New ideas in smart lighting

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Light emitting diode (LED) technology has enabled an unprecedented control of the spectral power distribution (SPD) and posed fundamental questions: What is the "best" light for a specific application? And how to make lighting "smart"? Conventional metrics of lighting quality (such as the color rendering index) widely used in hardware stores today are often misleading and clash with subjective perceptions. Statistical measures of light quality are based on the analysis of light rendering using a very large number of color samples [1] allow for a much more accurate assessment of light quality and for tailoring SPDs to specific applications by implementing color rendition engines [2]. Using such color rendition engines revealed important cultural differences in light perception [3]. These smart lighting sources have already found applications in museum lighting (reducing photochemical damage to the art objects and even "restoring" aging paintings and other art objects by light [4]).

Another important smart lighting concept is changing SPD depending on the object being illuminated [5,6]. Two examples are automobile headlights changing from "yellowish" to "bluish" white light depending on oncoming traffic and the flash in the iPhone 5s that varies depending on the skin color.

The effects of light on health have been discussed from ancient times, but the LED technology brings this field to a completely new level. Efforts are now under way to consider and implement "light as a medical device" [7] for reducing hospital stays, alleviating pain, and improving sleep.

And LEDs have been extended beyond the visible spectrum – for example, producing UV light at wavelengths as short as 200 nm – with applications ranging from water purification and controlling hospital-acquired infections to prolonging the produce storage time [8].

The LED market is already oversaturated, but the emerging smart lighting applications are just the tip of the iceberg.

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