Bright Environments Vision of the Intelligent Lighting Institute (ILI)

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Abstract
The Bright Environments research program of the Eindhoven University of Technology Intelligent Lighting Institute aims to find new methods of intelligent lighting control and human interaction. We present a summary of the institute's work on this research field and the research vision of the Bright Environments program as well as an overview of the related research projects.

Author Keywords
Intelligent lighting; Layered light control; Smart spaces; User interaction for lighting

Introduction
Ever since the light bulb was first discovered, we have turned lights on and off with a switch. Today, the intelligent lighting technology allows many opportunities ranging from autonomous lighting control to advanced user interaction styles. If researchers in the Bright Environments research program of Intelligent Lighting Institute (ILI) get their way, radical change is on the way.

Bright Environments Research Program

Thanks to the latest developments in the solid state lighting technology, miniaturization of processing hardware and wide-spread usage of wireless communication, we are entering a new era of lighting. Light sources can now be embedded into everyday objects and be controlled by low power devices with digital computing capability. Thus, traditional light sources that just aim to light living and working spaces are slowly being replaced by networked intelligent lighting systems that are ideally energy and cost efficient. These systems have many goals ranging from simple illumination to performance and well-being support for people, aesthetics through decorative lighting and information delivery through coded light. This is a paradigm shift that will change the way we live in a way similar to the transition into the smart phone era.

A toggle light switch does not match humans' needs in terms of imposing desired lighting settings for different user activities and environment contexts.

The advantages promised by indoor intelligent lighting are compelling. There are opportunities to be seized in terms of advanced – and autonomous - control and user interaction capabilities, but there are difficulties to overcome as well. Intelligent lighting systems are composed of many devices that have digital computation and communication capabilities, e.g. smart lamps, interaction devices and sensors. Given such complexity, it is important to find a good balance between autonomous lighting behavior and user control. Currently, programming such a system requires significant expertise and writing lines of code. In Bright Environments research, we investigate how to identify activities and contexts in an environment and how to define and impose a corresponding desired lighting behavior on the system, as well as new methods of interaction between humans and light sources.

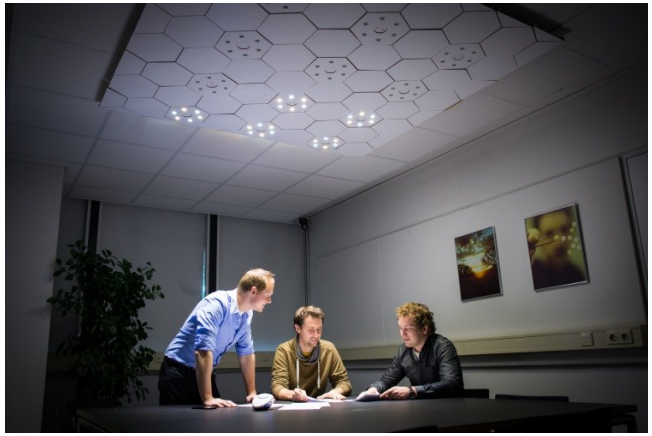

Figure 1 A meeting room intelligent lighting installation featuring Hyvve, a hexagonal light tile with computation and wireless communication capabilities (design by Remco Magielse, TU/e Industrial Design).

In the future, the internet will reach the leaves of intelligent lighting systems.

Intelligent lighting is tightly linked to the developments for the realization of the Internet of Things (IoT) concept, which connects digital "things" to the Internet Protocol (IP) domain. Today, there are more IP connected devices than there are humans on the planet. According to a Cisco report on IoT, the number of IP connected things in 2020 will reach 50 billion. We envision that a fair share of these will be low capacity lighting and sensing components. In this direction,

lighting systems as well as building management and other services that are enabled by an indoor lighting infrastructure will converge to all-IP solutions, with IP reaching end-points. At ILI, we aim to develop robust, dependable and secure full-IP intelligent lighting systems that are energy and cost efficient.

Figure 2 A personal, portable light controller that we call Bolb (design by Remco Magielse, TU/e ID).

Relevant Projects

Adaptive Lighting Environments (ALE)

ALE was a TU/e internal project where the departments of Electrical Engineering, Computer Science and Industrial Design collaborated to develop technology and concepts for adaptive lighting systems of the future, including user interaction models and tools. In this multidisciplinary project, technological innovation and an understanding of social effects of lighting were gained in parallel, which was very special. Results with respect to human interaction with light were presented in [1] and [2]. In this project, we also investigated decentralized algorithms for activity detection, distributed control and emergent behavior in intelligent lighting systems.

Smart Context-aware Services (SmaCS)

The aim of the SmaCS project was to create critical software building blocks on top of intelligent lighting infrastructures for providing contextual services to humans. The goal was to analyze the data gathered in by wireless sensors and (novel) user interaction devices in an intelligent lighting environment to learn user preferences and automatically actuate lights to provide most suitable light settings in various contexts.

Acknowledgements

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References

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