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Modern Day Washing Machine

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***Abstract*: This paper presents an overview on modern day washing machines.**

***Keywords*: washing machine**

1. Introduction

Washing machine is a machine that quickly washes clothes, linens and other items. Shown below is one of the earliest washing machines which was manual and imitated the motion of the human hand on the washboard, by using a lever to move one curved surface over another and rubbing clothes between the two ribbed surfaces.

The rapid advancement in technology has given rise to the fully automatic washing machine which is widely used in the present day. These machines have thousands of components and are much sophisticated and user-friendly than the ones used at early stages of development. The main purpose of this report is to discuss the functionality, raw materials and their life cycles of the Fisher & Paykel Eco Smart GWL10 washing machine. Major concerns with these life Cycles from a sustainability perspective and possibilities of increasing efficiency of the machine are determined followed by a discussion on how a service could be used to replace the product and foreseeable advantages and problems encountered in implementing such a scheme.

A. Functionality of the Machine

The Eco Smart GWL10 is a fully automatic washing machine that has a separate set of controls to determine all of its operations. User can choose whether the machine should use hot, warm or cold water during its wash and rinse cycles, set controls to select the length of washing and rinsing time and also the amount of water entering the machine by selecting the load size. Water enters the machine through hoses connected to household cold water pipes and need not be connected to a separate hot water line since it's got a built-in electric heating system.

Fig. 1. The Fisher and Paykel Eco smart GWL10 washing machine [3]

Once the wash and spin cycles are completed an alarm beeps to let the user know that the laundry is ready to be taken out and further dried. This allows the user to attend to other work while the laundry's being done instead of monitoring the whole process. If unattended for more than 5 minutes' power is cut off automatically thus saving energy. Some of the main functions of the Eco Smart GWL10 washing machine can be listed as follows.

- Minimum water level uses only 14 gallons to further conserve water compared to the 18 gallons used by most other washing machines.
- Three cubic feet washing capacity helps to wash large sized loads up to 17lbs.
- This machine has five different water temperatures and sensors for accurate temperature control. This provides greater care for clothes containing raw materials such as silk and wool which require delicate handling.
- The 1000-rpm spin speed helps to dry the laundry in a quick and an efficient manner.

B. How efficiency of the product can be improved

Fisher & Paykel Eco Smart GWL10 washing machine has been named as the America's most energy efficient washer for this year and awarded 5 stars by The Consortium of Energy Efficiency, which rates washing machines in the market on three main factors, Energy Factor, Water Factor and Remaining Moisture Content. Although it is very efficient compared to most other washers, its efficiency can be further improved by following means. Even though this machine is a top loader, it

does not fill up completely with water. It mimics a front loader and uses up to 40% less water than a regular top loader but further research on the machine has shown that this could be increased up to 50%. This difference would mean less water and energy consumption.

The current, maximum spin cycle of the machine runs at 1000 rpm. This can further be increased using more efficient motors reducing drying time as well as energy costs by up to 30% when compared with the present maximum spin speed. The spin cycle generally makes a loud noise at the beginning. This is due to considerably high friction between the agitator and the stainless-steel shaft connected directly to the brush-less DC motor. Introducing alternative materials with less friction could help to overcome this situation and keep noise levels at a minimum. How a service can be used to replace the washing machine.

The many advantages the washing machine has provided to the society are beyond controversy. Yet the social and environmental hazards caused during manufacture, processing, fabrication and other stages of the machine cannot be ignored by any standards. Therefore, it is quite important that these impacts be mitigated while achieving the human requirements.

Pickup and delivery type laundry services are already in existence although not widely used. Collecting dirty laundry on a regular basis, washing, drying and ironing them and then returning to the owners is how such a service generally functions. Laundry is placed in a separate bag with appropriate user identification methods to avoid mix up of clothes between different users.

When many domestic washing machines are in use, the energy, water and resource consumption would be much greater than using a few machines with higher washing capacity. Therefore, if the government can make agreements with companies to provide a laundry service where laundry will be collected once a week, washed, dried and ironed and then returned after a fixed number of days, a great amount of resources can be saved and energy and water consumptions minimized. A fixed rate should be introduced for a fixed volume or number of clothes so that it would be a service to the community rather than a business. It would also avoid competition between service providers.

C. Advantages of this service

The washing machines used by the service providers will need to be designed with larger washing capacities. Since a fewer number of washing machines would be required compared to the many domestic washing machines used at present, there will be a reduction in metals and other raw materials used in the manufacturing process. More clothes will be washed in one cycle thus reducing amount of water and energy consumed. For example, washing machines X and Y will consume more water and energy than a larger washing machine used with the combined loads of X and Y.

Waste water from the service providing companies will be easy to analyse, treat, purify and recycle since major contamination constituents would be quite similar unlike from different households. For example, waste water from a household could come from many places and activities such as toilets, kitchen, washing, shower and so on contributing to a mixture of constituents making purification and treatment harder processes.

D. Foreseeable problems in implementing the service

The major concern would be the reluctance shown by washing machine manufacturing companies. The present designs will need to be redesigned to accommodate larger washing capacities while maintaining low water and energy inputs. Such redesigning processes could be quite costly and time consuming.

Implementing this service on a large scale would not be quite feasible while domestic washing machines are in use. Domestic washers will need to be collected though an organized scheme so that they can be disassembled and possible parts reused and recycled.

A special way of identifying clothes will be required since clothes from many households will be washed in the same cycle. An organized code system is recommended in this regard.

Working out a reasonable load per household could be quite a task since it depends on many factors such as number of people living, season of the year, age of inhabitant and hygiene practices of the people. This will need to be pre-determined using an appropriate methodology.

2. Description

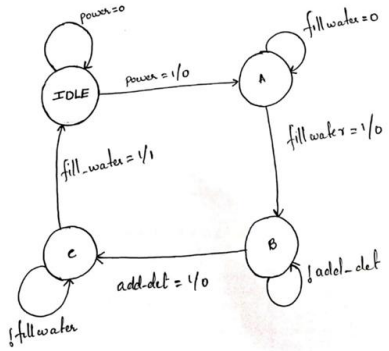

Fig. 2. FSM of simple washing machine

In this FSM, there are 4 states:

1. "IDLE" state: It is the state when the machine is doing nothing and is idle. In "idle" state, if power button is "on" then the state transition takes place from state "idle" to state "A" and the output is low. If power button is "off ", then the state remains in "idle".
2. "A" state: In state "A", if fill_water is 1(that is if the water gets filled) then the state moves to state "B" otherwise it remains in state "B".
3. "B" state: It is the wash state of the machine. In "B"

state, if add_det = 1(that is if the detergent is added) then the state moves to state "C" otherwise remain at state "B".

4. "C" state: It is the rinse state of the machine. In "C" state, if the water is filled that is if fill_water = 1, then the process gets completed and the state returns back to its idle state and the output is 1. Otherwise it remains in state "C".

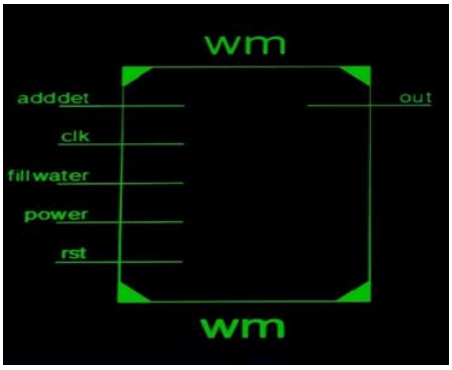

Fig. 3. RTL view

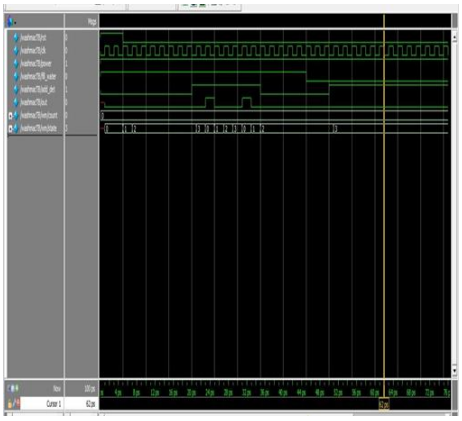

Fig. 4. Simulation waveform

3. Future scope

The historically laborious process of washing clothes has at times been labelled woman's work. The spread of the washing machine has been seen to be force behind the improvement of woman's position in society. Mostly, washing machines just automate the same process of clothes.

4. Conclusion

The washing machine has greatly influenced people's life styles by providing easy means of washing clothes and drying them out to a considerable extent. It not only saves time and amount of water used but also helps the user to wash and dry clothes with a lot of ease due to its fully automatic nature. Most of the raw materials used in the manufacturing process of the washing machine have unacceptable social and environmental impacts in their life cycles. Therefore, it is quite important to mitigate these effects and also look at other possible alternative materials while achieving the functionality of the product.

Due to the many drawbacks in various stages of washing machine manufacture, alternative options of washing need to be looked at. A service can be provided where dirty laundry will be collected on a weekly basis, washed, dried, ironed and then returned to users amidst some feasibility problems. It is believed that by providing such a central service, material use and water and energy consumption patterns could be minimized to a great extent. Although implementation of such a service could be a daunting task at present, it could be one of the few available options to maximize the use of limited amount of resources available and save them for the future.

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