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# Test Specification

## Bluetooth Low Energy Tracker (BLU)

Version 1.0

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# Table of Contents

Executive Abstract.....	3
Unit Level.....	4
Module Level.....	8
Integration Level.....	12
System Level.....	15
Acceptance Level.....	18

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## EXECUTIVE ABSTRACT

This document will review all test cases for the BLU website. Each test case will review relevant factors affected if a given test case fails. This document organizes test cases into five levels: Unit, Module, Integration, System, and Acceptance. Each test case will go over a set of characteristics that show the specific nature of the test cases. The characteristics follow the ISO 25010 quality model:

- Quality Criterion - Characteristic of the user experience/application functionality that the test case is checking
- Description of Test - Description of what the test involves
- Requirements Reference - Use cases that are relevant to the test case
- Steps of Test Case - Steps taken by script/tester
- Expected Outcome - End case for a successful test

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## UNIT LEVEL

The Unit Level will focus on testing and verifying individual components of our application. The units in the following test cases are the smallest testable parts of the application, such as specific buttons, controls, or validation of very specific portions of input. As the developers, we will use small unit level tests to ensure specific portions of code work as intended, independently of the rest of the system.

### 1. Create Account

Test Level	Unit
Quality Criterion	Data Integrity
Description of Test	Verifies that the system correctly handles new user sign-ups by creating a new account and storing all data securely in the database after verification.
Requirements Reference	Use Case #1: User Logs In Use Case #5: Creating Profile
Steps of Test Case	<ol style="list-style-type: none"><li>1. Input new account information, username, password, and email into the proper fields</li><li>2. Click Create Account and begin verification</li><li>3. Verify email</li><li>4. Check the database and verify that the new account has been accurately created and stored</li></ol>
Expected Outcome	A new user account is created and stored in the database after verification.

### 2. Login

Test Level	Unit
Quality Criterion	Functionality
Description of Test	Test the login functions correctly, allowing access to users with valid credentials while preventing access when invalid credentials are entered.
Requirements Reference	Use Case #1: User Logs In

Steps of Test Case	<ol style="list-style-type: none"> <li>1. Open login page</li> <li>2. Enter existing username or email and password (ensure these are correct)</li> <li>3. Verify that the user is redirected to login if the password is correct</li> <li>4. Log out and attempt log in with an incorrect password</li> <li>5. Verify that an error message exists and persists if the username or password is incorrect</li> </ol>
Expected Outcome	If the credentials are valid the user should be directed to the application's dashboard page, otherwise, the application should display an error message indicating incorrect login and prevent access to the next page.

### 3. Queue Status Message

Test Level	Unit
Quality Criterion	Usability
Description of Test	Verifies that the queue status message displays correctly, providing users with information on their position in the queue.
Requirements Reference	Use Case #19: Join Queue for Bluetooth Receiver
Steps of Test Case	<ol style="list-style-type: none"> <li>1. Press Join Queue to simulate a user entering the queue in a high-traffic scenario.</li> <li>2. Verify that a status message appears indicating the user's position in the queue.</li> <li>3. Validate that the queue number updates as the position changes.</li> <li>4. Ensure the message is easily readable and displays relevant information to the user</li> </ol>
Expected Outcome	The queue status message is displayed with clear information on the user's position and updates dynamically as the user's position in the queue changes.

### 4. Begin New Path

Test Level	Unit
Quality Criterion	Reliability

Description of Test	Ensures that the Begin Path button initiates tracking consistently and without errors, even when accessed multiple times, paused, ended, and restarted.
Requirements Reference	Use Case #10: Begin New Path Use Case #11: End Current Path
Steps of Test Case	<ol style="list-style-type: none"> <li>1. Open the application and navigate to the Create Path page</li> <li>2. Initiate the "Begin Path" button to begin tracking.</li> <li>3. Verify that tracking begins successfully and the Bluetooth connection is established.</li> <li>4. Stop and restart the "Begin Path" function multiple times to test consistency.</li> <li>5. Verify that the Begin Path button triggers a display of the path to the user</li> </ol>
Expected Outcome	The Begin Path function initiates tracking consistently without any errors or crashes under various conditions. The Bluetooth low-energy connection is reliably established each time the Begin Path function is triggered while maintaining tracking functionality under various conditions.

## 5. Path History Access

Test Level	Unit
Quality Criterion	Security
Description of Test	Ensures that only users with admin privileges can view all paths in the database, non admin users can only access their path history.
Requirements Reference	Use Case #9: Access Previous Paths Use Case #15: Sort Path History Use Case #18: Delete Path Data
Steps of Test Case	<ol style="list-style-type: none"> <li>1. Log in as an admin user and attempt to access the full path history in the database.</li> <li>2. Verify that the admin can view all paths.</li> <li>3. Log in as a non-admin user and attempt to access the path history.</li> <li>4. Verify that the non-admin user can only view their paths and is restricted from viewing the paths of other users.</li> </ol>
Expected Outcome	Admin users can view the full path history of all users in the database

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	while non-admin users can only view their path history and are restricted from accessing other users' paths. The security criterion is met by ensuring that unauthorized access attempts by non-admin users are blocked by proper security controls.
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## MODULE LEVEL

The module level will focus on testing how the units of our application work together and interact. In this case, a module is used to describe the web pages that make up the overall system which will include as listed below, the login/sign-up page, the dashboard page, the map queueing page, the map page, and the user profile view page.

### 1. Login/Sign Up Page

Test Level	Module Level
Quality criterion/attribute	Security
Description of test	Users can sign up and log in to their specific account with their unique credentials
Requirements Reference	Use Case #1 - User Logs In Use Case #5 - Creating Profile Use Case #8 - Reset Password
Steps of the test case	<ol style="list-style-type: none"><li>1. Launch the application</li><li>2. Enter user credentials: email and password</li><li>3. Click login button</li></ol>
Expected outcome	Users will be met with 1 of 2 possible outcomes, a redirect to the dashboard page if the credentials are correct or the system will give the user an incorrect credentials message and prompt them to re-enter the password, reset the password, or create an account.

### 2. Dashboard Page

Test Level	Module
Quality criterion/attribute	Functionality
Description of test	Users can navigate to other pages of the application, including the user profile view, the map page, the previous paths page, and the pair new device page.
Requirements Reference	Use Case #4: Access Map Use Case #9: Access Previous Paths Use Case #13: Pair New Device(s)



	Use Case #6: Update Profile
Steps of the test case	<ol style="list-style-type: none"> <li>1. After a successful sign-in users are redirected to the dashboard page.</li> <li>2. Press any of the options listed to be redirected to its corresponding webpage <ol style="list-style-type: none"> <li>a. Press the user icon to be redirected to the user profile view</li> <li>b. Press the “Join Map Queue” to be placed in the access map queue</li> <li>c. Press the “Access Previous Paths” to be redirected to the path history page</li> <li>d. Press the “Pair New Device” to access the pair device page</li> </ol> </li> </ol>
Expected outcome	Users can navigate the application using the dashboard as a hub to carry out tasks.

### 3. Map Queuing Page

Test Level	Module
Quality criterion/attribute	Flexibility
Description of test	Users are placed in a queue when the map is being accessed by another user.
Requirements Reference	Use Case #4: Access Map Use Case #19: Join Queue for Bluetooth Receiver
Steps of the test case	<ol style="list-style-type: none"> <li>1. Press the “Join Map Queue” Button to join the queue</li> <li>2. View the place in the queue the user is currently in</li> <li>3. Once the user is no longer in the queue, the system will redirect to the map page</li> </ol>
Expected outcome	Users will be told what place in the queue they are in when the map page is already in use by another user.

### 4. Map Page

Test Level	Module
Quality criterion/attribute	Interaction Capability
Description of test	Users can interact with their Bluetooth device by tracking their location in real time and viewing this tracking as a trail.

Requirements Reference	Use Case #2: Pause Path Tracking Use Case #3: Resume Path Tracking Use Case #4: Access Map Use Case #10: Begin New Path Use Case #11: End Current Path Use Case #12: Customize Path Use Case #16: Set Points on Path Use Case #20: Alert User When Crossing Boundary
Steps of the test case	<ol style="list-style-type: none"> <li>1. View route tracked by the Bluetooth low-energy device</li> <li>2. Press Start New path to begin tracking a new path           <ol style="list-style-type: none"> <li>a. Press the Pause button to pause tracking</li> <li>b. Press the Resume button to resume tracking</li> <li>c. Press the End Path button to end path tracking</li> </ol> </li> <li>3. Press Customize Path to change the colors of the trail and map</li> </ol>
Expected outcome	Users can interact with Bluetooth low-energy device tracking and view their trail as they walk.

## 5. User Profile View Page

Test Level	Module
Quality criterion/attribute	Reliability
Description of test	User information is accessible and displayed with accuracy and reliability.
Requirements Reference	Use Case #5: Creating Profile Use Case #6: Update Profile Use Case #7: Delete Profile Use Case #9: Access Previous Paths Use Case #13: Pair Device(s)
Steps of the test case	<ol style="list-style-type: none"> <li>1. Press the user icon in the dashboard view to access the user profile view page</li> <li>2. View user information including email and password           <ol style="list-style-type: none"> <li>a. Change email if the user wishes to change the registered email</li> <li>b. Change the password if the user wishes to change the password</li> <li>c. Press save changes</li> <li>d. Verify changes with an email sent to the user</li> </ol> </li> <li>3. Press delete profile to remove user data and account</li> </ol>

	<p>from the database</p> <ol style="list-style-type: none"> <li>4. Press access previous paths to access the previous paths page</li> <li>5. Press Pair Device(s) to add a new device</li> </ol>
Expected outcome	Users can successfully modify their information or delete their account entirely and navigate to other web pages.

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## INTEGRATION LEVEL

The Integration level goes over how the application and system interact with external software such as APIs and databases. There are several ways that these systems may function in adverse ways if gone unchecked, so it is important to be thorough when testing the functionality of these features.

### 1. MariaDB Database Connection

Test Level	Integration
Quality criterion/attribute	Functionality
Description of test	Ensure that the web server can make a connection to the MariaDB instance which should be running on the local machine, although may be running on other machines
Requirements Reference	Use Case #5 Creating Profile Use Case #6 Update Profile Use Case #7 Delete Profile Use Case #8 Reset Password
Steps of the test case	<ol style="list-style-type: none"><li>1. Use “systemctl status mariadb” to ensure that MariaDB is up and running properly</li><li>2. Ensure that the BLU user exists Log into BLU and make a new path. See if it saves properly, even after a restart of the server</li></ol>
Expected outcome	Path and user data should persist

### 2. Device Connection Over IP

Test Level	Integration
Quality criterion/attribute	Functionality
Description of test	Ensure that the web server can connect to the Raspberry Pi
Requirements Reference	Use Case #10 Begin New Path Use Case #13 Pair Devices
Steps of the test case	<ol style="list-style-type: none"><li>1. Log into the Raspberry Pi device</li></ol>

	<ol style="list-style-type: none"> <li>Run the command “ip -c addr” to make sure that the internet interface is up and has a proper, routable, IP address</li> <li>Run the command “ping &lt;server-ip-address&gt;”</li> </ol>
Expected outcome	Pings should be going through with low latency and without many drops

### 3. Ensure COM Port Connection

Test Level	Integration
Quality criterion/attribute	Functionality
Description of test	Ensure that the web server can connect to the Raspberry Pi
Requirements Reference	Use Case #13 Pair Devices
Steps of the test case	<ol style="list-style-type: none"> <li>List directory /dev/</li> <li>See if ports from the NRF device are present “/dev/ttyACM0 and /dev/ttyACM1”</li> <li>Use the screen command to open up the serial port <ol style="list-style-type: none"> <li>Command: “screen /dev/ttyACM1 115200”</li> </ol> </li> <li>Press reset button</li> </ol>
Expected outcome	Screen should show

### 4. Test Path Accuracy and Reflector Adjustment

Test Level	Integration
Quality criterion/attribute	Reliability
Description of test	Ensure that the device is showing the correct location on the path tracking screen.
Requirements Reference	Use Case #10 Begin New Path
Steps of the test case	<ol style="list-style-type: none"> <li>Start a new path and watch as you move throughout the room</li> <li>See if the path matches roughly your actual path throughout the room</li> <li>Adjust the reflectors accordingly, make sure they are at a 60-degree angle from each other</li> </ol>
Expected outcome	The path should accurately reflect the real path that the user

	walked in
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## 5. Database Correctly Stores User Info

Test Level	Integration
Quality criterion/attribute	Efficiency
Description of test	Make sure users are properly being added to the database
Requirements Reference	Use Case #5 Creating Profile Use Case #6 Update Profile Use Case #7 Delete Profile Use Case #8 Reset Password Use Case #13 User Devices
Steps of the test case	<ol style="list-style-type: none"> <li>1. Log into MariaDB with an admin account</li> <li>2. LIST the USERS table from the blu database</li> <li>3. Ensure all users are there</li> <li>4. Log into BLU with an admin account</li> <li>5. Create new users</li> <li>6. Check the database with the LIST command</li> </ol>
Expected outcome	New users and their attributes should be in the database

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## SYSTEM LEVEL

System level refers to test cases that involve the functionality of the application's system. These test cases will include benchmarks for several parts of the backend as well as system integrity to ensure a consistent user experience.

### 1. Server Restart

Test Level	System
Quality Criterion	Reliability
Description of Test	Check that the website is functioning normally after a server reset
Requirements Reference	N/A
Steps of Test Case	<ol style="list-style-type: none"><li>1. Restart server</li><li>2. Browse pages in the website for any abnormalities</li></ol>
Expected Outcome	The website functions the same as it did before resetting

### 2. Web Server Pull Requests

Test Level	System
Quality Criterion	Performance
Description of Test	Automate a large amount of pull requests from the server to emulate a large number of users on the website.
Requirements Reference	Use Case #14: Download Paths
Steps of Test Case	<ol style="list-style-type: none"><li>1. Run 100 pull requests per second</li><li>2. Monitor speed</li><li>3. Open the website on a browser</li></ol>
Expected Outcome	The website will open quickly and work properly

### 3. Database Updates

Test Level	System
Quality Criterion	Performance
Description of Test	Automate a large amount of database lookups and inserts from the database to emulate a large number of users on the website
Requirements Reference	Use Case #1: User Logs In Use Case #5: Creating Profile Use Case #6: Update Profile Use Case #7: Delete Profile Use Case #11: End Current Path Use Case #14: Download Paths Use Case #18: Delete Path Data
Steps of Test Case	<ol style="list-style-type: none"><li>1. Insert 10000 new rows to a table</li><li>2. Log the time to complete</li><li>3. Select all rows from the same table</li><li>4. Log the time to complete the selection</li><li>5. Delete the 10000 new rows</li><li>6. Log the time to complete</li></ol>
Expected Outcome	The time to complete the tests is acceptable

### 4. Search Path History

Test Level	System
Quality Criterion	Performance
Description of Test	Test efficiency of the search bar in View Path History
Requirements Reference	Use Case #14: Download Paths Use Case #15: Sort Path History
Steps of Test Case	<ol style="list-style-type: none"><li>1. Create account</li><li>2. Insert 1000 paths to the database under this account, each with the name "testfile1", with the number incrementing for each file</li><li>3. Go to the path history page</li><li>4. Search "testfile"</li><li>5. Search "1000"</li><li>6. Search "0"</li></ol>



Expected Outcome	The time to search for the tests is acceptable
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## 5. Tracking Device Connection

Test Level	System
Quality Criterion	reliability
Description of Test	Test the reliability of the server to maintain a connection to a tracking device
Requirements Reference	Use Case #4: Access Map Use Case #10: Begin New Path Use Case #11: End Current Path
Steps of Test Case	<ol style="list-style-type: none"> <li>1. Connect device</li> <li>2. Ping the device from the server for one hour</li> <li>3. Log the connection information and review for any network failure</li> </ol>
Expected Outcome	The device maintains a steady connection with the server

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## ACCEPTANCE LEVEL

Acceptance level refers to the general ability the user will have when interacting with the BLU application. This level will test the usability of the software, hardware, and communication between the two to meet the user's standards. It will also help the development process of locating possible errors when accessing BLU from the user's perspective.

### 1. Create an account

Test Level	Acceptance
Quality Criterion	Security
Description of Test	The user creates an account through unique credentials. The user's credentials should not already exist in the application's database.
Requirements Reference	Use Case #5: Creating Profile
Steps of Test Case	<ol style="list-style-type: none"><li>1. Navigate to the log-in menu</li><li>2. Click "Create Account"</li><li>3. The user fills out the email and password</li><li>4. The system confirms that the email is unique</li><li>5. The user account is successfully created</li></ol>
Expected Outcome	A unique account will be created under the user's credentials.

### 2. Login

Test Level	Acceptance
Quality Criterion	Reliability
Description of Test	The user logs in after having an existing account.
Requirements Reference	Use Case #1: User Log in
Steps of Test Case	<ol style="list-style-type: none"><li>1. The user enters their credentials (email and password).</li><li>2. The system verifies credentials through the database.</li><li>3. The user is brought to the main dashboard.</li></ol>
Expected Outcome	The user should be taken to the dashboard if they enter the right credentials. If not, the user should get a pop-up detailing their need to

	re-enter their email/password.
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### 3. Pair Device

Test Level	Acceptance
Quality Criterion	Compatibility
Description of Test	The user pairs their NRF boards to the web application under their account.
Requirements Reference	Use Case #13: Pair Device(s)
Steps of Test Case	<ol style="list-style-type: none"> <li>1. The user clicks on “Pair Device” on the dashboard.</li> <li>2. The user logs the credentials (MAC address) of the hardware.</li> <li>3. The system confirms that the MAC address is unique to the user’s account.</li> <li>4. The system logs the device information in the database.</li> <li>5. The system confirms that the device registration was successful.</li> <li>6. The user should be able to view the device from their profile.</li> </ol>
Expected Outcome	The user should successfully pair their device by entering the correct credentials. If the credentials were inputted incorrectly, the user should be prompted to try again.

### 4. Create Path

Test Level	Acceptance
Quality Criterion	Interaction Capability
Description of Test	The user creates and starts a trial with their NRF boards, Raspberry Pi, and Bluetooth receiver.
Requirements Reference	Use Case #2: Pause Path Tracking Use Case #3: Resume Path Tracking Use Case #4: Access Map Use Case #10: Begin New Path Use Case #11: End Current Path Use Case #19: Join Queue for Bluetooth Receiver
Steps of Test Case	<ol style="list-style-type: none"> <li>1. The user clicks “Create Path” in the dashboard</li> <li>2. The system confirms that the devices are on and displays the map to the user.</li> </ol>

	<ol style="list-style-type: none"> <li>3. The user can start a recorded trial and be able to view their path in real time.</li> <li>4. The user pauses the path and the timer and current path pauses.</li> <li>5. The user resumes the path and the timer resumes as well as the current path.</li> <li>6. The user can stop the path and is given the option to save the path.</li> <li>7. The user saves the path and views it through their user profile.</li> </ol>
Expected Outcome	The user should be able to establish a successful connection and properly display their device location and the boundaries. The user could start, pause/resume, and stop at any time. The user should be able to save the path data to their account.

## 5. View Path History

Test Level	Acceptance
Quality Criterion	Functionality
Description of Test	The User views their path history via their profile. The user views all the paths they have saved in previous trials as well as no repeats. The user will delete paths from their profile.
Requirements Reference	Use Case #9: Access Previous Paths Use Case #15: Sort Path History Use Case #18: Delete Path Data
Steps of Test Case	<ol style="list-style-type: none"> <li>1. The user navigates to their profile.</li> <li>2. The user navigates to their path history through their profile.</li> <li>3. The user searches for specific path names, order based on time, or order based on date.</li> <li>4. The user can choose a path and delete it from the history and should see the path gone from the user's profile.</li> </ol>
Expected Outcome	Users should successfully view and filter their previous trials based on the trial date, time, or name. The user should be able to delete previous trials and should stay removed.

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## 6. Download Path

Test Level	Acceptance
Quality Criterion	Performance Efficiency
Description of Test	The user chooses a path from their history and downloads the path data. The user can choose to download as a CSV or JSON file.
Requirements Reference	Use Case #9: Access Previous Paths Use Case #14: Download Paths
Steps of Test Case	<ol style="list-style-type: none"><li>1. The user accesses their path history.</li><li>2. Upon selecting a previous path, the user can navigate to the download button.</li><li>3. The user chooses the "Download as CSV" to get a CSV file of the path data.</li><li>4. The user chooses the "Download as JSON" to get a JSON file of the path data.</li><li>5. Both downloads should be confirmed by the system that the download was successful and complete.</li></ol>
Expected Outcome	User should be able to properly download the file as either a CSV or JSON file on their computer.