International Journal of Emerging Technology and Advanced Engineering
Website: www.ijetae.com (ISSN 2250-2459 (Online), An ISO 9001:2008 Certified Journal, Volume 3, Special Issue 2, January 2013)
National conference on Machine Intelligence Research and Advancement (NCMIRA, 12), INDIA.

VHDL Environment for Smart Vending Machine

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Abstract

Vending machines are very common in the countries like Japan, Germany, and U.S. etc. The requirements of the vending machines are increasing day by day due to the modern and fast life style. This paper describes the designing of vending machine using Finite State Machine (FSM) Model also with the auto-billing features. FSM modeling is the most important part in developing proposed vending machine model as this reduces the required hardware. In this paper MEALY Machine Model is used to modeled the process for state i.e. user selection, waiting for money insertion, product delivery and servicing. The Spartan 3 development Board is used to test the proposed model.

Keywords- ***FSM; VHDL; Vending Machine; FPGA Spartan 3 development board;***

I. Introduction

Vending Machines are the machines which are used to dispense products such as Wafers, Cold Drink, Cookies, Coffee and Cans of Soda etc. The first vending machines were introduced for dispensing of Post Cards in London and England in the early 1880s. Vending machines are more able to be easily used and practical than the standard purchasing method. The FPGA based vending machines are more flexible and faster than the CMOS based machines. The FPGA based vending machine is also programmable and can be reprogrammed whereas in the Embedded based machines we have to change the whole architecture of the machine if we want to change or enhance the design of the machine. This paper proposed approach to design a Vending Machine with auto-billing features using FSM model. This machine also have as "Cancel Request" feature which provide the user to withdraw cancel the request and return back the money to the user. The user will get a bill of total number of products.

II. Operation Of Vending Machine

i. When the user puts the money, Money counter tells the control unit, the amount of money inserted in Vending Machine.
ii. When the user presses the button to purchase the products 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.

III. FSM (Finite State Machine)

In FSM or finite state machine the output of the circuit is defined as a different set of state. In FSM the state register holds the state of machine and a next state logic which decodes the next state. The output register of FSM defines machine's output. In FSM based machines the algorithm can be explained in one process because the hardware get reduce.

There are two types of state machines, they are as follows:-

MEALY Machine: Mealy machine is that state machine, which uses only input actions, so that the output depends on the present state and also on inputs. The MEALY machine model is shown in figure 1.

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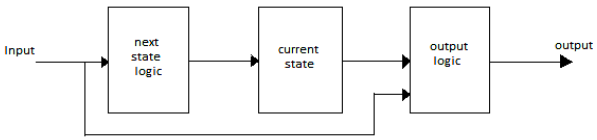

Figure 1.MEALY Machine Model.

MOORE Machine: MOORE Machine is that state machine which uses only entry actions, so that its output depends on the present state. The MOORE machine

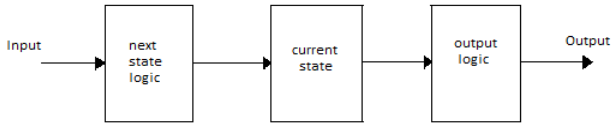

Figure2. MOORE Machine Model.

IV. Implementation Of Vending Machine

In this paper a state diagram is, constructed for vending machine, which can be able to vend four products i.e. wafers, cookies, mineral water, and chocolates. Four select (sel_1, sel_2, sel_3, and sel_4) inputs taken for the product selection. In this the sel_1 is used for selecting wafers, similarly sel_2, sel_3 and sel_4 are used for selecting cookies, mineral water and chocolates respectively. Rs_10 and Rs_20 inputs represent rupee 10/- and 20/- notes respectively. If the user count to withdraw his request, a cancel input is used by which the money will be returned through return output. Product, return and change are the outputs. Change and return vector are the seven bits. Money is input/output signal that can be updated with the total amount money of all products delivered at a particular time. Money signal is also seven bits wide. At every transition, money count which is an internal signal can be updated and this signal is also seven bits wide. The change will be returned through the change output signal when the inserted money is more than the total money of product clk and reset are also two input signals. The proposed machine will work on the positive edge of clock and when the reset button is pressed, machine will return to its initial state. The proposed sending machine is designed using FINITE STATE MACHINE (FSM) modeling and is coded in VHDL language.

The products along with their prices shown in table 1 and the details of the entire signal with their direction and description are shown in table 2.

Table 1: Product with their price

S.NO.	*PRODUCT*	*PRICE*
1.	Wafers	30/-
2.	Cookies	40/-
3.	Mineral Water	40/-
4.	Chocolates	30/-

Table 2: Inputs/Outputs with remarks

Name	*Width*	*Direction*	*Description*
Clk	1	Input	Clock
Reset	1	Input	Sync. reset
Sel_1	1	Input	Wafers
Sel_2	1	Input	Cookies
Sel_3	1	Input	Mineral Water
Sel_4	1	Input	Chocolates
Cancel	1	Input	Cancel
Money	7	InOut	Total money
Rs_10	1	Input	10 Rupees
Rs_20	1	Input	20 Rupees
Product	1	Output	Product out
Change	7	Output	Extra change
Return	7	Output	Return money

V. Design Methodology

The state diagram consist 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 to the user for selecting the product. After this the user selects the product which is to be dispersed. This state can be one of the sel_1, sel_2, sel_3 and sel_4. Firstly, the machine will check the availability of the product. After this, the control unit will move to the waiting state, where it will wait for the insertion of money.

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If the product is not available in the machine the servicing is demanded by the control unit. After which the machine will get reset. This methodology is explained by using a flow diagram, as shown in figure 3.

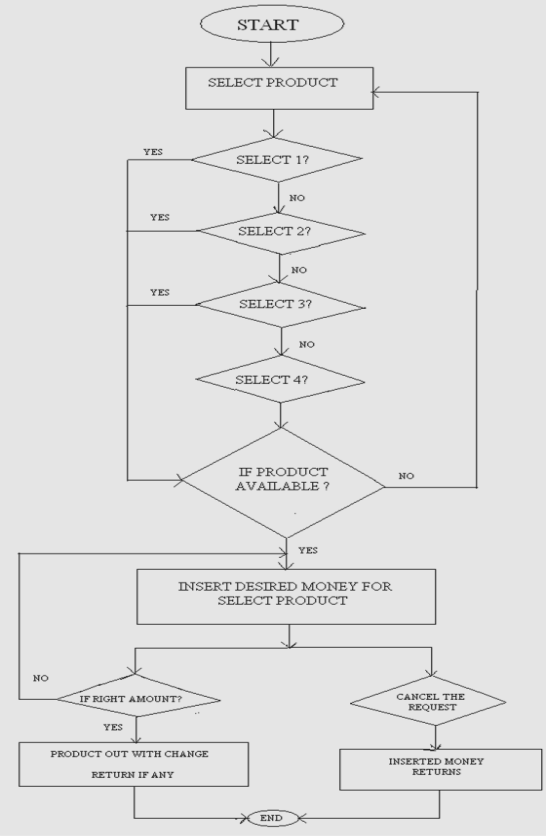

Figure 3: Flow Chart for Proposed Vending Machine.

There is a feature added to it, which withdraw request if the user does not want to take the product, and when the cancel button is pressed by the user the inserted money will be return back to the user through the return output. For calculating the total money count signal is used. The money signal shows the total money of product taken at a particular time. Similarly the user can select and get the other products following by the above procedure.

VI. Description Of State

At initial:

- Money_count=0;
- change=0;
- product=0;

At_select1:

- Sel_1&!sel_2&!sel_3&!sel_4
- Product_available=1=>nx_st1<=waiting1 ;
- When product_available=0=>nx _st1<=service1;

When waiting1**:**

- When rs_10&!rs_20=>nx_st1<=state_1;
- When !rs_10&rs_20=>nx_st1<=state_2
- Change=0; Product=0;
- When money_count>=30 nx_st1<=wafers;

At state 1:

- Rs_10=1&rs_20=0;
- Product=0; Change=0;
- Money_count=money_count+10;

At state2:

- Rs=10=0 & rs_20=1;
- Product=0; Change=0;
- Money_count=money_count+20;

At wafers:

- Money_count>=30;
- Product=1;
- Change=money_count-30;
- Wafers_count=wafer_count-1;

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At service:

- Wafer_count=4
- Product<=0;
- Next_state<=reset;

At cancel1:

- Cancel=1;
- Return<=money_count;

Similarly, we can select other items (cookies, mineral water and chocolates).

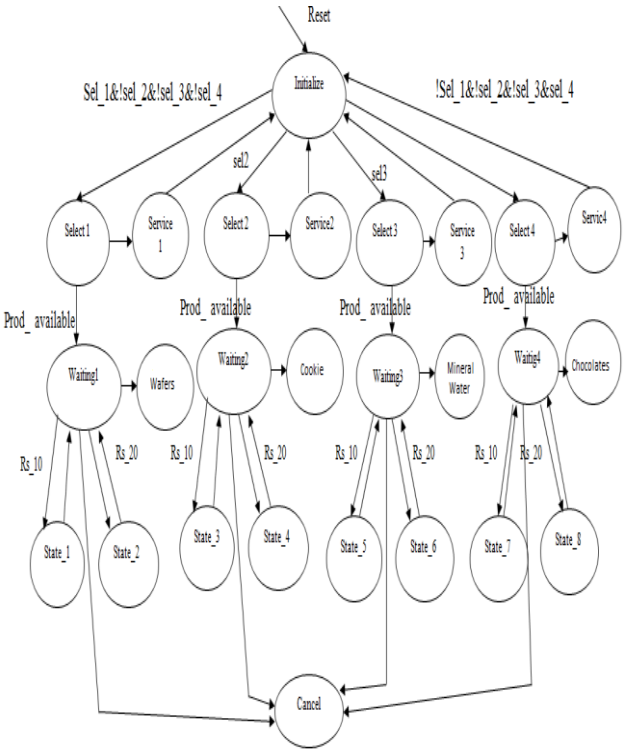

Figure 4: Finite State Machine Diagram of Vending Machine

VII. CONCLUSION

The study has been done up to the above state/level. Further, implementation has to be done on FPGA and we see the result on XILINX software.

REFRENCES

[1] Xilinx Inc., Spartan 3 Data sheet: http://www. xilinx.com.

[2] Peter Minns & Ian Elliott, "FSM-based Digital Design using Verilog HDL", John Wiley & Sons Ltd 20

[3] Steve Kilts."Advanced FPGA Design: Architecture, Implementation and Optimization", Wiley- IEEE Press -2007.

[4] J.Komer (2004) "Digital logic and state machine design", 2nd ed., Oxford.

[5] C. J Clement Singh, K Senthil Kumar, Jayanto Gope, Suman Basu & Subir Kumar Sarkar (2007) "Single Electron Device based Automatic Tea Vending Machine" proceedings of InternationalConference on Information and Communication Technology in Electrical Sciences (ICTES 2007) , pp891-896.

[6] Bhaskar "VHDL primer" Second Edition

[7] M. Zhou, Y. J. Son, & Z. Chen, (2004), "Knowledge Representation for Conceptual Simulation Modeling" Proceedings of the 2004 Winter Simulation Conference, pp. 450 – 458

[8] Muhammad Ali Qureshi, Abdul Aziz & Hafiz Faiz Rasool "Design and Implementation of Automatic Ticket System using V HDL" proceedings of international conference on Information Technology, pp- 707-712.