



Computer Science
&ENGINEERING

State-Based Plot Coloring

Acceptance Criteria and Testing Strategy and Plan

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Team #36

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March 6th, 2018

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1. Abstract

Our project is a State-based Plot Coloring which is designed to help users monitor their condition of machines. It allows users to see their condition of machines into four different states which are a rolling state, a startup state, a running state, and a shutdown state with different colors. It makes this project to be unique because it can offer users convenience way of observation for the condition of their machines in four different states. Each state represents a specific machine state, so it can possibly help people to have less failure of their machine since the user might be able to take an action on the problems after observing the graph. In conclusion, the objective of the project is intended to be designed to let the users be able to observe what states their machines are in and check whether their machines have problems. The project is implemented in C# and Oxyplot for the ease of development and better performance for the User interface.

2. Project Updates and Changes

2.1 Progress

We have developed the user interface for our project. For 2D graphics, the WPF coordinate system locates the origin in the upper-left corner of the rendering area. We have changed it to the customer coordinate system whose origin is in the bottom-left corner of the canvas. We have added two classes, which are `ChartStyle2D` and `ChartStyle3D`. They define all chart layout-related information. In addition, we are able to display data in the Cascade Plot. The software we are developing can display the overlap between states using different colors in the Cascade Plot. Moreover, after the user selects a machine, the colors for the data of the machine that the user selects will change. The following lists the major developments completed:

- The Main User Interface
- Text File Reader
- Cascade Plot
 - Display data in the Cascade Plot
 - Handle the overlap between states in the Cascade Plot
 - Handle the overlap between machines in the Cascade Plot

2.2 Changes

Because the documentation of the Oxyplot, which is a free 2D plotting library, is bad, and most good WPF 3D plotting libraries cost about 1000 dollars, we decide to make our own 2D and 3D coordinate systems rather than use a plotting library by modifying some existing 2D and 3D coordinate systems that we found online. Furthermore, according to the requirements that our sponsor provided us, instead of dealing with real-time data, we will focus on displaying data nicely in the Trend Plot, the Cascade Plot, and the Bode Plot when there is an overlap between states and between machines.

3. User Stories and Acceptance Criteria

3.1 User Interface

- As a system analyst, I want to view the trend plot so that I can monitor the frequency of the machines over time.
 - 1. A trend plot is displayed.
 - 2. The trend plot contains the correct data.
 - 3. The trend plot is easily readable.
- As a system analyst, I want to view the bode plot so that I can monitor the phase shift and frequency response of the system.
 - 1. A bode plot is displayed.
 - 2. The bode plot contains the correct data.
 - 3. The bode plot is easily readable.
- As a system analyst, I want to view the cascade plot so that I can monitor the RPM and HZ frequencies of the machines over time.
 - 1. A cascade plot is displayed.
 - 2. The cascade plot contains the correct data.
 - 3. The cascade plot is easily readable.

3.2 Text File Reader

- As a system analyst, I want the system to read in machine data so that the data can be plotted into the three plots.
 - 1. Cascade plot data is read into the system.
 - 2. Bode plot data is read into the system.
 - 3. Trend plot data is read into the system.
 - 4. The data read in can be displayed in the plots.
- As a system analyst, I want the system to read in predefined state files so that the machine states can be defined by the machine.
 - 1. The state names are read into the system.
 - 2. The state ranges are read into the system.

3.3 Trend Plot

- As a system analyst, I want to display data in a trend plot so that the data can be monitored.
 - 1. Correct data is displayed.
 - 2. The plot is formatted correctly.
 - 3. The plot is easily readable.
- As a system analyst, I want overlapping states to be readable so that monitoring the system is easier.
 - 1. The user can see when the data is in multiple states.
 - 2. The user can easily read the plot.
- As a system analyst, I want overlapping machines to be readable so that monitoring the

system is easier.

- 1. The user can see when multiple machines data overlaps.
- 2. The user can easily read the plot.

3.4 Cascade Plot

- As a system analyst, I want to display data in a cascade plot so that the data can be monitored.
 - 1. Correct data is displayed.
 - 2. The plot is formatted correctly.
 - 3. The plot is easily readable.
- As a system analyst, I want overlapping states to be readable so that monitoring the system is easier.
 - 1. The user can see when the data is in multiple states.
 - 2. The user can easily read the plot.
- As a system analyst, I want overlapping machines to be readable so that monitoring the system is easier.
 - 1. The user can see when multiple machines data overlaps.
 - 2. The user can easily read the plot.

3.5 Bode Plot

- As a system analyst, I want to display data in a bode plot so that the data can be monitored.
 - 1. Correct data is displayed.
 - 2. The plot is formatted correctly.
 - 3. The plot is easily readable.
- As a system analyst, I want overlapping machines to be readable so that monitoring the system is easier.
 - 1. The user can see when multiple machines data overlaps.
 - 2. The user can easily read the plot.

3.6 Communication between WPF windows

- As a system analyst, I want to be able to select a machine so that only that machines plot is visible.
 - 1. Other machine plots lose visibility.
 - 2. The chosen machines plot is visible by itself.
- As a system analyst, I want the selected machine to match in all plots so that the machine can be monitored in all the plots.
 - 1. Other machines plots lose visibility in all three plots.
 - 2. All plots display only the selected machine.

4. Testing Workflow

4.1 Happy Path Workflows

1. Load data into the software
2. Click the “Display” button
3. Display data in different colors in the Trend Plot

We plan to finish implementing the Trend Plot and integrating it into the software by March 25. We will test it on March 26. Mock data will be loaded into the software. We will also test it with the data provided by General Electric(GE). We will check if the data can be displayed correctly in the Trend Plot and if the software can display the overlap between states using different colors. If it is the case, the happy path workflows are validated.

1. Load data into the software
2. Click the “Display” button
3. Display data in different colors in the Cascade Plot
4. Resize the Cascade Plot by adjusting the window size
5. Rotate the Cascade Plot by adjusting elevation and azimuth angles using two sliders

We will test the Cascade Plot on March 26. Mock data will be loaded into the software. We will also test it with the data provided by General Electric(GE). We will check if the data can be displayed correctly in the Cascade Plot and if the software can display the overlap between states using different colors. In addition, we will also adjust the window size and change the elevation and azimuth angles to see if the software can correctly update the Cascade Plot. If it is the case, the happy path workflows are validated.

1. Load data into the software
2. Click the “Display” button
3. Display data in different colors in the Bode Plot
4. Change the colors for the data of the machine that the user selects by clicking a line segment in the Bode Plot

We plan to finish implementing the Bode Plot and integrating it into the software by March 25. We will test it on March 26. Mock data will be loaded into the software. We will also test it with the data provided by General Electric(GE). We will check if the data can be displayed correctly in the Bode Plot and if the software can display the overlap between states using different colors. In addition, we will also check if the software can change the colors for the data of the machine that the user selects when he or she clicks a line segment in the Bode Plot. If it is the case, the happy path workflows are validated.

4.2 Unhappy Path Testing Workflows

1. Click the “Display” button.
2. Generate a warning message to tell the user to load files before clicking the “Display” button

We plan to click the “Display” button without loading files needed for the software on March 26. If software generates a warning message instead of showing a plot that contains no line segment, the unhappy path testing workflows are validated.

1. Load data from files to the software

2. The files contain negative values.
3. Click the “Display” Button
4. Generate a warning message to tell the user that some values in the files are not within the range of the speed that he or she sets. Ask the user if he or she wants to display data in the Trend Plot, Cascade Plot, and Bode Plot using black as the color for undefined values.
5. Click the “Yes” button in the warning message dialog
6. Display data in the Trend Plot, Cascade Plot, and Bode Plot using black as the color for undefined values.

It is possible that some values in the files are not within the range of the speed that the user sets. It means that the user does not set any color for these values. We plan to run the program using files that contain negative values and test the software on March 26. After clicking the “Display” button, a warning message should be generated. After the user clicks the “Yes” button in the warning message dialog, if the program displays data in the Trend Plot, Cascade Plot, and Bode Plot using black as the color for undefined values, the unhappy path testing workflows are validated.

5. Testing Strategy

- Types of Tests
 - Acceptance test
 - ◆ Test each requirement of the project to determine whether the project meets specification or contract.
 - ◆ The test is needed as the last step just before the program is going to be for actual use.
 - Unit tests
 - ◆ Test individual units of source code or function step by step to determine whether they are fit for use.
 - ◆ The test is needed during the development process, so the project can be tested occasionally.
 - System tests
 - ◆ Test the entire system of a project in terms of a Functional Requirement Specification to determine whether the design, behavior, and event meet the expectation of the customer
 - ◆ The test is needed after the project is completed, so the project can be tested in terms of compliance.
 - Happy Path Testing
 - Unhappy Path Testing
- Testing Responsibilities

Functionalities	When will test the functionalities	Who will test the functionalities
User Interface for the Cascade Plot	26 th March 2018	Myeongwan Beom

User Interface for the Bode Plot	26 th March 2018	Zachary Young
User Interface for the Trend Plot	26 th March 2018	Haoxuan Lin
Text File Reader	26 th March 2018	Myeongwan Beom
Displaying of data in the Cascade Plot	26 th March 2018	Myeongwan Beom
Displaying of data in the Bode Plot	26 th March 2018	Zachary Young
Displaying of data in the Trend Plot	26 th March 2018	Haoxuan Lin
Displaying of overlapping states in the Cascade Plot	26 th March 2018	Myeongwan Beom
Displaying of overlapping states in the Bode Plot	26 th March 2018	Zachary Young
Displaying of overlapping states in the Trend Plot	26 th March 2018	Haoxuan Lin
Readable Overlapping Machines in the Trend Plot	26 th March 2018	Myeongwan Beom
Readable Overlapping Machines in the Cascade Plot	26 th March 2018	Myeongwan Beom
Communication between WPF windows	26 th March 2018	Zachary Young

- **Handle defects found and report**

Firstly, we will rank the defects into a list of acceptable and unacceptable quality such as major, minor, and critical in order to determine a priority of the work. After creating the list of defects, distribute the defects and assign part of the defects to the proper team member. After that, make a report containing the list and the assigned works then distribute the report to all members of the

team to handle the defects.

● **Determine completeness of the project**

Firstly, we can use the unit test to determine whether each function and subtasks output are desired output. If each unit of function or subtasks is fine, we can use the system test to determine whether entire system of our project is designed correctly or behave correctly. If there is no problem with the system test, we can use acceptance test to determine whether our project is ready to be on a actual use for the customer. If all those 3 tests are passed, we determine that our project is complete. If one of those tests is failed, we determine that our project is not completed.

● **Test Plan**

Test No.	Test Type	Target File or Screen	Test Name	Purpose of the Test	Test Data or Situation	Expected Result	Actual Result	Outcome and Actions Required
1	Acceptance Test	TrendPlot.xaml	Trend Plot's UI	Test if the Trend Plot is displayed correctly when the user clicks the "Trend Plot" button in the UI	Date set: 26 th March 2018 1. Sample Data	1. Correct data is displayed in the Trend Plot when the user clicks the "Trend Plot" button in the UI. 2. The Trend Plot is formatted correctly when the user clicks the "Trend Plot" button in the UI. The plot is easily readable	1. It will work as expected 2. It will work as expected It will work as expected	The software will display data in different colors in the Trend Plot when the user clicks the "Trend Plot" button in the UI.
2	Acceptance Test	CascadePlot.xaml	Cascade Plot's UI	Test if data is displayed as expected when the	Date set: 3 th March 2018	1. Correct data is displayed in the Cascade Plot when the user	1. As expected. 2. As expected.	The software displayed data in different colors in the

				user clicks the “Cascade Plot” button in the UI	1. Sample Data	clicks the “Cascade Plot” button in the UI. 2. The Cascade Plot is formatted correctly when the user clicks the “Cascade Plot” button in the UI. 3. The plot is easily readable	3. As expected.	Cascade Plot when the user clicked the “Cascade Plot” button in the UI.
3	Acceptance Test	BodePlot.xml	Bode Plot’s UI	Test if the Bode Plot is displayed correctly when the user clicks the “Bode Plot” button in the UI	Date set: 26 th March 2018 1. Sample Data	1. Correct data is displayed in the Bode Plot when the user clicks the “Bode Plot” button in the UI. 2. The Bode Plot is formatted correctly when the user clicks the “Bode Plot” button in the UI. The plot is easily readable	1. It will work as expected 2. It will work as expected 3. It will work as expected	The software will display data in different colors in the Bode Plot when the user clicks the “Bode Plot” button in the UI.
4	Acceptance Test	TextFileReader.cs	Read in data from a file.	Test that the system can read in sample machine data and use it to	Date set: 26 th March 2018	1. Cascade plot data is read into the system. 2. Bode plot data is read	1. Will work as expected.	The data to be plotted will be read into the system in a manner that can be

				display plots.	1. Sample data	into the system. 3. Trend plot data is read from the system. 4. The data read in can be displayed in the plots.		plotted. No actions will be required.
5	Acceptance Test	TextFileReader.cs	Read in predefined machine states from a file.	Test that the state names and value ranges are read into the system.	Date set: 26 th March 2018 1. Sample data	1. The state names are read into the system. 2. The state ranges are read into the system.	1. Will work as expected.	The system will be able to read in state names and ranges. No actions will be required.
6	Acceptance Test	CascadePlot.xaml.cs	Displaying of data in the Cascade Plot correctly	Test if data is displayed as expected in the Cascade Plot	Date set: 3 th March 2018 1. Sample Data	1. Correct data is displayed in the Cascade Plot. 2. The Cascade Plot is formatted correctly 3. The plot is easily readable	1. As expected. 2. As expected. 3. As expected.	The software displayed data in the Cascade Plot as expected. No actions required.
7	Acceptance Test	CascadePlot.xaml.cs	Displaying of overlapping states in the Cascade Plot	Test if overlapping states is displayed as expected when the data is in multiple states in the Cascade Plot	Date set: 3 th March 2018 1. Sample Data	1. The user can see when the data is in multiple states. 2. The user can easily read the plot.	1. As expected. 2. As expected.	The software displayed overlapping states in different colors when the data was in multiple states in the Cascade Plot as expected. No actions

								required.
8	Acceptance Test	CascadePlot.xaml.cs	Handling overlapping machines in the Cascade Plot	Test if the software can change the colors for the data of the machine that the user selects when he or she clicks a line segment in the Cascade Plot	Date set: 3 th March 2018 1. Sample Data	1. The user can see when multiple machine data overlaps 2. The user can easily read the plot.	1. As expected. 2. As expected.	The colors for the data of the machine that the user selected were changed when he or she clicked a line segment in the Cascade Plot as expected. No actions required.
9	Acceptance Test	TrendPlot.xaml	Display data in Trend Plot	Test that the Trend plot is displayed correctly.	Date set: 26 th March 2018 1. Sample data	1. The user can see when the data is in multiple states. 2. The user can easily read the plot	1. Will work as expected	Date will be displayed correctly. No actions will be required.
10	Acceptance Test	TrendPlot.xaml	Readable Overlapping States	Test that the trend plot displays overlapping states in a readable manner	Date set: 26 th March 2018 1. Sample data	1. The user can see when the data is in multiple states. 2. The user can easily read the data	1. Will work as expected	Data in overlapping states will be distinguishable in an easily readable manner. No actions will be required.
11	Acceptance Test	TrendPlot.xaml	Readable Overlapping Machines	Test that the trend plot displays overlapping machines in a	Date set: 26 th March 2018 1. Sample	1. The user can see when multiple machines data overlaps.	1. Will work as expected	Data overlapping between machines will be distinguished in an easily

				readable manner.	data	2. the user can see easily read the plot.		readable manner.
12	Acceptance Test	BodePlot.xml.cs	Displaying of data in the Bode Plot correctly	Test if data is displayed as expected in the Bode Plot.	Date set: 26 th March 2018 1. Sample Data	1. Correct data will be displayed in the Bode Plot. 2. The Bode Plot will be formatted correctly 3. The plot will be easily readable	1. Will work as expected. 2. Will work as expected. 3. Will work as expected.	The software will display data in the Bode Plot as expected. No actions required.
13	Acceptance Test	BodePlot.xml.cs	handling overlapping machines in the Bode Plot	Test if the software can change the colors for the data of the machine that the user selects when he or she clicks a line segment in the Bode Plot	Date set: 26 th March 2018 1. Sample Data	1. The user will be able to see when multiple machine data overlaps 2. The user will be able to easily read the plot.	1. Will work as expected. 2. Will work as expected.	The colors for the data of the machine that the user selected will be changed when he or she clicked a line segment in the Bode Plot as expected. No actions required.
14	Acceptance Test	Communication between WPF windows	Selecting a machine, so that only that machine is visible	Test if other machine plot lose visibility and chosen machine is visible	Date Set: 26 th March 2018 1. Sample Data	1. only a chosen machine will be visible in the plot. 2. other machines will not be visible once a machine is selected.	1. Will work as expected. 2. Will work as expected.	The visibility of other machines will be changed when he or she choose a machine.

15	Acceptance Test	Communication between WPF windows	Selecting a machine in order to match in all three plots	Test if other machine plot lose visibility and chosen machine is visible in all three plots	Date Set: 26 th March 2018 1. Sample Data	1. other machines will not be visible once a machine is selected.	1. Will work as expected. 2. Will work as expected.	The visibility of other machines will be changed when he or she choose a machine.
16	Happy Path Testing	TrendPlot.xaml.cs	Displaying of data in the Trend Plot	Test if data is displayed as expected in the Trend Plot	Date set: 26 th March 2018 1. Sample Data	No discontinued line. The software should display data in different colors in the Trend Plot. The software should display the overlap between states using different colors.	1. It will work as expected. 2. It will work as expected. 3. It will work as expected.	The software will display data in the Trend Plot as expected. No actions required.
17	Happy Path Testing	CascadePlot.xaml.cs	Displaying of data in the Cascade Plot	Test if data is displayed as expected in the Cascade Plot Test if the Cascade Plot can be correctly updated when the user adjusts the window size, the	Date set: 3 th March 2018 1. Sample Data	The software should display data in different colors in the Cascade Plot. The software should display the overlap between states using different colors. The	1. As expected. 2. As expected. 3. As expected.	The software displayed data in the Cascade Plot as expected when the user adjusted the window size, the elevation angle and the azimuth angle. No actions required.

				elevation angle and the azimuth angle.		software should correctly display data in different colors in the Cascade Plot when the user adjusts the window size, the elevation angle and the azimuth angle		
18	Happy Path Testing	BodePlot.xml.cs	Displaying of data in the Bode Plot	<p>Test if data is displayed as expected in the Bode Plot</p> <p>Test if the software can change the colors for the data of the machine that the user selects when he or she clicks a line segment in the Bode Plot</p>	<p>Date set: 26th March 2018</p> <p>1. Sample Data</p>	<p>No discontinued line.</p> <p>The software should display data in different colors in the Bode Plot.</p> <p>The software should change the colors for the data of the machine that the user selects when he or she clicks a line segment in the Bode Plot</p>	<p>1. It will work as expected.</p> <p>2. It will work as expected.</p> <p>3. It will work as expected.</p>	<p>The software will display data in the Bode Plot as expected . The software will change the colors for the data of the machine that the user selects when he or she clicks a line segment in the Bode Plot as expected. No actions required.</p>
19	Unhappy Path Testing	Machine.xml.cs	Generating Load files before clicking ‘Display’	Test if the software can generate a warning message to tell the user to load files if the user	Date set: 3 th March 2018	The software should generate a warning message – “Load files before clicking ‘Display’”	1. As expected	The software generated a warning message – “Load files before clicking ‘Display’” as expected.

				does not load files before clicking the “Display” button.				No actions required.
20	Unhappy Path Testing	Machine.xml.cs	Using black as the color of undefined state	<p>Test if the software can generate a warning message to tell the user that some values in the files are not within the range of the speed that he or she sets.</p> <p>Test if the software can display data when some values in the files are not within the range of the speed that he or she sets.</p>	<p>Date set: 26th March 2018</p> <p>1. Sample Data</p>	<p>The software should generate a warning message – “Some values in the files are not within the range of the speed you set”</p> <p>After the user clicks the “Yes” button in the warning message dialog, the program displays data in the Trend Plot, Cascade Plot, and Bode Plot using black as the color for undefined values</p>	<p>1. It will work as expected</p> <p>2. It will work as expected</p>	<p>The software will generate a warning message – “Some values in the files are not within the range of the speed you set” as expected. After the user clicks the “Yes” button in the warning message dialog, the program will display data in the Trend Plot, Cascade Plot, and Bode Plot using black as the color for undefined values as expected. No actions required.</p>

6. Contributions of Team Members

Haoxuan Lin spent 4 hours contributing to the following:

- Cover Page
- Project Updates and Changes
- Testing Workflow
- Testing Strategy
- Contributions of Team Members

Myeongwan Beom spent 4 hours contributing to the following:

- Table of Contents
- Abstract
- Testing Strategy

Zachary Young spent 4 hours contributing to the following:

- User Stories and Acceptance Criteria
- Testing Strategy