Innovation Lecture: Internet of Things

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What is Internet of Things?

- The network of physical objects—"things"—that are embedded with **sensors**, **software**, and **other technologies** for the purpose of connecting and exchanging data with other devices and systems over the internet.
- A 'thing' can refer to a
  - connected medical device
  - a biochip transponder (think livestock)
  - a solar panel
  - a connected automobile with sensors that alert the driver to a myriad of possible issues (fuel, tire pressure, needed maintenance, and more) or
  - any object, outfitted with sensors, that has the ability to gather and transfer data over a network.
- Could range from ordinary household items to sophisticated industrial tools.
- **taking all the things in the world and connecting them to the internet.**

Why IoT matters?

- When something is connected to the internet, that means that it can send information or receive information, or both.
- Example : Song streaming on your smartphone.
- To be smart, a thing doesn't need to have super storage or a supercomputer inside of it. All a thing has to do is connect to super storage or to a supercomputer.
- In the Internet of Things, all the things that are being connected to the internet can be put into three categories:
  - Things that collect information and then send it.
  - Things that receive information and then act on it.
  - Things that do both.

Collecting and Sending Information

- This means sensors.
- Example: temperature sensors, motion sensors, moisture sensors, air quality sensors, light sensors etc.
- Sensors, along with a connection, allow us to automatically collect information from the environment which, in turn, allows us to make more intelligent decisions.
- Automatic information of soil moisture can help farmers with proper irrigation.

Receiving and Acting on Information

- Things that collect information and send it, but also receive information and act on it - power of IoT.
- Eg. If the irrigation system receives information about the weather from its internet connection, predicts rain and decides not to turn the irrigation on.
- Information related to irrigation system and crop yield can be collected over time and analysed to generate insights about best way to irrigate crops for good yield.
- **The internet of Things, or "IoT" for short, is about extending the power of the internet beyond computers and smartphones to a whole range of other things, processes, and environments.**
- **The IoT integrates the interconnectedness of human culture – our 'things' – with the interconnectedness of our digital information system – 'the internet.'**
- Internet of Things Video

- The term IoT is mainly used for devices that wouldn't usually be generally expected to have an internet connection, and that can communicate with the network independently of human action.

- For this reason, a PC isn't generally considered an IoT device and neither is a smartphone – even though the latter is crammed with sensors.

- A smartwatch or a fitness band or other wearable device might be counted as an IoT device, however.

- It is predicted that 41.6 billion connected IoT devices by 2025.

What Technologies have made IoT possible?

- Access to low-cost, low-power sensor technology.
- Connectivity
- Cloud computing platforms
- Machine learning and analytics
- Conversational artificial intelligence (AI)
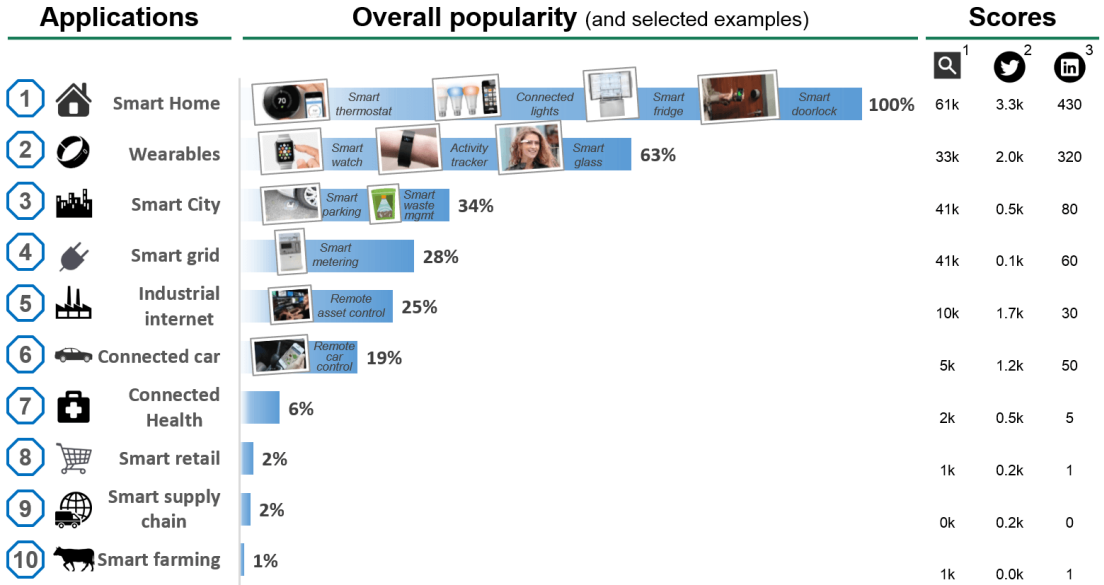
Benefits of Internet of Things for Consumers

- Makes our environment – our homes and offices and vehicles – smarter, more measurable.
- Smart speakers like Amazon's Echo and Google Home make it easier to play music, set timers, or get information.
- Home security systems make it easier to monitor what's going on inside and outside, or to see and talk to visitors.
- Meanwhile, smart thermostats can help us heat our homes before we arrive back, and smart lightbulbs can make it look like we're home even when we're out.
- Self-driving cars and smart cities could change how we build and manage our public spaces.

Top IoT Applications

- Create new efficiencies in manufacturing through machine monitoring and product-quality monitoring.
- Improve the tracking and "ring-fencing" of physical assets.
- Use wearables to monitor human health analytics and environmental conditions.
- Drive efficiencies and new possibilities in existing processes.
- Enable business process changes. Eg. Remote monitoring of the health of machines.

Industries that can benefit from IoT

- Manufacturing
- Automotive
- Transportation and Logistics
- Retail
- Public Sector
- Healthcare
- General Safety Across All Industries

IoT Analytics – *Quantifying the connected world*

Applications Overall popularity (and selected examples) Scores

| #	Application	Popularity	Examples	1 (search)	2 (twitter)	3 (linkedin)
1	Smart Home	100%	Smart thermostat, Connected lights, Smart fridge, Smart doorlock	61k	3.3k	430
2	Wearables	63%	Smart watch, Activity tracker, Smart glass	33k	2.0k	320
3	Smart City	34%	Smart parking, Smart waste mgmt	41k	0.5k	80
4	Smart grid	28%	Smart metering	41k	0.1k	60
5	Industrial internet	25%	Remote asset control	10k	1.7k	30
6	Connected car	19%	Remote car control	5k	1.2k	50
7	Connected Health	6%		2k	0.5k	5
8	Smart retail	2%		1k	0.2k	1
9	Smart supply chain	2%		0k	0.2k	0
10	Smart farming	1%		1k	0.0k	1

1. Monthly worldwide Google searches for the application 2. Monthly Tweets containing the application name and #IOT 3. Monthly LinkedIn Posts that include the application name. All metrics valid for Q4/2014.
Sources: Google, Twitter, LinkedIn, IoT Analytics

IoT Applications

- Wearables: Fit Bits, heart rate monitors and smartwatches.
- Guardian glucose monitoring device: detects glucose levels in the body, using a tiny electrode called glucose sensor placed under the skin and relays the information via Radio Frequency to a monitoring device.
- Smart Home applications
- Smart City: Palo Alto Example for traffic management.
- Sensors were installed at all the parking spots around the city. These sensors pass the occupancy status of each spot to the cloud. Any number of applications can consume that data. It can guide the drivers through the shortest route to an open spot.

Smart Greenhouse

Inside the Greenhouse

Industry Automaton
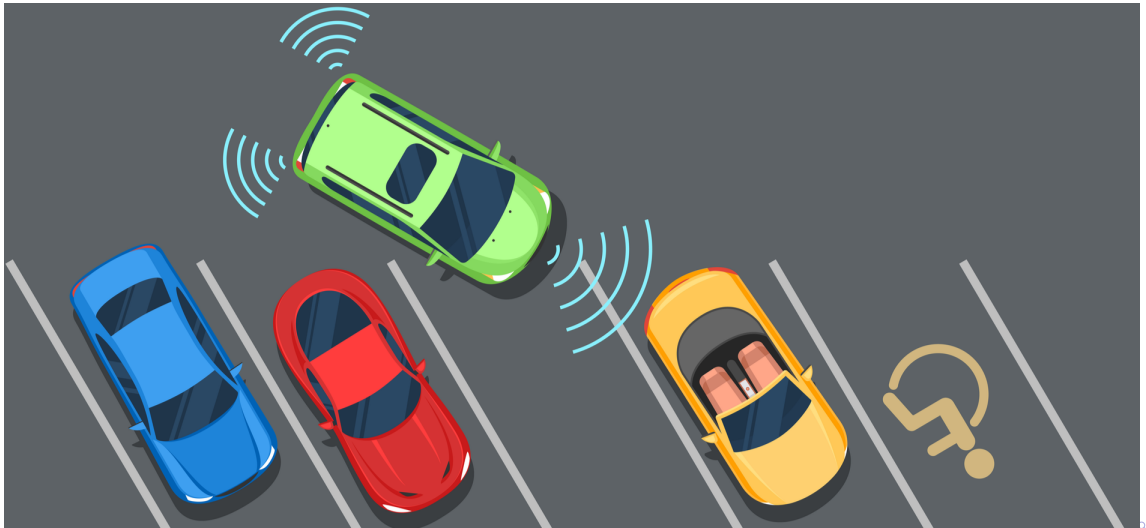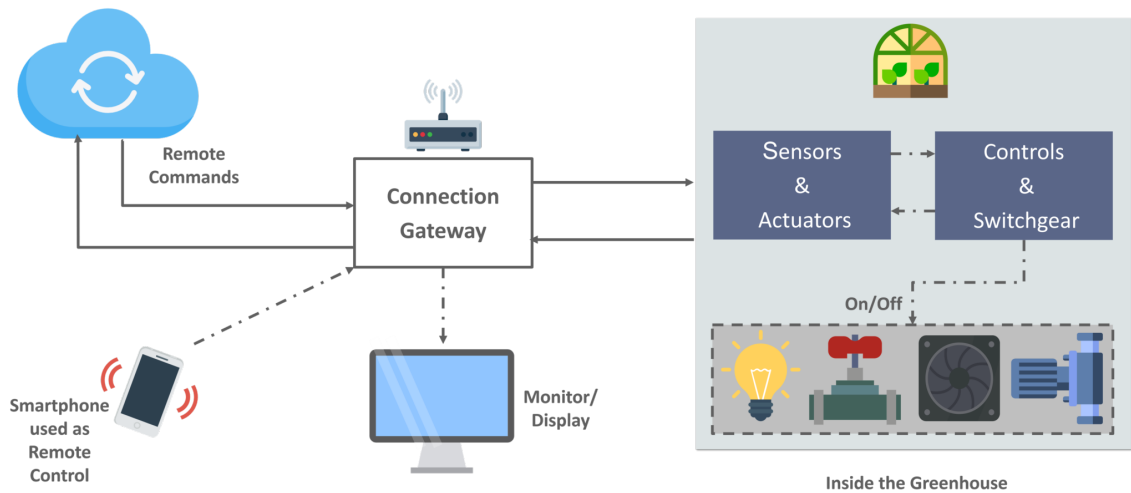
IoT Applications in Industrial Automation

- Smart tracking for products in-transit

- Notifies users on deviations in delivery plans

- Creates Digital Factories

- Improves Line-of-Command in work units

- Monitors in near real-time through out the supply chain

- Provides cross channel visibility into inventories

- Product Quality testing in various stages of Manufacturing cycle

- Packaging Optimization

Internet of Things Security

- Sensors are collecting extremely sensitive data.
- Security track record for IoT has been extremely poor.
- Encryption of data in transit and at rest is extremely important.
- Hackers are now actively targeting IoT devices such as routers and webcams because their inherent lack of security makes them easy to compromise and roll up into giant botnets.
- Flaws have left smart home devices like refrigerators, ovens, and dishwashers open to hackers.
- Hackers can track the wearer's location, eavesdrop on conversations, or even communicate with the user.
- Industrial espionage or a destructive attack on critical infrastructure are both potential risks.

Internet of Things Privacy

- IoT is a potentially vast privacy and security headache.
- What happens to the data collected by smart devices is an important privacy matter.
- Badly installed IoT products could easily open up corporate networks to attack by hackers, or simply leak data.

Internet of Things and Big Data Analytics

- IoT generates vast amounts of data: from sensors attached to machine parts or environment sensors, or the words we shout at our smart speakers.
- Data culled from sensors around a city could help planners make traffic flow more efficiently.
- That data will come in many different forms – voice requests, video, temperature or other sensor readings, all of which can be mined for insight.

Some concerns

- It is always upto us to decide how much space we should give to technology in our lives.
- Internet is a space which is useful and risky at the same time.
- Discretion in usage and caution in sharing personal information online is advised.

Upcoming

- Next Lecture: An overview of Data Analysis and Innovation/Research.
- External speaker on IoT Practical Applications.