SUSTAINABLE ADAPTIVE LIGHTING SYSTEM: A SOCIETAL NEED

Divyaraj Singh, Abdul Wahab, Ashish Verma
B. Arch student, Amity School of Architecture and planning ,Lucknow campus, Uttar Pradesh

ABSTRACT

In today's society, electric lighting is a major energy consumer due to the significant demand of huge illumination.Light creates a feeling of emotions. The origin of light is natural light, which is also known as daylight. There must always be space for natural light; even when people design artificial light, they will want it to look like natural light.Light controls people's behaviour and emotions. It can make people even happier. When people design light for space they need to put in position of people working in that space. Light, space and human they effect and work with each other. Space needs light to illuminate; light needs space to receive it, light within the space change human experience.

Architecture needs to use light to create a different order and rhythm change the spatial effect gives different atmosphere.In this Paper our major focus is throwing light on the topic "Adaptive Lightning System" which is also known as "Smart Lighting". If we See Present Scenario of our country we are running towards Energy Efficient Technologies because we all know that someday there will be scarcity of Electricity at which rate we are consuming it. So Light is the major contributor in which, if we focus smartly than we can save lot of energy.

Keywords: *sustainability, Smart lighting system, Architecture, Comfort, Energy*

1. ADAPTIVE LIGHTING SYSTEM

An adaptive lighting system automatically adjusts its light output and operation to provide targeted light levels based on environmental conditions, user schedules, or other application specific criteria. An adaptive system can also often be manually tuned, over time, in terms of light level, and in some cases, colour, to provide optimal lighting conditions as designated by system operators, building owners or occupants. This feature set is accomplished by combining controllable luminaries with lighting controls and communication hardware that are able to interpret changes in the environment and adjust the luminaries accordingly. Therefore this system provides huge electrical energy saving, which is possible by developing energy efficient devices, effective controls and design [1-2].

An adaptive lighting system having a detection unit by which one or more extrinsic variables, that is variables occurring outside the adaptive lighting system, can be detected and can be transmitted, preferably in the form of at least one electric signal, to an evaluation and control unit, to the evaluation and control unit by which a control signal can be generated from the transmitted extrinsic variable(s) and can be transmitted to one or more adaptive light source(s) and to the one or more adaptive light source(s) which is/are designed to vary one or more it its/their emission properties on the basis of the transmitted control signal [3].

An adaptive lighting system can include many different types of products including dimmable lamps and luminaries, occupancy sensors, photocontrols, time clocks, communication panels, and wireless communication nodes.

2. NEED OF ADAPTIVE LIGHTING SYSTEM

Compared with a conventional lighting system, a system where every light has a manual switch or dimmer that you must operate directly , "Intelligent lighting" can be as simple as automating a single light, so that it can be controlled by a remote control device or timer. Proper lighting enhances the beauty of the room, interior spaces and provides illumination for tasks and activities [4-5].

Adaptive Lightning is the good way which enables to minimize and save light by allowing the householder to control remotely cooling and heating, lighting, and the control of appliances. This ability saves energy and provides a level of comfort and convenience. Adaptive Lighting control systems serve to provide the right amount of light where and when it is needed.

Lighting and its control have a major part to play in the 21st century low carbon economy. One fifth of electricity consumption in India is through Lighting. There could not be a more appropriate time to assess current and future demand for lighting and its control in public industrial and commercial buildings. Our Topic objective is to size current and future demand for wireless control in the commercial and industrial lighting industry and analyse why and how, Wireless Lighting Control will converge to create enormous opportunities in smart lighting controls over the next 15 years. At the same time electricity is becoming more expensive while its consumption is getting higher [6].

3. HOW ADAPTIVE LIGHTING SYSTEM IS GOOD FOR BUILDINGS

Forget lighting whose only options are on or off. Several companies are introducing programmable lighting systems that can react to resident movements, adjust themselves to the level of light needed and even mimic different times of the day.

Lighting isn't just about brightness. The latest developments are harnessing the impacts of colour and hue as well. For example, "Amber lighting" can have soothing effects on residents with dementia compared to incandescent or LED lighting.

A clear disadvantage of a conventional lighting system is that it lacks the flexibility for any relocation of light sources, and it requires a great effort to rewire the entire system once it gets big. In a conventional lighting system, a light source can be merely switched on/off manually, while, instead in a smart one, various preset lighting modes are preloaded into the lighting system, either wired or wireless, to meet the user's specific needs a lighting system can be made adaptive, such that the indoor brightness can be maintained at a constant level taking into account the contribution of outdoor sunshine.

Smart lighting contributes major of electrical energy consumption worldwide. People often forget to turn off the light in their house when they go out so the room is lit even when there is no need for it. Sometimes the lights continue to be On until the room is already illuminated by natural light. There is also a problem of the use of excessive amounts of light. So there is need of smart lighting system, that uses the day lighting of the room and an automatic occupancy system to shut-off when nobody in the room. Remote control for home appliances can be operated by a handheld device, such as a smart phone, a tablet, etc.

Saving energy using need-based lighting management in homes and offices: By collecting and identifying real time data about occupants, incident sunlight and light-field sensing, Smart lighting system can optimize the required light output in both day and night. By maximizing light usage in the appropriate places expected energy savings are between 40-70% higher than simply adopting CFL bulbs [7].

(A) SUNLIGHT TRANSPORTATION SYSTEM

An emerging new technology is that of sunlight transportation. Natural sunlight is collected on roof panels and transported into a building via fibre optic cables for distances up to 15 metres. These sunlight-piping systems can be used in combination with solar panels to integrate natural and artificial light systems, so that there is always light in the home.[9].

(B) COMPACT FLUORESCENT LIGHTS (CFL)

These are small versions of full fluorescent lights, and consist of a glass tube coated with phosphor, filled with gas and a small amount of mercury. Electricity jumps off electrodes on the end of each tube, and excites the mercury molecules to emit ultraviolet light. This excites the phosphor coating, which emits visible light that shines out of the tube. CFLs give off the same amount of light as incandescent bulbs, but they are up to 80% cooler, are 4 times more energy efficient (to replace a 60-watt incandescent, you only need a 15-watt CFL), last 10 times longer (up to 20,000 hours), and are responsible for the emission of 70% less carbon dioxide[9].

CFLs come in many different configurations and wattages, and are suitable for all lighting purposes. Although more expensive to buy than a standard bulb, they easily recover their costs in energy savings. On the downside, they contain trace amounts of mercury, which is hazardous to health and the environment. Care needs to be taken to ensure the glass tube doesn't break and that the bulbs are disposed of safely.

(C) LIGHT EMITTING DIODES (LED)

LEDs are small, solid light bulbs that are lit by the movement of electrons in a solid semi-conductor material as electricity is passed through it. This is also called 'solid state lighting', because it uses a solid material, as opposed to gas (CFL) or filament (incandescent). LEDs are extremely energy efficient, lasting over 100 times longer than incandescent bulbs, and up to 10 times longer than CFLs. They have low heat generation, low power requirements, and are highly durable because there is no filament or tube to break.

LED is a relatively new technology, and currently the bulbs are most suitable for track and recessed lighting, where a pointed light is required rather than radiated light. They are more expensive than CFLs, but energy savings over their lifetime means their cost is soon recouped. Because their power inputs are minimal, LEDs are readily combined with solar panels to provide reliable, energy efficient lighting day and night.

4. FEATURES OF ADAPTIVE LIGHTING SYSTEM

4.1 High End Trim

This strategy saves energy by tuning the maximum allowable light level to a lower recommended level and setting this level as the maximum output of the system.

4.2Bi level adaptive lightning system

Bi-level adaptive control is the most commonly used strategy for smart corridors. This strategy utilizes an occupancy sensor to dim the luminaries after the space has been vacant for a set period of time [8]. These sensors automatically turn lights up when an occupant is present in the sensor’s field of view. This strategy can be made more complex with scheduling, allowing for different high and low levels for the lighting during open hours and closed hours.

4.3Daylight Harvesting

Daylight harvesting controls allow the electric lights to scale their output based on the daylight contributions into a space. The electric lights dim or turn off during the day and return to full output only when needed.

4.4 Demand Response

DR is enacted in cooperation with local utilities to trim energy usage during peak hours or periods of critical demand. Some utilities have automated demand response programs that automatically signals advanced control systems to reduce lighting loads to predefined levels.

4.5Dynamic contrast

Dynamic Contrast is the increase in the ratio between anluminance target, such as a display, as compared to the general luminance based on occupancy triggers, which draws occupant attention to the target.

4.6 Dimming

This is a theoretical dimming scheme based on occupant density that could be applied to general luminance levels, such as wall washers. When more occupants are in the store, the overall illumination can slowly be brightened.

5 Occupancy Timeout and Zoning

Most occupancy sensors allow users to select a timeout period, usually between 0 and 30 Minutes, which controls how quickly luminaires are extinguished after the sensor no longer Detects occupants in the space. The length of the timeout period has a direct influence on the energy use of a lighting system. Systems controlled by occupancy sensors with a long timeout period use more energy than those controlled by sensors with short timeout periods. The challenge in a retail environment, however, is to reduce frequent switching, which can negatively impact customers and sales. This is achieved by lengthening the timeout period at the expense of energy savings. To better understand the tradeoffs associated with the use of

occupancy sensors in retail spaces, researchers recorded the occupancy patterns in a typical retail space and applied varied occupancy timeout profiles to the data, resulting in a spectrum of energy use correlated to occupancy sensor timeout period.

6 CONCLUSION

Energy efficient lighting also includes considerations of the control of light and the use of daylight. A sustainable lighting solution includes an intelligent concept, high quality and energy efficient lighting equipment suitable for the application.Lighting is a large and rapidly growing source of energy demand and greenhouse gas emissions. At the same time the savings potential of lighting energy is high even with the current technology, and there are new energy efficient lighting technologies coming on the market.

This paper shows that Adaptive Lighting System is the future of Smart Buildings. In terms of Energy efficiency this system is very much responsive than conventional lighting system, because it helps to save wastage of electricity and also helps to make building more economic. This system provide alternative for sustainable environment for future generation.

7 REFERENCES

- P. Kozodoy, S.P. DenBaars, A.J.Heeger, White light from InGaN/conjugated polymer hybrid light-emitting diodes, Appl. Phys.Lett. 70 (1997) 2664–2666.
- Guillemin, N. Morel, An innovative lighting controller integrated in a self- adaptive building control system, Energy and Building, 33, (2001), 477–487.
- Yin, C., Stark, B., Chen, Y., Zhong, S. M., & Lau, E. Fractional-order adaptive minimum energy cognitive lighting control strategy for the hybrid lighting system. Energy and Buildings, 87, (2015), 176-184.
- Reinhart, A. Fitz, Findings from a survey on the currentuse of daylight simulations in building design,Energy and Building, 38, (2006), 824–835.
- Rosemann, M. Mossman, L. Whitehead, Development of a cost-effective solar illumination system to bring natural light into the building core, Solar Energy, 82, (2008),302–310.
- https://www.control4.com/solutions/smart-lighting
- http://ieeexplore.ieee.org/stamp/stamp.jsp?tp=&arnumber=7116079
- http://www.ledsmagazine.com/articles/iif/print/volume-3/issue-/features/regulations/lighting- control- requirements-will-drive-building-energy-reduction.html.
- http://www.sustainablebuild.co.uk/sustainablelighting.html