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ИНТЕЛЛЕКТУАЛЬНОЕ ОСВЕЩЕНИЕ В ИНДУСТРИИ 4.0

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Интеллектуальное освещение на производстве относится к использованию подключенных и интеллектуальных систем освещения в производственных условиях. Эти системы могут быть использованы для оптимизации уровней освещения и цветов для улучшения видимости, повышения безопасности и повышения производительности. Например, интеллектуальные системы освещения могут использоваться для регулировки уровня освещенности в зависимости от выполняемой задачи, времени суток или присутствия работников. Это может привести к экономии энергии, так как освещение может быть приглушено или выключено, когда в этом нет необходимости. Кроме того, интеллектуальные системы освещения могут быть интегрированы с другими производственными системами, такими как роботы или датчики, для улучшения автоматизации и повышения эффективности. Интеллектуальное освещение также может использоваться для предоставления данных для аналитики, которые могут быть использованы для оптимизации производственных процессов, снижения затрат и повышения общей производительности.

Ключевые слова: умное освещение, Индустрия 4.0, система, датчик, оптимизация, производительность, энергоэффективность.

SMART LIGHTING IN INDUSTRY 4.0

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Smart lighting in production refers to the use of connected and intelligent lighting systems in manufacturing environments. These systems can be used to optimize lighting levels and colors to improve visibility, enhance safety, and increase productivity. For example, smart lighting systems can be used to adjust lighting levels based on the task being performed, the time of day, or the presence of workers. This can result in energy savings, as lights can be dimmed or turned off when not needed. Additionally, smart lighting systems can be integrated with other production systems, such as robots or sensors, to improve automation and increase efficiency. Smart lighting can also be used to provide data for analytics, which can be used to optimize production processes, reduce costs, and improve overall performance.

Keywords: smart lighting, Industry 4.0, system, sensor, optimization, performance, energy efficiency.

Industry 4.0 is the current trend of automation and data exchange in manufacturing technologies, it includes cyber-physical systems, the Internet of things, cloud computing and cognitive computing. Smart lighting in Industry 4.0 refers to the use of connected and intelligent

lighting systems in industrial settings. These systems use sensors, software, and network connectivity to adjust lighting levels and colors based on the needs of the environment and the people in it [1]. This can improve energy efficiency, enhance safety and productivity, and provide data for analytics and automation. Smart lighting can be integrated with these technologies to optimize industrial processes, reduce costs and increase efficiency.

The norm of lighting for a person refers to the recommended levels of lighting that are considered to be appropriate for different types of activities and environments. These standards are established by organizations such as the International Commission on Illumination (CIE) and the American National Standards Institute (ANSI) [1].

For general indoor lighting, the CIE recommends an average illuminance of 300-500 lux for residential spaces and 500-1000 lux for office spaces. For tasks that require high levels of visual acuity, such as reading or working with fine details, the CIE recommends an illuminance of at least 750 lux [2].

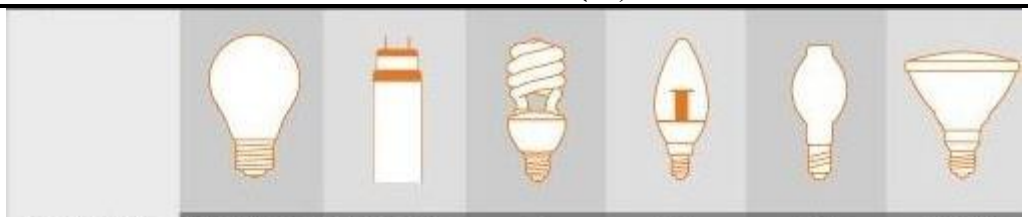
For outdoor lighting, the American Medical Association (AMA) recommends a maximum average maintained illumination level of 5 lux for residential areas and 20 lux for commercial and public areas.

It is important to note that lighting levels should be adapted to the specific needs of the individual and the task at hand. For example, older adults may require higher levels of lighting than younger adults, and people with certain medical conditions, such as age-related macular degeneration, may require even more light to see clearly.

In addition to the quantity of light, the quality of light is also important for human well-being. Some studies shows that certain types of lighting, such as cool white or blue-enriched white light, can disrupt natural circadian rhythms and lead to sleep disorders, while warm white light or natural light can promote better sleep and reduce eye strain.

Smart lighting refers to the use of connected and intelligent lighting systems that can be controlled and monitored through a network connection, such as through a smartphone app or a central control system. These systems can automatically adjust lighting levels and colors based on various factors, such as time of day, occupancy, and ambient light levels. Smart lighting systems can also be integrated with other smart home devices, such as voice assistants, for hands-free control. They can also be integrated with building automation systems to improve energy efficiency and provide data for analytics. Smart lighting can be used in various settings, such as homes, offices, industrial environments, and public spaces [3].

LEDs (light-emitting diodes) are widely considered to be the future of lighting technology due to their many advantages over traditional lighting sources. LEDs are much more energy efficient than incandescent and fluorescent bulbs, they last much longer, and they produce less heat. They also come in a wide range of colors and can be easily controlled and dimmed. Figure 1 shows a comparative table of different types of light bulbs.



FEATURES	Incandescent	Fluorescent	CFL	HID	LED	Halogen
Rated Avg. Life	750-1000	20,000	10,000	20,000	45,000	3,000
Life Span	Low	Long	Long	Long	Very Long	Medium
Watts	3 – 500	4 – 215	3 – 120	35 – 1500	2.5 – 16	5 – 500
Cost to Operate	High	Low	Low	Lowest	Low	Medium
Price of Product	Low	Medium	Medium	High	High	Medium
Lumens per Watt (LPW)	15	60 – 100	60	Up to 120	45	25
Color Temperature (in Kelvin)	2700K	3000K – 6500K	2700K – 6500K	1700K – 6500K	2700K – 6500K	3000K

Figure 1 – Comparison of lamp types

In the future, LEDs are expected to become even more efficient and versatile. Advances in materials science and semiconductor technology are expected to lead to the development of new types of LEDs with even higher efficiencies and lower costs. Additionally, the integration of LEDs with the Internet of Things (IoT) and other smart technologies will make it possible to control and monitor lighting remotely, and to use lighting to gather data for analytics and automation [4-5].

LEDs are already being used in various applications such as automotive, street lighting, general lighting, and backlighting for displays, as well as in many other areas where energy efficiency, long life, and color flexibility are important. With their continued development and increased adoption, LEDs are expected to play an increasingly important role in reducing energy consumption and improving the quality of lighting in homes, offices, and industrial environments.

The quality of lighting is important in production for several reasons:

1. Visibility: Good lighting is essential for ensuring that workers can see what they are doing and perform their tasks safely and accurately. Poor lighting can lead to eye strain, headaches, and mistakes, which can slow down production and increase the risk of accidents.
2. Productivity: Adequate lighting can help to improve worker productivity by reducing the need to stop and adjust to changing light conditions. This can help to minimize downtime and increase the speed and efficiency of production.
3. Safety: Good lighting can help to improve worker safety by reducing the risk of accidents and injuries. This is particularly important in industrial environments, where workers may be exposed to hazardous materials or machinery.
4. Color rendering: Quality of lighting also affects the color rendering of the objects, it can have a significant impact on the perception of color, which can be critical in industries where color accuracy is important, such as printing, textiles, and automotive.

5. Maintenance and cost: Poor lighting can also increase maintenance costs and the need to replace bulbs and fixtures more frequently. Smart lighting systems with sensors and software can help to optimize lighting levels, reduce energy consumption and minimize maintenance costs.

Overall, providing quality lighting in production environments can help to improve worker well-being, enhance productivity, reduce costs and improve the overall quality of the final product.

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