VTT Lab for SeeThrough Environments

Janne Aikio  
VTT Technical Research Centre of Finland.  
Kaitoväylä 1.  
Oulu, 90571 Finland  
janne.aikio@vtt.fi

Eveliina Juntunen  
VTT Technical Research Centre of Finland.  
eveliina.juntunen@vtt.fi

Vesa Pentikäinen  
VTT Technical Research Centre of Finland.  
vesa.pentikainen@vtt.fi

Esa-Matti Sarjanoja  
VTT Technical Research Centre of Finland.  
esa-matti.sarjanoja@vtt.fi

Abstract
In this document we represent VTT’s work in See-Through Environments project, which is a joined project between Center for Internet Excellence (the project coordinator) and VTT Technical Research Centre of Finland.

We represent the demo laboratory being built ad VTT’s premises, and some of the technologies required to be able to recreate natural lighting scenes in the demo lab. The demo laboratory is also able to be used in video-conference purposes being able to represent movement as subtle changes in lighting.

Author Keywords
SeeThrough; Smart lighting; Integrated lighting control; People tracking; Printed electronics

Introduction
The main effort of VTT in the SeeThrough project is in building up a system where light scenes can be recorded using mobile devices or web cameras, and recreating those scenes in a demo lab consisting of controllable RGB lighting.

The idea is to be able to recreate lighting scenes that the user of the system has experienced so nice, that he/she would like to experience similar lighting at home.

NordiCHI 2014 workshop on Interactions and Applications on See-through Technologies  
October 26, 2014, Helsinki, Finland  
Authors maintain the copyright.
Another use case for such lighting would be for example phone calls with non-intrusive video-conference like lighting control: callers’ movement would be seen as subtle changes in the lighting.

Development
The concept represented on the introduction section consists of various technological parts developed during other projects of our team. Selected technologies represented as follows are used in making our vision reality.

**PeopleTracker**
PeopleTracker is software solution which visualizes people and their tracks on a 2D map using depth sensors. The depth sensors provide a rasterized visualization of the environment where pixel intensity represents distance. Depth sensors are unobtrusive way to gather information from the environment as it does not gather color information. Potential privacy issues are more easily handled as the targets are not easily visually recognized.

**LightingMessageBroker**
Lighting message broker operates as a middleware engine metering, controlling and orchestrating sensors and actuators connected to it. The Lighting message broker is able to transfer messages between various heterogeneous interfaces such as serial ports, Ethernet sockets and higher level HTTP REST interfaces.

**Technology Development in Several Projects:**
- Examples
  - AthLEDics (TEKES)
    - Provided a base for intelligent lighting control applications
  - Guiding light (VTT)
  - SparkSpace (TEKES)
  - People tracking
  - Affecting to people’s behavior through controllable dynamic lighting

These projects function as enablers for the technologies needed in our SeeThrough vision.

**Technologies Needed**
- Controlling heterogeneous lighting systems
- Capturing light scenes both indoors and outdoors
- Measuring the quality of the projected light reflected to sources
- Personal lighting
  - People tracking
  - Translating moving head spot pan and tilt to people tracker xyz coordinates

SeeThrough demo lab

Figure 1 Layout of the SeeThrough demo lab at VTT Oulu
The SeeThrough demo lab represented in Figure 1 is located at VTT premises in Oulu, Finland. It will be used for the experiments of the SeeThrough project. The lab is going to be equipped with 12 pcs of PAR-30 RGB spot luminaires, 4 pcs of LED light Bars, an artificial horizon made from LED strips and a RGB / tunable white LED moving head capable of panning and tilting over 360 degrees. Figure 2 represents some the commercially available luminaires used in the project.

The lab will also be equipped with depth camera based people tracking. The tracker is capable of detecting the people moving in the room.

The tracking data is able to be used in controlling the local lighting, but also to provide effects to a remote space. For example, if a similar space would be assembled into another location, the person having a phone conversation in our demo lab would affect the remote location’s lighting.

The underlying technologies have been abstracted with Lighting Message Broker. The system is able to control for example DMX, DALI and Philips HUE, but the control messaging is always done the same way no matter the technology underneath.

Printed electronics concepts for the SeeThrough project

Printed electronics could provide either large low resolution screens or printed graphics that change color in different lighting scenes. Fig. 3 on the side panel represents an example of printable panel.

Functionality of the panel prototype

- The graphics is driven by the ambient light
- The graphics is dim on dark lighting and changes the state on bright lighting gradually segment by segment from down to up making the organic effect