

# Sensors will define our future

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Our planet has always generated enormous amounts of data. However in the past we weren't always aware of this data because we couldn't capture it. The amount of captured data is expected to be 44 times greater in 2020 than it was in 2009. Most likely this expectation is too cautious. We have seen the emergence of a global data field. More and more of this data is generated by individuals rather than companies however our data is stored, protected and managed by these enterprises. The expectation is that this trend will continue in the near future.

There are multiple trends causing the increase in global data. The most important facts are the improvements in electronics and the increased internet connectivity. Furthermore we have sensors capable to translate all kind of different physical activities into an electrical signal. These electrical signals are then converted by computers into understandable data (Wilson, 2008).

Due to these improvements we are able to interconnect all our devices and give them access to our global data network. This kind of global data network is commonly referenced to as the Internet of Things (IoT). The original definition of the IoT is stated as follows:

*"The Internet of Things is a system where the Internet is connected to the physical world via ubiquitous sensors." Kevin Ashton*

The IoT doesn't limit itself to consumer electronics. It's a vision to connect new places to the internet like healthcare facilities, transportation systems and even manufacturing systems. Every place connected to the internet that's able to represent itself digital can deliver and gather information from the global data network. If more data is gathered from different places, an increasing amount of opportunities will arise to improve safety, security and to create new opportunities.

However the kind of networks mentioned above and the gathered data lead to multiple implications. They give rise to new kind of privacy issues, risks etc... These issues will be discussed in the next chapter. The chapter after the issues give a short view on the economic and ecological importance of sensor networks. Also some applications examples will be discussed in the subsequent chapter. The final part gives a small conclusion .

## Issues

### PRIVACY ISSUES

In the last few years more and more privacy implications have been discussed. Privacy issues arise due to the data collected from all the sensors in your devices. It's very easy to think of a future world in which you can retrieve when you are at home, when you will leave or arrive. How often you cook yourself or buy take-away food. With the captured data, predictions and so called consumer patterns can be created. Due to the sensors in all your devices an enormous amount of information about the individual which is using these devices, is made available. At the moment you can still protect your privacy by opting to not use these services. In the future this will become nearly impossible. Today there are already examples of situations in which you are deliberately disadvantaged by protecting your privacy. An example of such a situation is the installment of smart-meters in your home. People opting for such a smart meter are provided with a lower energy bill at the end of the year. However in return you shared information about your energy usage to the companies. Smart grids can have major impacts on improving energy distribution (Adam and Wintersteller, 2008). Another example is the fact that companies like Facebook, Google and other social media (even ING bank) stores user data about everything you do. They use it to customize the advertising you see as a customer for example, but

there are a lot more applications where this data is used. Nowadays, almost no-one can use internet without using a search engine anymore, like Google. The moment when everybody uses social media like Facebook is also coming closer every day, this collection of user data will be unavoidable in the near future. (Dover, 2008)

Despite these privacy issues, global regulation concerning privacy is still lacking. Even national regulation still lacks practical mechanisms. Due to the lack of current regulations, innovation is most likely crippled. It should be mentioned that security issues making data available during collection, recording and transmission are only a small part of it and likely to be solved with technical measures.

One of the main problem's arising when the IoT develops is the possibility to re-personalize anonymously gathered data using the increasingly powerful data analytics.

## **RISKS**

The use and analysis of big data contains a risk. For example the Google Flu Trends which is a flu tracker that's popular in the US. It combines the data from searches related with flu activity to predict the number of doctor visits in the coming weeks. According to a recent study the used algorithm overestimates the flu-related visits with over 50%. The problem is caused by the misuse of the data. The Google flu tracker is only one example of such applications. We assume that the data and the algorithm is neutral. However often it isn't.

*"Algorithmic accountability is one of the biggest problems of our time"* (Selinger, E).

We often have no idea how the algorithm does the data processing. It's not transparent at all on how it is gathered. This makes the conclusions a lot less trustworthy. It's important that when we are going to make decisions using the data based on these algorithm's, that they become transparent. (Hodson, 2014)

# **Economic and ecologic importance**

## **ECONOMIC IMPORTANCE**

The economic importance and possibilities of sensor networks are enormous. There are many examples to prove their importance. To relate to our thesis, we'll take the economic footprint of the aviation industry. This industry directly and indirectly contributed more than 22 million jobs and over 1400 billion US dollars to the Global Domestic Product.

Furthermore other industries growth is facilitated and supported by the aviation sector. The usage of sensor networks in aviation industry is a common fact. Going from the scanning of boarding passes and automatic luggage transportation systems, to the sensor networks like the one we developed, used in the development process of the aircrafts. We may assume quite a part of the aviation industries achievements are made possible by these intelligent networks and sensors. (Perovic,2013)

## **ECOLOGICAL IMPORTANCE**

In theory the ecological importance of sensor networks and the generated data is significant. Due to the use of smarter systems and adapting our behavior using the generated data, our lifestyle can become more ecological. However a big part of it is still reliant on the people and their behavior in our opinion. The earlier mentioned example of smart grids and smart meters is one of the favorite examples of ecologists to prove the ecological importance of sensor data. The OECD, (a unique forum where the governments of 30 democracies work together) concluded the following:

*A review of different studies assessing the environmental impact of ICTs and especially sensor and sensor networks reveals that these technologies can contribute significantly to more efficient use of resources and an important reduction of greenhouse gas emissions.* (OECD,2009) Figure 1 is giving an overview of some

important examples of wireless sensor networks. In the next section some examples of applications are discussed.

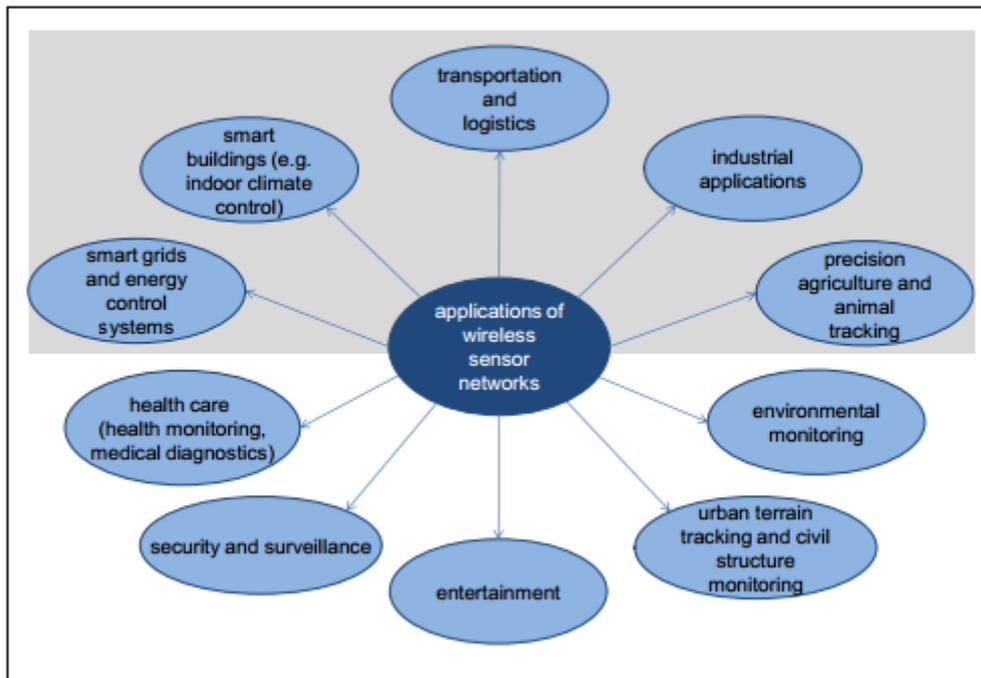


Figure 1: overview of WSN applications (OECD,2009)

## Applications

### THE BIG BROTHER EFFECT

In the United States they recently decided to make a tracking device mandatory in all vehicles by 2015. This tracking device would make it possible to communicate with stationary objects like traffic lights, mobiles of pedestrians and so on.

The tracking data is then placed on the internet of things, which could be accessed by court order. This is a bit concerning because it will increase the ability of the government to monitor its inhabitants. This could lead to a Big Brother scenario, to prevent this they will restrict what the state or other parties can do with the information. (Diehn, 2012)

In EU, eCall will be implemented by 2015. It is the implementation of the tracking devices without the privacy issues. The eCall system sends data to the emergency services and traffic services when that vehicle had an accident, this to provide a faster emergency intervention. The positive about this is that eCall doesn't have the issues of the privacy because it only sends tracking data in case of an emergency. (Van Miltenburg, 2014)

### SOCIAL SENSING

Social sensing is best described as gathering information about people and social interaction using a data source. Commonly the data source is your mobile phone according to the definition of the Digital Enterprise Research Institute (DERI). Most smartphones contains quite some sensors. For example an accelerometer, GPS, shock-sensor, microphone, camera-sensor etc.... However the definition of social sensing isn't limited to gathering data with mobile phones only. Mining and aggregating user inputs and content over multiple social networking sites is also a form of social sensing. For news centers and journalists the network gained from

social sensing is a goldmine. News-stories can be gathered directly at the source. It's delivering new info faster than ever before. The downside to this is that less journalists are needed. The only thing they need to do is to verify the stories before spreading them as official news. (Diehn, 2012)

### **SMARTHEALTH**

So the internet of things offers a lot of benefits in multiple application fields, especially in the field of healthcare. It could improve the total efficiency of treatments when sensors are directly connected to the IOT so there is no need to enter data manually. This will save time, decrease the cost and most of all it will rule out human errors. Certainly in the health sector it's important to rule out errors that can mean the difference between life and death. So not only will sensors upload their data directly to the cloud, they can also do other things.

Sensors with data processing on it can be inserted in the body or attached to it, to monitor patients and their parameters. They can measure vital functions of the patient, like blood pressure or temperature. This makes it possible to follow up a patient much better and anticipate eventual side-effects or allergic reactions. By attaching such a sensor to all people in a hospital, this could drastically improve the quality of care because it would automatically alarm caregivers in case of a patient in need of assistance.

It will not only keep track of the patients conditions but because some elderly or ill patients can't think straight anymore, they sometimes wander off. This chip could then give a signal when a patient leaves his room, to prevent lost patients. A technique that's applied at the moment in some elderly homes, to check if the elderly people are in bed. The care givers are alerted when something goes wrong or if the patients are out of bed. This is all done by the use of radar and ultrasound.

Sensors can not only collect data to observe them over time, they can also be used to replace certain surgeries which are unpleasant to the patient. Like how much more practical and safer would it be if a gastroscopy or a colonoscopy would be replaced by swallowing a pill camera. This pill would then use the camera inside to send images of live stream to the wireless receiver in the neighborhood. When you think out of the box, you could also do this procedure when the patient is sitting at home, you give the patient a pill camera and then make it connect to WIFI. This would make more people take a normally unpleasant investigation because they can now sit at home without any discomforts, this can save lives because examining more people does mean finding problems earlier. (Niewolny, 2013)

## **Conclusion**

Sensors-data will become increasingly important in the near future. More and more sensors networks are created, every minute, all gathering information. Furthermore principles like social sensing are delivering additional data. All this information is influencing our lives. There are huge economic opportunities to reform our society to a more intelligent one. However threads exist. Privacy issues, security issues, unclear algorithms and an outdated regulation should be dealt with to provide society with the full advantages of sensor data. However the most challenging problem for the future is to gather relevant data in our opinion. According to our view, it becomes easy to lose oversight of all the information available. We conclude that data from sensor networks can aid people in their decision and we'll encounter exciting changes in almost every field of society in the future, a future defined by sensors and their applications.

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