Proposal - Interactive City Lighting

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Abstract
LED based lighting systems have enabled radically new possibilities in the field of artificial lighting. This is due to in part to the LED being digitally controllable which means this efficient light source can also be integrated with sensors and smart environments. This has opened up a new world of lighting and lighting interaction opportunities that has been applied in new concepts in many of the indoor lighting domains. The outdoor lighting domain however has focused mostly on the LED's efficiency and low cost of ownership to save energy and money for local governments. The use of the LED as a potential means for providing interactive city lighting for social good or entertainment is as yet a fairly unexplored area. This is therefore the focus of this workshop to bring together a community of researchers, designers and technologists to explore the potential of interactive city lighting and how it could support or enhance the lives of those living in a city.

Goals of the Workshop
In previous workshops on the subject of interactive lighting systems (Interact 2011, AmI 2011, and DIS 2012), several topics were identified as being the core of this research area: semantics of light; light applications and technology; multi-user; and interaction paradigms. The conclusion was that with a greater understanding of these topic areas, others can apply interactive lighting more confidently to their particular applications. In this workshop we want to

continue this exploration and promote research into this domain. In particular the focus will be on the different aspects of interactive urban lighting from the stakeholders' perspective e.g. government, pedestrians, business, residents, wildlife etc. The goals of this workshop are:

1. *Identify key opportunities for new forms of interactive lighting systems in urban contexts.*

The urban environment is changing throughout the world and individual cities will have their own particular requirements; one size is unlikely to fit all in this case. Therefore, the global reach of this conference will help us bring together a diverse group of people who can share their insights from their own work and cities. This inspiration will help to stimulate ideas as to how different cities and communities may utilize interactive lighting. Differences and similarities between cities and people will be explored and recorded which can fuel new research topics.

2. *Explore interaction paradigms that can be (re-) used for interactive urban lighting.*

The CHI community has many years of experience in interactivity and applications of UI technology and this wealth of knowledge will be extremely useful in pushing this domain forward. Existing or new UI methods may be applicable to the urban context to assist with the needs and desires of the people that will be explored in the first part of this workshop.

3. *Examine adequate ways of prototyping and evaluating interactive lighting systems.*

The scale and complexity of many urban lighting systems makes the evaluation and prototyping of such systems challenging. In some cases virtual prototyping using systems such as a CAVE environment can be used. In other situations small scale models of the environment can be created to preview the interaction; however, it is not clear which evaluation method is best for particular types of installation. Evaluation methods may be used to assess the light output and the acceptance of the wide range of users and stakeholders, such as residents, tourists, traffic specialists and police departments.

Workshop Plan

The aim is to bring together a mix of researchers and practitioners from disciplines such as interaction design, user-centered design, human factors, lighting design, and human-computer interaction who are interested in exploring urban interactive lighting systems.

Before the Workshop

We establish a dedicated website for announcements, communication, related work and accepted contributions. The call for participation will be sent to relevant groups of researchers and practitioners.

Soliciting and Selecting Contributions

Potential participants should submit a 2-4 page position paper describing their interest and/or previous work related to the topic of the workshop. We will select participants based on the quality and relevance of their paper. We will limit the size of the workshop to 12-18 people to ensure effective discussion in the second part of the workshop. All selected papers will be published on the website prior to the workshop.

During the Workshop

The first part of the workshop (the morning) will be dedicated to the introduction of emerging forms of

urban lighting interaction and the presentations of the individual attendees. Time will also be given to prepare a list of topics for the afternoon session.

After a successful 'hands on' session during the last workshop at DIS 2012, where three working prototypes of interactive lighting systems were created, we will apply the same approach for this workshop. In the afternoon session the attendees will be split into groups, with each taking one particular aspect of urban lighting (presented or identified during the morning session). We will then attempt to work out a concept of interactive lighting system and finally create a simple working prototype. This activity will stimulate discussion on how to prototype and evaluate an urban lighting concept.

Plans for Dissemination

The results of the workshop will be summarized and published on the workshop's website. Depending on the maturity of the submissions and the outcome of the workshop we intend to write a special journal issue with the right publisher to promote this research area and our initial findings.

Organizers

The workshop organizers are all active researchers in the area of user interaction, light control and light perception specifically focusing on new forms of interaction and collectively have considerable experience in organizing workshops on similar topics.

Dzmitry Aliakseyeu is a senior scientist in the Human Interaction and Experiences group of Philips Research. His research interests are in new forms of interaction and user interaction in the areas of lighting.

Bernt Meerbeek is a senior scientist at Philips Research in Eindhoven. His research interests are in user interaction solutions for intelligent systems, ranging from smart consumer appliances to smart environments and lighting systems.

Jon Mason is a senior scientist at Philips Research in Eindhoven. His work at Philips has included the design of new user interaction means for lighting in the retail, office and hospitality contexts. His interests include UI design, design methodology, and the inclusion of art in design.

Harm van Essen is an assistant professor in the Department of Industrial Design at Eindhoven University of Technology. His work focuses on the integration of technology and insights from social sciences in design. His research interests are in new interaction styles for novel lighting platforms in multi-user environments.

Alexander Wiethoff is a senior scientist at the University of Munich. Currently his key research focus is in the area of hybrid interactions and the design of prototyping toolkits to support interdisciplinary teams.

Andres Lucero is a senior researcher at NRC in Tampere, Finland. His interests lie in the areas of mobile human-computer interaction, user-centered design, and design research.

Elke den Ouden is full professor in the department of Industrial Design at the Eindhoven University of Technology. She is also founder and strategic director of LightHouse – the solution partner of the Intelligent Lighting Institute at TU/e. Her research interests are in creating value with intelligent lighting systems for a wide range of stakeholders: people, organizations and society.

Ext. Abs. - Interactive City Lighting

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Author Keywords
LED lighting; lighting control; city lighting; multi-user

ACM Classification Keywords
H.5.m. Information interfaces and presentation (e.g., HCI): Miscellaneous.

General Terms
Design; Human Factors

Introduction

The Light Emitting Diode (LED) has caused a profound change within the lighting industry. This is due in part to the LED's key properties of being digitally controllable, physically small, highly efficient, and cheap to manufacture. Each of these contributes to the attractiveness of the LED over the traditional light sources and consequently the LED is fast becoming the default choice. For outdoor lighting the LED is particularly beneficial for being highly energy efficient and simple to maintain due to its long lifespan. Furthermore, due to the variety of colours available from LED sources they have often been used for city beautification to illuminate buildings and places of public or national interest [12]. The digitally controllable aspect of the LED means it can be easily managed by software and digital interfaces [9]. Consequently, when used in conjunction with sensors and software programs the light output can be used as a response to people or situations; a key aspect that is worth exploring, especially in the context of city and public lighting for this has yet to be fully deployed or exploited. For example, the interactivity can optimize energy saving schemes where lights can be dimmed when no one is present. Similarly, interactivity can be used for making decorative lighting more dynamic and engaging by allowing people to control some aspects of their urban lighting [4,10,11].

In previous workshops on interactive lighting control [1,2] several projects that were focused on city lighting were presented. These few examples showed how a number of independent teams were beginning to realize the potential of using the LED and its attributes to the full in outdoor lighting.

Poulsen et al. [11] investigated how pedestrians' movements can be used for controlling the illumination of a town square. When people walked through the square the general lighting was dimmed slightly and a brighter circle of light would appear and then follow them as they walked. One of the key findings was that many people who crossed the square did not notice any change of illumination, while those who could see the square from a distance, such as from their apartment, clearly noticed the change in lighting, creating a notion of actors and observers. Another example is the work of Pihlajaniemi et al. [10] who created LightStories. Using the LightStories website, any visitor could create a dynamic lighting design to be presented along a pedestrian street for a whole hour.

Many cities will use light to illuminate architecture in urban prime locations. Boring et al [4] implemented a remote interaction system in conjunction with a media façade that enabled people to colour a building by changing the light in each window using their smartphones.

One other direction that is being explored is to enrich lighting systems with sensor networks that will enable intelligent and autonomous lighting control, based on contextual or implicit user information [3]. An example of an experiment done by the Intelligent Lighting Institute at the TU/e is on the effects on a.o. perceived safety of dynamic road lighting which continuously adapts to the presence and behavior of pedestrians [7]. Work of this nature would have a natural fit with urban environments that are highly dynamic and need to support a greater variety of activities such as everyday commuting and shopping to festivals and promotions.

These examples of responsive urban lighting demonstrate different levels of interaction: implicit or presence based lighting [3,7,11]; indirect by creating a lighting scene that can later be reproduced by a lighting system [10]; and finally real-time explicit interaction [4]. However, while this work is interesting and commendable, there is a need for research into how people react and accept interactive city lighting and for what they may need it for. Initial work has been undertaken in this area on the acceptance of dynamic lighting solutions by various stakeholders [6], but a validated approach is lacking. Hence, the design of interactive systems in this domain is in need of a more coherent and systematic research effort to explore and understand the application of dynamic light in public spaces.

In previous workshops on the subject of interactive lighting systems, several topics were identified as being the core of this research area: semantics of light; light applications and technology; multi-user; and interaction paradigms. The conclusion was that with a greater understanding of these topic areas, others can apply interactive lighting more confidently to their particular applications. In this workshop we want to continue this exploration and promote research into this domain. In particular the focus will be on the different aspects of interactive urban lighting from the stakeholders' perspective e.g. government, pedestrians, business, residents, wildlife etc.

Goals of the Workshop

In the previous workshops [1,2] the domain of interactive lighting as a research area was outlined and our initial vision was formulated. This workshop focuses on the particular domain of urban lighting and how the public may interact with it. The goals of this workshop are:

1. *Identify key opportunities for new forms of interactive lighting systems in urban context.*

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Other methods may also be required to assess the interaction of urban lighting systems since this domain may enable new forms of interfaces to be applied which in turn questions how to build such systems from scratch [5]. Unlike interaction with a traditional GUIs for example, idioms and methods for urban/public UI are still evolving. Early prototyping of these systems is critical in order to get the *design right* and achieve a usable and enjoyable outcome.

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