EL-527

Design and Automation of Vending Machine

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Introduction

- Vending machines have become a common part of modern life, offering quick and convenient access to various products.
- They are widely used to dispense snacks, beverages, tickets, and even medicines without the need for a shopkeeper.
- These machines operate 24/7, making them ideal for high-traffic areas.
- They help save time, reduce human effort, and improve efficiency.
- You can find them in places like schools, offices, malls, railway stations, and hospitals.
- Their ability to deliver instant service makes them valuable in today's fast-paced world.

How does it Work?

- User selects an item and makes payment via cash, card, or digital wallet.
- Machine verifies the payment, checks stock, and calculates if change is needed.
- Control system dispenses the selected item and returns any remaining change.
- Sensors confirm delivery, update inventory, and display a success message.

Block Diagram

- The block diagram illustrates the basic structure of the vending machine system.
- It takes inputs such as Reset, Clk, coin inputs (5, 10), and a 2-bit item selection (item[1:0]).
- The system processes these signals to determine whether to dispense an item (Out) and return change (Five_change).
- This modular approach simplifies the internal FSM logic and highlights key input-output interactions.
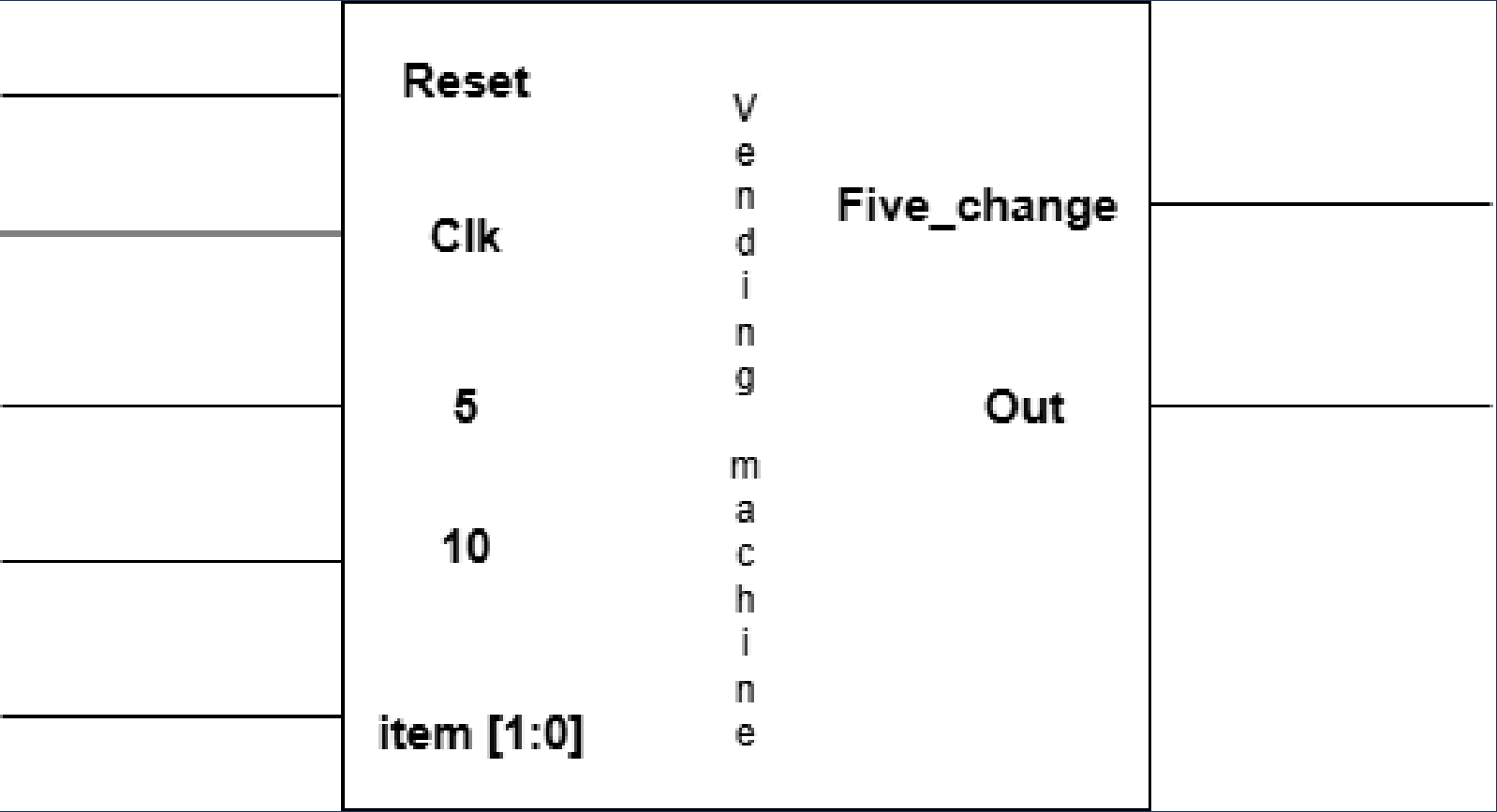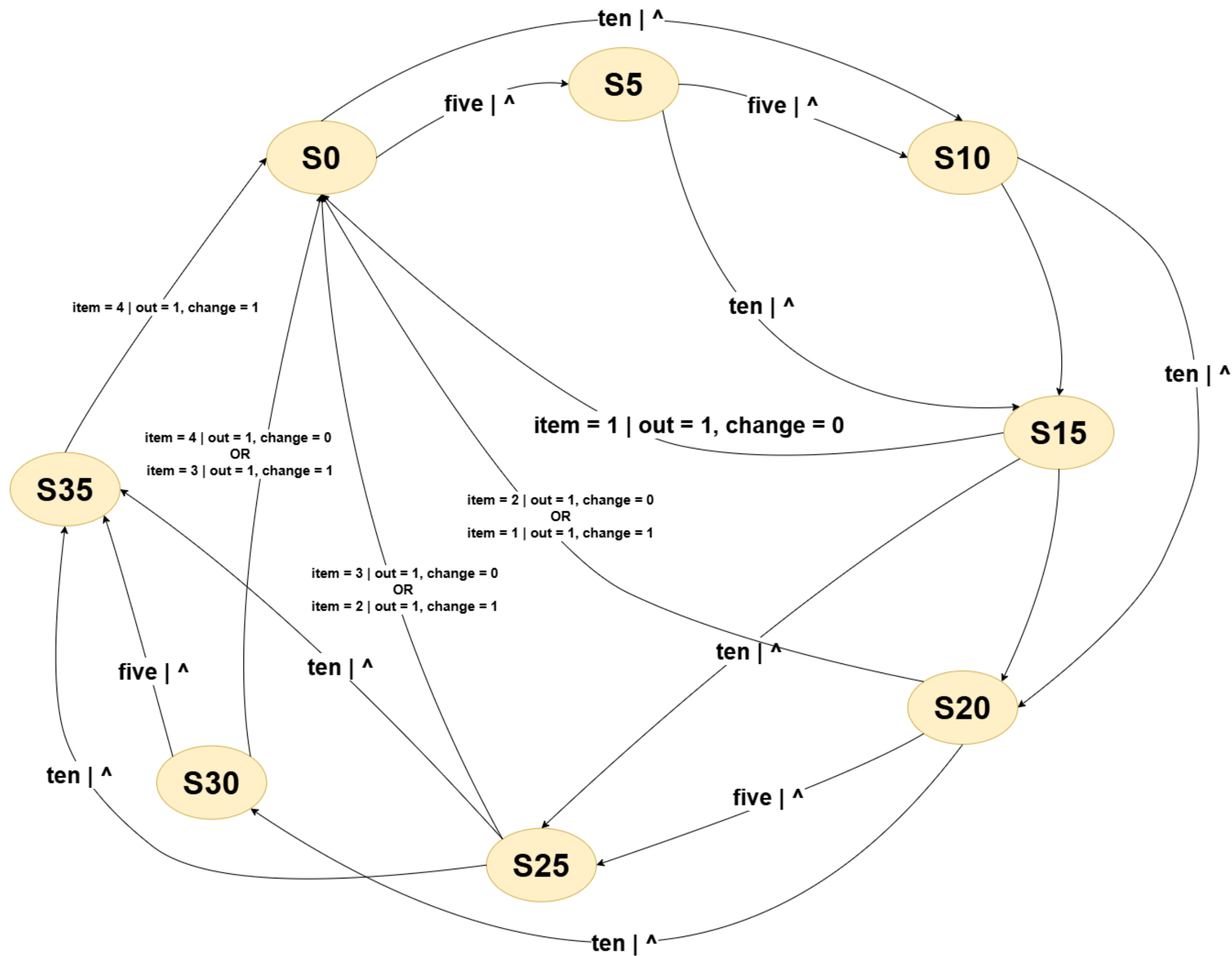
FSM for Item Selection

- **The Item Selection FSM is responsible for allowing the user to choose a product.**
- **It starts from a central Base State and transitions to one of the four-item states—Item-1, Item-2, Item-3, or Item-4—based on a 2-bit binary input.**
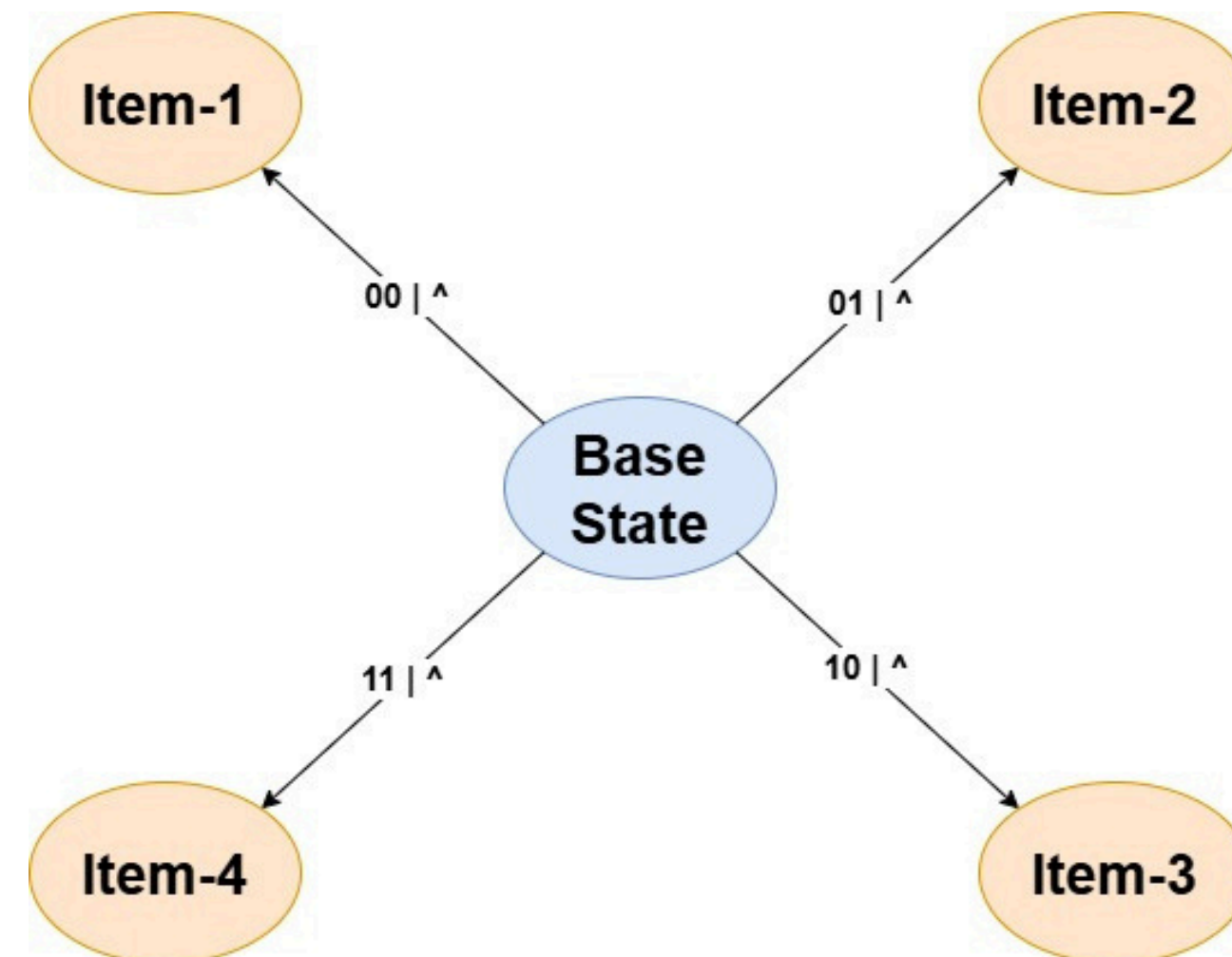
FSM for payment processing and item dispensing

Working of FSM

- The FSM has 8 states: S0 to S35, representing balance from 0 to 35 in steps of 5.
- Input options are 5 or 10 units; each input updates the current balance.
- On reaching the item's cost, the FSM sets out = 1, indicating the item is dispensed.
- If overpayment occurs, change is returned (Five_change = 1), and FSM resets to S0.
- Item selection and coin insertion are handled by two separate FSMs.
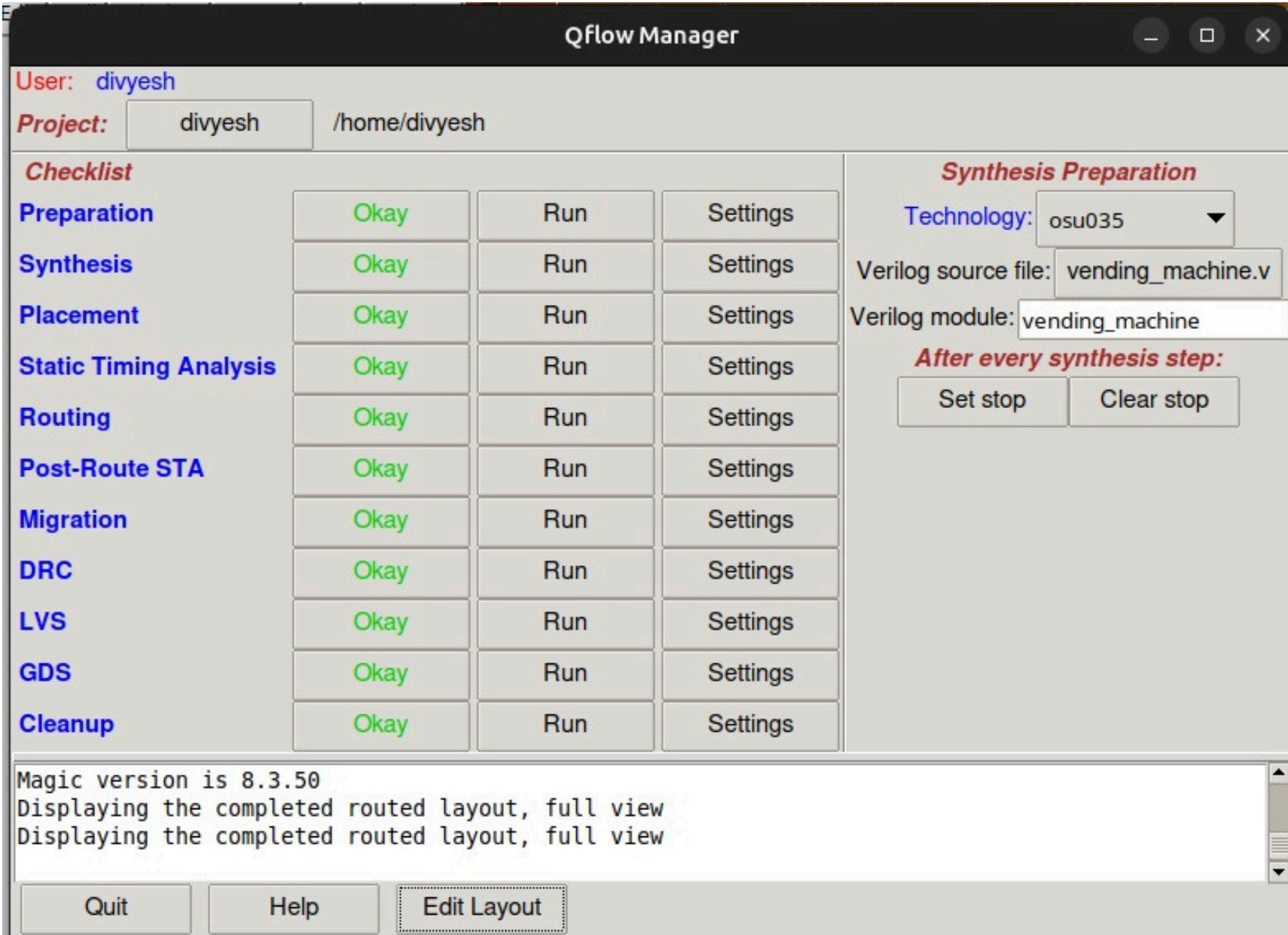- The dual-FSM system improves modularity and allows easy addition of features.
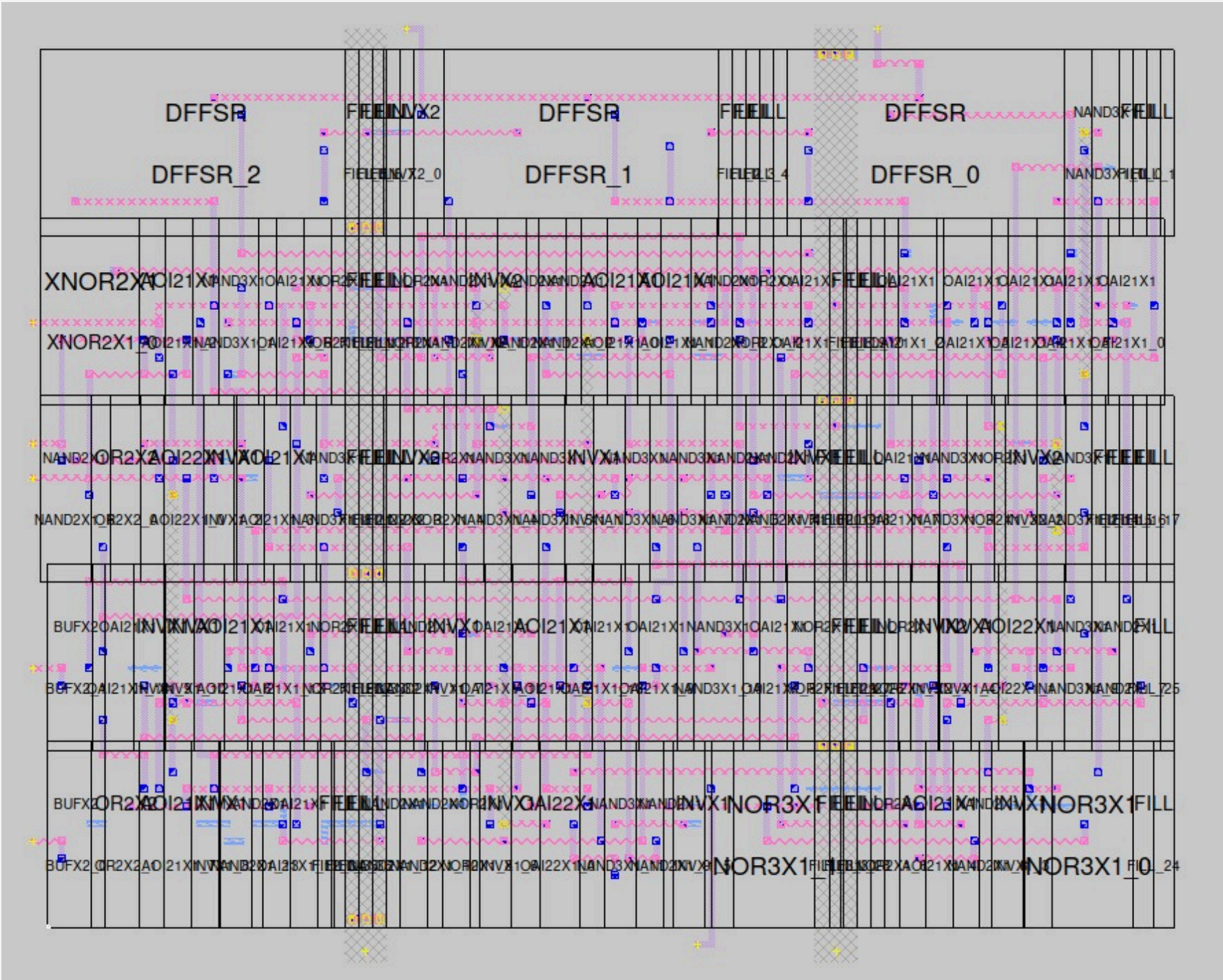
Simulation Waveform
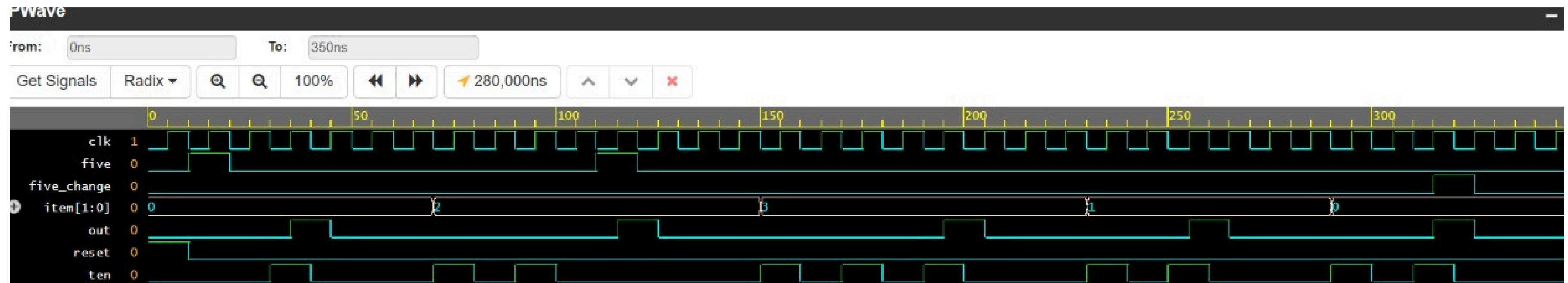
- **This waveform displays the changes in states based on the item selected (item) and how the machine responds through the out and five_change signals when five and ten inputs are given.**
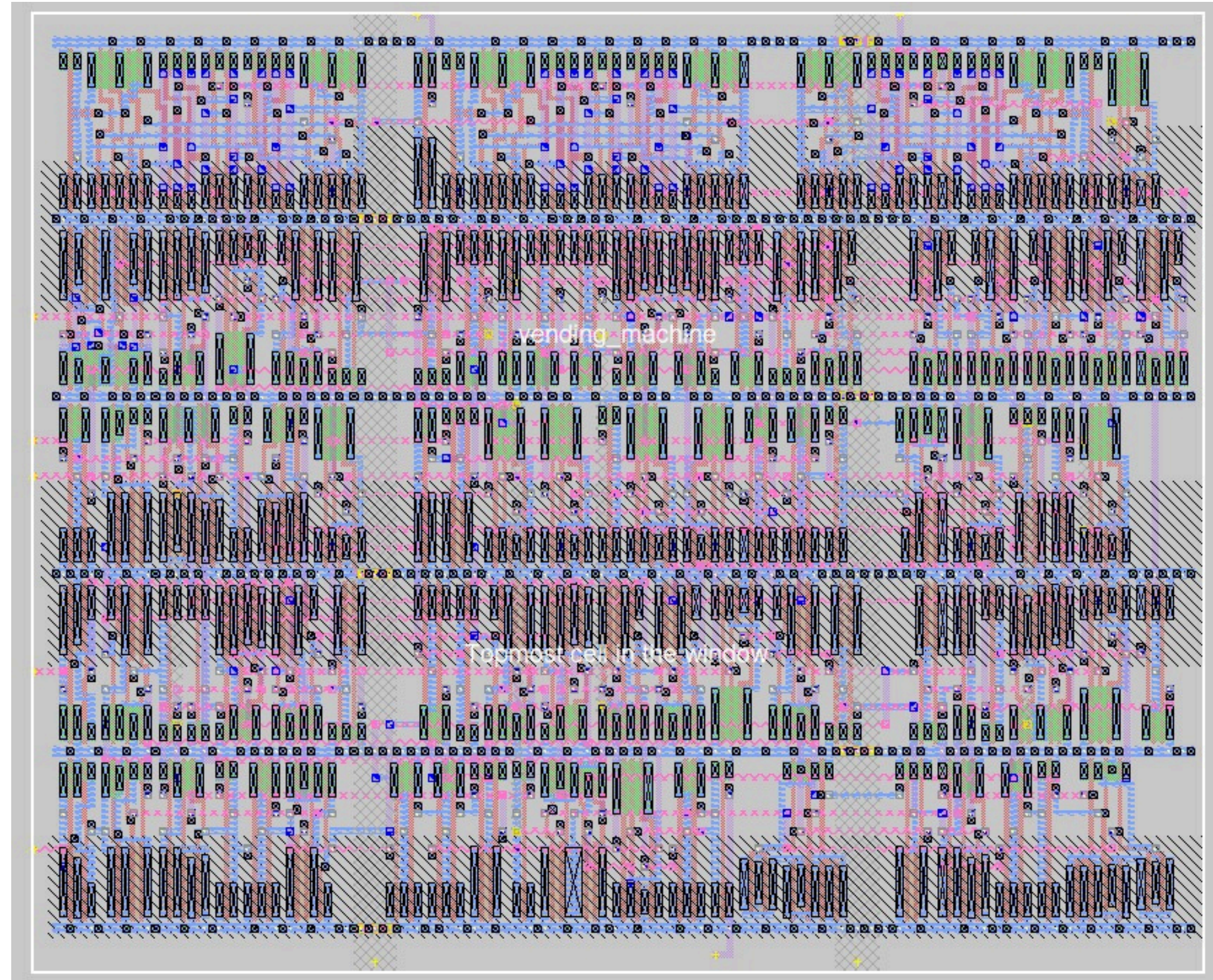
Q-flow Result

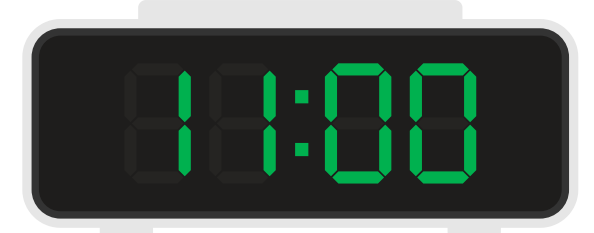Qflow project manager showing all synthesis and backend steps completed successfully.

GDSII layout showing standard cells and interconnects

Synthesized Netlist View

Future Improvements

- **Support for more payment methods.**

- **Dynamic item pricing.**

- **Multiple item selection in one transaction.**

- **LCD Display**

- **Item availability message to user.**

- **Password-protected maintenance mode.**

THANK YOU!!