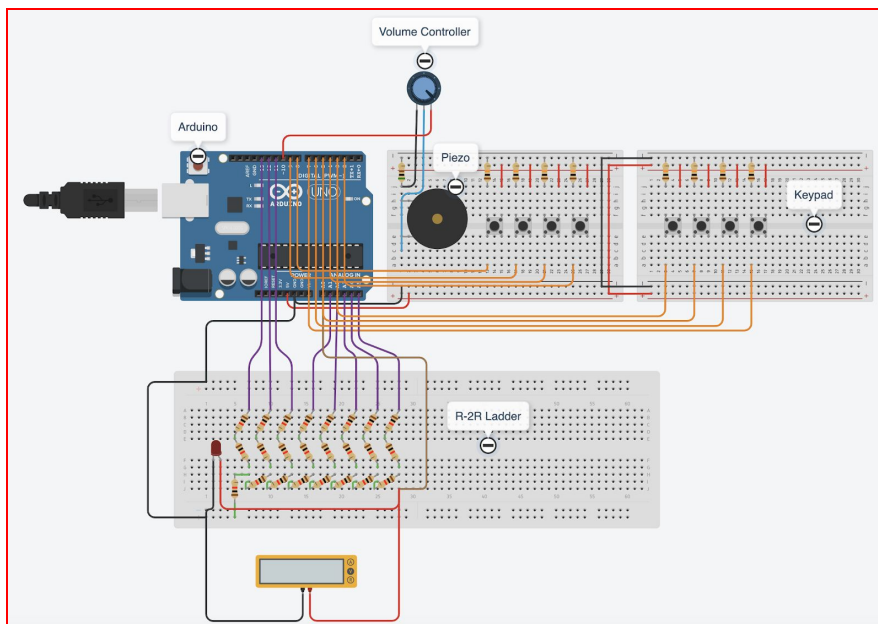
### Group Details

- Group number: 8
- Group members:
  1. COE17B010
  2. COE17B036
  3. COE17B047
  4. CED17I001
  5. CED17I046

### Project Title

Create a DAC using R-2R Ladder for Piano using Switch and Resistance for 8 bit.

### Diagram



## Components Used

- Arduino Uno R3
- Buttons
- Multimeter
- Potentiometer
- Piezo speaker
- 10kΩ resistors - 8
- 1kΩ resistors - 24
- 500Ω resistor - 1
- 1 Red LED

## Pin Configurations

Pin Name	Pin Type	Connection
8	DIGITAL INPUT	BUTTON 0
9	DIGITAL INPUT	BUTTON 1
4	DIGITAL INPUT	BUTTON 2
2	DIGITAL INPUT	BUTTON 3
3	DIGITAL INPUT	BUTTON 4
5	DIGITAL INPUT	BUTTON 5
6	DIGITAL INPUT	BUTTON 6
7	DIGITAL INPUT	BUTTON 7
10	DIGITAL OUTPUT	Terminal 2 Potentiometer
13	DIGITAL OUTPUT	R-2R Ladder BitPosition 1
12	DIGITAL OUTPUT	R-2R Ladder BitPosition 2
11	DIGITAL OUTPUT	R-2R Ladder BitPosition 3
A0	ANALOG INPUT	R-2R Ladder Output

A1	DIGITAL OUTPUT	R-2R Ladder BitPosition 4
A2	DIGITAL OUTPUT	R-2R Ladder BitPosition 5
A3	DIGITAL OUTPUT	R-2R Ladder BitPosition 6
A4	DIGITAL OUTPUT	R-2R Ladder BitPosition 7
A5	DIGITAL OUTPUT	R-2R Ladder BitPosition 8

## Group Contributions

- **Arduino Connections:**
  - Button configuration setting: COE17B010, COE17B047
  - Integration of Modules: CED17I001
  - R2R ladder: COE17B036, CED17I046
- **Arduino Code:**
  - Setup: CED17I001
  - Button click checking: COE17B036
  - Frequency generation using DAC: COE17B010, COE17B047, CED17I046
- **COE17B010**
  - Worked on button to pin connections (VCC, GND, OUTPUT from Button)
  - Worked on deciding which pins to use for DIGITAL INPUT from 8 buttons and assigned those pins as DIGITAL INPUT
  - Worked on Arduino Code for Frequency Generation for piano keys from ANALOG OUTPUT from DAC
  - Worked on Arduino Code for Amplitude generation in Sine Wave for generation of the actual ANALOG OUTPUT to Piezo
- **COE17B036**
  - Constructed R-2R Ladder Design for 8-bits in TinkerCAD using RESISTORS and WIRE CONNECTORS
  - Connection of Multimeter and LED in the R-2R Ladder.
  - Worked on Arduino Code for checking which buttons are clicked by reading corresponding pins and recognizing which are high and sending corresponding frequency signals to Arduino.
  - Convert the frequency into an 8 bit binary number and set the resistor-port to a corresponding HIGH value.
- **COE17B047**
  - Worked on sending the signal of pushbuttons to Arduino pin connections (VCC, GND, taking output signal from push buttons when pressed and feeding the input to Arduino)

- Worked on Arduino code for sending binary input values (corresponding frequencies of piano notes) from Arduino to corresponding R-2R Ladder resistors in the circuit.
- Worked on deciding which pins to use for DIGITAL INPUT from 8 pushbuttons along with their configurations and the Arduino pin connections for resistors in R-2R ladder.
- Calculated the frequencies of 8 different piano notes and worked on changing the output volume from the piezo speaker using a potentiometer and verifying the correctness of output voltage using a multimeter.
- CED17I001
  - Integration of different modules(R-2R Ladder, PushButton and Arduino).
  - Worked on WIRE CONNECTORS between Buttons to Arduino, Arduino to R-2R Ladder, Arduino to Piezo (Connections between all major modules)
  - Worked on setting up the completed circuits and assigning proper code to Arduino and simulating it using TINKERCAD
  - Worked on Initialising frequency values and other parameters in Arduino Code
- CED17I046
  - Constructed R-2R Ladder Design for 8-bits in TinkerCAD using RESISTORS and WIRE CONNECTORS with LED Indicator and Multimeter for Validation of frequency
  - Checking and Setting Frequency for 8 Basic notes in music for the generation of Sine Wave to get through DAC R-2R Ladder
  - Worked in Arduino Code for reading ANALOG OUTPUT Pin from R-2R Ladder to corresponding Arduino Port
  - Worked in Arduino Code for giving ANALOG OUTPUT from Arduino to Piezo to play the specific frequency

## Code Logic

1. Setup
  - a. Initialise all required pins as INPUT or OUTPUT and set initial values for frequencies in binary
2. Button Click Checking
  - a. Check Button Click and detect which button is clicked by checking input from respective digital pins
  - b. If digital input is HIGH - Clicked in that instance
3. Frequency generation using DAC
  - a. Read Corresponding Binary value of frequency for the button and input the values to DAC 8 bits input
  - b. DAC R-2R Ladder circuit converts this digital value to analog
  - c. Capture the analog output from DAC and multiply 2 to get actual piano note frequency

- d. Use `tone()` function to send output to Piezo to play specific frequency sound