



Conference Paper

IOT, Industry 4.0, Industrial IOT... Why Connected Devices are the Future of Design

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Abstract

This paper looks at Industrial Internet of Things (IIoT) technology looking at what it is, how it works, how it's being used and why it's changing the way we design the next generation of products.

Predominantly companies investing in this technology are looking for ways to help improve the performance of their designs, leverage big data to help them make better decisions, provide more functionality to the end user and leverage services to create additional revenue streams.

Through the course of this paper we'll look at a number of key technologies being developed in this field, with a particular focus on the web connected technology.

An example, Premier Deicers, is used to illustrate innovative ways that manufacturers are applying these technologies to improve service performance, minimize downtime, provide their customers with unique insight and generate more revenue. Through the use of IIoT they've been able to provide unique services and win new customers, something many manufacturers are trying to do in otherwise challenging conditions.

Keywords: internet of things, industrial iot, iot

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Received: 28 November 2016

Accepted: 4 December 2016

Published: 9 February 2017

Publishing services provided
by Knowledge E

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Selection and Peer-review
under the responsibility of the
DesTech Conference
Committee.

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1 Introduction

Referred to in many forms, the Internet of Things (or 'IoT') is part of the next generation of technology set to disrupt the traditional manufacturing business model. These new products will offer unprecedented opportunities for manufacturers to reimagine the way they design, make and use things.

With IoT comes the ability for products to communicate with their user, the manufacturer, to each other and to a broader system. These smart products will be able to sense the environment in which they're being used and communicate with one and other to optimise the way they work. And on-board data capture will enable products to become autonomous, allowing them to make real-time decisions to improve their performance or avoid costly maintenance issues.

And consider for a moment the impact that these new connected products will have on world economies. Estimates suggest that the global impact of IoT will be in the order of US\$6.2 trillion by 2025¹ so it will come as no surprise that as many as 75% of companies across industries already exploring IoT².



Figure 1: WHITEGOODS ARE JUST ONE INDUSTRY TO BE DRASTICALLY IMPACTED BY IOT.

IoT offers the ability to capture enormous amounts of data and this provides designers with the unique ability to leverage real world information to improve the quality of the products they're making. In this increasingly connected world, the designers of the future will drive product advancement through the connected products of the future and IoT will be at the heart of this.

2 Methodology

2.1 What is Industrial IoT?

IoT, an acronym for the Internet of Things, represents the next generation of smart, connected products that are becoming, more and more, an integral part of our lives. More typically associated with consumer products such as the Fitbit activity tracker or Nest thermostat IoT, these connected products offer the end user a unique experience not available with the designs of the past. The Nest thermostat, for instance, is self-learning and adjusts room temperatures based on your activity history whilst the Fitbit activity tracker syncs users' activity enabling them to access a comprehensive dashboard where they can see statistics and gather insight to help them achieve their goals. These types of products and services are becoming so prevalent that recent studies suggest that 33% of adults already use some form of IoT in their lives³.

The Industrial Internet of Things (or 'IIoT') uses similar principles to that of IoT but applies them to the products used by companies to provide goods and services such as industrial machinery and vehicles. Industrial IoT potentially offers a greater market opportunity than that of consumer IoT as industrial machinery often requires considerable investment and ongoing expense.



Figure 2: REMOTE MONITORING AND CONTROL OF MACHINERY VIA IIOT.

2.2 What makes Industrial IoT work?

So what is it that makes IIoT products so smart? There are a number of key systems that comprise a IIoT product. Below is a list of the more critical aspects that should be considered:

Product: Typically, an IIoT product incorporates mechanical hardware, electro-mechanical hardware, electrical hardware, electronic hardware and software solutions into the one system. Each of these systems play a critical role in the overall system, from gathering information through sensors to storing or transmitting data.

Sensors: More affordable and smaller in size, sensors have never been more accessible than they are today. An electro-mechanical device that gathers information about its surroundings, sensors can measure a wide range of information including pressure, force, humidity and voltage, to name a few.

Connectivity: From the sensors comes the data, but it needs to be transmitted from the product to the broader system where the information can be further analyzed. Typically, this is done using communication protocols with some of the more common being Bluetooth, Wi-Fi and cellular, each offering different range, power consumption and internet connection characteristics. A gateway then normalizes data from various sources into a common format and prepares it for transmission via the internet.

Cloud: The best place to gather and analyze all of this data is in the cloud. Here the data can be securely stored, processed and analyzed. Combining software, a big data engine, application platform and a database, the cloud is able to organize and analyze data, provide product insight, and visualize results, with much of this happening in real-time.

External Information: An often overlooked aspect of an IIoT system is the ability to use external sources as further input. This might be weather, traffic, prices or maps, all of which can be gathered from the internet. Gathering information from CRM or PLM systems further enables valuable insight into a products performance.

Visualization of Data: Data visualization is the user interface that enables end users the ability to control their products remotely. Often in real-time, data visualization allows users to see trends, compare products and track information. Commands can also be sent through to products, essentially enabling remote access or control via the cloud.

3 Results

3.1 What are some of the more typical results?

In general, Industrial IoT products have the ability to take advantage of the following key benefits:

Closed Loop Design: Using data gathered from real world use, designers are able to better understand how products are being used. This further enables them to design better performing products that meet the needs of the end user.

Increased Consumer Value: With the ability to share valuable information, offer unique features and functionality, as well as provide more convenience and functionality, IIoT products provide the end user with a better experience.

Predictive Maintenance: Machinery uptime is critical for any industrial machinery manufacturer. The ability to use IIoT and gather data offers users the ability to implement predictive maintenance and avoid machine downtime before failures occur.

New Service Lines: Implementing IIoT enables manufacturers the ability to obtain new revenue services through predictive maintenance programs, offering remote monitoring services, and better enabling remote software updates and improvements.

3.2 How is it used by industry?

The adoption of IIoT is rapidly advancing. With manufacturers across a broad range of industries adopting this technology there are numerous examples available that highlight the value that IIoT has for manufacturers from various industries, and of all shapes and sizes. The following example highlights some of the key advantages discussed in this paper.

Premier Deicers: In cooler climates, de-icing of planes is a common but critical process used to ensure the performance and reliability of aircraft during takeoff. For the airline company any excessive delays in the de-icing process can result in lost revenue and

profitability. Furthermore, the fluids used are hazardous and require extensive reporting and compliance. This is the exact reason why a large regional airline in the US looked to IIoT to help solve some of their problems.

The airline company worked with their de-icing services provider, Premier Deicers, to develop a real-time fluid management system that would better enable them to understand and control various aspects of the de-icing process.

Electronic equipment, in the form of J1939 CanBUS monitoring and GPS hardware, was retrofitted to new and existing de-icing machinery enabling Premier Deicers the ability to gather information related to engine diagnostics, fluid volume and dispensing data. And integration of Autodesk's Fusion Connect IIoT management platform meant that data taken from the machinery could be used to better understand a wide range of critical processes.

Having implemented the system Premier Deicers is better able to understand the time taken to de-ice planes and how much fluid is used during the process. Furthermore, vehicle monitoring enables them to better predict potential engine failures and implement predictive maintenance to reduce the chance of machine downtime.

Overall, adoption of IIoT has resulted in a number of key benefits to Premier Deicers and/or their customer/s:

- Accelerated de-icing by 40%
- Improved on time departures
- Increased revenue protection
- New revenue streams
- Competitive edge

4 Summary and Conclusion

Not since the Industrial Revolution have we seen such considerable change to the manufacturing industry as we're experiencing at the moment. And Industrial IoT is changing the types of products we design giving designers the ability to incorporate onboard electronics that can gather and share information around a products use.

Furthermore, the ability to gather information on a products use enables designers to better understand the conditions under which it is used and, ultimately, help them improve the performance of products. This closed loop design process will enable designers to create products that better meet the needs of their end users whilst, at the same time, be more reliable.

Though there will be considerable challenges during this period of moving to connected products, the opportunities to offer unique services to customers will likely cre-



ate a new breed of manufacturers who will be focused, more than ever, on big data and analytics as a means of differentiating themselves from their competitors.

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