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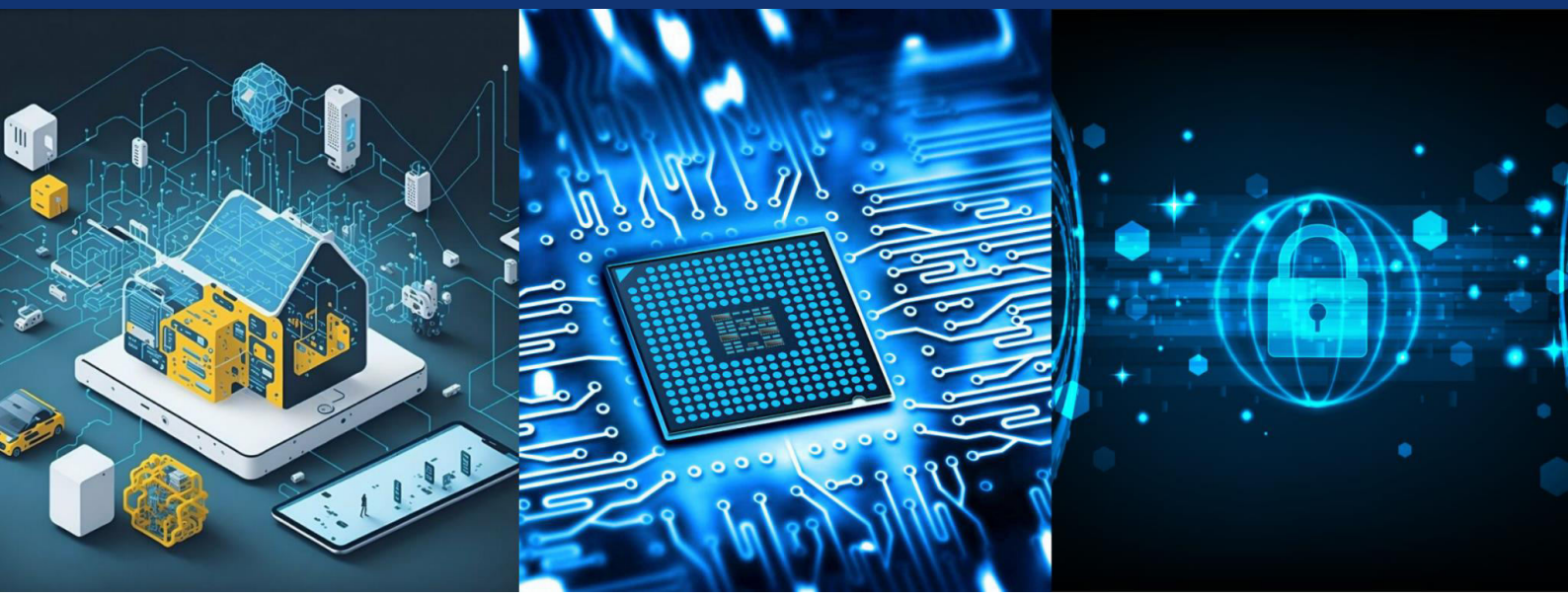

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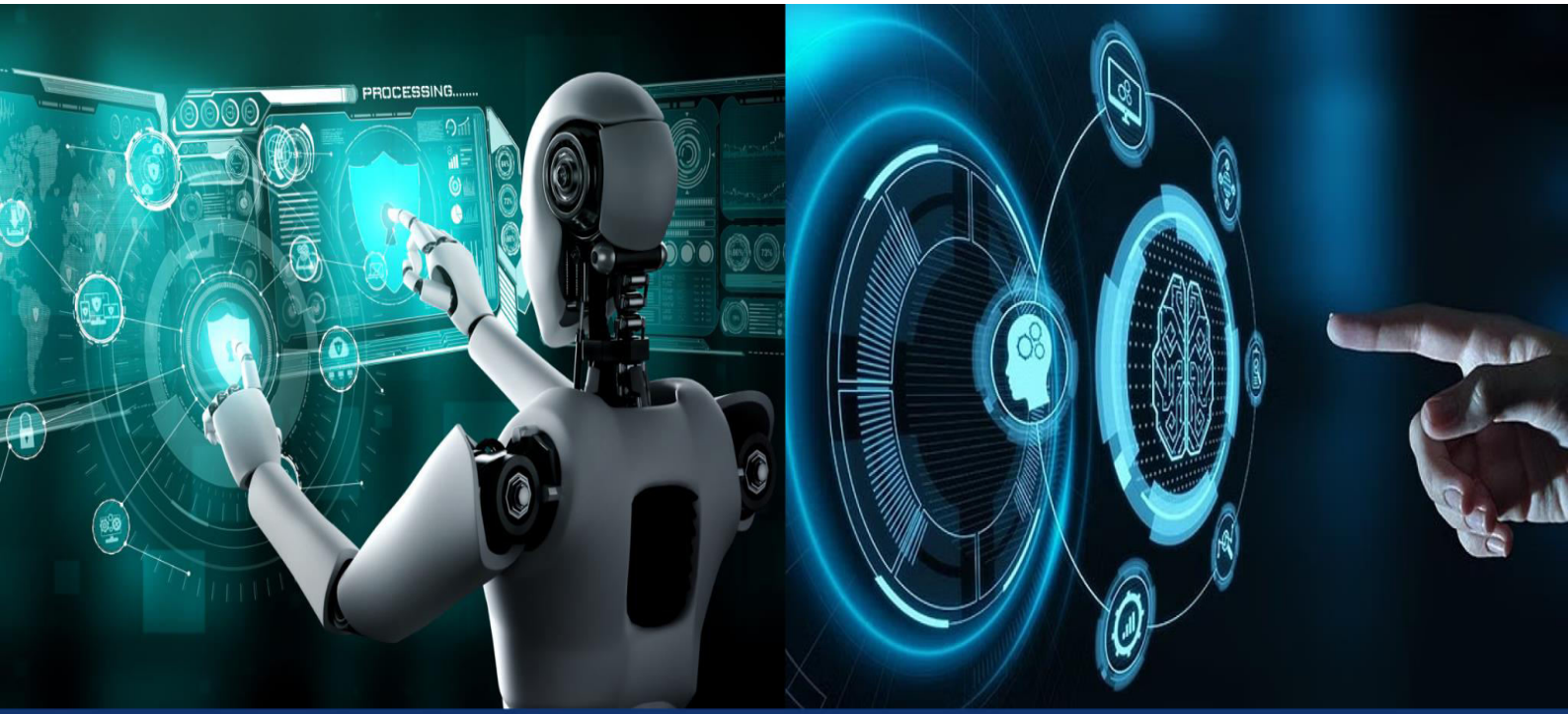

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Design and Verification of Car Parking Management System using Verilog

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ABSTRACT: In recent years, the rapid increase in the number of motor vehicles has resulted in major challenges such as environmental pollution, traffic congestion, and inefficient utilization of parking spaces. Conventional parking systems are mostly manual or semi-automated, leading to increased waiting time, improper slot allocation, and limited security for parked vehicles. These drawbacks highlight the need for an automated and secure car parking management system. This paper proposes a secured car parking management system designed and implemented using Verilog Hardware Description Language (HDL). The proposed system is divided into two main functional modules. Module-1 is responsible for parking slot identification, where the availability of parking slots is monitored and displayed in real time using LCD display screens, allowing drivers to easily identify vacant parking spaces. Module-2 acts as a security indicator that enhances vehicle safety by detecting and alerting against unauthorized attempts to vacate or access a parked car. The integration of these modules ensures both efficient parking management and improved security. Both modules are modeled, simulated, and verified using Verilog HDL to ensure accurate functionality and reliable system performance. The results demonstrate that the proposed system effectively reduces parking congestion, improves space utilization, and enhances vehicle security. In conclusion, theVerilog HDL–based car parking management system provides a scalable, efficient, and secure solution suitable for modern smart parking applications and future real-time hardware implementation.

KEYWORDS: Verilog HDL,Hardware Description Language,Parking, Slot Detection,Automated , Parking System, Smart Parking ,Security System , Real-Time Monitoring,Digital System Design , FPGA Implementation

I. INTRODUCTION

In rapidly developing countries like India, the rapid increase in population and vehicles has created significant parking and traffic challenges. The lack of sufficient parking spaces often forces drivers to park on roads, leading to congestion, slow traffic movement, and increased emissions from vehicles searching for parking. This not only wastes time but also harms the environment with CO2 and other harmful gases. To address these issues, advanced parking systems, like automated and smart parking solutions, can efficiently use land, reduce congestion, and minimize environmental impact by providing real-time information about available parking spaces. These systems use sensors to monitor occupancy and guide drivers to vacant spots, improving parking efficiency in crowded areas like hospitals, shopping centers, airports, and universities.

The implementation of a smart parking system using sensors and Web APIs offers a cost-effective solution to the growing parking problem. This system automatically tracks parking space availability, generates parking tokens, and records vehicle check-in times, which helps reduce the time spent searching for a space. Developed using technologies like Laravel, the web based application manages data related to vehicles, ensuring better monitoring and management of parking lots. By automating parking management and eliminating the need for manual supervision, this system not only saves time but also reduces the risk of theft and vandalism, offering a more efficient and eco-friendly solution to urban parking challenges.

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II. RELATED WORK

Design and Verification of car parking management system using verilog give me the related work in paragraph format .Here is a well-written "Related Work" paragraph for your topic "Design and Verification of Car Parking Management System using Verilog" based on existing research:

Several researchers have explored the design and implementation of car parking management systems using hardware description languages and FPGA-based architectures. Early work by Kaur and Singh proposed a parking system modeled using finite state machines (FSM), consisting of identification and slot-checking modules, demonstrating how HDL-based designs can efficiently manage parking operations.

Later studies extended this concept by integrating Verilog HDL to improve speed and real-time performance through FPGA implementation, enabling rapid detection of vacant slots and efficient vehicle handling. Recent works focus on enhancing automation and security by incorporating password-based access control, sensor- driven vehicle detection, and automated gate systems, which reduce manual intervention and improve reliability. Additionally, multi-slot parking architectures have been developed using modular Verilog design and FSM techniques to ensure scalability and adaptability for large parking areas

Some approaches also integrate smart features such as online booking, real-time monitoring, and distance calculation for slot allocation, addressing urban challenges like traffic congestion and inefficient parking utilization. Beyond HDL-based implementations, intelligent parking systems using IoT, mobile applications, and image processing have also been proposed to provide advanced functionalities like reservation systems and automated vehicle identification. However, despite these advancements, there remains a need for robust verification methodologies in Verilog-based parking systems to ensure correctness, reliability, and fault-free operation under different scenarios.

III. METHODOLOGY

The design and verification of a car parking management system using Verilog follows a structured hardware design methodology that begins with clearly defining the system requirements. These requirements typically include tracking available parking slots, detecting vehicle entry and exit, controlling gate operation, and displaying slot availability. Based on these requirements, the system is divided into smaller modules such as entry sensor logic, exit sensor logic, slot counter, control unit, and display interface. A top-level module is then created to integrate all submodules. The design phase involves writing synthesizable Verilog code for each module, using finite state machines (FSMs) where appropriate—for example, to manage gate control or vehicle flow logic. Care is taken to ensure proper clocking, reset behavior, and avoidance of race conditions.

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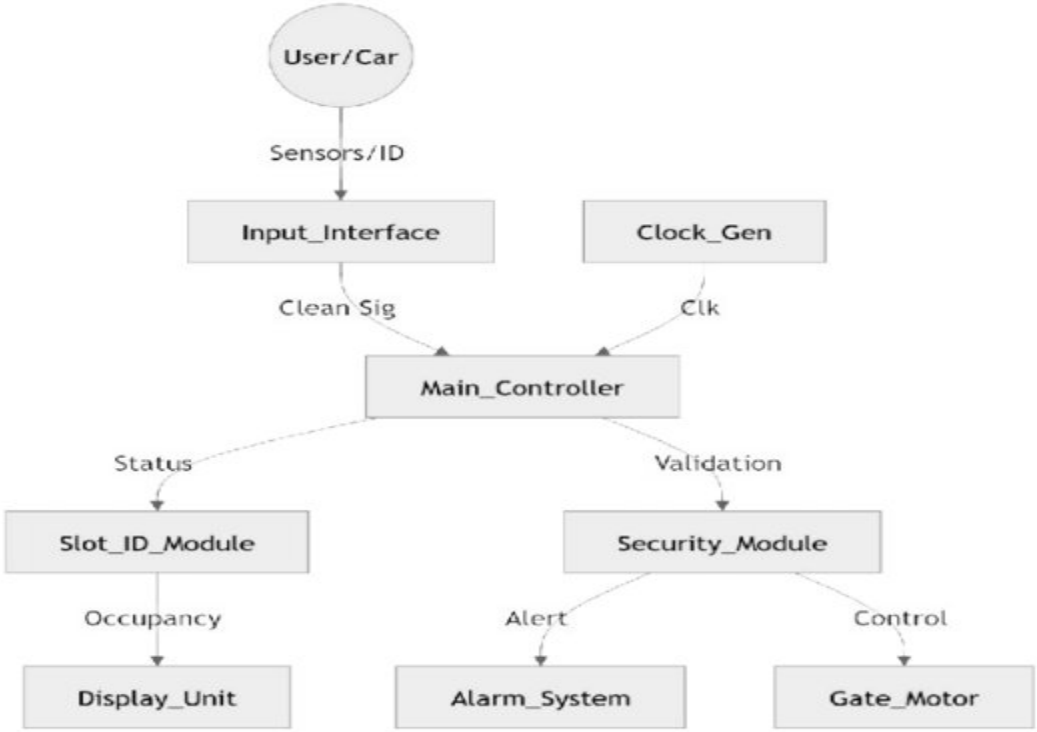

Fig.1 Top level block diagram

Once the design is complete, the verification phase begins with the creation of a comprehensive testbench. The testbench simulates real-world scenarios by generating input stimuli such as vehicle arrival and departure signals, and checks whether the system correctly updates the parking count and control outputs. Functional verification is performed using simulation tools like ModelSim or Xilinx Vivado, where waveforms are analyzed to confirm correct behavior. Edge cases, such as parking overflow or simultaneous entry and exit, are also tested. Assertions and coverage metrics may be used to improve verification quality. After successful simulation, the design can be synthesized and implemented on an FPGA platform for hardware validation, ensuring that the system operates correctly in real-time conditions.

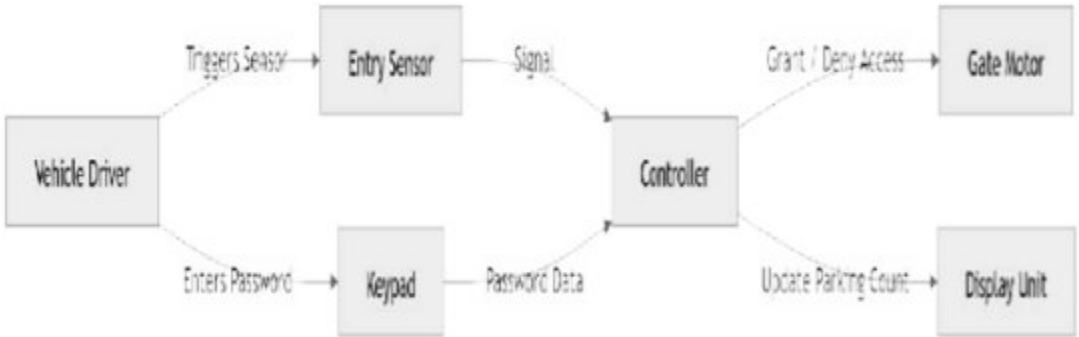

Fig.2 Activity block diagram

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IV. EXPERIMENTAL RESULTS

The design was verified using Mentor Graphics ModelSim.

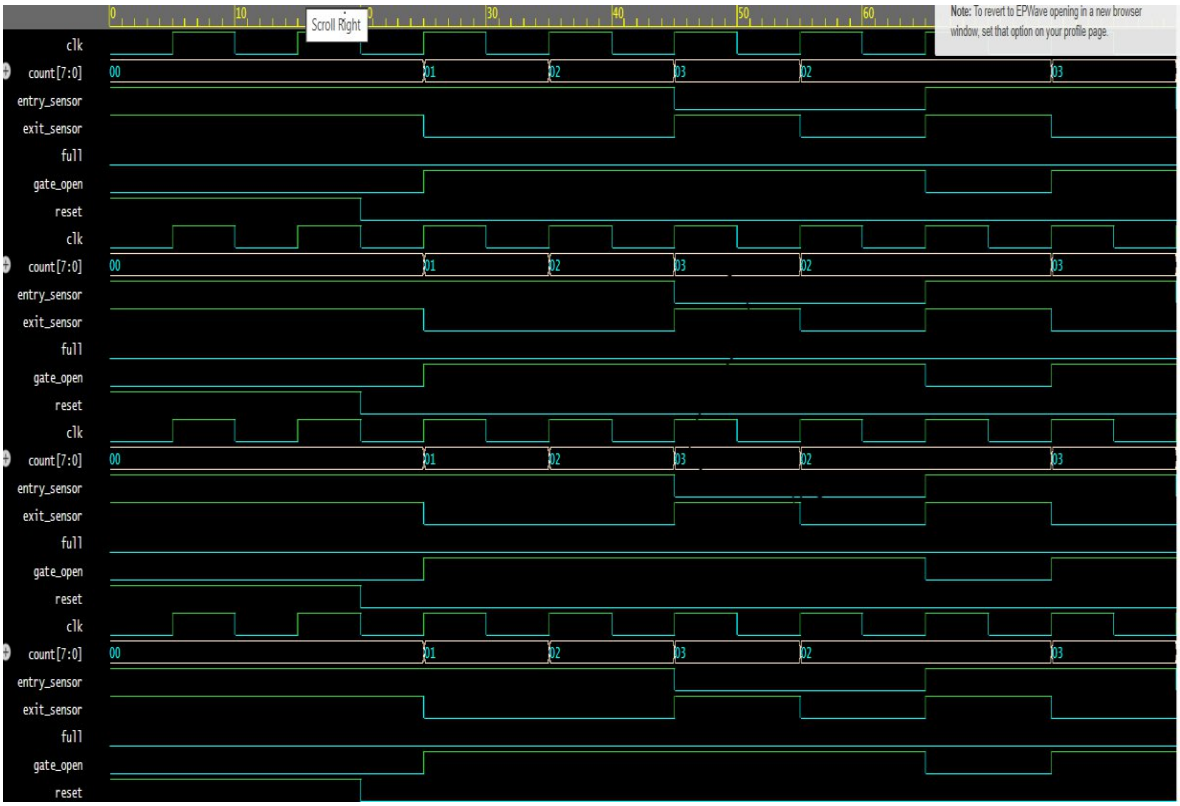

Fig.3 Simulation Result

The simulation confirms that the hardware logic executes the “Secure Parking Algorithm” correctly. The alarm mechanism triggers in a single clock cycle (10*ns*), which is practically instantaneous compared to software-based polling loops which might take milliseconds. This speed ensures that a fast-moving vehicle cannot “trick” the system by exiting before the check logic completes. Results typically display real-time occupancy on LCD screens, showing updated spot availability, "Parking Full" notifications, and functioning entrance/exit barrier controls.

V. CONCLUSION

An efficient car parking system that monitors vehicle entry and exist is successfully designed and implemented. The system caters to a wide range of issues. Device utilization was found to be much lower in comparison to the existing models. It is a safe and cost-effective personalized parking solution that focuses on the fundamental principle of saving time while parking. Because the majority of the operation is hardware based, maintaining the network of incoming and outgoing cars is also relatively simple. The concept also promotes quick parking. The proposed system would enable users to find car parking slots. If a driver is able to find a parking slot before reaching the area, it would definitely save e a lot of time and energy. Implementation of this solution would help to reduce traffic conjunctions near parking areas and would help users to find slots without driving their vehicle all around the area. Which eventually saves the fuel and reduce pollution due to the toxic gases ejected from vehicle.

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REFERENCES

[1] Gongjun Yan; Weiming Yang; Rawat, D.B.; Olariu, S.,(2011) "SmartParking: A Secure and Intelligent Parking System," Intelligent Transportation Systems Magazine, IEEE , vol.3, no.1, pp.18-30.

[2] Liu Liang; Zhang Lei; Xiao Jin; ,(2011) "The simulation of an auto-parking system," Industrial Electronics and Applications (ICIEA), 2011 6th IEEE Conference on , pp.249-253.

[3] Soh Chun Khang; Teoh Jie Hong; Tan Saw Chin; Shengqiong Wang;(2010) , "Wireless Mobile- Based Shopping Mall Car Parking System (WMCPS)," Services Computing Conference (APSCC), 2010 IEEE Asia-Pacific , pp.573-577.

[4] Gupta, A.; Divekar, R.; Agrawal, M.; ,(2010) "Autonomous parallel parking system for Ackerman steering four wheelers," Computational Intelligence and Computing Research (ICCIC), 2010 IEEE International Conference on , pp.1-6.

[5] Hua-Chun Tan; Jie Zhang; Xin-Chen Ye; Hui-Ze Li; Pei Zhu; Qing-Hua Zhao;(2009) , "Intelligent car-searching system for large park," Machine Learning and Cybernetics, 2009 International Conference on , vol.6, no., pp.3134-3138.

[6] Srikanth, S.V.; Pramod, P.J.; Dileep, K.P.; Tapas, S.; Patil, M.U.; Sarat, C.B.N.;(2009) , "Design and Implementation of a Prototype Smart PARKing (SPARK) System Using Wireless Sensor Networks," Advanced Information Networking and Applications Workshops, 2009. WAINA '09. International Conference on , pp.401-406.

[7] Gongjun Yan; Olariu, S.; Weigle, M.C.; Abuelela, M.; ,(2008) "SmartParking: A Secure and Intelligent Parking System Using NOTICE," Intelligent Transportation Systems, 2008. ITSC 2008. 11th International IEEE Conference on , pp.569-574.

[8] Tsung-hua Hsu; Jing-Fu Liu; Pen-Ning Yu; Wang-Shuan Lee; Jia-Sing Hsu; ,(2008) "Development of an automatic parking system for vehicle," Vehicle Power and Propulsion Conference, 2008. VPPC '08. IEEE , pp.16.

[9] Insop Song; Gowan, K.; Nery, J.; Han, H.; Sheng, T.; Li, H.; Karray, F.; ,(2006) "Intelligent Parking System Design Using FPGA," Field Programmable Logic and Applications, 2006. FPL"

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