**Title:**

Design and Implementation of Automated Teller Machine (FSM) Controller.

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**Small paragraph/Abstract on the problem of choice:**

The project "Design and Implementation of Automated Teller Machine (FSM) Controller" focuses on the development of an FSM (Finite State Machine) controller for an automated teller machine (ATM). The objective is to design a robust and efficient controller that can handle the various operations of an ATM, including PIN entry, transaction processing, balance inquiries, cash withdrawals, and deposits. The implementation is based on a hardware description language (HDL) and utilizes a state-based approach to model the behaviour and transitions of the ATM system. The FSM controller ensures proper sequencing of operations, enforces security measures such as PIN validation and account locking, and maintains accurate transaction records. The project aims to deliver a reliable and user-friendly ATM system that adheres to industry standards and provides a seamless banking experience for customers.

**Introduction:**

The design and implementation of an Automated Teller Machine (ATM) Controller is a crucial aspect of modern banking systems. It involves the development of a robust and efficient system that manages the interactions between users and the ATM machine, ensuring secure transactions and maintaining account integrity. This project aims to design and implement an ATM Controller using Finite State Machine (FSM) methodology.

The implemented code, presented in the module "ATM Machine," serves as the central controller for the ATM system. It handles various input signals such as clock, reset, keypad, card swipe, withdrawal amount, and deposit amount, while providing output signals including display, locked status, and mini statement. The code incorporates internal registers, variables, and constants to facilitate the functionalities of the ATM system.

The ATM Controller module operates on a set of defined states, such as IDLE\_STATE, PIN\_ENTRY\_STATE, TRANSACTION\_STATE, and LOCKED\_STATE. It ensures secure PIN entry, validates PINs, processes transactions for withdrawals and deposits, maintains account balances, tracks recent transactions, and handles account locking in case of multiple invalid PIN attempts. The display output provides user feedback, while the mini statement output enables users to access their recent transaction history.

By implementing the ATM Controller code, this project aims to demonstrate a functional and efficient solution for managing ATM operations. The FSM-based design methodology enables clear state transitions and robust handling of user interactions, ensuring the integrity and security of the ATM system. The project's implementation serves as a foundation for further enhancements and integration with other hardware components to create a complete ATM system.

**Why/Motivation behind the problem:**

The motivation behind designing and implementing an Automated Teller Machine (ATM) Controller lies in the growing reliance on electronic banking services and the need for secure and efficient financial transactions. ATMs have become an integral part of our daily lives, providing convenient access to banking services such as cash withdrawals, balance inquiries, and fund transfers.

The primary motivation for this project is to address the increasing demand for reliable and user-friendly ATM systems. By developing an ATM Controller, we aim to contribute to the advancement of banking technology and enhance the overall user experience. The key motivations behind tackling this problem are:

1. Convenience: ATMs provide users with the convenience of accessing banking services anytime and anywhere. By designing a robust ATM Controller, we aim to enhance user convenience and streamline the banking experience.

2. Security: Ensuring the security of financial transactions is of utmost importance. By implementing secure PIN entry and account locking mechanisms, we aim to safeguard user accounts from unauthorized access and potential fraud.

3. Efficiency: An efficient ATM system reduces transaction processing time, minimizes errors, and enhances user satisfaction. Through the development of an optimized ATM Controller, we strive to improve transaction efficiency and provide users with a seamless banking experience.

4. Innovation: The field of banking technology is constantly evolving. By undertaking this project, we embrace the opportunity to contribute to the innovation and advancement of ATM systems, exploring new approaches and techniques for designing efficient and secure financial transaction controllers.

By addressing these motivations, the project aims to create a reliable and user-friendly ATM Controller that aligns with the needs and expectations of modern banking customers.

**Prior Work/Background:**

The development of Automated Teller Machine (ATM) Controllers has been an ongoing area of research and innovation in the field of banking technology. Numerous studies and projects have focused on enhancing the functionality, security, and user experience of ATM systems.

One significant aspect of prior work in this domain is the utilization of Finite State Machines (FSMs) to design ATM Controllers. FSMs provide a structured approach to modelling and controlling the behaviour of an ATM system, allowing for efficient state transitions and accurate representation of the ATM's functionality.

1. User Interface Design: Prior work has focused on designing intuitive and user-friendly interfaces for ATM systems. This involves considering factors such as button placement, screen layout, and menu navigation to ensure a smooth and efficient user experience.

2. Security Measures: Security is a critical concern in ATM systems. Prior work has investigated techniques for secure PIN entry, card authentication, encryption of sensitive data, and protection against fraudulent activities such as card skimming and identity theft.

3. Transaction Processing: Efficient and reliable transaction processing is essential for ATM systems. Prior work has addressed issues related to cash withdrawals, balance inquiries, fund transfers, check deposits, and other transaction types, aiming to optimize processing time and accuracy.

4. System Architecture: The architectural design of an ATM system plays a vital role in its performance and scalability. Prior work has explored different system architectures, including client-server models, centralized or distributed processing, and integration with banking networks and databases.

5. Usability Studies: Usability studies have been conducted to assess the user experience and identify areas for improvement in ATM systems. These studies involve gathering user feedback, conducting surveys or interviews, and analysing user interactions with the ATM interface.

The prior work in this field has laid a foundation of knowledge and insights that can be leveraged to design and implement an efficient and secure ATM Controller. By building upon the existing research and addressing the limitations and challenges identified in prior work, this project aims to contribute to the advancement of ATM technology and provide a robust and user-centric solution.

**Our Approach:**

In this project, our approach to designing and implementing the Automated Teller Machine (ATM) Controller is based on a Finite State Machine (FSM) architecture. The FSM allows us to model and control the behavior of the ATM system through well-defined states and transitions.

Our approach involves the following key steps:

1. System Requirements Analysis: We start by analyzing the requirements of the ATM system, considering factors such as user functionality, security measures, transaction processing, and system constraints. This analysis helps us define the scope and objectives of our project.

2. FSM Design: Based on the system requirements, we design the FSM for the ATM Controller. The FSM consists of various states, such as IDLE\_STATE, PIN\_ENTRY\_STATE, TRANSACTION\_STATE, and LOCKED\_STATE, each representing a different phase of the ATM operation. We also define the inputs, outputs, and internal variables required for the FSM.

3. State Transitions and Logic: We define the state transitions and the corresponding logic for each state in the FSM. This includes handling user inputs from the keypad and card swipe, performing PIN validation, processing withdrawal and deposit amounts, updating the account balance, and managing the mini statement generation. We also incorporate error handling and security measures to ensure the integrity and confidentiality of the ATM transactions.

4. Implementation: With the FSM design and logic defined, we proceed to implement the ATM Controller using a hardware description language (HDL) such as Verilog or VHDL. The implementation involves coding the FSM, instantiating the required registers and variables, and connecting the inputs and outputs to the appropriate pins of the target FPGA device.

5. Verification and Testing: Once the implementation is complete, we perform rigorous verification and testing to ensure the correctness and reliability of the ATM Controller. This involves simulating the system behavior, performing functional testing with various test cases, and analyzing the results to verify that the ATM operates as expected in different scenarios.

6. Performance Optimization: In this step, we identify potential areas for performance optimization, such as reducing power consumption, optimizing resource utilization, or improving transaction processing speed. We analyze the design and make necessary modifications to enhance the overall performance of the ATM Controller.

By following this approach, we aim to develop an ATM Controller that meets the specified requirements, adheres to security standards, and provides a seamless and secure user experience.

**Result:**

The results of our project, implementing the Automated Teller Machine (ATM) Controller using a Finite State Machine (FSM) approach, were successful. The ATM Controller demonstrated accurate functionality and performed key operations such as PIN validation, transaction processing, and user interface interactions. It correctly handled user inputs, processed transactions within specified limits, and provided appropriate feedback through the output display. Overall, our project achieved the goal of designing a reliable and efficient ATM Controller.

**Conclusion:**

Several tests were carried out to validate the functionality of the ATM machine. These tests included scenarios such as card swiping, PIN entry, valid and invalid transaction amounts, account locking, and generating mini statements. The tests were designed to cover different states and transitions within the FSM, ensuring that the ATM machine operated correctly in various scenarios.

**References:**

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**Link to solution**

**- Code/Results - Github link:**