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Comparison Between Mealy and Moore Using Automated Machine

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Abstract

In India goods and sales via automated machine are growing rapidly. In our daily life we can see automated machine anywhere. This is due to our lifestyle are changing with a high quality and with a faster rate. For an example we can found in schools, colleges, railway stations automated machine providing different drinks (coffee, tea, cold drinks), even automated machine providing chocolates are available. This means that automated machine modelling is the crucial part for developing proposed model using concept of FSM (Finite state Machine) and also reduces the human resources. The main characterize is to make proposals for appropriate improvement, which would make ease usage of automated machines. The automated machine delivers the product/products which are demanded and accepts different coins (money) in any sequence as inputs when amount is deposited and gives back the change if entered amount is greater than the cost of product. Moreover carry cancel feature, which denotes a user can withdraw the appeal any time and entered money will be returned back with the termination of product. The mechanism 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 pushing a cancel button. The proposed model will increase the efficiency of vending machine and will also lead to cost reduction, saving time and ease of usage. One more facility is provided i.e coins count that machine count how many coin was inserted in a particular day this is done to stop fraud cases which are usually done. The proposed model will increase the efficiency of vending machine and will also lead to cost reduction, saving time and ease of usage. Here comparing both FSM i.e Mealy and Moore to conclude which FSM is better and relevant for use.

Index Terms: *Automated machine, FSM, Mealy concept, Moore concept, Vendee*

1. INTRODUCTION

Now adays automated machines were generally available universally and the demand for them is continuously rising, and also the deployment has grown rudely for automated machine for the duration of the recent decades, due to high charge of human staff and low rates of hardware. But for any organization a well designed machine can help out in raising the profits and also add to customer satisfaction.

Basically there were two types of automated machines installations on and off principle. In On-principle machines are usually more complex and advanced, multi-function machines that can be accomplished by any different branches, and thus they are more expensive. And in off-principle machines are installed by particular institutions or Independent Sales Organizations (ISOs) [13] where there is an only requirement is cash, so they are usually low-priced distinct functioned devices. Off-principle automated machines are not interconnected but distributed that means they are installed independently in a distributed network; enabling people to vend different products from machines for those costs are charged to users which they have to pay to machine. Due to heavier demands and the falling price of Off-principle machines, they are moved to customer having hardware architectures using microcontrollers and/or application-specific integrated circuits.

Modern automated machine provides physical security and money handling security that means it concentrates on refuse the use of the money inside the machine to a thief. This is used to prevent fraud. There may have a number of incidents of fraud by inserting incorrect amount into the machine. Some machines may include coin recycling facility. That means the coin which are inserted may be returned if the costumer want change. Before machine is placed for commercial use, it has to undergo for extensive testing with test money and the backend computer systems [11] that allow it to perform transactions Any automated machine weather it works in on or off principle their architecture are made in the concept of FSM (Finite State Machine). Any automated machine weather it works in on or off principle their architecture are made in the concept of FSM (Finite State Machine).

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1.1 Operation of Automated Machine

- When user push the button the machine will inform the user that the product is existing or not, for that it will display a message.
- When users choose the product for consumption and quantity of it, it will manually calculate the net amount required to be paid/insert by the user.
- User will have to now slot in the specified amount for buy the product. Then machine will verify the amount provided for the product.
- If extra amount is inserted then machine will check for change to return. If it available then it will return the change and will dispense the product.
- Otherwise it will cancel the product and return the amount inserted. The whole procedure will be terminated.
- User even can cancel the product before delivery that means cancellation assets are provided to user.

1.2 Method of Payment

Method of payment for this type of machine can be illustrating in three methods or techniques. Several automated machines are accomplished of constructing changes, and several more modern ones allow paper money or credit cards. The technique using was using note, coin, and by means of prepaid as disbursement.

- Coin insertion method.
- Money insertion method.
- Prepaid operated method (Cashless method work on steps forward).

1.3 FSM Concept

A finite state machine (FSM) is a statistical model of computation used to design both sequential logic circuits and computer programs. Or FSM is a digital sequential circuit that consists on number of pre-defined states that are controlled by one or more inputs [3] [4]. FSMs are considered in the wide-ranging of field of automata theory like turnstile used to organize the access to subways and amusement park rides etc. The FSM approach can be adapted in any systems whore jobs represent a well-structured record in such a way that all of the states can be feasibly specified for representing outputs. That means a typical state machine can be implementation. At the time of developing, a user-defined enumerated data type will be initialized, having a list of all possible states [9]. A FSM is specified by five different entities: “States”, “Present state”, “Input state”, “Output state” and “Transition or Next state”. [10] It pictures a conceptual machine that can be within one or more number of “States”. At a time the machine can be in only one state; at any given time the state it is in is called the “Current State”. Machine can change to one state from another when it will initiate by event or condition; it is called as “Transition or Next State”. The general structure of the finite state machine (FSM) shown in fig 1.1 below.

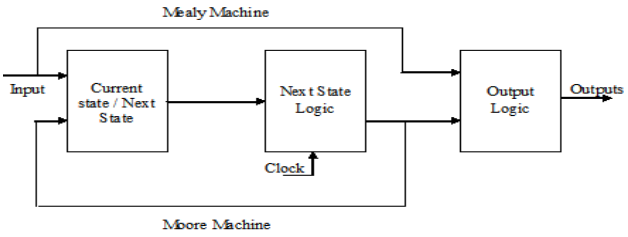

Fig. 1.1 General Structure of FSM

I. Mealy Machine:

In a Mealy machine, the outputs are a function of the present state and the value of the inputs as shown in Figure below.

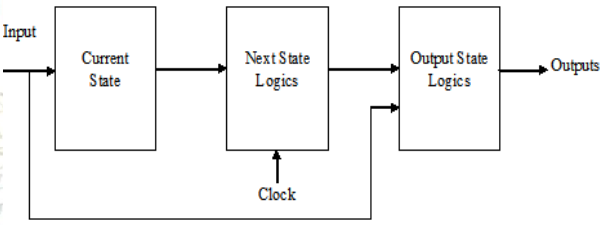

Fig. 1.2 General diagram of Mealy machine

- As a result, the outputs may alter synchronously in reaction to any change in the inputs.
- A combinational logic block maps the inputs and the current state into the necessary flip-flop inputs to store the appropriate next state just like Mealy machine.
- On the other hand, the outputs are calculated by a combinational logic block whose inputs are only the flip-flops state outputs.
- The outputs alter synchronously with the state transition triggered by the active clock edge.
- A mealy machine is a kind of Finite State Machine with no accepting state or final state and giving output to each corresponding state and input.
- In mealy machine there is an output for each and every input.
- Mealy Machine allows NULL STATE.
- In Mealy Machine for n input there is n output.
- Mealy Machine is used for Transition.

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II. Moore Machine:

In a Moore machine, the output functions are dependent only on the value of the input.

- The output state modify asynchronously in response to some change in the input states.
- There is no false result known as output glitch given by Moore machine.
- States are encoded with binary values state and after that converted into equivalent states.
- Moore machine do not allow NULL STATE.
- It will give n+1 output for n input.
- An output function like $G : S \rightarrow \Lambda$ mapping a picture of each state to the output alphabet.

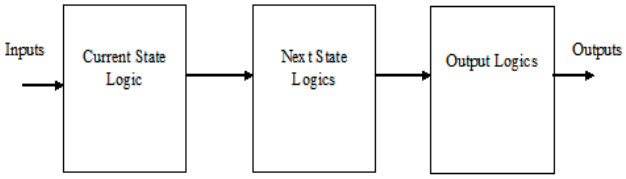

Fig. 1.3 General diagram of Moore machine

1.4 MTS (Modal Transition System)

In FSM a Modal transition systems (MTS) is used. MTS is an automata-like formalism [12] for the speciation of a selection of software scheme. Through MTS systems or machines are then refined that means the behaviour of the machine is made more and more accurate until we get proper labelled transition system (LTS) where all possible behaviour is completely known to the machine. In the MTS, the machine may transition either employ (selected product) or is mislaid (here it is coin) functions. In MTS states are denoted by circle, May condition is denoted by dashed lined ----- and Must condition are denoted by continues lines _____..

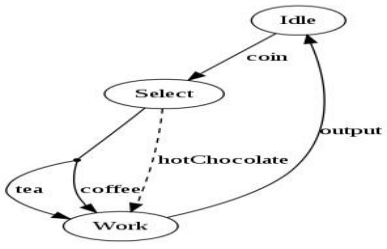

Fig. 1.4 MTS for vending machine

On execution modal modification overlap with the traditional conception of strong bi-similarity, and on modal transition systems lacking of one must transitions it matches to the simulation pre-order. The MTS frameworks have demonstrated to be useful as a requirement formalism of component-based systems as it maintain compositional verification and stepwise modification. Nevertheless, convenient are some margins of the supposition, explicitly that the naturally distinct notions of modal alteration and modal composition are imperfect with respect to the semantic view based on the location of the implementations of a specified MTS arrangement.

1.5 Verilog Coding

Verilog, standardized as IEEE 1364, is a hardware description language (HDL) used to model electronic systems. It is most commonly used in the verification of analog circuits and also for designing and verification of digital circuits at the register-transfer level of abstraction. Verilog designs consist of a hierarchy of elements. Element encapsulate design hierarchy, and communicate with last modules during a set of declared input, output, and bidirectional ports [2].

2. LITERATURE REVIEW

A number of researches have been accepted out for designing the machine, which dole out the change that can be used to enlarge a recital and the efficiency of a machine. And also to boost the method so that problems in existing technique will be removed throughout implementations. Some of the works previously done are:

2.1 Vending Machine with Auto-Billing Features

A new approach is proposed in April 2012 to design an "FSM based Vending Machine with auto-billing features". "FSM based Vending Machine with auto-billing features". At the start when the reset button is pushed, the machine will be ready for the users to select the product [1]. For four products this machine was made. This means that user has option to dispense with the combination of 10/- and 20/- rupees. Auto-Billing characteristics using Finite State Machine form. In this paper the procedure of four states like user Selection, insertion for money, product delivery or servicing has been modelled using MEALY Machine Model.

2.2 Train Ticketing System Using Verilog HDL

In the year 2010 this technique accepts coins in any sequence, and deliver tickets when the desired amount is deposited, it also give back the change if inserted amount is greater than the required amount. Paper says that

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ATTS (Automatic Train Ticketing System) propose and performance on Spartan-3 xc3s400 is planned, since it is FPGA based ATTSs [2] as many recompense over active microcontroller based ATTSs, a few of these advantages were; straightforward constitution towering reliability, speediness, number of input/output ports, concert and less power consumption which are all very important in every ATTS design. This system is executed on the basis of finite state machine (FSM), by using Xilinx State CAD tool [3].

2.3 Finite State Machine and VHDL Coding Techniques

In this system demonstration was given by evaluating the similarities and differences of VHDL [15] and Verilog [16] languages. This paper discusses a variety of issues regarding finite state machine design using the hardware description language. VHDL coding styles and different methodologies are presented. Study of FSM focuses on the modelling concern such as VHDL coding style [8], state encoding schemes and Mealy or Moore machines. Treatise is limited to the synchronous FSM, in which the transition is controlled by a clock signal and can occur only at the triggering edge of the timer.

2.4 Logic circuit design for vending machine

The modular advance method will be engaged for this project, using simulation to test out the functionality of each individual module. Thereafter all the individual modules are integrated to form the vending machine system. The design is compiled and simulated using verilog [6] (HDL simulator). In this it was investigated that the problem of foreign currency is not possible at any machine for vending and identify this kind of problem and logic circuit was designed that is closely related to the standard vending problem without logic circuits and also differs in some important aspects. Like demand is explicitly permitted to be negative and, the shortage cost is assumed to be independent of the magnitude of shortage [14].

2.5 Vending machine with Xilinx technique

In this paper Vending machine was imitated, and prototyping with tools to facilitate and provided by Xilinx ISE 12.1 In this a simple design circuit of a 2-input having AND gate can be straightly goes to Xilinx ISE 12.1 for combination, post synthesis recreated and timing study. Several chronological digital paths can be distorted into a status mechanism using state graph in Xilinx. In a status mechanism the circuit's production or amount shaped is defined in a different set of states i.e. every productivity or quantity created is a condition. In this a State Register is available to hold the place of the mechanism and next location logic to deduce the next location. And as well there are output records that exemplify the output of the instrument. After that location logic is the chronological part of the mechanism and the present state and output are the documentation part of the logic.

3. PROBLEM IDENTIFICATION

At present, the rapid use of automated machine is growing on mounting more and more but the existing techniques are not able to completely solve the problems occurring while accessing the technology. Automated machine has lots of technical problems such as method of product capacity payment, very serious structure, level of protection, and various more.

- The previous machine is based on combination of Mealy and Moore concept where the output is of Mealy machine is converted into the output of Moore machine. This obtains long time to dole out the output and that output is reliant on Moore machine. One machine is asynchronous and another one is synchronous, both the perception is very dissimilar in behavior and that why machine is not capable of providing suitable output to the machine.
- The machine should be based on one concept i.e. either on Mealy or Moore**.** This arranges more comfortable to the mechanism to achieve. Dimensions be only occupied by the machines and the savings were estimated sustain on the calculated figures because no data is dependent only on the input situation.
- Make sure that the machine is loaded properly. Even a partial filling of cans may create several troubles. If anyone column has a can jam due to improper loading or other reasons then the entire machine will be out of service. A measuring device should be provided during loading so that the filler do fill the proper filling of products. Even overfilling of machine may also create jam to the machine.

4. METHODOLOGY

Like many machine designer design and build tradition specialized machine, most of those machine designers will get involved in medium investment with multiple function production equipment. Similarly in this paper the general method is designed for any automated machine which is user friendly. The design is simulated by using verilog coding for both Mealy and Moore machine concept in contrast to time saving and suitable for convention.

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According to the flow chart of methodology the machine is unlocked state so that the user may select the product among the products given. After that the user will insert the amount for that particular selected product but in previous to it the machine will calculated the net amount. After that the machine will check whether the machine has to return some amount to the user or not. If yes, than it will return to the user.

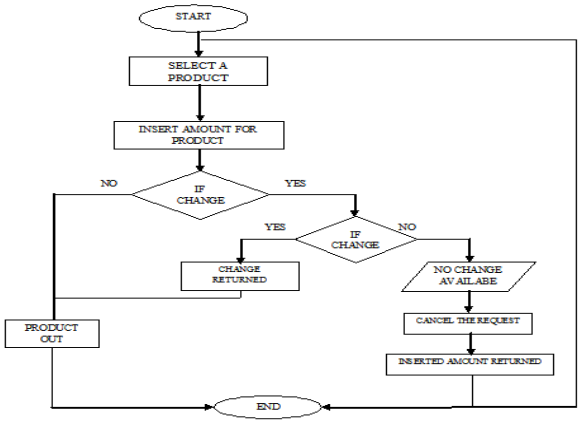

Fig. 4.1 Flow chart of Methodology

The whole procedure is having two states: Locked and Unlocked [13]. The Locking and Unlocking procedure will provide security and unauthenticated person will not be able to use the machine. These are two inputs that affect state of machine. The machine will be in the unlocked state so that the user will select the product as per his/her choice. Now the machine will move toward from Unlocked to Locked state.
This transition of Unlocking and Locking state will supportive to the machine to make a decision to execute a proper state. The transition of Locking and Unlocking state was given in a block diagram below.

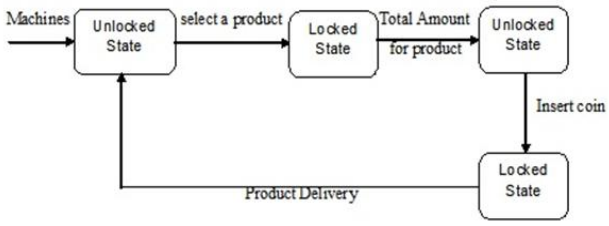

Fig. 4.2 Locked and Unlocked Transition

The whole procedure can be easily explained with the help of Transition diagram. The transition diagram for both FSM is same because the procedure is same.

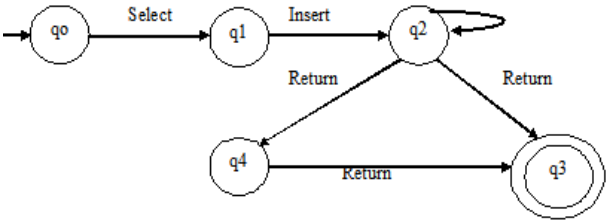

Fig. 4.3 Transition diagram of methodology

The above figure has different states having different weight age of every state and has different effect on the methodology during transition.

- q0 - Start state.
- q1 - Product
- q2 - Coin
- q3 - Selected product Delivered
- q4 - Remaining coins

The above states describe the detail of transition of whole procedure, states were denoted by circle and transitions between the states are denoted by row Here q0 is starting state which is in Unlocked state and the vendor will choose the product at this same time the state goes to Locked state i.e q1. The total amount is calculated internally and state goes to Unlocked state. Now the vendee will insert the desired amount for that product which he/she selected. Here the state will change q1 to q2. In state q2 there is a self loop which shows the vendee can insert the coin again if it does not match to the desired amount since the machine is having COINCOUNT.

5. RESULTS

The best part of using this simulator is that for the designer need not set the Waveforms; this facility is already been present in this software. The designer only needs to click Simulate Behavioural Model. The designed machine can be used for many applications and we can easily enhance the number of selections. The machine 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 machine

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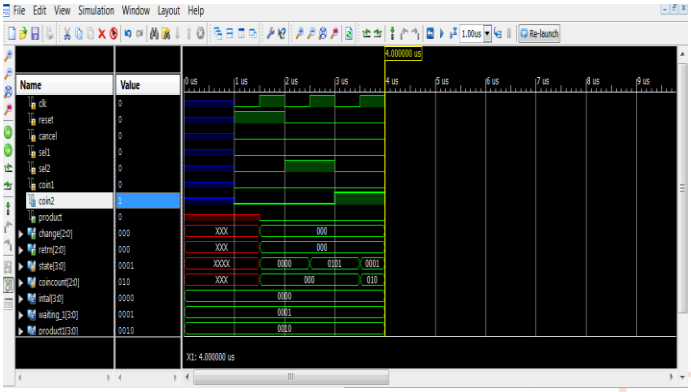

Fig.5.1. Snapshot showing waveform in Mealy machine

Above Fig show the deliverance of output after selection of product and insertion coins in Mealy machine.

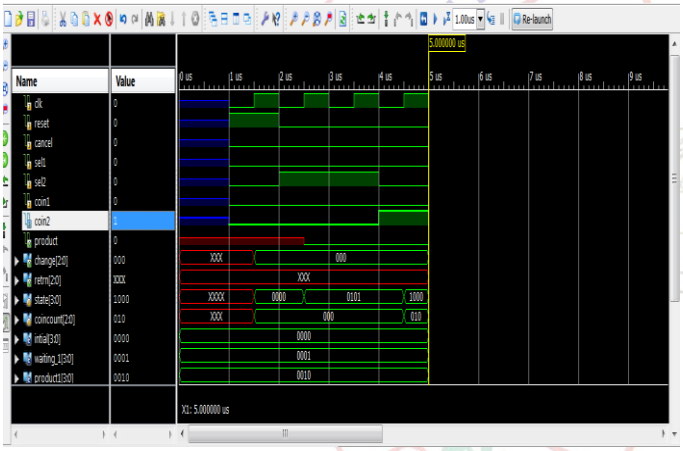

Fig.5.2 Snapshot showing waveform in Moore machine

Above Fig show the deliverance of output after selection of product and insertion coins in Moore machine.

During the execution of the whole procedure the insertion of coin will be cancel if the user does not want to selected product as output. The procedure is undoubtedly seen in each figure of result analysis. Each figure shows different execution of steps. And after that the entire user will get the desired product as output. The procedure is little bit lengthy as it was simulated but will give the desired output.

6. CONCLUSION

The analysis revealed several weaknesses in the existing user interface of automated machine and a number of improvements based on the proposed design heuristics were suggested. The resulting user interface would be more robust, more tolerant to user mistakes, more intuitive and efficient to use. The objective in this thesis is to weigh up the product supply procedure to diminish functional expenses and afford an optimum or close to best possible delivery management solutions for the vendors and as well as developers. Mealy concept based automated machine algorithm is very flexible and reliable for the developers so that they can easily develop the algorithm for large number of products and coins of different denominations at low cost as compared to other FSM's. As this discussed in above chapter that Mealy give n output for n input where as the Moore give n+1 output for n input. So it is clear that Moore took more time to execute since it goes to initial state to validate the output is correct or not, for producing desired output.

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