

Assignment 3

Research on Internet of Things

Concept of Internet of Things (IoT)

The Internet of things (IoT) is the network of physical devices, vehicles, home appliances, and other items embedded with electronics, software, sensors, actuators, and network connectivity which enable these objects to connect and exchange data. Each thing is uniquely identifiable through its embedded computing system but can inter-operate within the existing Internet infrastructure. ^[1]

The IoT allows objects to be sensed or controlled remotely across existing network infrastructure, creating opportunities for more direct integration of the physical world into computer-based systems, and resulting in improved efficiency, accuracy and economic benefit in addition to reduced human intervention.

"Things", in the IoT sense, can refer to a wide variety of devices that collect useful data with the help of various existing technologies and then autonomously flow the data between other devices. The quick expansion of Internet-connected objects is also expected to generate large amounts of data from diverse locations, with the consequent necessity for quick aggregation of the data, and an increase in the need to index, store, and process such data more effectively. ^[2]

Simply put, IoT is the concept of basically connecting any device with an on and off switch to the Internet (and/or to each other). This includes everything from cellphones, coffee makers, washing machines, headphones, lamps, wearable devices and almost anything else you can think of. This also applies to components of machines, for example a jet engine of an airplane or the drill of an oil rig. If it has an on and off switch, then chances are it can be a part of the IoT. The IoT is a giant network of connected "things" (which also includes people). The relationship will be between people-people, people-things, and things-things.

History of IoT

The IoT has not been around for very long. It has evolved due to a convergence of multiple technologies, including wireless telegraphy, embedded systems and commodity sensors, and most important of all, the Internet.

Machines have been providing direct communications since the telegraph (the first landline) was developed in the 1830s and 1840s. Described as "wireless telegraphy," the first radio voice transmission took place on June 3, 1900, providing a necessary component for developing the Internet of Things. The development of computers began in the 1950s. ^[3]

The Internet, the most significant component of the IoT, started out as part of DARPA (Defense Advanced Research Projects Agency) in 1962, and evolved into ARPANET in 1969. In the 1980s, commercial service providers began supporting public use of ARPANET, allowing it to evolve

into our modern Internet. Global Positioning Satellites (GPS) became a reality in early 1993, with the Department of Defense providing a stable, highly functional system of 24 satellites. This was quickly followed by privately owned, commercial satellites being placed in orbit. Satellites and landlines provide basic communications for much of the IoT. ^[3]

One additional and important component in developing a functional IoT was IPv6's remarkably intelligent decision to increase address space. Put another way, we are not going to run out of internet addresses anytime soon.

Kevin Ashton, the Executive Director of Auto-ID Labs at MIT, was the first to describe the Internet of Things, while making a presentation for Procter & Gamble. He believed Radio Frequency Identification (RFID) was a prerequisite for the Internet of Things. He concluded if all devices were "tagged," computers could manage, track, and inventory them.

To summarize, all these technologies have evolved individually, and have been combined to form the vision of the Internet of Things, where everything with sensors and embedded systems can be tagged using RFID technology, have an IPv6 address, can communicate with other objects through wireless telegraphy, and all these services are provided by the Internet. Hence, the Internet of Things.

Current and Potential Applications of IoT

The Internet of Things has been around for not very long, but its growth has shown immense potential. Coming from its parent technology, the Internet, IoT shows tremendous potential in multiple fields. Some real-world applications of IoT are ^[4]:

A. Smart Homes

Smart homes have become the revolutionary ladder of success in residential spaces, and are predicted to become as common as smart phones. With IoT creating the buzz, 'Smart Home' is the most searched IoT associated feature on Google. But, what is a Smart Home? Wouldn't you love if you could switch on air conditioning before reaching home or switch off lights even after you have left home? Or unlock the doors to friends for temporary access even when you are not at home. That is exactly what smart homes are.

B. Wearables

Wearables have experienced an explosive demand in markets all over the world. Companies like Google, Samsung have invested heavily in building such devices. Wearable devices are installed with sensors and software which collect data and information about the users. This data is later pre-processed to extract essential insights about user. These devices broadly cover fitness, health and entertainment requirements. The pre-requisite from Internet of Things technology for wearable applications is to be highly energy efficient or ultra-low power consuming and small sized.

C. Smart Cities

Smart city is another powerful application of IoT generating curiosity among world's population. Smart surveillance, automated transportation, smarter energy management systems, water distribution, urban security and environmental monitoring all are examples of Internet of Things applications for smart cities.

D. IoT in Agriculture

With the continuous increase in world's population, demand for food supply is extremely raised. Governments are helping farmers to use advanced techniques and research to increase food production. Smart farming is one of the fastest growing field in IoT. Farmers are using meaningful insights from the data to yield better return on investment. Sensing for soil moisture and nutrients, controlling water usage for plant growth and determining custom fertilizer are some simple uses of IoT.

E. Smart Retail

The potential of IoT in the retail sector is enormous. IoT provides an opportunity to retailers to connect with the customers to enhance the in-store experience. Smartphones will be the way for retailers to remain connected with their consumers even out of store. Interacting through smartphones and using technology can help retailers serve their consumers better. They can also track consumers' path through a store and improve store layout and place premium products in high traffic areas.

F. IOT in Healthcare

Connected healthcare yet remains the sleeping giant of the Internet of Things applications. The concept of connected healthcare system and smart medical devices bears enormous potential not just for companies, but also for the well-being of people in general. Research shows IoT in healthcare will be massive in coming years. IoT in healthcare is aimed at empowering people to live healthier life by wearing connected devices. The collected data will help in personalized analysis of an individual's health and provide tailor made strategies to combat illness.

Benefits of IoT ^[5]

IoT has shown immense potential to ease daily activities, make smarter devices and make human perceive technology in an all new manner. It has proven to be impactful, which naturally comes from a long list of benefits that it provides, some of which are:

Safety, Comfort, Efficiency

Imagine measuring and managing hazardous environments without putting people at risk, and optimizing all physical environments for comfort and productivity while controlling energy costs.

Monotonous tasks can be automated and done by machines. For example, smart assembly lines could report misconfigurations and errors in real time, producing higher yields and less downtime. The result is more time for productive and rewarding work. This would drive higher employee satisfaction and retention, while dramatically improving profit margins.

Better Decision Making

If you can analyze larger trends from empirical data, you can make smarter decisions. This takes assumptions out of the equation, giving you data-backed visibility into every aspect of your business. For example, testing machines would radically shorten – lowering the costs to optimize a process. Additionally, the visibility into system behaviors can yield new insights and ideas, guiding your business like never before.

Revenue Generation

At first, the above benefits from the IoT will impact your bottom line simply by reducing expenses and improving efficiency. However, it's only a matter of time before IoT data analysis helps you realize new business functions – and thus new revenue opportunities. The IoT may be the “X factor” that gives many organizations a strategic advantage over the competitors in the next decade.

Unintended Consequences of IoT ^[5]

Every technology comes with its set of threats and unintended consequences that make users hesitate over its use. For IoT, some of them are:

Security and Privacy

Digitally-connected things have definite security risks. Even when access controls are present, many organizations don't have strong security protocols in place. This is the IoT equivalent of having a username/password combination of “admin” and “password”. Even if you're savvy enough to properly configure the connected device, other gaps exist. Connected device manufacturers are often slow to update firmware or release patches. In short, both security and privacy on your network of things has to be your responsibility as the user implementing the technology.

Data and Complexity

The IoT generates countless bytes of data, but business value is measured not in bytes, but in the analysis of trends and patterns. For example, if you have a single sensor reporting one of ten possible values every week. In one year, you'd collect 52 points of data. Now, imagine the complexity of thousands of sensors collecting data each hour across a single organization. If you don't have a plan to process and analyze these huge quantities of data, you won't be able to translate any of these findings to better business practices.

Effects of IoT

IoT has a large audience that it attracts. Each of them is affected by the potential that this new technology shows. According to an emerging consensus, virtually every walk of life and industry sector will be transformed by IoT, including manufacturing, supply chain management, health and wellness, transportation, agriculture, and household living, to name a few. In summary, IoT shows the most impact in the following sectors:

Global Society

We are entering a critical period where major and disruptive changes in society will soon be upon us. One only has to look back at the development of the “Internet of People” to see how radically and rapidly it has changed society, access to information, and disrupted business models. ^[6]

Problems could result from generation of large quantities of data that are not necessarily valuable or needed, and that can be misused in ways that lead to invalid inferences; but data generated in the course of everyday life and work will also present great opportunities for global society, for example, in the design of more efficient transport systems.

Public attitudes, opinions and behavior will be critical if the public cares more about privacy, data protection, and other social issues of the IoT – as opposed to the potential benefits in terms of public safety, energy conservation, and lower costs.

Government

Like companies, government agencies are striving to deliver quality services in increasingly complex environments. And the public sector is also looking at ways to apply Internet of Things technology to find new value for citizens, aiming to enhance capabilities, streamline processes, and engage partners. ^[7]

However, strategic application of the Internet of Things (IoT)—the suite of embedded sensors and wirelessly connected devices—is still nascent in government. One justification of this could be the way IoT impacts the confidentiality and discreteness of crucial data collected by the government. One security breach can break the entire system. That said, applications like smart cities cannot be implemented without the support of the government. Many departments in the government too can use IoT to streamline their processes and reduce financial overhead and serve the citizen better.

Businesses

There is a thin line between the Internet of Things making or breaking your business. Applied the right way, IoT effects businesses in ways that it can make profits go beyond the roof. The amount of data that is collected, if analyzed to the fullest, can reveal business insights that the management would never even think of otherwise. Imagine knowing everything that is happening in your business at all times, that is what IoT brings to you.

IoT will also bring about an enhancement in the speed at which the work is done. With all device interconnected with each other, the amount of time it takes to communicate with other will be as good as zero. All these benefits impact the productivity of your business.

Initial costs to implement IoT in business may be steep, but it does reduce costs of personnel and guarantee accurate results which will eventually drive up the profits.

Consumers

In many scholarly articles, Internet of Things has been thought to revolutionize the way consumers interact with the physical world. The IoT ecosystem enables consumers to connect to, communicate with and control devices in various environments. [8]

The Internet of Things (IoT) has the power to change our world. And while we are starting to see its incredible impact, we are still very much at the beginning of the transformational journey. Soon every device you own – and nearly every object you can imagine – will be connected to the Internet. Whether it's through the phone, wearable tech or everyday household objects, IoT will connect consumers in ways they can't even imagine yet.

Think about the latest products in technology. Amazon's Echo Dot, Alexa, Google Home, and device that makes smart living possible. Apple Watch, FitBit, may look like simple watches and wrist bands, but in reality, are connected to your phones and to your bodies, taking note of even the human heartbeat. All these devices are nothing but mechanical forms of the concept of the Internet of Things, and these devices have made consumers' lives, in the simplest of term, easy.

Relationship Between IoT and Big Data

IoT is about devices, data and connectivity. The real value of the Internet of Things is about creating smarter products, delivering intelligent insights and providing new business outcomes. As millions of devices get connected, IoT will trigger a massive inflow of Big Data. The key challenge is visualizing and uncovering insights from various types of data (structured, unstructured, images, contextual, real-time) and in context of your applications. Deriving intelligence from Big Data using Artificial Intelligence technologies is the key enabler for smarter devices and a connected world. [9]

Using appropriate Big Data algorithms for analyzing data generated by and collected from devices connected with each other, implementing the concept of IoT, can be seen as beneficial for businesses and consumers. Various other technologies can also be incorporated for more detailed insights. For example, the use of Artificial Intelligence technologies like deep learning will be a key differentiator to derive insights rapidly from massive streams of data, or implementing Machine Learning strategies to better understand the users.

In summary, the Internet of Things is a concept that is fueled by Big Data, towards a more connected environment of devices and humans. [9]

Wordcount: 2429 words

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