# Smart Turn - Testing Document

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# Ad Hoc Testing

Some parts of our project were tested as we went along and completed it, this mostly focuses on connecting parts together with hardware and checking for their power indication LEDs to light up. This was performed on the UNO, Flora and HC-05.

# CI/CD Testing

We have set up GitLab pipelines to execute Unit tests for our Flutter app on each commit to the main branch to test if a new feature integrates into the current code. Set up automated arduino mock tests to be executed on a push utilising PlatformIO[22] and inbuilt Flutter testing software[23, 24].

# Unit Testing

## Flutter app

Unit testing for the flutter app has been conducted using CI/CD, where API calls and functions were tested using sample values to ensure their correct operation. We mocked and mimicked functionality, testing and checking for correct values and types from change of the app states.

*UI*

Displaying correct Text

```
testWidgets('Navigating between tabs works correctly', (WidgetTester tester) async {
  await tester.pumpWidget(const SmartTurnApp());

  await tester.pump(Duration(seconds: 1));
  await tester.pumpAndSettle();


  await tester.tap(find.text('Select on Map'));
  await tester.pumpAndSettle();


  await tester.tap(find.text('Enter Location'));
  await tester.pumpAndSettle();
```

Refresh and Icon

```
testWidgets('Has refresh button in app bar', (WidgetTester tester) async {
  await tester.pumpWidget(MaterialApp(
    home: MapScreen(
      onLocationSelected: (_) {},
      startCoordinates: LatLng(0.0, 0.0),
    ), // MapScreen
  )); // MaterialApp

  expect(find.byIcon(Icons.refresh), findsOneWidget);
});
);
```

*Navigation*

Correctly parse Geopoints and Turn instructions

```
group('NavigationStep Tests', () {
  Run | Debug
  test('NavigationStep initializes correctly', () {
    final step = NavigationStep(
      instruction: 'Turn right',
      distance: 0.5,
      endLocation: LatLng(53.5, -7.5),
    ); // NavigationStep

    expect(step.instruction, 'Turn right');
    expect(step.distance, 0.5);
    expect(step.endLocation.latitude, 53.5);
    expect(step.endLocation.longitude, -7.5);
  });
});
```

*Bluetooth*

Test for initial false connection then True on successful connection

```dart
test('Bluetooth isConnected should be false initially', () {
  final bluetoothManager = BluetoothManager.instance;
  expect(bluetoothManager.isConnected, isFalse);
});

Run | Debug
test('MockBluetoothManager can simulate connection', () async {
  final mockManager = MockBluetoothManager.instance;
  mockManager.mockConnectResult = true;
  bool result = await mockManager.connectToHC05();
  expect(result, isTrue);
  expect(mockManager.isConnected, isTrue);
});
```

Test for sending data and disconnecting

```dart
test('MockBluetoothManager can simulate sending data', () async {
  final mockManager = MockBluetoothManager.instance;
  mockManager.mockIsConnected = true;
  mockManager.mockSendResult = true;

  String testData = "Test message";
  bool result = await mockManager.sendData(testData);

  expect(result, isTrue);
  expect(mockManager.lastSentData, equals(testData));
});

Run | Debug
test('MockBluetoothManager can simulate disconnect', () async {
  final mockManager = MockBluetoothManager.instance;
  mockManager.mockIsConnected = true;

  await mockManager.disconnect();
  expect(mockManager.isConnected, isFalse);
});
```

*Permissions*

Tests to check for permission questions upon loading up the application

```dart
testWidgets('shows loading initially', (WidgetTester tester) async {
  await tester.pumpWidget(const MaterialApp(
    home: Scaffold(body: CircularProgressIndicator()),
  )); // MaterialApp

  expect(find.byType(CircularProgressIndicator), findsOneWidget);
});

Run | Debug
testWidgets('shows permission dialog if needed', (WidgetTester tester) async {
  await tester.pumpWidget(const MaterialApp(
    home: Scaffold(
      body: AlertDialog(
        title: Text('Permissions Required'),
        content: Text('Location and Bluetooth permissions are necessary please ensure access rights'),
        actions: [
          TextButton(onPressed: null, child: Text('Open Settings')),
          TextButton(onPressed: null, child: Text('Try Again')),
        ],
      ), // AlertDialog
    ), // Scaffold
  )); // MaterialApp

  expect(find.text('Permissions Required'), findsOneWidget);
  expect(find.text('Open Settings'), findsOneWidget);
  expect(find.text('Try Again'), findsOneWidget);
});
```

*API*

Tests for working API

```dart
group("API Calls", () {
  // Ensure API Returns somthing
  Run | Debug
  test('Ensure results for Longford, Ireland', () async {
    final results = await fetchLocationIQAutocomplete('Longford, Ireland');

    // Just ensure something was returned
    expect(results, isNotEmpty);
  });

  Run | Debug
  test('Nominatim results for Longford, Ireland', () async {
    final results = await Nominatim.searchByName(query: 'Longford, Ireland', limit: 1);
    expect(results, isNotEmpty);
    // May fail this if html -> Not too important (As long as HTML checker works)
    expect(results.first.displayName.toLowerCase(), contains('longford'));
  });
```

# Front Assembly

This includes Arduino UNO, Touch Sensor, HC-05 Bluetooth module, and Screen

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**Software Application**: Smart Turn **Tester Name**: Josh

**Release Version:** 0.4 **Test Date:** 02/04/2025

## Test Information

**Test Type:** Unit

**Pre-Requisites:** UNO connected to a laptop, Arduino IDE installed, Screen wired to UNO

**Components Tested:** Screen

## Results Summary

Screen working as indented when running the test example from Arduino IDE.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User uploads the Screen test code to UNO | The code compiles and is put onto UNO | As expected | Pass |
| User observes the screen | Test output for the screen is displayed with no issues. | As expected | Pass |

**Possible Faults:**
Wires were not connected correctly.
Code failed to compile due to syntax error.
Screen module is faulty.

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**Software Application**: Smart Turn **Tester Name**: Jakub

**Release Version:** 0.3 **Test Date:** 17/03/2025

## Test Information

**Test Type:** Unit

**Pre-Requisites:** UNO connected to a laptop, Arduino IDE installed, MPR 121 Touch Sensor connected to UNO.

**Components Tested:** MPR 121 Touch Sensor

## Results Summary

Touch sensor worked as intended; the correct pins were “pressed” and “released” in the serial monitor output on Arduino IDE.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User uploads the touch sensor test code to UNO. | The code compiles and is put onto UNO | As expected | Pass |
| User opens up the serial monitor using the Arduino IDE and presses pin 1 with their finger. | A message saying: pin 1 is pressed appears in the serial monitor. | As expected | Pass |
| User lifts their finger up from pin 1. | A message saying: pin 1 is released appears in the serial monitor. | As expected | Pass |

**Possible Faults:**
Wires were not connected correctly.
Code failed to compile due to syntax error.
Touch sensor module is faulty.
Pins are not soldered correctly resulting in a pin being “pressed” constantly.

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# Rear Assembly

This includes Adafruit FLORA, Bluefruit UART Bluetooth and NeoPixel LEDs

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**Software Application**: Smart Turn **Tester Name**: Jakub

**Release Version:** 0.1 **Test Date:** 01/03/2025

## Test Information

**Test Type:** Unit

**Pre-Requisites:** Flora connected to power, NeoPixel LED, 3 Wires, Arduino IDE installed

**Components Tested:** NeoPixel LEDs (This test was repeated for all LED's in our project.)

## Results Summary

NeoPixel LEDs were powering on and displaying Red, Green and Blue colours.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User uploads the NeoPixel test code to FLORA | The code compiles and is put onto Flora | As expected | Pass |
| User attached wires in the following order:<br>GND to "-" on LED<br>VBATT to "+" on LED<br>#6 to "->" on LED | The LED lights up Red then Green and then Blue in a loop | As expected | Pass |

**Possible Faults:**
Wires were not connected correctly.
Code is missing the ".show()" function to initiate the LED.

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**Software Application**: Smart Turn **Tester Name**: Jakub

**Release Version:** 0.3 **Test Date:** 17/03/2025

## Test Information

**Test Type:** Unit

**Pre-Requisites:** Flora connected to power, Bluefruit UART module wired to Flora, Arduino IDE installed

**Components Tested:** Bluefruit UART module

## Results Summary

BLE module working as intended; AT command's show output in serial monitor of the Arduino IDE.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User uploads the Bluefruit UART test code to FLORA. | The code compiles and is put onto Flora | As expected | Pass |
| User opens up the serial monitor and checks for information about the BLE module. | Information about the BLE module is displayed. | As expected | Pass |
| User inputs AT help into the serial monitor and presses enter. | All the AT commands show in the serial monitor | As expected | Pass |

**Possible Faults:**
Wires were not connected correctly.
Code is missing the ".show()" function to initiate the LED.

# Integration Testing

## Flutter app

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**Software Application**: Smart Turn **Tester Name**: Josh

**Release Version:** 0.2 **Test Date:** 14/03/2025

### Test Information

**Test Type:** Integration

**Pre-Requisites:** App Installed, Bluetooth Enabled

**Components Tested:** Flutter Bluetooth & HC05

### Results Summary

- Phone connected to HC05
- Passed Data to HC05
- Maintained Connection to HC05

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| Enable Bluetooth | Connects to HC05 | Connected to HC05 | Pass |

**Possible Faults:**
Fails to connect to bluetooth device, bluetooth was not enabled, wired incorrectly

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**Software Application**: Smart Turn **Tester Name**: Josh

**Release Version:** 0.6 **Test Date:** 20/03/2025

## Test Information

**Test Type:** Integration

**Pre-Requisites:** Have app installed, Selected Destination, Location Enabled

**Components Tested:** Flutter App Navigation

## Results Summary

- App sensed destination reached
- Users current location updated on movement
- Distance to destination displayed correctly
- Minor issues of turn

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| Location & Destination | Calculated Route and Distance | Calculated Route and Distance | Pass |
| Walk to Destination | Display “Destination Reached” | Displays “Destination Reached” | Pass |
| Turning at a Turn | Updated directional information | At turn point of 0 distance alternating directions received | Fail |

**Possible Faults:**
Constant alternation of directions when at turn point.

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**Software Application**: Smart Turn **Tester Name**: Josh

**Release Version:** 0.8 **Test Date:** 05/04/2025

## Test Information

**Test Type:** Integration

**Pre-Requisites:** Device Connected to HC05, App Opened, Location Selected

**Components Tested:** Flutter App

## Results Summary

- Data continued to send even when phone was asleep or other apps were in use

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User Entered Location | Data starts sending to display | As expected | Pass |
| User sleeps phone or uses other app | Data continues to be sent and displayed | As expected | Pass |

**Possible Faults:**
Collision of processes in Device OS terminating or disrupting the operation.

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**Software Application**: Smart Turn **Tester Name**: Josh

**Release Version:** 1.2 **Test Date:**09/04/2025

## Test Information

**Test Type:** Integration

**Pre-Requisites:** Flutter App open

**Components Tested:** Flutter App

## Results Summary

- Users are prompted to confirm the location they want to travel to, a navigation line is drawn on the map and the next step is displayed at the bottom of the screen for debugging but it updates too quickly to be meaningful.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User opens Flutter App and presses the map Icon near the bottom right of the screen | The App displays an OSM map. | As expected | Pass |
| A User taps on the OSM to select a location they want to travel to. | The user is prompted with a pop up to confirm the location they have chosen. | As expected | Pass |
| User pressed confirm. | A black line with red turn points appears on the map. | As expected | Pass |
| N/A | Debugging information shows up below the map to ensure the next turn distance and direction is correct. | Debugging information is showing but it updates too quickly. | Fail |

**Possible Faults:**
User does not press confirm on when prompted.
The API is being called too frequently which causes the debug info to update too fast.

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# Front Assembly

This includes Arduino UNO, Touch Sensor, HC-05 Bluetooth module, and Screen

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**Software Application**: Smart Turn

**Tester Name**: Josh

**Release Version:** 0.9

**Test Date:** 06/04/2025

## Test Information

**Test Type:** Integration

**Pre-Requisites:** Have the app installed and running on a phone, Uno connected to power with HC-05 wired to it.

**Components Tested:** HC-05 and Flutter App

## Results Summary

- Flutter App displays bluetooth not connected in red text when HC-05 is offline, bluetooth is connected in green text when HC-05 is online and connected to.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User opens Flutter App with the Uno powered off | App displays bluetooth not connected in red text | As expected | Pass |
| User turns off the app, plugs Uno to a power source and opens the app again | App bluetooth is connected in green text | As expected | Pass |

**Possible Faults:**
Code bug, checking for bluetooth connection incorrectly.
HC-05 not wired properly.

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**Software Application**: Smart Turn **Tester Name**: Josh

**Release Version:** 1.0 **Test Date:** 07/04/2025

## Test Information

**Test Type:** Integration

**Pre-Requisites:** Uno connected to power, HC-05 and Screen wired to the Uno.

**Components Tested:** HC-05 and Screen and Flutter App

## Results Summary

- Device connected and a green circle appears on the screen when the UNO is connected to the app.
- Device disconnected and a red circle appears on the screen when the UNO is disconnected from the app.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User opens Flutter App with the Uno powered On. | Screen displays: Device connected and a green circle. | As expected | Pass |
| User turns off the Flutter App while the Uno is powered On. | Screen displays: Device disconnected and a red circle. | As expected | Pass |

**Possible Faults:**
Device disconnected does not appear when the app is first launched due to a bug.
Incorrect wiring.

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**Software Application**: Smart Turn **Tester Name**: Josh

**Release Version:** 1.3 **Test Date:**10/04/2025

## Test Information

**Test Type:** Integration

**Pre-Requisites:** Uno connected to power, HC-05 and Screen wired to the Uno, Flutter App open.

**Components Tested:** HC-05 and Screen and Flutter App

## Results Summary

- Directions show up on screen but they show up too quickly and in the wrong location on the screen.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User opens the Flutter App with the Uno powered On. | Screen displays: Device connected and a green circle. | As expected | Pass |
| User turns off the Flutter App while the Uno is powered On. | Screen displays: Device disconnected and a red circle. | As expected | Pass |

**Possible Faults:**
Device disconnected does not appear when the app is first launched due to a bug.
Incorrect wiring.

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**Software Application**: Smart Turn **Tester Name**: Josh

**Release Version:** 1.3 **Test Date:**03/04/2025

## Test Information

**Test Type:** Integration

**Pre-Requisites:** Uno connected to power, HC-05 and Screen wired to the Uno, Flutter App open.

**Components Tested:** HC-05 and Screen and Flutter App

## Results Summary

- Messages still passed when android screen was off or different apps were in use

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User opens Flutter App and inputs location | Screen displays: Distance and direction with distance | As expected | Pass |
| User turns off device and uses other applications | Messages pass to the hardware and display | As expected | Pass |

**Possible Faults:**
Operations in the mobile OS interfere with the Application.
Application stops functioning when screen is not active.

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**Software Application**: Smart Turn **Tester Name**: Jakub

**Release Version:** 1.3 **Test Date:**13/04/2025

# Test Information

**Test Type:** Integration

**Pre-Requisites:** Uno connected to power, HC-05 and Screen wired to the Uno, Flutter App open.

**Components Tested:** HC-05 and Screen and Flutter App

## Results Summary

- Directions show up on screen and change when a different route is selected.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User opens Flutter App with the Uno powered On, presses the map icon on the bottom right of the screen. | App displays the OSM map. | As expected | Pass |
| User selects a location on the map they want to travel to and confirms it. | A line is drawn on the OSM map showing the route, directions are showing up on the screen. | As expected | Pass |
| User selects a different location on the map and confirms it. | A different line of travel is drawn on the OSM map, new directions show up on the screen. | As expected | Pass |

**Possible Faults:**
User does not confirm the selected location.
Directions do not update in a timely manner due to API calls being slow or too fast.

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# Rear Assembly

This includes Adafruit FLORA, Bluefruit UART Bluetooth and NeoPixel LEDs

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**Software Application**: Smart Turn

**Tester Name**: Jakub

**Release Version:** 1.0

**Test Date:**07/04/2025

## Test Information

**Test Type:** Integration

**Pre-Requisites:** Flora Connected to Power, Bluefruit BLE wired to Flora, Bluefruit connect app, Arduino IDE serial monitor open.

**Components Tested:** Bluefruit BLE.

## Results Summary

- Phone connects to the BLE module but there was no output in the serial monitor after user input.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User downloads the Bluefruit connect app on their phone, powers on Flora and Bluefruit BLE module. | App installs on their device, Flora and Bluefruit power indicators light up. | As expected | Pass |
| User opens the Bluefruit connect app and connects to the Bluefruit BLE module and opens the Serial Monitor in the Arduino IDE. | Bluefruit BLE module connection LED lights up Blue. | As expected | Pass |
| User selects UART option and sends a 1 to Bluefruit module. | A 1 shows up in the serial monitor. | Nothing showed up in the serial monitor | Fail |

**Possible Faults:**
The Bluefruit BLE module was not in UART mode, but instead in command mode.

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**Software Application**: Smart Turn

**Tester Name**: Jakub

**Release Version:** 1.0

**Test Date:**07/04/2025

## Test Information

**Test Type:** Integration

**Pre-Requisites:** Flora Connected to Power, Bluefruit BLE wired to Flora, Bluefruit connect app, Arduino IDE serial monitor open, **BLE module in UART MODE**

**Components Tested:** Bluefruit BLE.

## Results Summary

- Phone connects to the BLE module and 1 is displayed in the serial monitor once the user sends it.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User download the Bluefruit connect app on their phone, powers on Flora and Bluefruit BLE modules, and ensures the BLE module is in UART mode. | App installs on their device, Flora and Bluefruit power indicators light up. | As expected | Pass |
| User opens the Bluefruit connect app and connects to the Bluefruit BLE module and opens the Serial Monitor in the Arduino IDE. | Bluefruit BLE module connection LED lights up Blue. | As expected | Pass |
| User selects the UART option and sends a 1 to the Bluefruit module. | A 1 shows up in the serial monitor. | As expected | Pass |

**Possible Faults:**
N\A

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**Software Application**: Smart Turn **Tester Name**: Jakub

**Release Version:** 1.5 **Test Date:**14/04/2025

## Test Information

**Test Type:** Integration

**Pre-Requisites:** Flora Connected to Power, NeoPixel LEDs Right Arrow connected to Flora and stitched.

**Components Tested:** Right LED Arrow.

## Results Summary

- The LED arrow lights up orange but not fully.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User uploads NeoPixel test program, changes the LED amount to 10, output Pin to 6 and color to orange using RGB values and loads it up onto Flora. | Code compiles and is loaded onto Flora to execute. | As expected | Pass |
| N/A | Right LED arrow lights up orange. | Not all LED's light up orange. | Fail |

**Possible Faults:**
Wiring of the arrow Signal/Power/Ground line isn't done correctly.

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**Software Application**: Smart Turn **Tester Name**: Jakub

**Release Version:** 1.5 **Test Date:**14/04/2025

## Test Information

**Test Type:** Integration

**Pre-Requisites:** Flora Connected to Power, NeoPixel LEDs Right Arrow connected to Flora and stitched, **Signal line between LED 5 and 6 was restitched**.

**Components Tested:** Right LED Arrow.

## Results Summary

- The LED arrow lights up orange fully.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User uploads NeoPixel test program, changes the LED amount to 10, output Pin to 6 and color to orange using RGB values and loads it up onto Flora. | Code compiles and is loaded onto Flora to execute. | As expected | Pass |
| N/A | Right LED arrow lights up orange. | As expected | Pass |

**Possible Faults:**
N/A

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**Software Application**: Smart Turn **Tester Name**: Jakub

**Release Version:** 1.5 **Test Date:**14/04/2025

## Test Information

**Test Type:** Integration

**Pre-Requisites:** Flora Connected to Power, NeoPixel LEDs Left Arrow connected to Flora and stitched.

**Components Tested:** Left LED Arrow.

## Results Summary

- The LED arrow lights up orange fully.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User uploads NeoPixel test program, changes the LED amount to 10, output Pin to 10 and color to orange using RGB values and loads it up onto Flora. | Code compiles and is loaded onto Flora to execute. | As expected | Pass |
| N/A | Right LED arrow lights up orange. | As expected | Pass |

**Possible Faults:**
N/A

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**Software Application**: Smart Turn **Tester Name**: Jakub

**Release Version:** 2.2 **Test Date:** 21/04/2025

# Test Information

**Test Type:** Integration

**Pre-Requisites:** Flora connected, Bluefruit BLE wired to flora, Flutter App running.

**Components Tested:** Flutter App

## Results Summary

- Flutter App is connected to the Bluefruit BLE module.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User opens the Flutter App. | The app opens up. | As expected | Pass |
| N/A | The user observes if the connection LED lights up blue. | As expected | Pass |

**Possible Faults:**
BLE module not wired correctly.

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**Software Application**: Smart Turn **Tester Name**: Jakub

**Release Version:** 2.3 **Test Date:** 21/04/2025

## Test Information

**Test Type:** Integration

**Pre-Requisites:** Flora connected, Bluefruit BLE wired to flora, Flutter App running.

**Components Tested:** Flutter App

## Results Summary

- Flutter App is connected to the Bluefruit BLE module, upon disconnection the app tries to connect again.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User opens the Flutter App. | The app opens up. | As expected | Pass |

| | | | |
|---|---|---|---|
| N/A | The user observes if the connection LED lights up blue. | As expected | Pass |
| User Powers off the Flora and turns it on again. | The connection LED should switch off when the power is cut and lights up blue when the connection is established. | As expected | Pass |

**Possible Faults:**
BLE module not wired correctly.

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# System Testing

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**Software Application**: Smart Turn **Tester Name**: Jakub

**Release Version:** 1.8 **Test Date:** 20/04/2025

## Test Information

**Test Type:** System

**Pre-Requisites:** Uno Connected to Power, Screen and HC-05 connected to UNO, Flutter App launched.

**Components Tested:** Flutter App and Screen.

### Results Summary

- Flutter App is calling the API too quickly for the UNO to display it on the screen without overflowing the set bounds.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |

| | | | |
|---|---|---|---|
| User opens the Flutter App, selects a destination and confirms it. | A line is drawn on the OSM map to the destination. | As expected | Pass |
| N/A | The directions show up on screen and are called with enough time for the UNO to process them. | Directions update multiple times a second causing an overflow, messages printing on top of eachother. | Fail |

**Possible Faults:**
API calls are made too often.
A function is executed multiple times.

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**Software Application**: Smart Turn **Tester Name**: Jakub

**Release Version:** 1.9 **Test Date:** 20/04/2025

## Test Information

**Test Type:** System

**Pre-Requisites:** Uno Connected to Power, Screen and HC-05 connected to UNO, Flutter App launched, **A function that called the API multiple times as edge case was removed as it was redundant.**

**Components Tested:** Flutter App and Screen.

## Results Summary

- Flutter App is calling the API in a timely manner as the UNO can process it before the next input is received.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |

| | | | |
|---|---|---|---|
| User opens the Flutter App, selects a destination and confirms it. | A line is drawn on the OSM map to the destination. | As expected | Pass |
| N/A | The directions show up on screen and are called with enough time for the UNO to process them. | As expected | Pass |

**Possible Faults:**
N/A

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**Software Application**: Smart Turn **Tester Name**: Josh

**Release Version:** 2.0 **Test Date:** 21/04/2025

## Test Information

**Test Type:** System

**Pre-Requisites:** Uno Connected to Power, Screen and HC-05 connected to UNO, Flutter App launched.

**Components Tested:** Flutter App and Screen.

## Results Summary

- Flutter App is calling the API and updating as the user moves, it does not update when app is running in background or when the screen is locked, screen gets over loaded once the user is back in the app.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User opens the Flutter App, selects a destination and confirms it. | A line is drawn on the OSM map to the destination. | As expected | Pass |

| | | | |
|---|---|---|---|
| N/A | The directions show up on screen and are called with enough time for the UNO to process them. | As expected | Pass |
| User walks/cycles according to the directions | The distance updates as the user gets closer to the next turn | As expected | Pass |
| User goes back to the home screen while the app is running | The distance updates as the user gets closer to the next turn | The distance updates rarely its not consistent and it sometimes overloads the screen | Fail |
| User locks his phone | The distance updates as the user gets closer to the next turn | The distance doesn't update until the app is open again by the user, and it overloads the screen with all the previous API calls | Fail |

**Possible Faults:**
App is not forced to still run in the background.
Old hardware (using an old phone to test it).

---

**Software Application**: Smart Turn **Tester Name**: Jakub

**Release Version:** 2.1 **Test Date:** 21/04/2025

## Test Information

**Test Type:** System

**Pre-Requisites:** Uno Connected to Power, Flutter App launched with debug in PowerShell, Touch Sensor and HC-05 attached to Uno and connected to App.

**Components Tested:** Flutter App and Touch Sensor.

## Results Summary

- Flutter App debug shows messages sent when the touch sensor is activated.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User runs the Flutter App in a power shell terminal. | App compiles and runs | As expected | Pass |
| User presses the touch sensor | Messages from HC-05 display in the powershell terminal. | As expected | Pass |

**Possible Faults:**
HC-05 not connected.

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**Software Application**: Smart Turn **Tester Name**: Josh

**Release Version:** 2.1 **Test Date:** 21/04/2025

# Test Information

**Test Type:** System

**Pre-Requisites:** Uno Connected to Power, Screen and HC-05 connected to UNO, Flutter App launched, **We used a newer phone with Android 12 instead of 8.10.**

**Components Tested:** Flutter App and Screen.

## Results Summary

- Flutter App is calling the API and updating as the user moves, it updates in the background and when the phone is locked.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User opens the Flutter App, selects a destination and confirms it. | A line is drawn on the OSM map to the destination. | As expected | Pass |
| N/A | The directions show up on screen and are called with enough time for the UNO to process them. | As expected | Pass |
| User walks/cycles according to the directions | The distance updates as the user gets closer to the next turn | As expected | Pass |
| User goes back to the home screen while the app is running | The distance updates as the user gets closer to the next turn | As expected | Pass |
| User locks his phone | The distance updates as the user gets closer to the next turn | As expected | Pass |

**Possible Faults:**
N/A

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**Software Application**: Smart Turn **Tester Name**: Jakub

**Release Version:** 2.5 **Test Date:** 22/04/2025

## Test Information

**Test Type:** System

**Pre-Requisites:** Flora connected, Bluefruit BLE wired to flora, Flutter App running, Touch Sensor and HC-05 connected to a powered Uno.

**Components Tested:** Flutter App, Bluefruit BLE, HC-05, Touch Sensor

## Results Summary

- Flutter App is connected to the Bluefruit BLE module and HC-05 the data is being sent from Uno to the App but it does not reach the Flora.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User opens the Flutter App and a PowerShell terminal to debug the touch sensor output. | The app opens up. | As expected | Pass |
| User touches the right hand side of the touch sensor. | The output is shown in the terminal and the corresponding turn signal lights up. | Output shown in terminal but the Flora didn't receive it so the turn signal wont turn on. | Fail |

**Possible Faults:**
BLE module not wired correctly.
BLE module characteristics not discovered.

---

**Software Application**: Smart Turn **Tester Name**: Jakub

**Release Version:** 2.6 **Test Date:** 22/04/2025

## Test Information

**Test Type:** System

**Pre-Requisites:** Flora connected, Bluefruit BLE wired to flora, Flutter App running, Touch Sensor and HC-05 connected to a powered Uno. **Made sure BLE characteristics are discovered before the connection is made.**

**Components Tested:** Flutter App, Bluefruit BLE, HC-05, Touch Sensor

## Results Summary

- Flutter App is connected to the Bluefruit BLE module and HC-05 the data is being sent from Uno to the App it reaches Flora and the correct turn signal lights up.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User opens the Flutter App and a PowerShell terminal to debug the touch sensor output. | The app opens up. | As expected | Pass |
| User touches the right hand side of the touch sensor. | The output is shown in the terminal and the corresponding turn signal lights up. | As expected | Pass |
| User touches the middle of the touch sensor. | The currently lit up turn signal turns off. | As expected | Pass |
| User touches the left hand side of the touch sensor. | The output is shown in the terminal and the corresponding turn signal lights up. | As expected | Pass |

**Possible Faults:**
N/A

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**Software Application**: Smart Turn **Tester Name**: Jakub

**Release Version:** 2.8 **Test Date:** 27/04/2025

## Test Information

**Test Type:** System

**Pre-Requisites:** Flora connected, Bluefruit BLE wired to flora, Flutter App running, Touch Sensor and HC-05 connected to a powered Uno. **Made sure BLE characteristics are discovered before the connection is made.**

**Components Tested:** Flutter App, Bluefruit BLE, HC-05, Touch Sensor

## Results Summary

- Flutter App is connected to the Bluefruit BLE module and HC-05 the data is being sent from Uno to the App it reaches Flora and the correct turn signal lights up and an arrow indicating which direction is turned on shows up on the screen.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User opens the Flutter App and a PowerShell terminal to debug the touch sensor output. | The app opens up. | As expected | Pass |
| User touches the right hand side of the touch sensor. | The output is shown in the terminal and the corresponding turn signal lights up. A green arrow pointing Right shows up on the screen. | As expected | Pass |
| User touches the middle of the touch sensor. | The currently lit up turn signal turns off. The current turn signal Arrow is cleared. | As expected | Pass |
| User touches the left hand side of the touch sensor. | The output is shown in the terminal and the corresponding turn signal lights up.A green arrow pointing Left shows up on the screen. | As expected | Pass |

**Possible Faults:**
Arrow not being drawn in the correct place.
Clearing function misaligned.

**Software Application**: Smart Turn **Tester Name**: Jakub

**Release Version:** 2.8 **Test Date:** 27/04/2025

## Test Information

**Test Type:** System

**Pre-Requisites:** Uno connected to Power, Touch Sensor, HC-05 and Screen Wired to Uno.

**Components Tested:** Screen and Flutter App.

## Results Summary

- When the Flutter app updates the location, the previous text gets cleared fully similarly with the Arrows.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User opens the Flutter App and makes sure the HC-05 is connected. | The app opens up, HC-05 Connection light is lit up Blue. | As expected | Pass |
| User selects a destination and confirms it. | The Direction and distance is showing on the screen with no artifacts or uncleared text left. | As expected | Pass |
| User touches the left/right hand side on the touch sensor. | The corresponding turn signal indicator is shown on the screen with the previous one being removed. | As expected | Pass |
| User shuts down the app. | Disconnected text appears and the rest of the screen is cleared. | As expected | Pass |

**Possible Faults:**
Mismatched dimensions when clearing the screen.

**Software Application**: Smart Turn **Tester Name**: Jakub

**Release Version:** 3.0 **Test Date:** 28/04/2025

## Test Information

**Test Type:** System

**Pre-Requisites:** Uno connected to Power, HC-05 and Screen Wired to Uno.

**Components Tested:** Screen and Flutter App.

## Results Summary

- When the Flutter app updates the navigation directions while the app is in foreground but it does not update when the app is in the background.

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User opens the Flutter App and selects a destination and confirms it. | A polyline is drawn towards the destination and directions start sending to the screen. | As expected | Pass |
| N/A | Directions keep updating as the app is in foreground. | As expected | Pass |
| User exits the app leaving it to execute in the background/locks their device | Directions keep updating as the app is in the background. | Direction updates are not sent through. | Fail |

**Possible Faults:**
Bluetooth disconnects when the app goes to background mode.
Geolocation calls stop when the app is in background mode.

**Software Application**: Smart Turn **Tester Name**: Jakub

**Release Version:** 3.3 **Test Date:** 28/04/2025

## Test Information

**Test Type:** System

**Pre-Requisites:** Uno connected to Power, HC-05 and Screen Wired to Uno.

**Components Tested:** Screen and Flutter App.

## Results Summary

- When the Flutter app updates the navigation directions while the app is in foreground and in the background. **We added a new library that enables us to update the user's location while the app is in background mode.**

| Results Details | | | |
|---|---|---|---|
| **User Input** | **Expected Result** | **Actual result** | **Pass/Fail** |
| User opens the Flutter App and selects a destination and confirms it. | A polyline is drawn towards the destination and directions start sending to the screen. | As expected | Pass |
| N/A | Directions keep updating as the app is in foreground. | As expected | Pass |
| User exits the app leaving it to execute in the background/locks their device | Directions keep updating as the app is in the background. | As expected | Pass |

**Possible Faults:**
N/A

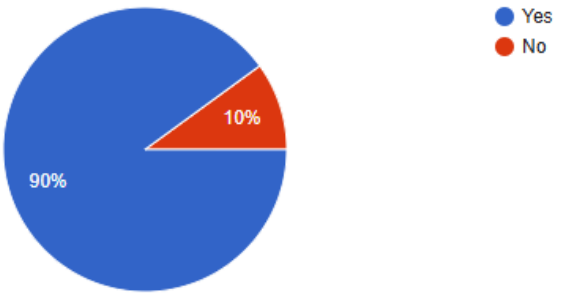
# User Testing

10 participants filled out an anonymous evaluation survey on the 26/04/25 for our project and here were the results.

Do you think Smart Turn has the potential to improve road safety for cyclists and electric scooter users ?

Copy chart

10 responses

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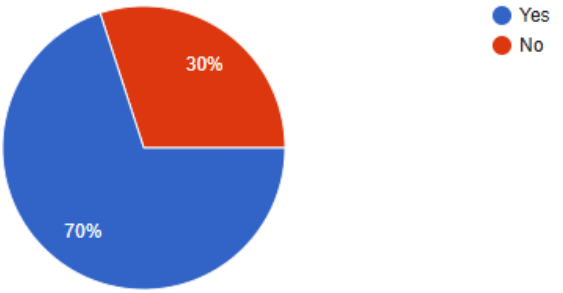
Did you find the turn signal feature useful ?

Copy chart

10 responses

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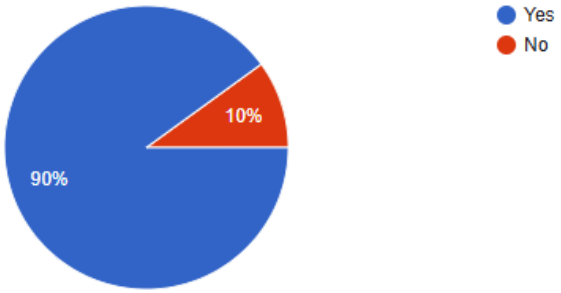
Do you think our navigation screen is useful ?

Copy chart

10 responses

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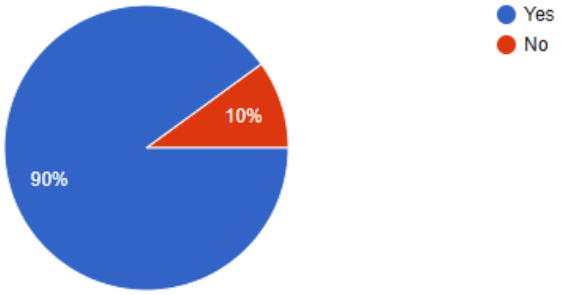
Was Smart Turn intuative to use ?

Copy chart

10 responses

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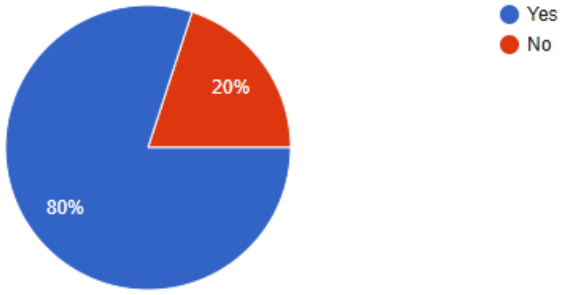
Do you think our navigation screen is less distracting than a mobile phone ?

Copy chart

10 responses

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Please leave any aditional feedback you have in the box below

10 responses

No display of what current turn signal is on if it is on

Hoodie included with product?

Slightly on the bulky side.

Screen provided is way less distracting than a mobile phone

Screen is a bit hard to see in well sun lit areas

Turned off phone and it stopped working. Bad to leave phone in pocket while on?

Screen muddled with messages. Message overlapping

N/A

Interesting Idea