Embedded Systems Course Project

Hierarchical Finite State Machine

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Abstract

This project proposes the design of an hierarchical finite state machine for a vending machine . We have implemented the code using C++ programming language. The basic idea behind this work is to deliver an efficient way for the working of a vending machine, so we have implemented a hierarchical finite state machine which contains four states named Select, Quantity, Qalculate, and Update, here the initial state of our model is Select.

Introduction

The **Finite-state machine** is a set of all possible states that controls transitions from one state to the next in response to external input. It is also known as a finite state automaton, or FSA . It's a mathematical tool for describing processes with inputs and outputs. It assists the control unit in a variety of physical systems, such as elevators, traffic lights, and vending machines. The efficiency of Vending Machine directly influences the number of states used in the design and the number of steps used in the tools employed. In this project we have focused on the efficient design of vending machines improved from the basic FSM so we have implemented a **Hierarchical Finite state machine**. Basically it captures the commonality by arranging the states in a hierarchy. Higher-level states handle common messages, whereas lower-level states inherit commonality from higher-level states and conduct state-specific functions. Here a **State** is a condition in which a system reacts to subsequent inputs based on previous inputs. One state is designated as the **Initial state** ; this is where the machine's execution begins. The input for which a state is changed from one to another is defined by a **State transition**

The proposed model can provide five types of items with different costs and their initial states of availability as shown in the below table

| Product ID	Name	Availability	Price
1	COKE	10	40
2	LAYS	8	20
3	OREO	10	40
4	DAIRY MILK	15	100
5	REAL JUICE	20	20

Basic Idea of Finite State Machine

Initially We have implemented a simple Finite state machine in which We have Selecting as the starting state and Updating is the terminating state. We have state transitions based on the provided input, as shown in the figure which may contains substates which can be neglected or we can also merge them into a single state, so we tried to implement all the states in a Hierarchical manner in which we can neglect all the substates to reduce the complexity of our model
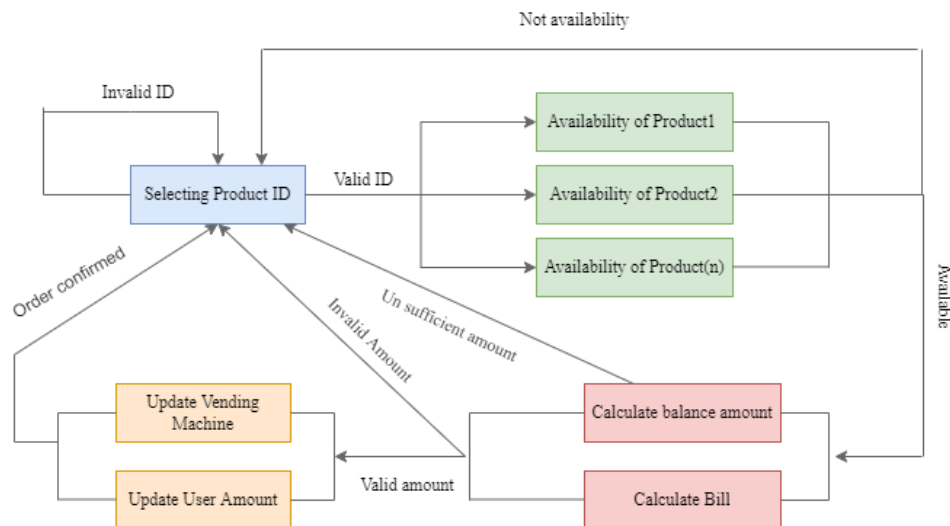
Implementation :
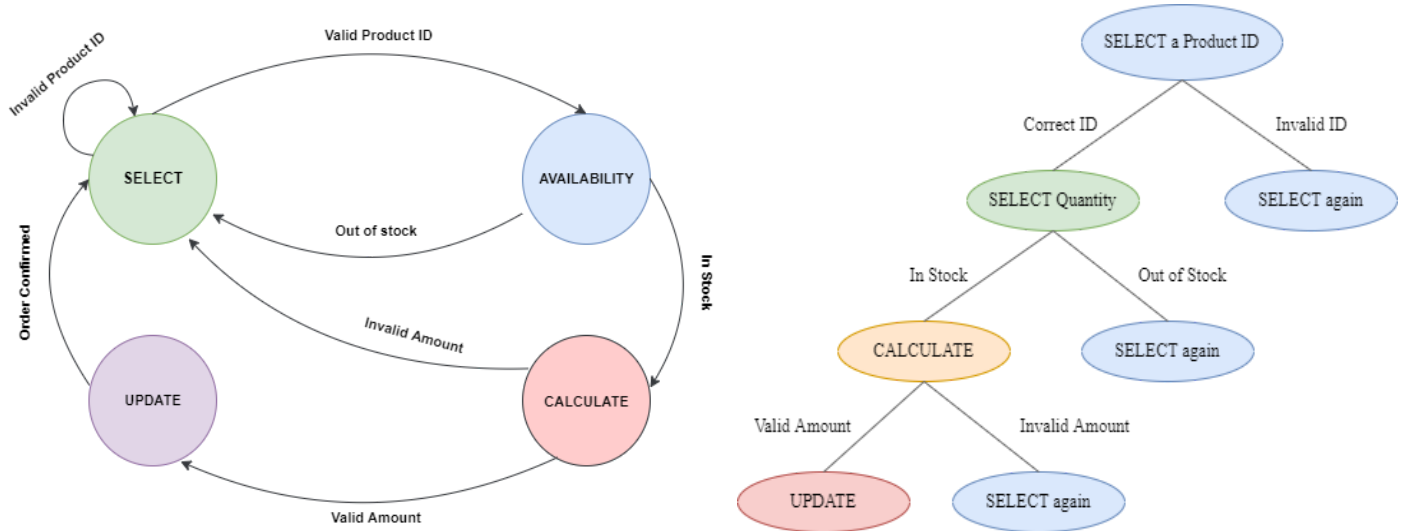
We have implemented a Hierarchical Finite machine with 4 states: that consists of SELECT, AVAILABILITY, CALCULATE and UPDATE Where SELECT is the initial/default state and UPDATE is the final state.

The state diagram consists of different states. The initial state is the first state of the design where the proposed machine will be ready for the users to **SELECT** the products if the user enters valid product then it checks for the **AVAILABILITY** of the product if available the machine will first **CALCULATE** the amount of the billing else directly calling **SELECT state** without involving any substates and finally it checks whether the sufficient amount of money is inserted or not if machine receives correct amount then the machine will deliver the product and **UPDATE** the status of the vending machine else redirects to the initial state SELECT . Hence we can say that all the States are invoked in a hierarchical manner.

Demonstration

```
Current Status of Vending Machine

Product    AVAILABILITY PRICE

1          10           40
2          8            20
3          10           40
4          15           100
5          20           20

Total Points You have : 500

PRODUCT NAME            PRODUCT ID

COKE                    1
LAYS                    2
OREO                    3
DIARYMILK               4
REAL                    5

Select a Product from the Above ID's : 2

Product selected : LAYS
Required Quantity: 3

Your order has been received. You placed an order 3 Product(s)
Total Amount : 60
Please type in your payment : 60

Thank you! Your change is 0 points.

quantity Updated
```

Find the code here:

https://github.com/Hemanth-Gattu/Hierarchical-Finite-State-Machine

Detailed description for executing the code is given in the readme

https://github.com/Hemanth-Gattu/Hierarchical-Finite-State-Machine/blob/main/README.md

Conclusion

We've now looked at what a Finite State Machine is and why it's so popular since it's simple to understand. However, it also has several disadvantages : Due to the numerous transitions that must be built manually, it is difficult to maintain and grow and at the same time Modularity and reusability are additional challenges. Therefore Hierarchy is a useful design for improving the expressive capacity of finite state machines and making huge systems easier to represent . The proposed system for a vending machine is implemented. Our model satisfies the main aim behind the problem statement

References

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