

# Bluetooth Application for Data Download and Display

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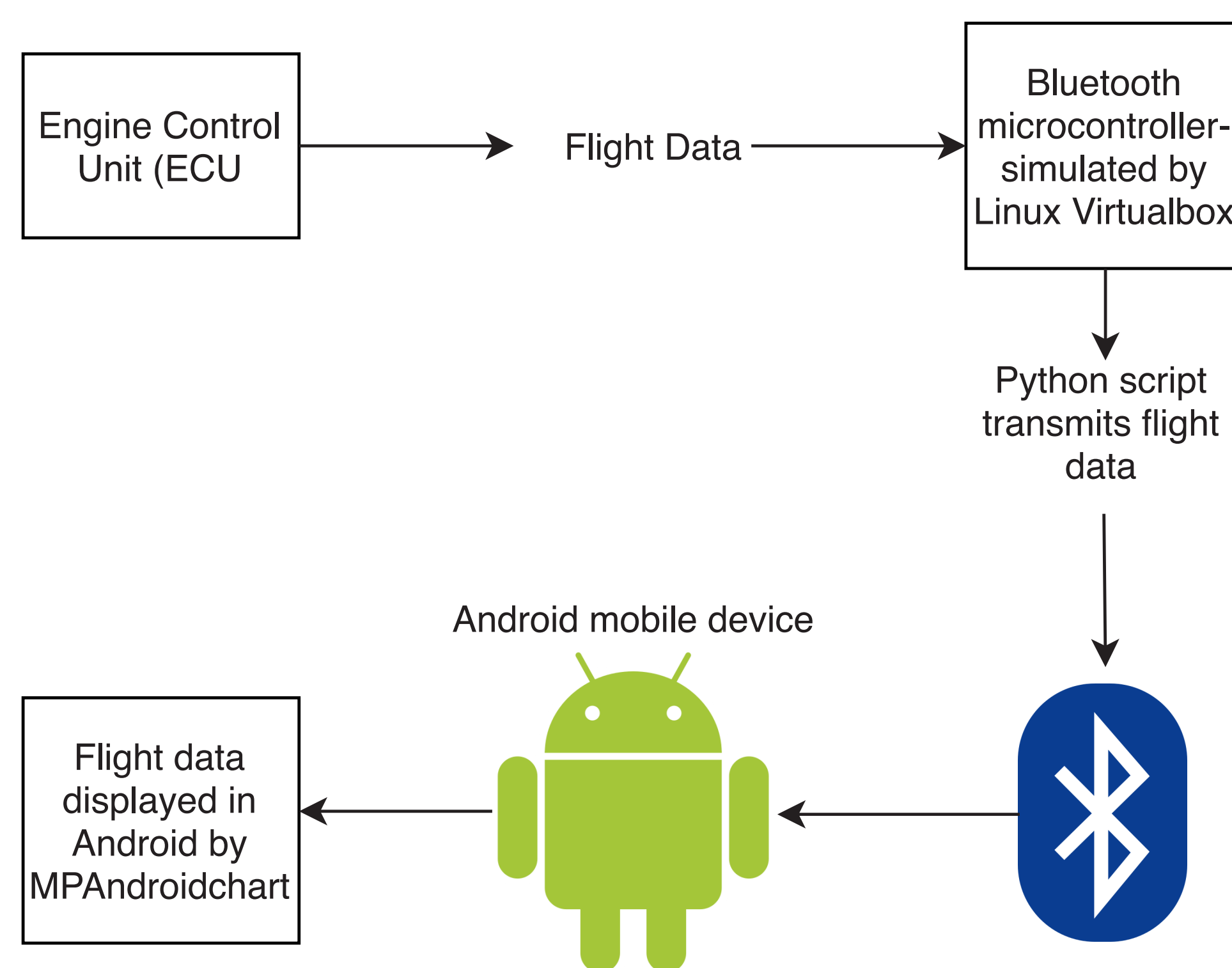
## Problem Statement

Every day, over one hundred-thousand flights are scheduled across the globe. With so many flights occurring everyday, accidents are inevitable. In 2016 alone, there were sixty five accidents on commercial airlines resulting in ten deaths worldwide. Accidents can happen for a number of reasons, most of which are out of the control of aircraft operators and engineers. However, it is the responsibility of the aircraft engineers and operators to minimize the risk of failure as much as possible. We are focusing our concerns on the needs of the engineer, and the best way to see a problem in your system before it happens is to collect ample operation data. The only problem with that is that currently that operation data is not collected often enough. The reason for this is that the current way to get this data off of the plane and into the technicians hands is very slow and cumbersome.

## Solution Overview

Our solution will take the form of a mobile application that will use Bluetooth in order to connect with a micro controller that will be installed on the engine. This micro controller will be able to send that engine data via Bluetooth to our application. Our application will then be able to receive this data and display it so that a technician will be able to go through and diagnose problems. With the use of Bluetooth our application will greatly speed up the time that it takes for a technician to get this data off of the plane and into something that they can actually use to solve a problem.

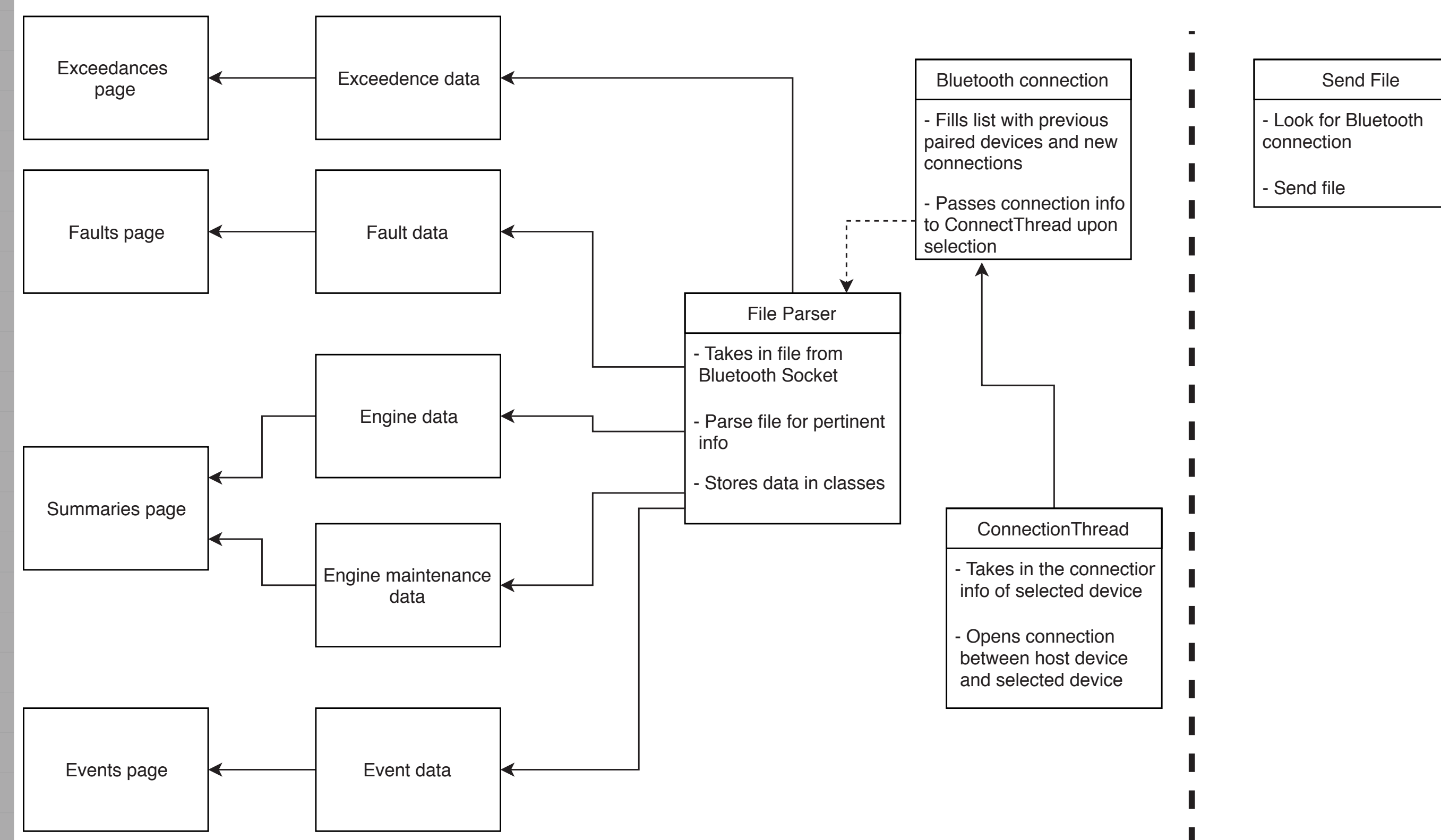
## Solution Diagram



## Key Features

- ▶ Engine download application is accessible to users with a smartphone or tablet
- ▶ Engine data can be downloaded anytime or place the plane has landed, with only a smartphone running the engine download application
- ▶ Application is able to download all of the data from the ECU
- ▶ Application allows for review of engine data, with functionality similar to EEI

## Architecture Diagram



## Technologies



- ▶ **Bluetooth**
  - ▶ The team used Bluetooth to allow for the wireless download of data from the micro controller. It also provided some basic security for the system in that one must be within range of the aircraft to download the flight data and the connection between devices must be accepted prior to download
- ▶ **Linux Virtualbox**
  - ▶ The team used a Linux Virtualbox to represent the micro controller during testing. In this way the team can be sure that the final implementation is capable of connecting to and downloading data from a Linux machine like the micro controller.
- ▶ **Android Studio**
  - ▶ The team used Android Studio to develop the application. Android was the chosen platform because Android is the most accessible and widely used mobile platform and the tools provided by Android Studio allowed the team to develop a prototype quickly and effectively in one cohesive environment.
- ▶ **MPAndroidChart**
  - ▶ The team used the library MPAndroidChart to create the line graphs within the application as Android Studio does not have an easily accessible means of doing so on its own.

## Challenges

- ▶ **Debugging Bluetooth Errors**
  - ▶ Feedback was limited while testing Bluetooth on a device. This was remedied by a combination of testing the application on a device connected to a laptop and displaying messages within the application.
- ▶ **Displaying Pop-Up Messages and Modifying Navigation System**
  - ▶ Modifying the application to use a tabbed navigation menu and to display pop-up messages proved to be difficult due to constraints with features in Android. To solve these issues, the team ended up having to restructure and modify certain pages and pass data differently.

## Testing

- ▶ **Unit Testing**
  - ▶ Unit tests will focus mainly on the data that is supplied to the various pages that are in the application. These tests will check to see if the correct data types are entered.
- ▶ **Integration Testing**
  - ▶ Integration tests will ensure that all modules and pages interact well. We will test data structures before and after passing information between pages to ensure that the correct information is received.
- ▶ **Usability Testing**
  - ▶ Usability tests will consist of test subjects retrieving information from the application. These test subjects will provide feedback on the ease of use and navigation of the application.

## Outcomes

- ▶ **The Business Case**
  - ▶ The prototype provides our client with a business case for further development of the system. Because implementing our solution provides no immediate monetary returns it is necessary to demonstrate how our system could benefit our client.
- ▶ **Increased Data Collection**
  - ▶ Our prototype increases the ease of access to flight data. By allowing Honeywell technicians to download and view flight data in a matter of minutes we have dramatically increased the amount of data that can be collected from their clients' aircraft.

## Future Work

- ▶ **Improved GUI**
  - ▶ The initial focus was to provide a proof-of-concept for a wireless engine downloader. As the GUI was not the focus, the team intends to work on and improve the GUI with a focus on ease of use and navigation, as well as ensuring that data can be found easily and intuitively.
- ▶ **Increased Data Display**
  - ▶ As initial focus was on Bluetooth download functionality, data display is minimal, and the team focused on populating data deemed the most necessary. There is more information that the application can display, and the team already has a basis for creating these new modules.