Computer Engineering Department
Course Name: Microprocessor Lab   Number: 10636392
Lab Report Grading Sheet

Instructor: Dr. Aladdin Masri	Experiment #: 3
Academic Year: 2019/2020	Experiment: A Musical Electronic Organ
Semester: Summer Semester	

Students	
1- Mohammad Badawi	2- Taher Anaya
3-	4-
Performed on: 16th of August	Submitted on: 18th of August

Report's Outcomes				
ILO __ =( ) %	ILO __ =( ) %	ILO __ =( ) %	ILO __ =( ) %	ILO __ =( ) %

| Evaluation Criterion	Grade	Points
Abstract answers of the questions: "What did you do? How did you do it? What did you find?"	0.5	
Introduction and Theory Sufficient, clear and complete statement of objectives. In addition to Presents sufficiently the theoretical basis.	1.5	
Apparatus/ Procedure Apparatus sufficiently described to enable another experimenter to identify the equipment needed to conduct the experiment. Procedure sufficiently described.	2	
Experimental Results and Discussion (In-Lab Worksheet) Crisp explanation of experimental results. Comparison of theoretical predictions to experimental results, including discussion of accuracy and error analysis in some cases.	4	
Conclusions and Recommendations Conclusions summarize the major findings from the experimental results with adequate specificity. Recommendations appropriate in light of conclusions. Correct grammar.	1	
Appearance Title page is complete, page numbers applied, content is well organized, correct spelling, fonts are consistent, good visual appeal.	1	
Total	10	

Abstract:

In this experiment, we are going to use the 8253 provided by the MML8086K3 training board along with switches to produce different sounds.

Objectives:

- To be more familiar with the 8253 timer/counter and its applications.
- To use the microprocessor to produce sounds using a timing device.

Procedure:

A musical organ is an electrical keyboard that uses electronic circuits to produce sounds. The sounds are radiated through speakers. The organ can be made by using a timing device (8253 in our case) to produce different frequencies depending on which key is pressed, which then can be radiated through an amplifier.
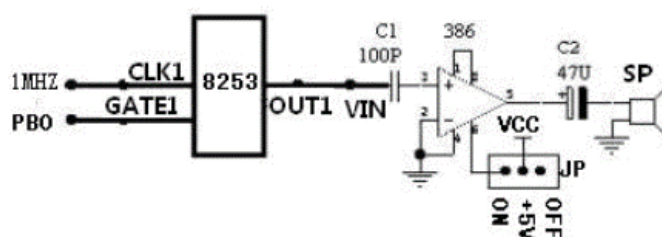
After physically connecting the 8253 timer to the sound amplifier, we need to read the state of 7 buttons and output a certain frequency depending on which button is pressed. To do so, we need the 8255 PPI device so we can connect the buttons to the microprocessor.

First, we need to configure the 8253 counter 1 as a square wave frequency generator:

```
1    MOV AL, 76H
2    OUT 43H, AL
```

Then, we need to configure the 8255 to read the state of the buttons from port A and output their state using port B:

```
4    MOV AL, 90H
5    MOV DX, 0FF2BH
6    OUT DX, AL
```

Procedure: *(cont.)*

After we are done from the configuration process, we need to know which button is pressed and give it a certain frequency. The value n which will be sent to the 8235 is calculated as follows:

$$n = \frac{f_{in}}{f_{out}}$$

The following table presents the final values for each button:

PB	1	2	3	4	5	6	7
Frequency	440.0	493.88	554.37	587.33	659.26	739.99	830.61
n in Hex	08E0	07E8	07B0	06A6	05EC	0547	04B3

If one of the buttons is pressed, we need to change the value of the output B on the 8255 to High, as it is going to be the enable signal for our 8253 device (GATE1), because if it was enabled all the time it is going to continuously produce sounds which is not our intent. If neither of the buttons is pressed, we simply don't need to do anything, so we will set the GATE1 value to Low.

```
8    LOOP:
9    MOV DX, 0FF28H
10   IN AL, DX
11   MOV DX, 0FF29H
12
13   CMP AL, 0FEH          38   L1:                    
14   JZ L1                 39   MOV AL, 0E0H           
15   CMP AL, 0FDH          40   OUT 41H, AX            
16   JZ L2                 41   MOV AL, 8H             
17   CMP AL, 0FBH          42   JMP CONT               
18   JZ L3                 43                          
19   CMP AL, 0F7H          44   L2:                    62   L5:
20   JZ L4                 45   MOV AL, 0E8H           63   MOV AL, 0ECH
21   CMP AL, 0EFH          46   OUT 41H, AX            64   OUT 41H, AX
22   JZ L5                 47   MOV AL, 7H             65   MOV AL, 5H
23   CMP AL, 0DFH          48   JMP CONT               66   JMP CONT
24   JZ L6                 49                          67
25   CMP AL, 0BFH          50   L3:                    68   L6:
26   JZ L7                 51   MOV AL, 0BH            69   MOV AL, 47H
27   MOV AL, 0             52   OUT 41H, AX            70   OUT 41H, AX
28   OUT DX, AL            53   MOV AL, 7H             71   MOV AL, 5H
29   JMP LOOP              54   JMP CONT               72   JMP CONT
30                         55                          73
31   CONT:                 56   L4:                    74   L7:
32   OUT 41H, AX           57   MOV AL, 0A6H           75   MOV AL, 0B3H
33   MOV AL, 1             58   OUT 41H, AX            76   OUT 41H, AX
34   OUT DX, AL            59   MOV AL, 6H             77   MOV AL, 4H
35   JMP LOOP              60   JMP CONT               78   JMP CONT
```

Conclusion:

In the end, we learned how to use the 8253 device in a different application rather than simply using it as a frequency generator. We also learned how to produce musical notes using the microprocessor. Lastly, we learned how to combine different devices to produce a certain product.