PORTABLE CYBER-PHYSICAL SYSTEM FOR REAL-TIME DAYLIGHT EVALUATION IN BUILDINGS

Tech ID: 32456 / UC Case 2022-003-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	12,588,123	03/24/2026	2022-003

BRIEF DESCRIPTION

In developed countries, buildings demand a large percentage of a region's energy-generating requirements. This has led to an urgent need for efficient buildings with reduced energy requirements. In office buildings, lighting takes up 20% to 45% of the total energy consumption. Furthermore, the adoption of smart lighting control strategies such as daylight harvesting is shown to reduce lighting energy use by 30% to 50%.

For most closed-loop lighting control systems, the real-time data of the daylight level at areas of interest (e.g., the office workbench) are the most important inputs. Current state-of-the-art solutions use dense arrays of luxmeters (photosensors) to monitor the daylight environment inside buildings. The luxmeters are placed on either workbenches, or ceilings and walls near working areas. Digital cameras are used in controlled laboratory environments and occasionally in common buildings to evaluate glare resulting from excessive daylight. The disadvantage of these sensor-based approaches is that they're expensive to install and commission. Additionally, the sample area of these sensors is limited to either the area of the luxmeters or the view of the cameras. Consequently, many sensors are needed to measure the daylight in a large office space.

To address this situation, researchers at UC Berkeley developed a portable cyber-physical system for real time, daylight evaluation in buildings, agriculture facilities, and solar farms (collectively referred to as "structures").

SUGGESTED USES

- Daylight monitoring in commercial and residential buildings. This system facilitates the collection of data for more effective daylight harvesting. Accordingly, it reduces the energy use of lighting and improves the wellbeing of occupants.
- Daylight monitoring in agricultural facilities such as greenhouses or agrophotovoltaic solar farms. This system facilitates the collection of data to enable real-time estimation of the daylight distribution in the facility. This is important for estimating the growth of the crops and controlling the environment of the facility.
- Daylight monitoring in solar farms, where this system can be used to monitor/track the sun position and estimate the irradiance distribution, providing data for the optimal positioning and orientation of solar panels.
- The parallel luminance sensor component of the system can be used as a cost-effective and practical parallel luminance sensor for Goniophotometer applications.

ADVANTAGES

There are four main advantages of the novel cyber-physical system compared with the prevalent luxmeter photosensor-based daylight evaluation method.

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OTHER INFORMATION

KEYWORDS

Clean tech, Energy efficiency, Lighting, Sensors, Built Environment

CATEGORIZED AS

- **Agriculture & Animal Science**
  - Other
- **Energy**
  - Lighting
  - Other
- **Environment**
  - Other
  - Sensing
- **Sensors & Instrumentation**
  - Environmental Sensors
  - Other
  - Physical Measurement

RELATED CASES

2022-003-0

1) This system does not require sensors to be installed throughout the structure space, thereby reducing the installation and the commissioning costs.

2) The high-definition luminance data the sensor captures enables evaluation of the daylight distribution in the whole structure area, rather than at the spots where the traditional sensors are installed.

3) Without the need to attach luxmeters on the workbench area, it is less intrusive for the occupants.

4) This system can be deployed and redeployed easily because of its small form factor and the ease of conducting simulations instead of recommissioning.

RELATED MATERIALS

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