Express delivery

Designing a fire suppression system required reliable prototyping tools. ***By Jeremy Snow and Troy Ingram.***

As global trade continues to proliferate, the role of courier companies becomes increasingly important to businesses around the world. Using a range of methods, companies such as FedEx and UPS can get everything from A4 envelopes to pallet loads of technology to the other side of the world in little more than the blink of an eye.

FedEx is the world's largest express transportation company, providing delivery to more than 220 countries and territories around the world. Using the FedEx Express air and ground network, shipments can usually be delivered in one to two business days.

But the range of goods which FedEx ships can expose its planes to danger: there is a very slim chance that the contents of a shipment might catch fire. And fire is the last thing you want on an airplane, particularly when it's on a transoceanic route.

While there are fire suppression systems supplied with the aircraft which FedEx uses, the company recently decided to develop a cost effective and reliable fire suppression system for the main deck of FedEx Express aircraft to prevent catastrophic fires within the aircraft and to keep pilots, packages and planes safe from fires that may start in the shipping containers. Ventura Aerospace was commissioned to prototype and deploy the control solution for the system and to do so on a very aggressive deployment schedule.

The system monitors the temperature and controls the suppression system that deploys foam into a container if a fire is detected. Ventura was able to prototype its system for FedEx rapidly using LabVIEW and CompactRIO, creating a final deployed solution using NI Single-Board RIO – all in less than a year.

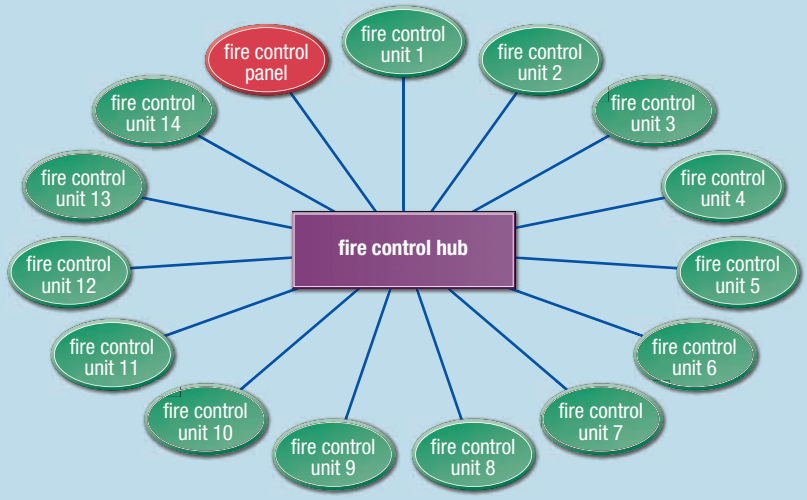
In the final system, NI Single-Board RIO devices act as the primary control system in the fire suppression application. Two devices within each plane use a NI Single-Board RIO – the Fire Control Unit and the Fire Control Hub.

The Fire Control Hub – which is responsible for checking safety interlocks, power distribution and communication – is at the centre of the system. It contains an NI Single-Board RIO device, a power supply, a signal conditioning daughterboard built by Ventura and an Ethernet switch.

The Fire Control Unit, meanwhile, contains an NI Single-Board RIO device and a daughterboard developed by Ventura. The Fire Control Unit reads temperatures from 16 infrared sensors, then processes and records the data.

Cargo is housed inside the airplane in an array of containers. For example, in an MD-11 airplane, there are 14 rows of containers and each row of containers has

Figure 1: Ventura's fire suppression system is aircraft independent



its own Fire Control Unit. Thus, with the Fire Control Hub and the 14 Fire Control Units, a total of 15 NI Single-Board RIO devices are needed.

The Fire Control Unit and Fire Control Hub devices are designed to be aircraft and location independent. Ventura has built the devices from the ground up to function in any type of aircraft. Using LabVIEW, the company has programmed intelligence into both the Fire Control Unit and the Fire Control Hub, allowing each device to identify aircraft type and position based on the installation. This allows for greater interchangeability and the ability to work on any plane.

The system runs with full autonomy and requires zero operator input; each unit continuously monitors its own health. In addition, the system is fault tolerant – it continues to function to the best of its ability if a fire or fault should occur. If there is a fault in the system, its location is notified after each flight.

All of this is possible because of the reliability of the real time processors, fpgas and I/Os featured on NI's reconfigurable I/O (RIO) hardware products, along with the flexibility of LabVIEW.

Getting a reliable solution to market quickly was crucial for customer and developer alike. Using the RIO deployment curve, Ventura was able to rapidly prototype the system using LabVIEW and CompactRIO and to create a final deployed solution with NI Single-Board RIO.

The flexibility of the embedded CompactRIO system, allowed a working prototype of the suppression system to be quickly developed using LabVIEW graphical tools, along with CompactRIO and NI C Series analogue and digital modules.

Although this was Ventura's first experience with CompactRIO and the LabVIEW FPGA module, the designers were able to get to grips with the technology quickly and to complete a working prototype in three months.

Due to the small size and low cost of the NI Single-Board RIO, it was decided to deploy the final solution on an NI sbRIO-9612 device. The sbRIO-9612 contains an onboard real time processor, reconfigurable fpga and analogue and digital I/O. Control algorithms, with the networking and data logging of the application, were implemented on the real time processor. Its onboard analogue inputs are connected to the infrared sensors via custom signal conditioning.

The transition from prototyping to deployment was seamless due to the common hardware architecture shared between CompactRIO and NI Single-Board RIO. Creating the final deployed solution was simple because Ventura was able to reuse its LabVIEW prototyping code without any major coding changes. The fact that NI provides hardware and software to quickly prototype and deploy embedded systems was crucial and Ventura is sure it would not have hit the aggressive deadlines without NI tools.

Author profiles:

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