Implementation of FSM Based Automatic Dispense Machine with Expiry Date Feature Using VHDL

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Abstract: *In present scenario Automatic Dispense Machine is commonly used in different countries (Like Japan, Germany, U.S. and Singapore e.t.c.) because nowadays everybody wants fast response. In this paper we design and implement Automatic Dispense Machine with expiry date feature. We are using FSM (Finite State Machine) modeling for implement our work. In this paper process of states i.e start, product selection, check expiry date, insert money, dispense product, extra amount returned by machine and feedback are designed by Melay Machine Model. We implement our design for coin as well as currency note. The proposed algorithm is implemented in VHDL. For designing purpose we are using Xilinx ISE 14.2 tool that is also used for synthesis and for verifying results (Simulation) we are using Modelsim 10.2a student addition.*
Keywords: *VHDL, FSM, Xilinx ISE 14.2, Modelsim 10.2a, Automatic Dispense Machine.*

I. INTRODUCTION

Automatic Dispense Machines are used to dispense various products like Cold drink Bottle, Coffee, Chips, and Chocolate etc. when money is inserted into it. Automatic Dispense 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 Automatic Dispense 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 Automatic Dispense drinks and snacks , in banks as ATM machine and provides even diamonds and platinum jewellers to customers [4]. This paper proposed approach to design an Automatic Dispense Machine with expiry date features using FSM model by VHDL. The expiry date feature is very useful for user if any product is expire than that product will not dispense and return back the money to the user. We are using FSM (Finite State Machine) modeling to implement our work.

1.1 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. In FSM based machines the hardware gets reduced as in this the whole algorithm can be explained in one process.

Two types of State machines are:
1. Mealy Machine.
2. Moore Machine.

1.1.1 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 fig 1.

In the theory of computation, a Mealy machine is a finite-state machine whose output values are determined both by its current state and the current inputs. A Mealy machine is a deterministic finite state transducer: for each state and input, at most one transition is possible. The Mealy machine is named after George H. Mealy, who presented the concept in a 1955 paper, "A Method for Synthesizing Sequential Circuits".
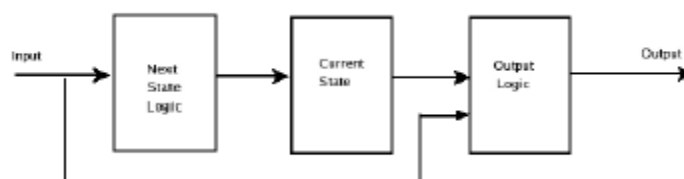
Fig. 1: MEALY Machine Model

1.1.2 MOORE MACHINE

In Moore machine model the output only depends on the present state. The MOORE machine model is shown in fig 2.

In the theory of computation, a Moore machine is a finite-state machine whose output values are determined solely by its current state. This is in contrast to a Mealy machine, whose output values are determined both by its current state and by the values of its inputs. The Moore machine is named after Edward F. Moore, who presented the concept in a 1956 paper, "Gedanken-experiments on Sequential Machines.
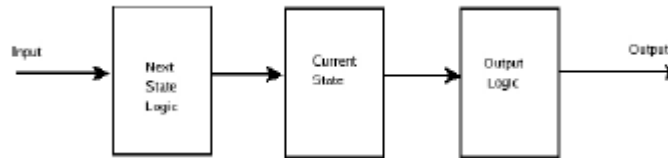
Fig. 2: MOORE Machine Model

II. RELATED WORK

The various researches have been carried out in order to design the Automatic Dispense Machines. A few of them are discussed here as: Fauziah Zainuddin [1] proposes a Automatic Dispense 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 Automatic Dispense machine application. Conceptual modelling is described in [6]. In [7] the concept of automatic mobile payment is discussed. This concept is based on the short message payment with the main control module M68HC11 and GPRS module MC35. Thee various methods of designing VHDL based machines are discussed in [2], [3] and [8]. Also in [5] the passenger's requirements for ticketing system are given. In [4] a coffee Automatic Dispense 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.

The Cedrone patent (US. Pat. No. 4,776,548) discloses a system for monitoring a vending machine and periodically transmitting information relating to machine conditions, sales and product inventory to a central computer. The Girouard patent (US. Pat. No. 4,982,346) discloses. An automated system for point-of-sale-type advertising and promotional campaigns, having a computer which can display advertisements on a monitor, manage promotional sweepstakes, display product or store locator maps, dispense coupons, accept orders, manage customer surveys, and communicate With a remote host computer.

The Gorog patent (US. Pat. No. 4,947,028) discloses a vending machine that can accept voice commands via a voice recognition system (and communicate with the customer via a voice synthesizer) to accommodate those per sons who are unable to perform manual data entry tasks. In addition, the Gorog patent discloses a vending machine that can remotely verify a customer's credit Worthiness prior to permitting a sale on credit to the customer.

III. METHODOLOGY

The In this paper a state diagram is constructed for the proposed Automatic Machine which can vend four products that is cold drink, coffee, chips and chocolate. Four inputs are taken for selection of products. We select the product and input money 8 Rs. for cold drink, 10 Rs for coffee, 20 Rs for chips and 30 Rs for Chocolate. We took 1, 2, 5 as a coin for input as well as 10, 20 as a currency note for respective products. An Expiry date feature is also available in our machine which is used for if any product is out of date then machine will not dispense that product and two output change and ret (Return) are available in our machine for provide the change money to the user and if there is no product available in our machine then return full money. The products with their prices are shown by table 1. 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.

S. NO.	PRODUCTS	PRICE
1	Cold Drink	8
2	Coffee	10
3	Chips	20
4	Chocolate	30

Table 1: Products with their prices

The state diagram mainly consists of states (Reset, Selection Products, Product available, Expiry date, Insert money, Dispense Product, change and exit). Initially when the reset button is pressed, the machine will be ready for the users to select the product and cold storage has 10 quantities of all products. This state is the initial state of the design. After this the user will select the product to be dispensed. The machine can accept 1, 2, 5 amount of coin and two types of notes i.e. rupees 10/- and 20/-. Let us suppose that the user selects coffee. The machine will firstly check that whether the products are available in the machine or not. After this the control unit will move to check whether product is expire or not, if product is not expiry then insert the sufficient money. Then if rupees 10/- note is inserted then the machine will go to next state and dispense the product. 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.
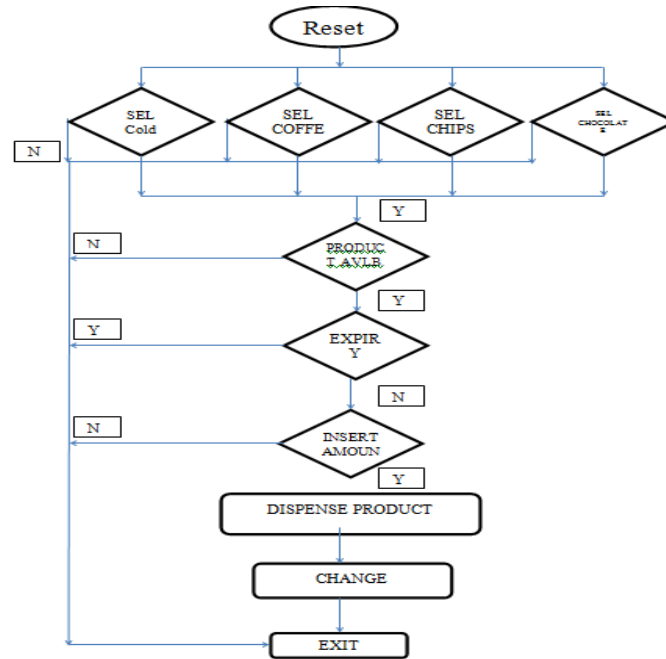

Fig 3: Flow Chart for Automatic Machine

IV. SIMULATION RESULTS

In case of bottle dispense we take reset is '0', input rupees as 8 INR and expiry date (bexpirydate) is '0' then bottle will dispense. We took expiry date as a feedback of product if our product (cold drink bottle) is expire then there is no dispense. If machine has no product then empty signal will be high and return full money. These all operation will perform on positive edge clock. If reset is high then machine will not any do any performance and 10 cold drinks will be stored in cold storage. Fig 4 shows the cold drink dispense.
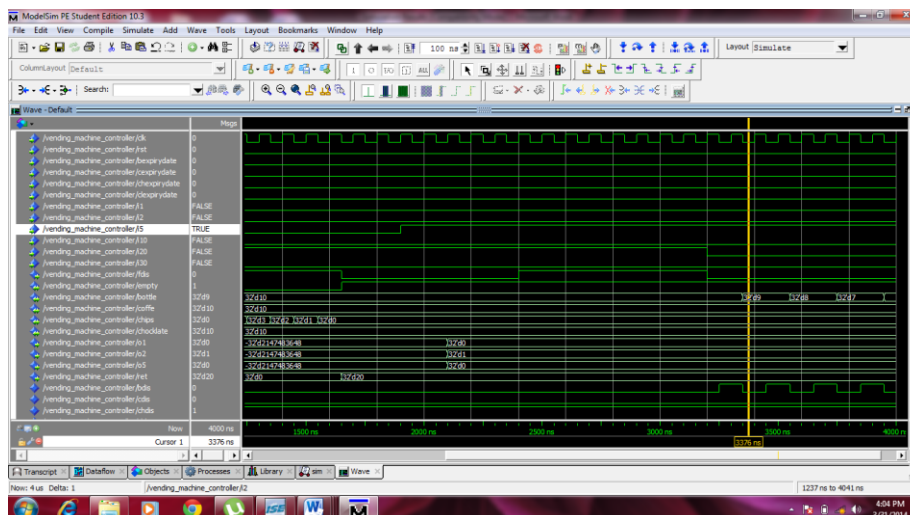
Fig. 4: Simulation result for Cold drink bottle dispance

In case of coffee dispense we take reset is '0', input rupees as 10 INR and expiry date (cexpirydate) is '0' then coffee will dispense. We took expiry date as a feedback of product if our product (coffee) is expire then there is no dispense. If machine has no product then empty signal will be high and return full money. These all operation will perform on positive edge clock. If reset is high then machine will not any do any performance and 10 coffee will be stored in cold storage. Fig 5 shows the coffee dispense.
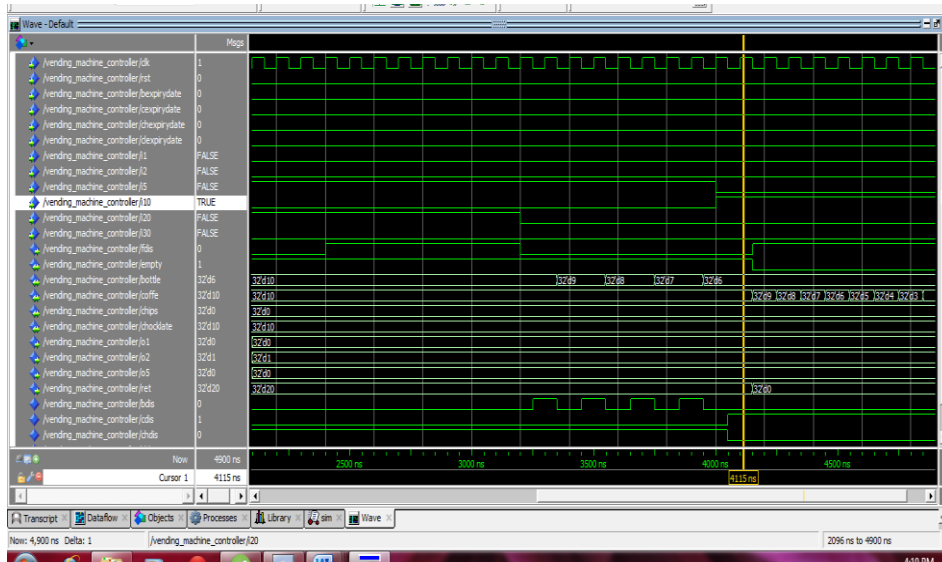

Fig. 5: Simulation result for Coffee dispense

In case of chips dispense we take reset is '0', input rupees as 20 INR and expiry date (chexpirydate) is '0' then chips will dispense. We took expiry date as a feedback of product if our product (chips) is expire then there is no dispense. If machine has no product then empty signal will be high and return full money. These all operation will perform on positive edge clock. If reset is high then machine will not any do any performance and 10 chips will be stored in cold storage. Fig 6 shows the coffee dispense.
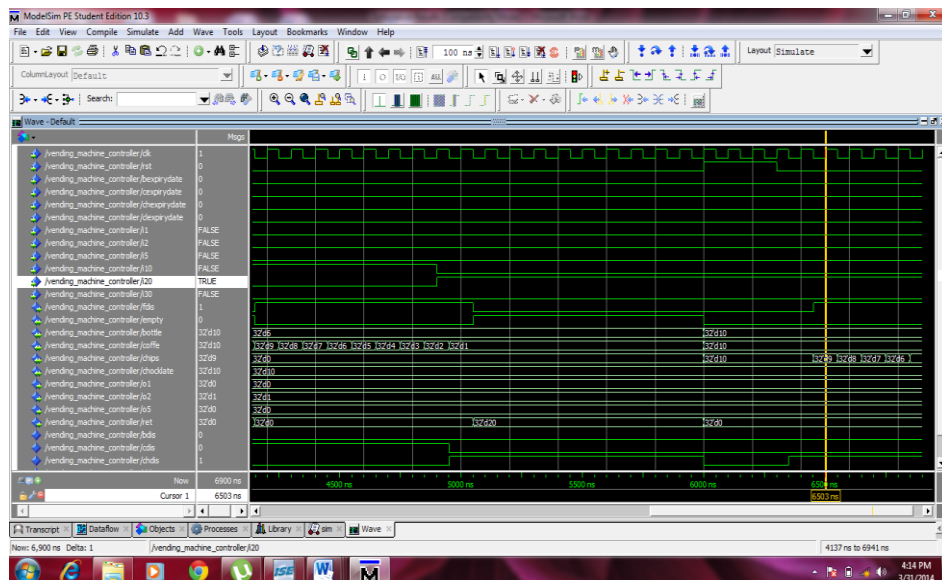

Fig. 6: Simulation result for Chips dispense.

In case of chocolate dispense we take reset is '0', input rupees as 30 INR and expiry date (clexpirydate) is '0' then chocolate will dispense. We took expiry date as a feedback of product if our product (chocolate) is expire then there is no dispense. If machine has no product then empty signal will be high and

return full money. These all operation will perform on positive edge clock. If reset is high then machine will not any do any performance and 10 chocolate will be stored in cold storage. Fig 7 shows the coffee dispense.
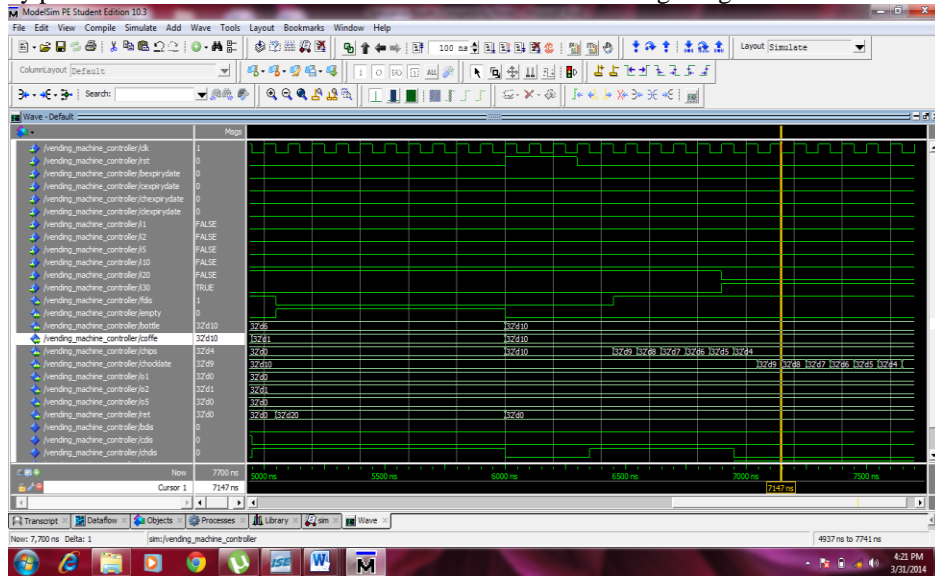

Fig. 7: Simulation result for Chocolate dispense

V. CONCLUSION

We Implement the FSM based automatic dispense machine using Xilinx ISE 14.2. For verification (Simulation) we used Modelsim 10.2a student addition tool from Mentor Graphics Company. We conclude that our design is cost effective and dispense multi products. We also added an expiry date feature that is very useful for common man if any product is out of date or expire machine will not dispense that product and if any person have inserted money for the same product machine will return full amount. At present scenario it is very use full in malls, shopping Complexes, PVRs, railway stations and airports etc.

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