NORTHROP GRUMMAN

Weapon System Support Software

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NAU NORTHERN ARIZONA UNIVERSITY

Our Clients & Business

Aerospace & Defense Contractor

- Armament Systems
- $30 billion in revenue / year

Harlan Mitchell

- Sr. Systems Engineering Manager

Laurel Enstrom

- Principal Systems Engineer

B-2 Spirit Stealth Bomber
Source: Northrop Grumman

RQ-4 Global Hawk
Source: Northrop Grumman

NORTHROP GRUMMAN

The Problem

Advanced Weapon Systems

Faults with these weapon systems produce a lot of data

NG must dispatch engineers with a tool to collect data

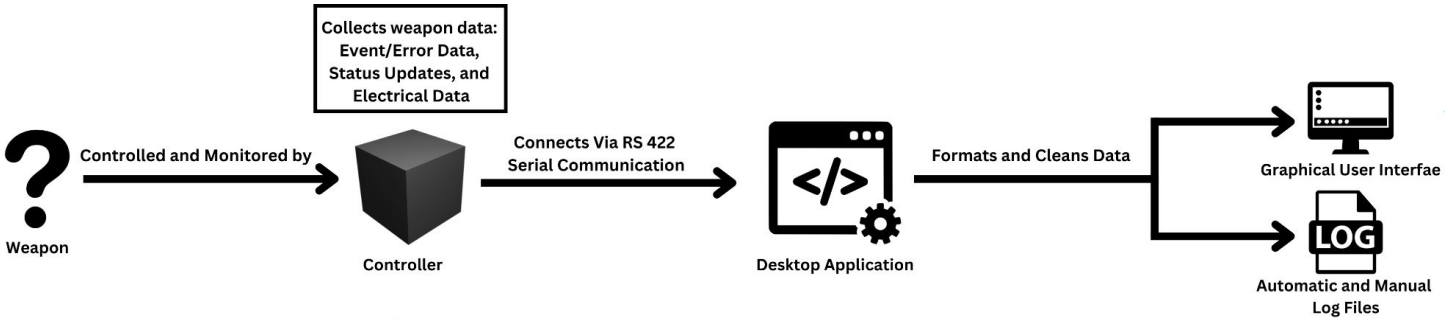
NG will work to resolve the problem, traveling to and from as much as needed

No end-user diagnostic tool

Complex, or insignificant data in existing tool

Expensive to dispatch engineers

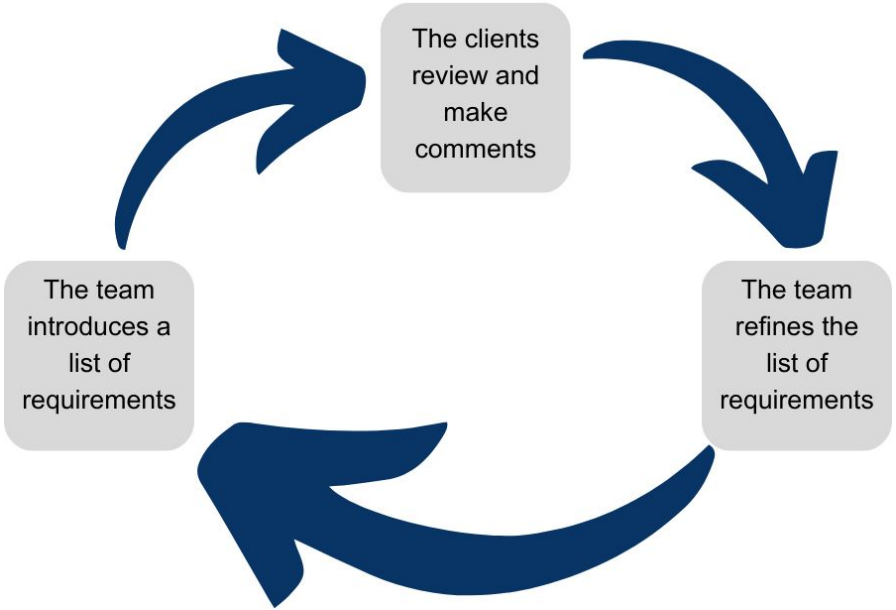
Solution Overview



- Controller will send data to the software application via RS 422 serial communication
- The application will display the data into GUI and log file if selected by user
- The application will be installed by an installer that does not require administrator rights

Key Requirements

- **Key Requirements**
  - Must be able to filter weapon events and errors
  - Must be a desktop application
  - Read data via RS 422 serial communication
  - Must be able to output to logfile



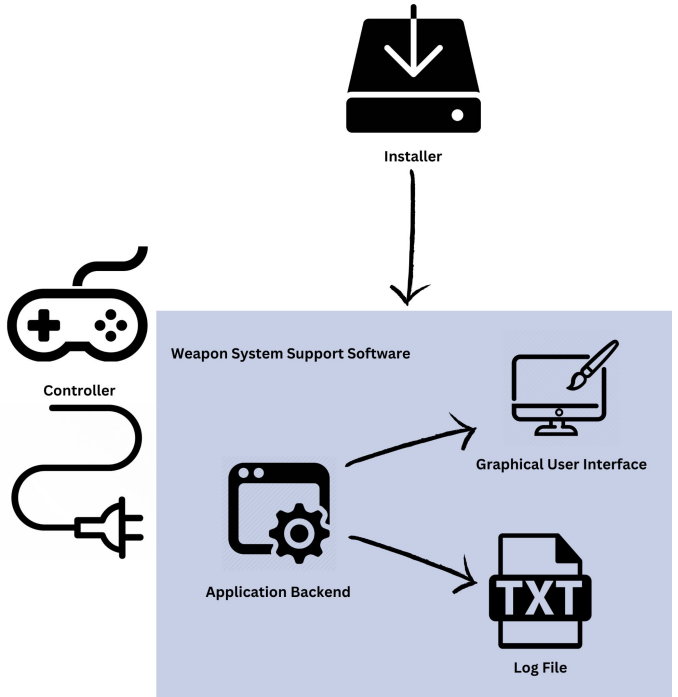
Implementation Overview

QT Framework

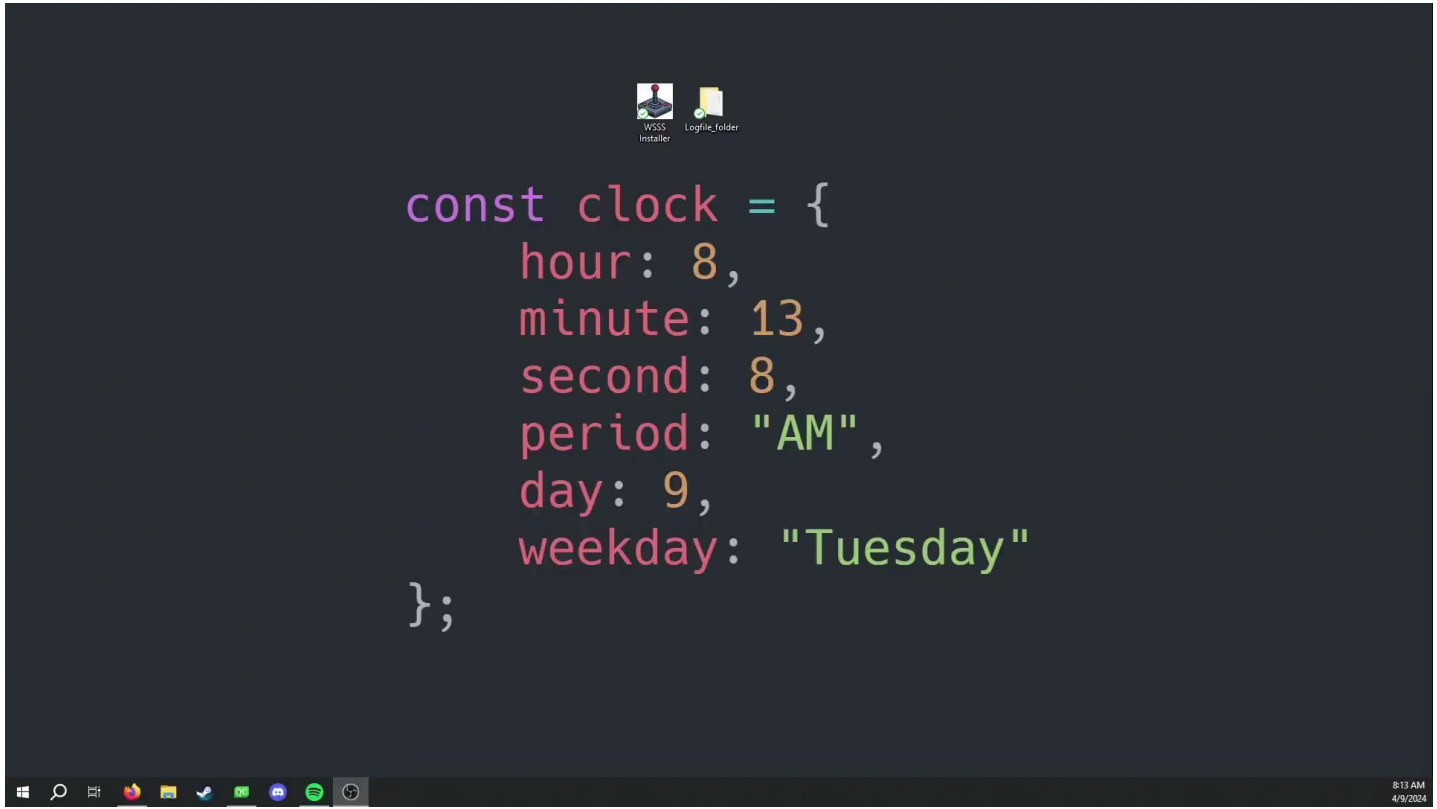
- QT Serial Bus
- QT Serial Port
- QT Graphical User Interface support

C++ Backend

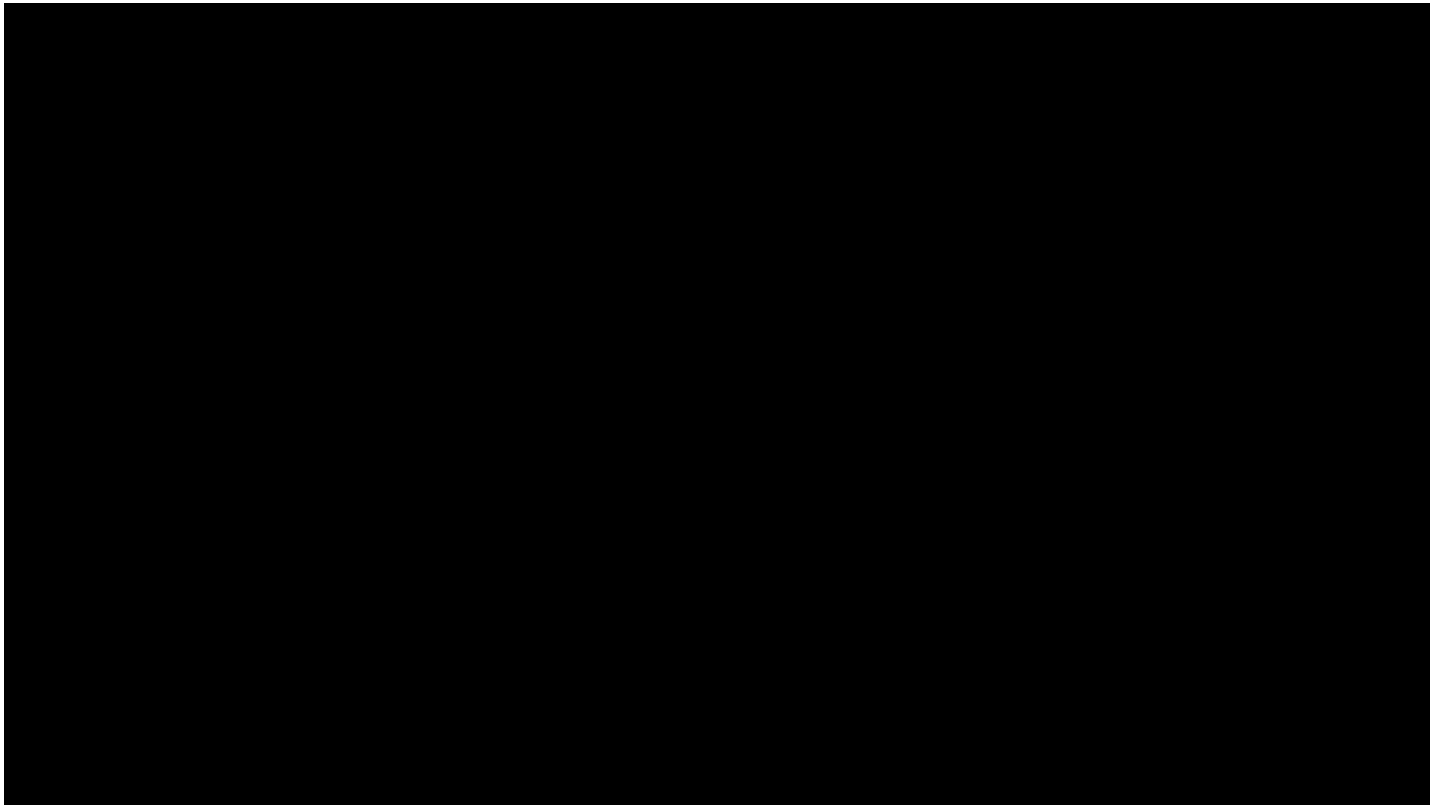
- OOP based classes
- Dynamic memory management



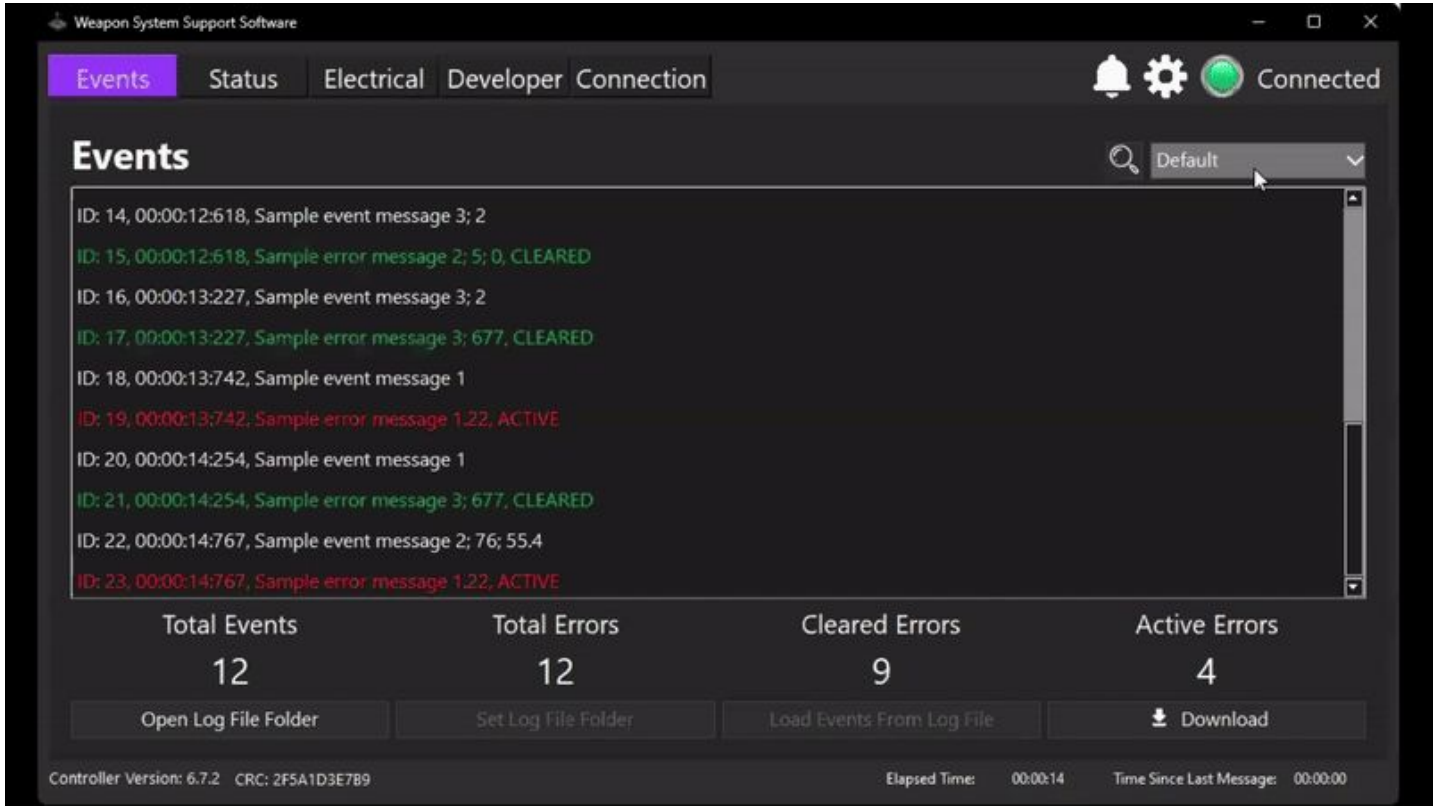
Demonstration: Installer



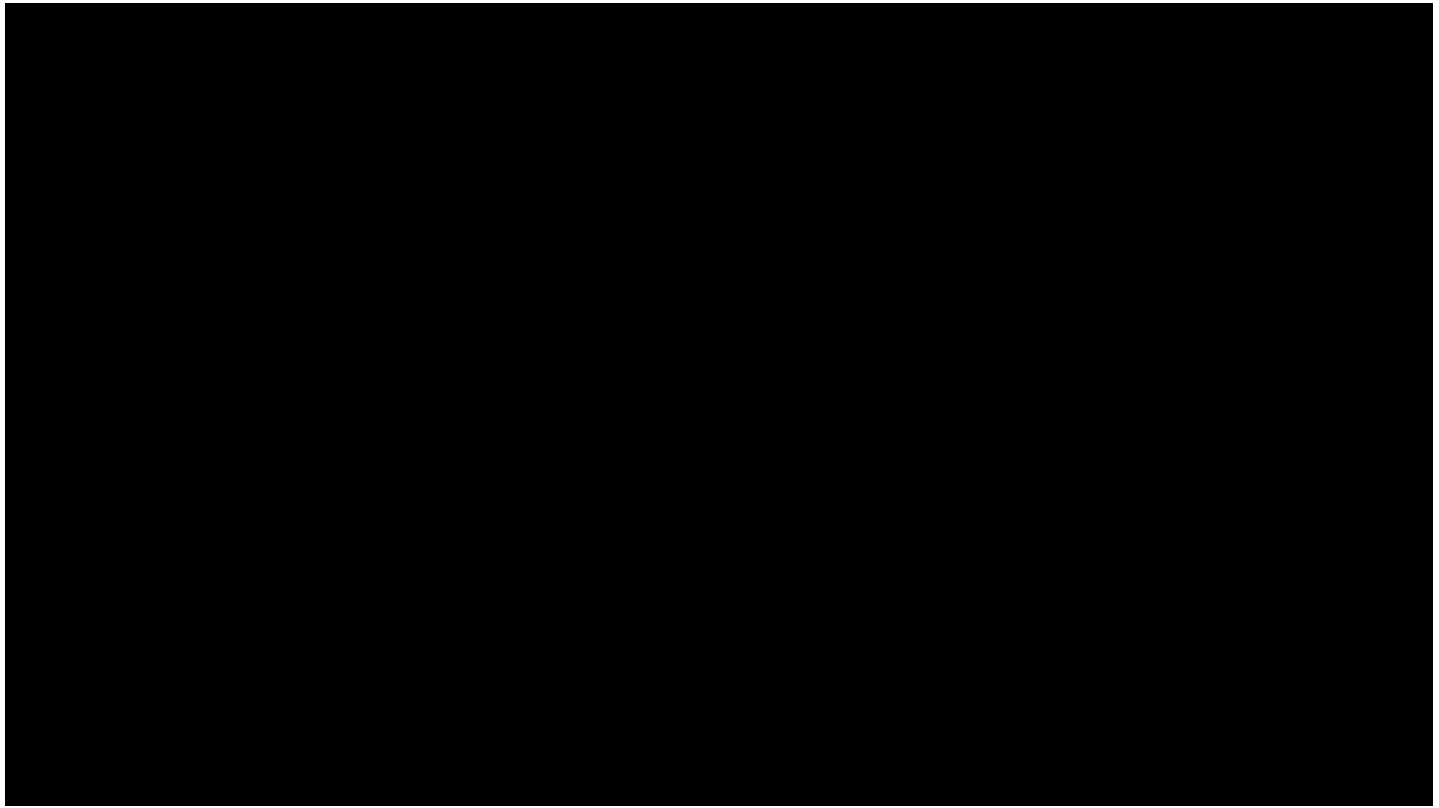
Demonstration: Connection Page



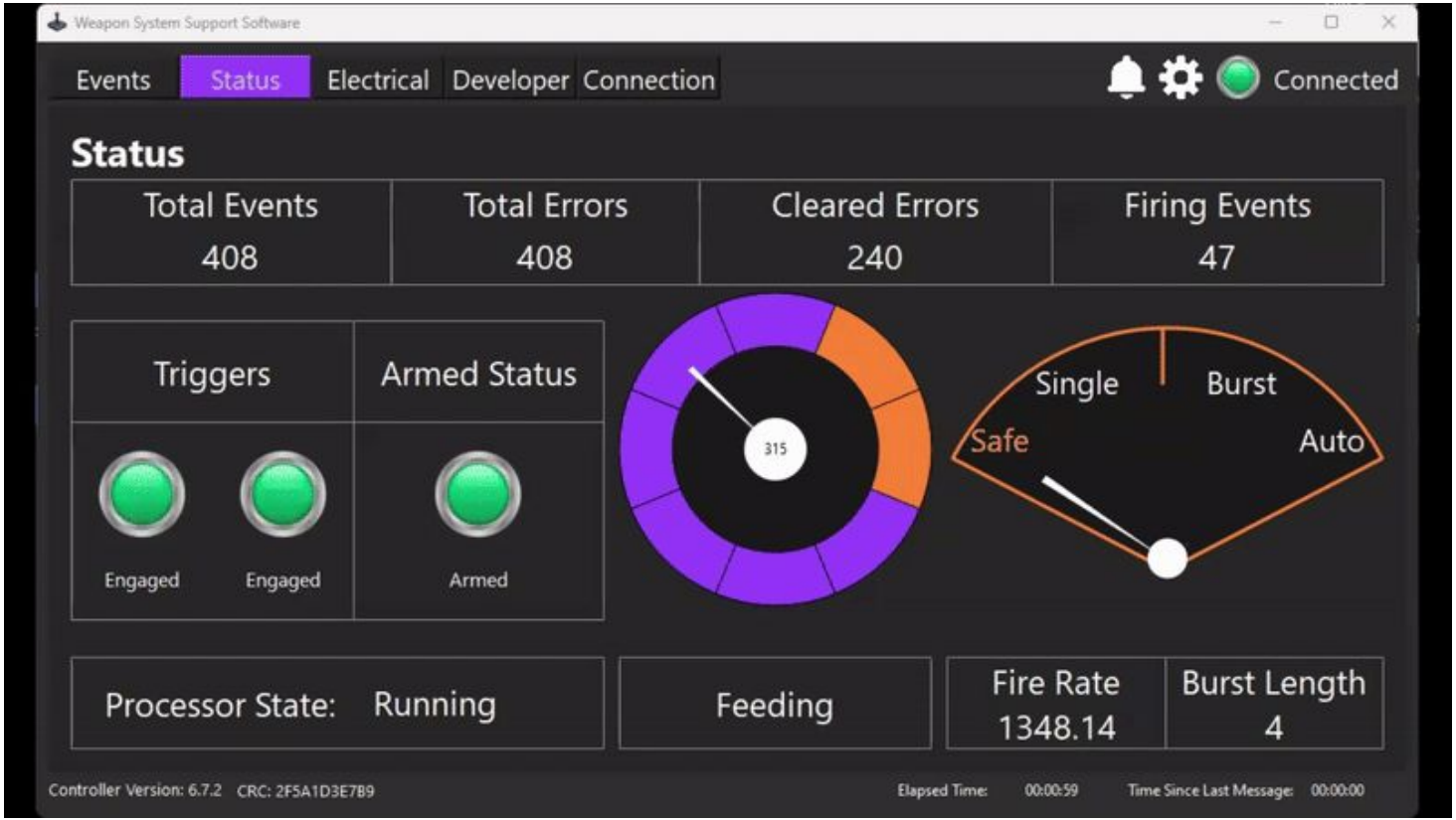
Demonstration: Events Page



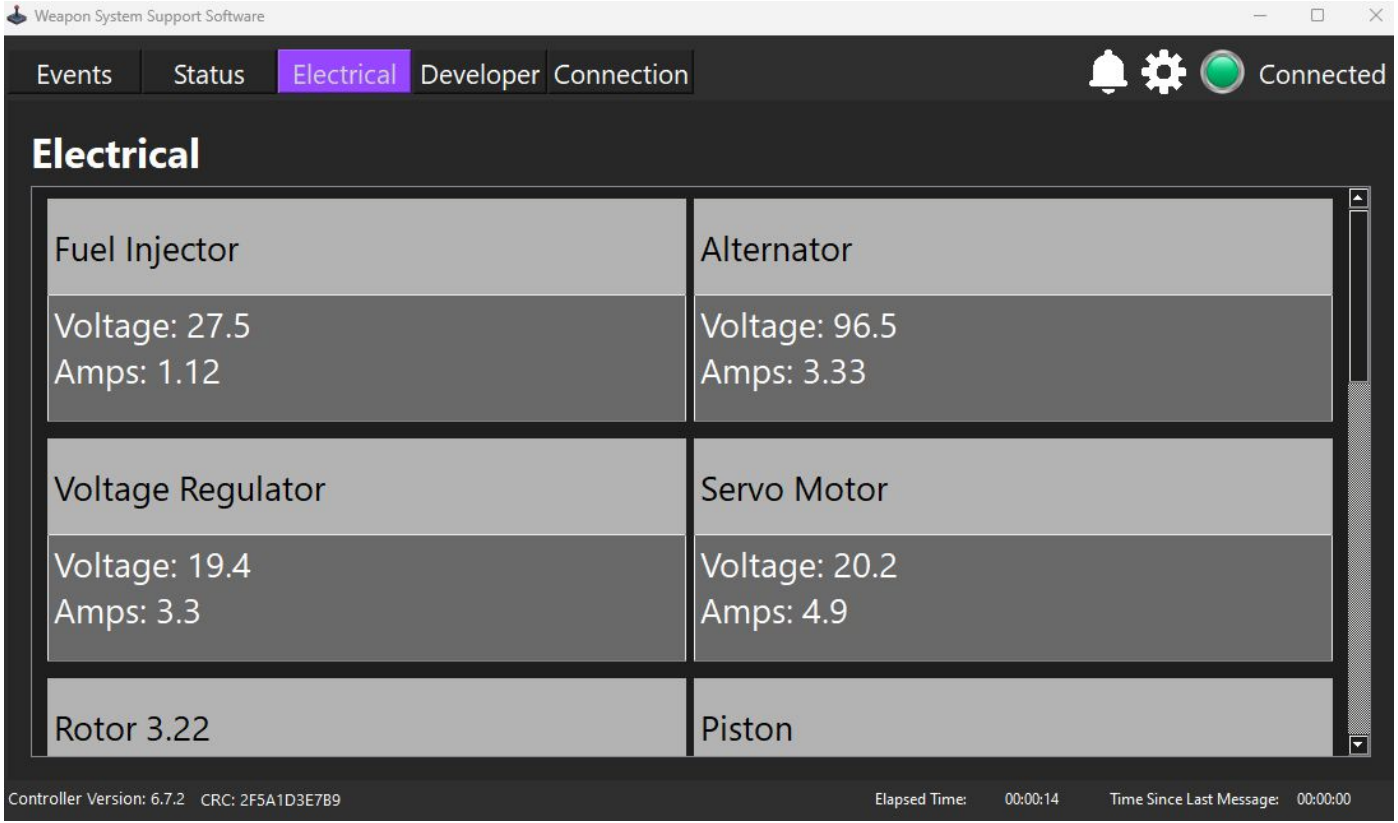
Demonstration: Events Page



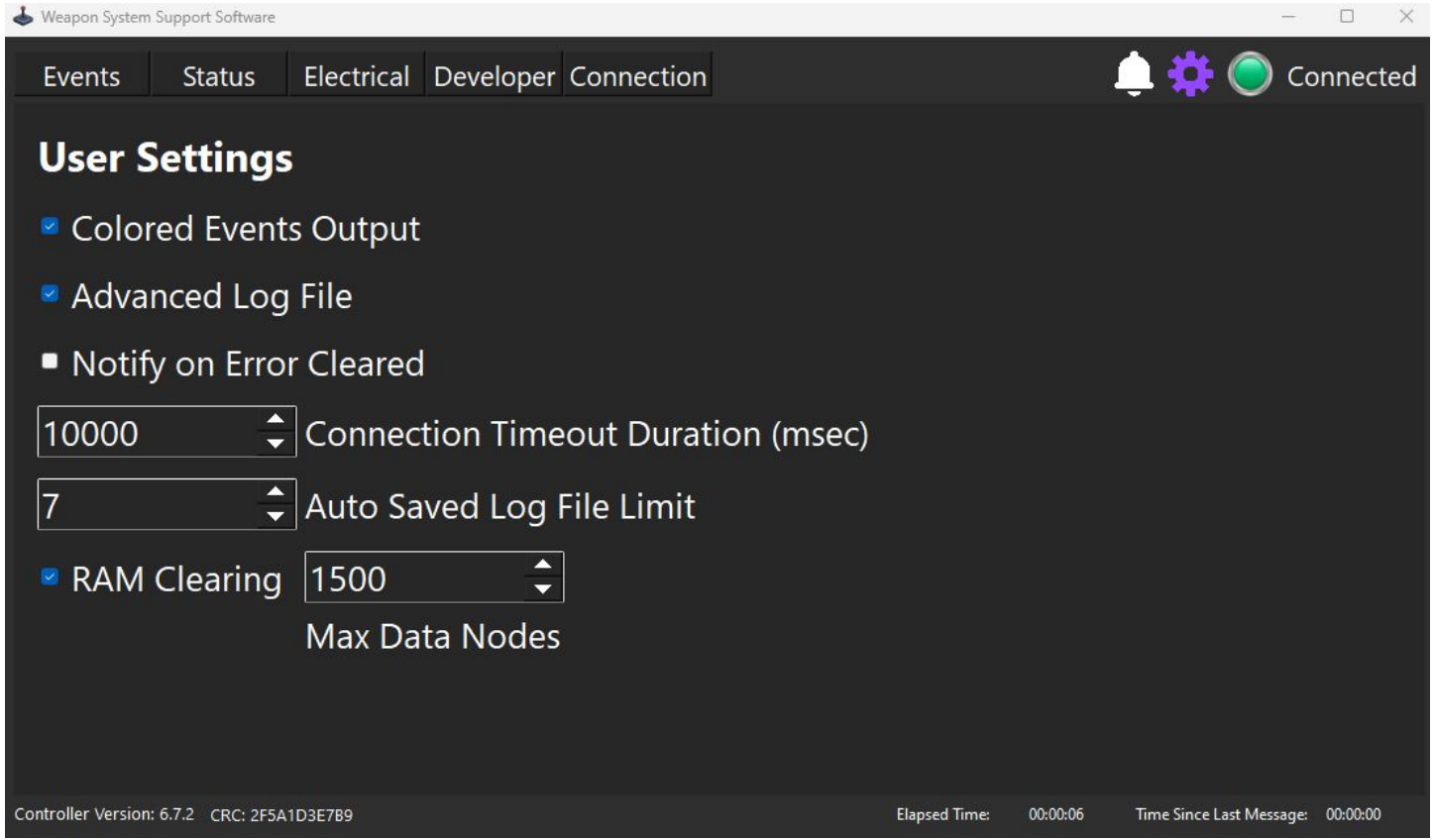
Demonstration: Status Page



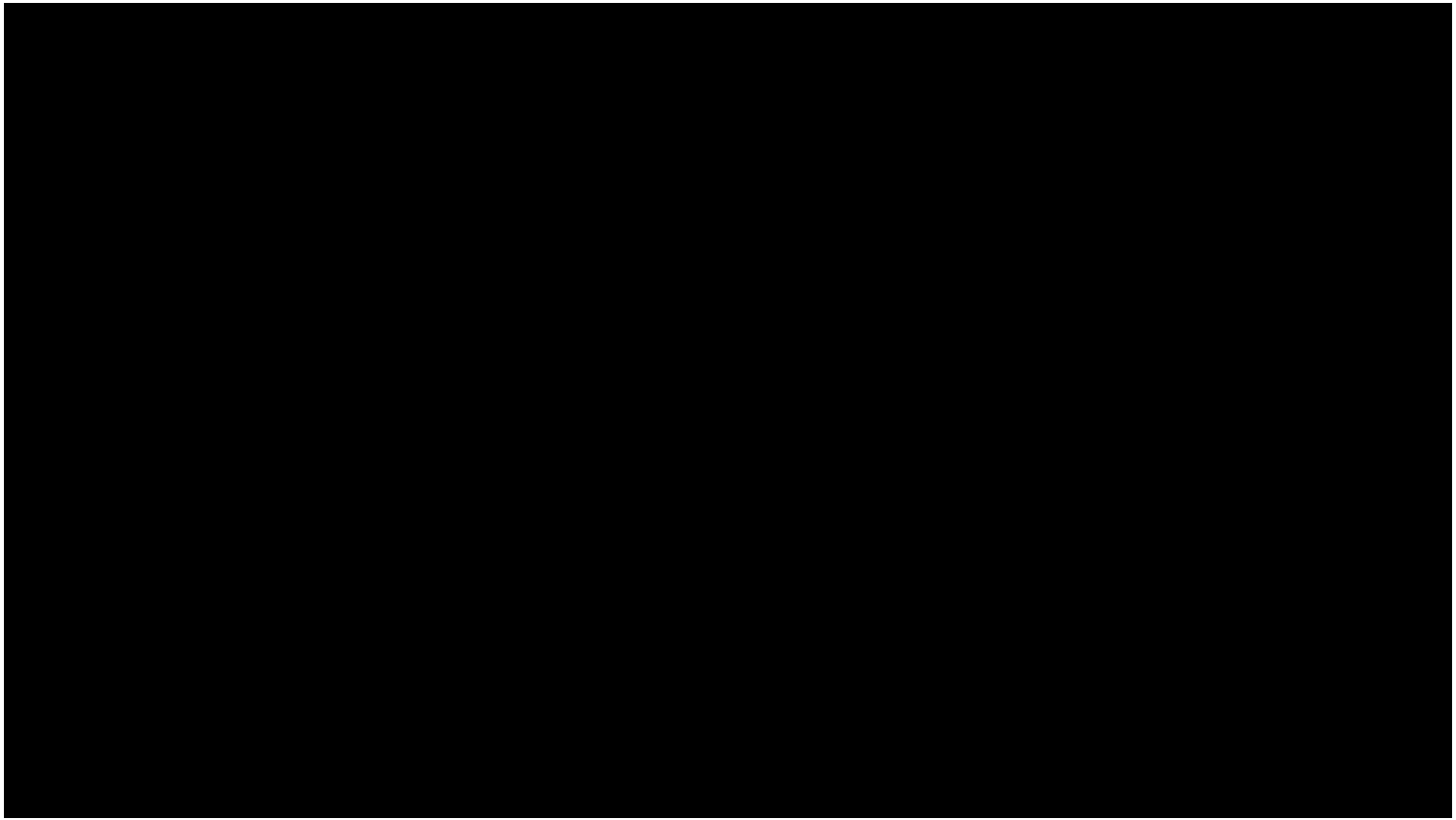
Demonstration: Electrical Page



Demonstration: Settings Page

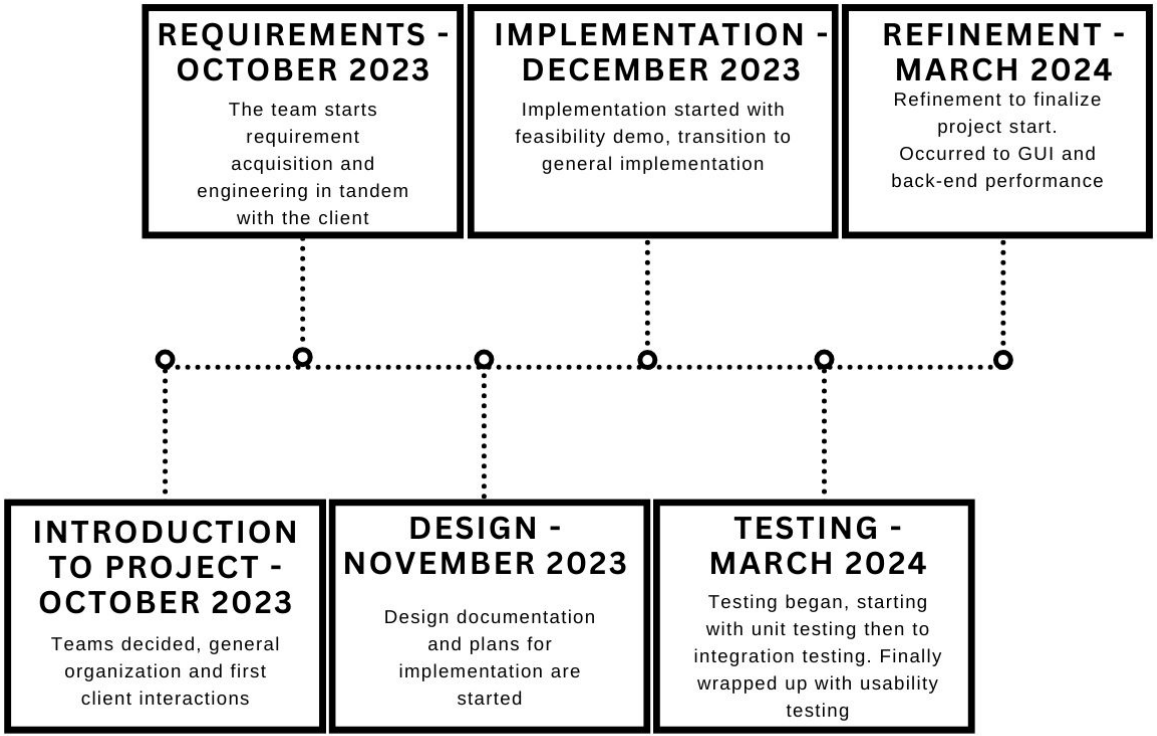


Demonstration: Developer Page

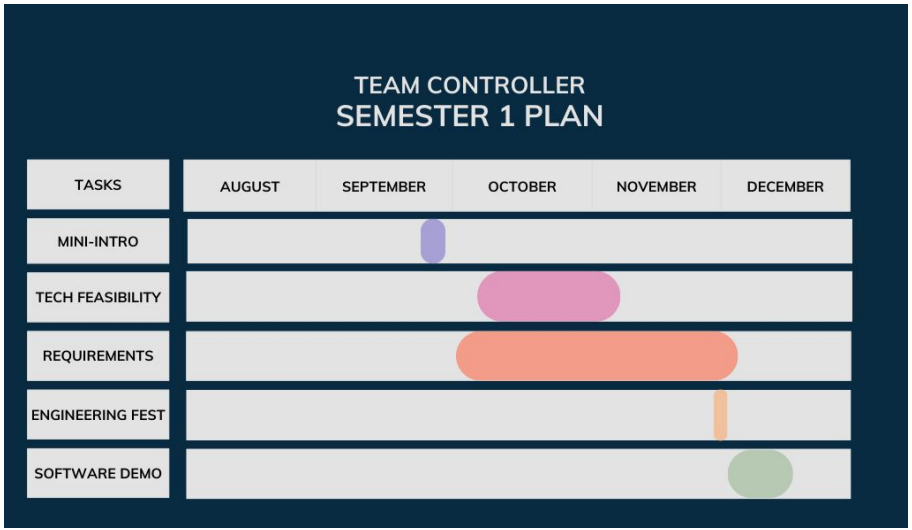


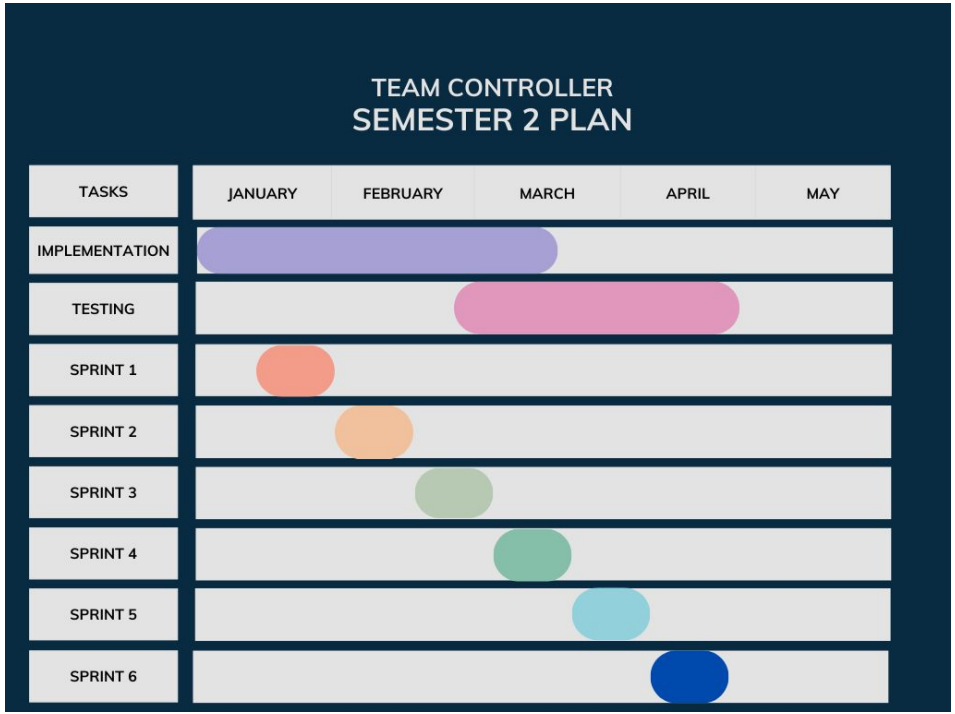
Demonstration: Notifications Page

Project Stage Overview



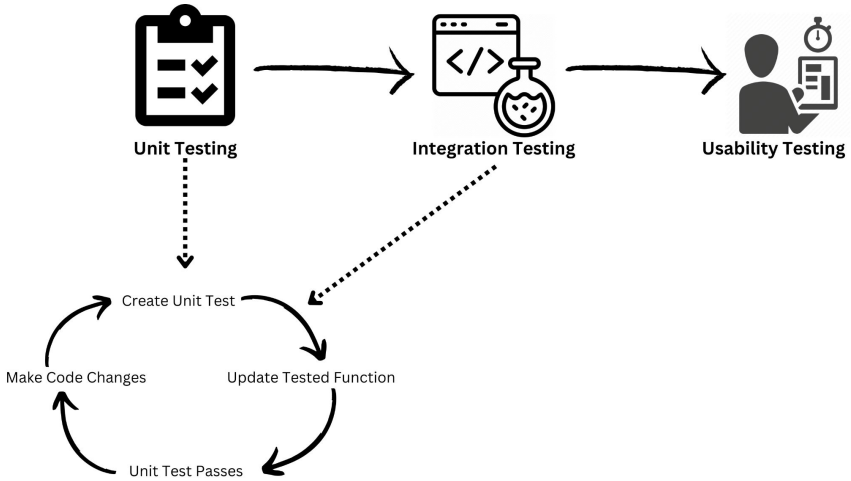
Deliverables Overview





Testing Plan

- Linear testing path
  - **Unit testing** - 39 total test cases
  - **Integration test** - 2 total test cases
  - **Usability testing**
- QTest library
  - QCOMPARE()
  - QVERIFY()



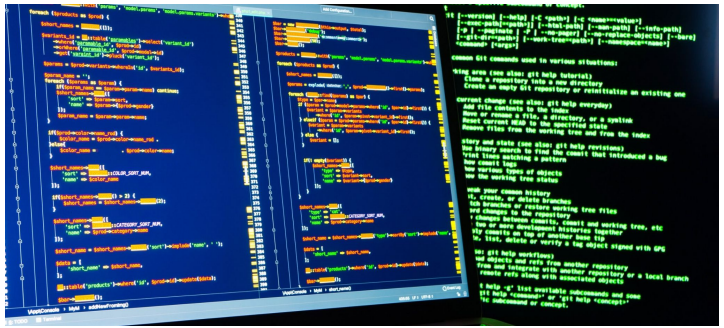
- Testing made robust code segments
- Testing paradigms increased standardization

Challenges and Solutions

Challenge	DESCRIPTION	SOLUTION
Front end custom widgets	Needed a custom feed position and fire mode	Sub classing the QT dial widget
Simulated Serial Communication	Needed to simulate serial connection to test program	QT serial communication libraries
Installer	Needed a working installer with no admin rights	Inno setup
Device to Device serial Communication	Needed a test to simulate the weapon to laptop connection	Laptop to laptop connection via RS422
Testing	Needed to integrate unit tests, integration tests, and usability tests.	QTest library

Future Work

- Deliver our work to Northrop Grumman
  - Software documentation
  - Source code
  - Installer
  - Guides
- Northrop Grumman engineers will continue our work
  - Have access to the actual weapon controller
  - Modify our framework



Conclusion

Our clients are Northrop Grumman and the main issues are:

- Long travel times
- Complex data
- (Lack of) End user tool

Our goal is to provide our clients with an easy to use desktop application so a non-engineer can diagnose weapon data

We met weekly to showcase what has been accomplished with our clients during our two week sprints