Software Requirements Document for Remaining Battery Life

TEAM: 01

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Version	Date	Author	Change
0.1		SM	
1.0	4/18	KR	Initial Use Cases, screen sketches, Overall Description, Concept of Operations
1.1	4/25	KR	Added terms, updated screen sketches
1.2	4/29	KR	Updating features, assumptions
1.3	5/1	EW	Performance requirements, design constraints, user characteristics
1.4	5/2	KR	Added Product Perspective, updated diagrams
1.5	5/5	KR	Updated to include capacity prediction features and info
1.6	5/6	KR	Updated to finalize capacity prediction and diagrams

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1 Introduction

1.1 PURPOSE

The purpose of this document is to establish how the application should interact with the end user, and establish all application requirements functional, and non functional. Once finalized, this document will state what must be accomplished for the application to be considered finished.

1.2 SCOPE

This SRS covers a number of potential use cases that users may encounter, as well as an overview of the project and its intended uses. It also includes information on the project's UI sketches, but the primary purpose is to give detailed descriptions of anticipated use cases.

1.3 DEFINITIONS, ACRONYMNS, ABBREVIATIONS

Term	Description
Cell	An individual battery being tested in the lab.
Cycle	The charging and discharging of a battery within the Neware tester. Cycles are one of the main measurements of time within the battery data.
End of life threshold	Percentage of initial or nominal capacity specified by the user.
RUL	Remaining Useful Life

2 Overall Description

Researchers at Iowa State are using a Neware battery tester and its provided software to run tests on battery cells to learn about their performance and durability over time. However, this data is provided to the lab's computer by a physical connection so it cannot be viewed anywhere else without manually organizing and exporting the files, and the data is not as easily viewable as it could be. This web tool will be accessible from any computer with access to the campus network and will display the data in a more consolidated and user-friendly manner.

2.1 PRODUCT PERSPECTIVE

"Voltaiq", a company providing commercial battery-monitoring and performance prediction tools
"NorthStar ACE", a Bluetooth solution for monitoring and viewing historical performance of NorthStar branded batteries
"Qnovo", a company providing battery management intelligence software

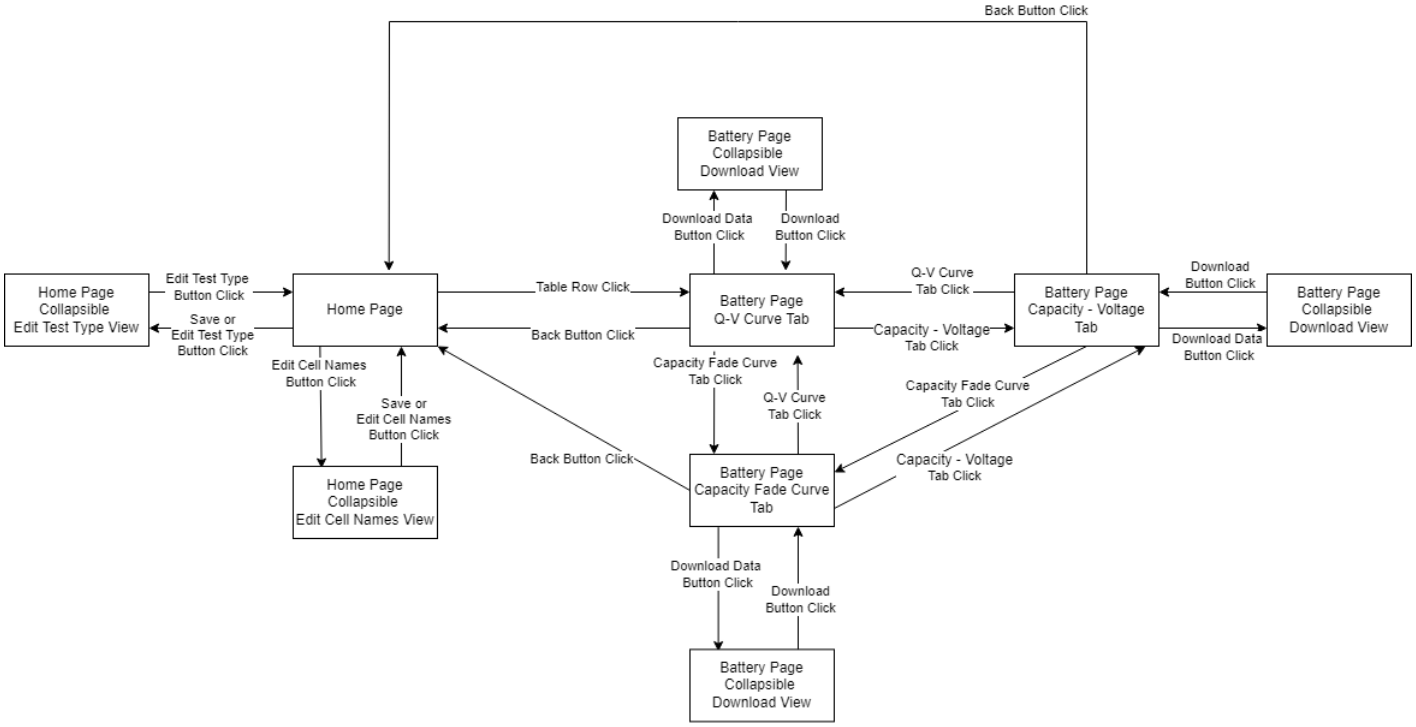
2.1.1 Concept of Operations

This project will be a web-based tool that allows the user to monitor the status and history of battery cells being tested using a Neware battery tester. The tool will display a main dashboard giving an overview of all cells with their current statuses. From this page, users can change the name of a cell, to differentiate it from a different cell that was tested in the same position in the tester, to ensure data correctness.
From this page, users can load pages for each cell that will display several graphs of data for each cell, representing its capacity vs. voltage, for example. A user can navigate between the graphs using a tab bar, labeled with the name of each kind of graph, so that only the relevant graphs are displayed at a given time. Additionally, from this page, users can download all of the data for the particular cell.
This system is supported by a database which stores the cell status, cycle, name, voltage, capacity, and relevant data. The lab computer physically connected to the Neware tester passes information

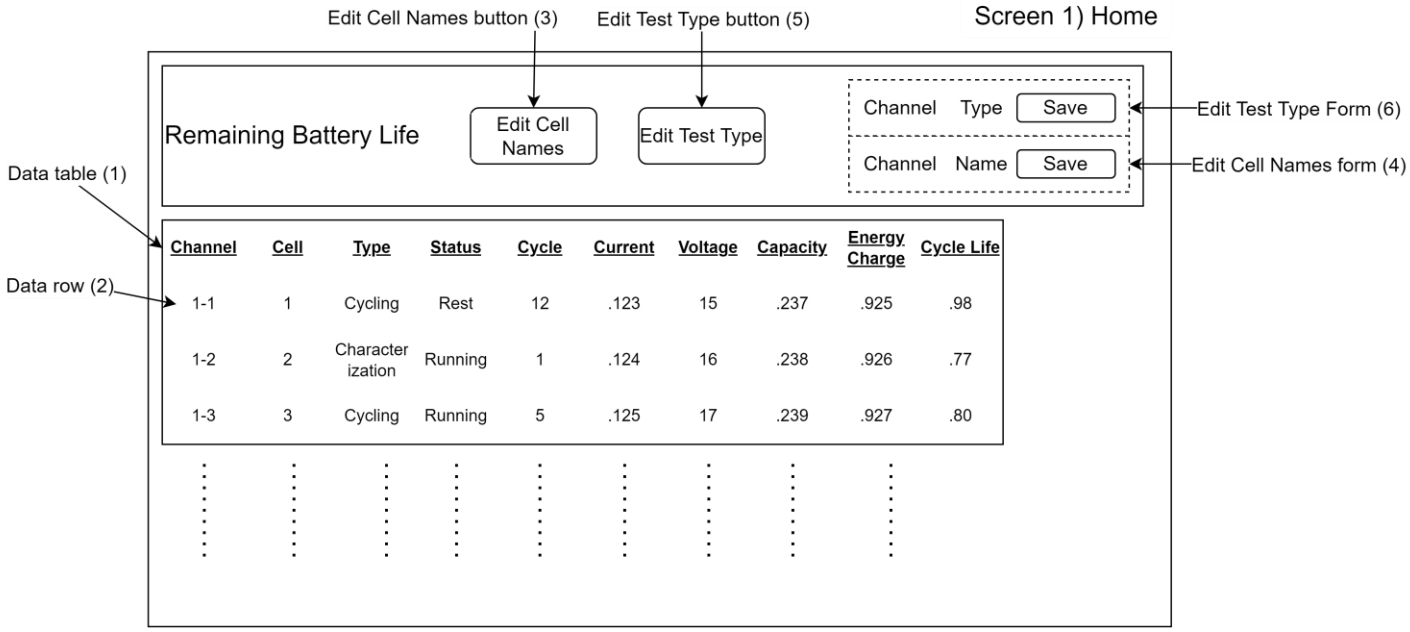
periodically to the database, and the web tool pulls new data from the database at intervals to display the most up-to-date information to users.

2.1.2 Major User Interfaces

The following screen flow diagram describes how users navigate between pages in the web tool. Several of the pages contain a collapsible view that may be minimized – all items available from the page without the collapsible section visible are also available when the collapsible is expanded. For example, within the Battery Page Collapsible Download View, the Back Button could be pressed to return to the Home Page. However, for simplicity those duplicated arrows are omitted from the collapsible sections of this diagram.



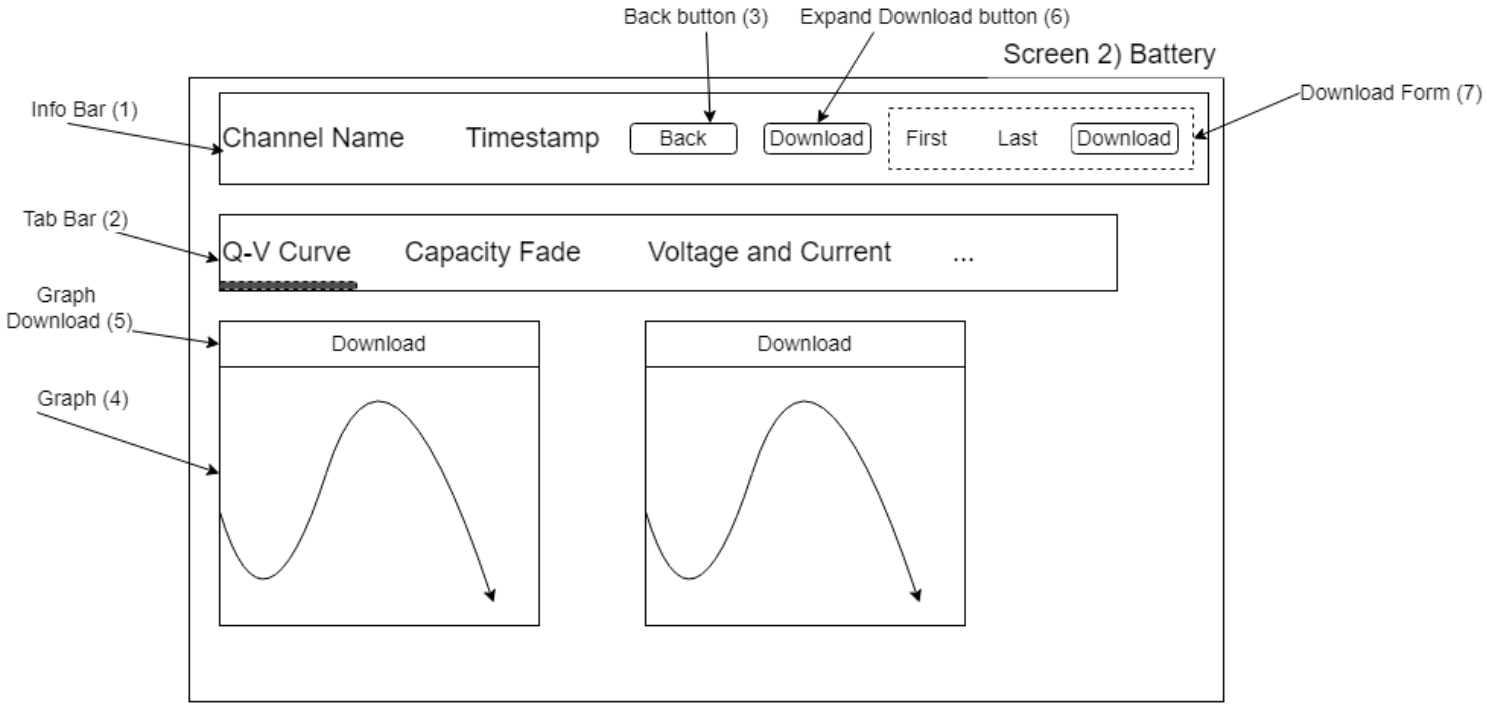
2.1.2.1 Home Page Screen Sketch



The Home screen is what is displayed when a user first opens our site. It provides a dashboard overview of the tests being run in the Neware battery tester. It allows users to view the status of their tests and monitor the progress of all channels simultaneously.

The data is displayed in a data table (1), which contains information such as the channel name, cell voltage, and cell capacity. Each row (2) contains the information about a particular channel and the cell currently in it. Clicking on a particular row loads a page with the graphs for that cell where users can view more in-depth information about it. For a particular channel, the cell currently being tested in it may change at times. Users can use the Edit Cell Names button (3) to open the Edit Cell Names form (4) which by default is not visible. This allows users denote which battery cell is currently being tested in it, so that the appropriate historical data is fetched. The form includes 2 inputs, one for the channel to edit a cell name for, and the other to set the new name, as well as a save button that pushes the information to the database and closes the form again to preserve the simplicity of the page. Similarly, users can use the Edit Test Type button (5) to open the Edit Test Type form (6), which is not visible by default. This uses 2 inputs to set the type of test currently being run on a channel, and follows the same open and close logic as edit cell names.

2.1.2.2 Battery Information Page Screen Sketch



The Battery screen is what is displayed when a user clicks a row on the Home page and is navigated to the Battery page for the clicked-on row. It displays more detailed information about the cell running in the particular channel by displaying graphs of its real-time and historical data

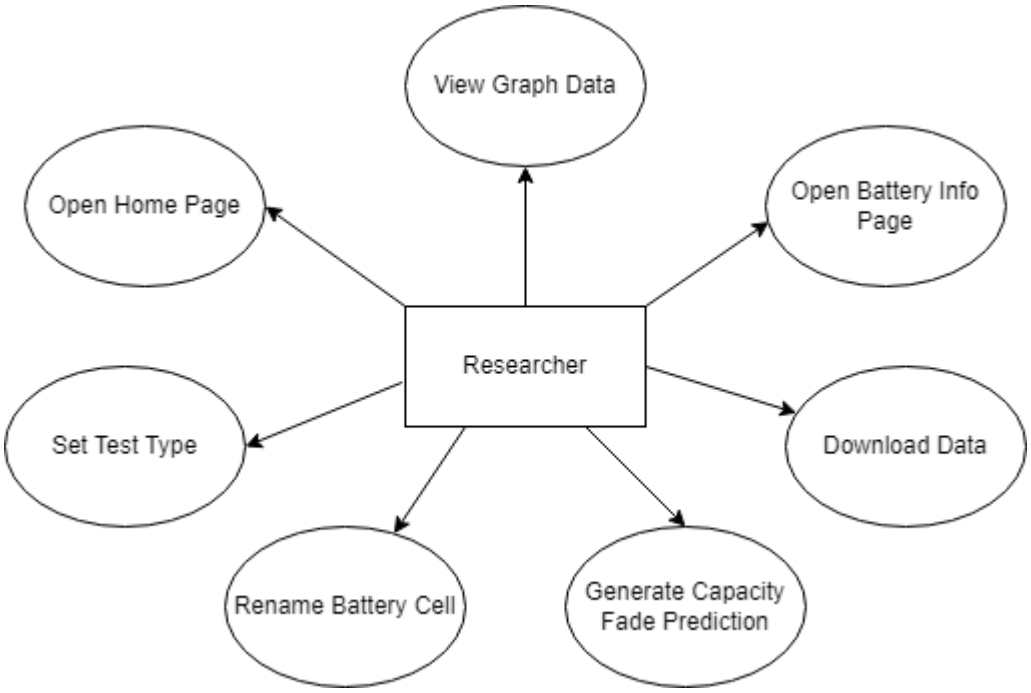
Basic Information about the which channel's data is being viewed, as well as when it was last updated can be viewed in the Info Bar (1), which also contains the Back button (3) that lets a user return to the Home page when they've finished viewing this channel's data. Users can switch between graphs using the Tab bar (2), that lets a user select a particular category, such as Q-V, and view the graph(s) for that category. The Graph (4) uses a scatter plot to display a cell's historical and real-time data. Additionally, in the case of Capacity Fade, the graph displays predicted data based on a user's input in an attached form. For a particular category, there may be 1-3 Graphs, each of which contains a Download button (5) that allows users to download a copy of the graph data in JSON format for use in machine learning training, for example. Additionally, users can select the top Download button (6) to expand a form (7) that allows a user to select which cycles to download data from, and then press the rightmost button to download all data for those cycles (not just a particular graph's data. The form is split into 2 inputs, First and Last, both of which are optional, and which represent the first cycle to pull data for and the last cycle to pull data for, respectively, or if blank are assumed to be the first and last cycle, respectively. The download button within the form writes the correct information into a .json file and downloads it, then closes the form again to preserve the simplicity of the page.

2.1.3 Hardware Interfaces

Any device that supports a web browser and current standards of HTML, CSS, and JS.

Not all features are currently supported with Internet Explorer

2.2 PRODUCT FUNCTIONS



These use cases describe the steps that a researcher would need to take in order to accomplish the main tasks in monitoring the battery cells, such as viewing each page and the data contained within them.

2.2.1 UC-1

"Open Home page" (User goal / Researcher)

Main scenario:

1) The researcher does not currently have the web tool open in their browser.
2) The Researcher navigates to the provided web tool URL.
3) The browser displays the home page.

Extensions:

1a. Researcher currently has the web tool open, on a battery information page.

1a1. The Researcher instead selects the Back button near the top of the page.

2.2.2 UC-2

"Open Battery Info Page" (User goal / Researcher)

Main scenario:

1) The researcher does not currently have the web tool open in their browser.
2) The Researcher navigates to the provided web tool URL.
3) The browser displays the home page with a data table.
4) The user clicks on the table row containing the battery cell that they wish to view the battery information page for.

Extensions:

1a. Researcher currently has the web tool open, on the home page.

1a1. The user clicks on the table row containing the battery cell that they wish to view the battery information page for.

1b. Researcher currently has the web tool open, on a different battery information page.

1b1. The Researcher instead selects the Back button near the top of the page.

1b2. The browser displays the home page with a data table.

1b3. The user clicks on the table row containing the battery cell that they wish to view the battery information page for.

2.2.3 UC-3

"Rename Battery Cell" (User goal / Researcher)

Main scenario:

1. The Researcher opens the main page.
2. The Researcher selects the "Edit Cell Name" button.
3. The site displays a form with spaces to input the channel name where the cell to be updated is located, and the new name for the cell.
4. The Researcher selects "Submit" or presses the Enter key.
5. The data table displays the new name and updates the database to store the new cell name.

2.2.4 UC-4

"Set Test Type" (User goal / Researcher)

Main scenario:

1. The Researcher opens the main page.
2. The Researcher selects the “Edit Test” button.
3. The site displays a form with spaces to input the channel name where the cell to be updated is located, and the new test type name for the cell.
4. The Researcher selects “Submit” or presses the Enter key.
5. The data table displays the new name and updates the database to store the new test type.

2.2.5 UC-5

"Download Data" (User goal / Researcher)

Main scenario:

1. The Researcher opens the battery information page for the cell to download data for.
2. The Researcher selects the “Download Data” button to download all available data for the particular cell.
3. The Researcher may input values for First Cycle and Last Cycle in the generated input boxes to filter what data should be downloaded. If omitted, the first available cycle or last available cycle will be assumed, respectively.

2.2.6 UC-6

"View Graph Data” (User goal / Researcher)

Main Scenario:

1. The Researcher opens the battery information page for the cell to view graph data for.
2. The Researcher selects the tab labeled with the type of data they wish to view.

2.2.7 UC-7

"View Capacity Prediction” (User goal / Researcher)

Main Scenario:

1. The Researcher opens the battery information page for the cell to view the prediction data for.
2. The Researcher selects the tab labeled Capacity Fade Curve.
3. The researcher inputs the desired EOL threshold in decimal format and prediction cutoff in integer format.
4. The Researcher presses the predict button.
5. The site displays the graph with a predicted capacity fade curve.

2.3 USER CHARACTERISTICS

- Users are researchers at Iowa State and employees in the lab.
- Users may leave tool running in the background or have a high frequency of usage.
- Users may require new graphs to be created and added to the battery page.

2.4 CONSTRAINTS

- Data needs to be updated periodically on site to show near-real-time data.
- No budget was specified for buying licenses for tools.
- The data size is large, so not all tools will support displaying this data in a timely manner.

2.5 ASSUMPTIONS AND DEPENDENCIES

2.5.1 The web tool must be on the campus network to run – so, users must either use it from a computer connected to an Iowa State internet network or connected to the Iowa State VPN.

2.5.2 The server hosting the web tool must be available, with needed dependencies such as npm not removed.

2.5.3 The frontend code depends on several external packages, including MUI, Grommet, and CanvasJS, so these must be available for the tool to work properly.

2.5.4 The lab computer must maintain a connection with the Neware battery tester, or the data cannot be sent to the database, and thus displayed in the web app.

3 Specific Requirements

3.1 FEATURES

3.1.1 Home Page

3.1.1.1 Home page should update on intervals with new near real-time data.

3.1.1.2 Home page should display a table with an overview of all cells being tested.

3.1.1.3 Home page should allow users to update the names of cells being tested.

3.1.1.4 Home page should allow users to update the test type of cells being tested.

3.1.2 Battery Information Page

3.1.2.1 Battery information page should update on intervals with new near real-time data.

3.1.2.2 Battery information page should display graphs containing data for a particular cell.

3.1.2.3 Battery information page should allow users to specify which cycles the downloaded data should be for.

3.1.2.4 Battery information page should allow users to download a cell's data to their device.

3.1.2.5 Battery information page should allow users to generate the predicted capacity fade curve

3.2 PERFORMANCE REQUIREMENTS

3.2.1 Graphs should load data in a reasonable amount of time, with respect to the number of data points.

3.2.2 Cell name and test type changes should update and be visible on screen nearly instantly.

3.2.3 Real-time data should update and be visible on screen every 10 seconds approximately.

3.3 DESIGN CONSTRAINTS

3.3.1 The web tool is merely representative of Neware Battery Tester and Neware Software running on lab computer.

3.3.2 Limited by free packages offered by React developers, including CanvasJS charting capabilities, due to only using a trial version.

3.3.3 No mobile support or available application for download.

3.4 SOFTWARE SYSTEM ATTRIBUTES

3.4.1 Reliability

3.4.1.1 The web tool should display consistent and accurate information on every load.

3.4.2 Availability

3.4.2.1 [None]

3.4.3 Security

3.4.3.1 No confidential data is entered into our tool, so no login or authentication is needed

3.4.3.2 Source code should be protected in private git repository so that only authorized users may edit it to prevent tampering.

3.4.4 Maintainability

3.4.4.1 The site should be modular and extensible to account for changes in data being studied and allow for easy addition and removal of new charts and data points.

3.4.5 Portability

3.4.5.1 The web tool should be available on any computer connected to the Iowa State network.

3.4.5.2 The source code should be available on a git repository for authorized users to clone and modify or view.

3.5 OTHER REQUIREMENTS