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# Simulating and Optimizing the Response of a Sine Wave Finite state Machine with Timestamp Simulation Using Simulink

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**ABSTRACT –**

*Objective - we have been using sine wave functions from our high school calculus.*

*Simulation is a integral part of anyone's life now. We will program in simulink to see how can we simulate a sine wave and obtain a optimized wave. Also we will see how can we change the initial conditions of our parameters in simulation on the run. Secondly we will build a finite state machine that will show a tradeoff between position and velocity using sine wave. It is encountered with many usual problems. We will fix those problems using simulation in simulink at small intervals of time.*

## CHAPTER – 1

## INTRODUCTION

### 1. Finite State System

An FSM can be represented by a state transition diagram, a directed graph whose vertices correspond to the states of the machine and whose edges correspond to the state transitions; each edge is labeled with the input and output associated with the transition. Suppose that the machine is currently in state 1. Upon input b, the machine moves to states 2 and output 1. Equivalently, an FSM can be represented by a state table with one row for each state and one column for each input symbol (Gillespie, 2008). For a combination of a present state and input symbol, the corresponding entry in the table specifies the next state and output. A state machine represents a system as a set of states, the transitions between them, along with the associated inputs and outputs. So, a state machine is a particular conceptualization of a particular sequential circuit. State machines can be used for many other things beyond logic design and computer architecture. (Hasheim, 2012) Any Circuit with memory is a Finite State Machine. Even computers can be viewed as huge FSMs. Design of FSMs Involves: Defining states, Defining transitions between states, Optimization /Minimization. (Hasheim, 2012)

**State Diagram**

Illustrates the form and function of a state machine. Usually drawn as a bubble-and-arrow diagram.

**State**

A uniquely identifiable set of values measured at various points in a digital system. (Kumar, 2013)

**Next State**

The state to which the state machine makes the next transition, determined by the inputs present when the device is clocked.

**Branch**

A change from present state to next state.(Kumar, 2013)

**Mealy Machine**

A state machine that determines its outputs from the present state and from the inputs.

**Moore Machine**

A state machine that determines its outputs from the present state only. (Singh et. al., 2012)

On a well-drawn state diagram, all possible transitions will be visible, including loops back to the same state. From this diagram it can be deduced that if the present state is State 5, then the previous state was either State 4 or 5 and the next state must be either 5, 6, or 7. .(Singh et. al., 2012)

**Moore and Mealy Machines**

Both these machine types follow the basic characteristics of state machines, but differ in the way that outputs are produced. (Kumar, 2013)

**Moore Machine**
Outputs are independent of the inputs, i.e. outputs are effectively produced from within the state of the state machine. (Kumar, 2013)

**Mealy Machine**
Outputs can be determined by the present state alone, or by the present state and the present inputs, i.e. outputs are produced as the machine makes a transition from one state to another. (Aljeaid et. al., 2014)

**SIMULATION -** The component-based approach is an important design principle in software and systems engineering. In order to document, specify, validate, or verify components, various formalisms that capture behavioral aspects of component interfaces have been proposed. These formalisms capture assumptions on the inputs and their order, and guarantees on the outputs and their order. (Hasheim, 2012) For closed systems (which do not interact with the environment via inputs or outputs), a natural notion of refinement is given by the simulation preorder. For open systems, which expect inputs and provide outputs, the corresponding notion is given by the alternating simulation preorder. (Ivan et. Al., 2011) Under alternating simulation, an interface A is refined by an interface B if, after any given sequence of inputs and outputs, B accepts all inputs that A accepts, and B provides only outputs that A provides. (Hasheim, 2012) The alternating simulation preorder is a Boolean notion. Interface A either is refined by interface B, or it is not. However, there are various reasons for which the alternating simulation can fail, and one can make quantitative distinctions between these reasons. For instance, if B does not accept an input that A accepts (or provides an output that A does not provide) at every step, then B is more different from A than an interface that makes a mistake once, or at least not as often as B. (Cerny et al., 2000)

**CHAPTER - 2**

**LITERATURE SURVEY -**

**WORK DONE BY DIFFERENT RESEARCHERS ON FINITE STATE MACHINE AND SIMULATION IN PREVIOUS YEARS**

| RESEARCHER | OBJECTIVE | METHODOLOGY | RESULT |
|---|---|---|---|
| Stewart Robinson, (1993) | Discusses simulation, its benefits and the range of manufacturing issues to which it can be applied. | A case study | Improve work organization and determine human resource requirements. |
| Horta-Rangel et al. (2008) | The study of pressure-volume-temperature (PVT) process is necessary to understand the physical behavior of materials. This paper seeks to | Software Analysis. | This simulation procedure allows one in a simple way to vary the properties and |

| | | | |
|---|---|---|---|
| | develop a simulation procedure to predict phase behavior. | | characteristics of the sample. This makes the computer simulation a useful tool together with the experimental test, in the development of novel materials. |
| R.A. Proctor, (1991) | Development in micro computer software packages is examined as they impinge on the area of creative problem solving in business. I | Computer modeling | A review is provided of different computer aids to creative problem solving and an overview is given of the different approaches to management games. Many of the different kinds of management game are amenable to computerization. |
| Dolęga et al. (2012) | To enable the correct selection of the radiofrequency thermal ablation (RFTA) process parameters for an individual patient by applying a computer modeling of RFTA. | professional package of *FLUX3D* to generate the geometric models | The computational results show that the RFTA algorithm is effective in solving this practical problem. The computational results show that the selection of the type of electrodes used in the RFTA |

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| | | | |
|---|---|---|---|
| | | | process is as important as the correct selection of the process parameters, i.e. voltage and frequency. |
| G. Southern, (1986) | Demonstrates the techniques of CAPM by means of manual simulation. | Computer simulation model | the CAPM system is presently installed on the ACT Sirius and the IBM personal microcomputers. It consists of a series of basic programs and data files in four modules. There is wide scope for using both versions in degree courses in mechanical and production engineering and production management. |
| Brian Leaned, (1993) | Provides an introduction to simulation, and discusses the use of a modern simulation environment. | simulation tools | The gap is even further reduced if the manager understands something of simulation terminology and methods. simulation is a tool which can aid |

| | | | |
|---|---|---|---|
| | | | managers in policy making and decision making. |
| McWaters et al. (1994) | Describes how simulations were executed for all combinations of eight fabrics and three contact surfaces, and presents the experimental results obtained for similar conditions and fabrics. | Computer simulation model | Proves the validity of the computer model by comparing the experimental results with those obtained by simulation. Describes how the computer model could be used to choose the optimum diameter of a fabric feeder picking roller. |

## CHAPTER -3

## PAPER OBJECTIVES

Finite state machine response is simulated for corresponding sine wave also simulating the working by simulation using Simulink and Mat lab.

Finite state performance is simulated using simulation in Simulink.

## CHAPTER – 4

## METHODOLOGY

1. Building a simulation interface for sine wave with appropriate multiplexer and integrator using simulink as a tool.
2. Obtaining the curve for sine wave corresponding to random values as input.
3. Varying parameters of simulator on the go.
4. Generating a chart as output of the integrator
5. Designing a state flow structure in the chart using 3 different states.
6. Designing the tradeoff between 2 basic parameters in the chart.
7. Analyzing the output of finite state machine
8. Output showed when position symbol becomes positive output does not go to 1.
9. This is called simulation overstepping the critical time instant.
10. Removing the problem using simulink
11. Obtaining the output curve again at different small intervals of time.
12. Thus the Problem is fixed, Output goes to 1 as soon as position becomes positive. Optimizing system performance.

## CHAPTER – 5

## RESULT AND CONCLUSION

1. Here we have build a model for simulation of continuous sine wave. We are studying how a sine function respnds when simulated in simulink. Structure is shown in figure 2

2. When we run this model for time t = 10 units we get the output shown in figure 3

3. Here yellow curve = Velocity sine wave
4. pink curve = Position waveform (Integral form of velocity sine wave).

5. Now here is an error. Position wave which is obtained by integrating velocity sine wave is starting from point zero.

6. We know integral of sine starts from -1 rather than 0.

7. We can model this error by using simulink. Which gives the corrected output as shown in figure 4

8. Figure 4 shows Position waveform starting from -1 rather then 0.

9. Using the existing system shown in figure f1 we will now build a velocity – position finite state machine and chart as shown in figure 5 and 6

10. Figure 5 shows Model for implementing position – velocity finite state machine

11. Figure 6 shows Finite state chart used in the model shown in figure f4

12. Now when we run the above velocity position finite state machine for time units t = 10.0 we get the output shown in figure 7

## CHAPTER -6
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**FIGURES USED IN THE PAPER**

| CONDITION/STATE | STATE 1 | STATE 2 | … | STATE i | … | STATE p |
|---|---|---|---|---|---|---|
| CONDITION 1 | | | | | | |
| CONDITION 2 | | STATE 3 | | | | |
| …. | | | | | | |
| CONDITION j | | | | STATE K | | |
| …. | | | | | | |
| CONDITION m | | | | | | |

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**FIGURE 1 - The state diagram for a finite state machine**

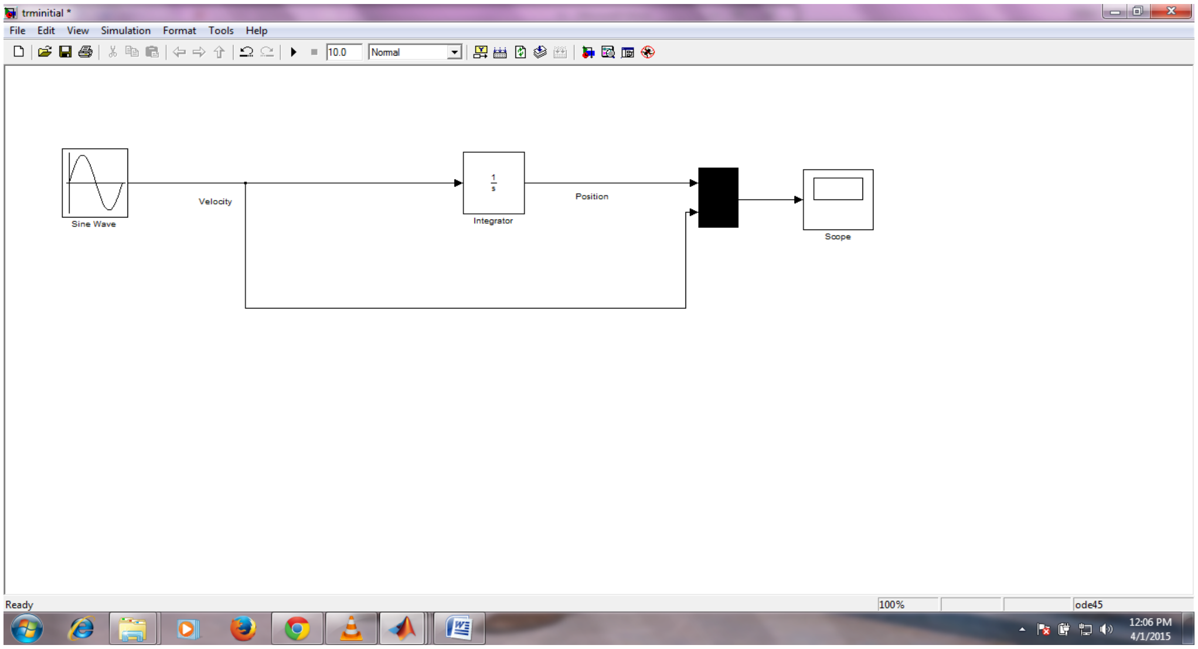


**FIGURE 2**

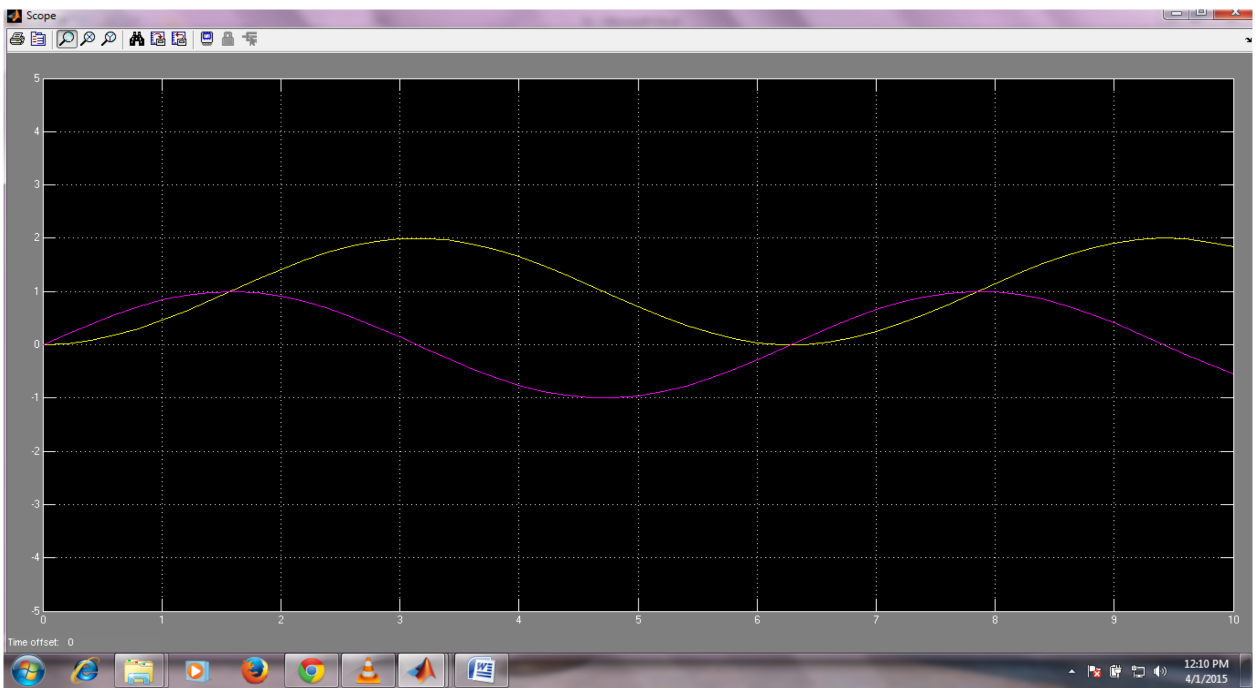


**FIGURE 3**

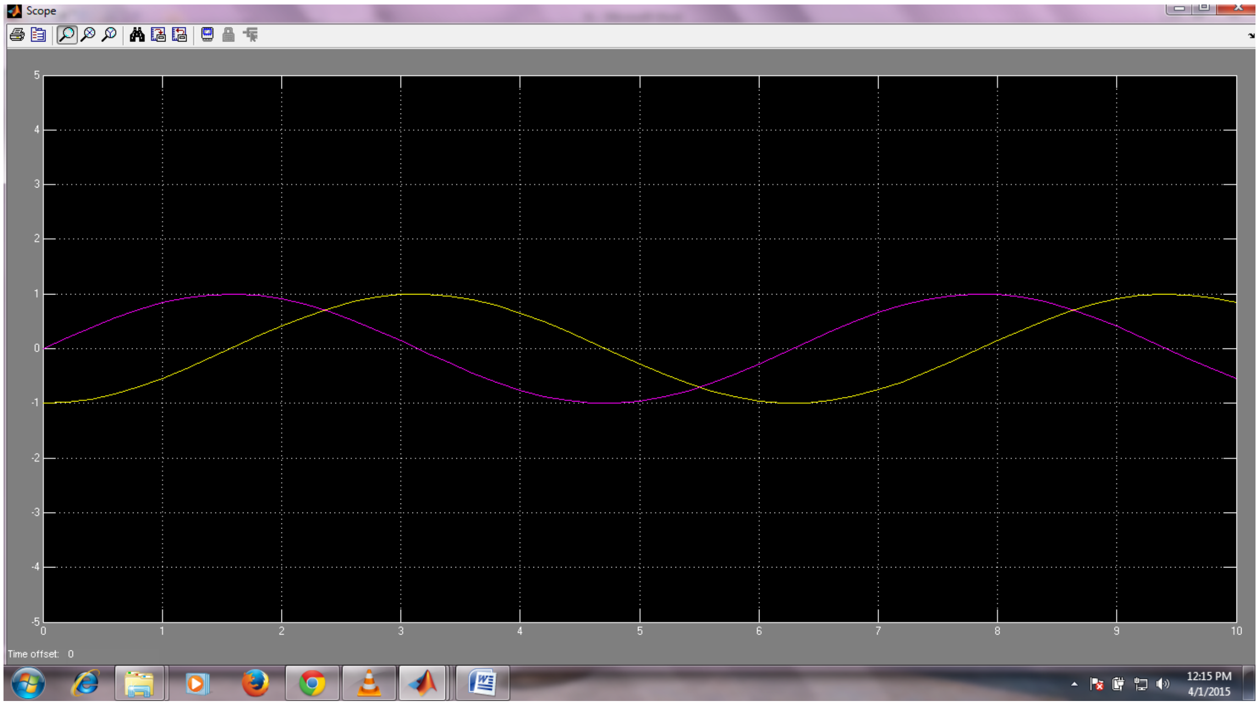


**FIGURE 4**

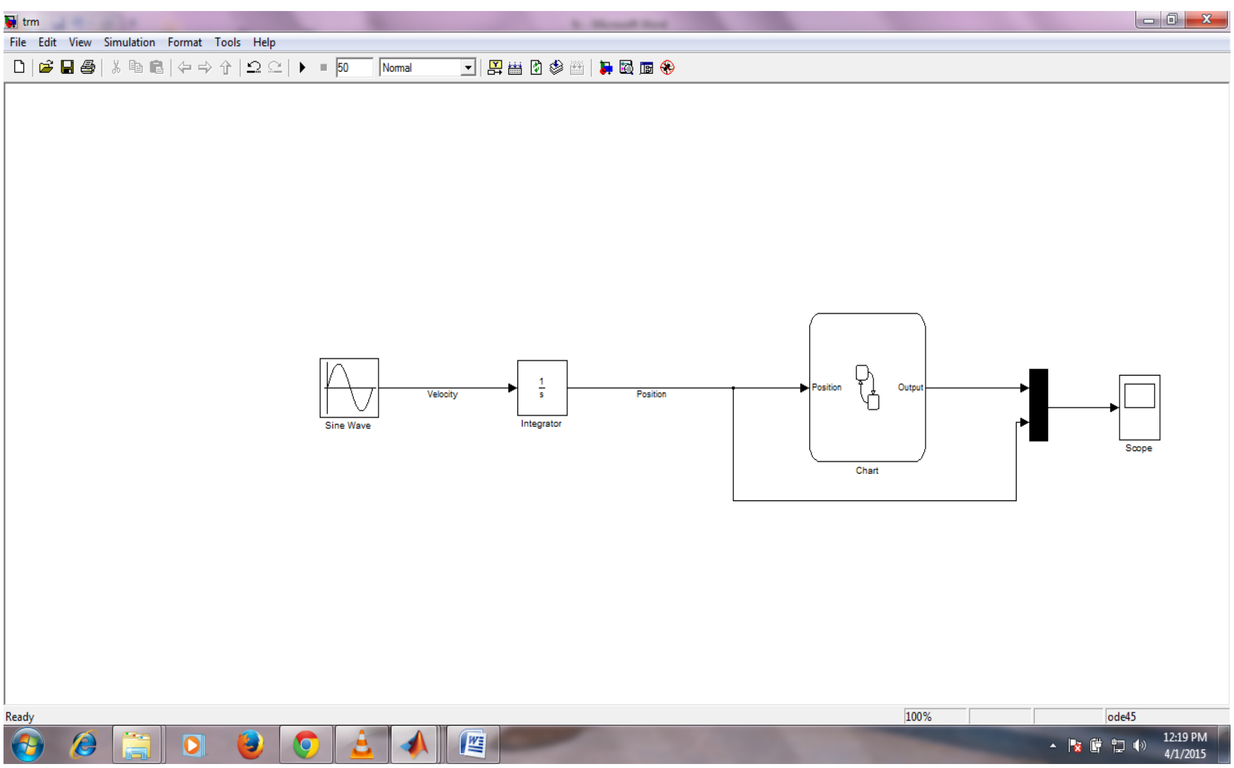


**FIGURE 5**

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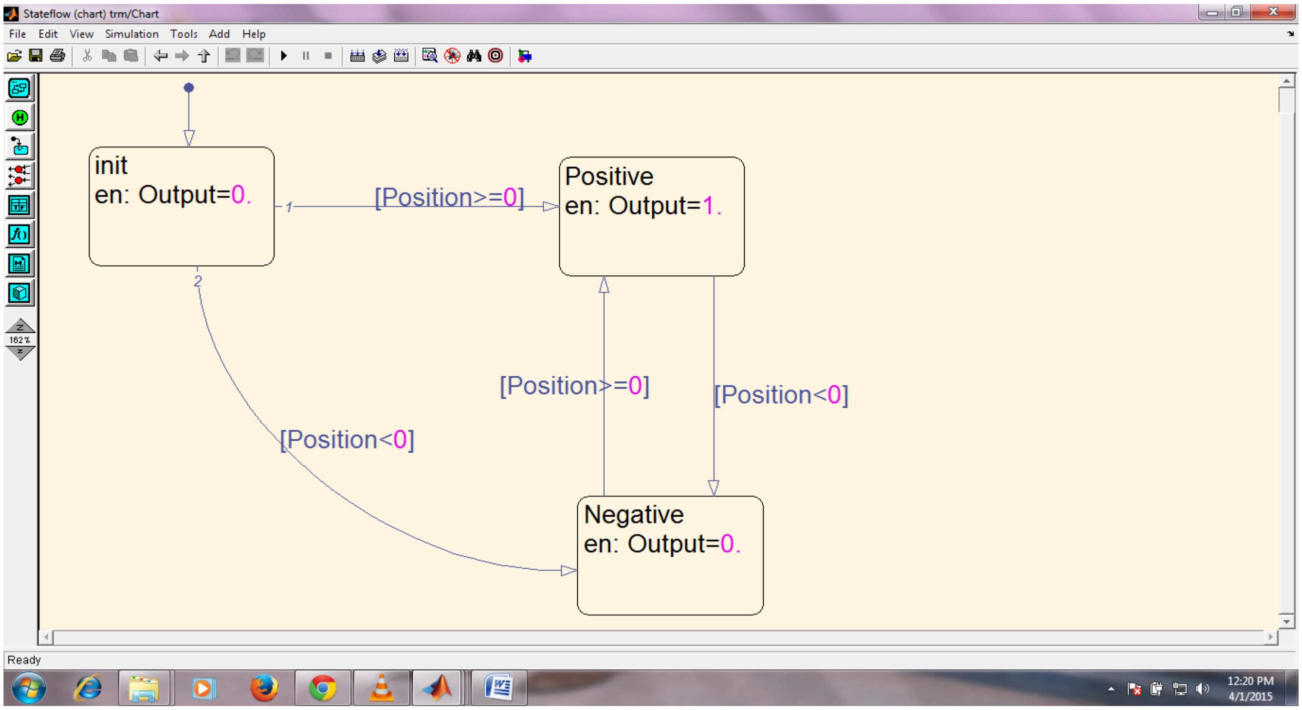


**FIGURE 6**

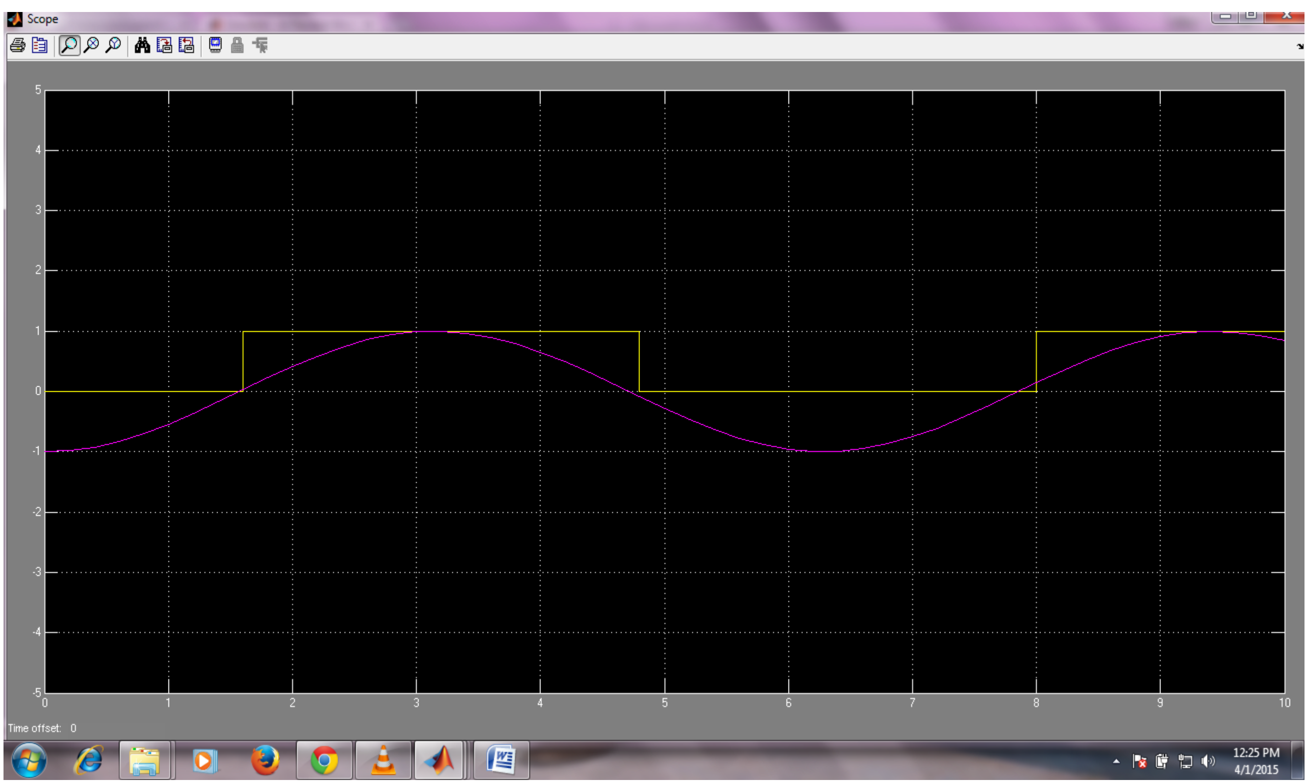


**Figure 7 – Final Velocity – Position finite state machine**