Actualization of the Internet of Things: Some Closing Remarks

First, many thanks to my co-organizers Jeff Hunt (Boeing) and Steven Lambert (APS)

The scientific advisory committee:
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And to all of the speakers, poster presenters, and attendees

…for making this a wonderful conference!

What are some of the key messages?

I. IoT is showing a lot of promise, on many fronts

--Many different types of sensors, some even with the possibility of responding to feedback (Medical, Environmental, Organic gases (food spoilage), crops, vehicles, cities, power plants, manufacturing lines, etc.)

--Advances in physical models are enabling real-time response

--A convergence with Big Data Analytics, Machine Learning, and AI, allowing deep understanding of the sensor data

--Many sensors are inexpensive and off the shelf, but also many special ones are being built, at the frontiers of physics, chemistry, engineering, and biology. Flexible sensors, printed sensors.

--Huge opportunity for inspection and optimization – defects, parts, processes

--The promise of improving environmental pollution, health, energy, agriculture, global disaster monitoring and warning, and many industrial processes, is enormous. (Several very inspirational talks)

II. Actualization of the Internet of Things is a multi-stage process: **a system**

--Hardening of sensors/adaptation to environment/Packaging

--Edge computation and storage

--Secure transport of data

--Data analytics in secure cloud

--Physical models plus statistical analysis

--Customer and larger community buy-in

III. Challenges

--All the technical challenges to implementing the steps on previous slide, plus:

--Security in every aspect of the access: physical, wireless, RFID, routers, switches, servers, etc. Data has often many miles to go before reaching secure cloud.

--Huge amounts of data to process and transport

--Sometimes the opposite problem: sparse data to process

-- Will our internet systems be able to handle trillions of additional sensors?

--How much accuracy will sensors be required to have? (Eg, cars, planes, elevators vs environmental vs food spoilage) Arrays of inaccurate sensors plus AI to give tailored info.

--Power for the sensors – batteries small, low-discharge, last for years or need photocell to recharge, in low-light or hot/cold, need power to send signals

--Lightweight specialized encryption needed because limited CPU and memory

--What if the IoT device is not patchable?

--Two-factor authentication? Self-calibration?

Challenges, continued

--Societal/political

Good news: these are not (for the most part) robots! Sensors are not taking jobs. In many cases, IoT is creating jobs.

In fact, many sensors do not even have a camera, and many are not involved with “sensing” people. → IoT should be an easy sell!

Indeed, sensors in industrial environments will be treated by the public as “business as usual”- power plants, farms, mining, manufacturing, cars, etc.

Where the challenge will come in will be widespread sensors in:

-medical (privacy issues for use on well populations)

-cities

-outdoors: suburbs, countryside

-stores, schools

These will require some interactions with communities/politics and education to smooth the way. Regulations will be a reality.

IV Final message

--Actualization of the IoT has been with us for a while now, but the scale is growing in an accelerating manner
--Enormous potential benefits, almost no downside
--A great opportunity for students in physics, chemistry, all sorts of engineering, CS, not the least for advanced power sources
--Quantum computers developing, eventually good for Big Data/Machine learning. They are things on the internet.
--The time is ripe for IoT course modules to be developed – for college level, but also high school and junior high. The sensors are cheap and plentiful – students should experiment and learn.

→Would you like to do this again next year? If so, write to Steven Lambert!
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