

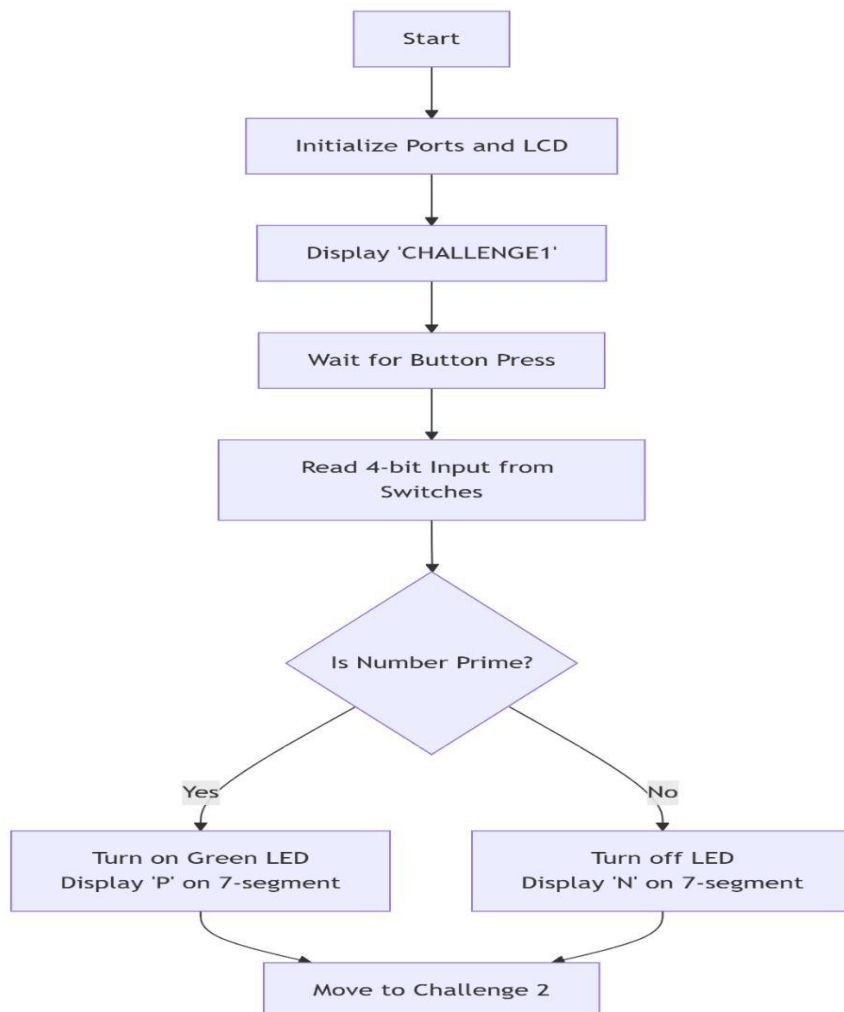
# Escape Room Project Report

This project simulates an **Escape the Room** game that challenges the player with a sequence of three logic-based tasks. The player must attempt each challenge in order, regardless of whether previous answers were correct or incorrect. However, **only by** correctly solving all three challenges will the player successfully escape the room. If the player answers any of the challenges incorrectly they may continue to the other tasks, but escaping the room will no longer be possible. The game combines decision logic, user interaction, and progress tracking to create a simple yet engaging escape room experience.

## Software design:

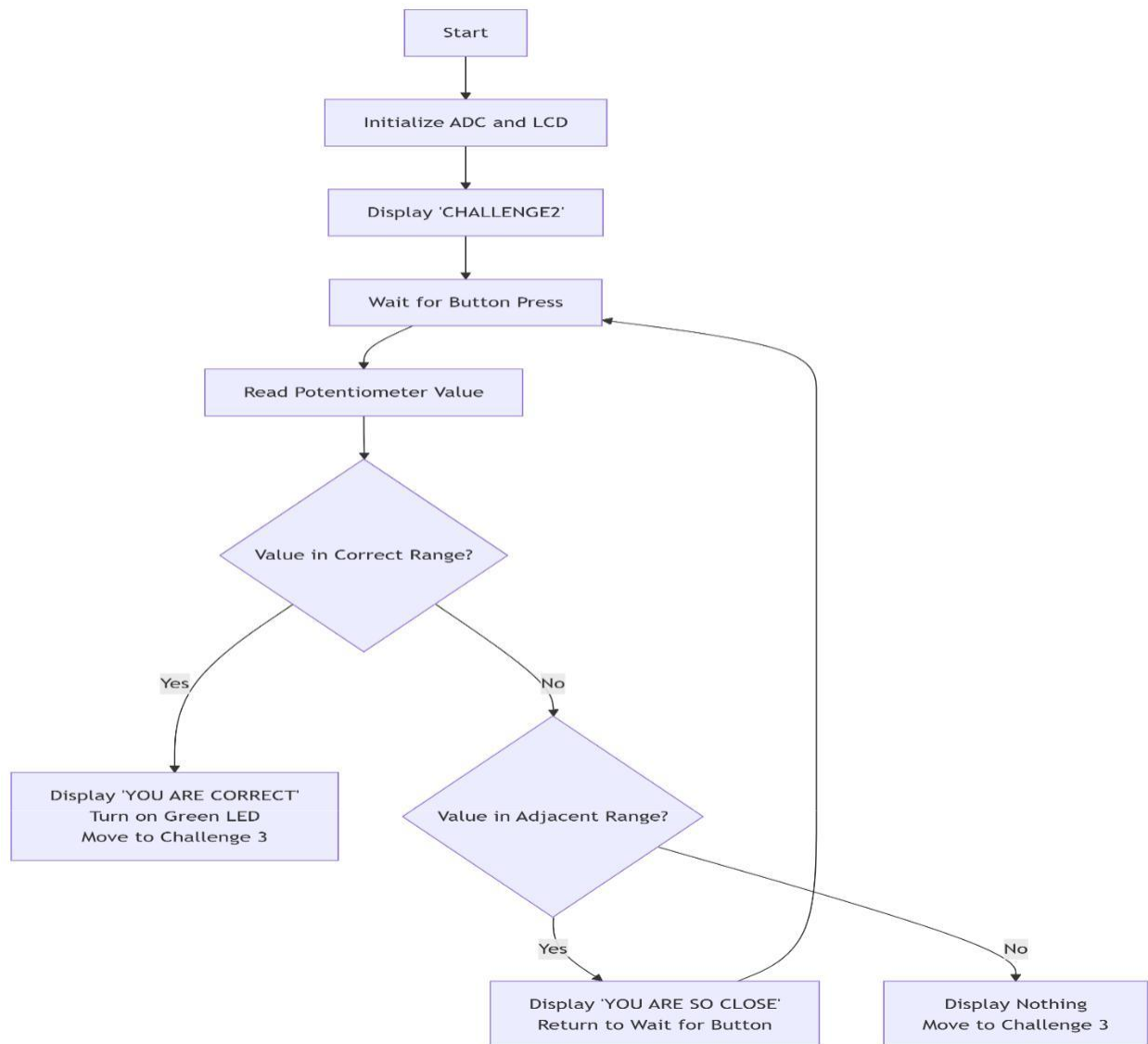
### Challenge 1:

For challenge 1, Firstly we clear out all the registers used and we initialize the PORTS to be INPUT or OUTPUT and then Display a CHALLENGE1 string on the LCD, After that we keep waiting for the start button to be pressed, if its pressed we read the value on PORTB and to take the 4 switches value only we AND PORTB value with 1111 0000 then swap it so we get the value entered by the user correctly , then we check if its prime or not and display on the 7-segment 'p' or not, and if its prime the first LED will turn On, then it will proceed to challenge 2.



## Challenge2:

For challenge2, As we did in challenge 1 a string of 'challenge2' will appear on the LCD and we will wait for the start button to be pressed, after that the the ADC will be ON and we will keep waiting until the ADC finishes the conversion from analog to digital (polling the ADIF flag) when the convergence is done, the value of ADRESH will be moved to adc register (we neglect ADRESL because it wont make a difference) to test the value we got from the potentiometer, we put the thresholds for each level as if  $adc \leq 25$  its correct and a string of 'YOU ARE CORRECT' will appear on the LCD and the second LED will turn ON, if  $adc \leq 52$  its very close and the string 'YOU ARE CLOSE' will appear on the LCD and the program will wait from the user to change the value another time and press the start button again, else its incorrect and nothing will appear on the LCD and the LEDS will be OFF, then the program will proceed to challenge 3.



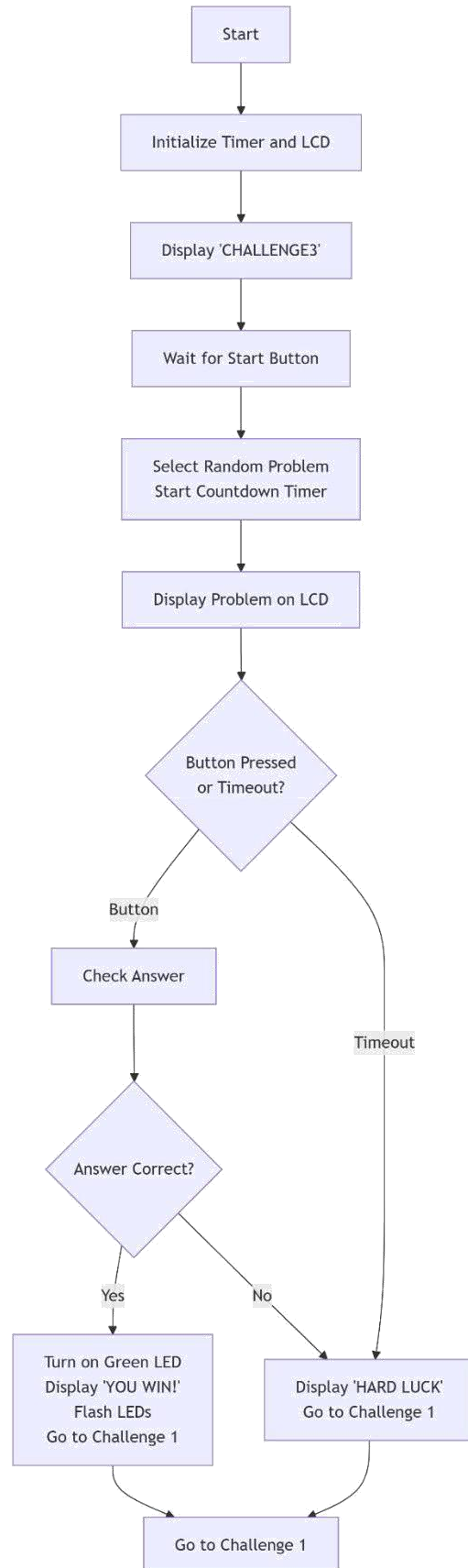
### Challenge 3:

For challenge 3, same as before a string of 'CHALLENGE3' will appear and timer0 will start counting and the program will wait for the user to press the start button, after the button is pressed Timer 1 will be turned on and its configured on 1:8 prescaler which is approximately 0.5 second, we decrement the countdown register value on each timer 1 overflow and we made the lookup table that the value of 9 for example will show 2 times in a row then on the third time it will show 8 and like that for the others too, in that way we made the timer on the 7-segment be decremented once each second.

Now we will go through how the problem is chosen randomly, as we said before timer0 started counting before the button is pressed, when the challenge starts we need to choose the problem to be displayed, so we AND the value of TMR0 register with 0000 0111 so now the value of the problem\_index will be from 0-7 but we want the value of the problem\_index to be 0-4, so we test on the bit 2 if its 1 we subtract from the value 3 else we keep the value as it is, in this way we make sure that the value is from 0-4 and its totally randomly choosed.

After everything is set and the problem index is set correctly and the countdown starts, A string of the problem chosen will show on the LCD, it will keep shown until the user either presses the finish button or the time reaches 0, if the user pressed the finish button we will read the values of the switches (in the same way in challenge 1) and compare them to the real answers if they are equal then the third LED will go on and it will be considered correct, else it will be considered wrong, and if the time runs out without pressing the finish button the challenge will be lost too.

At the end, after the 3 challenges are done, we will see if the user answered correctly for all the three challenges a string of 'YOU WIN! ESCAPE' will appear on the LCD and the LEDS will start flashing ( we can know that from the correct flags we added at the end of each challenge) and if the user had one or more wrong answer, a string of 'Hardluck' will appear on the LCD. Then the program will go back to challenge 1 and redo all of the challenges.



## Hardware Design:

As we can see in **Fig4**. there is multiple devices and we will go each of them now:

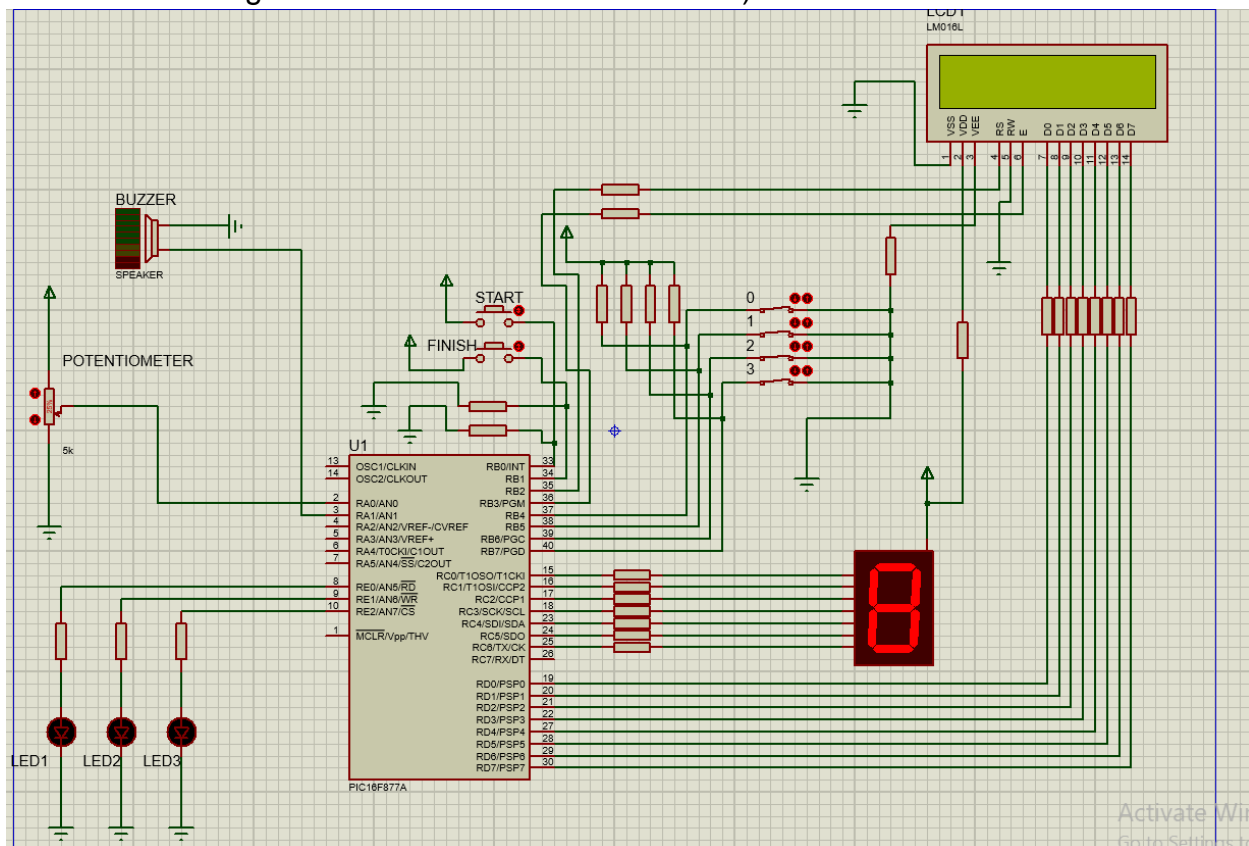
**Inputs:** we have 3 input sources, the first one is the start and finish buttons and these are used to start the three challenges and the finish button is used to submit the value for challenge 3, for the second input source we have the four switches and as we can see in Fig.4 we have a number beside each switch and the number demonstrates the bit (bit0, bit1, bit2, bit3), And for the third source it's the potentiometer and it is used to enter the guessed value for challenge 2.

**Outputs:** For outputs we have a lot of them, we have:

- 1- 7-segment which is used in challenge 1 to show if its prime or not and in challenge 3 its used as a countdown timer.
- 2- LCD which is used in all challenges to display some useful information.
- 3- LEDS which are used to show if the user won or not by lighting up if he won the challenge, and if he won all the three challenges they will start flashing.
- 4- Buzzer which will make a sound when the user answer the three challenges correctly.

**Pull-up resistors:** they keep digital input pins at a known logic level (as the ones on the buttons and the switches).

**Current-limiting resistors:** they protect both of the devices from excess current (as the ones on the 7-segment busses and the LCD busses).



**Fig4.** Proteus circuit

## Test Cases:

In **Fig.5** we entered 0010 which equals to 2 and it's a prime number so we got LED 1 on and 'P' on the 7-segment display.

In **Fig.6** we entered a value of 25% on the potentiometer which is in the range of the correct, and we got the YOU ARE CORRECT string with LED 2 on.

In **Fig.7** we got a problem after pressing the start button then we entered the correct answer for it which is in our case '8' by pressing the finish button and we got the Led 3 on which indicates for the correct answer.

In **Fig.8** after we solved the three challenges correctly we got the 'YOU WIN! ESCAPE' string as expected and the leds started flashing and the keeps giving a sound.

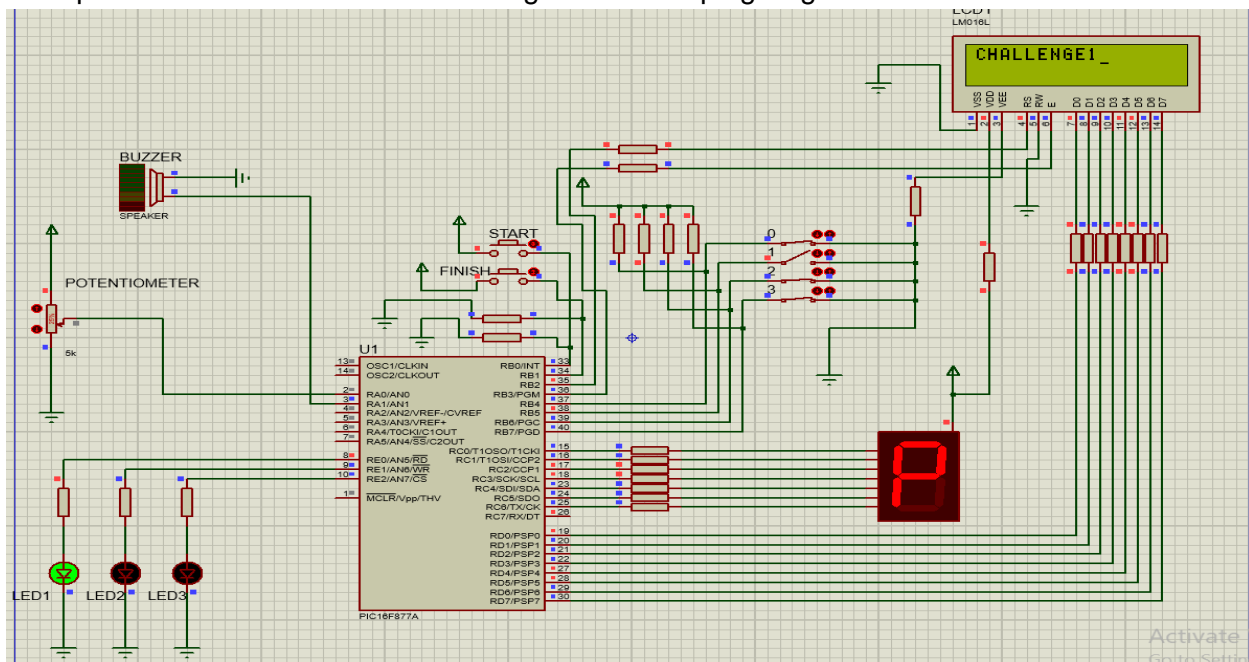


Fig.5 test case for correct challenge 1

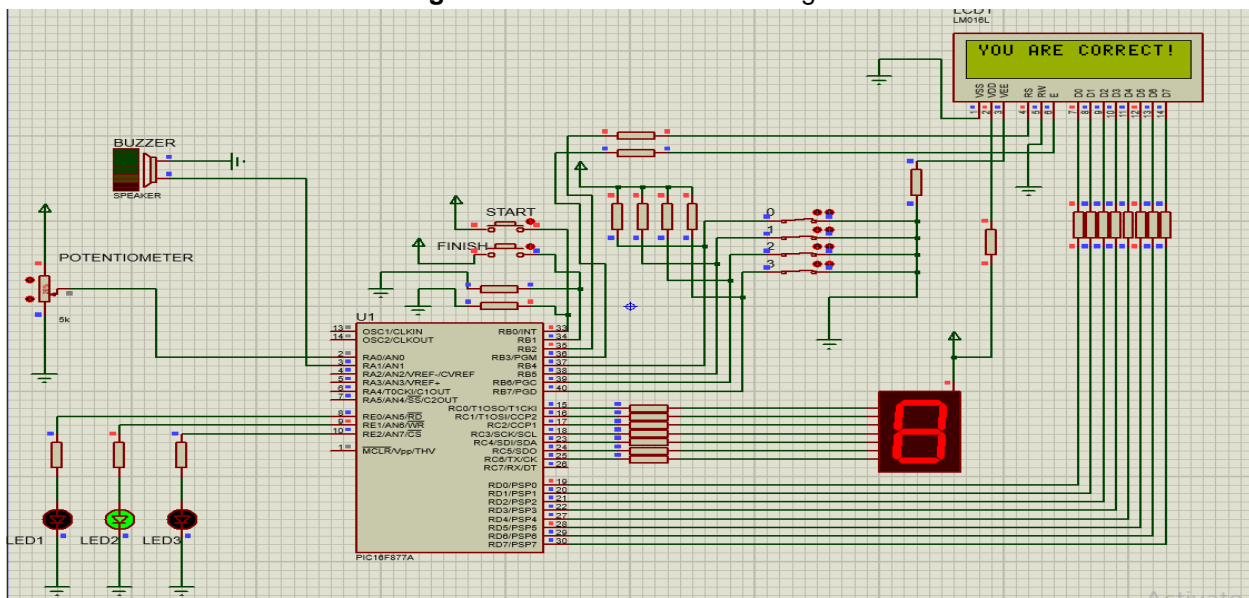


Fig.6 test case for correct challenge 2

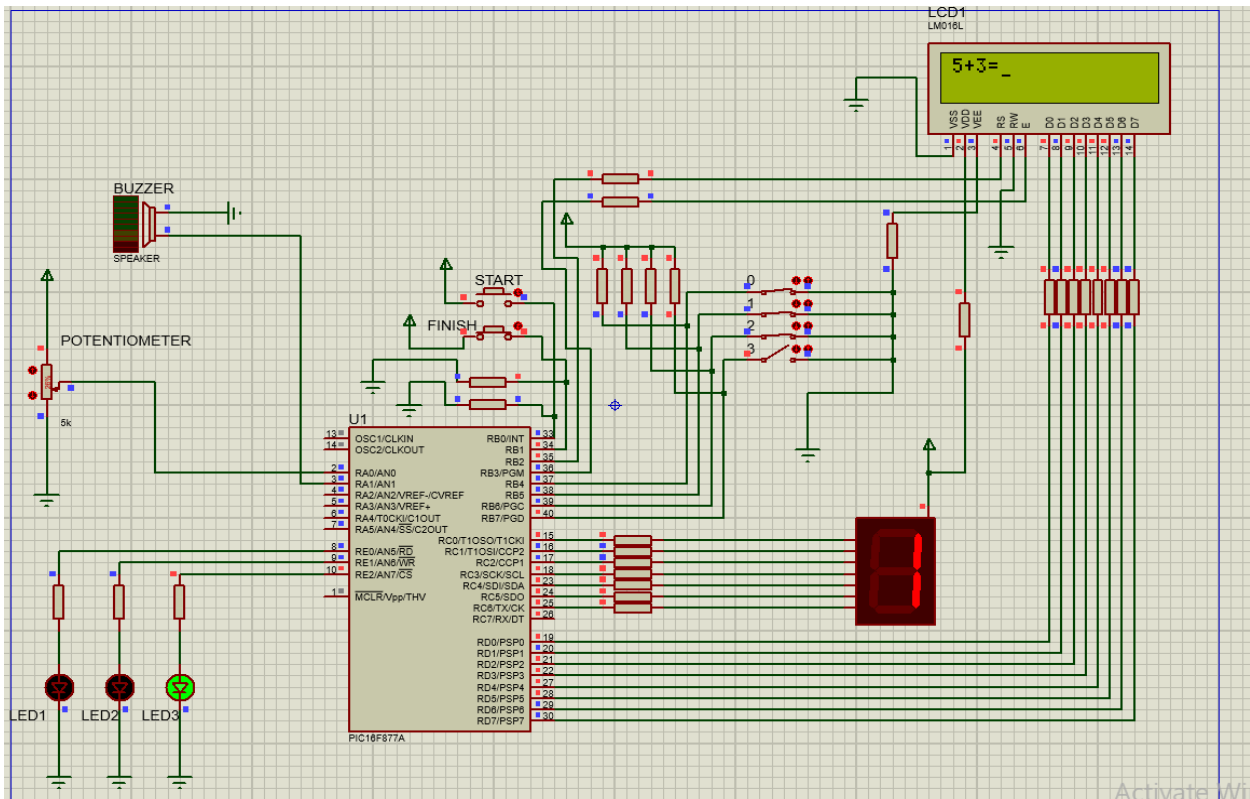


Fig.7 test case for correct challenge 3

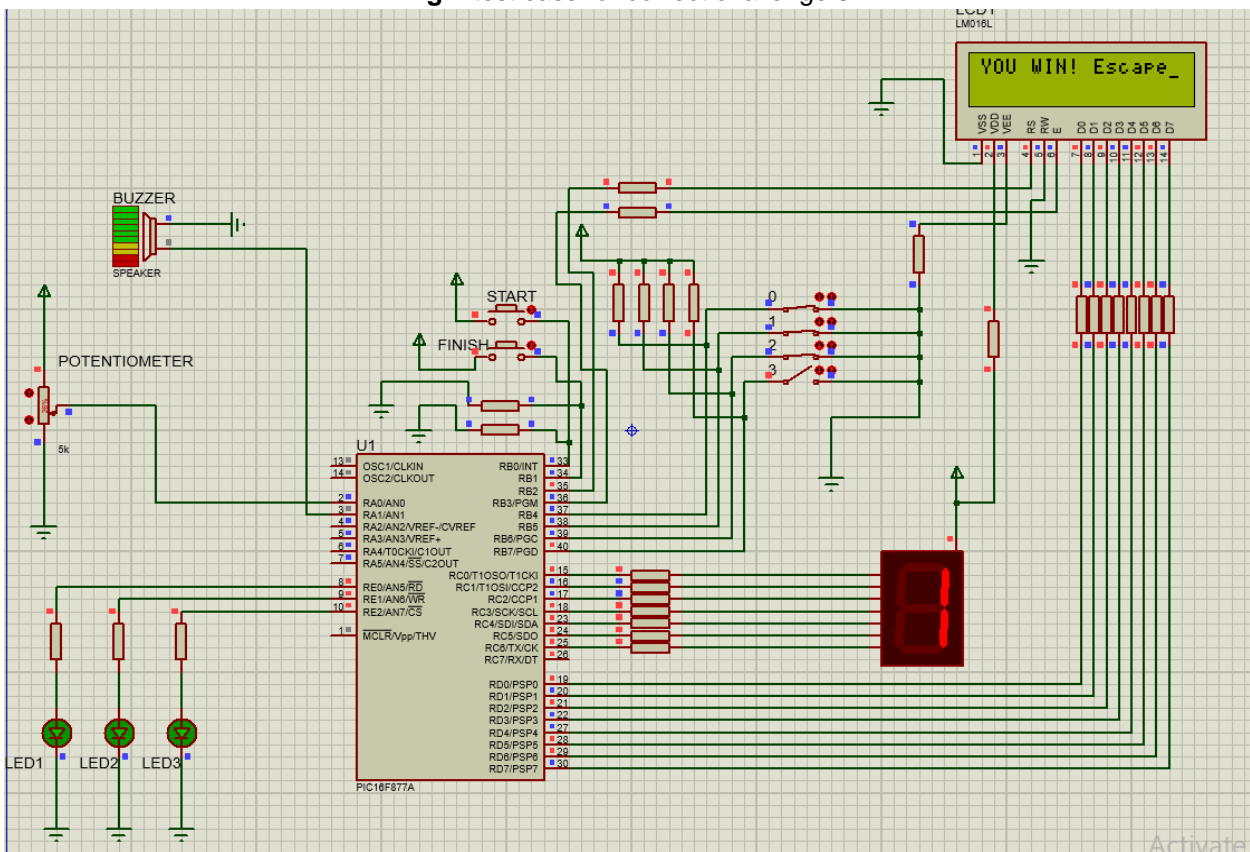


Fig.8 test case after the three challenges are solved correctly

**Errors we encountered:**

- 1- Address Out of Range: Too many RETLW instructions in countlookup so the PCL jumps to incorrect address.
- 2- incorrect ADC setup in Initial or CHALLENGE2 or it read wrong values.
- 3- Forgetting to enable peripheral interrupt.
- 4- Timer1 overflow not handled properly.

**Conclusion:**

The Escape Room Project implements three logic-based challenges using embedded systems, integrating hardware (switches, potentiometer, buttons, LCD, LEDs, 7-segment display, buzzer) and software to create an interactive experience. Challenges tests prime number identification, analog precision. Although we had issues like ADC errors and timer mishandling, the team resolved them through collaboration. The project met its goals, providing clear feedback and a winning sequence for correct answers. This work demonstrated effective embedded system design and teamwork. Future enhancements could include more challenges or refined difficulty levels.

**How We Worked:**

**Ahmad Qatawneh:** did everything on challenge 1 and made the proteus circuit.

**Almiqdad Alnaeme:** did the ADC part of challenge 2 and made all of the calculations needed for it plus making the 7-segment lookup tables.

**Ahmad Nazzal:** helped with implementing challenge 2 and made the prompts of the LCD plus the absolute value routine in challenge 2.

**Yahya Jad:** did everything on challenge 3 and wrote the report.



