Real-time Spatial Photobiological Light Monitoring and Control System

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Introduction

A smart portable device is proposed to monitor and analyze photobiological parameters of light, i.e. image forming and non-image forming, in the space and control artificial lighting and building façades systems with respect to occupants' behavior and local photoperiods.

Image forming (IF) effects[1]

The biological process of light through the human eye system and brain which results in image formation and vision.

Non-image forming (NIF) effects[1]

The impact of light on human body clocks, alertness and performance after stimulating human-eye photoreceptors.

Key Conclusions & Future Developments

- A real-time spatial basis to monitor interior-exterior lighting parameters and adapt the indoor ligating environment to photobiological needs of occupants for a particular activity
- Intelligent occupants' behavior and activity patterns detection
- Smart control of lighting and envelope systems based on different lighting adaptation scenarios
- Integrated analysis and presentation of photobiological lighting factors of the space in a virtual reality environment through a user-friendly and remotely controlled interface
- Future developments to capture all environmental data including thermal and CO2 emissions in order to offer a fully smart control system for adjusting building components to health factors

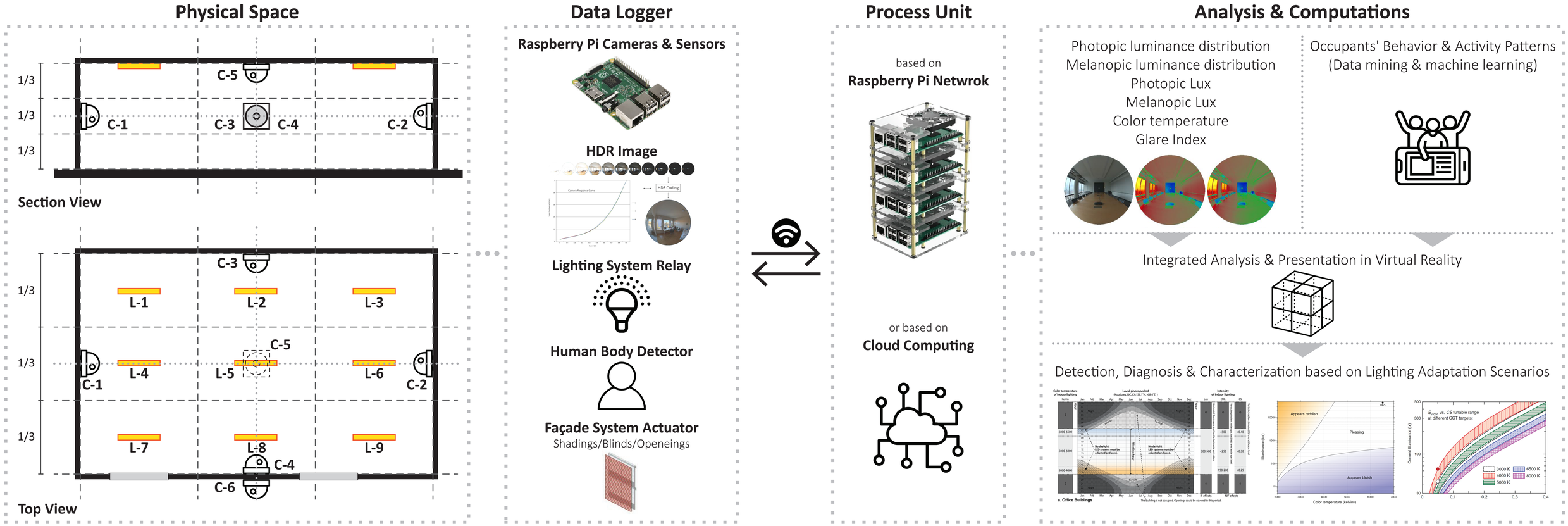

Figure 1. The layout of the device architecture

Device Architecture

- A sensory environment is designed through using Raspberry Pi cameras and sensors to capture required data.
- The data loggers are remotely connected to a computational server to store and process the captured data.
- High dynamic range imagery and image processing techniques are employed to analyze photobiological lighting parameters[2,3,4].
- Data mining and machine learning algorithms are used to analyze occupants' behavior and activity patterns.
- The data is integrated, processed and presented in a virtual reality space.
- The lighting performance is characterized, errors and faults are detected, solutions and strategies are diagnosed, and finally proper commands are issued to adjust indoor lighting to adaptation scenarios[5,6,7,8].

References

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