ILI2017

Intelligent Lighting Institute | Edition 7, May 2017

- / Atlas Living Lab Update
- / Adaptive Healing Room for stroke patients
- / Interview - Mary-Ann Schreurs
- / AfterGlow
- / The SkyLight Project
- / And more....

TU/e Technische Universiteit **Eindhoven** University of Technology

Technische Universiteit Eindhoven University of Technology

Intelligent Lighting Institute

Harold Weffers | Operational manager

Welcome

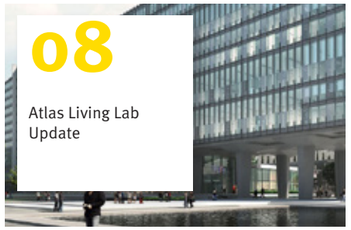
I am extremely pleased to present to you the seventh edition of our ILI Magazine. Since the last edition in November 2016 much has happened and I hope that after reading the various contributions in this magazine you will agree with me that many exciting and promising developments have been happening.

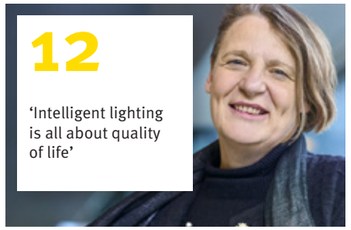
Amongst others you will be informed about some of the latest relevant developments in our research programs, our research infrastructures, our strategic partnerships and our ecosystem.

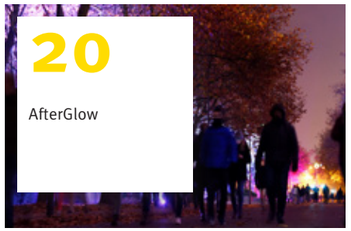
In particular you will be informed about our new research program related to 'Data for Light', about some of the latest results of our research programs and about the developments with respect to our various research infrastructures annex Living Labs where especially the developments related to the new Atlas building are particularly exciting.

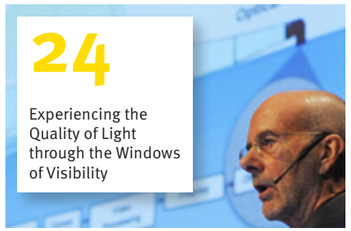
Pleasant reading!

ILI2017 CONTENT









Editorial // ILI Magazine 2017 is a biannual edition of ILI for ILI members, colleagues, collaboration partners, policy makers and related companies // ILI Magazine 2017 is published in May // Editorial staff - Harold Weffers, Marlies Bergman // Design - Volle-Kracht concept, ontwerp en organisatie // Illustrations - ILI // Article contributions - Moesasji & ILI // Photography - Bart van Overbeeke Fotografie, Philips Communications, ILI // Visualizations - TeamV architecten // Contact - P.O. Box 513, 5600 MB Eindhoven The Netherlands T: +31(40)247 5990 E: ili@tue.nl //

Ingrid Heynderickx | Scientific Director

“Data for Light”: a new ILI program line

LEDedification of light opens a new playfield towards connected lighting systems. Because LEDs, sensors and chips are produced with essentially very similar technology, these devices can easily be integrated. Each light pole or luminaire can be considered as a sensor in an inter-networked grid of smart, digitally connected lighting devices. This network can measure occupancy in open-plan offices, mobility in city centers, aggression in bar districts, maintenance needs, to just name a few examples. With such networks, light enters the era of the “internet of things”, and yields daily huge amounts of relevant data.

The Intelligent Lighting Institute supports this trend of “Lighting beyond illumination” by starting a new research program in its Lighting Flagship with Philips Lighting and related partners. This new ILI program line “Data for Light” will cover research from data engineering and data analytics up to the application of data tools in process, maintenance, product and system optimization. From a business perspective, information derived from data may be used to optimize a company’s after-sales services, such as in-time maintenance, or as a commercial product, for example in collaboration with city government to optimize mobility through the city center. All these examples illustrate that the new “Data for Light” program needs to combine various disciplinary perspectives, ranging from computer science to develop algorithms to get most information out of the huge data sets, over psychology to monitor and change human behavior, operations management to optimize maintenance and service models, to innovation management and entrepreneurship to develop new business opportunities. The program will be fueled by a combination of PhD and PDEng-students, where the PhD-students will develop fundamental knowledge on algorithms and their application, while PDEng-students will translate this knowledge into the design of actual industry relevant implementations.

As a scientific director of the ILI, I am pleased with this new development and with the extension of the ILI in the direction of Data Science. I am convinced that this extension very well fits the competencies we have at TU/e, and that this new program line makes our institute even more relevant for the future of the lighting business.

Calendar

May 2017 - November 2017

May 3-4, 2017 Velux daylight Symposium
Location: Berlin

May 16-18, 2017 International Conference on Networking, Sensing and Control (ICNSC)
Location: Calabria, Southern Italy
http://icnsc2017.dimes.unical.it/SLESC.html

May 31, 2017 Licht in Breed Perspectief – Lighting design for all *Location:* TU/e Zwarte Doos

July 2-5, 2017 Healthy Building Europe
Location: Lublin, Poland

September 18-20, 2017 Lux Europa
Location: Lubljana, Slovenia

September 25-29, 2017 ENUMATH 2017
Minisymposium on Monge-Ampère solvers with applications to illumination optics by Jan ten Thije Boonkkamp and Wilbert Ijzerman *Location:* Voss, Norway

November 11-18, 2017 Glow 2017
Location: Centre of Eindhoven **www.gloweindhoven.nl**

November 14, 2017 ILIAD public outreach event 2017
Location: Location TU/e

Local lighting control

Saving energy while maintaining users' comfort

Author | Christel de Bakker **Supervisors** | Mariëlle Aarts, Helianthe Kort & Alexander Rosemann

Lighting in open-plan offices is not yet fully aligned with the individual patterns of its occupants. This can be overcome by controlling lighting locally per desk and therefore significantly reduce the energy consumption of lighting. At the same time, this is not to be accomplished at cost of occupants' comfort. The PhD project "Local lighting control – saving energy while maintaining users' comfort" investigates on how to keep a balance between user comfort and energy consumption of lighting systems.

Figure 1: The office space in the Building lighting lab where the first study was conducted

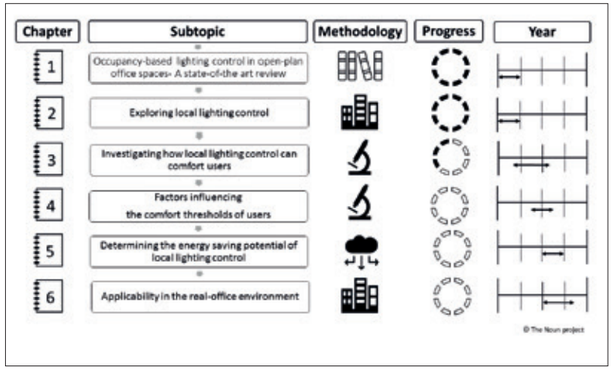


Figure 2: Thesis outline

Background

Open-plan offices are shared by occupants who differ largely in their occupancy patterns. They seldom occupy their desks all day as office workers have meetings or take breaks throughout the day. Nevertheless, lighting tends to be controlled centrally, i.e., lighting is continuously switched on in the complete space and thus wasting electrical energy. The introduction of smart lighting systems enables a more precise control as each luminaire is equipped with different sensors, like occupancy and light sensors. Occupancy sensors allow to switch off or dim down luminaires based on the presence or absence of users. Fine-grained sensors allow for control the luminaires at individual desk level. This strategy aligns the lighting with the individual occupancy patterns, hence lighting can be optimally used.

Current research

The PhD project was started with a literature review, where was found that this local lighting control strategy has already been tested in prior research, but the research had only been carried out in offices with a cubicle lay-out. European open-plan offices tend not to have high partitions separating the desks. Users thus can oversee the whole office space. Local lighting control introduces a fluctuating luminance as luminaires are dimmed up and down when occupants respectively arrive and leave their desks. This might annoy and distract the co-workers that are present in the space. Consequently, we concluded that local lighting control needs further research before it can be applied in these type of offices, which hence forms the focus of the PhD research.

A first study

When the office is not fully occupied, different luminance levels can be applied throughout the space. Following the current standards, these can be varied across three areas: the task, surrounding and background area. In our first study at the Building Lighting lab we varied the luminance in the surrounding and background area. Typical office luminaires were used. Their range was fully explored by varying the surrounding and background luminaires at a minimum, medium and maximum level, resulting in nine different lighting conditions. The study was carried out in a controlled lab environment decorated as a medium-sized open office space. Participants' age varied from 18 to 60, to represent the typical office population. Results are promising regarding the energy saving potential and intended to be published soon in a scientific journal.

Future plans

Several follow-up studies are planned to be carried out. First of all, a large study will be conducted in a larger open-plan office space to investigate which lighting level is just acceptable to occupants in the surrounding and background area. Subsequently, the influence of other factors, such as the presence of co-workers and daylight, will be tested. After these have been determined in controlled environments, the recommended local lighting control strategy will be tested in several real offices. In addition, part of the research will be performed in the United States to investigate the applicability of local lighting control here, which would largely extend its market. The eventual aim of the PhD is to develop an automatic occupancy-based lighting control strategy that is applicable in open-plan offices all over the world. The thesis outline can be found in Figure 2.

Atlas Living Lab Update

Author | Philip Ross | Project leader Atlas Living Lab | p.r.ross@tue.nl

Already back in 2013, TU/e formulated the ambition to make the new Main Building, renamed Atlas, into a living lab when it opens in autumn 2018. A lot has happened since then. ILI has taken a leading role in realising this ambition, working closely together with TU/e's Dienst Huisvesting (facility management), the Total Engineer and several other parties. This article is an update on our vision on the Atlas Living Lab and the challenges we are tackling.

Let's first start with the question why we would want a Living Lab in the Atlas building. Much of ILI's research is about the interplay between intelligent lighting technologies and human beings. The phenomena of interest, like people's use of technologies, their long-term impact on behaviour, wellbeing, energy use, etc., cannot be studied sufficiently in a traditional lab environment. A real-life environment with 'normal' daily use of people fits the kind of questions better. To make such an environment suitable for research, it needs to be enriched with research enabling technologies such as specific sensors, actuators and light behaviours. The Atlas building offers the opportunity to house a living lab of unique scale and character. Several researchers already indicated interest for doing research on topics as varied as personal light for wellbeing, sensor networks, energy-saving through smart climate control and artificial intelligence for autonomous lighting behaviour.

So what will the Atlas Living Lab look like? The plans for the Living Lab have a technical side and an organisational side. I will briefly treat the plans for both sides, and indicate what we are still working on.

The main technical infrastructure of the Living Lab consists of a customized version of the Philips Lighting Connected Office system, installed on the top 8 floors of the building. This system features LED luminaires that are powered over Ethernet, and very importantly, addressable via IP. Every other luminaire has an Actilume sensor installed that can detect presence, movement and light levels. The luminaires and sensors can be individually read and/or controlled via the network, using management software. This is in itself a state-of-the art lighting system, that can help save energy and help manage a building in new 'smart' ways. For the living lab, we went one step further. We will have secure access to the system's API, which offers a way to control the luminaires and read out

sensors with our own research software. This allows researchers to collect data and build new applications on top of the 'standard' infrastructure. We will also have the ability to add extra luminaires and sensors to the system for specific research purposes. The Connected Office system will also have an interface to the Building Management System, which gives it the possibility to also involve the heating system.

That is the technical side of the story. Equally important the organisational side of the story. Because using a living lab like this is challenging. Unlike a traditional lab space, the building is in the first place an everyday working environment for people. Many questions have emerged in the last years: How can we make sure the privacy of the building users is respected? How can we tell who is responsible for a (perceived) malfunction? Who should be informed and consulted before doing an experiment? Which research or innovation partners will have access to the living lab, and to what extent? What are the relevant legal aspects? To tackle these and other organisational questions, I initialised a workgroup last January with representatives of the main parties involved: ILI researchers and future residents, TU/e's Dienst Huisvesting, Dienst ICT, the Chief Information Security officer (TU/e's authority on privacy matters), the Innovation Lab, Philips Lighting Benelux, Philips Lighting Research, and installation company Unica.

Discussions in this workgroup are ongoing. We do not have the answers to all the questions yet, but we are making progress. The constructive attitude of all parties involved makes me confident that we will be ready to fruitfully use the living lab in autumn 2018. Already, the effort has helped bring international recognition. In March, The Atlas Building design won a BREEAM sustainability award in the category Education & Healthcare. The jury noted "the strong health and wellbeing aspects of the project, and its value to the research community and as a demonstrator to other projects moving forward." We are proud that we were able to make a contribution to this recognition. If you would like to know more about our vision and preparations for the Living Lab, feel free to contact me.

ILI introduces new employees







Samantha Peeters

After receiving my Bachelor's degree in Industrial Design at the Eindhoven University of Technology, I did my Master's at Human Technology interaction. Throughout my years of studying I got interested in the topic of lighting and therefore wanted to do my Master thesis in the area of lighting.
Last summer I graduated on the topic of "The Acute Alerting Effects of Light During Daytime", supervised by Prof. dr. ir. Yvonne de Kort and dr. ir. Karin Smolders. It was through my supervisors that I learned about a possible PhD project in the area of lighting. So as of November 1st, I am working as a PhD Student on the project 'Optimizing Human Centric Lighting: Towards Quantified human models' with Yvonne as my promotor. This project is part of the larger multidisciplinary STW project 'OptiLight: Mathematical Optimization for Human Centric Lighting' of the Intelligent Lighting Institute. The overall goal of the project is to make lighting control systems more centered towards the human user. This requires not only better insights in how humans experience light but also demands quantified models and optimization algorithms that are executed by automated control systems.

Anton Alexeev

Anton Alexeev finished his masters in chair of Aerophysics and Gas Dynamics of Novosibirsk State University, Russia. Afterwards he moved to the Netherlands to work on "Design and Technology of Instrumentation" Professional Doctorate in Engineering program. During the program Anton Alexeev had a project in Philips Lighting. The project was devoted to LEDs compact thermal model development. After completion of the program he was enrolled for a PhD position in Department of Electrical Engineering of Eindhoven University of Technology. The research that he is assigned to is connected to Delphi4LED project on multi-domain compact modeling of LEDs. The main goal of the project is to define thermal, electrical, and optical compact models for various LEDs architectures.

Firat Ismailogu

I graduated from Selcuk University, Turkey with a B.Sc in Mathematics in 2007. Thereafter, I did a master in Mathematics (topology) at Mersin University, Turkey for one year. Then I shifted my academic interest more towards computer science.

In this sense, I obtained a master in Knowledge Discovery and Data Mining from University of East Anglia, UK in 2010. My master thesis entitled Medical Data Mining Application Covering Patients Over 90 Years Old by Using the CART Algorithm was published at the journal Archives of Gerontology and Geriatrics.

In September 2011, I started working my PhD research at the Department of Data Science and Knowledge Engineering, Maastricht University, the Netherlands. During my PhD research, I worked on decomposing multiclass classification problems of machine learning. In doing so, I submitted two journal papers to Patter Recognition Letters and IEEE Transactions on Bioinformatics. Additionally, my works were also published in top AI conferences.

In September 2016, I completed my PhD.

As of February 2017, I started my postdoc project which is supervised by Prof.Dr. Mykola Pechenizkiy at TU/e. This project is funded by Philips Lighting and we aim at data mining of indoor positioning data provided by new Philips led systems.

Jochem Bonarius

I received my Master's thesis in Computer Engineering from Delft University of Technology in 2007. Since then I worked as a consultant on embedded systems and FPGAs for Philips Research, NXP, ASML and some smaller companies. After that, I worked at Bosch communication systems for some years as a digital audio processing specialist. Last year I worked at the electro-optical communication group of the electrical engineering department at TU/e on the topic of high-speed receiver DSP for multimode fiber communication.
On the 1st of April I started as a PhD student on the OptiLight project in the signal processing systems group of the electrical engineering department at TU/e. I will be under the supervision of Jean-Paul Linnartz. The goal of this NWO TTW funded project is to make lighting control systems more centered towards the human user. I am looking forward to the collaboration with the other departments (Architecture, Building and Planning and Human-Technology Interaction) on this project. I am also happy to be part of the ILI team!

Shokoufeh Mardanikorani

I believe the tremendous achievements in the field of Communication will no more be attained unless novel ideas are developed. It is the creativity of enthusiastic students with strong academic background that when accompanied by precise supervision can lead to reinvigoration of the field. Believing to possess these necessary qualifications, I applied to Eindhoven University to seek such super-vision. I have always loved Physics and Mathematics and have welcomed challenges in these areas so when the time came to choose a career, I knew my way. Talking to my advisor who had also majored in Electrical Engineering made me realize how much I would like it.

Due to my academic background and interests in Communication Systems, my ultimate goal is to receive a PhD degree in Communication Engineering and enjoy the satisfaction of contributing to applicable science of Communication engineering.
I believe studying at Eindhoven University will provide me with the golden opportunity of learning from great people with exceptional scientific and thinking abilities.

Josephine Sari

I received my B.Sc and M.Sc degrees from Parahyangan Catholic University, Indonesia.

My interest in the implementation of science and technic in industry has led me to pursue my PhD with the topic "Multivariate degradation modelling and its application to reliability testing" under supervision of prof.dr.M.J.Newby, prof.dr.ir.A.C.Brombacher, and Dr.L.C.Tang.

During my PhD research, I developed great interest in both statistical methods and Solid-State lighting (SSL) industry. After receiving my PhD degree in 2008 from Eindhoven University of Technology and National University of Singapore, I got the opportunity to work as a researcher at Knowledge Centre WMC.

In 2010, I moved back to Eindhoven and worked as Q&R engineer at LedNed BV, where I actively involved in product development and improvement, quality control, regulation compliance, and implementation study of LED lighting system.
Since March 2017, I joined TU/e as postdoctoral researcher in the Delphi4LED project under the guidance of Dr. A. Di Bucchianico. In this project, I will contribute my experience and knowledge of SSL and statistics to develop reliable and standardized LED models for design and simulation that will enable the European Lighting industry to regain the leading position.

Marlies Bergman

Marlies is the new Management Assistant ILI. As you may have heard, Samantha Sperling decided to pursue another career journey by further developing her own company and as such decided to leave ILI and thus also the Flagship Lighting. Her activities have been recently taken over by Marlies Bergman whose office is located in Room 5.096 of Building "MetaForum".

‘Intelligent lighting is all about quality of life’

Interview | Mary-Ann Schreurs interviewed by Michiel de Boer of Moesasji

“Do you know what's so great about lighting? It is everywhere! And the moment you convert lighting systems into a smart grid, it means that you have created a smart public space,” says Mary-Ann Schreurs, Vice-Mayor of Innovation and Design, Sustainability and Culture at the Municipality of Eindhoven. “Ledification and digitalization of lighting brings unprecedented possibilities. We aim for a deployment of lighting that enhances the quality of life.”

By the end of 2016, the Municipality of Eindhoven contracted the consortium Philips Lighting / Heijmans for the further development of Eindhoven as a smart society. The consortium will build on the ‘Roadmap Smart City Lighting Eindhoven 2030’, which was developed in collaboration with the Technical University of Eindhoven and ILI. The city wants to be on the forefront of developments in the field of intelligent lighting. “Our approach is to work in co-creation with numerous stakeholders, including the public. We are developing, so hardly anybody can or should predict the actual outcomes. By co-creating, co-designing and co-decision-making we will be able to develop lighting solutions that add real value. We already gained experience with this living-lab methodology at for instance Stratumseind, with great results.” The popular entertainment area Stratumseind is a living lab for the research on the influences of different light scenes on public behavior.

Testing grounds

As a first implementation, the parties involved have designated five areas in Eindhoven as testing grounds for smart public lighting: the traffic route John F. Kennedylaan-Eisenhowerlaan, the traffic route Ring and the residential areas of Gijzenrooi, Schrijversbuurt and Woenselse Heide (West). The testing grounds will be equipped with led lampposts, controllable in a smart grid. The consortium will collaborate intensively with all testing grounds, together with the Municipal Council, TU/e, entrepreneurs and the public. The experiences gained at the testing grounds will deliver input for the further development of the complete smart city lighting system in 2030.
Schreurs: “Of course there is a lot of unknown territory to explore. For example: we participated in a lighting solution for recovering patients. Near a small lake at the outskirts of Eindhoven, some physiotherapists went for walks with the patients. For their recovery it is important to walk consistently at a certain speed. The idea emerged to develop a lighting system to guide these patients. Once the system was put in place it showed promising first results. That’s what I mean with: we cannot predict the outcomes. And that’s precisely why we are setting up testing grounds: to explore the benefits of the technology at hand and to generate new ideas. The methodology that we use, makes sure that you get a kind of total inventory which touches, in addition to lighting, - other aspects of public space as well.”

Identity

“Our future smart city solutions will be locally rooted, resembling our identity. After all, light perception is a cultural phenomenon. In China, for example, people like flashy, intense, almost circus-like lighting. Within the framework of my activities as chair of LUCI (Lighting Urban Community International) I recently visited Copenhagen. I was amazed by the dimmed, low-intensity street lighting situation. When I referred to this, people gazed at me, quite puzzled. They didn’t perceive it as such; to them this was a completely accepted phenomenon. So, lighting and a wider public space need to fit the cultural identity of a city.
We have put a lot of energy in the preparation of our activities. TU/e and ILI have created a clear and realistic roadmap based on extensive research and current trends. The first line considers the developments in digitalization and the role that gathering and sharing information will play in our lives. The second line is the development of lighting technology, in which ILI plays a major role. In short, ILI is exploring what’s possible and what’s next. The third line is all about social change. This is specifically important for the public domain. In what way will technology influence our lives and what do we want from technology? Now and by 2030. That’s why we entered into a 15 year partnership within the consortium. To be able to truly explore and achieve great results together.
It is good to know that – following the philosophy of co-creation - we are also exporting our design process approach to other cities in Europe. Cities with less technological expertise can benefit from our approach and develop their own unique smart city solutions.”

Light connects people

“So we cannot give a very specific answer to the question, “What will Smart City Eindhoven look like in 2030?” And we don’t have to. I think that we’re entering a new era, the do-democracy, and a time in which companies, citizens, scientists and governments join forces and develop together. Will we succeed in developing a great lighting system and smart public space together? I don’t doubt that. The program is designed to suit our core competences: technology and design. And remarkably enough, it is again light(ing) that unites our efforts. We return to the values of our Philips Lighting heritage. Collaborating, creating knowledge and sharing knowledge is what makes us enthusiastic. Co-creating will deliver new systems and structures that improve our quality of life.”

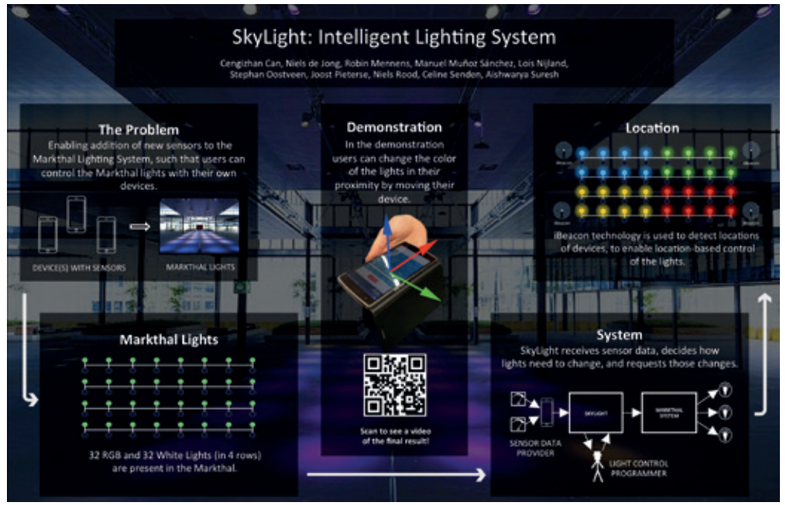
The SkyLight Project

Authors | Manuel Muñoz Sánchez and Niels de Jong

The goal of the SkyLight project was to create a system that allows the addition, configuration, and removal of sensors from the existing intelligent lighting system present in the MetaForum's Markthal at Eindhoven University of Technology. These sensors were made effectively usable in the existing virtual IP-based system to enable their unique identifiability and the retrieval of data from them. Ultimately, the intelligent system can be used to create an interactive application that controls the 64 lights in the Markthal.

To provide extensibility and ease-of-use, SkyLight differentiates between three types of entities in the internal architecture:

- **The Sensor Data Provider,** which can be any device that has some kind of sensory data. Examples are phones, smartwatches and micro-computers such as the Raspberry Pi.
- **The SkyLight System**, which entails the 32 RGB lights and 32 dimmable white lights present on the ceiling of the Markthal. The back-end system of SkyLight handles control of the lights.
- **The Light Control Program**, which dictates how the provided sensor data affects changes in the SkyLight System. The MQTT protocol is used by SkyLight to provide the Light Control Program with the required sensory data.



Results

In eight weeks, the students working on the SkyLight project managed to build, test and document an extensive system that can be easily used and configured by users with minimal programming experience. To demonstrate the capabilities of the system, the team developed several demonstration programs that made use of sensory data from Android devices, as well as location data provided by Bluetooth beacons. Ultimately, the system was demonstrated by means of an application that uses location data to create a spotlight that tracks the location of the user. Using the SkyLight application library, such a program can be written in elementary Java with about 50 lines of code. The SkyLight system additionally provides the option for extension of sensor data from many different sources, such as wearable devices, microphones, cameras and more.

Future Development

A proposal for a new Software Engineering Project is scheduled in the near future. The goal of this project is to use a visible light communication solution developed by Philips Lighting in order to provide accurate indoor positioning to the existing software platform. The new functionality will be showcased by tracking the position of a Blue Jay drone in the MetaForum's Markthal, providing an interesting addition to the existing architecture.

Software Engineering Project

SkyLight was developed in the Software Engineering Project (SEP) course at Eindhoven University of Technology. This is the final project of the Bachelor's program Computer Science. Students taking the SEP course demonstrate the ability to develop large non-trivial software by a group of people. The skills and experience gained from the courses taken in the Bachelor's program are applied in a practical setting.

ILI Short

Optical Fiber Communication Conference

Jean Paul Linnartz gave an invited talk about the future of using the lighting infrastructure to communicate data (sometimes called LiFi) at the Optical Fiber Communication Conference (OFC) in Los Angeles. On Sunday March 19th, Jean Paul Linnartz has participated as expert panelist at the Optical Fiber Communication Conference (OFC) in Los Angeles. Optical Wireless – Can it Become a Gigabit wireless alternative? Capabilities, Opportunities, Challenges and Threats.
Optical wireless communications is seeking to deliver wireless connectivity over the free-space using the visible and infrared spectrum. Optical wireless can play a complimentary role for example offloading the burden from the radio technologies in situations such as high-capacity picocells. In the future 5G and 5G-beyond networks, optical wireless may provide crucial roles in meeting the 5G grand challenges such as 1000x throughput, ms latency, 0.01x power consumption, etc. This forum brings together competing ideas and leading experts from research and industry into a collision space and to facilitate a critical debate on the fundamental capabilities of optical wireless technologies and its chance in the very competitive wireless market.

The Optical Fiber Communication Conference and Exhibition (OFC) is the largest global conference and exhibition for optical communications and networking professionals. OFC attracts 13,000 attendees.

Workshops, Conferences and Symposia

SIAM Conference on Computational Science and Engineering
Jan Thije Boonkkamp and Wilbert Ijzerman organized a Minisymposium on Computational Methods for Illumination Optics, SIAM Conference on Computational Science and Engineering, February 27 - March 3, 2017, Atlanta, USA.

NVVA symposium, "Beriepziekten; beroepsziekten, verleden tijd?!"
Juliëtte van Duijnhoven was a contributor to a workshop about healthy lighting in offices at the NVVA symposium, "Beriepziekten.; beroepsziekten, verleden tijd?!" April 12, 2017, Zeist

15th International Radiance Workshop
Parisa Khademagha, Myriam Aries, Alex Rosemann and Evert van Loenen contributed with the workshop "Application of a spectral sky in Radiance for daylighting calculations including non-image-forming light effects" at the 15th International Radiance Workshop August 2016, Padua, Italy.

4th International Artificial Light at Night (ALAN) Conference
Parisa Khademagha, Myriam Aries, Alex Rosemann and Evert van Loenen made a contribution to the 4th International Artificial Light at Night (ALAN) Conference with "Directionality : an important light factor for human health to consider in lighting design", Cluj-Napoca, September 26-28, 2016

ILI in the Media

18-March-17 - TV & Radio
Studio Brainport at Studio 040
JP Linnartz interviewed Yvonne de Kort on how surgeons can adapt the light settings to visually emphasize malicious tumors in real time during surgery.

The design of an Adaptive Healing Room for stroke patients

Author | Elke Daemen

In recent years, perceptions of performance and quality of healthcare organizations have begun to move beyond providing excellent clinical care and to consider and embrace patient experience as an important indicator of quality of care.

The hospital building in which patients receive healthcare services is inherently part of their experience. Well-designed facilities may increase positive emotions and support the patient experience, which in turn could positively affect patients' health and well-being. The patient room can be seen as the stage upon which the experience happens, because hospitalized patients spend most of their time in the patient room. Although the term healing environment exists for a long time and many guidelines are written over the past years, even today, hospital patient rooms remain highly institutionalized environments that confine patients to an artificial and unfamiliar environment. These environments are not helpful in supporting the healing process of the patient and the patient experience. Ideally, a patient room needs to facilitate improved health outcomes and support the patient experience.
There are a number of design strategies and interventions that can influence patient outcomes. The effects of daylight and nature views on patients are strong, especially on length of stay, sleep, depression or mood, and likely on pain. The same is true for coloured lighting where the effects are robust on improved sleep and depression. Sound has a reducing effect on pain and stress. Understanding these effects allows to design an environment that positively affect the health and well-being of patients. Contextual research was performed to understand the user (patient) and the context. Several experience goals were found such as the need for dosing environmental stimuli and the need for structuring the day. The combination of both experience goals and prioritized design strategies formed the basis for a first set of concept ideas. Based on the feedback from clinical stakeholders it was decided to continue with designing and prototyping an Adaptive Healing Room (AHR). A validation of AHR with clinical stakeholders and with former patients and their spouses was performed in the lab. The results of the lab study show that hospital staff expects a positive effect on the healing process of the patient. In addition the AHR would not intervene with their

workflow which is also crucial for the success of the room in an actual hospital setting. Patients and their spouses believe that most of the aspects of the AHR concept would have helped them while being in the hospital. The qualitative feedback was used to enhance the prototype before implementing it in a clinical setting.

In the final phase of the research, two field studies were set up to analyse firstly the impact on patient experience and secondly the impact on sleep, emotional parameters, activity and patient satisfaction. From the first study we can conclude that the AHR enhances patient experiences. We can conclude that the envisioned experience goals that were contributing the most to the experience of stroke patients were dosing stimuli over the day, providing structure and waking-up gently. From the second study, we can conclude that the lighting system of the AHR enhances the spontaneous activity of hospitalized stroke patients. The results of the field trial show that the lighting system of the AHR achieves more active patients during the periods patient's activity is not imposed by the hospital protocol. The American Heart Association and the European Stroke Organization recommend that physical activity and exercise prescription be incorporated into the management of stroke survivors, because studies show a proven effect on outcome. Therefore we believe that the effect found is a promising result.
We believe that by combining both experience goals and design strategies, the concepts are a stronger proposition because they are more appealing by offering an integrated solution: focusing healing factors (design strategies) in context (experience goals). Combining both is essential to bring real innovation to healthcare problems.

AfterGlow

Author | Philip Ross

On her 60th anniversary, TU/e welcomed the countless Glow visitors to her campus to enjoy light artworks with a relation to science and technology. Through collaboration between staff and students, ILI contributed three original installations to this 'Glow Science' route: Influx, A.R.T. and Intermedia. Furthermore, our honours students were involved in creating animations for the AnTUenna, the lighted chimney on TU/e campus. Here we look back on ILI's contribution to Glow and what happened since then.

Influx was a real-life experiment to test whether moving light could influence crowd flow. The walking paths of visitors were precisely measured using Kinect sensors, and statistics were generated real time and shown live: Average speed per lighting condition, density, etc. Analysis of the rich resulting data set is still ongoing, but a first conference paper about the experiment is already accepted. Many new challenges surfaced from this experiment, so if you are student and interested in contributing, please contact dr. Alessandro Corbetta.

A.R.T. aimed to restore people's ability to focus attention using a light- and soundscape inspired by Attention Restoration Theory. We've done a study involving 64 visitor interviews, taken at the start and the end of the installation, to learn how people experienced it. Results are encouraging. Meanwhile, A.R.T. is invited to the Klanglicht festival in Graz, Austria in April this year. This gives another nice opportunity to explore what the combination of light and sound can do for people in public space.

Intermedia, an interactive installation that invites people to interact with each other's silhouettes, was a crowd favourite. Especially the installation's high level of interactivity was appreciated. It was striking to see both young and old moving so freely before the screens and connecting to the people on the other side.

The AnTUenna was the big hit of the Glow festival, and it continues to shine on campus as a structural addition. Development of the AnTUenna goes on. In April, a group of Computer Science Bachelor students will work on making the AnTUenna sensitive to external data, so that it can respond real-time to events from inside and outside the campus.

I think we succeeded in making a number of ILI's research topics experienceable for the public in an appealing way. Next to that, students had a great learning experience, rich research data was produced and some installations stayed alive after the festival. All in all, a great afterglow!

foto's: Bart van Overbeeke

Highlights

Christel de Bakker won Fulbright Scholarship!

Christel de Bakker, a PhD candidate of TU/e Building Lighting group has been awarded a Fulbright scholarship. Every year, the Fulbright Center awards top candidates from master students, PhD students and researchers with such a scholarship.

Christel de Bakker performs her research in the project "Creating Healthy Environments – Offices", a public private partnership between Philips Lighting B.V. and the Building Lighting group of TU/e within the Lighting Flagship of the Intelligent Lighting Institute (ILI).
Her interest lies in reducing the energy consumption of open-plan offices while maintaining the visual comfort of the occupants.

The Fulbright scholarship will enable Christel to work together with top researchers in the United States on local lighting control strategies. Her research has been focusing on the European context in open office spaces and can now be enhanced to also consider the North American situation.

Christel has already published 3 articles in international peer-reviewed journals. In February she won the sustainability award as well as Bouygues Special Discretionary R&D Award within the COINS grand challenge.

Her PhD-supervisor prof. Dr.-Ing. Alexander Rosemann is happy: "We are all very proud of Christel. She joined our group just 1.5 years ago and has already accomplished a lot with her research. That she has won this scholarship indicates that her research topic is highly relevant to society, an aim that we have for all our research."

Christel de Bakker explained: "I did not expect to win this scholarship as I understand that there is quite some competition. But I am very happy to be given the opportunity to perform some research in the US and to gain more international experience."

Prof. dr. Ingrid Heynderickx, director of TU/e Intelligent Lighting Institute, sees great opportunities arising from this scholarship: "It is great to have such highly professional and recognized researchers in the institute. This scholarship allows Christel to extend her research to the US, where she can investigate to what extent human centric lighting solutions for open plan offices can be optimized similarly in the US than in Europe"

Innovation Program Manager Lighting Applications in Philips Lighting Sjoerd Mentink comments: "The world increasingly recognizes the importance of high quality, human centric lighting solutions in modern working environments. It is fantastic that Christel is awarded the scholarship to further advance this field and develop herself. Congratulations!"

More information

- **Fulbright program:**
  http://www.fulbright.nl/programmas/fulbright-programma.html
- **TU/e Building Lighting group:**
  www.tue.nl/buildinglighting
- **Intelligent Lighting Institute:**
  www.tue.nl/ili
- **The CHEO research project:**
  https://www.researchgate.net/project/CHEO-Creating-Healthy-Environments-Offices
- **Christel's profile on TU/e website:**
  https://www.tue.nl/en/university/departments/built-environment/the-department-of-the-built-environment/staff/detail/ep/e/d/ep-uid/20087297/ep-tab/4/

Related news

- **Christel's COINS Challenge Prize:**
  - https://www.tue.nl/en/university/departments/mathematics-and-computer-science/research/research-institutes/data-science-center-eindhoven-dsce/news/08-02-2017-coins-construction-industry-grand-challenge-winner-controlling-lighting-locally-per-desk/
  - https://www.tue.nl/en/research/research-institutes/top-research-groups/intelligent-lighting-institute/news/13-02-2017-christel-de-bakker-wins/

Highlights

Bernt Meerbeek nominated for TU/e Academic Awards 2017

In 2016, Bernt Meerbeek (advisors prof.dr. Evert van Loenen, prof.dr. Emile Aarts and prof.dr. Alex Rosemann) received a Cum Laude PhD degree for his thesis entitled: "Studies on User Control in Ambient Intelligent Systems". His work, performed mostly at Philips Research in Eindhoven, offers solution directions for issues encountered in our increasingly intelligent digital environment (the Internet-of-Things), where smart systems take decisions which do not necessarily match the expectations of the users. The research explored issues across a broad range of application domains, from home robotics to office daylighting systems, and potential solutions based on the concept of Expressive Interfaces. His thesis was judged of exceptional quality, and has been nominated by the Department of the Built Environment as candidate for TU/e Academic Award 2017.

Experiencing the Quality of Light through the Windows of Visibility

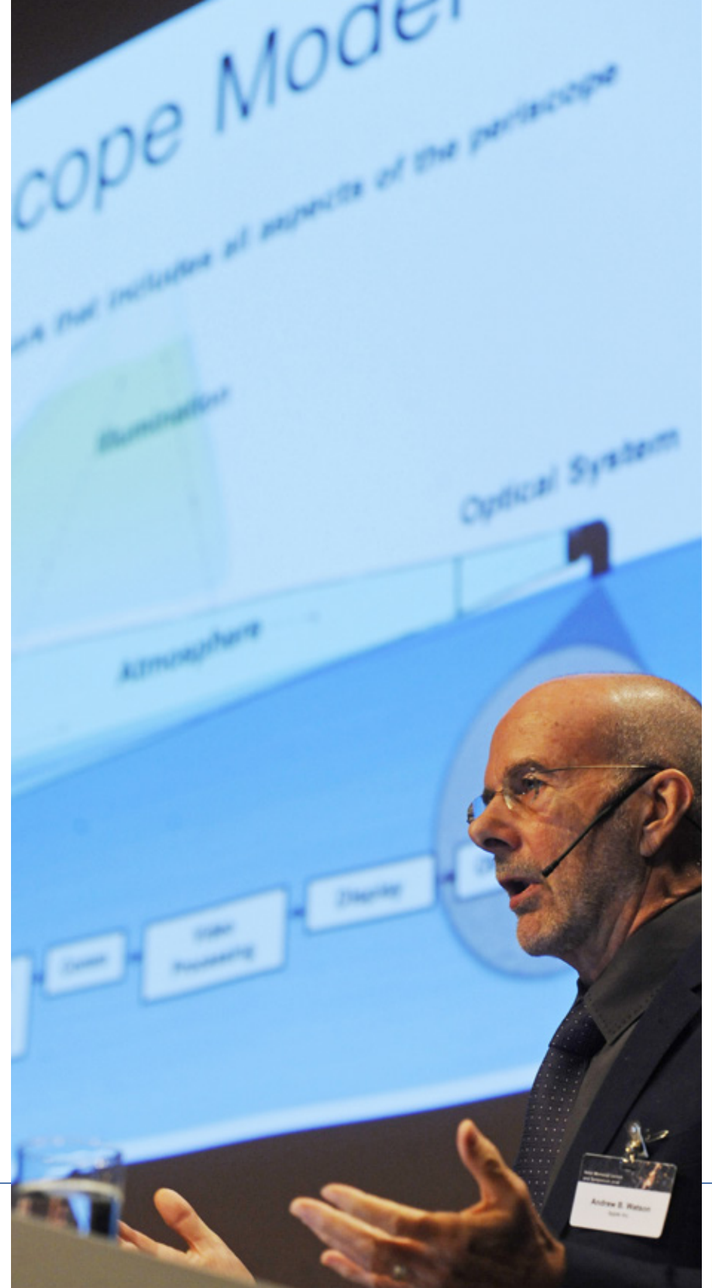
Holst Memorial Lecture and Holst Symposium 17 November 2016

Author | Joep Huiskamp

The 2016 edition of the Holst Memorial Lecture and the preceding Symposium drew a varied crowd to the Auditorium at the heart of TU/e campus. Researchers from both Philips Lighting Research and TU/e, PhD students and other guests turned out to look for inspiration and seize the opportunity to expose themselves to some serious scientific networking. The organizing Holst Committee, consisting of representatives from Philips Lighting and TU/e, had invited a quartet of excellent symposium speakers to shed their light on the Symposium topic.

Prof. Leo Marcelis (Wageningen University) shared his views on the revolution in horticultural plant production caused by the application of LEDs. Producing sufficient crops to feed the growing population of the world requires more efficient approaches to indoor plant production. The light emitting diode proves to be a crucial player in this respect.
The Internet of Things is here to stay. Filip jan Depauw (Philips Lighting) talked about Philips Hue, one of the largest connected-device installed systems globally that turns what was 'just' lighting into a safe, robust and entertaining experience.

Prof. Zary Segall (KTH, Stockholm) focused on how researchers explore the role of light 'beyond illumination'. How can light be used to solve problems? A clear understanding of semantic and cognitive light and its applications could provide solutions to the question.
Prof. Kent Larson (MIT) stated in his lecture that as the density of urban environments continues to increase, the innovation potential of cities should likewise grow. Innovative Lighting could play a significant role in revolutionizing the way we live in cities.
The Holst Memorial Lecture, the 40th since 1977, was given by Andrew B. Watson PhD. He reflected on his work as a Senior Scientist for Vision Research at NASA. The human visual system, dr. Watson explained, consists of a complex series of processing steps, through which the information available to the eye is continually reduced to produce the image we ultimately see. This process can be thought of as a series of windows, through which light passes. He ended his talk stressing the increasingly important role ubiquitous displays will play in our lives. After his talk, Dr. Watson received the Holst Memorial Lecture Award 2016.



Andrew B. Watson (Holst Memorial Lecture Award 2016). Photo Rob Stork

Highlights Holst Symposium 2016

On 17 November 2016, TU/e and Philips Lighting co-organised the Holst Memorial Lecture ("The Windows of Visibility") and its accompanying Holst Symposium ("Quality of Light").

As both were fully dedicated to Light & Lighting, it was the perfect opportunity for the Intelligent Lighting Institute to organise its annual public outreach event, ILIAD, on the same day.

A booklet with summaries of the various invited speakers of the Holst Memorial Lecture, the Holst Symposium and ILIAD will be available shortly. If you are interested in receiving a copy of this booklet, please let us know by sending an e-mail to ILI@tue.nl.

Videos of the Holst Lectures

ILI Top publications

October 2016 – May 2017

S. Bakker and K. Niemantsverdriet
The Interaction-Attention Continuum: Considering Various Levels of Human Attention in Interaction Design, International Journal of Design. 10, 2, 1–14 (2016).

K. Niemantsverdriet, H. A. van Essen, and J. H. Eggen
A perspective on multi-user interaction design based on an understanding of domestic lighting conflicts. Personal & Ubiquitous Computing (2017) online first. DOI:https://doi.org/10.1007/s00779-016-0998-5

M.P.J. Aarts, J. van Duijnhoven, M.B.C. Aries, A.L.P. Rosemann
Performance of personally worn dosimeters to study non-image forming effects of light: Assessment methods, Building and Environment, Volume 117, 15 May 2017, Pages 60-72.

de Bakker, C., Aries, M.B.C., Kort, H.S.M. & Rosemann, A.L.P. (2017)
Occupancy-based lighting control in open-plan office spaces: A state-of-the-art review. Building and Environment, 112, 308-321.

Chraibi, S., Crommentuijn, L., van Loenen, E.J. & Rosemann, A.L.P. (2017)
Influence of wall luminance and uniformity on preferred task illuminance. Building and Environment, 117, 24-35.

Despenic, M., Chraibi, S., Lashina, T.A. & Rosemann, A.L.P. (2017)
Lighting preference profiles of users in an open office environment. Building and Environment, 116, 89-107.

Chraibi, S., Lashina, T.A., Shrubsole, P., Aries, M.B.C., van Loenen, E.J. & Rosemann, A.L.P. (2016)
Satisfying light conditions: a field study on perception of consensus light in Dutch open office environments. Building and Environment, 105, 116-127. In Scopus Cited 3 times.

Khademagha, P., Aries, M.B.C., Rosemann, A.L.P. & van Loenen, E.J. (2016)
Why directionality is an important light factor for human health to consider in lighting design?. International Journal of Sustainable Lighting, 35(1), 3-8.

Meerbeek, B.W., Bakker, C. de., Kort, Y.A.W. de, Loenen, E.J. van, Bergman, T.
Automated blinds with light feedback to increase occupant satisfaction and energy saving. Building and Environment 103, 70-85 (2016)

T.C.F. van de Werff, K. Niemantsverdriet, H.A. van Essen, J.H. Eggen
"Designing multi-user lighting interfaces: four strategies to implement social translucence," DIS 2016 Companion Proceedings of the 2016 ACM Conference on Designing Interactive Systems. - New York : ACM, 2016. - ISBN 978-1-4503-4315-2. - p. 137-140

S. S. Guclu, T. Ozcelebi and J. J. Lukkien
"Improving Broadcast Performance of Radio Duty-Cycled Internet-of-Things Devices," 2016 IEEE Global Communications Conference (GLOBECOM), Washington, DC, 2016, pp. 1-7. doi: 10.1109/GLOCOM.2016.7841888

PhD Theses

Daemen, E.M.L. (2017)
The design of an adaptive healing room for stroke patients. Eindhoven: Technische Universiteit Eindhoven. ((Co-)promot.: Evert van Loenen, Emile Aarts & Alexander Rosemann).

Visiting Philips Lighting Research NA

Thomas Meyfroyt is a 4th year PhD student in the Stochastics section of TU/e Department of Mathematics and Computer Science. His research project, which is part of the Flagship Lighting, is entitled “Meshed lighting networks” and deals with the performance evaluation and design of communication algorithms for optimally controlling large wireless systems. He is currently visiting Philips Lighting Research in Cambridge, MA, USA and wrote the following.

“Since the start of my final year as a PhD student, I have been trying to decide whether I would like to continue my career in academia or in industry. Fortunately, my PhD project is a part of the Flagship Lighting, a strategic partnership on intelligent lighting between TU/e and Philips Lighting, which provided me with the opportunity to do an internship at Philips Lighting Research in Cambridge, Massachusetts. After a lengthy process of getting my visa and the appropriate paperwork, I was able to start the internship this January and I will finish in the beginning of April.

My internship focuses on the commissioning of large scale lighting networks for large office spaces. All the luminaires in these networks are equipped with sensors that are continuously collecting data, for example on occupancy or illuminance. Through wireless communication, these sensors need to send their data to a central controller where it can be processed. My task is to investigate how the sensors should route their data to this central point in such a way that the capacity of the wireless network is optimized, while minimizing communication traffic.

Besides my research activities, this internship also gave me the opportunity to familiarize with an organizational culture outside of the Netherlands. I enjoy seeing the industrial side of research, which is very different from the academic side. Instead of simplifying the problem in such a way that you are left with a model which admits a beautiful analysis, it is important to stay closer to reality, taking into account all practical aspects that are related to the problem and, if necessary, to rely more heavily on simulations and experiments to gain insights.

Last but not least, I enjoy living in another city - Cambridge is a great city to live in and being able to visit Harvard, MIT and Boston is amazing. So far I have been very lucky with the winter here, only experiencing one snowstorm. The cultural highlight of my trip has to be seeing the Super Bowl, which the New England Patriots (Boston) won with a miraculous comeback. “


TU/e
Technische Universiteit
Eindhoven
University of Technology