Software/Hardware Requirements Specification

for

SmartWash

Version 1.0 approved

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Revision History

Name	Date	Reason For Changes	Version

1. Introduction

1.1 Purpose

The specified product in this document is our SmartWash machine. This is our first iteration of the product. The specification will cover the washing/drying system of our SmartWash machine.

1.2 Document Conventions

n/a

1.3 Intended Audience and Reading Suggestions

n/a

1.4 Product Scope

The SmartWash combines a washer and dryer machine into one to automate the process of washing and drying clothes. The machine reduces the time for doing laundry. It uses minimal soap and water in order to be eco-friendly. This saves customers time and money when doing laundry. The SmartWash does not load clothes or detergent automatically.

1.5 References

n/a

2. Overall Description

2.1 Product Perspective

The SmartWash is a new product that replaces traditional washing and drying machines. It automates the laundry process to make life easier. This product is ideal for college students, athletes, and families. What these people have in common is that they're busy. They have large amounts of laundry that needs to be done and not enough time to do it. The SmartWash is aimed towards busy people with more money than time as it solves the time consuming problem of doing laundry.

2.2 Product Functions

The SmartWash machine is unique because it can:

- Sort clothes by color
- Automatically transfer clothes from washing to drying
- Fold and organize clothes
- Order detergent when it runs out
- Use minimal soap and water

2.3 User Classes and Characteristics

Joanne Lillark

Joanne Lillark decides to settle down and have a family after graduating college with a degree in Business Administration. Joanne constantly struggles to find time in her schedule to do household tasks. Her mornings are hectic with four teenage kids. However, after the kids are dropped off at school and her husband is at work, her day calms down a little bit. She can focus on cleaning up the house before going to work herself.

Although Joanne wishes that she could be a stay-at-home mom, with 4 children and a $500,000 home, she knows that is unrealistic. After school her kids each partake in their own respective sports (basketball, soccer, football, and track). Then, they are sent to their respective dance classes; ballet for the girls and hip-hop for the boys. By the time Joanne picks up her children, they each have three different pairs of dirty clothes that need laundering. And although each child owns more than one pair of clothes for their activities, the dirty laundry soon adds up.

Joanne and her husband arrive home at roughly the same time. After that, it’s time to cook to cook dinner. Following dinner, Joanne and her husband help the kids with their homework. The kids spend an hour watching TV and playing video games while Joanne and her husband clean the house and prepare tomorrow's’ lunches.

Afterwards, Joanne and her husband have a small reprieve before they have to tackle the mountain of dirty clothes from the day.

Lucy Williams

Lucy Williams is a single, 21 year old student athlete studying Biology at the University of California, Los Angeles. She is a part of her school's volleyball team and has a generous scholarship that leaves her with $20k spending money. She spends most of her time in the gym or otherwise training for volleyball. The rest of her time is spent in her classes. On the weekends she generally studies or goes out to party with her friends.

Lucy wakes up and showers before getting ready for class. She prepares her outfit for the day as well as her gym clothes and a volleyball uniform for later. She leaves her house at 9am and walks the short mile from her apartment to her campus.

Lucy spends several hours in class before being released into the LA heat. She sweats as she makes her way to the school's Subway for lunch. Afterwards she makes her way to the campus gym where she does a light workout for two hours.

Afterwards she works up a real sweat in volleyball practice. She plays a mock game with her team. The intensity of the practice leaves her drained but she walks the mile back to her apartment afterwards.

Lucy arrives home at 10pm after a long day of classes and volleyball training. She puts her dirty gym clothes and the outfit she wore into her almost full laundry bin. She eats leftovers from her lunch at Subway for dinner and settles down to relax and watch television. She takes a quick shower and falls asleep by midnight.

Terry Keenan

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Terry Keenan is an 18 year old single student who just graduated from high school and is now attending college for the first time. Terry has moved away from his parents and is now living in a dorm on campus for the first time. He is currently pursuing a degree in Electrical Engineering at the University of California, Irvine. Terry is an ambitious student and decides to take five classes for his first quarter.

A typical day for Terry is going to his classes, grabbing food to eat afterwards, going to the gym, and finally studying at home. When he's not studying Terry likes to play video games with his friends and go watch movies in his spare time. He is living the life of a college freshman student.

With his hectic class schedule, Terry is finding out that he doesn't have time to do any chores in his apartment, especially his laundry. At home, he had his mom doing all of his laundry for him while he was at school or hanging out with friends. Now Terry has to do all of his laundry by himself and has no time or energy to do it.

Weeks pass and soon Terry's roommates begin to complain that his dirty clothes are starting to smell up the apartment. They tell him to get his act together or he will be kicked out of the dorm.

2.4 Operating Environment

n/a

2.5 Design and Implementation Constraints

n/a

2.6 User Documentation

n/a

2.7 Assumptions and Dependencies

n/a

3. External Interface Requirements

3.1 User Interfaces

n/a

3.2 Hardware Interfaces

n/a

3.3 Software or Hardware Interfaces

n/a

3.4 Communications Interfaces

n/a

4. System Features

4.1 Buzzing Alarm

4.1.1 Description and Priority

Priority: Medium

What

An auditory signal when the machine finishes to let the user know.

Why Care

Terry wants to know when his laundry is finished.

How

A speaker outputs a buzzing noise when the laundry cycle is complete. Buzzing noise repeats for ten seconds.

What's Wrong

The buzzing noise could either be too loud or too soft depending on various situations. To mitigate this, there could be a user-input based dial to alter buzzing noise strength.

4.1.2 Stimulus/Response Sequences

Stimulus	Response
Terry's laundry finishes cycle.	Speaker turns on after completion.
	Speaker sounds for 10 seconds.
	Speaker stops alarm.

4.1.3 Functional Requirements

REQ-1: The system shall activate the speaker itself.
REQ-2: The system shall output a buzz loud enough for everyone in immediate vicinity to hear.
REQ-3: The system shall turn the speaker off after ten seconds.

4.2 Mechanical Clothes Separator

4.2.1 Description and Priority

Priority: High

What

A mechanical arm that moves in simple programmed motions and can grasp and release.

Why Care

Joanne wants to be able to just load all of her clothes at once. She is too busy to worry about separating her clothes manually.

How

Arm has two hands it can grasp together to move clothes.

What's Wrong

The arm could handle the clothes too aggressively and damage them. To mitigate this the arm is programmed to never move fast enough to cause more than .3 newtons of force on the clothing.

4.2.2 Stimulus/Response Sequences

Stimulus	Response
Joanne puts multiple clothing items in machine.	Mechanical arm grabs them one at a time
	Mechanical arm transfers items to next part of cleaning cycle.
Joanne puts a single clothing item in the machine.	The mechanical arm grabs it and transfers it.
	The mechanical arm returns to its resting position as it is finished.

4.2.3 Functional Requirements

REQ-1: Holding area for clothing exists
REQ-2: Destination area for clothing exists
REQ-3: Motions for arm are pre-determined.

4.3 Camera

4.3.1 Description and Priority

Priority: High

What

Camera attached to interior for scanning clothes.

Why Care

Lucy wants to be able to look into the inside of the system. She wants to be able to see how her clothes are doing.

The color sensing system (4.4) requires an image of the clothing to determine its color.

How

A camera is attached to the inside of the machine.

What's Wrong

Camera can get fogged up when using hot water. Camera can get scratched by items with zipper or metal buttons.

4.3.2 Stimulus/Response Sequences

Stimulus	Response
Lucy inputs all clothes for full wash and dry.	Camera passes scan of all clothes to color system detailed in 4.4
Lucy starts wash cycle.	Camera records interior of washing system.
Color sensing system requests an image of clothes.	Camera records a snapshot of current clothing and sends it to color sensing system.

4.3.3 Functional Requirements

REQ-1: System must have room for small camera.

REQ-2: System must have enough light for accurate scanning.

4.4 Color Sensor Software

4.4.1 Description and Priority

Priority: High

What

A sensor that can determine the colors present in part of an image. Sensor will be made entirely in software. It depends on images as input and outputs what colors are present in what amounts.

Why Care

Terry does not want his white shirts to be mixed with his red clothes. He does not want colors to bleed between his clothes.

How

Take an image of the item using the camera sensor (4.3) and then scan the pixels with software to determine what amounts of what colors are present.

What's Wrong

The system needs to be very specific on shades of colors or it may mix up bright and dark items. It also needs to avoid becoming so overly specific that the color separator can't process it's output easily. To mitigate this the system has color clusters that identify groups of colors, not specific shades.

4.4.2 Stimulus/Response Sequences

Stimulus	Response
Terry switches system to color sorting mode	Color sensor software activates and connects to camera sensor for input.
Camera sensor sends image to color sensor.	Color sensor scans the image pixel by pixel and tracks what colors show up in what amounts.
	Color sensor returns data on colors present to the item separation system.

4.4.3 Functional Requirements

REQ-1: System must have functional camera sensor.
REQ-2: System must be able to differentiate between shades of the same color.
REQ-3: System must be able to differentiate between different colors.

4.5 Progress Tracking

4.5.1 Description and Priority

Priority: High

What

A way for the system to keep track of how far along the laundry process it is. Lets the system know how much time is left which can be forwarded to other parts of the system.

Why Care

Joanne wants to track her laundry throughout the entire process. She wants to know when it is close to finishing so she can be ready to put away her clothes.

How

System will keep track of how much time has passed since start and subtract it from how much total time the processes will take. For processes without an exact time it will estimate based on earlier data.

What's Wrong

The system should not use too many estimates as it may become too inaccurate. To mitigate this progress time is on concrete numbers and previous trials for non determinate processes.

4.5.2 Stimulus/Response Sequences

Stimulus	Response
Joanne starts a laundry process.	The system sends a signal to timer to start.
Washing process sends finished signal to system.	The system moves the led progress bar to the drying stage.
Drying cycle sends finished signal to system.	The system moves the progress bar to folding stage.
Folding cycle sends finished signal to system.	The system moves progress bar to done.

4.5.3 Functional Requirements

REQ-1: Screen exists to place the led bar in.
REQ-2: System must know how long each part of the process takes.
REQ-3: System needs a timer to keep track of how much time has passed.

4.6 Detergent Orderer

4.6.1 Description and Priority

Priority: Low

What

Order detergent to be delivered by pressing a button.

Why Care

Lucy does not want to use multiple devices to complete her laundry. She wants all of her laundry related tasks on the same machine.

How

Machine forwards Lucy's order to Amazon.

What's Wrong

System should not be so connected to Amazon that it can't be changed to another provider. To mitigate this the software is templated to allow the easy switching of providers.

4.6.2 Stimulus/Response Sequences

Stimulus	Response
Lucy, who has payment info already connected, presses order detergent button.	System forwards order to Amazon.
Terry, who does not have payment info connected, presses order detergent button.	System prompts Terry to connect their payment information

4.6.3 Functional Requirements

REQ-1: System must be connected to Amazon account.
REQ-2: System must have internet connection.
REQ-3: System must have user interface done.

4.7 Phone Text Alert

4.7.1 Description and Priority
Priority: Low

What

The system is able to notify the user through a text message that laundry is done.

Why Care

Joanne does not want to have to check her phone every few minutes to see if her laundry is done. She wants the system to notify her when it is done.

How

The system sends Joanne an electronic text message to her connected phone

What's Wrong

The system should not send too many phone alerts or it risks annoying the user. To avoid this the system has an exhaustive settings page where the user picks what alerts they want.

4.7.2 Stimulus/Response Sequences

Stimulus	Response
Joanne starts a load of laundry.	System starts up and readies alert system.

Washer sends finished signal to system.	System sends a text alert to Joanne telling her the laundry is done.

4.7.3 Functional Requirements

REQ-1: System must have internet access.
REQ-2: Alert system must send electronic alert
REQ-3: System must have user's contact information.

4.8 Detergent Monitoring System

4.8.1 Description and Priority
Priority: High

What

The system keeps track of the amount of detergent currently available.

Why Care

Terry wants to know how much detergent is left so he can prepare to buy more. He doesn't want to run out and not have a refill already ready.

How

System has a liquid meter that measures the current level of detergent available.

What's Wrong

The system may struggle to report an accurate amount of detergent. To mitigate this the system has a laser sensor that can tell how much detergent is left down to the milliliter.

4.8.2 Stimulus/Response Sequences

Stimulus	Response
Terry puts 24 oz of detergent into an empty machine.	Machine reports there are 24 oz of detergent in the system.
Terry uses 12 of the 24 oz of detergent in the machine.	Machine reports there are 12 oz detergent left in the system.

4.8.3 Functional Requirements

REQ-1: Liquid meter must exist.

REQ-2: Container for detergent must exist.
REQ-3: System must display detergent level.

4.9 Washer Cycle

4.9.1 Description and Priority

Priority: High

What

System is able to select different washing cycles

Why Care

Lucy has different kinds of loads with different needs. She wants to run an extra heavy wash cycle with her gym clothes and a light cycle on her everyday clothes.

How

User inputs washing cycle setting and machine executes with selected setting.

What's Wrong

System wants to avoid giving the user too many options to choose from causing selection anxiety. To avoid this the system only has regular, light, and heavy options by default.

4.9.2 Stimulus/Response Sequences

Stimulus	Response
Lucy puts in her gym clothes and selects heavy cycle.	The machine records her choice and signals the washer it will need to run longer.

4.9.3 Functional Requirements

REQ-1: Button must exist to select different washing cycle.
REQ-2: Machine must use user input for cycle

4.10 Water usage sensor

4.10.1 Description and Priority

Priority: High

What

System monitors how much water it is using.

Why Care

Joanne is worried about the environment and wants to help fight global warming. She wants a washer that conserves water when it can.

How

System has a sensor that adjusts water usage as needed to sufficiently clean load selected

What's Wrong

System may be too conservative with water and not properly wash clothes. To prevent this the system has a minimum amount of water it will not go below.

4.10.2 Stimulus/Response Sequences

Stimulus	Response
Joanne puts her clothes in the machine.	Machine uses the minimum amount of water needed for Joanne's load size.

4.10.3 Functional Requirements

REQ-1: Water sensor must exist
REQ-2: Water valve must adjust output as needed

4.11 Air fan

4.11.1 Description and Priority
Priority: High

What

System has a fan to dry the clothes. Fans provide higher air flow for quicker drying.

Why Care

Lucy does not want to find her clothes are still wet when she retrieves them from the machine.

How

System has built in fan that blows air onto the clothes

What's Wrong

The fan gets clogged with dust and does not blow air at a sufficient level to dry the clothes. To mitigate this the fan has a filter that collects dust.

4.11.2 Stimulus/Response Sequences

Stimulus	Response

Lucy puts her clothes in to wash.	The system washes the clothes and passes them to the dryer.
	The system activates its fan and adds airflow to the dryer.

4.11.3 Functional Requirements

REQ-1: Air fan must exist
REQ-2: Fan must be able to output enough air to fully dry clothes

4.12 Clothes tumblr

4.12.1 Description and Priority
Priority: High

What

System tumbles the clothes around for even fan drying.

Why Care

Joanne wants her clothes to be evenly dried. She doesn't want some of her clothes to be more dry than others.

How

Machine has a baffle and agitator component to mix and spin the clothes inside

What's Wrong

Machine does not mix and spin the clothes inside leading to uneven drying of clothes

4.12.2 Stimulus/Response Sequences

Stimulus	Response
Joanne puts her clothes in the machine.	System starts spinning and washing clothes
	System transfers clothes to tumbler.
	System activates tumbler which uses agitator to mix up clothes.

4.12.3 Functional Requirements

REQ-1: Agitator must exist inside the system

REQ-2: Baffle must exist inside the system
REQ-3: Agitator and Baffle must be able to mix the clothing

4.13 Time selection

4.13.1 Description and Priority
Priority: High

What

System keeps a timer as part of the washing cycle in case the user wants to specify a time.

Why Care

Terry is often in a hurry and wants to wash a single load for a specific amount of time. He needs a way to select this time even if it is less than optimal.

How

A selection knob allows the user to select their timing.

What's Wrong

The machine keeps running after the allotted time inputted by the user.

4.13.2 Stimulus/Response Sequences

Stimulus	Response
Terry moves the timing knob to 60 minutes.	Machine transmits this 60 minutes to washing machine which prepares a timer.

4.13.3 Functional Requirements

REQ-1: Timer must exist to keep track of the time.
REQ-2: Machine is able to stop the timer.

4.14 Weight sensor

4.14.1 Description and Priority
Priority: Medium

What

Machine has a weight sensor to measure the clothes weight

Why Care

Joanne wants to ensure the system uses the right amount of detergent for each load size. She wants the system to use less detergent when there is less material.

How

Machine has a weight scale at the bottom of the machine to measure the weight of the clothes inside.

What's Wrong

Machine could report wrong weight if it measure wet clothes. To mitigate this, the machine only measures clothes when the are input.

4.14.2 Stimulus/Response Sequences

Stimulus	Response
Joanne inputs her clothes in the machine.	Machine activates weight sensor and records the weight for use in other parts of the system.

4.14.3 Functional Requirements

REQ-1: Weight sensor must exist
REQ-2: Weight sensor must be able to accurately record weight

4.15 Start Wash Cycle Button

4.15.1 Description and Priority
Priority: High

What

Machine starts washing and drying clothes when button is pressed.

Why Care

Lucy wants to specify when her wash cycle starts. She doesn't want the system to just start on its own.

How

A button is added the system that starts the washing cycle.

What's Wrong

Button could be too sensitive and might be accidently pressed if it is bumped against. To mitigate this the button has a sensor inside it to make sure it is a human finger that presses start.

4.15.2 Stimulus/Response Sequences

Stimulus	Response

Lucy presses start button.	Machine transmits high voltage signal from button to system which starts the wash cycle.

4.15.3 Functional Requirements

REQ-1: Start button must exist
REQ-2: Machine must be able to start the washing process

5. Other Nonfunctional Requirements

5.1 Performance Requirements

n/a

5.2 Safety Requirements

n/a

5.3 Security Requirements

n/a

5.4 Software or Hardware Quality Attributes

n/a

5.5 Business Rules

n/a

6. Other Requirements

n/a

Appendix A: Glossary

n/a

Appendix B: Analysis Models

n/a

Appendix C: To Be Determined List

n/a