Digital Twin for the Transportation Industry

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Digital Twin

What is Digital Twin?

**Digital Twin** is a software or virtual representation of a physical asset, with the objective of making the asset more valuable. The desired outcome can be improving reliability and uptime of the physical asset, gaining a better understanding of the asset’s current state, response to changes and improving business operations.

“75 Percent of Organizations Implementing IoT Already Use Digital Twins or Plan to Within a Year” - Gartner (Feb 2019)

Why Digital Twin for Intelligent Transportation?

Intelligent Transportation

Digital Twins apply to all forms of Transportation

- Aircraft
- Train/Locomotive
- Ships / Offshore Structures
- Trucks / Cars
Door-to-Door Transportation
Ships and Offshore Structures
Generate Value from Digital Twin
Digital Twin of Cars

Building the Digital Twin

(Some) Time Series Data

Airplane
Altitude
Barometric Pressure (in millibars/mb)
Outside air temperature (C/F)
Fuel pressure (number of engines)
Fuel flow (number of engines)
Cabin air pressure (psig)
Cargo air pressure, doors, bulkheads
Cabin temperature, smoke, bleed air
Cargo temperature
Fuel temperature, fuel tanks, fuel pumps
Radio Traffic (VHF)

Analysis

Hydraulic pressure, brakes, flaps, spoilers, rudder, aileron, landing gear pumps
Weight sensors
Turbo jet RPM (N1/N2), turbo fan pressure, temperature, fuel flow
VHFE fascinating, cockpit, main bus, cable, auxiliary power, cargo, engines, ARD Generator(ies) (engine, ARD)
Hydraulic and electric pumps, lights, fuel cells, cables, cargo
Fuel sensors, cabin, cargo, engines, fuel, brakes, electronics, ICAO
Carbon Dioxide, cabin, cargo
Magnetic Compass
GPS (satellite/terrestrial)
Radio Compass (RDR)
Doppler radar, weather, lightning, low altitude (ground)

Context

Digital Twin + Digital Thread
configuration
traceability
Building the Digital Twin – one part at a time

a) Math-based
b) Physics-based
Digital Twin: The Art of Bringing together the Physical World and the Sensor Data World
Pilot in Myanmar lands plane without front wheels

© 12 May 2019
IIC Testbed – Digital Twin of a Landing Gear

Challenge

Before takeoff, crew members run through a number of checks to ensure that the aircraft is ready. Typically, problems with landing gear can’t be detected until after pushback from the gate. Uncovering problems with the landing gear at this late stage usually results in a flight delay. Each flight delay costs the airline between $25,000 and $40,000, not to mention the impact on customer satisfaction. And if the delay occurs in the morning, it can have a cascading effect that impacts the entire day’s flight schedule.

In addition to this, when problems are detected with the landing gear, minimal information is provided and the exact cause cannot be determined until repair crews begin working.

"Each flight delay costs the airline between $25,000 and $40,000. With the digital twin, current landing gear issues can be diagnosed and the remaining useful life can be based on historical data."
The blending of Landing Gear (Physical World) to the Temperature and Pressure Sensor Data (Digital World)
Why Connected Cars?
Data Drives the Connected Car

Ref: https://it.hortonworks.com/blog/big-data-iot/
INTERNET OF THINGS

THE BUSINESS OF EVERYWHERE

How data from myriad IoT devices is driving unprecedented innovation

CREATE BUSINESS FROM DATA

BLOCKCHAIN BUILDS TRUST

BUILDING COMPLEX BOT RESPONSES WITH EASE
Role of IoT in Auto Industry

• “With the IoT data, automakers have the opportunity for greater engagement with the owners of the vehicles, and they’re able to educate them on the vehicle features.”

• VP Connected Car at Concentrix
Digital Twin of Cars

The Power of Real Time Digital Twin / OTA - 2018

“Tesla is releasing more battery capacity and giving free Supercharging to owners in Hurricane Florence’s path”

Owners on the Carolina coast received this notification from Tesla inside their cars when Category 4 Hurricane hit them:

“We are temporarily enabling your car to access additional battery capacity, as well as free Supercharging, in preparation for Hurricane Florence. We hope this gives you the peace of mind to get to a safe location, and will notify you before returning your car to its original configuration in mid-October. Badging on your display may adjust during this period. Safe travels.”

Tesla did the same thing in Florida last year when Hurricane Irma hit the region.

Results in unlocking 15 kWh of battery capacity for approx 30 to 40 additional miles

https://electrek.co/2018/09/12/tesla-releasing-more-battery-capacity-free-supercharging-hurricane-florence/
Summary & Wrap Up

- Defined Digital Twin - DT
- How it applies to Intelligent Transportation
- How to build DT – aircraft example
- Consumer Engagement – Tesla car example
- Q&A
Integrated Cloud
Applications & Platform Services