

# Vending Machine Controller with Auto-Billing Features

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**ABSTRACT:** Nowadays, Vending Machines are well known among Japan, Malaysia and Singapore. The quantity of machines in these countries is on the top worldwide. This is due to the modern lifestyles which require fast food processing with high quality. This paper describes the designing of multi select machine using Finite State Machine Model with Auto-Billing Features. Finite State Machine (FSM) modelling is the most crucial part in developing proposed model as this reduces the hardware. In this paper the process of four state (user Selection, Waiting for money insertion, product delivery and servicing) has been modelled using MEALY Machine Model. The present FPGA based vending machine controller is implemented using FSMs with the help of Xilinx ISE Design Suite 12.4. The design is verified on the FPGA Spartan 3 development Board. State machines based vending Systems enhances productivity, reduces system development cost, and accelerates time to market.

## I. INTRODUCTION

Vending Machines are used to dispense various products like Coffee, Snacks, and Cold Drink etc. when money is inserted into it. Vending Machines have been in existence since 1880s. The first commercial coin operated machine was introduced in London and England used for selling post cards. The vending machines are more accessible and practical than the convention purchasing method. Nowadays, these can be found everywhere like at railway stations selling train tickets, in schools and offices vending drinks and snacks, in banks as ATM machine and provides even diamonds and platinum jewellers to customers. Previous CMOS and SED based machines are more time consuming than the FPGA based machines [7]. In this paper a new approach is proposed to design an FSM based Vending Machine [3] with auto-billing features. The machine also supports a cancel feature means that the person can withdraw the request and the money will be returned back to the user. The user will get a bill of total number of products delivered with total price. This machine can be used at various places like Hotels, Restaurants and food streets. This reduces the time and cost.

### Operation of Vending Machine

- I. When the user puts in money, money counter tells the control unit, the amount of money inserted in the Vending Machine.
- II. When the user presses the button to purchase the item that he wants, the control unit turns on the motor and dispenses the product if correct amount is inserted.
- III. If there is any change, machine will return it to the user.
- IV. The machine will demand for servicing when the products are not available inside the machine.

### FSM (Finite State Machine)

In a Finite State Machine the circuit's output is defined in a different set of states i.e. each output is a state. A State Register to hold the state of the machine and a next state logic

to decode the next state. An output register defines the output of the machine.

## II. Proposed System

**MEALY Machine:** In this machine model, the output depends on the present state as well as on the input. The MEALY machine model is shown in figure 1.

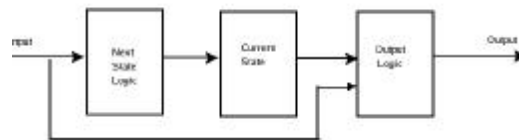


Figure 1: MEALY Machine Model

**MOORE Machine:** In Moore machine model the output only depends on the present state. The MOORE machine model is shown in figure 2. Edge detection using beamlet transform contains three stages such as image pre-processing, beamlet transform, image

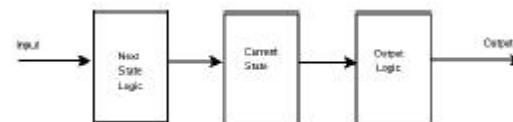


Figure 2: MOORE Machine Model

## II. RELATED WORK

Various researches have been carried out in order to design the Vending Machines. A few of them are discussed here as: Fauziah Zainuddin [1] proposes a vending machine for steaming frozen food using conceptual modelling. In which the process of three main states (user selection state, freezer state and steaming state) has been modelled using process approach, which emphasized on the process flow or control logic to construct the model for steamed buns vending machine application. Conceptual modelling is described in [6]. This concept is based on the short message payment with the main control module M68HC11 and GPRS module MC35. These various methods of designing VHDL based. Also in [5] the passenger's requirements for ticketing system are given. In [7] a coffee vending machine is designed using single electron encoded logic (SEEL). The designed circuit is tested and its power and switching time is compared with the CMOS technology.

## III. IMPLEMENTATION OF VENDING MACHINE

In this paper a state diagram is constructed for the proposed machine which can vend four products that is coffee, cold drink, candies and snacks. Four select (select1, select2, select3, select4) inputs are taken for selection of products. Select1 is used for the selection of snacks.

Similarly select2, select3, select4 are used for coffee, cold drink and candies respectively. Rs\_10 and rs\_20 inputs represents rupees 10/- and 20/- notes respectively. A cancel input is also used when the user wants to withdraw his request and also the money will be returned through the return output. Return, product and change are the outputs. Return and change vectors are seven bits wide. Money is an in/out signal which can be updated with the total money of all products delivered at a time. Money signal is seven bits wide. Money\_count is an internal signal which can be updated at every transition. This signal is also seven bits wide. If the inserted money is more than the total money of products then the change will be returned through the change output signal. The products with their prices. There are also two input signal clk and reset. The machine will work on the positive edge of clock and will return to its initial state when reset button is pressed. The proposed vending machine is designed using FSM modeling and is coded in VHDL language.

**IV.DESIGN METHODOLOGY**

The state diagram mainly consists of four states (User Selection, Waiting for the money insertion, product delivery and servicing (when product\_not\_available='1')). Initially when the reset button is pressed, the machine will be ready for the users to select the product. This state is the initial state of the design. After this the user will select the product to be dispensed. This state can be one of the select1, select2, select3 and select 4. The machine can accept only two types of notes i.e. rupees 10/- and 20/-. Let us suppose that the user selects sell input. The machine will firstly check that whether the products are available in the machine or not. After this the control unit will move to the waiting state, where it will wait for the money to be inserted. Then if rupees 10/- note is inserted then the machine will go to state\_1 and wait until the desired money is inserted. And if rupees 20/- note is inserted the machine will move to state\_2 and then wait until 30/- rupees are inserted to the machine. When the desired amount is inserted the machine will go to the snacks state and snacks will be delivered at the product output. If products are not available in the machine then the control unit will demand for servicing and after service the machine will get reset. This methodology is explained using a flow diagram shown in figure 3. There is also an additional feature of withdrawing the request if the user doesn't want to take the product. When cancel button is pressed then the money inserted will be returned to the user through the return output. A money\_count signal is used for calculating the total money inserted in the machine. And if the money inserted is more than the money of the product then the extra change will be returned to the user. The total amount of the product taken at a time is shown by the money signal. Similarly the user can select and get the other products following the above procedure.

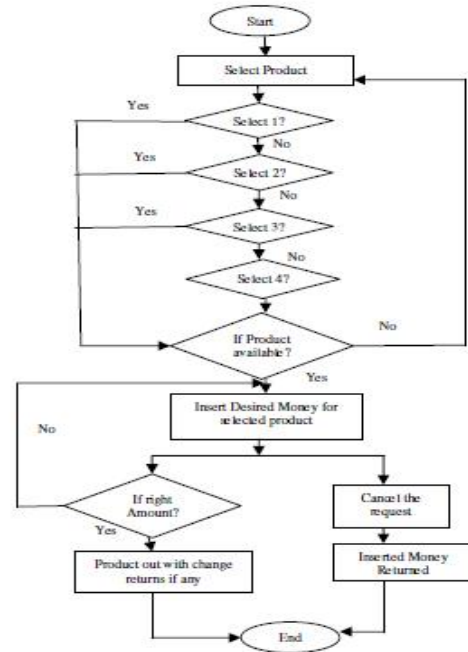


Figure 3: Flow Chart for Proposed Vending Machine

**V.SIMULATION RESULTS**

The state diagram shown in figure 4 is simulated using Xilinx ISE Simulator. Simulation Waveforms for the selection of four products like snacks is shown in figure 5 and 6 respectively with servicing feature when products are not available in the machine and change return features when the money inserted is more than the money of the product. Let us take an example that the user wants to take Snacks. When one selects sel1 button, the machine will check that whether the products are available or not, if available then it will go to the waiting state and wait for total money insertion. If rs\_10 note is inserted it will go to state\_1 and if rs\_20 note is inserted it will so to state\_2 and check whether money\_count >= 30 or not. If the money\_count > 30 then machine will go to state snacks and vend the product.

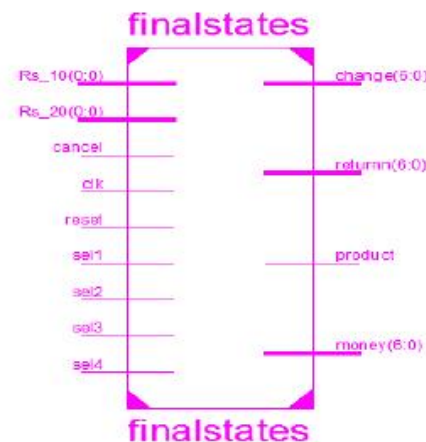


Figure 8: RTL view of Vending Machine.

