Annotation Legend

Yellow Highlight: Content in question
Cyan Highlight: Wetsoft Inc.'s insertion suggestions
Red Bold Italicized: Content in question suggestions/comments

SAM 5000

Shower Automation Machine

Developed by Just Right Showers

Contributors

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Executive Summary

This document will provide a detailed description of the SAM 5000 shower management system. First, the motivation behind developing the SAM 5000 as a method of maintaining the shower's temperature at a desired level will be explained. The system's most important functions will be highlighted, and the benefits it will provide for the user will be shown. The system's user interface will be described in detail, along with the intended interactions that the user can have with the system. A highlevel overview of the system's function classes and their relationships will be provided. Finally, the structure of our team at Just Right Showers will be provided including a breakdown of the project into subsections according to the team members who will be responsible for them.

The System: SAM 5000

The SAM 5000 or Shower Automation Machine 5000 is a comprehensive smart shower solution. It is comprised of a touch screen interface inside the shower, a mechanical shower system to turn the shower on/off and modify the temperature via user input to the touch screen, and sensors installed in the hot water heater.
Its main function will be to show the user how much hot water is left. It allows the user to set a shower routine, which turns the shower on / off at specific time intervals and sets the temperature. The user can save these routines and temperature preferences. It calculates how much longer the user must wait for a full tank of water, and displays this information.

The SAM 5000 is targeted primarily at multi-person households, though single people with small hot water tanks could also benefit from the information it provides.

The system is targeted at users who need to keep track of how much hot water remains in their hot water tank. This is primarily an issue in households where multiple people are using hot water around the same time, which creates a risk for hot water running out mid-shower. No one likes the water suddenly running cold on them, and the aim is to avoid such an unpleasant situation. To that end, the system provides a warning to the user if the hot water is running low, allowing the user to avoid the unpleasant shock of being frozen.
In tandem with this, the shower system will allow users to set “shower routines”, where the water will turn on/off automatically at the chosen times. This service is provided for users who need to conserve hot water, once again, to avoid running out mid-shower. In addition, the hot water conservation will allow the user to save water for the next people who need to shower. The system should not only prevent a cold shower, but allow thoughtful users to save some hot water for their family members or roommates.
Another benefit of shower routines is that users will no longer need to fiddle with the temperature endlessly to get it right; instead, the shower routine sets the temperature to a pre-chosen value.

The SAM 5000 system’s objectives are as follows:

- Inform the user of how much hot water is remaining
- Prevent the user from accidentally having a cold shower
- Implement user-defined “shower routines” and preferences like temperature
- Help the user save water for other household members / the environment
- Make the showering experience itself more streamlined

The system will help users make shower-related decisions by delivering important shower information to them in real-time. It will help the user have a pleasant shower experience by remembering temperature and duration preferences, making the showering experience more streamlined with fewer interruptions. This also helps users save water, benefiting other members of the household as well as the environment. Finally, the system helps users avoid that most terrible fate of a sudden - and unwanted - cold shower.

Most important features:

- Interactive, information-based touch screen interface.
  Touch screen features: displays remaining “hot water time”, percent hot water remaining, temperature, current routine, and current stage.
- Shower routines to automatically adjust water temperature and flow at user defined time intervals.

System hardware

Since the system will need to control the shower flow and temperature, a control system will need to be in place. For this reason, the system will require installing a new shower. This part of the project will be subcontracted. The shower installed will need to conform to the following:

- actuators to turn the hot and cold water on and off
- a control system to set the shower temperature based on an input temperature.

The touch screen interface will be installed inside the shower, set into the wall. It will be covered in waterproof glass to prevent damage to the internal electronics. A small embedded system will be the basis for the interface, since the system does not require any web connectivity or very demanding computations.
The touch screen will be a resistive touch screen, meaning that it will be less responsive but will still perform when wet. The glass will be treated in order to prevent fogging.
The system will also need to interface with sensors, both in the shower head and in the hot water tank. The hot water tank should have a small floating device placed within, which will need to be heat-resistant. This device will measure the water level in the tank as well as the speed with which it is dropping, which will provide the data needed for the system to display “percent hot water remaining” and “time to run out”[1]. The shower head itself should have a simple temperature sensor that can convey temperature information electronically, which will allow the system to display the actual temperature of the water. These sensors, and the wiring required for them to interface with the touch screen microcontroller/embedded system, will be installed when the shower is renovated.
In order to install the SAM 5000, the shower’s knob-based system for turning the hot and cold water on and off will need to be removed and replaced with a combined mechanical and electrical system. This system will receive input from the main system and change the flow of water from the hot and cold pipes according to the state (on/off) and temperature instructions it receives.
The system will include external knobs like an ordinary shower. These will serve as a manual override, so that if the SAM 5000 malfunctions, the shower is still useable. [2]
In addition, the touch screen interface will need to be installed in the wall of the shower and properly sealed. The shower head will also need to be replaced with an upgraded, sensor-fitted model. Due to the extensive nature of these renovations, a complete shower replacement will often be desirable.
The system will be compatible with ~~all~~ most hot water tanks, so no replacement will be necessary.

The precise design of the mechanical subsystem, as well as its installation, will be handled on a subcontractor basis, being outside of the expertise of our team at Just Right Showers Inc.

1. ***This is not how hot water tanks work based on our research. Hot water tanks are always full of water. When hot water is used, the hot water tank is filled with cold water, which lowers the temperature.***
2. ***Should be no need for a failsafe. emergency shutoff possibly is an option. having protruding knobs in the system for nothing but a failsafe is unfavourable.***

New user profile screen

Users will be able to create profile and set their own routines. Creating a profile includes the following steps:

1. The user is required to provide a username that contains only alphanumerical characters.
2. The slider lets the user select their preferred temperature between 10-50~~20-60~~ degrees Celsius.

   The lower bound should be dynamically based off of the cold water being fed into the system, that way we don't give off any false impressions that our system cools/doesn't go colder than 10 degrees.

3. There will be two buttons present at the bottom of the form. They can be "Create User" and "Cancel".
4. In order to successfully create the user profile, the user needs to click on "Create User ". (The user can skip the Create Routine process)

Expected output:

1. If the user clicks on "Create User Profile" button, the system checks whether inputs for the username is correct. An error message can be displayed if there was an incorrect input provided. It can be due to the following reasons:
   a. The username is empty or does not contain any alphanumerical characters.
   b. ~~Invalid input was entered in temperature field~~.

      Shouldn't a slider not give the user the ability to enter an invalid value?

2. When the correct inputs are present in the form, the system prompts the user to create routine. A dialog box will be shown to request the user for creating the routine. There will be two buttons available to click. The "skip" button can be clicked to skip the process and the "Create Routine" button to create a routine.
3. Clicking on the "Create Routine" button takes the user to the Create Routine page.

4. Clicking the “skip” button alerts the user that the user profile was created successfully.
5. If there was no input for the temperature the system automatically records the last temperature used.
6. If the user wishes to cancel the process, he can click on the Cancel button which takes him to the Home screen.

Create routine

When a routine is created, the user will be able to set the time for various stages during shower.
There will be three stages during shower. These can be drench, lather and rinse with three different labels in the routine screen. During drench and rinse stages the water will be turned on. The water will be turned off during lather stage. There will be three different labels named as stage 1, stage 2 and stage 3 by default which can be modified by the user. Stage labels can be modified with alphanumerical characters.

Allow for more stages and repetition of different stages in the user's preferred order.
This section is confusing. What is the difference between drench and rinse? Why can we label the sections, if drench, rinse, and lather have already been defined?

Beside the stage labels, there will be empty fields to input the time required for each of the stages. The user can enter time periods between 1-10 minutes for each stages.

Having a lower bound on time is unnecessarily restrictive.

Additionally, the user needs to select the shower routine progress. Selecting the “Automatic” tick box allows the system to function automatically based on the time for each stages. If the user selects the manual, the system will notify the user to turn on/off the water.

Need a way to manually end a stage/automatic routine.

When the user finishes filling all the inputs, he is required to click the “Done” or the “Back” button displayed at the bottom of the page.

Expected Output:

1. Clicking on the “Done” button will successfully create the routine. If there are wrong inputs provided by the user, an error message will be displayed to correct the error. An error message can cause due to the following reasons:

1. The stage labels are modified with non-alphanumerical characters or left as empty.

   Forcing non alphanumerical is not necessary. The system should either not have the option to insert a non-alphanumeric character or allow non-alphanumeric characters

2. Time period fields for any of the stages are left empty or filled with non-numeric characters.
3. Time period for any of the stages fall behind 1 minute or exceed more than 10 minutes.

   Again, should not limit between 1-10 minutes

4. If the automatic or manual tick boxes of the shower routine progress is left empty.

2. The "back" button will take the user back to the user profile screen. Clicking on this button would reset all the fields and tick boxes.

   What happens when you create a routine when making a new user profile?

User profiles screen

The user can click the different user profiles available in this screen. A button to create a new user profile and back button to navigate to the home screen are available in this screen.

Expected output:

1. Clicking the preferred user profile will prompt the user with a new screen. This screen shows the summary of the user profile which was selected.
2. If the user clicks the "Create new user profile" button, the system navigates to the new user profile screen.
3. Clicking the back button would take the user to the home screen.

User profile summary screen

A summary page will be displayed when the user selects a particular user profile. This page contains the following information:

1. The username
2. Temperature that was already set
3. ~~Favourite~~ routines

   This should probably just be labeled Routines.

4. Shower data

There will be an edit button available next to the username, temperature and routine fields. The user can click on this button if he/she wishes to modify them.
There should also be a button to delete the user.

Moreover, there will be a back button to navigate to the "select user profile screen". Beside this button, there will be another button called "Start shower" for the user to start the shower.

Expected output:

1. If the user clicks on edit button next to the username, the username field becomes active and the user can change the username.
2. The temperature field will also become active if the user clicks on the edit button available next to it.
3. If the user need to edit the routine, the system will take him to the routine page. This can be done by clicking the edit button.
4. The shower data contains the following information displayed to the user:
   a. Average water temperature
   b. Average time spent in shower (total time)
   c. Average time spent in shower (with water)
   d. Average amount of hot water used per shower
5. Clicking the back button will take the user back to the user profiles page.
6. Clicking the start shower button would turn on the water and user can shower.

Shower screen

When the user starts showering, the shower page is shown by the system. The user will be able to monitor the following information during shower:

1. The username
2. The hot water level that is available in the tank(percentage).
3. Time left for the shower to complete

   Assuming this is because of a routine. What if no routine is chosen? No time shown?

4. The current temperature of the water dispensed from the outlet.

Additionally, the user will be able to control the water by turning on/off during shower. This can be done by switching the on/off button available in this screen.

A button is available to logout the user from the system. The user will be able to click on this button when the shower is completely done or in the middle of the shower.

Does the water shut off when they logout in the middle of a shower?

Expected output:

1. If the user has selected the manual shower progress, the system will notify to turn on/off the water.
2. Automatic shower progress is fully controlled by the system. Therefore, the user does not need to control the water.
3. Clicking the logout button will make the user the exit the profile and go the home screen. The statistics will be saved accordingly.
   Fix grammar.

Home screen

The Home screen is the first view the user can see when the system is working. This screen contains the following features:

1. The current water temperature
2. Hot water level
3. Timer
4. Routines - These are pre-programmed routines available in the system
5. Shower On/Off
6. User Profiles
7. Settings

Below show is the Home screen of SAM 5000:

The user will be able to monitor the temperature, hot water level and the timing. Clicking on the User profiles button takes the user to profile screen for adding new user or selecting an existing user. The routines button will navigate the user to pre-programmed routines screen and the settings button is used to change settings of the system.

Expected output:

1. If the user is on the system, the system by default works with a pre-configured standard routine. Based on that routine, the hot water level, timing and the water temperature might change.

   Don't like how this defaults to a pre-programmed routine, it should default to manual operation where the user can change the temperature and duration freely.

2. The user needs to turn off the water in order to choose any option because the system locks the user from selecting any other buttons when the water is on.

So then why does the on/off button exist? Very confusing expected outputs. Please rewrite.

Pre-programmed routines

Pre-programmed routines allows user to pre-set routines from the system. There are 3 buttons for choosing in the pre-programmed routines menu. They can be the following:

- Environmental
- Standard
- Luxury

Expected output:

1. Once the user selects one of this button, he is taken back to the Home screen with the pre-set option that he selected.
2. Once he is in the home screen, he can turn on the water for shower.
3. The user can only select one button

Shouldn't it take the user to the shower screen, not the home screen? "The user can only select one button". Which button? Very confusing. Is this just choosing one routine?

Are these pre-programmed routines completely locked when in operation? Shouldn't the user be able to modify the temperature during operation?

Management Plan

Features:

- Touch Screen Interface
- Temperature Sensing,Changing
- Pre-programmable shower options
- Amount of Available Hot Water Sensing
- Timer
- Shower Data, Analytics (optional)

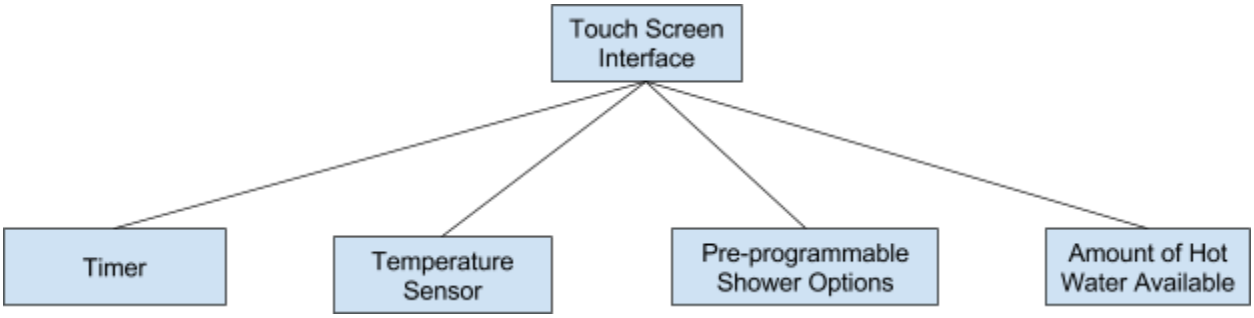
Touch Screen Interface:

- Will display User profile on screen
- Will allow client to switch User Profile using touch pad by logging in with username ~~and password~~

No passwords were specified in the requirements.

- Will display temperature of water on screen
- Will allow client to change water temperature using touch pad
- Will display different pre-programmable shower options on screen
- Will allow user to choose a pre-programmable shower option using touch pad
- Will display amount of available hot water on screen; with three different colours indicating different levels of hot water left - green = >50% yellow = >20% <50% red = =<20%
- Will display amount of time left remaining on shower using a countdown timer

The touch screen interface basically does everything. There's a lot missing here, alhough this section seems to be just repeating functionality already stated in sections above.



Don't know what this image means.

Temperature Sensing/Changing

- System will be able to sense what current temperature of water is within +/- 1 degree
- System will be able to change temperature

Pre-Programmable Shower Options

- System will have three pre-set shower options: Environmental, Standard, Luxury
- Environmental option will be 5 mins at 10 degrees less than set preferred temp (default 50 degrees Celsius)
- Standard Options will be 8 minutes at set preferred temp (default set at 50 degrees)
- Luxury Option with be 15 minutes at set preferred temp (default set at 50 degrees)
- System will allow users to create a showering program by altering preferred temperature and duration

50 degrees is insanely hot. 40 degrees is standard shower temperature.

The pre-programmable shower choices seem very odd. This functionality was not in the requirements and may be handy, but if they don't make sense there is no use for this functionality.

Amount of Available Hot Water Sensing

- System will sense how much water is available in the hot water tank
- System will take the how much hot water is left and current rate of use to determine how much hot water is left

Shower Data, Analytics

- System will calculate time of duration for a particular user, while user is logged on, system will keep this data for a month
- System will calculate average temperature for a particular user, while user is logged on, system will keep this data for a month

Was expected that statistics are over a lifetime, although not specified. If statistics are believed to reset, a manual reset option should be available instead.

- System will use duration and temperature of shower to calculate energy used during shower

This is highly dependant on the type of system you have, some hot water tanks are extremely inefficient while others are really good, not sure how this can be accurately calculated. This was not in the requirements and may make it hard to develop.

If all goes well, we would like to implement a separate mobile/desktop application where clients can set up a specific user profile and have access to shower data, and be able to create different shower routines.

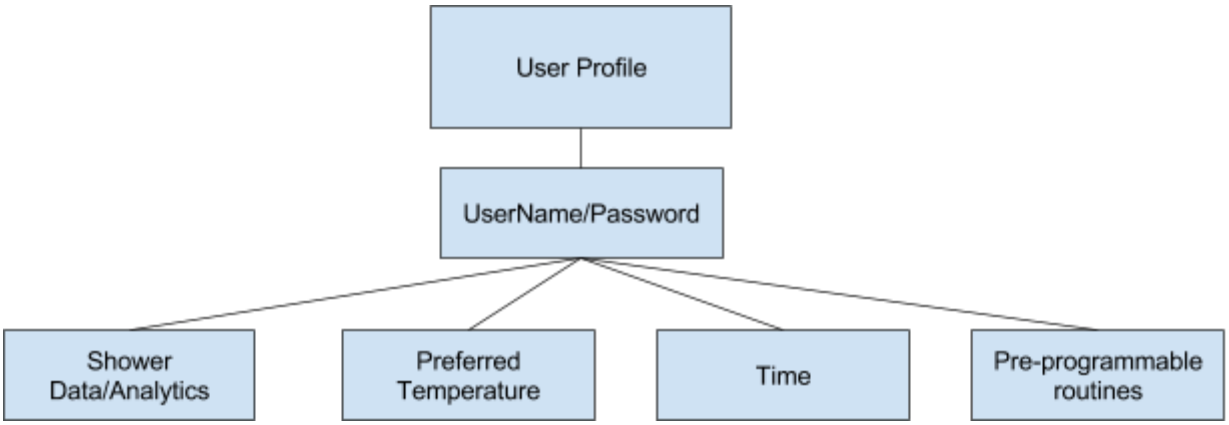
User Profile:

- Clients will be able to log into a User Profile with a username ~~and password~~
- Client will be able to set a preferred temperature
- Client will be able to set a preferred time of shower ***do you mean routine?***
- Client will be able to see past showering data
  - Average time of shower

- Average amount of water used
- Average energy used

- User Profile will be able to wirelessly connect to Touch Screen Interface via bluetooth

This wasn't in our requirements. Isn't the database included within the hardware of the touch screen interface?? Why are we storing user profiles somewhere outside of where the main interface is (the touch screen)



What is this image?

Team Structure

Rhiannon - System Integration Expert

Rhiannon is In charge of the physical usability, software integration with mechanical components and sensors of the SAM5000. This includes:

- Placement of TouchPad Interface in shower
- Temperature Sensor and Hot Water Heater Sensor
- Wired communication between sensors, shower actuators and touch screen
- Processing of Sensor data into display values for touch screen
- Processing of user input into instructions for the shower actuators

Kathleen - Client Account Manager

Kathleen is the client - supplier relationship expert, and is in charge of making sure clients are happy with the design and progress made during the project. Her main duties include:

- Scheduling regular client/supplier meetings
- Answering client questions

- Addressing client concerns in all stages of development
- Creating client/supplier links

Kushal - Front End Developer

Kushal will be In charge of creating the Graphic User Interface for the Touch Screen Interface. This will include:

- Creating icons
- Placement of icons on screen

- Transition to different screen

Ushanth - Back End Developer

Ushanth will be In charge of back-end design of Touch Screen Interface and Interface usability documentation.This will include:

- Displaying the rest of time left in the timer
- Displaying the water temperature
- Displaying the amount of hot water available
- Displaying the shower options
- Saving client-made shower routines