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Verilog Design for Multi-Car Parking Management System

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ABSTRACT: Parking spaces within closed environments such as shopping malls and multi-story buildings often present challenges in efficiently managing available slots, necessitating significant manual labor to monitor free space. To address this issue, this proposed endeavours to develop a multi-slot parking system using Verilog code and simulate it using ModelSim software. This objective includes synthesis targeting with the Xilinx Integrated Synthesis Environment. The proposed solution involves implementing an asynchronous parking slot of mechanism using Finite State Machines. The parking slot involves in digital design widely utilized for modelling sequential logical circuits, within the context of parking slots. Finite State Machines offer a framework to represent various states and transitions occurring as vehicles enter, park, and exit the parking area.

KEYWORDS: Verilog, Xilinx, Model Sim, Finite State Machines.

I.INTRODUCTION

As cities in India like New Delhi, Hyderabad, and Bangalore grow rapidly, the lack of parking spaces becomes a pressing issue. The growing number of vehicles makes the problem worse, leading to traffic jams, pollution, and messy parking situations. To solve this, cities often add more parking spots by turning parks and empty lots into parking areas or building parking garages with many levels. But this can be hard to do because land is scarce and building costs are high. Also, it's important to think about how parking spaces are assigned in residential areas. In response to these challenges, the text proposes a technology based solution using smart parking systems. These systems leverage sensors and software to provide real-time information about available parking spaces, optimizing their utilization. By minimizing the need for human labor and streamlining the parking process, smart parking solutions aim to alleviate congestion and improve overall efficiency. The proposed described in the text focuses on designing a car parking system using Verilog code and software tools such as Xilinx with ISE simulator and ModelSim. The primary goal is to develop a system of parking slots based on the Finite State Machine concept. This paper is structured into six sections, covering introduction and motivation, related works, state machines, proposed system and implementation, simulation results, and conclusion. Overall, the text highlights the critical need for innovative solutions to address parking space scarcity in urban areas, emphasizing the importance of technology-driven approaches to optimize parking space utilization and alleviate associated challenges.

II.RECENT WORKS

The advancements in car parking systems described in the provided various methodologies and technologies aimed at enhancing the efficiency, convenience, and accuracy of parking processes. Here's a detailed breakdown of each :

Finite State Machine-The integration of a FSM on a FPGA enables automated parking by providing a structured approach to modeling parking behaviors and implementing customizable control logic.

Fuzzy Logic Control for Design- Fuzzy Logic Control provides a way to handle imprecise inputs and uncertain environments, which can be useful in parking.

Centralized Parking System with Driver Selection- Drivers can choose the nearest available parking slot. This centralized approach involves a central control unit that communicates with individual parking slots.

FPGA - It likely involves sensor integration and real-time control algorithms to aid drivers in manoeuvring into parking spaces.

VHDL - This method likely involves creating a control system to manage parking access or enforce parking rules.
 IOT-Based Parking System with IR Sensors-This design utilizes Internet of Things technology along with infrared sensors to detect the presence of parked vehicles.
 RFID-Based Parking System - Radio-Frequency Identification technology is used for vehicle identification and access control in parking systems. The recharge functionality likely involves a payment.

2.1 Finite state machine FSMs are essential tools for designing software and hardware systems. They provide a structured way to manage different states in a system. At any given moment, an FSM is in only one state. When certain conditions or events occur, the FSM can transition to another state. FSMs help engineers create models that explain how complex systems behave and make it easier to design logic that controls those systems efficiently.

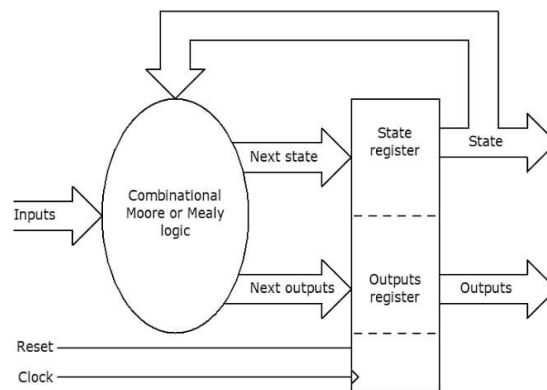


Fig 1 Mealy State Machine

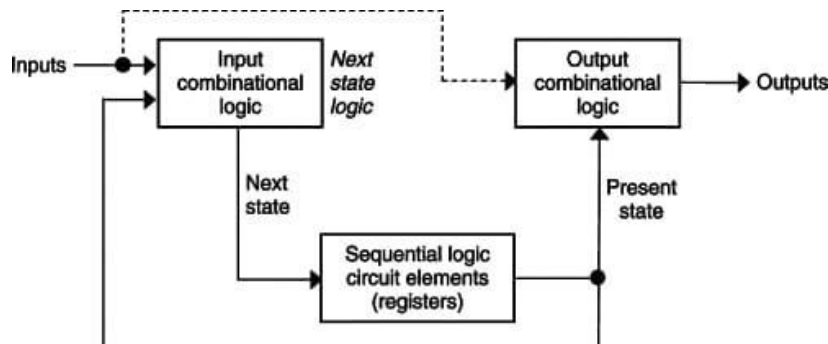


Fig2 Moore State Machine

Mealey Machine Mealy finite state machine, the output is based on both the current state and the input. They work in a sequential manner, determining the output values and nextstates based on the current state and output. Consequently, the output of a Mealy machine can vary with each input and state transition.

Moore Machine Moore state machine is indeed characterized by its dependency on current states alone for generating outputs. It comprises two essential components which determines the next states based on current inputs and states, and memory. Outputs are generated based on the current state alone, meaning tha the outputs are only valid after a transition to the next state occurs.

III.PROPOSED WORK

This system described is designed to manage entry and exit into a car parking arena using a Finite State Machine (FSM) model. It comprises five states:

IDLE -The initial state where the system waits for a car to enter.

Right Pass-The state indicating that the entered username and password are correct, allowing the car to enter.

Wrong Pass- The state indicating that the entered username and password are incorrect, prompting the user to re-enter.

Stop-The state indicating that the parking lot is full, and no more cars can enter.

Initially, cars must provide a username and password for entry verification, where the correct credentials allow access to park, while incorrect ones prompt for re-entry. A 'car count' variable keeps track of available parking slots, initially set to four for simulation ease but expandable for more slots. The system also employs two sensors, sensor_entrance and sensor_exit, to determine car movements, adjusting the car count accordingly as cars enter or exit. Once the parking slots reach capacity, the system enters the Stop state, denying further entry. Fixed user credentials (username: 01, password: 10) streamline verification. Overall, the system efficiently manages parking slot occupancy, ensuring security and effective utilization of space while addressing the challenge of multiple parking slots. The system discussed involves managing the access and departure of cars in a parking area using a Finite State Machine. When a vehicle approaches the parking area, the driver is required to input a username and password for authentication. These credentials are checked against predetermined values within the system. If the username and password match, the vehicle is granted access, and the system transitions to the Right Pass state, typically indicated by a green light. However, if the credentials do not match, the system remains in the Wrong Pass state, and the driver is prompted to re-enter the correct details until verification is successful. To monitor the movement of vehicles, the system employs two sensors: sensor_entrance and sensor_exit. When a vehicle enters, the sensor_entrance is activated, and when it exits, sensor_exit is triggered. This enables the system to keep track of the number of vehicles present in the parking area. One limitation of the current design is its inability to accommodate multiple parking slots. To address this issue, the system introduces a 'car count' variable, which monitors the available parking slots. Initially set for simulation purposes, the car count is adjusted dynamically as vehicles enter and exit the parking area. Once the maximum capacity is reached, as indicated by the car count reaching, the system enters the Stop state, preventing further entries. Furthermore, the system relies on fixed values for username and password for authentication purposes. Any deviation from these values results in the system denying access to the vehicle. In summary, the system effectively manages the ingress and egress of vehicles in the parking area while tackling the challenge of multiple parking slots through the incorporation of the car count variable and also reduces power consumption.

IV.RESULTS AND DISCUSSION

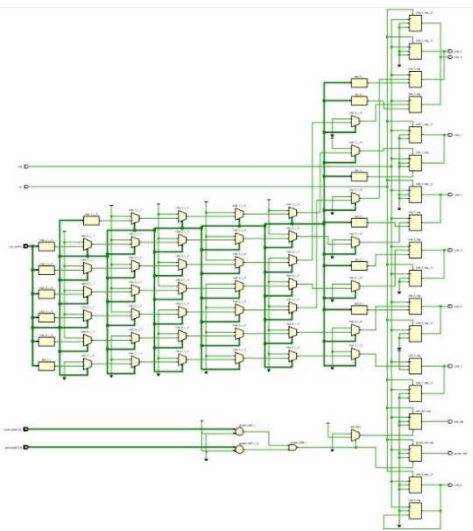


Fig.3 RTL Schematic Diagram

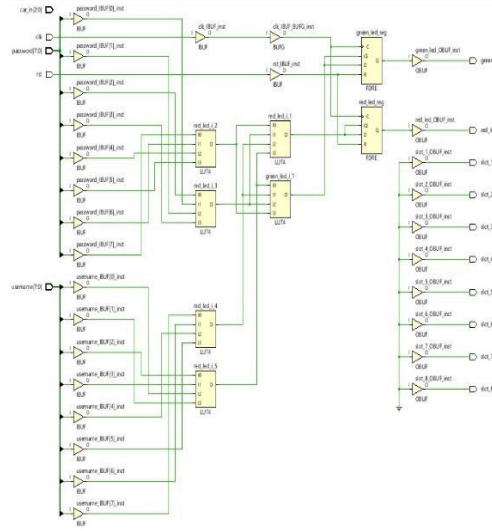


Fig.4 After Stimulation Schematic Diagram

RTL is a concept for defining the digital parts of a design. As it appears, this is a principle of abstraction that defines digital systems in today's technology and often plays the role of golden model in design and verification flow.

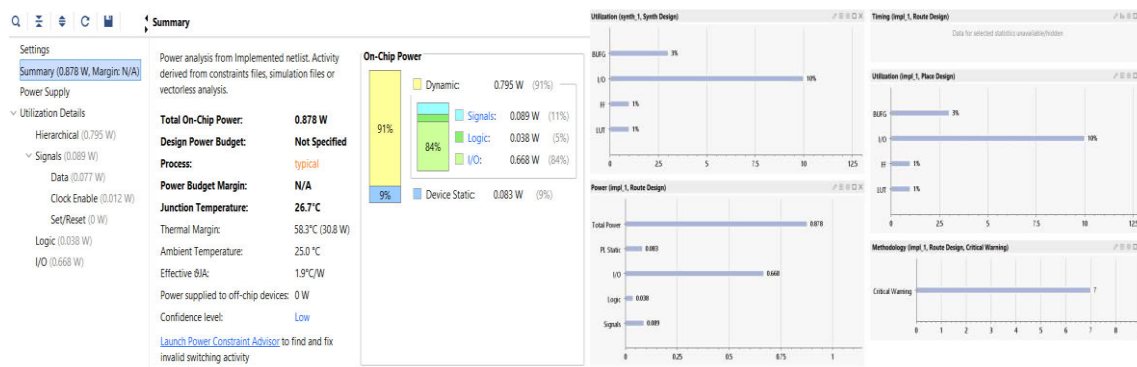


Fig.5 Power Consumption

Power consumption in multi-car parking systems is dependent on a number of factors such as the type of system, size of facility, lighting, ventilation, and other features such as security systems or charging stations for electric vehicles. In general, automated systems may use more energy because it involves the operation of machines and sensors.

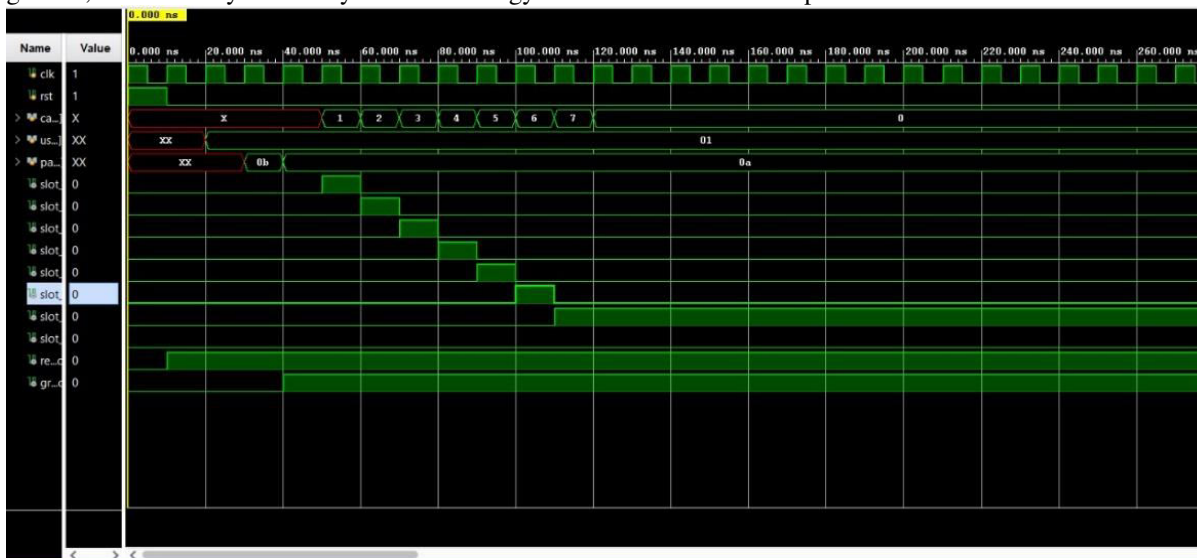


Fig 6 Final Waveforms

V.CONCLUSIONS

The proposed car parking system offers a simulation-based solution to parking challenges. It does this by efficiently detecting multiple real-time parking space availability for better resource utilization. It reduces inefficiencies associated with free spaces and which generally translates to low-cost parking. Drivers can quickly find out if there are any available slots as well as reduce the time, they spend in searching for parking areas, reducing fuel consumption and emissions due to prolonged searches. It helps save's money for the drivers and save's the time. It is an effective method of addressing urban car park challenges that encourages efficiency regarding resources while being cost friendly and also reduces power consumptions. It can detect the availability of multiple parking spaces, allowing for optimal use of resources.

VI.FUTURE SCOPE

The use of Verilog for building a multi car parking system involves a systematic approach in the handling of parking slots, tracking occupancy and making entrance and exit operations smooth. To achieve efficient use of the space available in these parking lots, there has been implementation of logic which automatically assigns an empty slot when cars enter into the lot and marks them as vacant on exiting. The presence of such real-time tracking is very critical because built-in display systems give customers up-to-date information concerning parking spaces availability. These

input interfaces help to imitate events of vehicles entry and exist thus enabling to check all possible cases during the system's testing.

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