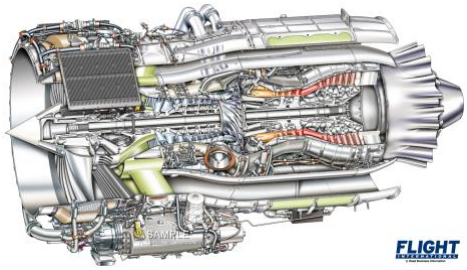
CS486C – Senior Capstone Design in Computer Science

Project Description

Project Title: Prototype Time Limited Dispatch (TLD) Application	
Sponsor Information: Honeywell	Harlan Mitchell, Systems Technical Manager HTF7K Controls Systems Integration https://aerospace.honeywell.com/en/products/engines/htf7000-turbofan-engine https://en.wikipedia.org/wiki/Honeywell_HTF7000 https://youtu.be/E8RlNXnyIgE Honeywell Harlan.mitchell@honeywell.com 602-206-7223

Project Overview:

Honeywell is known for small to mid-sized engines including auxiliary power units (APUs), propulsion engines, and turbo-chargers (note: vehicle turbo-chargers are similar in some ways to gas turbine engines). Honeywell is the largest producer of gas turbine APUs found on many leading aircraft with more than 100,000 APUs produced and more than 36,000 in service today. Within the propulsion engines group Honeywell has applications on helicopters, business jets, turbo props, military jets, and even the US Army Abrams Tank.



Within the Honeywell engines enterprise, our group, the Controls Systems Integration (CSI) group, is responsible for all aspects of engine control including the ECU (Engine Control Unit). In addition to the ECU itself the control system is comprised of temperature/pressure sensors, valves, the fuel pump, and other hardware components. The largest current project we are working on is the re-application of the HTF7000 engine on the new Cessna Citation Longitude business jet which was just certified on August 25th 2017. The Cessna Citation Longitude site is: http://cessna.txtav.com/citation/longitude

A vital feature of the ECU design is that a broad variety of moment-by-moment sensor data documenting each engine's performance is saved to non-volatile memory (NVM) during normal operation. This data is then downloaded by maintenance personnel either on a routine or as needed basis to analyze engine performance and reveal upcoming maintenance issues. The current method for doing the engine download is to connect a laptop to the aircraft engine maintenance port (usually in the cabin) using a 4 port RS-422 USB device and a cable. The user then uses software called EEI (Electronic Engine Interface) to do the download and review the data. See the video's below for more information.

HTF7000 EEI Download - https://youtu.be/LOjHXjF-JDE

HTF7000 EEI Data Review - https://youtu.be/ff5dytZUSQc

Honeywell is currently developing a product to allow engine downloads to be completed autonomously with the data uploaded wirelessly to the cloud where it will then be accessible remotely. The software that communicates to the ECU and does the download to a secure cloud server will be hosted on a small embedded computer located on the aircraft.

The data that will be captured and saved to the cloud falls into three distinct categories: Real time data collected while the A/C is in flight, snapshot data that is collected at various events and flight transitions, and fault data. Fault data can further be broken down into Time Limited Dispatch (TLD) faults and all other faults. The data file will include a CRC but additional mechanisms may be required to be carried with the data to ensure validity.

Engine control systems can be allowed to operate with faults for a specified period of time provided:

- Resulting system operation and overall average reliability is adequate
- Operating exposure, in this less redundant state, is appropriately limited

TLD is only concerned with faults that affect the loss of thrust control. TLD is specified in the following periods of time:

- Short time (ST) – typically 125 hrs. before performing maintenance
- Long time (LT) – typically 500 hrs. before performing maintenance
- No Dispatch (ND) – fault must be corrected before next flight

Using the existing EEI tool, users can evaluate faults and determine the A/C TLD status and make the appropriate maintenance decisions. Because EEI is used to make maintenance decisions it has to be a qualified tool per the FAA software development process.

Because our new product that allows automated downloads sends the data to an uncontrolled system (cloud data storage) a new tool will need to be developed to allow users visibility to the TLD data in a manner that guarantees the data validity. This tool will need to be qualified per the FAA software development process. The non-TLD data will be displayed in a unqualified web portal which is not part of this project.

This project is to prototype a modern cloud connected GUI for the purpose of evaluating TLD data. The primary requirement of the SW is that it verifies the data integrity such that it is not possible for incorrect data to be displayed. The project team will be expected to develop a platform independent based software module, running on a target PC, that will obtain and display verified TLD data.

Because the tool will need to be qualified, the SW architecture will need to be as simple as possible. Additionally, a very clean requirements document will be required of the project team.

Knowledge, skills, and expertise required for this project:

As with all projects, the team will be expected to learn the knowledge and skills required for this project early on. Beyond standard senior-level capabilities in programming and software design, helpful skills will include:

- Familiarity platform independent app development.
- Skills in user interface design, testing and refinement.

Equipment Requirements:

No special equipment should be required beyond a standard development platform (your laptop), as well as freely available environments and software tools.

Software and other Deliverables:

1. Software implementing the functionalities outlined above.
2. Complete professionally-documented codebase, delivered both as a repository in GitHub, BitBucket, or some other version control repository; and as a physical archive on a USB drive.

3. A strong as-built document that details the design and implementation of the software. This must be robust enough to allow a future development team to easily pick up where you left off.