April 8 & 9

Welkom, welcome! #iotrotterdam is about to start.

International Internet of Things Rotterdam 2016

April 9 is the International Internet of Things (IoT) Day. For the fifth time, the Rotterdam University of Applied Sciences (Hogeschool Rotterdam), and more specifically its Research Centre Creating 010, hosted the Rotterdam edition of the IoT day. This was a two-day event of lectures, workshops, presentations and even a Climate Hackathon, which took place on April 8 and 9, 2016 at two of the University's campuses on the Wijnhaven in Rotterdam: the Institute for Communication, Media and Information Technology and the Willem de Kooning Academy.

Lectures & Keynotes

Content

This is the report of the 5th International Internet of Things Day Rotterdam, focusing primarily on the content of the lectures given by seven experts in their respective fields, who spoke to a mixed audience of professionals, students and assorted strangers, telling them all about an interesting new development called the internet of things.

In addition, this report also includes impressions of the work done and presented during a number of workshops, a glimpse of the Climate Hackathon, and an overview of the demos presented by students of Rotterdam University of Applied Sciences designing products and services for the internet of things era.

We've all heard the term, the internet of things. But what does it mean exactly, other than a nice buzzword made up by the IT and creative industries to sell us a bunch of new fantastic products and services (which we will soon be asking ourselves how we ever managed to live without)? Also, what are the possible consequences and pitfalls of this new development, and what are the roles of citizens, governments, technology firms and other businesses?

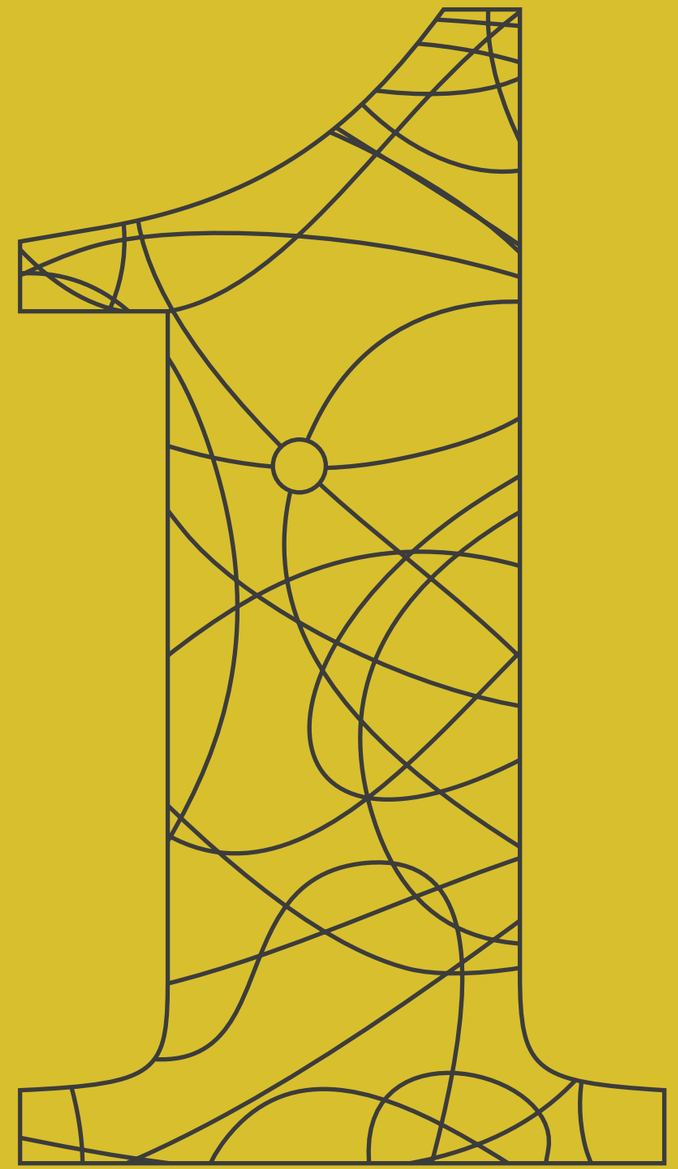
With this report we intend to share the interesting conclusions, insights and discoveries of these exciting two days. Creating 010 considers the International Internet of Things Day Rotterdam 2016 an excellent example of how research centres, as part of a University of Applied Sciences, can fulfil their mission of developing new knowledge for the curriculum, conducting research, experimenting and co-creating in challenging settings with students, practitioners and researchers, and sharing results with the professional field and with society at large.

We look forward to welcoming you to the next International Internet of Things Day. Mark the dates April 9 and 10, 2017 in your agenda! And for now, have a good read.

Paul Rutten
Programme Director, Creating 010

Day 1, April 8

International Internet of Things Rotterdam



The Parametric City

Pieter Ballon's idea of the parametric city **is based on the power of data, the power of platforms, and systematic innovation on all levels in which openness and collaboration are a** sheer necessity**.**

Keynote by **Pieter Ballon** 14:00

The opening speaker of the event was Pieter Ballon, who is a professor in Communications at the Free University of Brussels, leads the Living Labs at the Flemish research institute for ICT innovation iMinds, and is head of the Business Research Unit at iMinds/SMIT. Ballon discussed the meaning and implications of 'smart cities' and introduced his concept of the 'parametric city'. But first some general considerations about urbanisation.

We have now passed the point where more than half of the world's population is living in cities. Besides many new opportunities, this also creates new problems. Both can be explained to a great extent by what is known as network effects, and more specifically by 'West's law' (named after the theoretical physicist Geoffrey West): as a city doubles in size, the cost for each citizen of resources and infrastructure tends to decrease by approximately 15%, while the salaries of its residents, the number of patents issued, and even the walking speed of pedestrians all tend to increase, also by about 15%. The same applies to less desirable factors such as crime rates, traffic accidents and contagious diseases. So there seems to be some kind of built-in mechanism in cities which explains not only their universal appeal, but also the problems inherent in their growth. The only way cities have managed to avoid systemic collapse (with mixed success, judging from the historical record) was through innovation. Which brings us to the necessity of smart cities, the next obvious innovation in urban development.

'Smart' is the new buzzword, similar in this respect to previous hypes such as 'tele-' (1980s) 'e-' (1990s) and 'i-' (2000s). 'Tele-' was all about rendering obsolete the physical distance between two points; 'e-' was about creating a virtual cyberspace parallel to the physical world; and 'i-' was about making this virtual space personal, so we could carry it in our pockets and stay connected to it through social media. And now 'smart', which promises to unite the virtual and physical worlds, thus completing the circle.

One fundamental difference between the ‘smart’ revolution and previous shifts (or hypes) is that technological developments, in this case those related to smart cities, will to a great extent be developed and implemented locally, in a de-centralised fashion, and are thus no longer the exclusive domain of a tiny number of Silicon Valley specialists (presumably no one in the audience has played any meaningful role in the development of the iPhone or Facebook).

The smart city is still a relatively new idea, so there are as many definitions of the smart city as there are cities, or even citizens. Dystopian surveillance state? Or libertarian hacker’s paradise? The most important question may well be: what kind of smart city do we want? According to Ballon, the only way forward is what he calls the ‘parametric smart city’.

The term ‘parametric’ in this context originated in architecture, where the use of software algorithms now makes it possible to explore endless variations of flexible designs based on literally hundreds of parameters. This fundamentally transforms not only the design process, but also the end result of this process.

Ballon’s idea of the parametric smart city is based on three ‘pillars’: the power of data (collecting, measuring and analysing real-time and open data in order to make real-time decisions); the power of platforms (shared facilities that invite positive network effects while rewarding participating organisations for developing open tools and making these widely available); and systemic innovation on all levels (in which openness and collaboration, rather than proprietary solutions imposed by single parties, are no longer an idealistic position or a luxury, but rather a sheer necessity if we are to address pressing challenges in fields such as mobility, safety, cleanliness, air quality and local economy).

However, each of these ‘pillars’ also brings with it the potential to turn the smart city into a dystopian nightmare. For example, the power of data collection suddenly makes possible not only a ‘Big Brother is watching you’ surveillance state, but also drastically shifts the balance of economic power toward businesses that can now know everything about

their (potential) customers; the power of platforms can mean the dictatorship of whoever happened to set up the platform; and systemic innovation with a decreased role for government can lead to fragmentation, disorganisation, unreliable information and lack of overview.

In order to counter these dystopian effects, we need in the first place to be aware of their destructive potential, and also to consider right now the design choices that need to be ‘built in’ to innovation processes, as well as the role of governments in the regulation and oversight of these processes.

But how? First of all, by realising that the smart city is by definition a permanent area of experimentation, in which citizens are not only passive consumers but fully active partners. Second, by setting concrete goals that are measurable as well as ambitious. Third, by appointing a municipal ‘Chief Technology Officer’ to provide leadership and vision in bringing systemic innovation to government services. Fourth, by realising that the power of government regulation and oversight will remain necessary in order to ensure truly open systems rather than proprietary ‘black boxes’. And fifth, through cooperation and harmonisation between different cities and regions, rather than each city rushing to develop its own solution with its own private partners.

In the debate following his lecture Pieter Ballon stressed the need for designers who can somehow design the actual experience of the city, or at least design without getting in the way of this experience. Because a city is much more than just mobility, safety and public utilities. How can designers think about designing that experience, not in an artificial top-down way but in a way that enables engineered serendipity, the chance encounters that make cities a living, breathing, thrilling experience? How can we guide citizens and visitors through the city, based on user profiles generated from big data, but without turning the city into a gigantic shopping mall?

Also, we need to realise that no two smart cities will be the same, that there is no one-size-fits-all approach. And finally, the debate about what kind of smart city we want for the future should not be a technocratic debate but a democratic one, since the design choices we are making now will affect us all for many years to come. ○

‘No two smart cities will be the same, there is no one-size-fits-all approach.’

Valerie Frissen provided a mostly **critical perspective** on the questionable dogma of inevitable progress through **design and technology.**

Design Challenges for the Data Society

Keynote by **Valerie Frissen** 15:00

The second speaker on the first day of the event was Valerie Frissen, who provided a mostly critical perspective on the questionable dogma of inevitable progress through design and technology. Frissen is currently the director of the SIDN Fund, which is affiliated to the Dutch organisation responsible for internet domain names in the Netherlands, as well as a guest professor on the social impact of technology at the philosophy department of the Erasmus University Rotterdam.

A typical internet image search for 'smart city' will turn up a bunch of colourful infographics and bird's-eye view renderings of the type of utopian scenarios envisioned by policymakers and technologists: a brightly coloured (mostly green) legoland in which problems are nothing but solutions waiting to be implemented. But, as Pieter Ballon noted in the previous lecture, a real city is not, and should never become, something that can fit into a perfect computer model. The cities people actually live in are big, chaotic and messy, and still everything somehow manages to work; problems are fixed in a patchwork of often improvised solutions that have more in common with evolution by natural selection than with any kind of 'intelligent design'. In fact, one of the most appealing aspects of cities, and something that is almost entirely absent from the whole 'smart cities' narrative, is the fact that not everything in the urban environment is perfectly regulated, that we are not entirely protected from every possible danger, and that it is still possible to feel somehow invisible and anonymous among the urban crowd. Perhaps it would be better to leave some things not designed, but instead to allow them to grow organically? And perhaps the greatest danger actually facing us is in fact a blind belief in technological progress, or what is known as the 'technological imperative': the idea that what can be designed must necessarily be designed.

An interesting example to illustrate the kind of challenges facing us, is a recent project in a well-known nightlife district of Eindhoven (Stratumseind), the fifth-largest city in the Netherlands. Here a system of smart cameras was set up to monitor crowd behaviour, and, under the watchful eye of human operators, to make predictions as to where undesirable behaviour might arise, thus allowing police to preventively intervene before an anticipated problem even occurs. As an additional (and presumably more experimental) feature, a network of smart streetlamps was also set up to guide the movement, emotions and behaviour of the crowd, in response to the data collected from the cameras, with the goal of reducing the risk of undesirable behaviour. Of course, no one walking through this area has any idea that any of this is happening, let alone what is being done with all the collected data.

Despite the undeniably good intentions behind such a project, this type of data collection and crowd control technology raises a number of serious questions. Perhaps the first and most obvious of these questions is: as our civilisation becomes ever more intolerant to even the slightest risk of danger, how much surveillance are we willing to accept as the price to pay for this brave new world of public safety? Then again, why should we even presume that the algorithms being applied here are necessarily 'smart', when experience has shown that they just as often tend to draw inaccurate conclusions?

As our physical environment becomes 'smarter' and interacts more and more with citizens, we are faced with new questions regarding not only privacy and transparency, but also the balance of power between the different actors in the social arena. These are questions that should not be addressed only in hindsight, after something has gone wrong and someone has complained, but beforehand, during the design phase. But how?

‘As our civilisation becomes ever more intolerant to even the slightest risk of danger, how much surveillance are we willing to accept as a price to pay for this brave new world of public safety?’

We hear a lot about the need for ‘transparency’, but the real question may well be, who gets to decide who and what should be transparent, and to whom? The dystopian scenario here is the one-way mirror, through which you and I are transparent to some unseen entity. The paradox is that this kind of radical transparency can actually lead to less openness, and to the loss of the autonomy and trust which make a civil society work in the first place.

Also we can see that, although ethical and privacy issues are often mentioned in an almost obligatory fashion, they are in fact rarely implemented in the design process, but rather added as patches after a problem has been identified. However, ethical questions should be seen as inherent design challenges, rather than academic issues to be decided by ethics committees (made up of boring old people who have nothing better to do than to stand in the way of progress by guarding the boundaries between humanity and technology). Ethics, human values, issues of privacy and transparency should instead be built in to the fabric of design and software processes. Perhaps even a certain degree of user-unfriendliness would not be a bad idea, even if it’s only to remind us once in a while that we are in fact dealing with technology!

Another pitfall of the new smart data city is the widespread undermining and disruption of long-established systems, with little real debate about what we are getting in exchange: a case in point is the ‘social’ global taxi service Uber, which is also an excellent example of a platform that has managed to have a worldwide impact based on a very small infrastructure (and with a very small number of actual employees).

And in a society in which data is the most valuable commodity, the hundred billion dollar question is, who are the producers of all of this value? The answer is, of course, you and me, and all for free, or just for some ease of use of a shiny new app. Is Facebook the opium of the masses for the new ‘big data’ proletariat?

When it becomes so easy to collect virtually infinite amounts of data, one may wonder, well, why shouldn’t we? Let’s collect it now and maybe later we’ll find some use for it. But simply having more data does not necessarily lead to better or deeper insights. It’s very easy and tempting to establish causalities based on user profiles, however it is much trickier to ascertain and evaluate whether these conclusions are actually useful or even remotely accurate.

Finally, we may want to think twice before throwing overboard the democratic checks and balances that have been finely tuned over centuries, just for some cool new product or service. Bureaucracy is often synonymous with inefficiency, but it is also often the only way society can protect vulnerable citizens from predatory practices.

And so the concept of social engineering, which has already gone through several cycles of hype and discredit, is now making a comeback in the form of a new libertarian-corporate belief that ‘we’ (the ‘smart’ designers and entrepreneurs) can solve all of humanity’s problems, and of course much better and quicker than governments can, if only we can somehow get rid of all these bothersome regulations ○

Valerie Frissen: How smart are the algorithms that are part of smart city solutions actually? Good question. #iotrotterdam http://ow.ly./i/iiHCl

Student presentations

15:45

Companion Cube

‘Sometimes caring means knowing what’s going on behind closed doors. The Companion Cube connects the world behind those doors with the outside world.’

The Companion Cube, which is placed both inside and outside a senior citizen’s residence, turns green when people stay indoors too long. This makes it possible for others to see that it’s time to invite this senior citizen outside.

By Suzanne van Rossen and Erik van der Bas (CMD students, minor Urban Action Design)

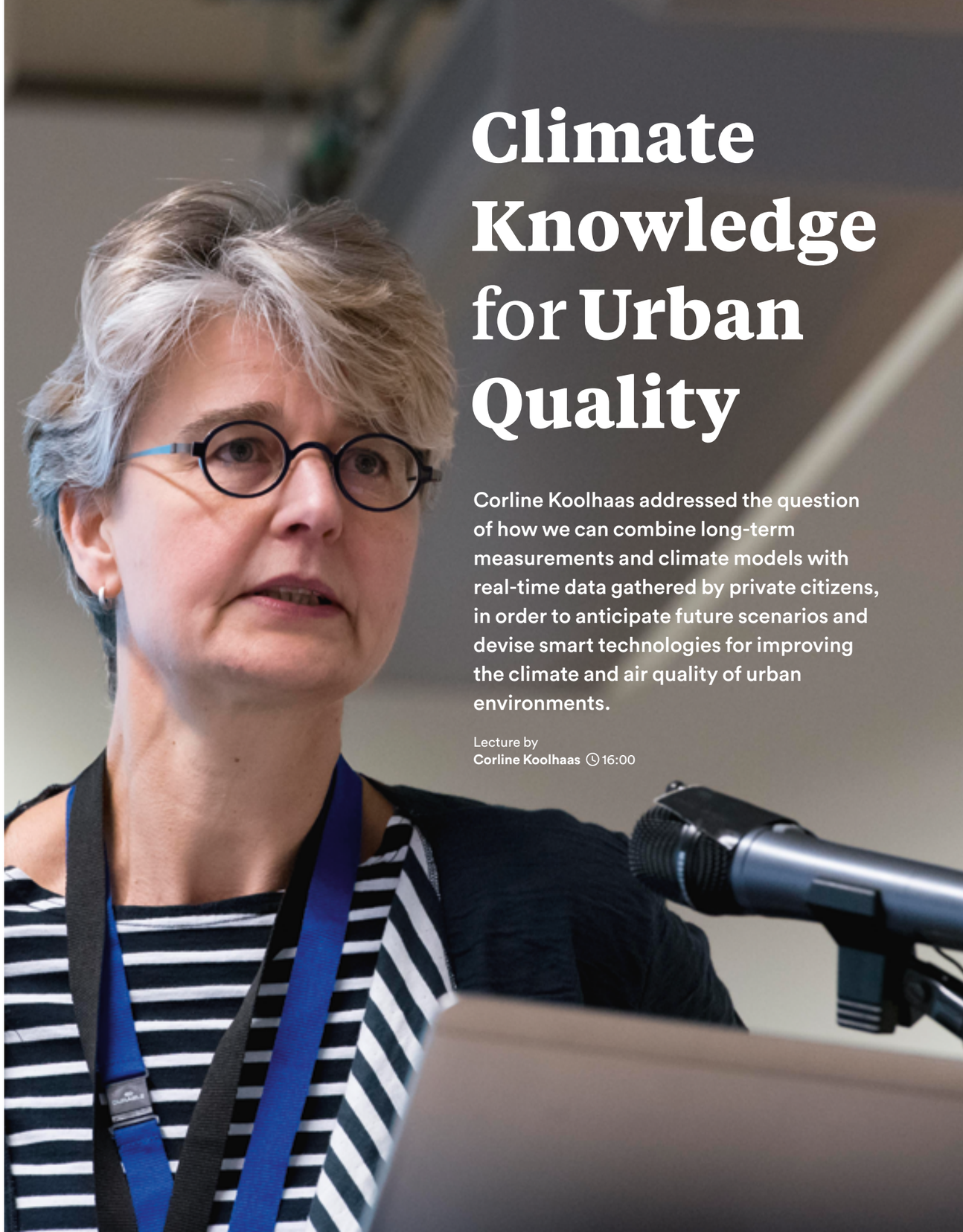
Coach

‘Using environmental data to advise joggers about the best time to go outside.’

People suffering from asthma or other ailments can be informed of the best time for them to go jogging. The app registers the amount of pollen, particulates and air humidity. User can fill in their own asthma or allergy triggers.

(www.teamhopscotch.co/ach)

By Jan Teunissen, Mike den Hertog and Koen Wijbrands (CMD students)



Climate Knowledge for Urban Quality

Corline Koolhaas addressed the question of how we can combine long-term measurements and climate models with real-time data gathered by private citizens, in order to anticipate future scenarios and devise smart technologies for improving the climate and air quality of urban environments.

Lecture by
Corline Koolhaas 16:00

The third contribution to the series of lectures represented the perspective of a practitioner, Corline Koolhaas, strategic business manager at the KNMI, the Royal Netherlands Meteorological Institute. The KNMI was also an important partner and provided the inspiration for the Climate Hackathon, another important event of the Internet of Things Day Rotterdam 2016.

The main question Koolhaas addressed was: how can we combine long-term measurements and scientific climate models with real-time climate and air quality data, much of it gathered by private citizens, in order to anticipate future scenarios and to devise smart technologies for improving the climate and air quality of urban environments? The KNMI has been collecting weather and climate data (observational data, satellite data and data from computer models) for some 150 years, and as an established meteorological institute provides a solid platform not only for gathering such data, but also for proposing concrete solutions to various challenges (including urban design problems) for the coming decades. Most of Koolhaas's presentation focused on two practical examples of how citizen science and low-tech solutions can be used in order to collect real-time weather and air quality data with a very high resolution, and then to analyse this data in a way that can be used in order to help formulate practical solutions to currently relevant challenges.

We all know from experience that the temperature is higher in cities than in the countryside. But just how much higher exactly? The first of these two practical experiments was conducted by a KNMI employee who used a self-made weather station mounted on his bicycle to measure (every morning for almost three years) the temperature on his route from his home in the suburbs, through the centre of the city of Utrecht, all the way to his workplace at the KNMI headquarters in a relatively green area just outside the city. The measurements were taken just before sunrise when the temperature is lowest, meaning that the employee in question had to get up a bit earlier every morning as the days got longer.

Predictably, the temperature was higher in the more densely built-up areas, with a difference of on average six degrees between the lowest and highest measured temperature. What was really interesting though was that he was able to measure this difference with a very high resolution, so that we can see where exactly in the city the hottest spots are located. This in turn makes it possible to design with greater accuracy solutions for reducing local 'oven effects' and especially for promoting cooling, since the biggest problem is that cities do not cool off enough at night. This can be improved to some extent by increasing the distance between houses and by planning more green spaces and more water (which also makes the city larger, so it's a mixed blessing).

For the second example, the KNMI scientists used data collected by individual citizens who could borrow from the KNMI a small (and relatively cheap) nitrogen-dioxide-detecting device with a built-in GPS locator, place it in the basket of their bicycle, and after a few hours of biking around return it for analysis.

'If you show people data about the levels of air pollutants in the playground of their children's school or in the football field where they play with their friends, then they might consider checking out if there's something they can do about it.'

Nitrogen dioxide is a major air pollutant, coming from a number of sources including industry and power plants as well as some natural sources, but mostly from the internal-combustion engines of automobiles. Again the resolution of the measurements was very high: in this case, one sample per second. And once again, predictably, the closer one got to the city centre, the more pollution the device would measure. But how much more exactly? At peak times and locations (traffic lights at rush hour, with densely packed cars that keep their engines running), the concentration of nitrogen dioxide turned out to be twice the generally accepted health limit for anything but a very brief exposure.

Another interesting question was, at which distance from a freeway are the nitrogen dioxide emissions of heavy traffic still clearly detectable? This too could be measured in high resolution by biking repeatedly across overpasses and access roads.

For the 2015 Tour de France the city of Utrecht was closed for automobile traffic for one whole day, providing a unique opportunity to measure the difference in nitrogen dioxide emissions with a 'normal' day. Surprisingly within just one day the measurements in the inner city dropped to levels one normally encounters in the countryside.

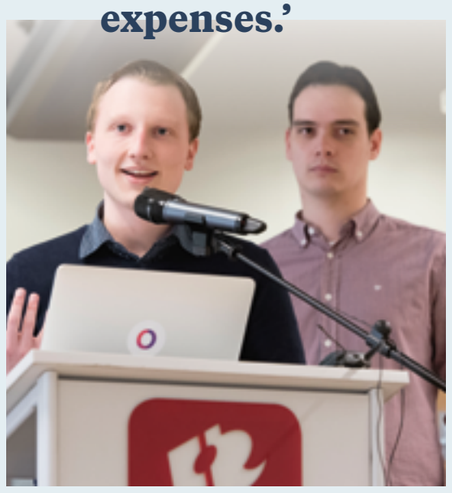
After these two examples, Corline Koolhaas invites everyone, from designers to average citizens and amateur inventors, to participate in the WOW-NL network (wow.knmi.nl/); for example, by building your own sensor, and after calibrating and validating it (to make sure you're measuring what you think you're measuring), uploading your data to the network. Or by building an app or website; Corline Koolhaas enthusiastically mentions the example of a student project that was presented here just prior to her lecture: an app that makes use of local real-time measurements of allergens to help people suffering from allergies plan in advance the best time for them to go out jogging.

During the discussion following her presentation, Koolhaas discussed the particulars of practical solutions on a local scale. If you tell people that global temperatures and sea levels are rising over a period of decades, they may think it's sad or scary but that there's not really very much they can do about it right now. However, if you show them data about the levels of air pollutants in the playground of their children's school, or in the football field where they go to play with their friends every Sunday (both located near a freeway because the land is cheap), then they just might consider checking out if there's maybe something they can do about it. ○

Student presentations

16:00

‘A simple method for remotely monitoring water quality makes it easier to keep fish healthy and to prevent unnecessary expenses.’



Vuilnisvanger (Trash Catcher)

There is a trash problem in the Essenburgbuurt neighbourhood. Many residents tend to leave their trash next to the underground trash containers, rather than in the containers.
This group of students has developed a smart camera system that registers what’s going on near the containers. Images of people who leave their trash next to the container can be seen on a social platform.

By TaiWai Tang, Jos Matthée, David Scholten and Daniël de Wit (CMD students)

Fishcase

Some agrarian businesses use water in which fish have swam to fertilise crops such as fruit and vegetables. The problem is that it’s difficult to measure the quality of the water. Fishcase offers a solution: a small device that can be placed inside a fish tank, and is connected to a web application through which the user can monitor all water-quality information on a smartphone, tablet or pc/laptop.

By Joost Kevin (CMD student)

Workshops

16:00

What if Objects Can Dream?

The workshop What if Objects Can Dream? organised by researchers of the Willem de Kooning Academy took the notion of the internet of things to a new level, actually building upon Florian Cramer’s lecture during this event on the subject of ‘object-oriented ontology’. In the age of the internet of things, sensors in objects measure not only straightforward data such as humidity or movement, but also complex environmental and personal data, and can thus determine the ‘mood’ of things. Objects become alive. They store information, have a memory, communicate with each other and with us. What if we were to stop treating them as slaves? What if we didn’t use them only to improve our own physical and mental functioning, but allowed them to inspire us instead? What if we treated them like sentient beings?

In the session focusing on ‘a Manifesto for Whispering Objects’, participants examined how the current ‘internet of things’ discourse could better articulate the possibilities and pitfalls of objects ‘whispering’ about our lives – storing detailed information about us in databases near and far, even listening in on our casual conversations. The round table session started with a group discussion prompted by a few relevant quotes from leaders in the field. Once a dialogue was established, the group broke up into three smaller groups, each of which wrote one manifesto.

The session on ‘stupid smart objects’ examined health gadgets that try to assist us in our daily lives. These sometimes beautifully designed devices have no problem acquiring hard data, but are not always so helpful in the interpretations they provide (and deliver to health insurance companies for instance). These constitute ‘bad dreams’, like human nightmares, distorted, partially or totally wrong. We tried to identify positive or new dreams and uses. We proposed to swap the stupid smart health gadgets, and also to put them on dogs and cats and in plants, to expand upon and share possible dreams.

The final session explored what it means when objects become active participants in everyday life. What happens when an object records its own history and can talk to the surrounding environment? Does my desk know that I am present? How will this change the way I relate to my desk? And what if it could tell me a story? Brainstorming and associative storytelling were applied here as methodologies for thinking about possible stories of objects. A number of questions arose, such as: if the object is connected, and if it has senses, what will it do, how does it see the world and how will it behave? Could we develop a small scenario for an object based on this information?

To support this process, the organisers introduced a story wheel (see photo above) using three specific objects illustrating the recurring cycle of daily life: a cup (morning), table (day) and pillow (night). The group was split into three sub-groups, each working with an object that was part of a circle, containing separate rings, each with a sense, space and context. The rings could be rearranged so that each group would combine three elements upon which to brainstorm and build their story. The mix of artists, academics and entrepreneurs in the audience proved to be a productive combination. The challenge was to work within the limited time and to focus on sensitivity and emotion rather than utility and service. One group came up with a short scenario from the perspective of a pillow; another with a speculative situation in which disposable cups can extend their own lifetime; and the third group explored situations in which tables dream of expanding their body.

Urban Big Data

The workshop Urban Big Data focused on potential uses of the huge amounts of data generated by objects (including human beings) connected in a network, e.g., the internet. In his presentation, Dr. Niels Netten (Research and Documentation Centre, Dutch Ministry of Security and Justice) indicated how different types of data generated by different actors can prove valuable in situations of crisis response. He argued that getting the right information to the right person at the right time is of crucial importance during a crisis. He presented a framework for improving the structure and reliability of the used data, for assessing the relevance of information, and for communicating and spreading this information in a timely manner. To illustrate its usefulness in practice, the framework was implemented and targeted for a crisis response situation. The presentation illustrated how different pieces of (advanced) technology were connected and integrated to solve real-life problems. After the presentation, there was a vivid discussion about the application of this framework in other domains.

During the second presentation, Dr. Mortaza Bargh (WODC and Creating 010) discussed a number of privacy issues involved in innovative big data applications in the context of the internet of things. He argued that the success of such applications depends on how they deal with privacy. This needs to be addressed proactively, which implies a privacy-by-design approach. He introduced a number of guidelines for dealing with privacy issues. Afterwards there was a lively debate on broader notions of privacy, more specifically on how to make privacy operational and practical in various 'big data' contexts.

Predictive Analysis

The workshop Predictive Analysis investigated the promise of a more predictable, less uncertain future. Participants explored a future in which, for example, the police knows where and when burglaries take place even before they actually happen. Other examples included: overproduction becomes obsolete when production is personalised and adapts to demand in time and place; zero-defect production can be achieved when machine failure can be predicted. All of these solutions and services require 'internet of things' applications.

The Research Centre Creating 010, with its roots in intuitive arts as well as media and information technology, is an ideal environment for exploring this emerging field of knowledge, in which big data and humanities come together. The Research Centre has conducted several exploratory studies using 'weak signal detection' as a methodology and a dedicated tool for exploring and defining trends, for example in the retail branch. This methodology was discussed in the workshop with more than 30 participants ranging from professional experts to teachers and students. Educators saw the tool as an instrument to allow students to gain an in-depth understanding of relatively obscure phenomena, while other experts pointed out the potential for investigating the adoption of new products and services.

Another issue brought up had to do with the disruptive effect of predictive analysis for the intuitive art of trend watching. The main issue of debate here was whether 'the machine' can replace humans in reading the present in order to detect future trends. As the Boston Consultancy Group stated recently: 'Human beings are still unique in their capacity to "go meta"– that is, to think outside the immediate scope of a task or problem. Machines can't yet do that well; they are good at executing a well-defined task or solving a well-defined problem, but they can't pose new questions or connect a problem to a different one they previously faced.'

'Privacy needs to be addressed pro-actively, which implies a privacy-by-design approach.'

Privacy in the Smart City

Liesbet van Zoonen talked about **public perceptions** and **experiences** of the use of **big data**, particularly in the sensitive areas of **privacy and surveillance.**

Keynote by **Liesbet van Zoonen** 12:00

The first speaker on the second day was Liesbet van Zoonen, who talked about public perceptions and experiences of the use of big data, particularly how big data raises concerns regarding privacy and surveillance. Liesbet van Zoonen is professor of Sociology and dean of the Erasmus Graduate School of Social Sciences and the Humanities at the Erasmus University Rotterdam.

First of all, just to get some perspective, how big is big data? We are now talking in terms of 'geopbytes' (numbers with thirty zeroes), meaning that the number of bytes in our databases is now greater than the number of grains of sand on the planet. Most of the data related to individual citizens is relatively 'small' on this scale. Chris Anderson, then editor-in-chief of Wired magazine, said already in 2008 that the amount of data we now have at our disposal means that the accumulation of knowledge no longer relies on the traditional method of formulating a theory and then testing it; Anderson claimed that with enough data, the numbers simply speak for themselves. A typical person living in the Netherlands is currently registered in an average of 250 databases: bank accounts, public transportation cards, supermarket customer cards, smartphone and web accounts, automobile license and parking data, municipal services… Wherever we go, we are constantly leaving behind a trail of data which is being used, among other purposes, to generate highly personalised profiles about us.

‘Though people say they are worried about privacy and surveillance, their behaviour often indicates otherwise.’

What is often forgotten in the ‘big data’ debate, is that by the time citizens have a chance to express how they experience new developments, it’s often too late to do anything about it because changes have already been implemented and there’s no going back. Though almost all of us will say that we are worried about privacy and surveillance issues, our behaviour often indicates otherwise. For example, we may feel uncomfortable about a national medical database, yet many of us post sensitive medical information on Facebook without a second thought. We say we are worried about identity fraud, however most of us use one single password for all our online transactions. A few years ago, the introduction of a new type of passport that registered our fingerprints was extremely controversial, yet we now gladly use the same fingerprints to unlock our smartphone.

In fact, though our behaviour in this respect is certainly paradoxical, it is not necessarily unpredictable, and can usually be understood by considering on one hand the nature of the data being collected and combined, and on the other hand the purposes for which this data is being used. First of all, is the data personal or impersonal in nature? Medical and financial records, for example, are universally regarded as highly personal and sensitive. Second, is the data being used to provide a service, or is it used for purposes of surveillance? Generally speaking we can say that collecting impersonal data in order to provide a service will meet the least resistance, and collecting personal data for purposes of surveillance will meet the most resistance (and is also unsurprisingly the most strictly regulated).

For example, monitoring crowds at big events, though clearly for purposes of surveillance, is generally considered okay as long as what is being monitored is the crowd as a whole; however, as soon as facial recognition software (or other ways of identifying individuals) are applied, the data becomes highly personal and thus potentially controversial.

Another example: equipping containers in which citizens deposit their household trash with a sensor that measures how full the container is and sends a message to the central collection service saying when it needs to be emptied, should not disturb anyone since the goal is clearly to provide a better service and there is no personal data involved. But when citizens are required to use a personalised key card in order to unlock the container and deposit their trash, it becomes a different story entirely. A ‘smart’ parking lot equipped with sensors to determine how many parking spaces are occupied is perfectly fine; but a parking lot equipped with cameras that can read individual license plates (or even faces) is another matter altogether.

Finally, the ways in which different databases are combined can also affect how the nature and purpose of the data is perceived. For example, hospitals would be interested in combining local environmental quality measurements (impersonal data, focused on service) with patient files (personal data, also focused on service) to provide their patients with personalised health advice. Though the intention is clearly again to provide a better service, the resulting personal profiling does bring up serious issues, particularly regarding how the information may be used in the future.

A question from the audience addressed the public perception and experience of how our data is being used: besides the personal/impersonal and service/surveillance factors, there may be another factor, the question of whether we willingly share our data, or whether this choice is being imposed upon us. All the examples of seemingly paradoxical behaviour (sharing sensitive information on Facebook, lazy password habits, fingerprint recognition on a smartphone) can also be explained as a matter of personal choice. Liesbet van Zoonen replied that this is what is known as the ‘control paradox’: once people feel that they get to decide for themselves whether or not to share their data, they tend to no longer look back at what happens afterwards with this data. For example, when patients in a hospital are asked whether they agree to share their medical data for purposes of research; people think ‘sure, why not’, check the box and forget all about it.

A final remark from the audience brought up the recent development in the world news: the Panama Papers, a huge leak (because all newsworthy leaks are of course ‘big data’ nowadays) of the offshore banking and tax-evasion practices of big corporations and wealthy individuals. The data is obviously highly personal, and leaking it can certainly be seen as a form of surveillance; however there is yet another factor to consider, and that is the value for society as a whole of disclosing this information. Interestingly however, the journalists handling the leak have indicated that almost all of the actual data will not be directly released, meaning that the vast majority of individuals implicated will in all likelihood never be prosecuted in a court of law. ○

Object-Oriented Ontology for the Internet of Things.

The subject of Florian Cramer’s thought experiment was the difference between people and things. Or rather, about the philosophical question of whether there is any meaningful difference between people and things.

Lecture by **Florian Cramer** 13:45

‘What is the difference between the internet of people and the internet of things?’

Florian Cramer, research professor of Visual Culture at the Research Centre Creating 010, Rotterdam University of Applied Sciences, began by reassuring the audience that that no prior knowledge of philosophy is necessary in order to understand and enjoy this lecture, and that he himself in no way claims to be a philosopher (although he is clearly a thinker). What is the difference between a philosopher and a thinker? This could be an interesting topic for another lecture in another time and place. Today the subject of Cramer’s thought experiment was the difference between people and things. Or rather, about the philosophical question of whether there is any meaningful difference between people and things. And, keeping in mind that the theme of this event is ‘the internet of things’: what is the difference between the internet of people and the internet of things? Does the internet ‘care’ whether any particular node of the network is a person or a thing? And what does this mean for designers working on bringing the internet of things to consumers? What would happen if they stopped focusing on the ‘user experience’ of human beings as the measure of all things?

First of all, to clear up a possible semantic confusion: both ‘object-oriented’ and ‘ontology’ mean something quite different in philosophy as they do in information technology. Interestingly, the way philosophers use the term ‘object-oriented’, which originated in information science, is something of a metaphor; just as the use in information science of the philosophical term ‘ontology’ is a metaphor. ‘Ontology’ is one of those words most people have to look up (like ‘epistemology’ and ‘stochastic’) but which actually means something quite simple: it is the ‘study of the nature of being, becoming, existence, or reality’. Some would say that philosophy is the art of taking something simple and obvious (like the fact that we exist) and making it complicated and confusing. But philosophy at its best is really about questioning what may on first sight seem obvious and not even worth thinking about, and showing us that our senses and intuition may not be as ‘smart’ as we assumed.

Object-oriented ontology (OOO for short) is a very recent philosophical movement, which interestingly includes designers as well as scholars from a more traditional academic background of philosophy. OOO begins with a rejection of the claim that philosophy should focus on the perspective of human experience, that there is anything unique about human beings, or that things can only be understood through our perception of them.

Traditional Western philosophy, from Plato onward, began from a metaphysical position that thoughts and ideas were somehow on a higher plane than material reality: the ideal image of an apple is more perfect and closer to the essence of an apple than any actual apple can ever be. Later, Enlightenment humanism focused on the human subject and on human perception and consciousness as the centre of all philosophical inquiry. The turn from metaphysics to ontology, which in Western philosophy began in the 20th century with Martin Heidegger, can be seen in a sense as ‘catching up’ with much of eastern philosophy, which has always been ontological, perhaps even object-oriented. A teapot is just a teapot, regardless of our perception of it.

The process of automation that has been going on since at least the beginning of the Industrial Revolution means that human actors in our society are increasingly being replaced by non-human ones. What does this mean for our society? What does this mean for our relation to this ever-growing inanimate proletariat? The Enlightenment introduced the concept of human rights, which seemed a revolutionary step at the time. Now we are starting to think about the rights of animals, as well as a broader ecological agenda that places limits on the previously absolute right of humanity to do whatever it damn well pleases with the environment. And what about the rights of objects? Interestingly, OOO often refers to scenarios borrowed from science fiction. It is an anthropomorphic robot an object? If it thinks and feels as we do, does that mean it should have rights similar to ours? What about a non-anthropomorphic robot? Where exactly do we draw the line? And why should we be the ones who get to decide where the line should be drawn?

A common critique of OOO is essentially the same objection that can be raised against any post-humanist or anti-humanist philosophy: if there is no essential difference between an object and a human being, then what’s the problem in treating human beings like objects? Another interesting critique of OOO, by the philosopher and cultural critic Slavoj Žižek, basically goes back to the humanist position that it is naïve to believe that we can escape metaphysics, or perceive reality from any other perspective than our own consciousness; even if we try to objectively describe a reality of objects, we can only do this from within our own subjectivity. Or, as Immanuel Kant put it, the ‘thing in itself’ will always remain unattainable to us. At this point in the lecture Cramer played a brief excerpt from a Japanese animated film: a surrealistic parade of humans, animals and inanimate objects, all happily dancing and morphing back and forth into each other. The clip ends with a shot of a traditional Japanese gate, one of the main symbols of Shintoism, which like all animist traditions is based on a profoundly ontological worldview.

But how does all of this relate to the internet of things? Well, if you do an internet search for ‘internet of things’, the first image that turns up looks a lot like that surrealistic Japanese parade we just saw. Florian says that, even though he has never seen anyone else make a direct connection between OOO and the internet of things, he can’t imagine he could really be the first.

An interesting question from the audience brought up the problem that somehow we still have to define what constitutes a ‘thing’. And judging from the different lists of things that popped up in the citations during this lecture, there seems to be some disagreement in this regard within the movement itself. What about abstractions, thoughts or emotions? (What about Platonic ideals, for that matter?) Indeed, says Cramer, generally speaking the academic philosophers within the movement tend to include immaterial ‘things’ while those from a design background tend to consider exclusively physical objects (though some apparently include physical objects that exist only in the imagination, such as Harry Potter).

Another question referred to the animated clip showed during the lecture, which featured highly anthropomorphic objects and thus brought to mind how in animist traditions (including ancient Greek religion) the objects that are worshipped as gods are also given human intentions, emotions and even character flaws. So perhaps Kant and Žižek are right to say that we can never escape the anthropocentric perspective… Florian Cramer replied that the objects with which we surround ourselves indeed tend to look and behave like us, such as the eye of that camera pointing at him right now. And with the beginning of what some call the Anthropocene epoch, in which the geology of the earth is being influenced more by us humans than by any other force of nature, the planet itself is now becoming anthropomorphic. ○

Human experience is *not* at the centre of philosophy. Everything is. #iotrotterdam @florian_cramer @Creating010

Workshops

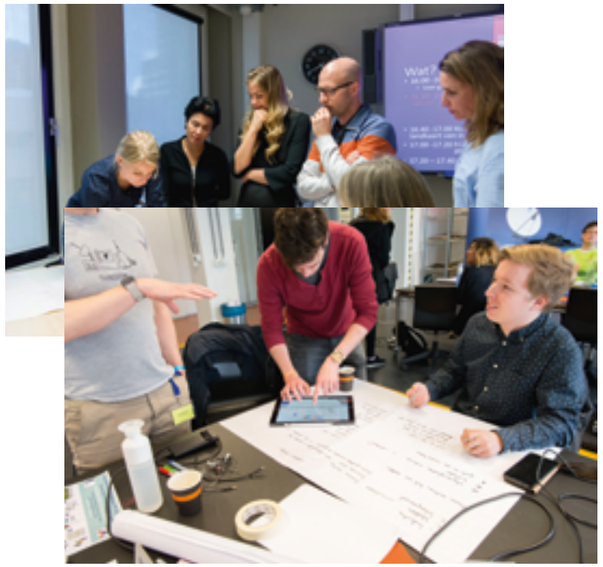
13:45

Next Steps in Retail Innovation

The focus of the workshop Next Steps in Retail Innovation was on raising the awareness of stakeholders in the retail branch regarding the opportunities provided to them by the internet of things. Mirjam den Boer, from the Institute for Communication, Media and Information Technology, Rotterdam University of Applied Sciences, introduced the concept and described a number of possible future scenarios, after which Bob Corporaal from Cool Blue, a leading Dutch online retailer, added some firsthand experiences and some challenging ideas for the future of the retail branch. A number of trends (omnichannel, hybridisation, nomadic retail) were described in detail for the participants who were then challenged to work with a retail innovation canvas, specifically designed for the workshop by the project team Retail Innovation in Rotterdam.

The subsequent debate, in subgroups as well as in a plenary session, focused on how big data generated in and by internet of things applications could help retailers develop their business proposition for customers, and how the relationship between the use of physical retail shops, online retail services and social media could support the business case of retailers. One of the issues discussed was how small and medium-size businesses can make good use of the changes brought on by these new developments, and how these businesses can be seduced to incorporate these changes in their strategy.

‘The debate focused on how big data could help retailers develop their business proposition.’



Things Network & City of Things

The leaders of the Things Network and the City of Things workshops decided to join forces and to organise an extra-long session on the application of the internet of things in the urban environment. Besides the many opportunities which the internet of things provides to businesses and industries, it also promises exciting new perspectives for cities and their inhabitants. The first part of this joint session focused on the potential of LoRa networks combined with the internet of things from the perspective of the end user, the citizen. LoRa allows for tiny packages of data or commands to be sent over long distances, in a very energy-efficient manner (long battery life) and without the use of the internet. Rotterdam already has such a network, set up by The Things Network 010 (ttn010.nl), a community that works on realising an open and freely accessible LoRa network for the city and port of Rotterdam, aiming to unleash the innovative potential of LoRa and IoT.

The goal of the workshop was to generate unexpected and fresh ideas for applications and services. The diversity in the professional and cultural backgrounds of the workshop participants, as well as the fact that all participants are of course also citizens, guaranteed a wide variety of concerns, insights and topics of investigation. In an effort to reach that point, the debate concentrated on three themes chosen by the workshop leaders: mobility, sustainability and social issues. The brainstorming resulted in a number of interesting ideas and concepts: local competition between energy-saving applications, an application using chemical-detecting sensors to identify possible terrorist or drug-related activity, and even an application to fight loneliness. In the debate following these proposals and ideas, a number of ethical issues were discussed extensively, addressing questions such as: do we want this technological push to increase the power of data? And: who owns this data? The participants demonstrated a clear awareness of the possible downsides that need to be considered and dealt with before everyone hooks up their front doorknob to the internet.

The second part of the workshop took the results of the first part as a point of departure for discussing the consequences in the broader context of the city and of city-making. How will (or can) a city change under the influence of the internet of things? Participants considered issues of mobility, resulting in a wide range of ideas such as self-driving cars which could potentially lead to cities without street parking, and personal traffic information devices opening up the possibility of streets without traffic lights and signs. Research focusing on social topics could lead to solutions such as apartment blocks with communal laundry spaces and spaces for package delivery. Climate-related issues, which are the central focus of the Climate Hackathon that also took place during the 2016 Internet of Things Day event, also brought up a number of interesting ideas, for example on shared installations for the production of renewable energy, or on individual and mass measurements of air quality with the potential for personalised, real-time navigational information allowing joggers to stay in 'clean lanes'.

This combined workshop demonstrated the close relationship between various factors such as technological development, data gathering, applications, citizenship, urban space and city making. Various disciplines related to city life, ranging from urban design and architecture to policy making and administration – and involving all concerned parties from investors to designers, from service providers to citizens – can greatly benefit from a better common understanding of each other's expertise, concerns and ambitions in the context of future internet of things applications.

Digital Social Innovation

Workshop leader Peter van Waart (Institute for Communication, Media and Information Technology / Creating 010) kicked off the workshop on Digital Social Innovation by stating that most internet of things applications that create value for customers, are provided by private businesses for commercial purposes. Examples of applications designed with social purposes in mind are less common and relatively unknown. In most cases these are the result of citizen participation and self-organisation, rather than planned policy and design by (government) organisations and institutions.

This distinction between on one hand commercial applications, and on the other hand socially oriented bottom-up solutions is an important one. The first has a more or less straightforward design process (one client – one design brief – one target group – one design), the latter deals with complex problems involving many different stakeholders. Designers find it difficult to position themselves professionally as well as commercially in the context of the development of applications with a social purpose. For instance, they may ask themselves: what is my role as a professional designer? Or: who will compensate professional designers for the value they create?

'Examples of internet of things applications designed with social purposes in mind are less common.'

Workshop participants were invited to work in teams on a case study. They started by mapping the various stakeholders and their interests. Next, they had to come up with a concept on how internet of things technology (network, sensor and data) can be applied to serve (a coalition of) stakeholders through smart data collection as well as planning and prediction in a specific domain of daily urban systems.

One of the teams focused on a city park as a case study to examine how human activities (such as jogging, picnicking, youngsters getting together in the evening, and people simply enjoying a relatively quiet and natural environment) affect the experience of various stakeholders, such as other park visitors or people living near the park. One of the solutions proposed by the team was to combine noise volume sensors with public displays showing the noise level and politely asking park visitors to consider lowering the volume of their activities.

In the end, the workshop was too short to fully investigate all of the possibilities offered by the internet of things for digital social innovation in the urban environment. However, a number of typical characteristics were identified for further consideration.

Internet of Things **Potentials and Challenges**

Sunil Choenni discussed the internet of things from the more technical and practical perspective of those who build the databases.

Keynote by **Sunil Choenni** 14:45

The third speaker on the second day was Sunil Choenni, who is head of the department of Statistical Information Management and Policy Analysis of the Research and Documentation Centre (WODC) of the Dutch Ministry of Security and Justice. He is also a research professor in the domain of smart and inclusive society at the Research Centre Creating 010, Rotterdam University of Applied Sciences. Choenni discussed some of the possibilities and difficulties of the internet of things, from the more technical and practical perspective of those who build the databases that actually contain all of this information that we as citizens and consumers are busy generating.

As the electronic devices with which we surround ourselves become increasingly 'smart' as well as increasingly networked, they generate more and more data and communicate not only with people but with each other, and with increasingly large and complex information systems. Automated information systems are nothing new; in the 1960s already, governments and big companies started using these for their administrative processes. Nowadays there is not only much more data than ever before, but also many more different types of data: for example audio-visual data and sensor data, which of course require much more storage space and processing power than a database of names and addresses. Traditionally, if we wanted to find out more about something, we needed to design an experiment, select a representative population and devise a methodology for collecting the data before we could start analysing it in order to generate (hopefully) meaningful information. Nowadays however, data mining technologies have turned the whole world into a huge living lab; all you need to do is ask the right questions, and of course gain access to the right database.

The possible applications of the combination of big data and the internet of things are well known, from self-driving cars to self-filling refrigerators. However all of these brave new developments also bring with them a number of challenges: to begin with, we are now generating more data that we can physically store and this shortage of storage space is growing exponentially. Besides the traditional 'hard' requirements (does the system perform according to the required specifications, within the desired response time, etc.), specialists designing and implementing information systems also need to deal with increasingly complex 'soft' requirements and challenges: which data can and should we use and combine? Are we drawing correct conclusions based on this data? And what about the reality that did not find

'A real danger is that governments and other institutions increasingly tend to trust the reality described in their information systems more than they do the subjective reality of the citizen standing in front of them.'

its way into this particular set of data? We only know what is registered, and it is tempting to disregard everything that is not in the statistics. A real danger is that governments and other institutions increasingly tend to trust the reality described in their information systems more than they do the subjective reality of the citizen standing in front of them (if the computer says it's so, then it must be so).

Data is always collected with a specific goal in mind. However, when this same data is later reused, and often endlessly recombined, without a proper understanding of that original goal, of the initial significance of the data, or of the context in which it was collected, then the accuracy and relevance of the data will only decrease over time, leading to increasingly wrong interpretations and thus wrong conclusions (while, paradoxically, the fact that the data has been reused so many times may in fact contribute to giving it a greater degree of legitimacy).

And of course we have the recurring issues of privacy and transparency. Many of these have been addressed at length by previous speakers, says Sunil Choenni, so he will go less in detail on this topic than he had originally intended; however there are some additional points worth mentioning. For example, there is an essential difference between access control (who is allowed to see the data) and usage control (who is allowed to do something with the data), but in practice this is often poorly regulated. Also, though we may tend to assume that violations of privacy are necessarily intentional, in fact they are just as often accidental, or the result of a poorly conceived attempt to protect privacy: for example, merely 'anonymising' sensitive, personal or stigmatising data is pointless if the same information can be correlated from other available data.

Addressing the complex issue of transparency, Choenni cites an interesting social experiment from China. The basic idea was that 'the people' were provided with technology allowing everyone to know where everyone else was at any given time. Not only that, but citizens could also 'like' or 'dislike' the location where other citizens happened to be. Perhaps such a social networking platform could prove useful in the event of a natural disaster, but what happens if you feel like attending a politically sensitive event of which your family or neighbours (to say nothing of the government) might disapprove? An interesting case in point for anyone who believes mass surveillance poses no threat to us decent law-abiding citizens who 'have nothing to hide'.

Another major challenge is data security. An ever-increasing number of devices, connected in an ever-increasing number of ways, of course provides an exponentially increasing number of opportunities for malicious interference. And though most software is tested extensively for its functional requirements (does it do what it's supposed to do?), the same software is usually tested very poorly, if at all, for its ability to handle exceptions that can be used as backdoors for breaking in (what does it do if a user does something they're not supposed to do?).

From the audience there was a suggestion that since many information systems are becoming increasingly complex, so that no single human being is able anymore to have a complete understanding of most of these systems, could it perhaps be a solution at some point in the future to use 'deep learning' algorithms to teach systems how to design and generate their own privacy and security features? Choenni is sceptical; for all the hype about 'deep learning', 'deep thinking' and other artificial intelligence paradigms, we have yet to design an information or knowledge system that can respond to a situation unlike anything it has ever encountered before. Information systems by definition only know what we put into them; even if the volume of this information is more than any human can ever learn, the human still has the ability to recognise new situations and make new connections. An interesting example in this respect was an online artificial intelligence system that seemed to pass the 'Turing test' (convincingly emulating the behaviour of a human being, in this case a university professor), until it was asked by a child: 'how old are you?' To which it replied with an accuracy to the millisecond. ○

Student presentations

16:00

'What if your rollator could be your friend, who brings you wherever you want to go?'

De Slimme Rollator
(The Smart Rollator)

Research has shown that mobility can be a decisive factor in the prevention of social isolation. The Smart Rollator can be programmed by the user or a family member to bring the user to their destination. The left or right handle vibrates to indicate when the user should turn left or right.

By Joris Phillipsen and Stijn Oude Lenferink (Minor Making for Professionals)

Appticien – Prevention Games

'Why change your behaviour when you can also use the problem as its own solution?'

Research has shown that the use of media devices is increasing among children aged 1 to 4. While there is a decrease in the use of older technologies such as television, there is at the same time a huge increase in the use of tablets and smartphones. This is a point of concern for ophthalmologists (eye doctors), since there is clear evidence that children who play less outdoors are at greater risk of developing myopia.

Mike has developed a platform for games which can only be played by going outdoors. For example, an app that scans and analyses images of animals and trees and other plants, from which children can compile an encyclopaedia of their own surroundings.

Mike explains how it works:
The app developer uploads a game app to a platform; the game app is reviewed by a professional specialist, and then by eye care specialists to determine the app's value in preventing myopia; only then is the app made available to children.

By Mike Vincent (New Frontiers WdKA)

Smart Industries
The Fourth Industrial Revolution

Ben van Lier talked about the merging of a number of technological developments, culminating in transformations to industrial practices on a scale unlike anything we have experienced since at least the first industrial revolution.

Keynote by **Ben van Lier** 16:45

The final speaker of the conference was Ben van Lier, who focused on yet another dimension of the internet of things: smart industries and the industrial internet. Van Lier is Director of Strategy and Innovation at Centric, a Dutch ICT company also active in countries such as Belgium, Norway, Sweden, Germany and Romania. He is also a professor at the Steinbeis University in Berlin and a research professor of Smart Industries at the Research Centre Creating 010, Rotterdam University of Applied Sciences. He also contributes to the Dutch top sector on High Tech Systems and Materials and is a member of the Dutch Smart Industries Forum.

The Fourth Industrial Revolution (a term coined by Klaus Schwab, chairman of the World Economic Forum) can be summarised as the merging of a number of technological developments, culminating in transformations to industrial practices on a scale unlike anything we have experienced since, well, since at least the first Industrial Revolution.

The central iconic device of our age is certainly the mobile phone (of which more and more are smartphones). Currently more than half of the world population owns a mobile phone, and these billions of devices are being used to transmit and receive not only speech, but increasingly also data, as well as serving as personal mini-hubs connecting even more devices that we carry in our pockets and wear on ourselves, and increasingly also inside our bodies.
This omnipresence of mobile phones and peripheral devices leads in turn to a growing demand for various new industries, products and services. An interesting and surprising example can be found in a number of African nations, where mobile phone subscription credits are used as a form of currency: businesses and individuals transfer credits, and thus value, to each other simply by sending

a text message, thereby bypassing the traditional banks (seen as too expensive) as well as governments (seen as unreliable and/or corrupt). In other words, telecom providers now unexpectedly find themselves assuming the role and function of banks.

Besides information and communication technology, we are seeing a number of parallel (and equally game-changing) developments in other fields such as nanotechnology, biotechnology, cognitive technology, as well as in established industries and products such as glassmaking, where techniques are currently being developed that will soon make it possible to use any glass surface, from a table top to a car window, as a display interface. Quantum computing, which just a few years ago seemed decades away, could now by some estimates become a reality within ten years or less. Besides the obvious benefits, all of these developments are also expected to have hugely disruptive effects on existing industries and services, from the financial sector to healthcare to transportation logistics.

Although the term 'internet of things' was coined in 1999 by the British entrepreneur Kevin Ashton (in an answer to a question at a conference about this emerging network of smart objects), the general idea of the internet of things has been around since earlier in the 1990s, when developers with an eye on the future started to wonder what would be the big next step after the personal computer and the World Wide Web. The fatal shortcoming of the personal computer was that it would always remain a big ugly box that took up space on your desk and could never become a natural part of its environment. Almost nobody is really interested in what a computer is, only in what it can do. What if computers could become seamlessly integrated in our daily lives, invisible or at least unnoticeable, embedded in traditional objects?

Cyber-physical systems, systems designed from the start as entities connected to a network, function in a completely different way from traditional autonomous systems. A self-driving car, which may on first sight seem autonomous compared to a

human driver, in fact works only because it is part of a network. Machines or systems of machines (from individual passenger cars to networked convoys of self-driving trucks to entire factories of networked industrial robots) equipped with sensors to determine when and where they require maintenance, make it possible not only to replace a part before it fails, but also to determine more efficiently which components of the system need to be improved or upgraded. Also, the interaction between on one hand physical machines and devices, and on the other hand software algorithms and information systems (and the data generated by them) is increasingly becoming something that we no longer need (or are even able) to directly perceive; and this is again something new in our history, that our environment is being shaped and determined more and more by processes with which we have no direct physical contact.

Though it makes many people in the Netherlands uncomfortable, Ben van Lier says that we must accept the fact that military applications will remain one of the main driving forces in the development of smart technologies; network-centric warfare was, for all means and purposes, the first internet of things. Also, big countries and big industrial corporations will continue to play a leading role in these developments, since they are the only ones with the huge resources required for the necessary investments; smaller countries such as the Netherlands, as well as small and mid-size businesses, will have no choice but to adapt to the changing industrial ecologies. Most product development is still happening in the United States, while emerging economies such as China and India are, besides the main manufacturing centres, also the fastest-growing markets. By comparison, most European countries are small fish in an increasingly large pond.

Ben van Lier ended his presentation by playing an infomercial about Amazon's new warehouse robots, which are not only able to process orders at a fraction of the cost and time of human warehouse employees, but also make it possible to stack the products in the warehouse higher and closer together than previously. An interesting example of converging industries within a single company: Amazon, which started out as a web retailer, and is now the leading provider of cloud services, also ends up purchasing a robotics company in order to streamline its own inventory shipment.

From the audience there was a question about how the emphasis on the importance of bottom-up solutions, which plays such an important role in the debate on smart cities, seems to be entirely absent in the smart industries discourse. Van Lier replies that this to some extent has to do with the nature of industry, the size of the investments required and again the shrinking global importance of countries such as the Netherlands; but also that there's really no way to predict the bottom-up solutions that can suddenly emerge as a result of technological developments: for example the use of mobile phone credit as a payment system in Africa, which is something that no one planned and no one could have foreseen, but which happened anyway. Another point raised during the debate was the position of small and medium-sized enterprises in the upcoming age of smart industries. Ben van Lier stressed that there are many possibilities for these firms to connect to this development; however they have to been keen and willing to adapt their products and services to new configurations that are still in the making. Innovation is the key. ○

'Systems of machines equipped with sensors make it possible not only to replace a part before it fails, but also to determine which components need to be upgraded.'

CLIMATE HACKATHON

The Climate Hackathon was another important part of the International Internet of Things Day Rotterdam 2016. Some 80 professionals, students, designers and programmers went to work on the question of how data can be used to improve the climate in Dutch cities.

The Netherlands is one of the most densely populated countries in Europe. Particularly in the big cities this leads to increased stress on the environment. Innovation and new forms of working collaboratively can play an important role here, and internet of things applications can provide solutions toward improving the quality of life in the urban environment. The teams participating in the Climate Hackathon were challenged to develop smart 'overnight solutions' for better distribution systems in the cities and a better urban climate. The goal was to arrive at the best and most innovative concept.

The Climate Hackathon was organised in a partnership with the Royal Netherlands Meteorological Institute (KNMI), which is interested in finding innovative applications for its vast amounts of climate and weather data. The data marathon took place at the Willem de Kooning Academy. A number of teams competed for a total of 3,000 euros in prize money. The 24-hour challenge ended with an exhibition and the selection of the best applications by a jury of experts.

The first prize went to the application Bezorgeloos by the team Nightshifters, who developed an innovative concept for organising parcel delivery in a more efficient, environmentally friendly and social way. People can have their parcels delivered to a central location where they can pick them up at the moment that best suits them. They can also leave the packaging material behind for recycling. The pick-up point is also a meeting place. The backend app informs people of the positive environmental impact of their actions for their own neighbourhood.

The second prize went to the application Smart Air. Gasses and particulates tend to accumulate at street level, posing a serious risk to public health. Smart Air is a system that automatically turns on when it detects low levels of natural air circulation. The air is sucked up from the streets by interactive inlet points and channelled towards the sewers, where the particulates are absorbed by the sewage water, resulting in cleaner air.

The prize for the greatest impact went to the Stadslab Luchtkwaliteit team who presented a smart route planner that calculates which route and which means of transportation are the cheapest, the most environmentally friendly, and also the healthiest in terms of calories burned!

Colophon

The International Internet of Things Day Rotterdam 2016 was organised by the Research Centre Creating 010 in collaboration with the Institute for Communication, Media and Information Technology (CMI) and the Willem de Kooning Academy (WdKA) – all of which are educational or research institutes of the Rotterdam University of Applied Sciences (Hogeschool Rotterdam) – and in partnership with the Royal Netherlands Meteorological Institute KNMI and the digital service agency 'info.nl'. The event took place on April 8 and 9, 2016, at the CMI (Wijnhaven 107) and the WdKA (Wijnhaven 67).

www.creating010.com | www.iotrotterdam.nl

International Internet of Things Day Rotterdam 2006

Programme:
Peter van Waart, Paul Rutten &
Justien Marseille

Production:
Daphne Swart and Helen Poelwijk

Communication and Design:
Jeffrey Epping

Workshops:
Mirjam den Boer (CMI), Yoana Buzova (WdKA/ freelance artist) Tony Busker (CMI/Creating 010), Sunil Choenni (WODC/Creating 010), Deanna Herst (WdKA), Matthijs Jaspers (R-iX/TTN010), Michelle Kasperzak (WdKA), Bob Korporaal (CoolBlue), Aldje van Meer (WdKA /Creating 010), Justien Marseille (Creating 010), Beam van Waardenberg (WdKA /freelance artist), Peter van Waart (CMI/Creating 010), Franklin van der Hoeven (TU Delft).

International Internet of Things Day Rotterdam publication

Editors:
Johanna Monk | vjmonx@gmail.com
Paul Rutten

Design:
www.eversendegier.nl

Contact:
creating010@hr.nl

CREATING 010

Partners:

HOGESCHOOL ROTTERDAM · WDKA · CLIMATE HACKATHON

Koninklijk Nederlands Meteorologisch Instituut
Ministerie van Infrastructuur en Milieu · info.nl · HOGESCHOOL ROTTERDAM Instituut voor Communicatie, Media & Informatietechnologie

The internet of things is one of the most significant innovations unfolding in our present era. Its impact on society at large and its ongoing influence on how cities are structured and operated cannot be overstated, although the way in which these changes will be implemented in practice is largely determined by local contexts. No two smart cities will be alike.

In terms of economic impact, the internet of things is also the main factor in what is already being called the 'fourth industrial revolution' leading to an age of smart industry, while on a more general level 'big data' is increasingly seen as a significant source of revenue and as a foundation for new business models. At the same time, the development of the internet of things leads to the empowerment of citizens and even to a redefinition of the very concept of citizenship.

As with many technologically driven innovations, the internet of things offers tremendous opportunities as well as serious pitfalls, for instance in the field of privacy and security, or regarding the concentration of data and information in the hands of a small number of state institutions and big corporations. Interestingly, the internet of things also opens up philosophical debates on the relationship between things and humans: if things are becoming smart and even intelligent, does that mean that objects and humans are converging?

This volume collects the knowledge shared during the 5th International Internet of Things Day, organised by the Research Centre Creating 010 in collaboration with the Institute for Communication, Media and Information Technology (CMI) and the Willem de Kooning Academy (WdKA), all of which are educational or research institutes of the Rotterdam University of Applied Sciences. The publication includes summary reports of the lectures and keynotes of a number of distinguished speakers from Creating 010 and other institutions, as well as impressions of workshops on a number of subjects related to the internet of things, and a brief impression of the 24-hour Climate Hackathon which was also part of this event that took place on April 8 and 9, 2016 in Rotterdam.

The reports of the keynotes and lectures were written by Johanna Monk, who also edited and translated the other texts.