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**How Human-Centric
Lighting Systems are
Revolutionizing Roadway
Safety and Sustainability.**



Summary

Human-centric technology has gained popularity as our world becomes increasingly dependent on AI technology, and for good reason. Human-centric technology can significantly improve the entire driving experience and effectively reduce the probability of accidents in the context of road safety. With its cutting-edge technology that prioritizes human needs, LEOTEK, a leading producer of electronic and optoelectronic components, has been at the forefront of this change for years.

In this white paper, we will explore human-centric lighting technology and its impact on roadway safety. We will also discuss how intelligent lighting solutions can help reduce accidents, enhance driver visibility, and provide a more comfortable driving experience, making the roads safer for everyone.



Challenges - Clearing the Way to Improved Roadway Safety

Both transportation authorities and motorists place a high importance on road safety. A greater demand is being seen for human-centric LED road lighting systems that prioritize well-being and safety as technology develops. While LED lighting offers numerous benefits, such as durability and energy efficiency, it also has some issues that need to be addressed in order to improve traffic safety.

One of the main challenges for LED lighting is glare, which can make driving exhausting, distracting, and even painful. Long hours of nighttime driving can be particularly problematic, as sudden bursts of brightness from street lights can be irritating and unsafe. The development of a model by a team of researchers from China and the Netherlands has highlighted the need to update the ways we characterize discomfort glare caused by LED road lights.[1]



In addition to glare, road surfaces may become slippery when it rains, causing the road reflectance model to differ from the design conditions. Moreover, fog scatters light, causing the projected light beam from the lighting fixture to change in distance and direction. This results in a decrease in road brightness uniformity and further affects drivers' safety. Human-centric LED road lighting systems can solve this problem by detecting the brightness of 20 points on the road surface. The control center receives the data and dynamically adjusts the street light beam distribution after calculation and determination. This efficient detection process and secure automation will provide energy-efficient and comfortable roadway lighting, improve driver safety, keep traffic flow smooth, and reduce environmental impact.

References

Improving Driver Safety: How to Prevent Streetlight Glare in the New World of LED Lighting - July 18, 2014, https://www.optica.org/en-us/about/newsroom/news_releases/2014/improving_driver_safety_how_to_prevent_streetlight/

A Closer Look - How Human-Centric LED Street Lighting Systems are Revolutionizing Cities

Human-centric LED street lighting systems are changing the way we light our cities. These innovative lighting systems are designed to provide the right amount of light at the right time, based on the needs of the people who use the space.

One of the key benefits of human-centric LED street lighting systems is that they can be programmed to adjust the color and intensity of the light based on the time of day and the needs of the people in the area, reducing glare problems. For example, the lighting can be dimmed during the late evening and early morning hours when there are fewer people on the streets, and brightened during peak hours to improve visibility and safety.

Another benefit of human-centric LED street lighting systems is that they are energy-efficient and eco-friendly. They use less energy than traditional lighting systems, which can help to reduce energy costs and lower carbon emissions.

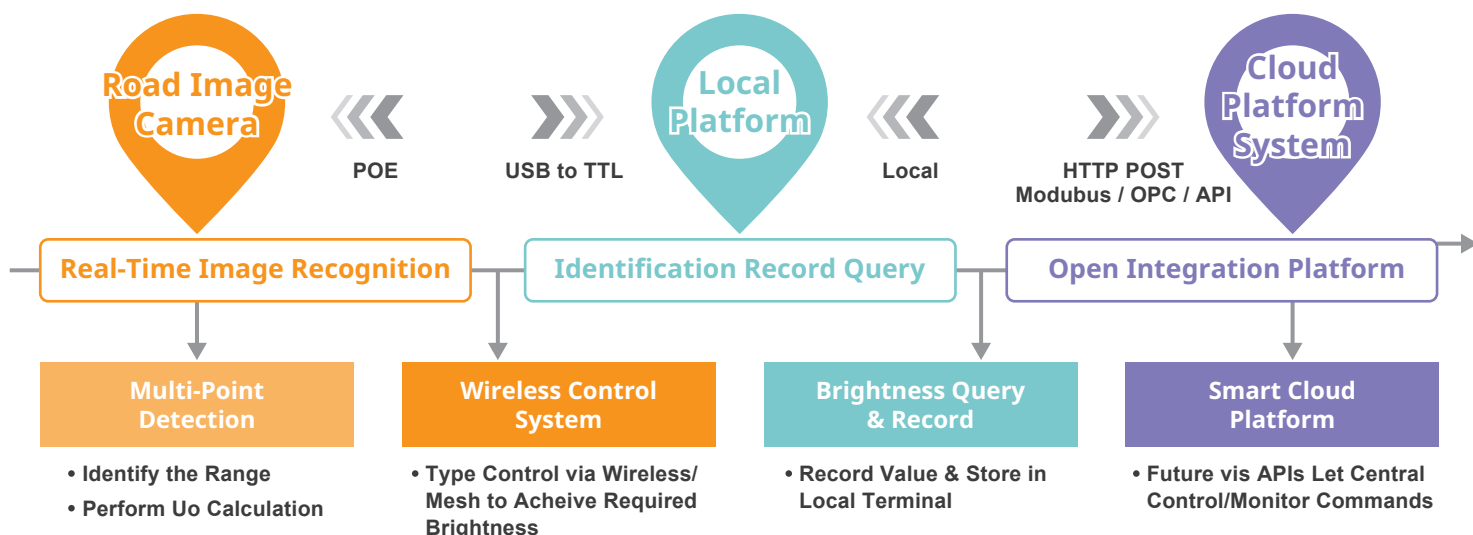
Moving from Traditional Street Lighting to Intelligence LED Street Lighting System

The perfect trio of hardware, software and services

The technology behind human-centric LED street lighting systems utilizes an image recognition system and a fuzzy control algorithm to capture photos of the road surface and analyze them for the best light distribution and intensity. The LED street lights then wirelessly receive the calculated control signals and modify the distribution and intensity of their light as necessary. This process creates energy-efficient and pleasant road illumination that enhances driver safety and maintains traffic flow.



Comparison between human-centric lighting systems and normal street lights on a rainy day.



Improving Roadway Safety Risk Mitigation

While we understand that glare can be caused by a variety of factors, including bright sunlight, oncoming headlights, and poorly designed lighting systems, human-centric LED street lighting systems can effectively maintain good roadway brightness uniformity on different road surfaces by changing the photometric distribution. In fact, the system has been shown to perform better than the minimum specification of 40% on dry roads, achieving up to 60% uniformity, compared to traditional non-adjustable street lighting fixtures. Even on wet and slippery roads, where non-adjustable street lighting fixtures typically achieve only 25% uniformity, human-centric LED street lighting systems meet the regulatory standard of 40%.

	LEOTEK Intelligent LED Street light (New)	Existing LED Street lights
Photometric Distribution	Dynamic Adjustment*	Stationary
Overall luminance uniformity on the dry pavement (min/Avg.%)	60%*	40%
Overall luminance uniformity on the wet pavement (min/Avg.%)	40%*	25%
Monitoring road surface & collect data	Yes*	No

*Based on data collected by the LEOTEK Research and Development Center

Choose the Right Solution - Key Features That Human-centric LED Street Lighting Systems Must Have

For cities wishing to install smart street lighting systems, human-centric LED street light systems must meet the following criteria :



1

Remote Management

The system's sophisticated control system must allow for remote control and monitoring of streetlights, eliminating the need for manual intervention. Through this, administrators can centrally control light brightness and distribution couple with color temperature switching.



2

Energy-Saving

It must use highly energy-efficient LED technology, consuming less electricity than conventional street lights. This helps communities reduce their carbon footprint while saving on electricity costs.



3

Context Awareness

Based on traffic and pedestrian activity, the system must be able to alter streetlight brightness in real-time to maintain well-lit, secure streets while using less energy.



4

Easy to Install

It must be able to be retrofitted into existing streetlight infrastructure and designed to be easy to install. This means communities are easily able to replace their street lighting system without extensive construction work.



5

Flexible Expansion

In the future, it may have several environmental sensors built in that can gauge the temperature, humidity, and air quality. These data points can be used by city officials to make data-driven decisions about urban development and environmental management.



The Future of Sustainable Cities - The Benefit of Human-centric Street Lighting on the Environment

Additionally, human-centric LED street lighting systems have a longer lifespan than traditional street lighting systems, which reduces waste and the need for frequent replacements. LED lights can last up to 50,000 hours or more, which is several times longer than conventional street lighting options. The longer lifespan means fewer materials are needed for replacements and fewer old lighting fixtures end up in landfills, reducing environmental impact.

Furthermore, LED lights contain no hazardous chemicals or materials, such as mercury or lead, making them safer to handle and dispose of. This is important for both the environment and human health, as hazardous materials can harm both living organisms and natural resources.

Overall, human-centric LED street lighting systems provide a sustainable and environmentally friendly lighting solution for cities and communities, reducing energy consumption, carbon emissions, and waste while preserving wildlife habitats and natural resources.

How Human-Centric Lighting Technology Can Benefit to Different Scenarios

Residential areas, commercial areas, industrial parks, and roadways are just a few of the urban and rural environments where the human-centric street lighting system is intended for use.

Residential Areas : Due to its extensive control capabilities, the system is ideal for residential spaces where lighting requirements alter throughout the day. The system may modify the light intensity and color temperature to match the time of day and the specific lighting requirements of the location.

Commercial Areas : Commercial areas can be made more pleasant and secure for drivers and pedestrians by installing a human-centric LED street lighting system that can react to movement and modify the light intensity and distribution based on traffic.

Industrial Parks : Human-centric LED street lighting systems can improve visibility for employees and visitors in industrial parks where safety and security are top priorities. Smart sensors in the system can detect motion and adjust the lighting as needed to make the area safer.

Roadways : Human-centric LED street lighting systems reduce ground reflection glare while ensuring safe driving conditions on roadways. These systems can be configured to adjust illumination settings based on traffic volume and environmental factors, ensuring that drivers always have optimal visibility.

In addition to these applications, human-centric LED street lighting systems can also be used in parking lots, parks, and sporting venues. Its advanced control features make it a flexible and efficient lighting solution for a variety of applications.



Conclusion

Our urban communities are facing various challenges, but there is hope with the introduction of human-centric technology. By implementing smart street lighting systems, we can increase the comfort, safety, and longevity of our cities. These systems provide benefits such as real-time monitoring, energy efficiency, and adjustable brightness, making them an excellent replacement for traditional lighting setups. In conclusion, institutions should consider employing such technology to enhance the functionality of our transportation spaces. Investment in new techniques, such as technology that prioritizes the driver and pedestrian experience, can result in better-collected data, better use of resources, and an overall improvement in our environment. Sustainable communities that can successfully endure future challenges should be our goal, and utilizing these technologies must be a main priority.

About LEOTEK

LEOTEK Corporation is the global leading manufacturer that develops both traffic and streetlights. Starting in North America under the brand of "LEOTEK" in 1992, it is deeply involved in the markets of the USA, Taiwan, Europe, America, New Zealand, Australia, and the Middle East. The products of LEOTEK have been adopted in government public work by more than 30 countries around the world, with over 3 million shipments globally and it has become the leading supplier of intelligent street and traffic lights in the world.

The portfolio of LEOTEK includes

1. Outdoor Lighting & Signaling – Street lighting & Traffic Signals
2. Ecofriendly Lighting – Human – Centric Smart Lighting & Nature Friendly Lighting
3. Smart lighting Solution – Smart streetlighting controller
4. Roadway Intelligence solution - IoT - enabled Lighting Solution, Intelligent Traffic Solution, Central Management System (CMS)

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