Report 1 Part 1 and 2

Pool Control System



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**Part 1 Contributions:**

***Steve:*** Customer Statement of Requirements and System Requirements.

***Taft:***Customer Statement of Requirements, System Requirements.

***Brenton:*** Table of Contents, Customer Statement of Requirements final editing, System Requirements overview edit.

**Part 2 Contributions:**

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***Brenton:*** Table of Contents

Customer Statement of Requirements

**Overview**

If you have a pool, would you like to control and monitor it with a computer. There are many people that own a pool, and almost everyone leaves the residence on which the pool is located for one reason or another. For some people it is a vacation home and they are gone more often than they are there. Do you want to raise and lower the temperature of the pool? How will you know if your pool is working so that it can be enjoyed upon returning? There are a lot of things that could go wrong. Equipment failure or a clog could happen at any time, without notice unless there's a mechanism to report problems.

The problem is there is no way to monitor your pool while you are away unless you hire someone to come check it for you. That would be very expensive or bothersome to a neighbor if he is kind enough to check it. There is also the competence factor. There is no telling how much your neighbor even knows about pool. It would be a lot cheaper and easier to just check it yourself online. That is why there is a system designed to monitor different components of your pool.

There are many individual components that make up the complete pool system. The pool system is a closed loop system with the most important part being the pool pump motor which draws pool water from the pool and forces it through the filter and other system components and back into the pool. This system must include a solar heating system control, pool motor starter, and pressure monitoring system. With a graphical user display that is easy to use and intuitive.

**The Basics**

The basic components of the system shall be:

Inputs:

* T1 – Temp sensor 1 (temp of the pool water)
* T2 – Temp sensor 2 (Temp of the roof)
* P1 – Pressure Sensor 1

Outputs:

* M1 – Motor contactor 1 for the main pump
* V1 – Valve 1, for Solar Heat
* V2 – For by pass

The system shall operate as follows, the user is allowed to enter the following Values on the graphical user display:

* Pump Start Time
* Pump Stop Time
* Target Pool Temp
* Max Pressure
* Min Pressure
* Bypass Valve Enable

A security measure will prevent unauthorized access to the system. The user will be able to operate the system with any web browser internet connection. The control system's connection to a web server enables communication with the user. From the website you will see the following: the temperature of the water in the pool, the set temperature that you would like the water to reach, the temperature on the roof where the solar panels are located, an on/off switch to enable pool heating, the pressure of the water in the tubing of the filtering system, the minimum and maximum pressures allowed by the system, the start and stop times for the pump, and the valves’ statuses (open or closed).

There will be controls to change the target temperature. This is the temperature to which the pool will heat up. The solar heating is based on several factors. When it is enabled on the user display. The control system shall monitor pool temp and roof temp. If the pool temp is below the “Target Pool Temp” and the roof temp is at least 20 degrees above the pool temp, then V2 should be enabled and the pool water shall be directed through the solar heating panels.

There will also be controls to change the minimum and maximum pressures allowed in the system to prevent damage to the pump, filter, and other parts of the system. Any time the pool pump is running the pressure should always be monitored. If the pressure is detected to be greater than the “Max Pressure”, it shall immediately shut the pump down and display a warning on the display. This warning shall be reset by the user only while the pump is off. The minimum pressure is active two minutes after the pump has been turned on. If at any point passed the two minutes the pressure is below the “Min Pressure” setpoint, the system should immediately shut down and display a warning. This would indicate a possible leak in the system.

There will also be controls for the start and stop times for the pump. The Pool Control shall turn the pump M1 on at the “Pump Start Time” and turn it off at the “Pump Stop Time”. These can be programmed for any time of the day. Every day that the system is turned to on, the pump will start at the given time and stop at the given time. There will be multiple stop and start times available if more than once a day is required. If all of the pump start times and pump stop times are deleted, then the system will not turn on automatically. A warning message should display saying that no automatic pump times have been added.

There are two valves that are used in the heating system. The valves are two position. Valve 1 is used as a bypass valve that will divert the water from the filter to the second valve when off and from the filter directly to the pool when on. The second valve V2 will direct the water from Valve 1 to the solar heating when enabled or through the regular return path. The bypass valve V1 shall always be in the off position unless it is selected on from the graphical user interface, if the bypass valve is on, V2 shall immediately be disabled and all heating functions shall be disabled.

System Requirements

The main controller system shall be a microprocessor that has Wi-Fi capability. It should have an open source firmware to allow easy adaption and future upgrades. A graphical user interface shall also be included with the design along with easy to use functions. The controller should be able to be connected to through either a local area network or the internet. The system should have a web application running the user interface. The web server should know the system state by calling the appropriate functions, such as the water temperature for example.

**Functional System Requirements**

|  |  |  |
| --- | --- | --- |
| **Identifier** | **PW** | **Requirement** |
| REQ 1 | 5 | The system shall obtain pool water temperature |
| REQ 2 | 4 | The system shall obtain roof temperature |
| REQ 3 | 5 | The system shall obtain water pressure |
| REQ 4 | 5 | The system shall obtain pump status (on/off) |
| REQ 5 | 5 | The system shall obtain valve 1 status (open/closed) |
| REQ 6 | 5 | The system shall obtain valve 2 status (open/closed) |
| REQ 7 | 4 | The system shall obtain heater status (on/off) |
| REQ 8 | 2 | The system should allow adding users and passwords |
| REQ 9 | 2 | The system should allow removing users and passwords |
| REQ 10 | 4 | The system should allow changing target temperature |
| REQ 11 | 5 | The system shall allow changing valve 1 status |
| REQ 12 | 5 | The system shall allow changing valve 2 status |
| REQ 13 | 4 | The system should allow changing the start pump time |
| REQ 14 | 4 | The system should allow changing the stop pump time |
| REQ 15 | 3 | The system should allow adding a start pump time |
| REQ 16 | 3 | The system should allow adding a stop pump time |
| REQ 17 | 3 | The system should allow deleting a start pump time |
| REQ 18 | 3 | The system should allow deleting a stop pump time |
| REQ 19 | 5 | The system shall have the ability to start the pump |
| REQ 20 | 5 | The system shall have the ability to stop the pump |
| REQ 21 | 5 | The system shall have the ability to open valve 1 |
| REQ 22 | 5 | The system shall have the ability to open valve 2 |
| REQ 23 | 5 | The system shall have the ability to close valve 1 |
| REQ 24 | 5 | The system shall have the ability to close valve 2 |
| REQ 25 | 4 | The system should have the ability to turn on the heater |
| REQ 26 | 4 | The system should have the ability to turn off the heater |
| REQ 27 | 3 | The system should have the ability to change the maximum pressure |
| REQ 28 | 3 | The system should have the ability to change the minimum pressure |
| REQ 29 | 5 | The system shall have the ability to compare the maximum pressure to the actual pressure |
| REQ 30 | 5 | The system shall have the ability to compare the minimum pressure to the actual pressure |
| REQ 31 | 4 | The system should have the ability to compare the target temperature to the pool water temperature |
| REQ 32 | 4 | The system should have the ability to compare the roof temperature to the pool water temperature |
| REQ 33 | 2 | The system should display a warning sign on the user interface if a component reads out of scope. |
| REQ 34 |  |  |
| REQ 35 |  |  |
| REQ 36 |  |  |
| REQ 37 |  |  |
| REQ 38 |  |  |
| REQ 39 |  |  |
| REQ 40 |  |  |
| REQ 41 |  |  |

**Nonfunctional System Requirements**

Functionality:

* The system should authenticate the user by matching the username and password.
* The system should not allow any other users besides the administrator.

Usability:

* The system should be able to monitor the system components regularly and accurately, updating changes to the website
* The user interface should be simple and easy to read.

Reliability:

* The system should be able to reboot after failure within a minute.
* The system should be able to run smoothly provided there is no interruption with the internet service.

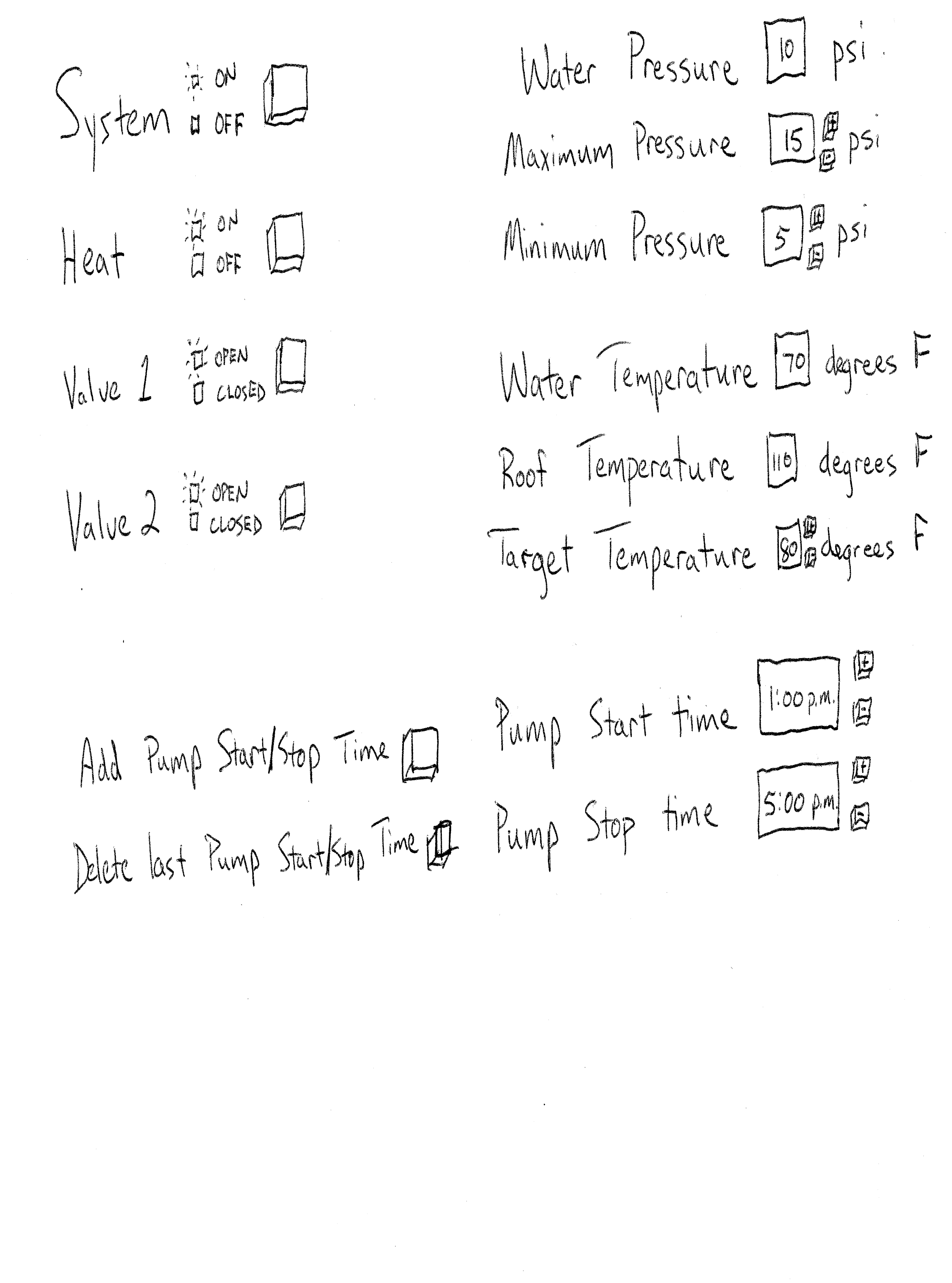
Performance:

* The system should be able to open and close valves or turn the system or heat on and off within a couple seconds.

Supportability:

* The system should be easily tested by getting on the website while at the pool by watching and listening after buttons are pushed on the user interface.
* Configuring the system to the appropriate settings is a personal option that is easy to do on the website. The only concern would be getting useful minimum and maximum pressures on the system.

**On-Screen Appearance Requirements**



This user interface is a simple design. The system has a button to push and lights to indicate whether the system is on or off. The heater is the same with a button and lights to indicate on and off. Valves one and two also have a button and light indicators for closed and open. The water pressure in a readout obtained from the system and automatically update. The maximum and minimum pressures can be adjusted with the + and - buttons beside it. The water temperature and roof temperature are readouts obtained from the system and automatically update. The target temperature is the temperature the user would like the pool water to be and is adjustable by the + and - buttons beside it. The pump start time and pump stop time are adjustable in 15 minute increments by the + and - buttons next to them. There are also buttons to add another start and stop times and to delete the last start and stop times. There will be additional space at the bottom of the user interface to add more start/stop times. It is possible to delete all the start and stop times. In this case there will not be an automatic system cycle. There will also be a spot at the top of the screen for warning messages from system abnormalities.

Functional Requirements Specification

**Overview**

Derive the use cases based on the requirements from Section 1 and 2 above.

Following is a copy paste from the online report styling guide:

1. Stakeholders  
   Identify anyone and everyone who has interest in this system (users, managers, sponsors, etc.). Stakeholders should be humans or human organizations.
2. Actors and Goals  
   Identify the roles of people or devices that will directly interact with the system, their types (initiating vs. participating) and the goals of the initiating actors.
3. Use Cases
   1. Casual Description  
      For **all** use cases that you can think of (based on your System Requirements), write a brief or casual text description. List explicitly the requirements that each use case responds to.
   2. Use Case Diagram  
      Draw the use case diagram with all the use cases. Indicate the relationships, such as <<include>> and <<extend>>.
   3. Traceability Matrix  
      Show how your system requirements map to your use cases. Calculate the priority weights of your use cases. The use cases with the highest priority should be elaborated and planned for the [first demo](http://www.ece.rutgers.edu/~marsic/Teaching/SE/demo1.html).
   4. Fully-Dressed Description  
      Select a **few most important** use cases and provide detailed (“fully dressed”) description. The “most important” use cases are indicated by your traceability matrix.  
      Your event flows must show step-by-step every action that the initiating actor (“user”) can take while running the given use case.
4. System Sequence Diagrams  
   Draw the system sequence diagrams for the **few most important** use cases selected above.

User Interface Specification

Begin describing here.

Copy-paste from the online report styling guide follows:

**(Note: If your system prints some forms or generates periodic reports, this is also considered part of the user interface and the format of forms/reports must be specified in this section.)  
The user interface should be specified only for the use cases elaborated in the previous section (“fully dressed” use cases).**

* 1. Preliminary Design  
     For a given use case, show step-by-step how the user enters information and how the results appear on the screen.  
     Use screen [mock-ups](http://en.wikipedia.org/wiki/Mockup) and describe exactly what fields the user enters and buttons the user presses. Describenavigational paths that the user will follow.   
     In case you are developing a graphics-heavy application, such as a video game, this is one of the most important sections of your report.
  2. User Effort Estimation  
     Select several typical usage scenarios and, as you walk through the flow of events, count and report the number of mouse clicks and/or keystrokes that are needed to accomplish the task. What fraction of these goes to user-interface navigation vs. clerical data entry?  
     See example in Appendix A: [User Effort Estimation](http://www.ece.rutgers.edu/~marsic/Teaching/SE/report1-appA.html).
* Project Management (described in Section 6 below) and References (described in Section 7 below)