PASSWORD PROTECTED VENDING MACHINE WITH MOORE FINITE STATE MACHINES (FSM) USING VERILOG

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ABSTRACT

A vending machine is a self-service machine that automatically dispenses a product that the consumer selected to buy after payment has been made. This machine can be implemented and controlled by many different ways including microcontroller. In this paper, Verilog code is used to create an algorithm with the concept of Moore Finite State Machine to control the mechanism of the Vending Machine. The idea of the Moore Finite State Machine is applied to the vending machine in terms of input and output of the machine wherein the output mechanism depends only on the current state or input. In this machine, the product to be dispensed will be dependent on the input payment and selected product. The vending machine accepts payment as input and delivers the product selected by the consumer only after the amount required to buy the specific product has been made and if the amount entered to the machine is greater than the price of the product then it will give the change. In addition, this vending machine is designed to have a password required in order to gain access on the vending machine. In order to open the machine and load products into it, a 1-bit, 8-input password assigned must be correctly entered. This is to add protection to the vending machine and make it secured from unauthorized person.

***Keywords**: Vending Machine, Verilog, Moore Finite State Machine, Password, Microcontroller*

INTRODUCTION

Background of the Study

Vending machines are more accessible and practical than common way of purchasing wherein there is the seller and a buyer. These machines can be found almost everywhere such as in schools, malls, and even in offices and cafeterias [1]. They can be implemented in different ways by using microcontrollers and other software tools. Due to the fast advancement of technology, people are getting involved with the use of the fastest and easiest way to make a reliable and new design of technology. One of this is the use of a microcontroller that uses a hardware description language (HDL), to model electronic systems. HDL is a flexible, programmable and can be re-programmed unlike in microcontroller based that if one wants to improve the design, he has to change the whole system again. In HDL you just need to reprogram the system.

Verilog is a hardware description language (HDL) used to design and verify digital circuits, analog circuits and mixed-signal circuits. Verilog is one of the first modern hardware description languages to be invented and is used as simulation language

[2]. Unlike other programming software, verilog includes ways of describing the signal and its propagation time.

In this paper, the proponents used a new approach to design a Moore FSM (Finite State Machine) based vending machine. The Moore Finite State Machine has the concept of getting and acquiring the output from the current input or state. The output product will be based on the input payment and selected product of the customer. Verilog Code will be used in order to create the algorithm for this system. The vending machine will also be password protected in order to secure it from unauthorized person.

Statement of the Problem

There is in need of a password protected vending machine system that will secure and protect the system when loading the product. The problem of the study also comprises the following:

- accuracy and measurability of the system
- reliability and flexibility of the machine
- consistency and dependability of the mechanism.

General Objective

- To simulate a Password Protected Vending Machine with Moore Finite State Machines (FSM) using Verilog Code.

Specific Objectives:

- To determine the application of Moore Finite State Machines in implementing the system
- To develop a system that deliver a certain product after money is deposited .
- To integrate password security in vending machine using Verilog
- To test the accuracy, reliability, measurability, and flexibility of the system

METHODOLOGY

Xilinx ISE or Verilog Programming Language

Xilinx ISE (Integrated Synthesis Environment) is a software tool produced by Xilinx for synthesis and analysis of Hardware Description Language designs, enabling the developer to synthesize ("compile") their designs, perform timing analysis, examine Register Transfer Level diagrams, simulate a design's reaction to different stimuli, and configure the target device with the programmer [3]. In this paper, the researchers used Xilinx ISE to make a simulation of what is actually happening inside an actual vending machine. This software can show how the system behaves with different inputs, which leads to different outputs as well. Xilinx ISE is very useful for the system because the vending machine has two different functions, one for the customer and another for the admin, in which the synthesis feature will be most effective.

Proposed System

The proposed system will be using Verilog code to create an algorithm for entering the 1-bit 8 input password for the administrator to open the machine and load products into it. If the user is a costumer, he/she will insert a coin or bill, wherein the bill is not greater than Php50, in order to buy a

certain product. After the costumer has inserted the money, the system will check if the amount of money is able to buy a certain product in the machine. If the money inserted meets the condition in order to purchase a product, then the machine will ask the costumer to select a product that he/she is willing to buy and dispense the selected product immediately. After the transaction has been made and there is a change for the money inserted, the machine will be giving the change.

Block Diagram

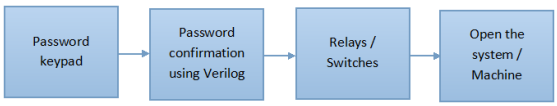

Figure 1 Password-protected machine block diagram

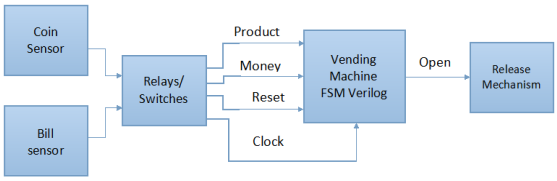

Figure 2 Vending machine block diagram

IPO Chart

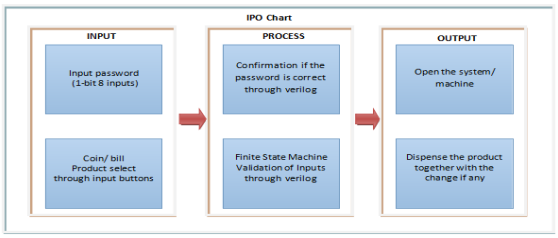

Figure 3 IPO chart of the system

Pseudocode

1. Start
2. If the user is a costumer
   a. Insert coin or bill
   b. Is the bill ≤ 50 php?
   c. If no go to step 4. If yes,
   d. Select the product
   e. Decide if the money ≥ amount of selected product?
   f. If no, go to step 4 or cancel the request and return the inserted money. If yes,
   i. Dispense the product with excess amount if any
3. If the user is an admin
   a. Enter 1-bit 8-inputs password
   b. Is the password correct?
   c. If no, go to step 4. If yes,
   d. Open the machine
4. end

Flowchart

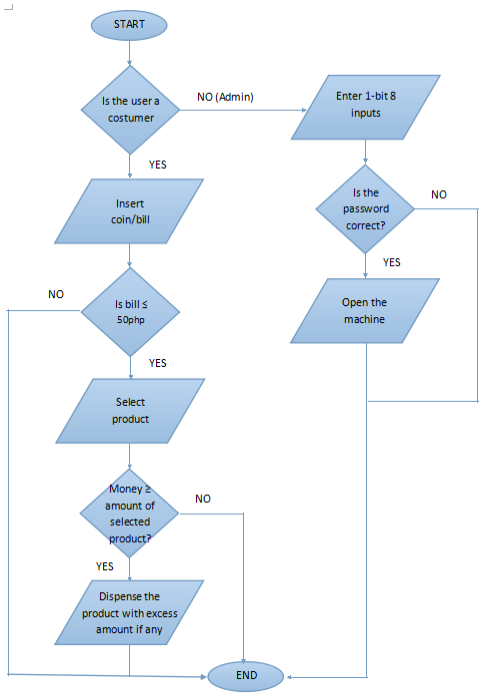

Figure 4 Flowchart of the system

RESULTS AND DISCUSSIONS

Project Description

In this paper, a vending Machine is designed using Moore Finite State Machine and Verilog code which can be used to vend or sell eight products; each with corresponding costs. The first state of the system will determine whether the user is an admin or a costumer. If the user is an admin, password will be require to open the machine otherwise the user is a costumer and can now proceed to te next state. The Password Protected Vending Machine with Moore Finite State Machines (FSM) Using Verilog can give accurate, flexible and fast response compare to other algorthm. In addition, this vending machine is designed to have a password required in order have access to the vending machine. In order to open the machine and load products into it, a 1-bit, 8 inputs password assigned must be correctly entered. This is to add protection to the vending machine and make it secured from unauthorized person. This proposed project gives an accurate and flexible output that dependent on the selected product and its corresponding price.

Table 1 The selected code of products used in the machine with their corresponding prices

Select	Product	Price
000	Sprite	25
001	Coke	25
010	Royal	25
011	Iced Tea	22
100	Minute Maid	20
101	Gatorade	35
110	Root Beer	25
111	Chuckie	20

Properties of the Project

This section covers the algorithm used and the Verilog coding using Xilinx ISE.

The proponents used structural modelling because several sub modules are needed to be created that will be integrated into one model. By this type of modelling, the coding will become more organized in order to avoid confusion for the programmer in case he/she wants to modify the program.

If-else statements were also used for certain conditions present in the system such as the response of the system if the inserted money is sufficient or not, the response of system with the corresponding selection of the user, and the response of the system when the password is correct/incorrect.

Functions of the System

The study is a simulation of an actual vending machine with password activated switch that accepts amount of money that is equal or less than Php50. When the amount of money inserted is enough to purchase a product then the system will allow the costumer to select a certain product he/she wishes to buy. If the money inserted is greater than the price of the selected product, the machine will give the excess amount. The password will be used only if the person is an admin that would like to open the machine and load products into it.

Tools and Methodologies of the System

All the results of Verilog code along with simulation of results have been established for their flexibility and accuracy in the Xilinx ISE Software. Simulation Waveforms for the selection of eight products are also shown.

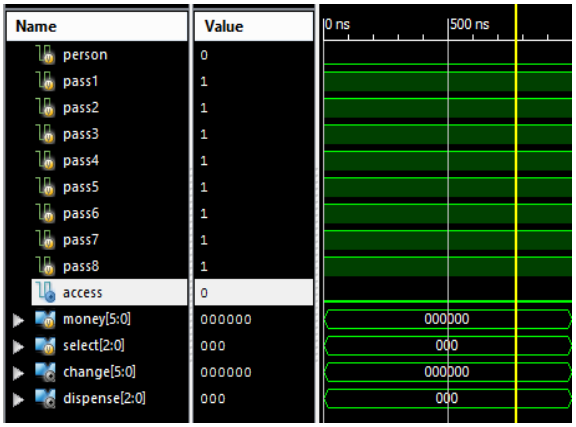

Figure 5 The person is an admin and the password entered is incorrect. The admin will not be able to gain access on the machine.

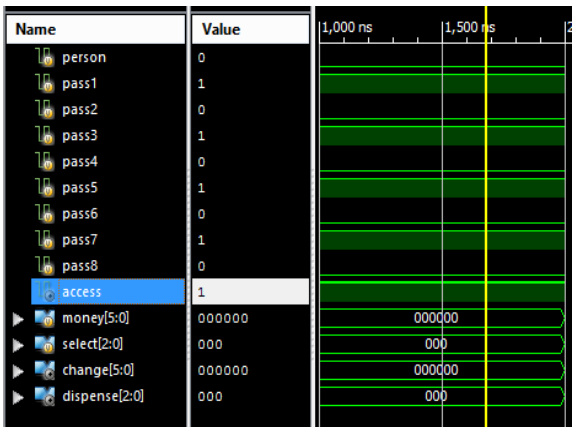

Figure 6 The person is an admin and the password entered is correct. The admin will be able to gain access on the machine.

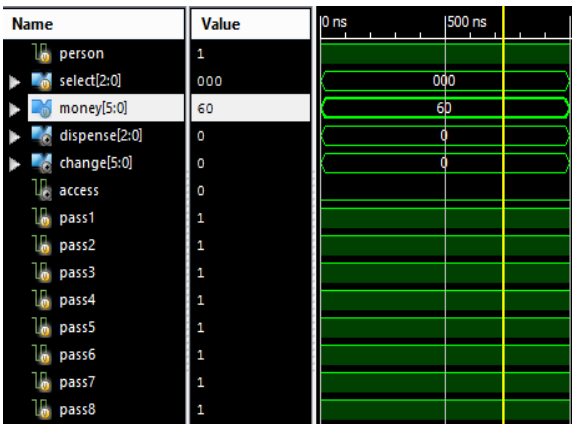

Figure 7 The person is a customer having the amount of money that is 60 pesos. The system will not accept the money because it is greater than 50 pesos, therefore the customer will not be able to buy a product.

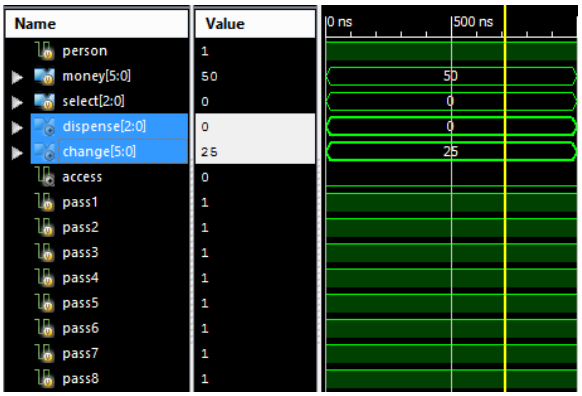

Figure 8. The person is a customer that has money of 50 pesos. The customer bought product "000" which is Sprite for 25 pesos and received a change of 25 pesos.

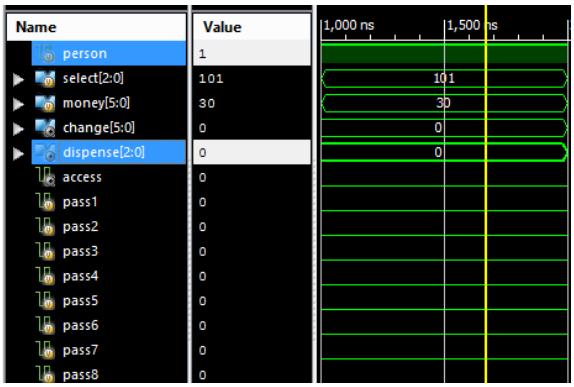

Figure 9 The person is a customer having money less than the price of the selected product, the machine then will not dispense the product.

The simulations above show the different conditions of the system. Figures 5 and 6 showed the use of the password for the admin. Unless the password entered is valid, the admin will not have the access to the machine. Figures 7, 8 and 9 show the mechanism of the system depending on the input, in this case, the money and the product selected. It is also shown in Figure 8 about the

ability of the system to give the change in case the money inserted is greater than the declared price of the product.

CONCLUSION

After conducting the research and simulations, it was observed by the proponents that through Xilinx ISE, the principle of vending machine and Moore Finite State Machine can be obtain using verilog code. The results show that the Password Protected Vending Machine with Moore Finite State Machines (FSM) Using Verilog gives fast response and is easy to perform by an ordinary person. In terms of other factors like the cost and reliability, the proposed system is more preferable since it is programmable and requires low cost. The designed machine can be used for many applications and can easily enhance the number of selections.

ACKNOWLEDGEMENT

This project study would not be possible without the help and support of the following people around us. It came to success because of these people who helped us complete this word.

We are deeply indebted to our professor Engr. Rionel Belen Caldo who guided us throughout the whole process of making this project. We owe him a lot for giving us the motivation and valuable ideas.

We also like to thank the institution, Lyceum of the Philippines- Laguna, and the College of Engineering and Computer Studies for encouraging us to work and finish this project study. Also, for nurturing the ideas we needed to accomplish this study.

We express our deepest gratitude to our parents for giving us moral and financial support. We thank them for letting us fulfill our dreams and for the words of encouragement they gave us through our ups and downs.

Last but definitely not the least, we thank God for the life He gave us and for the blessings He showered upon us. Everything will not be possible without His help.

REFERENCES

[1]Automatic Vending Machines on Highbeam Business. [Online]. Available:http://business.highbeam.com/industry-reports/equipment/automatic-vending-machines.

[2] SystemVerilog - Is This The Merging of Verilog & VHDL? on Sunburst Design, Inc. [Online]. Available: http://www.sunburst-design.com/papers/CummingsSNUG2003Boston_SystemVerilog_VHDL.pdf

[3] Swati Sharma and Mohit Bansal, “Designing of Cordic Processir in verilog using Xilinx ISE Stimulator,” International Journal of Research in Engineering and Technology, vol. 03, pp. 342-349, May 2014.