VENDING MACHINE USING VHDL

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ABSTRACT

Vending machines are used to apportion small different products, when a coin is fitted . These machines can be enforced in different ways by using microcontroller and FPGA board. Then in this paper, we proposed an effective algorithm for perpetration of dealing machine on FPGA board. Because FPGA grounded dealing machine give fast response and uses lower power than the microcontroller grounded dealing machine. The FPGA grounded vending machine supports four products and three coins. The dealing machine accepts coins as inputs in any sequence and delivers products when needed quantum is deposited and gives back the change if entered quantum is lesser than the price of product. It also supports cancel point means a stoner can withdraw the request any time and entered plutocrat will be returned back without any product. The proposed algorithm is enforced in Verilog HDL and dissembled using Xilinx ISE simulator tool.

Keyword : - *VHDL, FPGA, Xilinx ISE simulator tool, VHSIC*

1. INTRODUCTION

A vending machine is a machine that provides particulars similar as four different products indeed diamonds and platinum jewelry to guests, after the vendee inserts currency or credit into the machine using extremely simple way. These way would not be time consuming at all. The vendee would get all the details on the screen which he she should follow. The main purpose of this design was to produce a dealing machine which could give four different snacks products to the people using extremely simple way. We've made an attempt to sell four products of different prices in the same machine. The machine will also give the change to the vendee depending on the quantum of plutocrat he she has fitted .

Fig-1: Vending Machine

1.1 History

The first ultra modern coin operated vending machines was introduced in London in early 1880s, it dispenses cards. The machine was designed by Percival Everitt in 1883 and employed in road station and post services, allocating cards and notepaper. In 1887, The Sweetmeat Automatic Delivery Company was established in England as the first company to make the vending machines. The essence coil is used in the vending machine substantially in snack machine. When the coil is rotated the product is allocated out as the affair through the apportion.

1.2 VHDL Software

The VHSIC Hardware Description Language(VHDL) is a hardware description language(HDL) that can model the gates and structure of digital systems at multiple situations of abstraction, ranging from the system position down to that of sense gates, for design entry, attestation, and verification purposes. Since 1987, VHDL has been formalized by the Institute of Electrical and Electronics Engineers (IEEE) as IEEE Std 1076; the rearmost interpretation of which is IEEE Std 1076- 2019. To model analog and mixed- signal systems, an IEEE- formalized HDL grounded on VHDL called VHDL- AMS(IEEE1076.1) has been developed.

2. EXISTING MODEL OF VENDING MACHINE

The Arduino act as main processor. The vending machine has Arduino Uno that acts as a master controller along with RFID tag and reader. The external devices such as keypad, display can be connected through the various pins on the Arduino Uno. First, RFID card is scanned and reads the tag, after user can select the product for their own needs.This can be operated by using Arduino software. In between the Arduino and stepper motor, the motor circuit is placed. The controller current is not sufficient for the stepper motor because they need more current. The stepper motor is connected to the spiral ring, those products are inserted in the ring. Finally, the product can be selected and then the motor rotates to deliver the product.

2.1 Methodology

A 230v ac supply is converted into a 12v dc 1000mAH power supply given to DC jack and it is connected to bridge rectifier. The rectified DC power supply is given to voltage regulator IC7805 as an output of 5v DC. The output supply is given to Arduino UNO trainer kit and L298n motor driver. Arduino UNO consist of internal power supply source 5v it connected to VCC and Gnd of RFID reader and Arduino receiver (Rx) gets input signal from RFID transmitter (Tx). when the RFID tag is shown in front of the receiver the reader sense the tag and electromagnetic fields transfers data to Arduino receiver. The Arduino UNO send the signal to l298n dc motor drive which is connected to the motor A and motor B.

2.1 Operation

When a 5- rupee coin is entered into the vending machine, the coin detector will overlook the coin and checks its authenticity by checking its periphery, consistence and fall-time. However, but if coin is different from that which is been trained, also it'll be returned back to the client, If the coin is authentic also the coin sensor will accept the coin. From the main force the AC voltage is continuously supplied to the dealing machine. There's a diode therapy in the circuit, which converts the AC voltage into DC, and this voltage is supplied to a voltage controller(7805 IC) through an electrolytic capacitor present at the therapy. The capacitor stores some voltage and provides the smooth voltage to the controller. The controller converts the voltage supplied to a constant voltage of 5V. An LED is present in the circuit to indicate the working, with a resistor to drop the voltage because an LED needs veritably lower voltage for operating.When the product needed is named and the coin is fitted and if accepted by the coin collector a palpitation is given to the regulator and the separate motor is driven which in- turn drives the spring attached to it. The spring rotates the product, which also slides out of the box

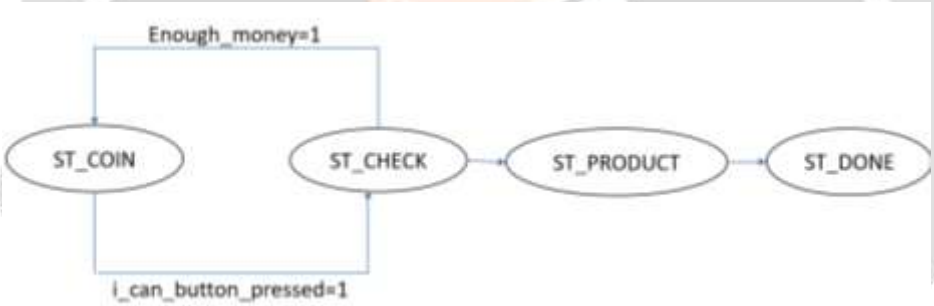
3. PROPOSED MODEL OF VENDING MACHINE

Former microcontroller or microprocessor grounded vending machines were hamstrung as compared to FPGA grounded vending machine. So, it is necessary to make it more dependable with effective algorithm that will be completely commanded by FPGA grounded result. The main purpose of this design was to produce a vending machine which could give four different snacks products to the people using extremely simple way. We have made an attempt to sell two or further products of different prices in the same machine. The machine will also give the change to the vendee depending on the quantum of plutocrat he she has fitted . It is also possible to withdraw the deposited plutocrat in between, if consumer wishes by pressing a cancel button.

3.1 Problem Definition

Suppose we've a vending machine that sells soda pop barrels that costs 10 ₹ each and a chocolate that costs 5 ₹ each. also, we've only 3 types of coins 1 ₹, 5 ₹ and 10 ₹. Our idea is to design a state machine that determines when to apportion a can and it indicates whether the stoner has fitted enough plutocrat or not to buy the named product.
In this design we will ignore the capacity of the stock, which means, we will assume that there will always be can in the dealing machine. Also, we can assume that only one action could be made in every " clock cycle " or state.

3.2 Finite State Machine



Explaining the states:

- The FSM has four states: ST_COIN, ST_CHECK, ST_CAN, and ST_DONE.
- 2.The current state is stored in the state signal.
- 3.The FSM logic is implemented in the proc_state_logic process, which is sensitive to the clock signal (clk) and the asynchronous reset signal (rst_async_n).
- 4.The FSM has transitions between states depending on the input signals and the current state.
- 5.The output signals (o_money_low and o_can_release) are generated based on the current state and other input signals.

Transitions between states are as follows:

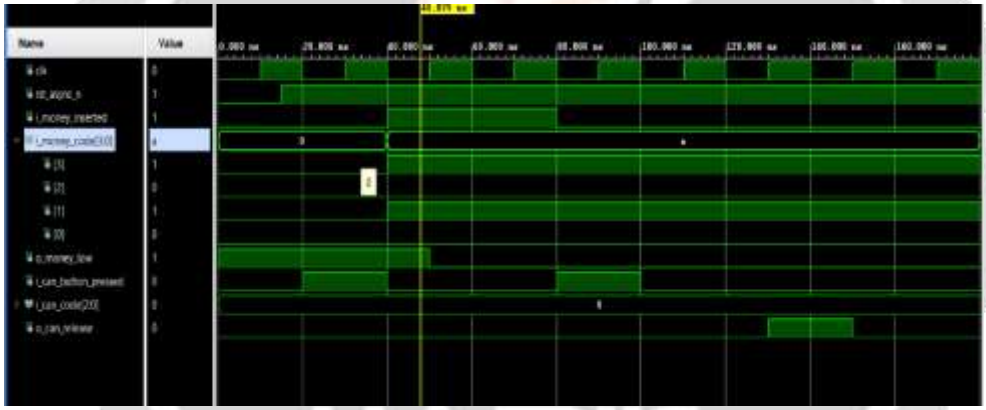
- From ST_COIN to ST_CHECK: When the i_can_button_pressed signal ishigh.
- From ST_CHECK to ST_CAN: When the enough_money signal is high.
- From ST_CAN to ST_DONE: This is the final state.

3.3 Methodology

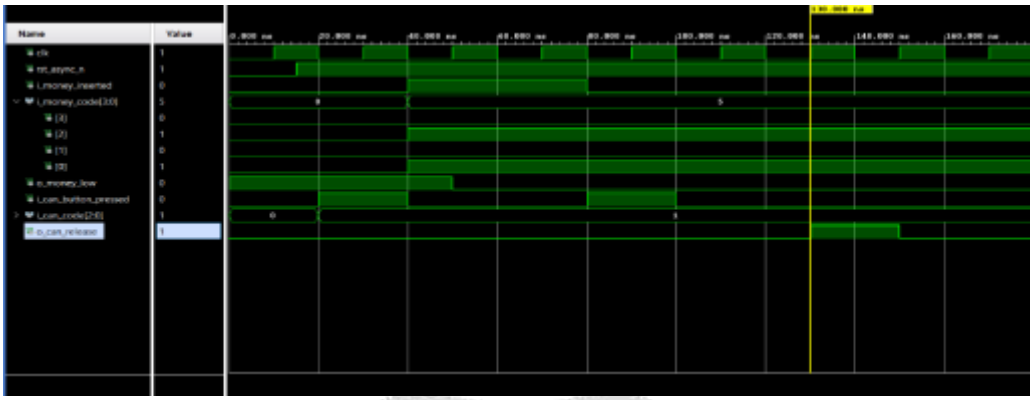
1. **Requirements Gathering**: The first step would be to gather the requirements for the vending machine, including its functionality, features, and user interface.
2. **System Design**: Once the requirements are gathered, the next step would be to design the system architecture, which includes the components and their interactions.
3. **VHDL Coding**: After designing the system architecture, the next step would be to write VHDL code for the various components, such as the controller, user interface, and vending mechanism.
4. **Simulation**: Once the VHDL code is written, simulation can be performed to test the design and identify any issues or errors.
5. **Implementation**: After the simulation, the VHDL code can be synthesized and implemented on a target FPGA or ASIC device.
6. **Testing**: The final step would be to test the implemented vending machine to ensure that it functions

4.SIMULATION RESULTS

The following simulation results has obtained after executing our VHDL testbench code in Xilinx ISE software.



In the above figure we have the given values rst_async_n, i_money_inserted, i_button_pressed as ‘1’ and we have given i_can_code as ‘0’ which is used to selectthe soda can and we have inserted the cost of soda by using i_money_code as 10.So, our required item soda can will get dispensed out by producing the ouput o_can_release as ‘1’ and o_money_low will be ‘0’ .Since, We have entered the enough amount.



In the above figure we have the given values rst_async_n, i_money_inserted, i_button_pressed as '1' and we have given i_can_code as '1' which is used to selectthe chocolate and we have inserted the cost of soda by using i_money_code as 5.So, our required item chocolate will get dispensed out by producing the ouput o_can_release as '1' and o_money_low will be '0'. Since,We have entered the enough amount.

In the above figure we have the given values rst_async_n, i_money_inserted, i_button_pressed as '1' and we have given i_can_code as '0' which is used to selectthe soda can and we have inserted the cost of soda by using i_money_code as 7.So, our required item chocolate will not get dispensed because the cost of soda is 10₹. So, we will get the ouput o_can_release as '0' and o_money_low will be'1'.Since, we didn't entered the enough amount.

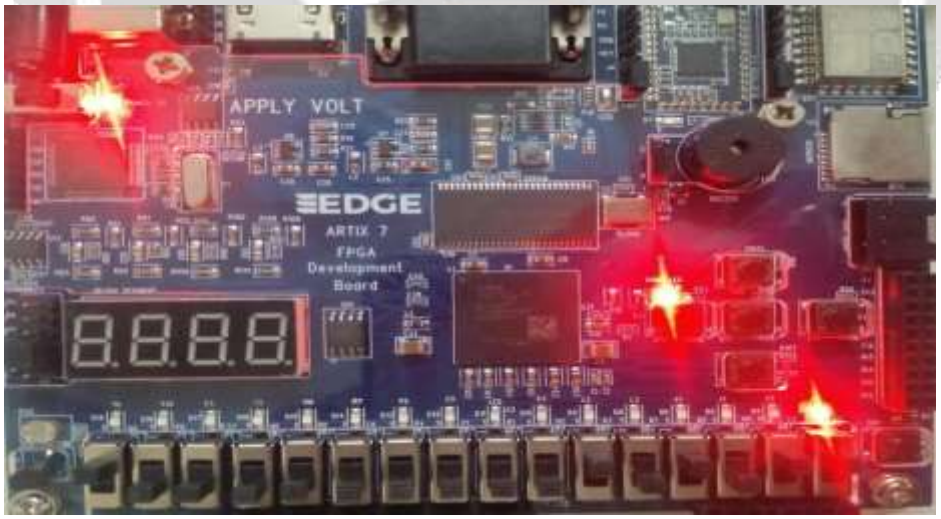
5. IMPLEMANTION OF VENDING MACHINE ON FPGA

5.1 FPGA pin description

Name	Direction	Neg Diff Pair	Package Pin	Fixed	Bank	I/O Std	Vcco	Vref	Drive Strength	Slew Type	Pull Type	Off-Chip T
All ports (5)												
i_money_code (4)	IN			✓	34	LVCMOS33*	3.300				NONE	NONE
i_money_code[3]	IN		M4	✓	34	LVCMOS33*	3.300				NONE	NONE
i_money_code[2]	IN		M2	✓	34	LVCMOS33*	3.300				NONE	NONE
i_money_code[1]	IN		M1	✓	34	LVCMOS33*	3.300				NONE	NONE
i_money_code[0]	IN		N3	✓	34	LVCMOS33*	3.300				NONE	NONE
Scalar ports (5)												
button	IN		L5	✓	34	LVCMOS33*	3.300				NONE	NONE
i_item	IN		L4	✓	34	LVCMOS33*	3.300				NONE	NONE
o_can_release	OUT		J3	✓	35	LVCMOS33*	3.300		12		NONE	FP_VTT_50
o_money_low	OUT		H3	✓	35	LVCMOS33*	3.300		12		NONE	FP_VTT_50
rst	IN		M6	✓	14	LVCMOS33*	3.300				NONE	NONE

We have given the inputs i_money_code(3:0) is given to pin numbers M4,M2,M1,N3 and button is given to pin number L5 and i_item is given to pin number L4 and rst is given to pin number M6 and the outputs o_can_release is given to pin number J3 and o_money_low is given to pin number H3.

5.2 Output



The following output has obtained by implementing our vhdl code of vending machine on Artix 7 FPGA board.In this we have given inputs rst on pin number M6 as '1' and i_item on pin number L4 as '1' to select the item chocolate and i_money_code as '0101' because, cost of the chocolate is 5₹.So, the output o_can_release is displayed as '1' on pin number J3 and the output o_money_low displayed as '0' on pin number H3 because, we have enteredthe enough amount.

6. CONCLUSIONS

We have developed an efficient algorithm for implementation of vending machine on FPGA board and the algorithm is implemented in VHDL and simulated using Xilinx ISE simulator tool.The required simulation results have obtained and the required output has obtained by implementing our vhdl code of vending machine on Artix 7 FPGA board.The drawback in our project is it doesn't give any change to the customer and do not accept large number of items. So, we can further modify our project by adding large number of items and to give the required amount of change to the customers.

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