VEHICLE PARKING SYSTEM USING VERILOG

1. **Introduction:** Parking slots in closed spaces like shopping malls and multi-storeyed buildings etc., usually find it difficult to keep track of free space and require manual labour to do the same. This work aims at creating a parking system with multiple slots to mitigate the problem of tight parking spaces and high manual efforts to keep track of free space within a constrained area. The overall idea focuses mainly on designing a vehicle parking system by simulating Verilog code to detect a vehicle entering and leaving the parking venue and enable security measures by verifying a password as the vehicle enters the parking.

2. **Theory:** A sensor becomes active upon detecting an approaching vehicle at the parking facility's entrance. After the sensor is triggered, a password must be entered to unlock the gate. If the password entered is correct, the gate opens to allow the vehicle to enter, but the gate remains locked if the password is incorrect. If a vehicle is already inside and another vehicle approaches the entrance, the gate will be locked again, and the new vehicle must also enter the correct password to gain entry. Additionally, when a vehicle leaves the parking facility, an exit sensor detects it.
   The following state diagram depicts the entire methodology used:

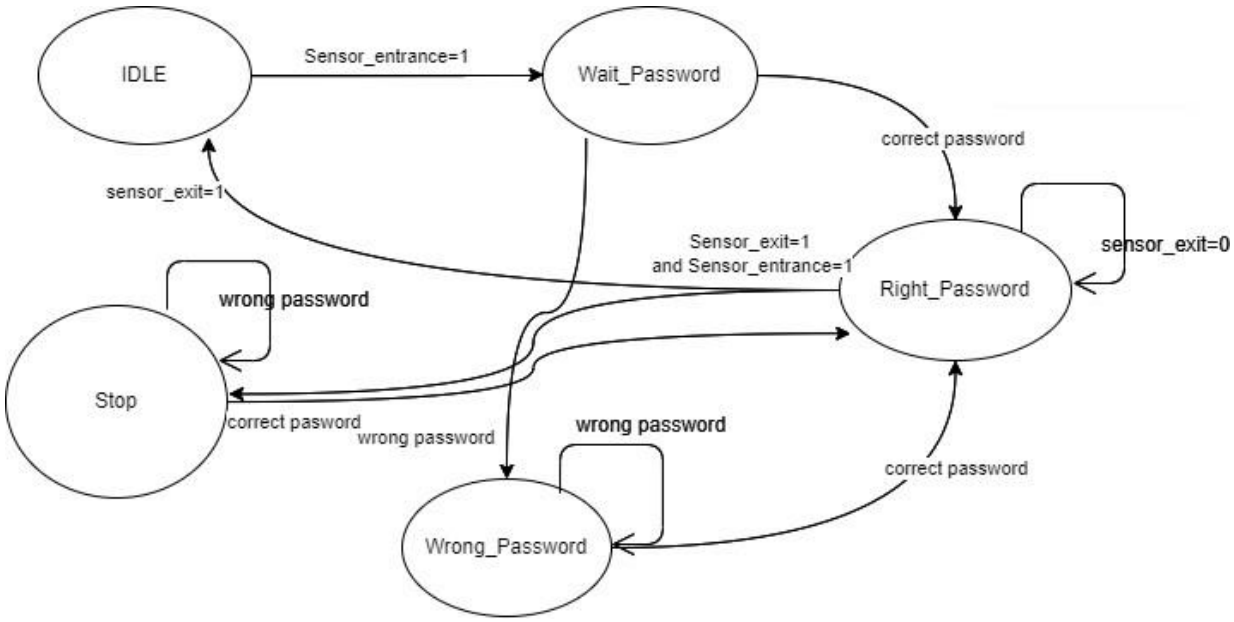


Figure 1: Finite state machine diagram.

We are taking into consideration the following inputs and outputs:

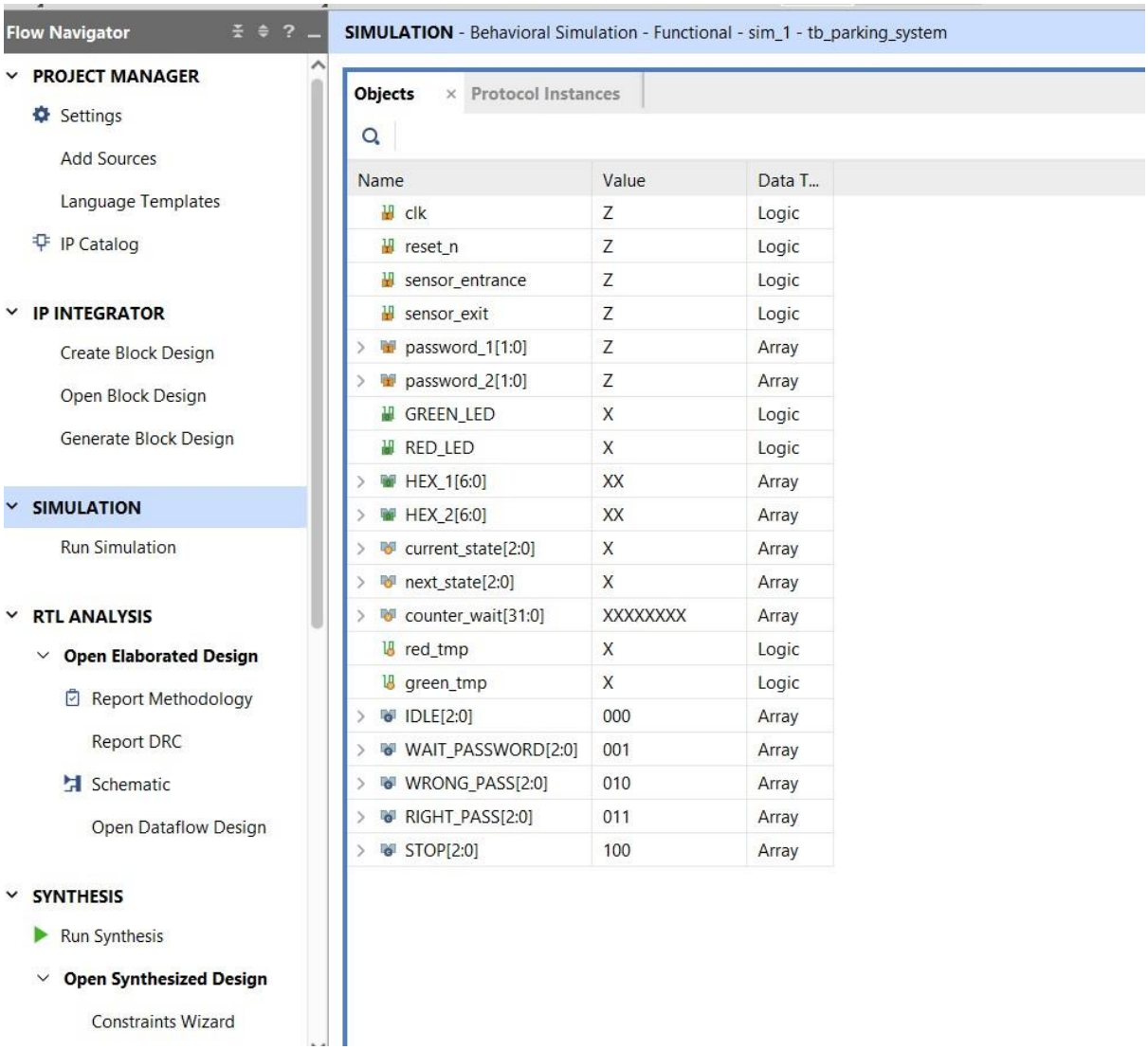


Table 1: Showing inputs and outputs.

3. **Result:** This design solves the issue of a vehicle parking system by proposing a simulationbased approach with the feature of identifying the availability of parking slots. The sensor at the entrance of the parking system is activated to detect a vehicle coming. Once the sensor is triggered, a password is requested to open the gate. If the entered password is correct, the gate would open to let the vehicle get in. Otherwise, the gate is still locked. If the current car is getting into the car park being detected by the exit sensor, and another car comes, the door will be locked and requires the coming car to enter passwords. Upon running the Verilog code, we get the following schematic in the RTL analysis:

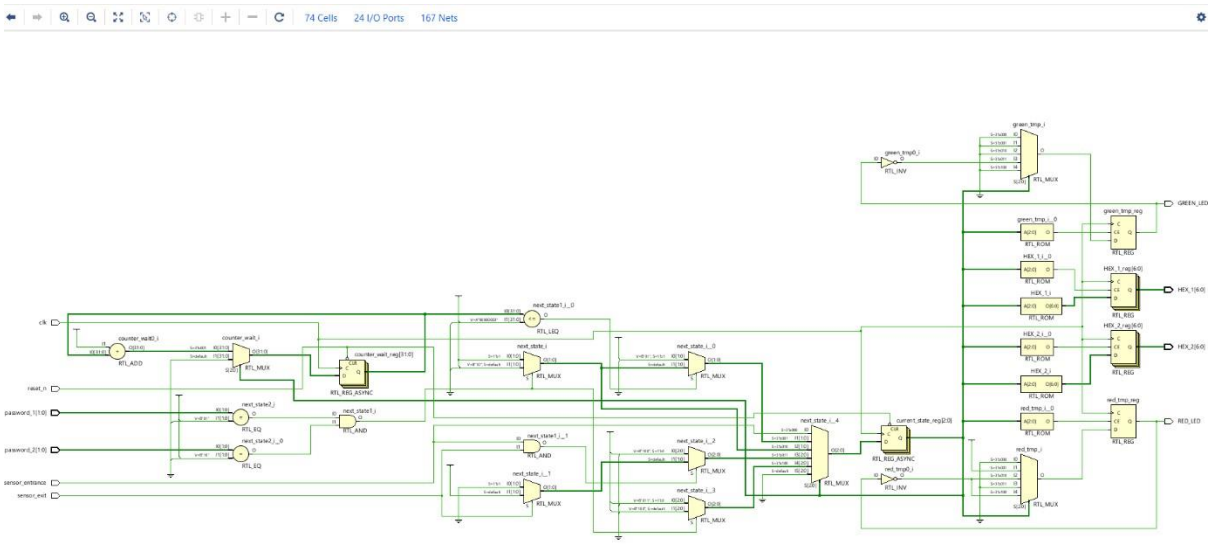
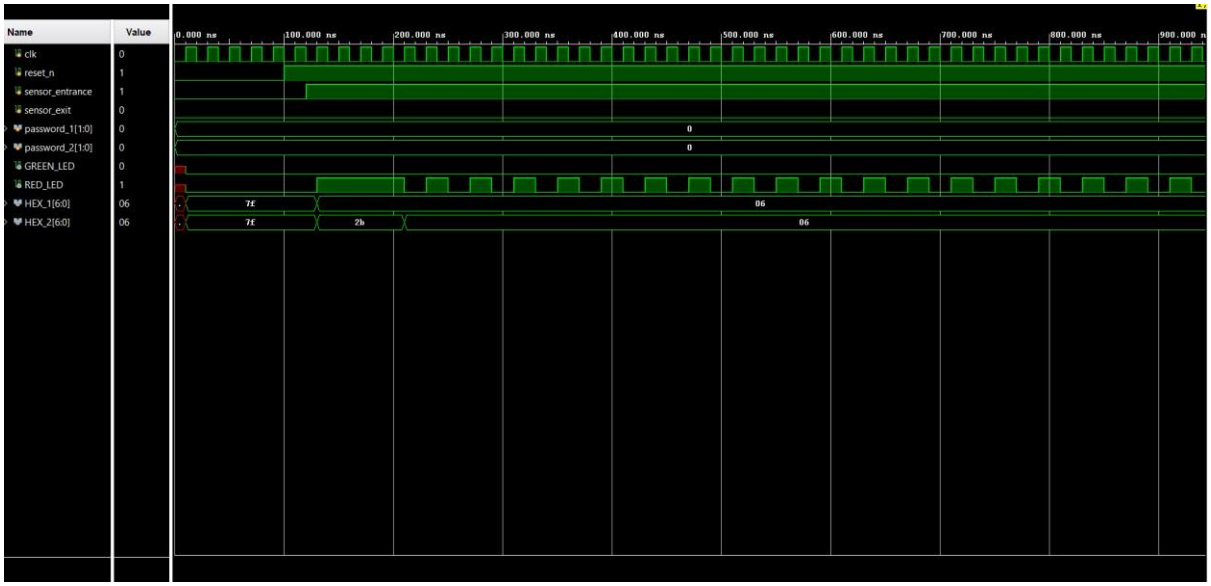


Figure 2: Schematic in RTL analysis.

We can observe this in the graphical result presented upon running a behavioral simulation:



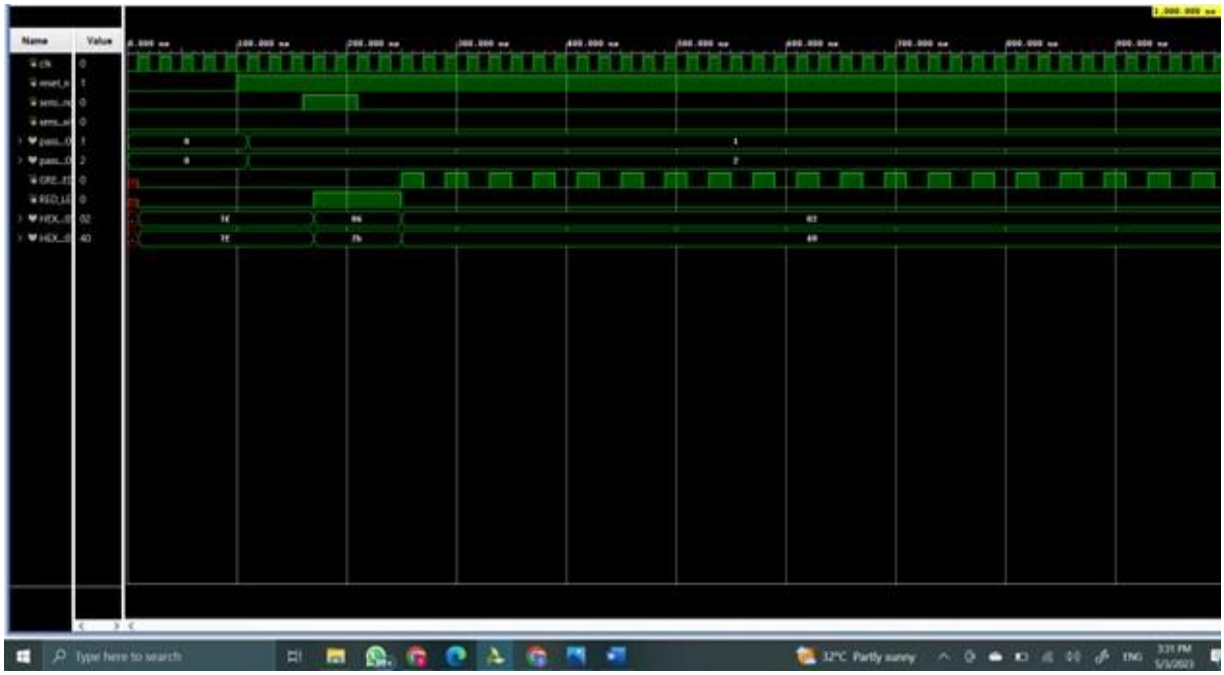


Figure 3: Results from the behavioral simulation.

4. Hardware Implementation:

Device Specifications:

Board: Basys 3

FPGA: Xilinx Artix-7

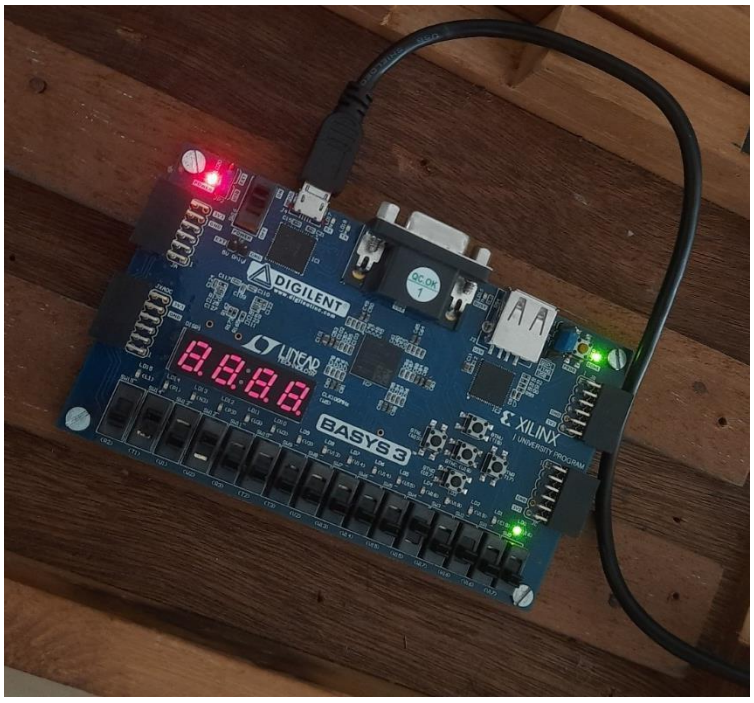
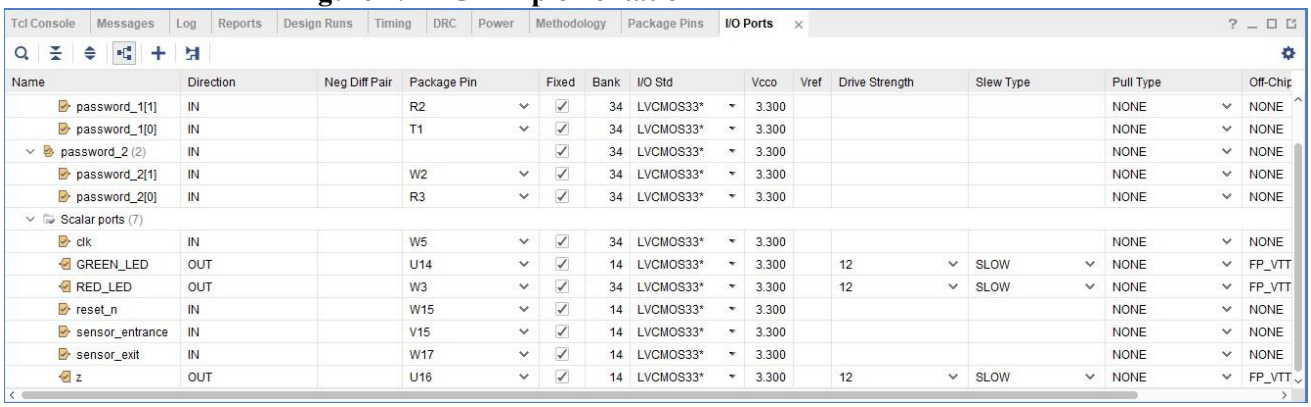


Figure 4: FPGA implementation



Name	Direction	Neg Diff Pair	Package Pin	Fixed	Bank	I/O Std	Vcco	Vref	Drive Strength	Slew Type	Pull Type	Off-Chip
password_1[1]	IN		R2	✓	34	LVCMOS33*	3.300				NONE	NONE
password_1[0]	IN		T1	✓	34	LVCMOS33*	3.300				NONE	NONE
password_2 (2)	IN			✓	34	LVCMOS33*	3.300				NONE	NONE
password_2[1]	IN		W2	✓	34	LVCMOS33*	3.300				NONE	NONE
password_2[0]	IN		R3	✓	34	LVCMOS33*	3.300				NONE	NONE
Scalar ports (7)												
clk	IN		W5	✓	34	LVCMOS33*	3.300				NONE	NONE
GREEN_LED	OUT		U14	✓	14	LVCMOS33*	3.300		12	SLOW	NONE	FP_VTT
RED_LED	OUT		W3	✓	34	LVCMOS33*	3.300		12	SLOW	NONE	FP_VTT
reset_n	IN		W15	✓	14	LVCMOS33*	3.300				NONE	NONE
sensor_entrance	IN		V15	✓	14	LVCMOS33*	3.300				NONE	NONE
sensor_exit	IN		W17	✓	14	LVCMOS33*	3.300				NONE	NONE
z	OUT		U16	✓	14	LVCMOS33*	3.300		12	SLOW	NONE	FP_VTT

Figure 5: I/O ports used on the FPGA

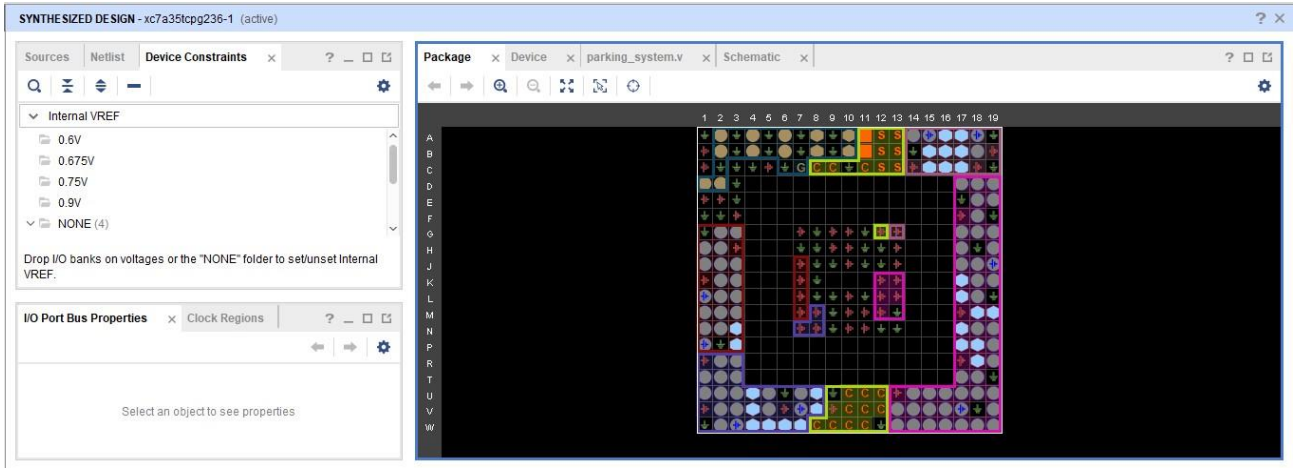


Figure 6: Package Design

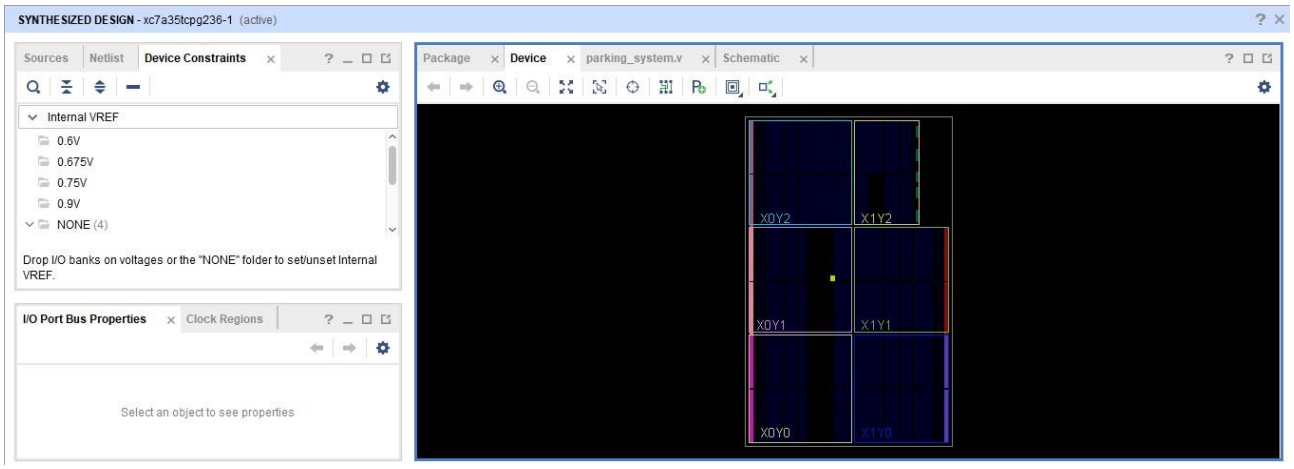


Figure 7: Netlist Design

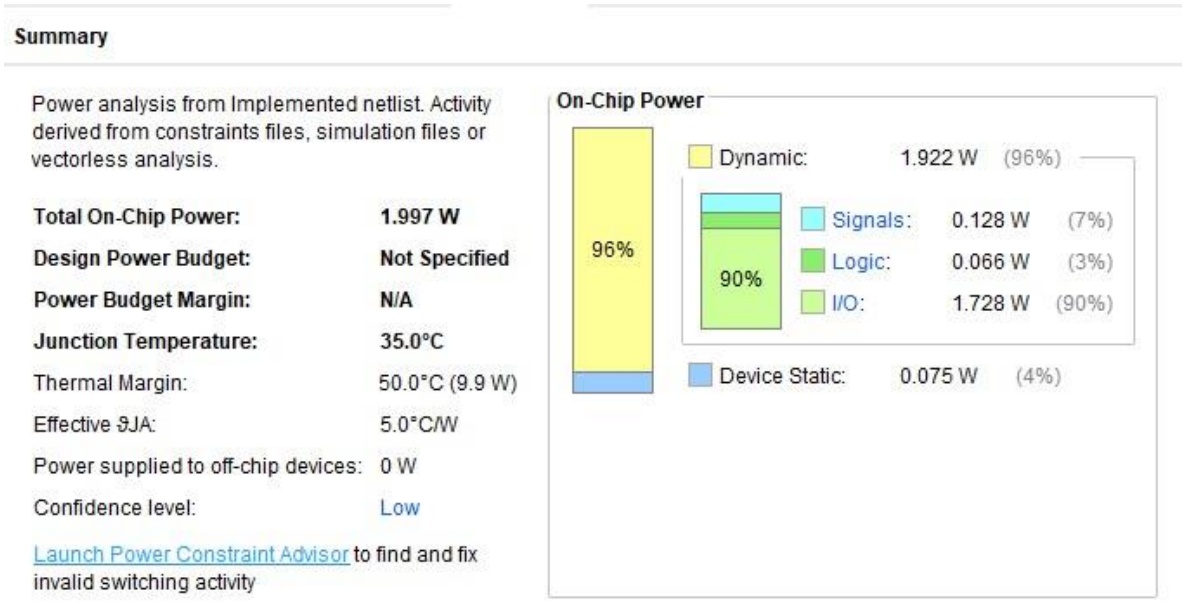


Figure 8: Power Analysis

5. Conclusion : In conclusion, the parking system with multiple slots offers an innovative solution to the common problem of tight parking spaces in closed areas such as shopping malls and multistoried buildings. The developed system offers a practical solution to the challenges of parking management in closed spaces, and its implementation could significantly improve the overall parking experience for users while reducing the manual labour required for parking management.

6. References:

https://www.researchgate.net/publication/360489566_Multi-Car_Parking_System_Using_Verilog

https://aircconline.com/vlsics/V4N3/4313vlsics07.pdf