

Converting Malfunctioned Fully Automatic (Electro-Mechanical Driven) to Semiautomatic Washing Machine

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ABSTRACT

This study converted a damaged fully automatic washing machine into a semi-automatic washing machine. Conversion of the machine was done due to unavailability of its electronic spare parts in the local market and to recycle the equipment. Thus, the study explored the conversion the washing machine that can be shared to the local technician to enhance their knowledge, skills and minimize environmental waste. It involved dismantling and rewiring, identifying the terminal leads of the motors, and testing recycled parts. Replacement of unserviceable part was done to turn into operation the said machine. Findings disclosed that the automatic washing machine converted into a semi-automatic have the similar operation cycles.

The only difference between the two washing machines was the controls and sequence of washing. In semiautomatic washing machine, it requires human intervention to control and to add and drain water. Cost incurred in converting the malfunction automatic washing machine into a semi-automatic function was much cheaper than buying a brand new one.

Keywords: Discarded Electronics, Washing Machine, Semi-Automatic, Vigan City, Ilocos Sur, Philippines

INTRODUCTION

Washing clothes have been a long-time practised by people across the globe to keep oneself tidy. Thousands of years, people washed their clothes by beating them against wood and rocks or by using their own hands which somehow a primitive approach. However, over the years, the primitive way of washing clothes had been changed. The development of advanced technologies or state-of-the-art facilities are now made available to people such as the use of washing machine. Technologies make life of many individuals very easy when doing certain job such as washing of clothes.

The development of commercial laundry machine started way back in the 1850's. After that, several brands of washing machines came to market. Improvements in washing technology came very fast. Part of inventor's development was the washing and wringing machine. The machine was semi-automatic to fully automatic electromechanical or microcontrollers made up the cartridge that programmed the different operation cycle. The technology of washing machine played an increasing important role in the world economy and not by households alone (Maxwell, 1982).

Washing machine is a term mostly applied only to machines that use water. It is different from dry cleaning which uses alternative cleaning fluids and is performed by specialist businesses or ultrasonic cleaners. Washing entails immersing, dipping, rubbing, or scrubbing in water accompanied by detergent or bleach. The simplest machines may agitate clothes in water while switched on. Automatic machines may fill, empty, wash, spin and heat in a cycle. Most washing machines remove substantial amounts of water from the laundry at the end of a wash cycle but do not completely dry clothes (Jefferson, 2013).

Stabber Industries released the system 2000 washing machine in 1994, which is the only top-loading, horizontal-axis washer to be manufactured in the United States. The hexagonal tub spins like a front-loading machine, only using about third of the water as conventional top-loaders. This factor has led to an Energy Star rating for its high efficiency.

On the other hand, James Dyson, a British inventor launched in 2000 the CRO1 Contra Rotator, a type of washing machine with two cylinders rotating in opposite directions. It was claimed that this design reduced the wash time and produced cleaner washing than a single cylinder machine. In 2004, there was the launch of the CRO2, which was the first washing machine to gain the British Allergy Foundation Seal of Approval. However, neither of the “ContraRotator” machines are now in production as they were too expensive to manufacture (Jefferson, 2013).

Moreover, Boscolo and Stebili (1980) and Cheng et al. (2001) had introduced a new sensing device and motor for washing machines. The new method proposed remote sensing of pressure inside the wash load of domestic washing machines via a wireless data acquisition system. Intelligent and fuzzy logic based controllers for washing machines were also successfully introduced since the 90s and quickly gained sizable market share

Top-loading electro-mechanical is a fully automatic washing machine. Automation is the use of control systems and information technologies to reduce the need for human work in the production of goods and services. Also, automation is a step beyond mechanization. It greatly helped human operators with less muscular requirements at work thus, automation greatly decreases the need for human sensory and mental requirements as well (Monroe, 2012).

Though automation plays an increasingly important role in the world's economy and daily experience, it has both advantages and disadvantages to the users. Advantages of automation include replacing human operators in tasks that involve hard physical or monotonous work and tasks done in a dangerous environment. Obviously, it performs tasks which are beyond human capabilities of size, weight, speed endurance and others therefore, an economy improves. However, automation or mechanization increased unemployment rate due to machines replacing humans and putting those humans out of their jobs, technical limitation, security threats or vulnerability, unpredictable development costs and high initial cost (Selsor, 2013).

At present, it is very tangible that Philippines is trying to be globally competitive but not yet fully advance when it comes to automation. Nevertheless, the use of technology is now adopted by many people both in rural and urban communities. But, using the technology gave problems to users like in the case of washing machine. If the equipment will be destroyed sometimes it becomes disposable due to unavailability of its spare parts in the local market. Thus, making equipment a garbage.

However, Filipinos are truly gifted as innovators that they have converted some technologies. It is because of the scarcity of resources, financial limitations they have or to increase and extend the usability of certain equipment. Conversion made includes

motorcycle into tricycle and a damaged rice cooker into a modified cooking stove using charcoal. The concept of conversion done by Filipinos is not just to improve or extend the functionality of a good or damaged equipment. It is also an opportunity to have a lucrative business as local entrepreneurs and earning income from what they are converting. Also, converting damage equipment into a useful one adheres the idea on recycle, reuse and at the same time reducing garbage in the community.

Inspired by the creativity and innovativeness of Filipinos, researchers conducted this study to find solutions to a malfunctioned electronic controlled top-loading washing machine. Further, conversions was done because of unavailability of its spare part in the local market. Hence, conversion of malfunctioned fully automatic washing machine into a semiautomatic operation was conducted.

OBJECTIVES OF THE STUDY

This study aims to look for a way to convert a malfunctioned fully automatic washing machine into a semiautomatic function. Primarily, to gain knowledge on how to convert the machine in order provide new knowledge and skills of a local technician the proper procedures through trainings. Also to inculcate among the concept of recycling, maintaining, repairing and converting washing machine to minimized environmental waste.

FRAMEWORK

The conceptual model showing the variables for the development of the project which guided this study is depicted below in the form of paradigm. The input includes the ideas on converting on design and developing fully automatic to semi- automatic washing machine, the billing of supplies and materials used, tools and equipment needed and alternative ideas from the study. The throughput involved the designing, developing, and rewiring the electrical connection of a washing machine utilizing old malfunctioned and discarded one.

The output of the study is the completed semi-automatic washing machine.

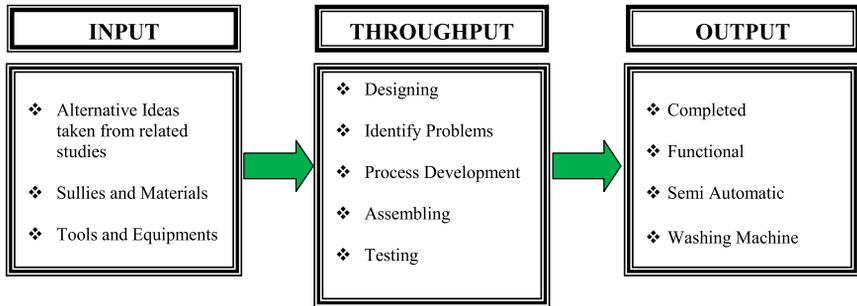


FIGURE 1

The study revolved around the paradigm

Related Literature

In 1998, the application of complex mechanical action as well as spinning during the wetting phase was considered to lead to a reduction of suds volume by 2-31 and to savings of 100 to 50 Wh per cycle (due to reduced heating).In 2005, the European Commission specifically considered the use of advanced motors as a good option to further improve the mechanical action (Faberi et al., 2007).

In 2005, 09% of all washing machines in the EU were expected to contain at least some sort of simple mechanical (friction or high pressure) shock absorbers. More sophisticated absorbers, capable of detecting an unbalance of the load, were applied to 5% of marketed machine (Faberi et al., 2007).

This development, it is even more important that washing machines also have a sensor capable of estimating the weight of the laundry load and which is able to automatically adjust programme duration, energy and water consumption accordingly. A half loaded machine would theoretically lead to a reduction of 50% of electricity and water consumption compared to a full load. Under real-world conditions, a reduction of about 15 to 20% can be achieved through load sensors. Load control features should be accompanied by an eye-catching visual indication in case of failure, to prevent full-load setting as default for long periods (Josephy et al., 2011)

Fully automatic electronics driven washing machine is the latest edition by technology. Manufacturer claim that it is blessed with easier operation methods and zero maintenance costs of its some of the advantages. More efficient and it can wash as well as dry simultaneously and is an excellent option for all those who have little time to spare for the washing purposes. It will transfer the clothes from the washer to dryer without any manual efforts.(Aqua, 2013).

Whirlpool Corporation introduced in 2001 the Calypso, the first vertical-axis high efficiency washing machine to be top-loading cleaning. A wash plate at the bottom nutated or has a special wobbling motion that bounce, shakes, and tosses the laundry around. Simultaneously, water containing detergent was sprayed on the laundry. The machine proved to be good at cleaning, but gained a bad reputation due to frequent breakdowns and destruction of laundry. The washer was recalled with a class-action lawsuit and pulled off the market (Tabler, 2012).

Manufacturer clamour in zero maintenance costs.(Aqua, 2012). This may be true, when no spare parts of an electronic controlled machine is locally available. In cases where in no spare parts available, conversion of a fully automatic to semi-automatic washing machine can be done substituting some spare parts. Hence converting is much cheaper and need only a less amount to most of the consumer in the developing countries like the Philippines. Converting an electronically driven to semi- automatic washing machine instead of buying a new one is also minimizing solid waste.

MATERIALS AND METHODS

This study utilized the discarded and or malfunctioned fully automatic electronically driven top-loaded washing machine for converting it into a semiautomatic operation. Conversion of the equipment was done due to unavailability of its electronic spare parts in the local market because these types of machine is a product in developed countries.

A project type of research was used in the conduct of this study. Materials utilized includes the motors and electrical wiring of the malfunctioned washing machine. Dismantling and rewiring was done to identify the terminal leads of the motors followed by testing recycled parts to evaluate its usability. Replacement of unserviceable part was also done to turn into operation the sample equipment used in the study.

RESULTS AND DISCUSSION

Automatic washing machine used cartridges to program different wash cycles. This system, called the “keymatic”, used plastic cartridges with key-like slots and ridges around the edges. The cartridge was inserted into a slot on the machine, and a mechanical reader operated the machine accordingly. The system did not commercially succeed because it offered no real advantages over the conventional program dial, and the cartridges were prone to getting lost. In hindsight, it can be seen as a marketing gimmick rather than offering any really useful functionality (Jefferson, 2013).

Further, Jefferson (2013) disclosed that automatic washing machine is dependent on electromechanical timer controls to sequence the washing and extraction process. Electromechanical timers consist of a series of cams on a common shaft driven by a small electric motor via a reduction gearbox. At the appropriate time in the wash cycle, each cam actuates a switch to engage or disengage a particular part of the machine.



Figure 2. Malfunctioned fully automatic washing machine before conversion

Despite the high cost of automatic washers, manufacturers had difficulty in meeting the demand. An example of fully automatic electromechanical driven washing machine is showed in Figure 3.

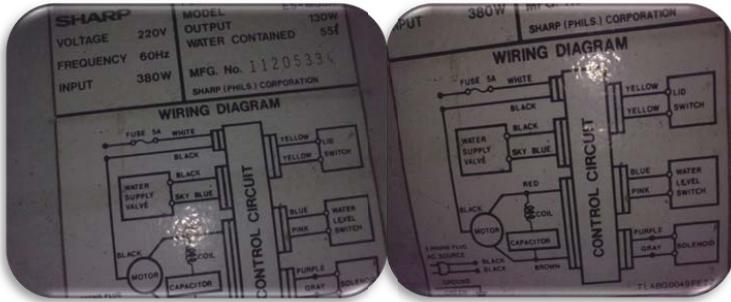


Figure 3. The electrical diagram of fully automatic washing machine

Semi-automatic washing machine

A semi-automatic machine requires the user to intervene at one or two points in the wash cycle. Some machines included two tubs: one with an agitator or impeller for washing, plus another tub for water extraction or centrifugal rinsing some are single tubes the model in the showed in Figure 4

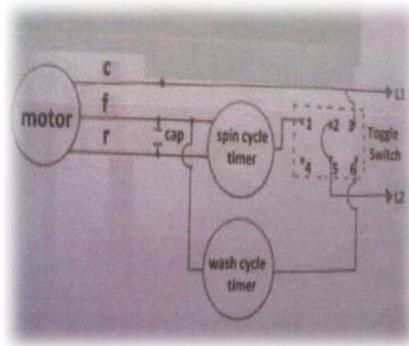


Figure 4. Electrical diagram on the conversion of malfunctioned washing machine into semi-automatic operation

The primary objective of this study was to convert the malfunctioned fully automatic washing into semi-automatic operation and to make it functional. The electromechanical cam of the machine is no longer capable to perform. In order that the malfunctioned fully automatic washing machine will be used again. This part was replaced as shown in Figures 7 to 9.

Conversion Process

Convention began by disassembling housing frame of the washing machine. This is necessary for all the electronic and electrical wiring to be visualized. The next step was examining the electronic control panel. If found that no available spare parts to substitute, then decision to convert into semi- automatic operation can be done.



Figure 5

Testing individual components



Figure 6

Re installation of the housing

Individual Testing-Individual testing of the main component is necessary to identify the worn out and functional part. First, test on the motor as the heart of the machine was done. followed by the test for grounded, shorted, and open windings. Also, checking of the capacitor was done to determine if it was still in good condition. Further, the main component was also tested using the multi-tester. After testing, all mentioned parts were found to be in good condition thus, the motor was energized and measured on its ampere rating to check if it's high. Other testing conducted includes verifying if the bearing/ bushing were in good condition. Another component for testing was the solenoid and the mechanical component of the machine. If all the testing conducted found to be operational, then it warrants the conversion as the component and converting of the machine continues. Expenditure at this point was at the ranged of Php 2500 to Php 3000.

Additional gadgets purchased in the conversion process

Toggle switches. There are two toggle switches needed. It selects or chooses on what operation that the washing machine will execute, whether it is to wash or spin

cycle operation. The second switch is for the drain motor that will drain the water from the tub.

Spin Drier Cycle Timer- a part of the converted washing machine that limits the operating time of the spin drier. Readjustment the time of drying period was done manually. It will control the dry cycle spins at very fast speed of up to several hundred revolutions per minute, wringing as much water as possible from the clothes.

Wash cycle timer - is a part of a converted washing machine that limits the washing time and to vary the rotation from forward to reverse. Also, it was used to readjust the time of washing by manually setting the number of minutes in operation. It will use to control the agitator motion to move the clothes through the water at the tub.



Figure 7
Toggle Switch

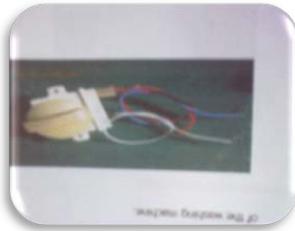


Figure 8
Spin Dry Cycle Timer



Figure 9
Wash Cycle Timer

III ASSEMBLING of MALFUNCTIONED WASHING MACHINE into SEMIAUTOMATIC OPERATION

To assemble the machine into semi- automatic washing machine, the researchers were guided to follow the working diagram as shown in Figure 3. However, before any reinstallation of each component will be made, body repair of the malfunction washing machine and repainting should be done. The following diagram is the procedures followed during the conversion process:

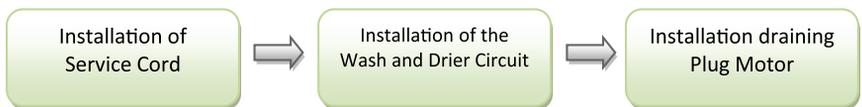


Diagram 1. Process flow on the assembling of malfunctioned washing machine into semi-automatic operation

Service Cord. This is an electrical device used as a path for flow of current to the machine. Provide at least three meters size number 16 stranded wires and connect to the other end which is a heavy duty male plug. The one line terminal will be connected to one terminal of the toggle switch while the other line of the cord will be connected to the common terminal of the wash/drier motor.

Wash and Drier circuit – is a part of a washing machine attached to the motor assembly to the original set up. Space was provided in mounting the wash and dryer timer and the toggle switch. Lay outting of the wire connection of the motor was also performed. The circuit for wash and the dryer is separated. The toggle switch was used to select the operation for use. The timer used to limit the washing and spinning the dryer time and to vary the rotation from forward to reverse. To re-adjust the operating time, it was done manually by setting the number of minutes in operation.

Drain plug motor – is used to reinstall the motor to its original location in the converted washing machine. It is a separate circuit that operates only when removing the water after washing and during spin drying. All joints and connection must be insulated with an electrical tape.

DEVELOPED SEMI-AUTOMATIC WASHING MACHINE

A fully automatic washer requires the user to put the clothes in, and returns them to you clean and dry whether a top-loading or front loading, semi-automatic machine, by contrast, requires that a human control and oversee the process of adding and draining water. Aside from that, the basic principle is the same: moving clothes around in water and detergent until they are clean, spinning them until they are partly dried. Most, if not all, semiautomatic machines are a top-loading which means that the user is the one that puts the clothes in the top of the machine.

Top- loading washer whether automatic or semiautomatic use an agitator, which stands up in the center of the wash basin and designed to move clothes in and out of the water. In some semiautomatic machines like the study, the wash tub is a double layer unit, with an outer tub that holds water and inner tube that has holes in it to allow water to drain out. Other machines have two tubs, one for washing and a perforated basket for spin-drying.



Figure 10. Dry run after the rewiring to semiautomatic operation



Figure 11. Actual appearance of converted malfunctioned fully automatic washing machine into a semiautomatic operation

OPERATION in USING a SEMIAUTOMATIC MACHINE

Starting a Load. To start a load of laundry using a semiautomatic machine, the first step is to add clothes and detergent. Then, using a tap or hose, add enough water at the desired temperature to fill the wash tub. The agitator, in the center of the wash tub, spins about three fourth of the way around, and then does the same in the opposite direction. This motion pulls clothes down into the water, which then work their way back up until they get pulled back down by the agitator.

The Rinse Cycle. Once the cycle is finished, the user needs to manually drain the water from the wash tub. The next step is to add clean water for rinsing, up to the correct water level as specified for your washer. After adding water, restart the washer. It will use the same agitator motion to move the clothes through the water, rinsing the dirty water and soap away and leaving your clothes clean.

Spin Drying. The spin dry cycle of a semiautomatic washer uses centrifugal force. The pressure generated when the inner drum or wash basket spins to squeeze excess water from the clothes. The dry cycle spins at a very fast speed of up to several hundred revolutions per minute (rpm), wringing as much water as possible from the clothes. In a machine with a single, double-layer tub, the user is required to drain the water from the wash tub before starting the drying cycle. In two-tub units, you will need to move the clothes from the wash tub into the drying basket before starting the spin drying. When the drying cycle is complete, hang the clothes to finish drying.

CONCLUSIONS

The study provides skills of local technicians in converting the machine. Assembling the machine into semiautomatic operation, dismantling, body repair and repainting was done. The motor from malfunctioned washing machine as well as its wirings and components were recycled after found usable for converting the machine into a semi-automatic operation. However, other parts needed for conversion were purchased to make a malfunctioned washing machine into a functional one.

The converted washing machine has similar operation cycles of the original or the fully automatic top loaded washing machine. On the other hand, similar principles were noted on the moving clothes around the water and detergent soap and on spinning until clothes are partly dry. However, there was a difference on the controls and sequence of washing machine. In the newly converted washing machine, it requires human intervention such as adding and draining water.

Further, the semiautomatic washing machine unlike most fully automatic where most of the components were made out of plastic materials. Thus, rust formation is minimized. The newly converted semi-automatic washing machine is ideal not only for domestic purposes but for local businessmen engaged in laundry business.

Finally, malfunctioned fully automatic washing machine can be converted into semiautomatic washing machine by utilizing most of its parts in the conversion process.

RECOMMENDATIONS

Automatic washing machine used cartridge to program the different operation cycles. It is relied on electromechanical timer control or sequence the washing and extraction process. Its cam actuates a switch to engage or disengage a particular part of the machine. It is true that manufacturers clamour that machine is zero maintenance costs, but it may be true if spare parts are available in the locality. However, due to no available spare parts, there is a need to convert these machines into semiautomatic, by substituting the electronics cartridge cam controls with toggle switches, wash cycle and spin drier cycle timers.

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