

# Portable Washing Machine

## Using VHDL

[Madhav Mehta, Rownaz Haque]

**Abstract**— Portable washing machine is a handy washing machine that can be used for traveling whether the laundry facilities are available or not. The coding has been done for an integrated circuit(IC) by ASIC approach using VHDL. It is a single tub wash cum dry Portable Automatic Washing Machine. The total weight is 12Kg, the height is 0.75 meters and radius is 0.31 meters. This is 1/3<sup>rd</sup> the weight of Washing Machine that are available in the market. Power consumption in a portable washing machine is minimized using the ASIC approach. As, the transistor size is decreasing day by day. So, the power consumption will also be really less. We have shown the simulations on the basis of the type of fabric being washed. If washing is enabled then user selects the cloth. Cotton, Woolen, Denim and Mixed (different fabrics washed together) are type of clothes that can be put in the washing machine.

**Keywords**— Portable, ASIC, VHDL, Wash, Spin

### I. Introduction

Portable Washing Machine (PWM) as the name says, it is an automatic handy machine that washes as well as dries our clothes in an easy manner. The machine can be carried to different places, like a suitcase and is especially for people who travel a lot and do not get laundry facilities everywhere. Currently a washing machine that follows an ASIC (Application Specific Integrated Circuit) approach and is also portable in nature is not available in market extensively. [3] It is modeled from the system level to the transistor level. Embedded System or VLSI Design, all lead to only one solution that is an ASIC.

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the cloth. Cotton, Woolen, Denim and Mixed (different fabrics washed together) are type of clothes that can be put in the washing machine. These are the few modes that are commonly used in day to day life. If spin is enabled by the user then the drain valve opens and the water drains out enabling the spin cycle.<sup>[4]</sup>

### II. Description

#### A. Algorithm

We have followed the VHDL approach for designing an IC. The basic cycles to choose are the Normal, Medium, and Heavy. Each cycle is dependent upon the amount of dirt which is there on the clothes. By some predefined or fixed values that we have set, the code is made accordingly. We have determined the size of the machine, a size that can be carried to different places. The size of this machine is about 0.75 meters. The maximum amount of water that can come in the tub is 30 kg's. By these calculations we determine the type of motor that can be used. This is shown in the calculation part.

The following block diagram shown below<sup>[3]</sup>

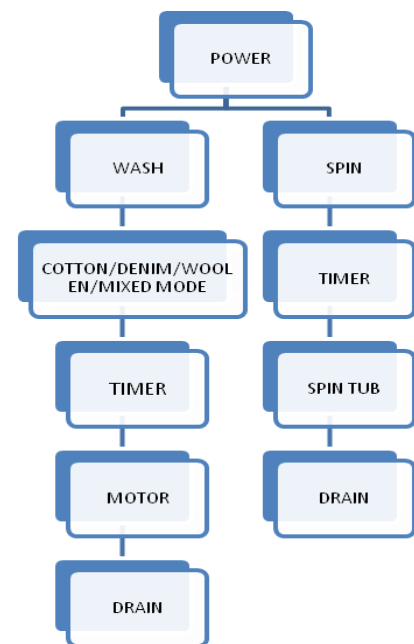


Figure 1: Algorithm to be followed

When the power is turned on, the user chooses the operation to be performed. In wash, the cycle is to be selected is Cotton, Denim, Woolen, and Mixed mode. In Spin mode the rotation is one sided only. The drum also rotates and by the centrifugal force it forces the water out of the tubs. Side by side the drain valve is controlled and is opened at the time of spin, to drain out the water.

The machine architecture describes the coding to be done in VHDL. We will start with the architecture and end with the code part.

### B. Machine Architecture

The body of portable washing machine has to be designed in such a way that while maintaining portability it should carry out its desired function that is washing and drying. The figure shows the overall architecture to implement and to check the ASIC design (front end part).<sup>[6]</sup>

The description of the above figure is as follows:

- **FPGA Board:** A field-programmable gate array (FPGA) is an integrated circuit designed to be configured by a customer or a designer after manufacturing—hence "field-programmable". The FPGA configuration is generally specified using a hardware description language (HDL) which is VHDL in our case. We have used Basys2 FPGA board.<sup>[1]</sup>
- **R1, R2:** These are the relays for controlling the motor. They work on 6V and pass 220V.
- **Motor:** The motor we have used is a single phase capacitor start induction motor. Since a capacitor is used the polarity is changed by connecting the ground to any of the two terminals.
- **Drain motor:** It is an ac motor which works on ac mains. This motor is used to set the drain valve and clutch arrangement free for letting the spin mode take over washing mode in the washing machine.

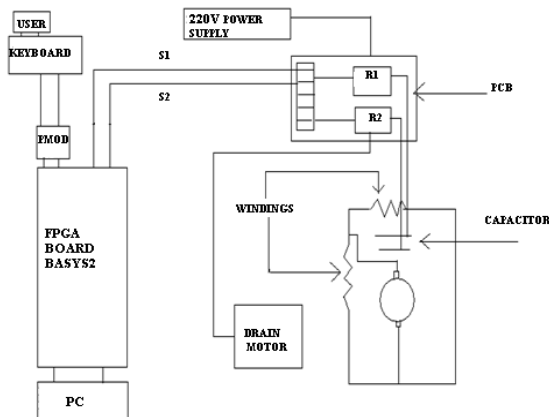


Figure 2: Block diagram

### C. Base Arrangement Of Portable Washing Machine

For a single tub washing machine a gear-clutch arrangement is required with the help of which the washing machine can be run either on the wash mode or spin mode. This is very important as during wash cycle only the rotation of pulsator is required whereas during spin cycle the whole inner drum is rotated at high speed.

The following figure shows the gear-clutch arrangement:

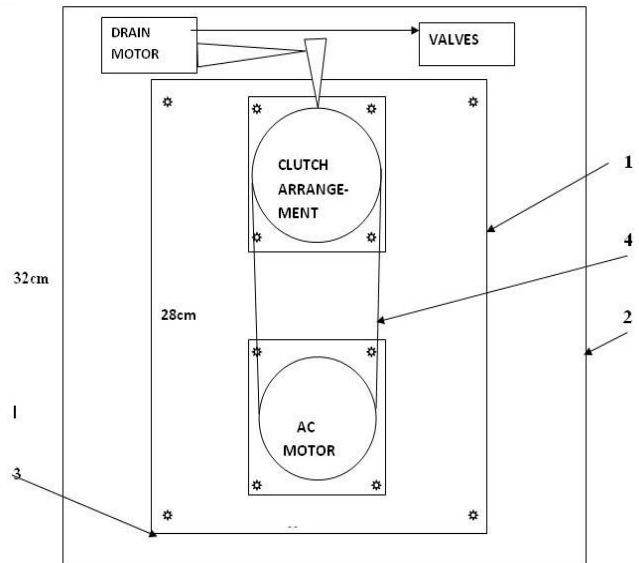


Figure 3: Base Arrangement of Portable Washing Machine

The various parts numbered in the figure are as follows:

1. Metallic Base
2. Outlined area
3. Nut
4. Belt

### D. Body design

A suspension system is required to provide support to the inner tub. The pulsator is within the inner tub and rotates during the wash cycle in both directions alternatively. The inner tub is contained within the outer tub. During the spin cycle, the gear clutch-system comes into action and brings the whole inner tub into contact with the motor. During spin mode of portable washing machine, with the help of speed control circuitry the speed of motor is increased. Thus the inner tub, which is now in full contact with motor, rotates at a very high speed thus providing a spin action.

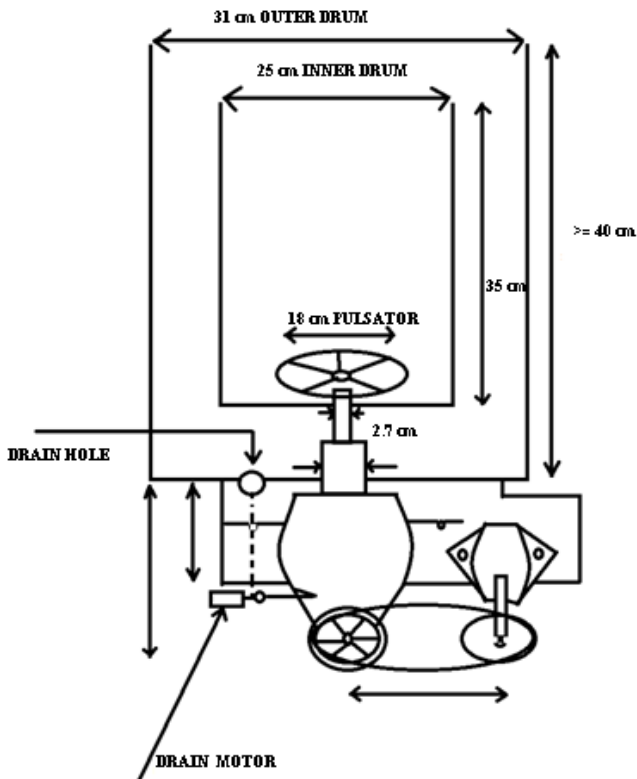


Figure .4. Machine architecture

### III. Results

Simulations based on the VHDL coding are as follows:

#### 1. Type of cycle to be selected

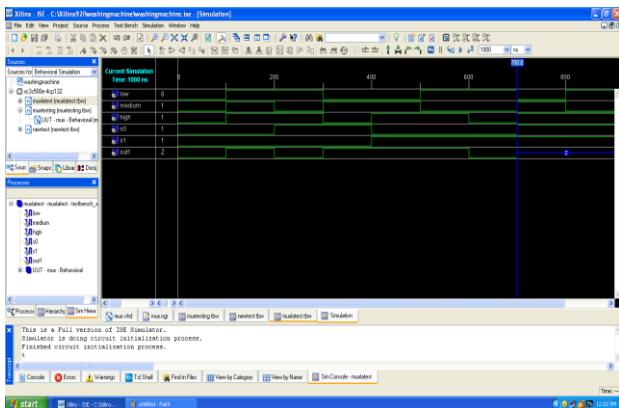


Figure 5: Selecting type of cycle

The adjacent figure describes the type of cycle to be selected. Whether a low, medium or a heavy wash cycle; the operation is performed accordingly. [2]

#### 2. Timer for 1 minute

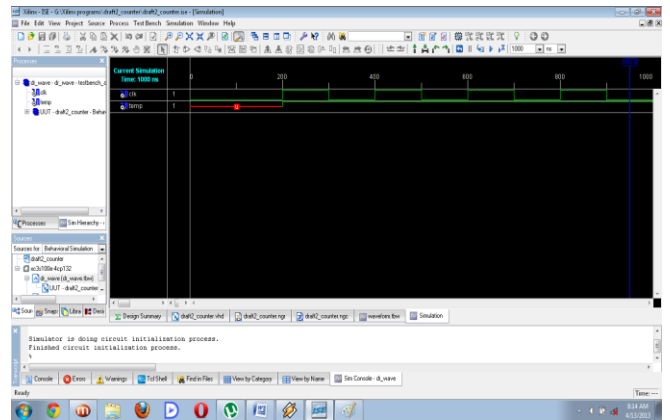


Figure 6: Shows the output signal is high whenever the timer runs i.e. a signal comes out.

#### 3. Main Module

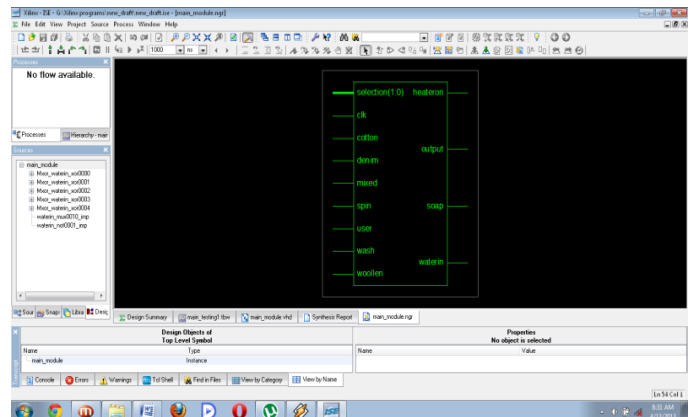


Figure 7: Shows the main module I/Os

Simulations 1 and 2 are obvious and are self explanatory in the case of timer. Simulation 3 is explained as follows:

When the user inputs the clothes, their weight is sensed and an input is taken by the user about the type of cloth and the amount of water enters accordingly. The soap content is determined by the amount of water and the type of cloth that is being input by the user. Then the temperature of the water is sensed and is changed accordingly. The change of cycle that is the normal, medium and heavy are automatically set by the programming flexibility. [7]

## IV. Conclusion

A washing machine that can be carried along is something in itself. The aim of this paper is to have washing machines that can be carried to different places that is showing portability. Power consumption by the ASIC approach is also minimised. We have followed the front end approach from system to the transistor level. We also know that the transistor size is decreasing day by day therefore reducing the power consumed by each transistor. Battery is another example that can be put if the consumption is minimised.

## V. Future Works

The main module simulation when combined in the hardware is something that we would like to continue in the future. Sensing the amount of dirt available in the cloth and then taking the appropriate action, also determining the type of dirt, whether an oil bond is there, grease or muddy cloth. We haven't determined the type of dirt till now to perform the appropriate action. By determining it we can moreover increase the quality of wash.

## Acknowledgment

We would like to thank our Head of Department Mr Mukesh Pathela for his guidance and constant support in writing this paper. We would also thank Prof. Vishal Ramola, Uttarakhand Technical University for giving us the path to follow while working on this paper. Mr. Arun Balodi, currently a research scholar in IIT Roorkee for his guidance. Mr. Rohan Raj head ECE, MIT for correcting the paper. We want to thank UACEE, IRED, Uttarakhand Technical University and SCE for giving us a platform in presenting the advancement in Electronics Engineering.

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