

1. [20 points] In the previous lab, quantization was performed on existing data samples. In this lab, you will use the board to read inputs, quantize and encode the inputs, and display the encoded digital outputs using the on-board LEDs.

Use `delay_1ms` subroutine shown below that generates 1 ms delay to make a subroutine to generate the required delay.

```
delay_1ms:
    push 00h
    mov r0, #4
    h2: acall delay_250us
    djnz r0, h2
    pop 00h
    ret
```

```
delay_250us:
    push 00h
    mov r0, #244
    h1: djnz r0, h1
    pop 00h
    ret
```

When using the logic analyzer in Keil, make sure you change the default clock frequency to 24MHz (as it is on the PT-51 board). To verify the delay amount, refer the **8051 Instruction Set** to find number of cycles each instruction runs for and how correct amount delay is achieved. This is called a software delay.

- Using above subroutines write functions to generate 5 seconds delay and 10 seconds delay.
- Write a function to take 4 user inputs using pins with the help of 10 seconds delay function, and store them in 4 memory locations.

### Procedure to take inputs

- First set the pins in the required port (P1.0 to P1.3 since they are connected to on-board DIP switches) as logic 1 (i.e store 0Fh in the port) to configure the pins as input pins. **do we have to set pins as 1 every time while taking the input?**
- Since the inputs are 8-bit values but only 4 switches are available, only 4-bits of an input can be read at a time. **For example, if the input to be provided is 1Ah, then the input pins should be provided with 0001 first and then with 1010** (after some delay).
- Use delay function to provide gaps between the applications of different inputs. The on-board LEDs can be used to indicate when the delay is complete. The scheme is illustrated below:
  - \* LED0 (indicating binary value of 1) should be on for 10 seconds, during which one half of the first input must be provided.
  - \* Subsequently, LED1 (indicating binary value of 2) should be on for 10 seconds, during which the second half of the first input must be provided.

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- \* Then LED1 and LED0 (indicating binary value of 3) should be on for 10 seconds, during which the first half of second input must be provided, and so on till all 4 inputs are read.
  - Before uploading on the board, give inputs using Peripherals → I/O-Ports → Port 1; and verify the outputs by adding P1.4 to P1.7 to Logic Analyzer separately as bits in Keil.
  - Write a function that performs quantization and encoding on the inputs based on the given scheme.
  - Write a function to display the 4 encoded outputs on the 4 on-board LEDs one after another with 5 seconds delay. Put this in an infinite loop so that you can observe the outputs repeatedly.

*Quantization scheme:*

```
if (sample >= 0 and sample < 10):
    quantized_sample = 5
else if (sample >= 10 and sample < 20):
    quantized_sample = 15
else if (sample >= 20 and sample < 30):
    quantized_sample = 25
else:
    quantized_sample = 35
```

*Encoding scheme:*

```
if (quantized_sample == 5):
    output 0001
else if (quantized_sample == 15):
    output 0010
else if (quantized_sample == 25):
    output 0100
else:
    output 1000
```

Starting Code-

```
// -- DO NOT CHANGE ANYTHING UNTIL THE **** LINE--//
ORG 0H
LJMP MAIN
ORG 100H
MAIN:
CALL TAKE_INP
CALL QUANT_ENC
CALL LED_DISP
HERE: SJMP HERE
ORG 130H
// *****
```

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```
DELAY:
// ADD YOUR CODE HERE
TAKE_INP:
// ADD YOUR CODE HERE
QUANT_ENC:
// ADD YOUR CODE HERE
LED_DISP:
// ADD YOUR CODE HERE
RET
END
```

## TA Checkpoints

1. Check if the student knows how to give inputs from Peripherals → I/O-Ports → Port 1 and how to verify the outputs in Logic Analyzer in Keil.
2. Check if the delays generated by the student are correct using Logic Analyzer (5 seconds and 10 seconds).
3. Check if the student knows how to operate Flip/ DFU Programmer, and shows all the tests mentioned.
4. Check if student knows how to generate the hex file, upload it onto the board, provide inputs using pins and display outputs on the LEDs.
5. Check the working for the following 2 test cases:
  - Input samples : 11H, 2AH, 01H, 18H.  
Outputs on LEDs : 0010, 0100, 0001, 1000.
  - Input samples : 3FH, 1CH, 0EH, 06H.  
Outputs on LEDs : 1000, 0100, 0010, 0001.