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VENDING MACHINE USING VHDL

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ABSTRACT

Vending machines are used to dispense small different products, when a coin is inserted. These machines can be implemented in different ways by using microcontroller and FPGA board. Here in this paper, we proposed an efficient algorithm for implementation of vending machine on FPGA board. Because FPGA based vending machine give fast response and uses less power than the microcontroller based vending machine. The FPGA based vending machine supports four products and three coins. The vending machine accepts coins as inputs in any sequence and delivers products when required amount is deposited and gives back the change if entered amount is greater than the price of product. It also supports cancel feature means a user can withdraw the request any time and entered money will be returned back without any product. The proposed algorithm is implemented in Verilog HDL and simulated using Xilinx ISE simulator tool.

1. INTRODUCTION

A vending machine is a machine that provides items such as four different products even diamonds and platinum jewellery to customers, after the vendee inserts currency or credit into the machine using extremely simple steps. These steps would not be time consuming at all. The vendee would get all the details on the screen which he/she should follow. Previous microcontroller or microprocessor based vending machines were inefficient as compared to FPGA based vending machine. So it is necessary to make it more reliable with efficient algorithm that will be fully commanded by FPGA based solution. The main purpose of this project was to create a vending machine which could provide four different snacks products to the people using extremely simple steps. We have made an attempt to vend four products of different prices in the same machine. The machine will also provide the change to the vendee depending on the amount of money he/she has inserted. It is also possible to withdraw the deposited money in between, if consumer wishes by pressing a cancel button.

2. DESIGN OBJECTIVES

To Design a powerful vending machine containing the following features:

1. Sell four different types of snacks and accept three types of coins (Rs1, Rs2, Rs5)

2. Give change after successful trade

3. Return money when trade fails

4. Small size and acceptable power consumption

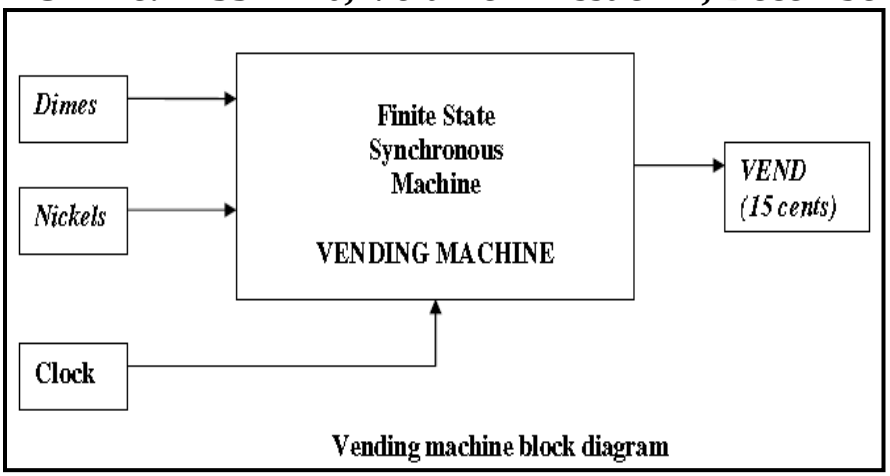
5. If cancel button is enter, amount will return

3. VENDING MACHINE DESIGN

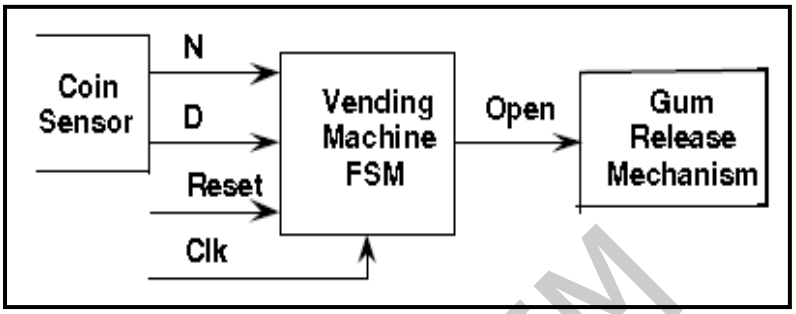
We know that a vending machine must remember how much money has been inserted. This means that its outputs are a function of past inputs, so it must be a sequential circuit. Probably the best way to design this circuit is as a state machine.

The vending machine delivers a package of gum after it has received **15 cents** in coins. The machine has a single coin slot that accepts **nickels and dimes**, one coin at a time.

A mechanical sensor indicates to the control whether a dime or a nickel has been inserted into the coin slot. The controller's output causes a single package of gum to be released down a chute to the customer.



Vending machine block diagram



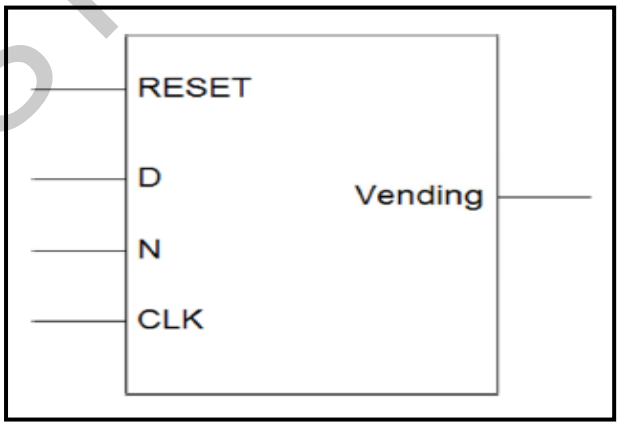
4. OPERATION OF VENDING MACHINE

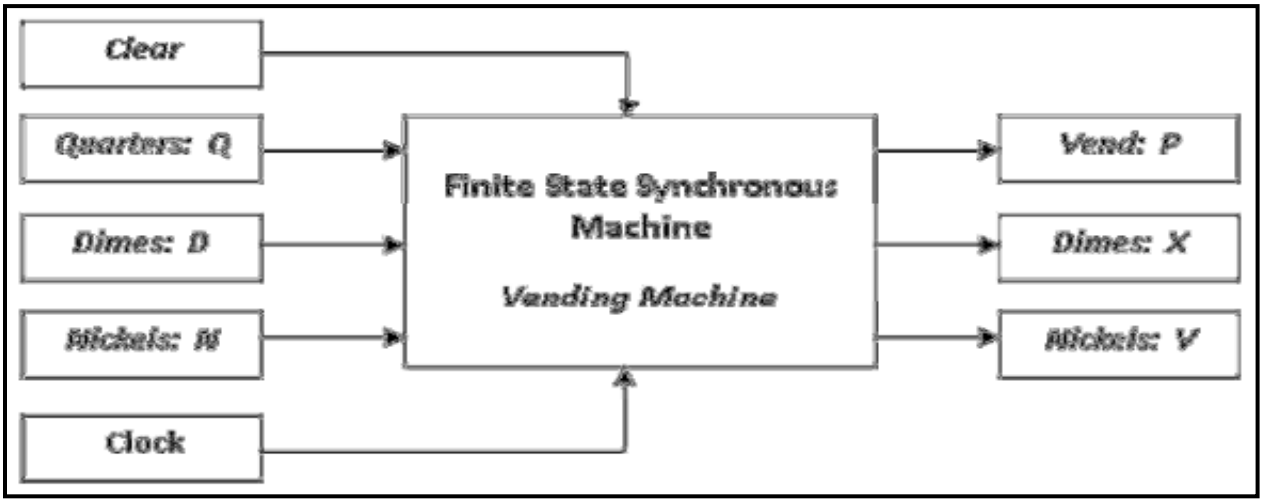
I. When the user puts in money, money counter tells the control unit, the amount of money inserted in the Vending Machine.

II. When the user presses the button to purchase the item that he wants, the control unit turn 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.





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5. COIN DISCREMINATOR

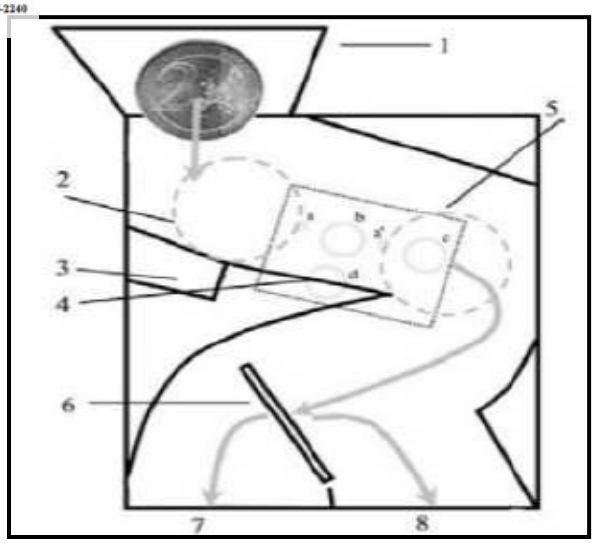
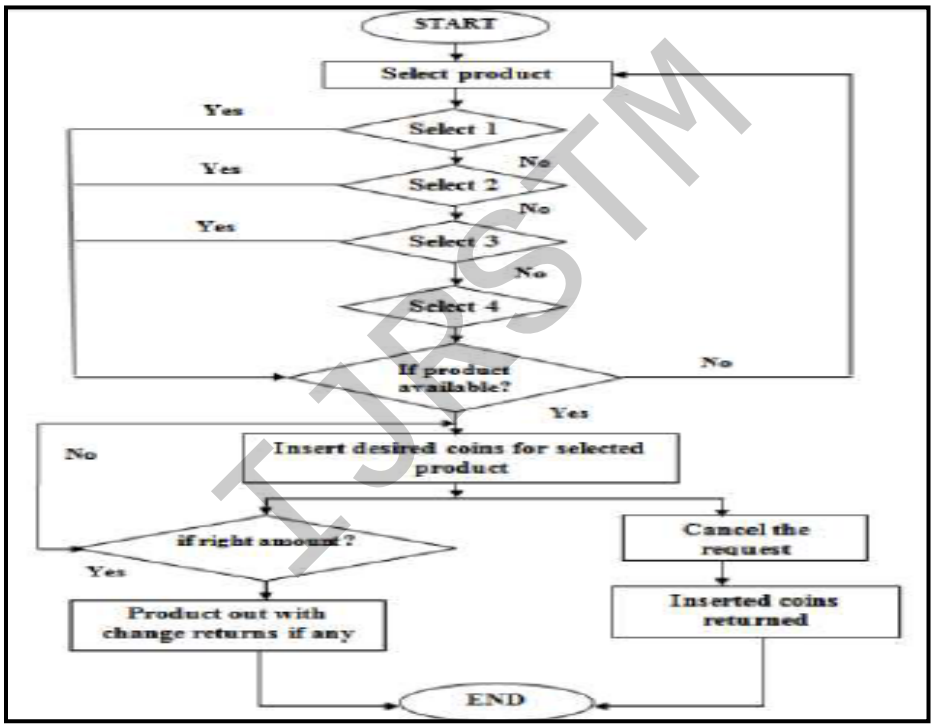


Figure: Schematic of coin discriminator

1- Coin entry, 2- Coin rolling, 3- Anvil, 4- Coin rolling ramp, 5- IR sensors, 6- Acceptation gate, 7- Coin acceptance chute, 8- Coin rejection chute

When a coin is introduced into the slot, it falls vertically and first hits an anvil, rolling down a short ramp of about ten centimeters. The sensors are located along this path, and their signals have to be processed to decide if the coin is good or a fake before it reaches the end of the ramp, where the coin is driven to the storage or returned to the customer. The role of the sensors is to measure physical properties of the coins, such as dimensions, conductivity, magnetic permeability, elasticity, etc., and even the existence or not of relief. Only the diameter of the coin, actually its secant, can be directly measured, while for the remaining parameters only indirect information is obtained. This is not a limitation, since what is really needed is to have for each coin a set of parameters, sufficiently large so that, even considering their drifts (due to aging, sensor accuracy, coin trajectory, etc.)

6. DESIGN METHODOLOY

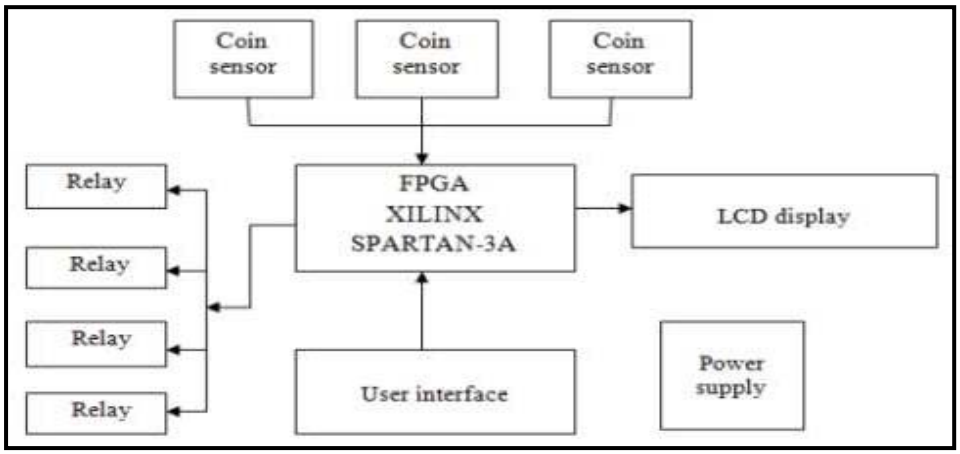


Flow chart of vending machine

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 three types of coins i.e. Re1, Re2, Re5. Let us suppose that the user selects 1 input. The machine will firstly check the whether the products are available in the machine or not. When the desired amount is inserted the machine will go to the product state and 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 Fig 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.

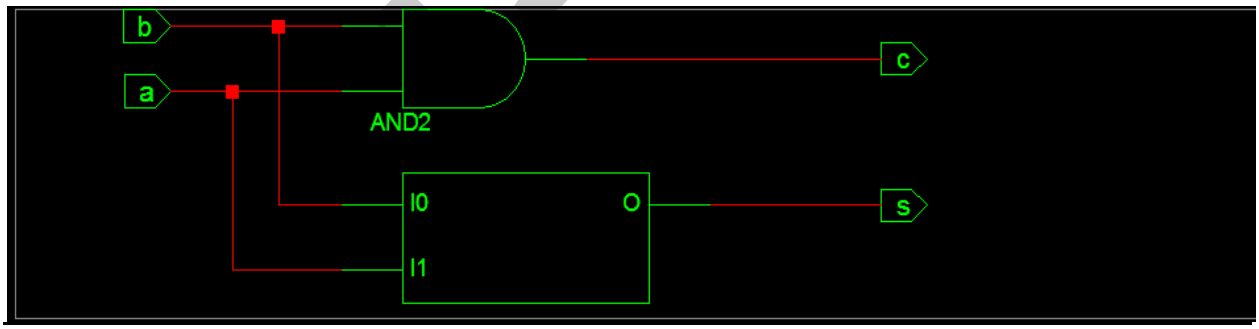
7. BLOCK DIAGRAM OF VENDING MACHINE



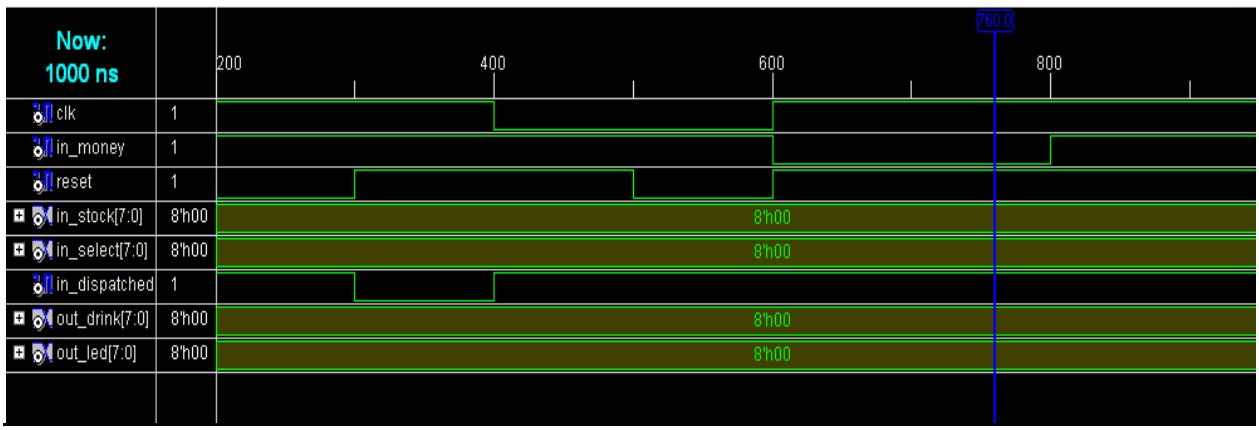
7.1.EXPLANATION

In Fig 2, the machine can accept the coins of one rupees, two rupees and five rupees in any possible sequence. There are coin slots and it commonly connected to the FPGA. User interface is used for coin dispense and product dispense. Relay is used to control the product dispatch. The program has written on KCPSM3 processor and downloads into the FPGA Spartan-3A kit by using ELBERT configuration for selecting products, coin sum and balance and it will be display on LCD.

8. RTL SCHEMATIC VIEW OF VENDING MACHINE



9. WAVEFORM OF VENDING MACHINE



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10. CONCLUSION

It was observed through different scenarios, that FPGA based vending machine give fast response and also show low power consumption and easy to use by an ordinary person. Our results clearly indicate that FPGA based solution increases the efficiency and accuracy of vending machines. Also we can monitor the FPGA based vending machine with the main frame computer. Its algorithm is very flexible and reliable as the vendor can easily enhance the algorithm for large number of products and coins of different denominations at low cost as compared to microprocessor based vending machine.