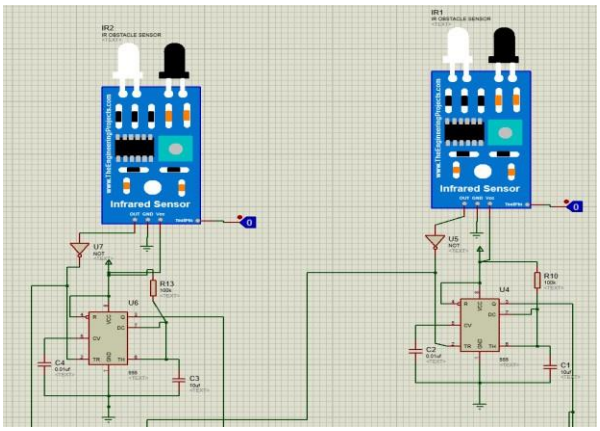
1. Vehicle Detection:

- IR sensors are placed at entry and exit points to detect vehicles.
- The IR sensor is an active-low component , when it detects an object , it outputs a LOW signal (not clocked) , which is not suitable to the up / down counter. Which makes a debouncing issue



- To solve this debouncing issue , each sensor triggers a monostable 555 timer to generate a clock pulse that will be used later in the logic for counting up / down in the 74192 counter

2. Counting Mechanism:

- The 74192 up-down counter tracks the number of vehicles entering and exiting the parking lot.
- The pin diagram connection of the 74192 up-down counter :

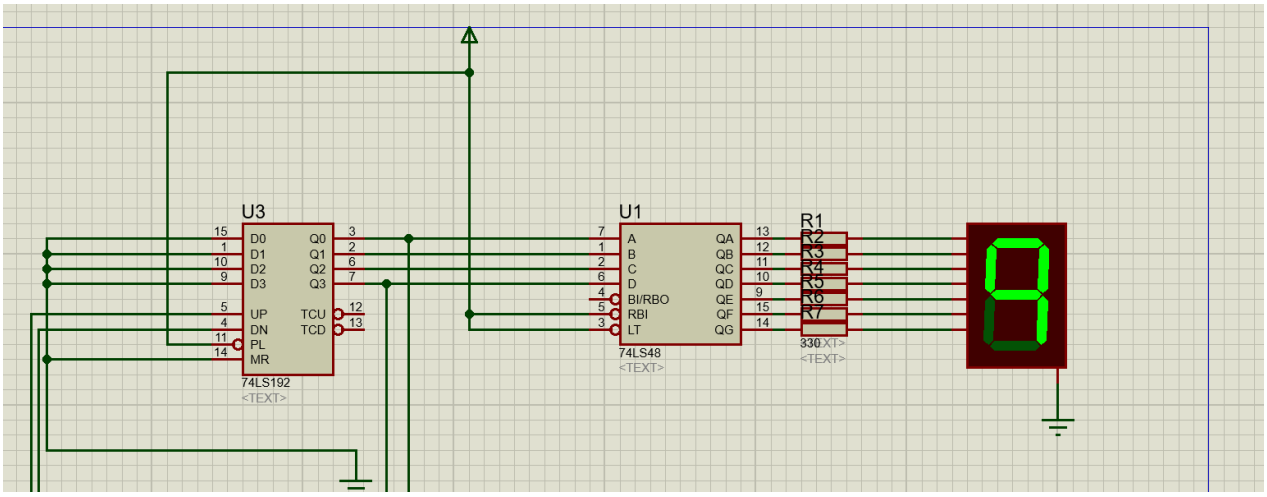
PIN DESCRIPTION

PIN No	SYMBOL	NAME AND FUNCTION
3, 2, 6, 7	QA to QD	Flip-Flop Outputs
4	CP_D	Count Down Clock Input
5	CP_U	Count Up Clock Input
11	$\overline{LOAD}$	Asynchronous Parallel Load Input (Active LOW)
12	$\overline{CARRY}$	Count Up (Carry) Output (Active LOW)
13	$\overline{BORROW}$	Count Down (Borrow) Output (Active LOW)
14	CLEAR	Asynchronous Reset Input (Active HIGH)
15, 1, 10, 9	DA to DD	Data Inputs
8	GND	Ground (0V)
16	V_{CC}	Positive Supply Voltage

- **The connection :**

1. Qn (counter output): connected to decoder input An .
2. Dn (parallel data input): connected to Ground.
3. MR (master reset input): connected to Ground.
4. PL(parallel load active low input): connected to VCC.
5. COUNT UP clock input
6. COUNT DOWN clock input

- Connect the counter to the 7448 decoder which takes the binary numbers as an input and display them in Decimal form on 7-Segment .



For the counter to count up or down , these conditions must be met :

TRUTH TABLE

COUNT UP	COUNT DOWN	$\overline{\text{LOAD}}$	CLEAR	FUNCTION
⎍	H	H	L	COUNT UP
⎎	H	H	L	NO COUNT
H	⎍	H	L	COUNT DOWN
H	⎎	H	L	NO COUNT
X	X	L	L	PRESET
X	X	X	H	RESET

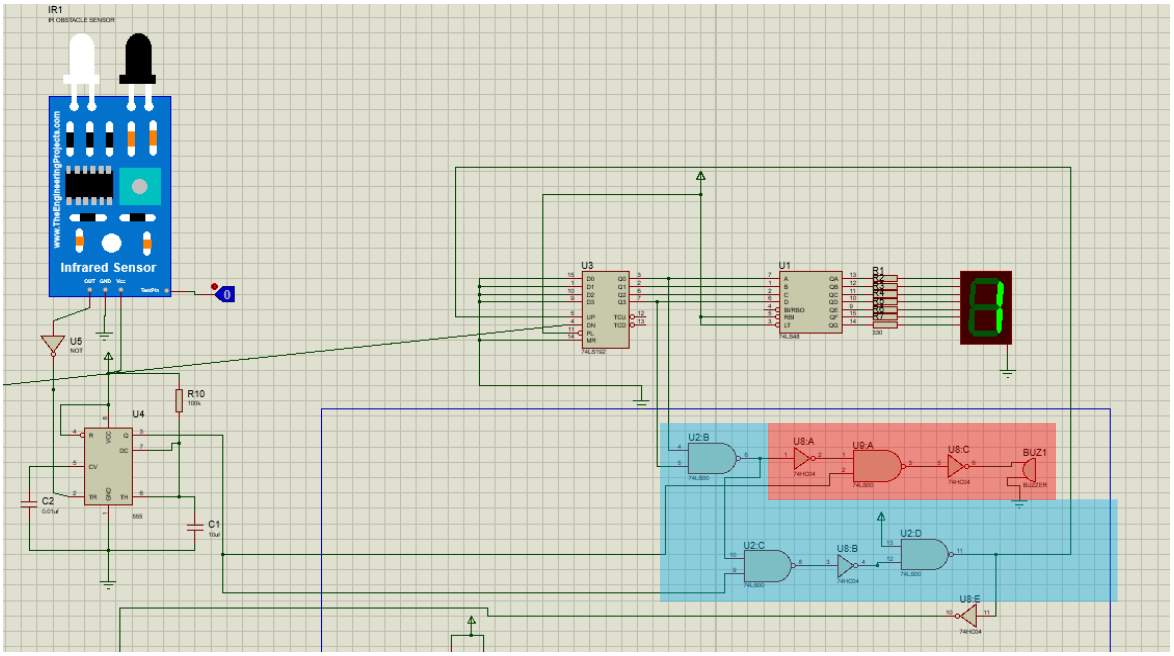
X: Don't Care

COUNT UP clock input logic :

- The main condition is that the counter only increments when the current count is not 9 (in binary :1001)
- so , Q0 and Q3 is NANDed to detect $COUNT9`$
- $COUNT9`$ Is ANDed with the $Timer\_up$ (sensor output from the 555 timer that count up)
- Then , $(COUNT9` . Timer\_up)$ is NANDED with HIGH , because the counter increment on rising edge of the pulse in addition that the COUNT DOWN pin must be HIGH
- The output of this logic circuit is connected to COUNT UP pin in the counter (shaded in blue)

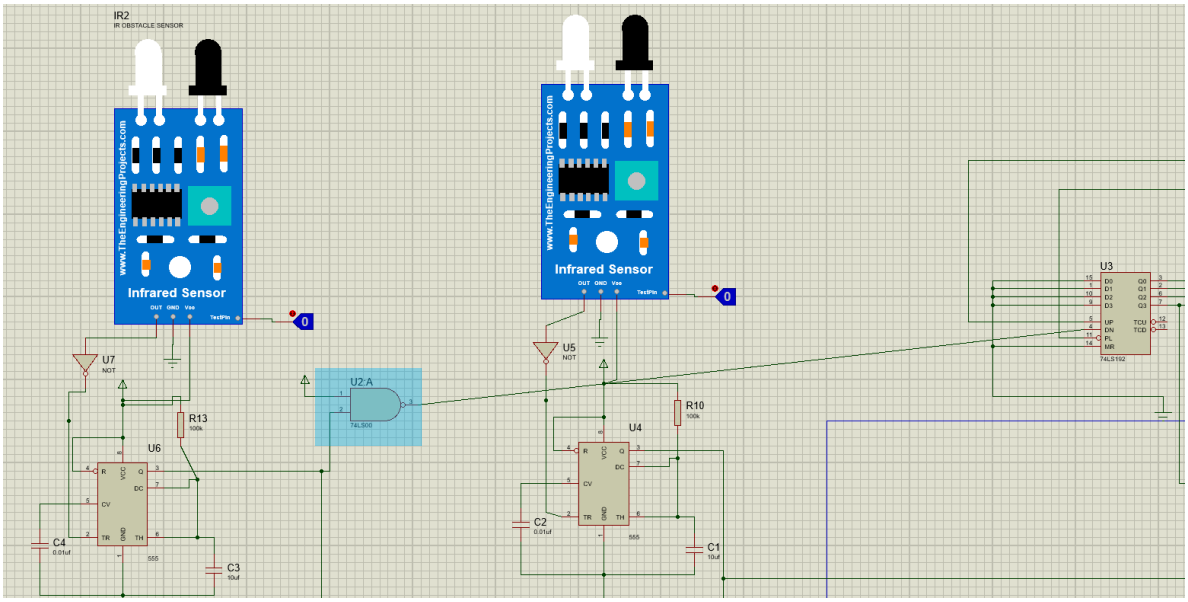
Buzzer connection

- If the count is 9 and another car attempts to enter, a buzzer is triggered, providing an alert.
- $COUNT9$ is ANDed with $Timer\_up$ and the output is connected to the buzzer (the red shaded part)



COUNT DOWN clock input logic :

- The $Timer\_down$ (sensor output from the 555 timer that count down) is NANDed with HIGH because the counter decrement on rising edge of the pulse in addition that the COUNT UP pin must be HIGH
- Its output is connected to COUNT DOWN pin in the counter (shaded in blue)



3. Gate Operation:

- The servo motor, controlled by a relay, opens and closes the toll gate when vehicles enter or exit
- In order for the servo to function correctly , the pulse frequency must be at 50hz , so a 555 timer is connected into astable multivibrator mode to achieve this frequency.
- This frequency is calculated by the equation

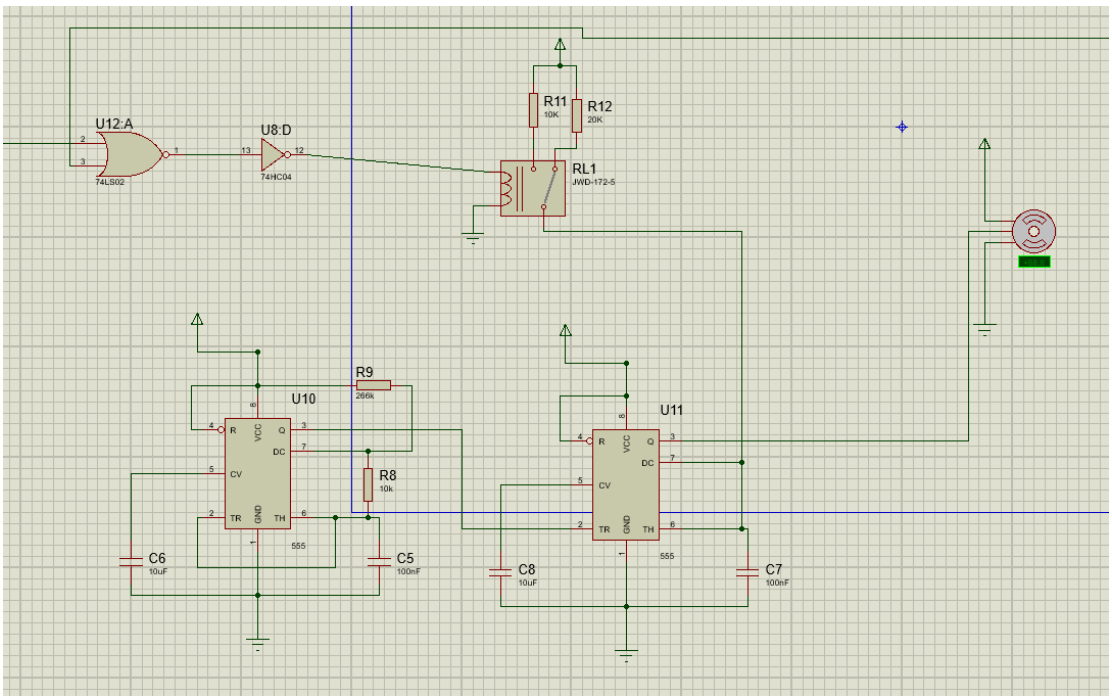
$$f = \frac{1.44}{(R_1 + 2R_2)\,C}$$

Where (F → frequency, R1 → first resistance, R2 → second resistance, C → Capacity of capacitor)

- The astable timer triggers another 555 timer in monostable mode , its output triggers the servo motor
- The relay acts a switch between 2 resistors (20k ,10k) ohms , that represents the position of the servo :

To get the zero-degree angle: use the 20K resistor
To get the ninety-degree angle: use the 10k resistor

- The relay is connected to pin 7 in the monostable timer
- The gate must be activated if there is any car enter(except if the count is 9) or exit the parking ,which uses the same logic to count up or count down the counter .
- So, the $COUNT\_DOWN$ is ORed with $COUNT\_UP$ to ensure that when any one of the sensors trigger , the gate action would activate
- The output of the OR gate is connected with the relay's VCC.



Conclusion:

This project demonstrates how Logic Design can be used to create a smart parking system. By integrating IR sensors, a servo motor, and a counter with the 7-Segment, which can efficiently manage parking spaces and automate gate control.