AUTODESK **UNIVERSITY** 2015

SD10083

Smart Connected Design with A360 Web Service and Internet of Things (IoT)

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Learning Objectives

- Explore new ways of making smart connected design and data
- Understand Autodesk 360 Web Service, View and Data API and functionalities
- Learn step by step how to connect design with Internet of Things using Autodesk Web Service and open source APIs
- Learn how to turn a design into an interaction-on-demand system that interacts with any device at any time

Description

Today, there are more than 16 billion active wireless-connected devices, and that number will more than double and exceed 40 billion by 2020, according to ABI Research. With more and more smart things surrounding us in smart homes, offices, streets, and cities, can our 2D and 3D design also become smarter and connected? Can our design data become a smart living thing that connects to the physical world, monitors and interacts with the surrounding environment, and helps deliver performance visibility toward predictive maintenance and reduced downtime?

The answer is yes! In this class we will explore new ways of building “smart connected” design and demonstrate how you can connect your design with physical microcontrollers and communicate with sensors in real time. We will also show you how to turn your design into an interaction-on-demand system that enables anyone to interact with any device at any time, all with the power of Autodesk 360 web service and Internet of Things (IoT).

Your AU Experts

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Making Connectd Design, Product and Service

For many years, we've been designing, reviewing and making our product in separate disconnected silos using different applications, tools and workflows. As the product lifecycle continues, the overall cost and waste increase, and the productivity and efficiency suffer. How can we reduce the gaps in the process? What can we do to make the design data more accessible to everyone involved?

Even when a product leaves the factory or installed at the site, we hear very little about our design or product until we discover problems in downstream stages or from customers. How well does our product perform in actual world? Can we make better design decision and respond more rapidly to customer needs by capturing data about process and product?

To find the answers for the aforementioned questions, we are going to explore brand new ways of connecting our design, product and service with the help from Autodesk 360 Web Services, open source APIs and Internet of Things (IoT) and wire them up all together without the need to write any code!

Internet of Things has been one of the most-talked about technology in recent years, occupying at the peak of Gartner's most recent Hype Cycle for Emerging Technologies. From Cisco's 50 billion projected connected devices by 2020 to Garner's economic value add of 1.9 trillion, it's yet to see whether IoT is a hype or reality. But we do know that IoT is not just about new devices or cool new sensors. Its biggest impact is how to rethink our industries and leverage its power to create new user value and experience. We will dive into IoT protocols, connectivity and look at ways to connect our design with physical microcontrollers and sensors in real time.

First, let's look at A360 Web Services and see how it can help close the gaps in our production process.

Introducing Autodesk 360 Web Services

A360 Web Services is a centralized, unified and simplified platform for you to:

- Discover, learn and experiment with Autodesk platform APIs
- Access docs, samples, SDK and source code
- Create and manage your apps easily
- Utilize all Autodesk APIs with one single consumer key and secret for each environment. No longer need to explicitly select APIs when you create a new application.

Sign up today at: https://developer.autodesk.com

A360 Web Services is a collection of web services and application APIs currently including AutoCAD I/O and View and Data API with more to come:

AutoCAD I/O

AutoCAD I/O web service allows you to run AutoCAD scripts remotely and enable them to process DWG files at cloud scale. You can create an AutoCAD script or use built-in script and have AutoCAD I/O web service run your script on the DWG files you designated and save the output to your specified web storage or location.

View and Data API

View and Data API is a web service that allows you to create custom web application to interactively visualize your design data in a web browser (with no plug-ins required) and on mobile device. It has the following features:

- REST and Javascript API to create applications easily
- Upload your model via REST API and let web service create the viewing stream for you
- Access the model and components data in your web app
- Visualize 2D and 3D models in your browser with detailed textures, smooth navigation and in-depth design data
- Browser compatibility with Chrome, Safari and Firefox
- Visualize and interact with more than 50 design file formats in your web app such as Autodesk Fusion 360, Inventor, Revit, 3ds Max, Navisworks, DWG, CATIA, SolidWorks, STEP, NX, JT and many more.

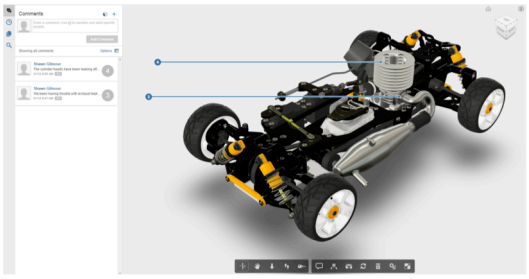
So, what can Data and View API do to help?

Sharing Data Centric Design

View and Data API lets you share your design with any stakeholder of your project from anywhere, anytime. You don't need to install any software or tool to view the design.

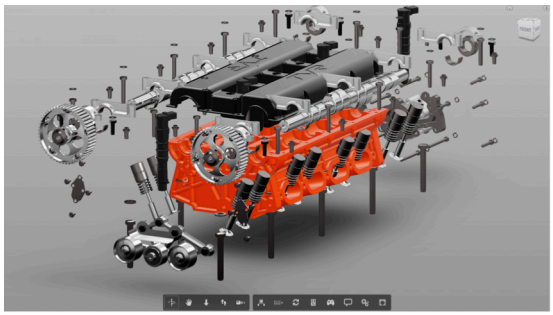
Navigate, Search and Review

View and Data API lets you easily navigate your design in 2D and 3D space, examine and search for specific parts. You can also add comments and navigate through comments on a model or drawing.



Large Model Capacity

View and Data API is able to load large models incrementally and in parallel. The progressive rendering allows you to view and navigate large model at interactive frame rate.



High Qulaity Visualization

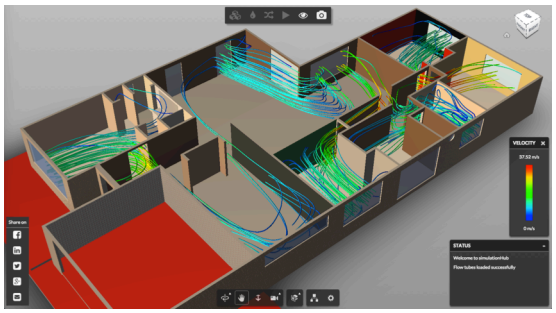
The real-time high-quality 2D and 3D rendering is made possible with the state-of-the art computer graphics on a web browser and mobile device.

Real-Time Collaboration

You can collaborate your design with your team around the world in real time by messaging. You can even share your view controls and navigate to a specific view for detailed discussion.

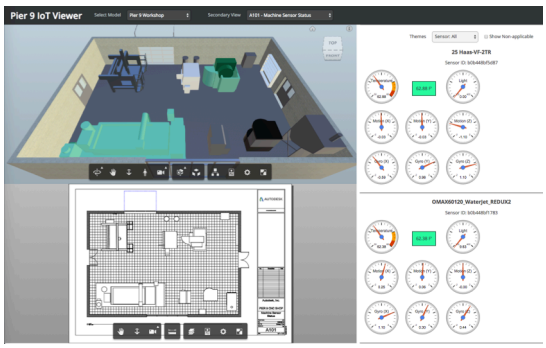
Simulation and Animation Support

View and Data API allows you to create interactive animation with camera and object transformation, visibility and annotation.



Visual Report and Presentation

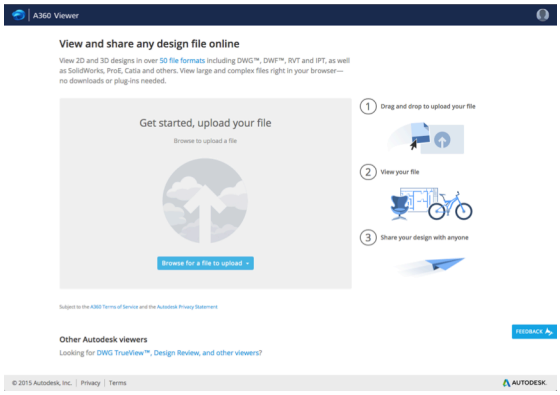
You can create compelling 2D and 3D visual report and presentation and share with your audience.



Online A360 Viewer

If you'd like to try it out (without signing up), visit the online A360 viewer (https://a360.autodesk.com/viewer) where you can:

- Drag and drop to upload your file
- View your file
- Share your design with anyone



Connecting Design and Product with Internet of Things

Once we have the View and Data API as the visualization frontend, next is to connect the design with physical world using IoT microcontrollers and sensors.

There are many kinds of smart IoT sensors using different protocols and connectivities. Here are some common open standards and their features:

Communication Protocols

Wi-Fi

Wi-Fi is based on 802.11 standard, uses 2.4 GHz and 5 GHz radio bands. It has universal compatibility but requires high power. A new 802.11ah standard that utilizes sub 1 GHz with low energy consumption and extended range (1km) for IoT is expected to be finalized in 2016 and chips and systems to hit the market soon.

Bluetooth Low Energy (Bluetooth Smart)

BLE provides reduced power consumption and longer range (60 meters) compared to Classic Bluetooth (10 meters), operates in 2.4 GHz radio frequency. It is low cost, small size and supported by most desktop and mobile operating systems, no paring required like Bluetooth.

ZigBee

ZigBee is based on 802.15.4 standard and operates in the 2.4 GHz frequency range with 250 kbps (worldwide), 915 MHz with 40 kbps (Americas and Australia) and 868 MHz with 20 kbps (Europe), uses 128 bit AES encryption. Low power consumption with approximated physical range between 10 to 100 meters.

Thread

Thread is IPv6 based, uses 6LoWPAN, which is built on 802.15.4. It operates in 2.4 GHz radio frequency. It's launched by Google's Nest, Samsung, ARM, Freescale etc.

Messaging Protocols

MQTT

Message Queue Telemetry Transport (MQTT) is a machine-to-machine protocol designed as a lightweight publish/subscribe messaging transport for small code footprint and low network bandwidth. It is a many-to-many protocol that runs on top of TCP protocol. IBM submitted MQTT 3.1, which is now OASIS standard. Facebook, Amazon, Xively, Evrything are also using MQTT.

CoAP

Constrained Application Protocol (CoAP) is for used with constrained nodes and constrained network, machine-to-machine protocol. It is a one-to-one protocol between client and server running on top of UDP, designed to easily translate to HTTP for web integration.

DDS

Data Distribution Service (DDS) for real-time system targets devices that directly use device data. It's optimized for distributed processing – directly connecting sensors, devices and applications to each other without any dependence on centralized IT infrastructure. It is best for decentralized processing instead of routing through centralized broker like MQTT.

AMQP

Advanced Message Queuing Protocol (AMQP) is a queuing system designed to connect servers to each other. It's mostly used in business messaging and server-based analysis functions.

XMPP

Extensible Messaging and Presence Protocol (XMPP) was original called Jabber, developed for instant messaging. It uses XML format over TCP, offers easy way to address a device and is ideal for consumer-oriented IoT application.

In this class, we will use MQTT, Bluetooth Low Energy, Bluetooth and Wi-Fi protocols to connect with IoT sensors and microcontrollers described next.

IoT Sensors and Microcontrollers

TI SensorTag

TI SensorTag from Texas Instrument is a multi-standard (Bluetooth Low Energy, 6LoWPAN, ZigBee) sensor with (infrared and ambient) temperature, humidity, pressure, light, 3-axis accelerometer, 3-axis gyroscope, 3-axis magnetometer sensors, microphone and buzzer.

Lightblue Bean

LightBlue Bean is an Arduino microcontroller (ATmega 328p). It supports Bluetooth Low Energy and has 3-axis accelerometer and temperature sensors, RBG LED, general-purpose input/output (GPIO).

Photon

Photon is a tiny Wi-Fi (802.11b/g/n) development kit with a Broadcom wi-fi chip, an ARM Cortex M3 (120MHz) microcontroller, 1MB flash, 128KB RAM, 18 GPIO.

Tethercell

Tethercell is a battery adapter that lets you connect and control AA-battery-operated device from your mobile device. It uses Bluetooth Low Energy protocol and consumes a very small amount of current (~20mA) by operating on a low duty cycle and staying mostly in sleep mode.

Chipolo

Chipolo is a small BLE enabled device with a temperature sensor, running on coin-size battery. Its mobile app lets you locate the device attached to lost or misplaced item.

Estimode Beacon

Estimode Beacon is small wireless sensor that broadcasts tiny radio signal about location, temperature and motion. It supports BLE and has motion and temperature sensors and compatible with Apple iBeacon and Eddystone, an open beacon format from Google.

PIR Motion Sensor

Passive Infrared (PIR) motion sensor is used to detect motion from animal or human in its range.

Vibration Motor

A coin-size permanent magnet DC motor that vibrates when inputs is logic high, used as a non-audible indicator just as your cell phone on silent mode.

Light Sensor

A photo resistor (GL5528) that detects light intensity of the surrounding environment.

Pebble

Pebble is a smartwatch with Bluetooth, vibrating motor, magnetometer and ambient light sensor. Pebble SDK provides access to on-board sensor data.

Wii Remote

Nintendo Wii remote controller (Wiimote) is Bluetooth enabled with accelerometer, vibration motor and D-pad direction control.

Wii Nunchuk

Nintendo Wii Nunchuk is controller with thumb stick with wired connection.

Open Source APIs

The following are the open source APIs we will use to connect with the above IoT sensors and microcontrollers:

Node.js

Node.js is an asynchronous event-driven, non-blocking I/O API designed to optimize performance and scalability for real-time web application. It's built on Chrome's V8 Javascript engine.

Johnny-Five

Johnny-Five is the original Javascript Robotics programming framework. It allows you to program IoT and robots with composable APIs that behave consistently across all supported hardware platforms including a variety of Arduino-compatible boards. For non-Arduino boards, platform-specific plugins are also available.

Cylon.js

Cylon.js is another robotics framework designed for controlling robots, embedded sensors and IoT devices with supports for 36 different platforms. It's built on top of Node.js.

MQTT.js

MQTT.js is a client library for the MQTT protocol written in Javascript for node.js and the browser.

Mosquitto

Mosquitto is an open source message broker that implements MQTT 3.1 and 3.1.1.

Node-RED

Node-RED is a visual tool for wiring together hardware devices, APIs and online service in a new and interesting way.

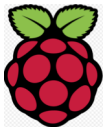
bip.io

Bip.io is a node.js based web automation framework that connects many different web services such as and performs useful works.

freeboard.io
Freeboard is a real-time dashboard builder for IoT and web mashups, an open-source alternative to Geckoboard.

Hardware

Raspberry Pi 2 Model B
Raspberry Pi 2 is a credit-card size single-board computer with 900 MHz quad-core ARM Cortex A7, 1GB RAM, Broadcom BCM2836 SoC, 4 USB ports, HDMI output, 17 GPIO.



Grove
Grove is an open modular electric platform for quick prototyping. Each module has one function and is pluggable to test the schemes with no soldering required.

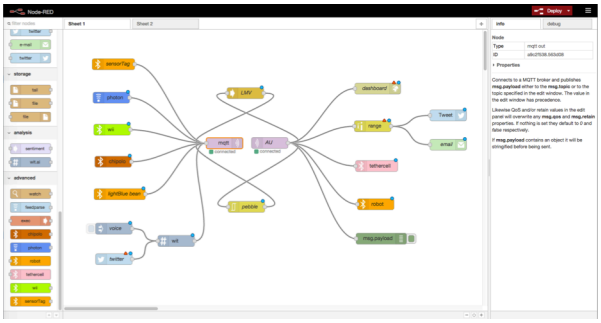
Retro Robot
A 1990s retro toy robot that “listens” to your commands with a little help from IoT.

Putting All Together

How can we get all these sensors, Pebble smartwatch, Wii remote, Nunchuk (and a robot) all talking to each other, interact with your design and communicate with your social network such as Facebook and Twitter? And without the need to write any code?

To put them all together, we will go over the following steps:

- Upload your design using View and Data API
- View and share your design in the browser and on mobile device
- Set up and launch IoT broker
- Connect your design with IoT sensors by wiring them up in the visual tool.
- Publish message to social network (Twitter, Facebook) from your design or IoT sensors
- Interact with sensors from your design and use the sensor data to configure your design in real time
- All without writing code!



Come join us for a fun and interactive demo and see a retro robot come alive with your command!

Building Interaction-On-Demand Design

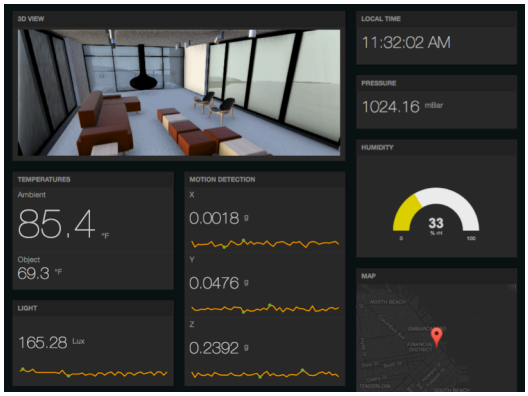
With the power of the A360 Web Service and IoT sensors, you can also turn your design into an interaction-on-demand system such as:

Interactive Content or Configuration

Connect your design with beacons or the mobile device via BLE or Wi-fi. With beacon or mobile device, you can determine the proximity or location of the person with the device. Once the person is within a range, you can show different design, content or configuration based on the identity or proximity.

Real-time Data Mashup

You can mash up your design with different data sources such as IoT sensor data, Google Map, Open Weather, clock etc (as shown on the right) and have them interact with your design. Each widget receives data from the different or same web or IoT service. The 3D View at the upper left corner is actually the View and Data API wrapped in a widget. The responsive layout is changed dynamically based on the input of the sensor data or location of the viewer.



3D Car Manual

Replace your car manual with a 3D interactive app on a tablet or mobile phone. It connects with on-board diagnostics (OBD) and other sensors displaying real-time and historical sensor data of your car such as speed, mileage, tire pressure, impact, GPS location and engine status along with the 3D view. Given the collected data, it will recommend best commute route that saves fuel, remind regular maintenance, advice road and traffic condition via email, text or twitter.