

A basic study on Human centric Lighting

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Abstract : Lighting technologies consistently evolving , bringing benefits to commercial products and end-users. These include better energy efficiency, flexibility in how lighting is applied and controlled in the workspace. Lighting technology highly impact on human life At the same time, there is a growing body of research and information available on the impact of lighting on human beings Human centric lighting is the means by which the emotional wellbeing, comfort, health and, indeed, productivity of individuals can be improved simply through the correct control of the lighting in place.

IndexTerms – Human centric lighting, light control, human interaction

I. INTRODUCTION

In the early 1990's, scientists started to study the efficacy of light therapy in the treatment of seasonal affective disorder (SAD). Michael Terman et al (1989) first noted the anti-depressant impact of bright, artificial light on SAD patients. It is clear then that with the reduction in daylight hours during the winter, we are subjected to longer periods of biological darkness for large parts of the day, and with this change in the seasons comes a lack of energy, low mood and irritability.

Melatonin is a hormone found both in plants and in mammals, it is particularly interesting in mammals because it chemically regulates the sleep-wake cycle. The release of melatonin in human blood increases before midnight and has a high value during the night. The melatonin release through the PRGCs is strongly related to the spectrum of the perceived light. By controlling the light spectrum perceived by our body it is therefore possible to actually tune the circadian rhythm with positive effects on human health and wellness.

As humans we are to be active in daylight and rest in the dark, the light that we are active in consist of every colour in the colour spectrum, in the modern world it consist of 16.7 million colours. In dynamic light we use 16.7 million colours to formulate the right lighting program to the specific purpose with focus on avoiding colours, which are disturbing our physiology. Research into the biological effects of light has made it possible to implement new ideas and technologies into the illumination of educational spaces to improve mood, performance, alertness and engagement.

It is possible to use artificial lighting in such a way as to mimic certain properties of natural light. The use of warm white accent lighting that looks like sun beams makes a space feel vibrant as well as being useful to draw attention to items placed on walls such as maps or charts. The illumination of walls and ceilings will help to promote wellbeing by copying the light distribution of daylight outdoors, where light is all around and not only directed downwards, something which can be achieve by using luminaires that emit light in both a direct and indirect manner. Furthermore, the use of different illumination levels and colour temperatures can have a physiological impact on the body, affecting not only the circadian rhythm but also blood pressure, heart rate and temperature. Light direction, colour, contrast and level are central parameters in the creation of psychologically beneficial and influential lighting

II. BASIC CONCEPTS AND IMPORTANT TERMS

LIGHTING CONTROL:

The term lighting control is often used to describe stand-alone control of the lighting within a space. An automated lighting control system is an intelligent network-based solution that incorporates communication between various inputs and outputs with the use of one or more central computing devices. These devices may include relays, occupancy sensors, switches or touchscreens, and signals from other building systems, such as, heating, ventilation and air-conditioning systems. Adjustment of the system occurs both at device locations and at central computer locations via software programs or other interface devices.

Lighting control systems are widely used on both indoor and outdoor lighting of commercial buildings to provide the right amount of light where and when it is needed. This type of system is often used to maximise energy savings and comply with relevant building regulations in specific countries.

LED Light Engine:

The basic idea of the present work is to design a simple, smart tunable white LED solution able to reduce the manufacturing costs and at the same time give a high quality emitted light with a strong variation of the blue emitted spectrum at the different color temperatures. The developed solution is based on a mix of the two state of the art solutions, as a matter of facts its key aspects are related to the use of a single channel power supply and a single PWM signal to change the color temperature without the need of electronic feedback. The LED light engine is also composed by a number of LEDs only 15 % higher with respect to a single color temperature LED system with the same output flux thus further containing the cost of the light engine. The emitted spectra is also achieved by means of color mixing of different wavelengths thus increasing the color rendering index.

With this work we reported that intensity and color temperatures of perceived light have a strong effects on human health and tunable white LED lighting allow the generation of the correct light during the different moments of the day

Color temperature:

Colour temperature is a fairly new, yet important facet of lighting control solutions within buildings. The colour temperature depicts the temperature of an ideal black-body radiator that radiates light of comparable hue to that of the source.

The **color temperature** of a light source is the black body radiator that radiates light of a color comparable to that of the light source. Color temperature is a characteristic that has important applications in lighting, photography, astrophysics and horticulture other fields. In practice, color temperature is meaningful only for light sources that do in fact correspond somewhat closely to the radiation of some black body, i.e., light in a range going from red to orange to yellow to to blueish white; it does not make sense to speak of the color temperature of, e.g., a green or a purple light. Color temperature is conventionally expressed in Kelvin, using the symbol K, a unit of measure for absolute temperature.

Circadian rhythm:

A **circadian rhythm** is a roughly 24 hour cycle in the physiological processes of living beings, including plants, animals, fungi and cyanobacteria. In a strict sense, **circadian rhythms** are endogenously generated, although they can be modulated by external cues such as sunlight and temperature.

Dyanamic Lighting:

Dynamic lighting provides varied light with different parameters such as colour temperature and illumination level. These changes in light parameters can be used to support the natural circadian rhythm, improve performance and alertness as well calm aggressive and restless behaviour.

III. APPLICATIONS

Human centric lighting is used to benefits those in several different applications.

These include Healthcare, Education, Workplaces, Industrial, Retail, Hospitality and Residential.

[1] In healthcare, patients can experience enhanced medicated efficacy, reduced therapy periods and capacity requirements and stimulation by light despite outdoor conditions.

[2] In education, it increases concentration and decreases fatigue. In the work place, it there has been found to be individualised maximisation of concentration and energy, increased employee motivation and commitment, as well as increase in work performance, alertness, and employee satisfaction.

[3] In industrial settings, it helps with biorhythm adjustment for nightshift workers, improved output and error rate of repetitive work steps.

[4]For retail, the increase in awareness levels was most important. Daylight compatible product presentations were possible, as well as staging of Point of Sale products with different colour temperatures and RGB.

Extended daytime in shopping malls was possible, in addition to zoning of shops through different lighting set ups, seasonal lighting stimulation and creating a feel good atmosphere.

These all allow for huge flexibility in changing a retails space's ambiance, without any alterations to the building.

Hospitality buildings saw support for wellbeing of guests, and bedrooms and in dining areas.

This increased value and comfort of these establishments. Similarly to retail, human centric lighting provides flexibility in lighting for different needs, such as transforming a dining room from bright and airy for breakfast, to relax for dinner and the use of colour allows for accentuation of architecture and design, and impact for events.

IV. Pictorial Representation:



V. SUMMARY

The ability to control light colour temperature with predefined rhythms gives interesting and new opportunities to implement lighting designs with high energy efficiency, which can boost the wellbeing of occupants and also provide many benefits when applied in different environments. By ensuring that lighting is human centric, we can enhance a user's day to day mood, wellbeing, productivity and attention levels. As we have seen, these benefits spread across a wide range of applications, from schools and offices, to retail and industrial applications.

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