ISA
International SSL Alliance

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ISA
International SSL Alliance

Solid state lighting (SSL) after decades of development has gradually reached a mature stage in terms of performence such as light quality, luminous efficiency, reliability and intelligent feature. SSL products, services and system solutions have been widely used in most parts of the world.

With the in-depth research and development and the continuous innovation of manufacturing technology, the SSL's non-visual functions are also being rapidly explored. Various innovations and applications of "beyond lighting" are entering many aspects of society and life. SSL has been showing its tremendous application potential and R&D depth in agriculture, health, communications, high-definition display, polymer curing, disease vector control, high value-added application integration and so on. Integrated innovation and interdisciplinary innovations based on SSL technology have yielded a steady stream of achievements, marking a new stage of SSL development.

Innovation drives development, which in turn fosters innovation. From the advent of the first GaN-based blue LED in 1978 to the commercial manufacturing of the first high-brightness blue LED in 1993, and the commercial manufacturing of blue and green LEDs with InGaN quantum well (QW) structures, SSL has gone from laboratory to industrialization in merely fifteen years as well as from manufacturers to thousands of households, all are the result of innovation.

The ISA twelfth Executive Member Meeting decided to establish the "Global SSL Award of Innovations Top 100", and start the selection from the year of 2021. The award aims to encourage and inspire the global SSL industry to persist the spirit of innovation in the new era to make new discoveries, explore more unknown areas, and create more applications in the field of "beyond lighting", to benefit mankind with more SSL miracle. This is the purpose and ultimate goal of this award.

Jianlin Cao

Jianlin Cao
President of ISA

International SSL Alliance

ISA Introduction

ISA is a non-for-profit international organization consists of regional alliances, association/society, leading companies and renowned universities in global Solid State Lighting (SSL) field.

The Business of ISA members have covered the whole SSL value chain of upstream, middle stream and downstream of global SSL industry such as epitaxy, packaging application, materials and equipment, design system integration and testing etc.

The currently ISA 75 members, representing more than 4000 individuals & organizations includes major players (such as Signify, Osram, Smsung, GE Lighting, Cree, Veeco, AIXTRON etc.). The output of which covers more than 70% that of global SSL industry.

The ISA Board of Advisers consists of leading experts and academic "Founder" level experts, such as the inventors of blue LED, yellow LED, Red LED, and OLED. Amongst Professor Shuji Nakamura, the Laureate of Nobel Prize in Physics in 2014, is the Co-Chair of ISA Board of Advisors (BOA) and Professor Hiroshi Amano, the Laureate of the Nobel Prize in Physics in 2014 is the member of ISA BOA.

The major works of ISA are: provide services to promote the development and application of global SSL, standardization, annually Global SSL Industry Report, annually SSL Awards, promote international, national and regional cooperation on SSL, etc.

The Mission of ISA

Cooperation with the global resources and efforts, ISA looks forward to fostering a more appropriate "eco-system" for the health development of the global SSL and its application. Echo the needs of the society with more added value services to ISA members. Strive to improve people's living and contribute a sustainable human society.

Global SSL Award of Innovations Top 100

Every year, according to the applications we received from all over the world, a certain number of SSL innovations projects will be selected as the winners of the "Global SSL Award of Innovations Top 100", which are judged by international authoritative experts. And medals, certificates and brochures will be given to encourage and praise.

Mission

To promote and stimulate the sustainable development of the global solid state lighting (SSL) industry, demonstrate the application and the innovation of the technology of SSL in the field of "beyond lighting", and push forward the global SSL into a new stage of development.

The Scope of the Application

The applications must be the technological innovation, product innovation or integration innovation etc. related to the SSL technology in the field of beyond lighting.

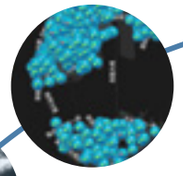
Include but not limited to the following areas:

1. Smart Lighting
2. Mini/Micro LED
3. Health Lighting
4. Visible Light Communication (LiFi)
5. Agriculture Lighting
6. UV-Curing
7. Others (Please specify)

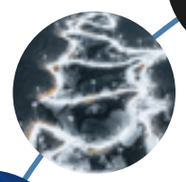
Criteria for Selection

The application (s) should be innovative in the country, region or the world, and the technology (ies) or product (s) should reach a certain advanced level, and solve some key problems in practical application.

01
SYMPHO®Street Smart Street Central Management System



02
Broadcast Lighting of Beijing 2022 Olympic Winter Games National Biathlon Centre Competition



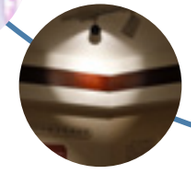
03
Multimedia Smart Lighting Fusion Technology

04
Broadcast Lighting of Beijing 2022 Olympic Winter Games National Ski Jumping Centre Competition

05
Integrated Innovation Technology for Urban Rail Transit Light Environment Fusion

06
The Antarctic Health Cabin

07
Thailand/USA/Canada – Innovative Horticulture Gardening Solutions for North American Market



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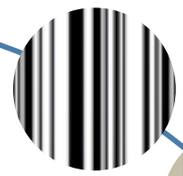
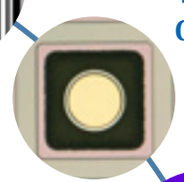
A Novel and Practical Optical Camera Communication System

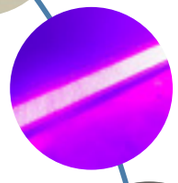
09
A Synchronization Method for Optical Camera Communication



10
GaN-on-Si Mini LED Blue & Green Chip



11
UV-A Curing Light Source Based on GaN-on-Silicon LEDs



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Immune Architecture Innovation Project Based on Deep Ultraviolet LED Disinfection Technology

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Metasight Solution

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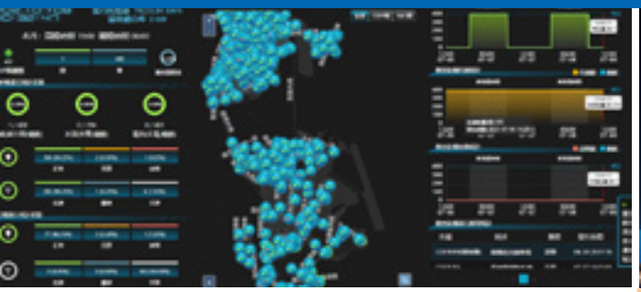
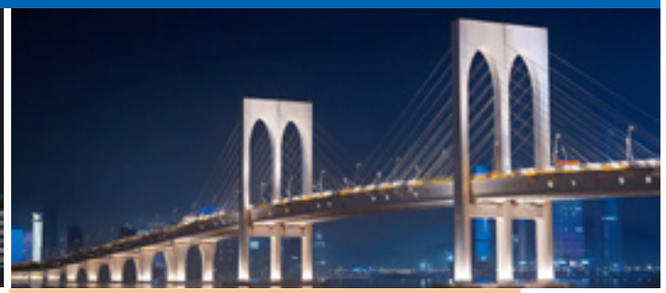
A Kind of Planar Emitting Lens for Tunnel Lamps

01

SYMPHO®Street Smart Street Central Management System





Traxon Lighting Company Limited

Brief Introduction

At present, smart city applications have been landed worldwide. Smart street lighting, comprising of the grid, electricity and pole, is the most important part of a smart city and the most effective way to its realization. Smart street lighting also provides the best location for the 5G ultra-dense network stations. Therefore, we launched the SYMPHO®Street Smart Street Central Management System, a city-level street solution featuring high compatibility, high efficiency and high return on investment.

Compatible with a variety of communication protocols, the SYMPHO®Street Smart Street Central Management System uses the network for the control, monitoring, analysis and feedback of the urban road lighting, forming an efficient road management network. Four standard versions of the system are made available to cater for project needs of different scales (supercity or city-cluster, big city, small and medium city, and small town). SYMPHO®Street consists of a central management platform, zone controller (ZC) and smart lighting controller (SLC).

System features:

1. GIS-based service: The system presents the distribution of city streetlighting control cabinets, smart lighting controller and street light pole in the form of various map layers and connects them by topology; the system also displays the street light operating data and status in the form of a map (basic map mode, terrain mode, satellite aerial model, etc.);

2. The system provides the administrator with a real-time urban management overview, displaying the current operating status and essential statistics of all streetlights on a general chart;

3. A multi-scheme lighting management flexibly controls road lighting according to different external conditions (such as weather, events, etc.);

4. The system monitors each individual light, automatically calculates overall lighting rate and delivers dynamic analysis based on different classifications, which provides quantitative analytical reference for other operating maintenance management.

Based on the international standard system framework structure, SYMPHO®Street Smart Street Central Management System can flexibly adapt to various streetlighting application demands. Besides, the system allows for software customization according to different project needs. With a predictive analysis of streetlighting performance, the system enables a target-specific report and timely alarm upon system fault and change. With outstanding asset management capability, it equipped municipal personnel with a comprehensive understanding of streetlighting status and data to enhance city management. At present, the SYMPHO®Street Smart Street Central Management System has been applied to the urban public lighting of Macao SAR, China.

The Innovation Points

At present, the SYMPHO®Street Smart Street Management System has been applied to the urban public lighting of Macao SAR, displaying outstanding compatibility, reliability and energy conservation. Amid the harsh conditions of high temperature, humidity or even typhoons in south China's coastal area, the system maintains a steady and sound operation. By alignment with new and old streetlights of over five brands such as OSRAM and Phillips, the system eliminates the necessity of light fixture replacement and saves project cost tremendously. Besides, the system has differentiated lights by operating period and brightness to achieve “lighting on demand”. For example, it divides nighttime into busy (before midnight) and non-busy hours (after midnight as there will be fewer vehicles and pedestrians) and reduces brightness or turns off every other light to make a balance between traffic illumination and energy conservation. Overall the system effectively saves energy by nearly 40%. And below are its innovative points:

Highly flexible, best fitting different projects: the strongest wish of almost all project owners is to reduce waste and achieve excellent return on investment. In response to this, the SYMPHO®Street Smart Street Central Management System offers four standard versions and a variety of standard or customized technological schemes, with a setup on the international standard system framework structure to adapt to varied streetlighting applications, catering for owners’ varied needs and budget plans, cutting on unnecessary features, and thusly reducing project costs effectively.

Highly reliable, providing professional predictive analysis: the municipal administration is liable for the city operating cost, and thus reducing financial expenditure by saving energy and electricity of urban lighting will be a serious concern. The SYMPHO®Street Smart Street Central Management System can predict and analyze energy consumption and generate professional energy conservation report, which will be of great use for urban management. It can also perform active system fault and change alarm and is highly reliable to ensure nighttime road safety.

Enhance municipal service and improve urban life quality: to improve people's lives is the ultimate goal of urban management. The system is primarily designed to be an effective communication channel between the government and urban dwellers. Built on a framework deployment, the SYMPHO®Street system collects data via the zone controllers and smart lighting controller at the front end to enable analysis and informed decisions at the central control room (back end), and then execution instructions will be sent to the front end to establish a two-way "end-to-end" communication.

The system function includes various modules, including circuit monitoring, sensor monitoring, IoT device monitoring, platform messaging, SMS and Email etc. It gives the urban administrator a straightforward overview on road lighting to greatly facilitate management and cut down on operation cost. Through data acquisition and messaging function, the system offers other valuable information (such as road condition, weather, etc.) and serves as an effective channel to interact with city dwellers (via SMS, Email and streetlight pole LED displays etc.) so that the government can provide more attentive services to the people.

The system has now been integrated to the smart city infrastructure of Macao, which fully proves its practicality. It has also been adopted for several other ongoing projects in cities around Asia, helping to facilitate the use of SSL related technologies in smart city projects across Asia Pacific and the whole world.

Possible Economic and Social Benefits

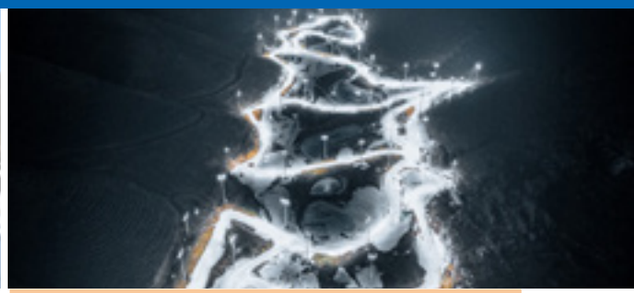
Save municipal expenditure and improve social efficiency: Traffic congestion and safety are ongoing issues to be addressed in the modern urban development. It's urgently expected to upgrade traffic management and road operation with intelligent solutions. The SYMPHO®Street Smart Street Central Management System can: (1) enable two-way "end-to-end" communication for better urban management (e.g. traffic management control, power distribution, etc.), reduced public system operating expenditure, and more attentive public services from the government; (2) provide real-time monitoring on each operating unit to ensure timely fault alarm, impeccable urban road transportation illumination (visibility) and driving safety.

Reduce crime and help safeguard personal safety and property: According to statistics in China and oversea bureaus (including New York, London), improved lighting conditions can help curb crime at nighttime. Therefore, an extensive, sufficient and stable urban lighting is indispensable to personal safety and property. The SYMPHO®Street system can provide support for projects of varied sizes from supercities to small towns. It interconnects and monitors each light circuit and provides instant alarm upon malfunction to ensure timely repair, reducing unlit corners where crime tends to occur.

The system has been applied to the public lighting of Macao SAR, China. It withstands the trial of typhoon and high temperature and demonstrates robustness and stability. The system's use in Macao fully proves its practicality. It has also been adopted for several other ongoing projects in cities around Asia, helping to facilitate the use of SSL related technologies in smart city projects across Asia Pacific and the whole world.

02

Broadcast Lighting of Beijing 2022 Olympic Winter Games National Biathlon Centre Competition



Beijing New Space Technology Co., Ltd.
Signify (China) Investment Co., Ltd.

Brief Introduction

The National Biathlon Centre of Beijing 2022 Olympic Winter Games and Paralympic Winter Games is located in the Guyangshu Competition Area of Chongli District, Zhangjiakou City, Hebei Province, about 220km away from Beijing.

The Biathlon covers a total of 139 hectares. There are three different tracks, including the race track in the middle, the training track in the east and the race track for the Paralympic Winter Games in the north valley. The race track lengths are: 1.5km, 2km, 2.5km, 3km, 3.5km, 4km respectively. The length of the training track is 2km.

The race tracks lengths of Paralympic Winter Games are 1km and 1.3km respectively, with widths of 6-9 meters. The scope of this project is to design and build the lighting system for the race track area of the competition venue, and to provide guarantees for competitions and high-definition TV broadcastings.

Designs and implementations:

1. Based on the site conditions, the basic requirements of biathlon and the basic requirements of lighting and TV broadcasting of Beijing Olympic Winter Games, this project provides suggestions for the preliminary design scheme of sports lighting, including the arrangement of lamp poles, the power and quantity of luminaires, and the illumination estimation at the position of basic relay cameras, etc.

2. Based on the detailed technical requirements of sports lighting and TV broadcasting of the Winter Olympics put forward by the Owner, the General Contractor, the Design Institute, the International Ski Federation and the International Olympic Broadcasting Service (OBS), this project provides the detailed design scheme of the venue lighting and the detailed construction drawings, which are verified and confirmed by the lighting experts of OCOG and OBS, and the lighting design scheme meeting the requirements of biathlon and ultra-high definition TV broadcasting is completed.

3. Based on the approved detailed scheme and drawings, this project completes the procurement, installation, commissioning and trial operation of lighting system, and at the same time coordinates and solves the installation conflicts with other specialties. This project is subject to the inspection and inspection of the lighting project by International Ski Federation, OCOG, OBS and other departments to confirm that it meets the use requirements.

4. Based on the adjustments of track layout and facilities in the course of site construction, this project adjusts the lighting design scheme and implementation scheme synchronously, and implements the debugging of lighting fixtures and systems in the whole site again.

5. Based on the running situation and streamline fine-tuning of the biathlon test competition, including partial debugging and adjustment for new demands, this project can better meet the lighting effect of the venue during the 2022 Olympic Winter Games, and provide guarantee for the effect of ultra-high definition TV broadcast.

6. Guarantee of venue lighting effect and ultra-high definition TV broadcast effect during the 2022 Olympic Winter Games and Paralympic Winter Games.

The lighting of the competition venue of the National Biathlon Centre is the largest project in the current Olympic competition venues. The number of lighting fixtures, the number of lighting control equipment and the project implementation period are unprecedented, creating the largest sports lighting in China.

The Innovation Points

This project is almost one of the most complex terrain and largest area in the world's venue lighting design. For the rationality of the project, the arrangement position of luminaires and camera position are adapted to local conditions from an innovative point of view.

1. Considering the influence of the lamp pole in the camera field of vision, adaptive adjustments are made in the open space and at the intersection of multiple tracks. When two snow trails are adjacent and parallel, the lamp pole is shared for lighting.

2. In order to meet the demands of broadcast cameras and athletes in the light environment to the greatest extent, and to reduce and avoid the abrupt appearance of tower equipment in the broadcast line of sight, the effect is strictly controlled from the aspects of tower positioning, illuminance, uniformity, glare control, color temperature, stroboscopic ratio, color rendering index, etc., so as to meet the requirements of OBS, OCOG, International Ski Federation and other event organizations, and achieve the best broadcast effect.

3. In terms of luminaire projection angle control, natural conditions such as mountains and buildings are fully used to control the stray light.

4. In terms of system stability, the mature system architecture is selected for the intelligent lighting control system. When transmitting in a long distance, it uses optical fiber transmission, and always pays attention to the low-temperature working performance of components.

5. In terms of control capability, the lighting terminal branch switch and DMX512 dimming are combined into a control system to improve convenience and reduce misoperation rate. In terms of expanding capacity, ports are opened to create convenience for the long-term use of the venue after the Games.

6. The illumination calculation method is innovated, the lamp pole position and the aiming point of the luminaires are determined according to the topography, camera position, athletes' route and direction, etc., a calculation model is established by using professional software, different requirements of the track for lighting are fully considered, the horizontal illumination, vertical illumination, uniformity, gradient and glare of all cameras are designed and calculated synchronously, and the reflected flare on the snow surface is verified, various parameters are adjusted constantly to meet all requirements, and then relevant parameters output to import drawings to verify the installation conditions.

7. With the concept of sustainable development, the post-game operation was considered at the beginning of designng sports lighting, and all the games-time luminaires were used after the competetion. The lighting effects of different scenes can be achieved through the combination of switch and dimming of intelligent control system.

Luminaires:

1. LED luminaires used are all customized for sports events, with long service life, energy saving and environmental protection. The luminaires strictly meet the requirements of broadcast lighting from various technical parameters such as color temperature, color rendering index, stroboscopic ratio, etc.

2. The luminaires are equipped with horizontal angle and vertical angle dials with memory devices, and are also equipped with professional aiming devices to ensure that the luminaires can be restored to the original set

projection angle after maintenance.

3. The driver and the luminaire are installed separately and integrally, and it is selected according to the actual installation conditions on site, which has a higher flexibility in the installation and application process.
4. Using DMX512 dimming, with dimming range of 5%~100%

Control system:
1. The optical fiber ring network communication is established based on the Ethernet network. The power supply control of luminaires and the dimming control of luminaires DMX512 are set at the distribution box end. The power supply controller subsystem completes the mode switching of wrong start-up and maintenance period, and the dimming system completes the mode switching of broadcasting, competition, training and entertainment after the game.

2. The core layer of the control platform connects the server equipped with general control software, DMX master controller, protocol converter, touch control screen and Ethernet gateway and other functional modules through the Ethernet network, and realizes mutual communication. DMX512 main controller realizes on/off/dimming control and feedback signal acquisition of DMX luminaires through mainstream protocols such as ArtNet, and after conversion by DMX512 protocol converter, the smallest unit of control is a lamp.

3. The control platform is equipped with centralized setting and adjustment functions, and preset multiple sets of scene schemes of dynamic light effects, which can be opened with one click according to the competition requirements during the game; After the game, the managers can switch the different dynamic lighting effects automatically or manually. It can perform lighting deduction and basic lighting at any time and can achieve real-time linkage.

4. The illuminance of the venue lighting system can achieve the lowest to the highest level and can be continuously dimmable, and it has the performance mode of the stadium light show, which can meet the sports display function of the stadium during major events. Moreover, it can meet the different illuminance requirements of different levels of events by dimming, and different modes can be switched with one click. It has multi-level manual control function to meet the requirements of luminaire maintenance and equipment maintenance, and can be operated in the control room;

5. The lighting control mode is intelligent control, which is controlled by physical keys combined with touch screen; Intelligent control panel: Programmable logic, with functions of individual control, group control and mode scene control, remote control function and status display, and the panel with password and authority to prevent random and wrong press.

6. The lighting circuit of the site has the functions of monitoring the state of the lamp circuit and the cumulative time of lamp use.

7. The control system has an external control interface, which can be connected to the console to realize the light show.

Possible Economic and Social Benefits

The Olympic Winter Games is a large-scale sports' event in the world. With the epidemic raging all over the world, this project actively cooperates with epidemic prevention measures, and responds to the green goal of “striving for carbon neutrality” during construction, so as to achieve environmental protection.

On the one hand, this project, as the first world-class biathlon broadcast lighting project in China, makes up for the blank of broadcast lighting of such sports events in China, and provides solutions to related problems for the future design and implementation of similar projects, accumulating valuable experience in the process of project implementation.

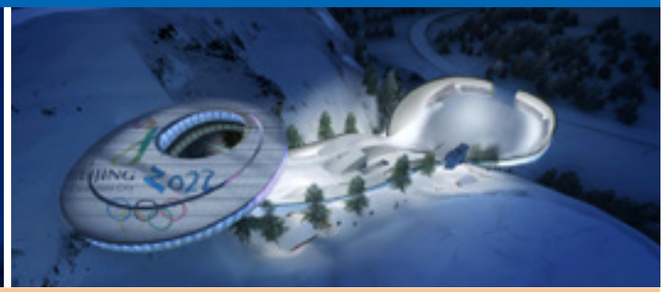
On the other hand, with the concept of sustainable development, the post-game operation was considered at the beginning of the design of this project, and all the games-time luminaires were used after the game. The lighting effects of different scenes can be achieved through the combination of on-off and dimming of the intelligent control system, which provides a foundation for the sustainable operation of the venue.

A world of ice and snow is like a mountain with golden and silver. Beijing Olympic Winter Games has activated China's ice and snow economy, making ice and snow not only a sport, but also a modern industry.

Looking forward, even in the future post-Winter Olympics era, the "Winter Olympics Economic Effect" brought by the Beijing Olympic Winter Games will continue and create more value.

03

Multimedia Smart Lighting Fusion Technology



HES Technology Group Co., Ltd.

Beijing HES Smart Metro-Region Technology Co., Ltd.

Brief Introduction

With the rapid development of China's economy and the deepening of international communication and cooperation, more and more large-scale sports events are being launched. HES Technology Group Co., Ltd. has been deeply engaged in the field of lighting technology over the years, and has always been committed to assisting the construction of Sports Powerful Nation, promoting the development of China's sports industry, and promoting the prosperity of China's sports culture. The company has successively built outstanding luminal art projects at National Olympic Sports Center, Tianjin Olympic Sports Center, Xi'an Olympic Sports Center, Zhengzhou Olympic Sports Center, Wuhan Sports Center, National Ski Jumping Centre "Snow Ruyi", National Sliding Centre "Snow Youlong", Big Air Shougang "Snow Flying Ribbon" and many other national sports venues.

The multimedia smart lighting fusion technology in the project mainly includes stereo projection fusion technology, control system fusion technology and multimedia synchronous joint control fusion technology. Wherein, the stereo projection fusion technology mainly realizes the complete unity of pictures through geometric correction, edge fusion and point simulation; the control system fusion technology mainly ensures the interconnection and intercommunication between various professional subsystems by improving the compatibility of the smart lighting system; the multimedia synchronization and joint control fusion technology mainly completes the synchronization and joint control between multimedia systems such as sound, lighting, and electricity systems by time code technology.

Through the combination of smart lighting control system and multimedia smart lighting fusion technology, the unity and integrity of stadium lighting effects and operation and maintenance management are realized. The stadium not only meets the basic functional requirements of various sports events as those of traditional stadiums, but also meets the operational needs of multi-dimensional scenes such as cultural performances, cultural tourism, and exhibitions, and gives full play to the sustainable operation of stadiums.

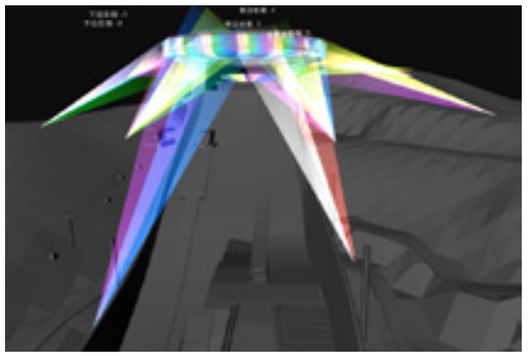
The Innovation Points

1. Stereo projection fusion

Multiple projection devices are often used in opening and closing ceremonies or performances in stadiums. As the projection devices have various angles or shapes of projection surfaces respectively and not all the devices have a projection angle of 90 degrees, projection distortion occurs. In addition, the overlapping projection of multiple projection devices tends to produce white bright bars in the projection area, resulting in sudden changes in brightness. Projection distortion and sudden change of brightness are two key problems those need to be solved in projection technology, which are mainly realized by geometric correction and edge fusion.

When multiple projection devices project images on a special-shaped screen, which are misaligned and distorted, the “grid” method is generally used to correct the misaligned geometric images, wherein the grid position of edge images are spliced and aligned, by analyzing the geometric position relationship between projected images of each other.

The edge fusion technology is to overlap the edges of the pictures projected by multiple projectors, and by means of edge fusion, the pictures can be seamlessly spliced, just like a picture projected by one projector. Edge fusion technology generally uses edge attenuation algorithm and brightness compensation method to perform edge fusion processing on images to ensure the consistency of the brightness of the entire projected picture and to achieve seamless splicing of projected images. The uniformity and color consistency of the image fusion and splicing are not only affected by illumination, but also by the projector point. Generally, all the projection points can be determined by repeatedly simulating the projection light path of the projector through on-site survey measurement and 3D software (see figure 1).



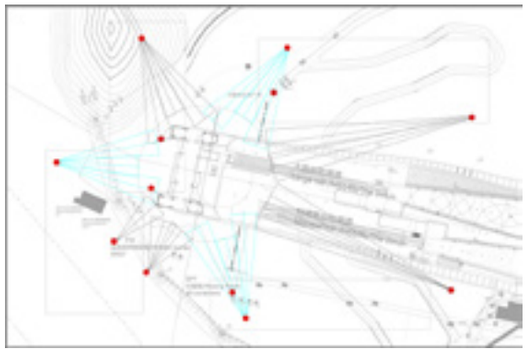


Figure 1 Projecting 3D projection angle simulation map and projection point map

The working principle of geometric correction and edge fusion (see Figure 2) is as follows. The information of the corner points of projected surfaces by cameras is obtained, and then the coordinate information of these positions is calculated according to a certain algorithm. The function of the projected surface is obtained, and then the correction is achieved by corresponding offset relationship between the pixel points and applied to each channel. The pixel values of adjacent channels are matched through the selection of shape parameters, and then applied to each channel. The edge weakening module between adjacent channels is one of the optimization modules after multi-channel splicing, which avoids the highlight problem in the overlapping area of the projector,

by attenuating the brightness value of the pixels in the fusion zone area. The color correction module between adjacent channels is another optimization module after multi-channel splicing, which realizes the smooth transition of the color of the fusion belt by adapting the overall pixel color value to the color value of the fusion zone area, as a result, avoiding the defectiveness of excessive color difference.

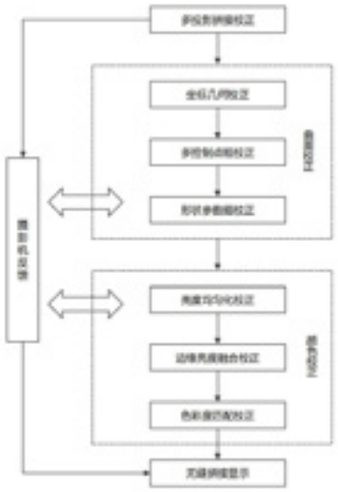


Figure 2 The working principle of geometric correction and edge fusion

2. Control system integration

The smart lighting control system of stadiums often integrates multi-professional equipment such as media facade lamps, outdoor lighting fixtures, stage lighting devices, laser projection devices, LED large screens, and audio systems; the communication protocols applicable to different equipment are also different, generally including ARTNET , DMX512, TCP/IP, UDP, HDCP, MIDI interface, API interface, etc.

In order to ensure the interconnection between systems, the smart lighting control system needs to support a variety of communication protocols to improve the compatibility of the system (see Figure 3).

When each of the on-site equipment controllers of the individual control systems of various professional equipment needs to collect equipment data and transmits control instructions by various communication protocols, the on-site controller selects a different network switch according to network conditions on site, and transmits equipment data to the smart lighting platform through different network protocols, so as to ensure the linkage and integration among the respective control systems of equipment.

Figure 3 Communication protocol of smart lighting control system

3. Multimedia synchronization and joint control integration

The synchronous joint control system of the stadium is an inter-professional multimedia synchronous playback system. It can not only play audio files as a multi-track player, but also connect the time code with a custom time as a control signal to the lighting control system and the screen control system, so that the sound, light and electricity can be perfectly matched and run automatically, thus realizing frame-to-frame synchronization and joint control fusion of the lighting effect, screen presentation and music.

Timecode is a method of precisely marking video frames during shooting. It works by counting the exact number of frames from the first to the last video. When counting frames, timecode assigns each frame a unique identifier, which is not a continuous integer. If the timecode is matched between the equipment, every content they record is automatically synchronized (see Figure 4).

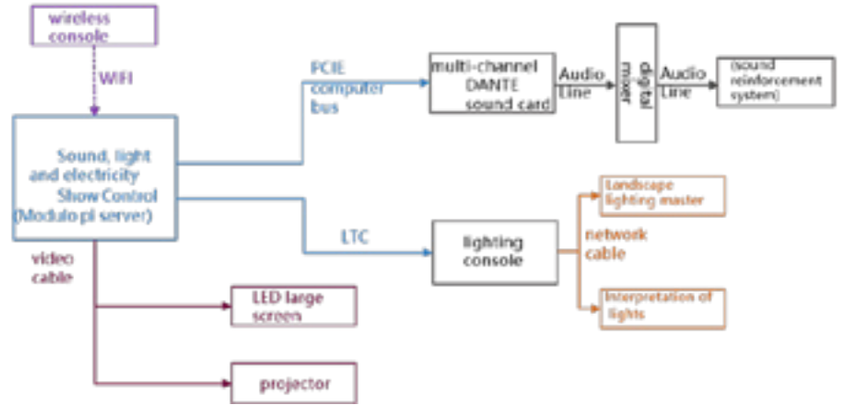


Figure 4 Multimedia synchronous joint control

Possible Economic and Social Benefits

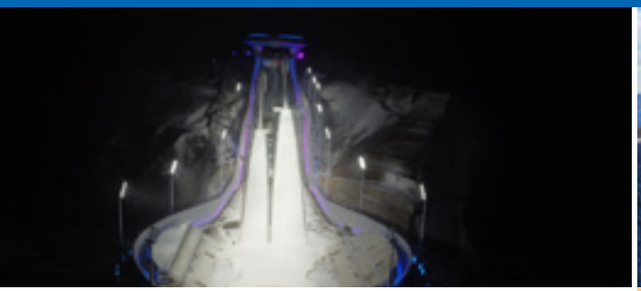
The multimedia smart lighting fusion technology integrates various complex types of equipment such as projectors, lasers, and flood lights, which can meet the operational needs of multi-dimensional scenes such as sports events, mass fitness, cultural tourism, and exhibitions, and fully release the "1+N" additive effect.

The technology achieves the integrity and unity of the projected image by using geometric correction, edge fusion and point simulation, presents different visual communication effects using lighting effects, and visualizes text, graphics, images, animations and other multimedia information to convey to the audience through lighting interpretation, attracts the hearing and vision of the audience, guides the thinking of them, and achieves the purpose of publicizing sports events, promoting sportsmanship, enhancing the city's image, enhancing service functions, and prospering the market economy.

Through the intelligent, advanced, effective and reliable smart lighting control system, all the lighting and related equipment of the stadium can be controlled in different scenarios and strategies, so as to realize the interconnection between systems and the management by different regions and modes, which reduces the difficulty of operation and maintenance and operating costs of the stadiums, avoids energy waste, very effectively achieves green and low-carbon operations, and provide a technical foundation and creative space for the sustainable operation and management of the venue.

04

Broadcast Lighting of Beijing 2022 Olympic Winter Games National Ski Jumping Centre Competition



Beijing New Space Technology Co., Ltd.
Signify (China) Investment Co., Ltd.

Brief Introduction

The National Ski Jumping Centre of Beijing 2022 Olympic Winter Games is also known as Snow Ruyi, is located in the Guyangshu Competition Area of Chongli District, Zhangjiakou City, Hebei Province, about 220km away from Beijing.

The Ski Jumping Centre is the competition venue with the largest capital construction, the most complex and the highest technical difficulty in snow events, and it is also the first international ski jumping resort in China. The National Ski Jumping Centre is divided into HS106 standard ski jumping platform and HS140 big ski jumping platform, which are composed of their respective starting areas, auxiliary ski slopes, landing areas, and shared buffer areas and auditorium areas. The slope length of HS106 is 106m, and the altitude of the takeoff point is 1750m; the slope length of HS140 is 140m, and the altitude of the take-off area is 1771.5m. The scope of this project is to design and build the lighting system for the competition venue, and to provide guarantees for competitions and high-definition TV broadcastings.

Designs and implementations:

1. Based on the site conditions, the basic requirements of Ski jumping competition of lighting and TV broadcasting of Beijing Olympic Winter Games, this project provides suggestions for the preliminary design scheme of sports lighting, including the arrangement of lamp poles, the power and quantity of luminaires, and the illumination estimation at the position of basic relay cameras, etc.

2. Based on the detailed technical requirements of sports lighting and TV broadcasting of the Winter Olympics put forward by the Owner, the General Contractor, the Design Institute, the International Ski Federation and the International Olympic Broadcasting Service (OBS), this project provides the detailed design scheme and detailed construction drawings are provided for the broadcast lighting of the competition which are verified and

confirmed by the lighting experts of OCOG and OBS, and the lighting design scheme meeting the requirements of biathlon and ultra-high definition TV broadcasting is completed.

3. Based on the approved detailed scheme and drawings, this project completes the procurement, installation, commissioning and trial operation of lighting system, and at the same time coordinates and solves the installation conflicts with other specialties. This project is subject to the inspection and inspection of the lighting project by International Ski Federation, OCOG, OBS and other departments to confirm that it meets the use requirements.

4. Based on the adjustments of track layout and facilities in the course of site construction, this project adjusts the lighting design scheme and implementation scheme synchronously, and implements the debugging of lighting fixtures and systems in the whole site again;

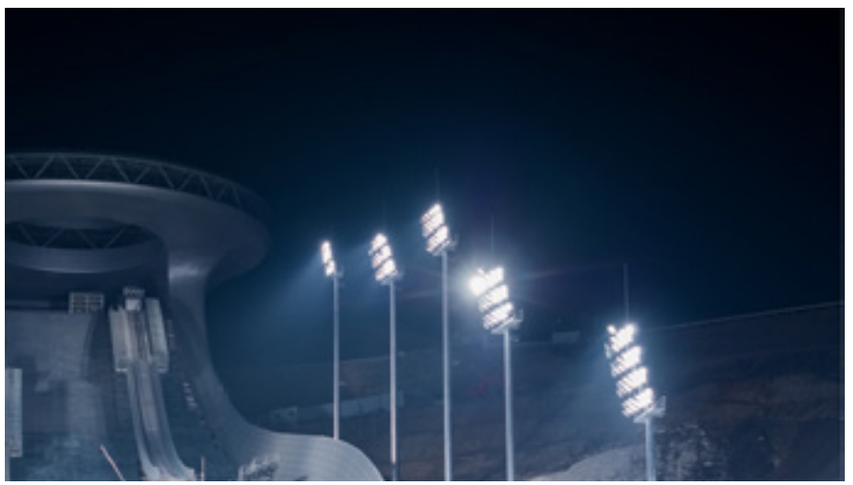
5. Based on the running situation and streamline fine-tuning of the biathlon test competition, including partial debugging and adjustment for new demands, this project can better meet the lighting effect of the venue during the 2022 Olympic Winter Games, and provide guarantee for the effect of ultra-high definition TV broadcast;

6. Guarantee of venue lighting effect and ultra-high definition TV broadcast effect during the 2022 Olympic Winter Games and Paralympic Winter Games.

The lighting of the competition venue of the National Ski Jumping Centre is the most difficult project in the current Olympic competition venues. The implementation of the lamp pole foundation and the debugging accuracy of the luminaires are very demanding, and it is the most demanding and professional ski resort in China at present.

The Innovation Points

1. The ski jumping project is an outdoor sports broadcast lighting with the largest terrain gap. The tracking of terrain drop is an important part of lighting design. During the implementation process, the requirements of horizontal illumination of the auxiliary ski slope and vertical illumination of the multi-directional camera of athletes are met, and at the same time, the abrupt appearance of the equipment in the broadcast line of sight is avoided. In addition, the effect is strictly controlled from the aspects of positioning, number of luminaires, aiming points, illuminance, uniformity, glare control, color temperature, stroboscopic ratio, color rendering index, etc.,



so as to meet the requirements of OBS, OCOG, International Ski Federation and other event organizations and achieve the best broadcast effect.

2.There are many cameras for ski jumping. In order to meet the lighting requirements of ultra-high definition cameras with different positions, types and functions, ensure the broadcast effect and avoid glare to cameras and athletes, considering that the line of sight of ski jumpers is different from that of plane sports, the illumination design of flight section (from the take-off stage to the landing area) fully considers the snow illumination uniformity of the background illumination. During the implementation, the vertical illuminance and uniformity requirements of each camera at different heights are satisfied after many times of debugging.

3. In terms of system stability, a mature system architecture is selected and optical fiber transmission is used for the project, so the low-temperature working performance of control components is always concerned. In terms of control ability, the lighting terminal branch switch and DMX512 dimming are combined into a control system to improve convenience and reduce misoperation rate.

4. In terms of expanding capacity, ports are opened to create convenience for the long-term use of the venue after the Games.

5. Innovation of illumination calculation method:

(a) The luminaires at the auxiliary ski slope are specially developed for the ski jump auxiliary ski slopes. The appropriate light distribution form is selected according to the distance, so that after the installation of the luminaires, the lighting can meet the requirements of the uniformity of the horizontal illuminance and the vertical illuminance machine of 17 respectively. At the same time, the appearance of the lamp is beautiful, which can provide a good visual effect.

(b) The luminaire position and projection direction are confirmed according to the terrain, camera position and shooting range. The professional software is used to establish the calculation model, and factors such as the size, elevation drop, spatial illuminance, surrounding terrain and obstruction of each part of the site are fully considered. The horizontal illuminance of each area, the vertical illuminance, uniformity, gradient, glare, etc. of all cameras are synchronously designed and calculated, and the situation of snow surface reflection flare is verified. Various parameters are constantly adjusted to meet all requirements, and then the related parameters are exported and imported into drawings, so the initial plan was formed.

(c) Superimpose the initial plan with geological conditions and existing equipment of other disciplines for

verification. If the demand cannot be satisfied or there is conflict, the position of lamp pole, number of luminaires / aiming points are modified, and the model establishment and data calculation are repeated until the required position is satisfied.

(d) Based on the preliminary results, the power supply and distribution and intelligent control circuit of the terminal line are deepened, and finally summarized into an electrical system diagram and a control system diagram.

6. The application environment of luminaires has also been considered. During the competition, the night temperature is lower than minus 25 degrees Celsius, which increases the low temperature resistance of luminaires and lighting systems.

7. With the concept of sustainability, the post-game operation is considered at the beginning of the project design, and the lighting effects of different scenes are completed through the combination of the switch and dimming of the intelligent control system. After the game, all the games-time luminaires can be used after the game.

Possible Economic and Social Benefits

Zhangjiakou National Platform Jumping Centre for the 2022 Olympic Winter Games is the first ski jumping venue in China, and it is also the competition venue with the largest amount of work and the highest technical difficulty in the construction of Zhangjiakou Olympic Winter Games venue group. It covers an area of about 62.5 hectares. The main project consists of the summit club, the middle ski slope area (including HS140 and HS106 tracks and the referee tower), and the bottom stadium. The summit club is 49m high, with an outer diameter of 79 meters and an inner diameter of 36 meters. The bottom stadium has an outer diameter of 170 meters and an inner diameter of 150 meters, and can hold nearly 10000 spectators.

The Olympic Winter Games is a large-scale sports' event in the world. With the epidemic raging all over the world, this project actively cooperates with epidemic prevention measures, and responds to the green goal of "striving for carbon neutrality" during construction, so as to achieve environmental protection.

On the one hand, this project is the first broadcast lighting project of ski jumping competition in China, makes up for the blank of broadcast lighting of such sports events in China, and provides solutions to related problems for the future design and implementation of similar projects, accumulating valuable experience in the process of project implementation.

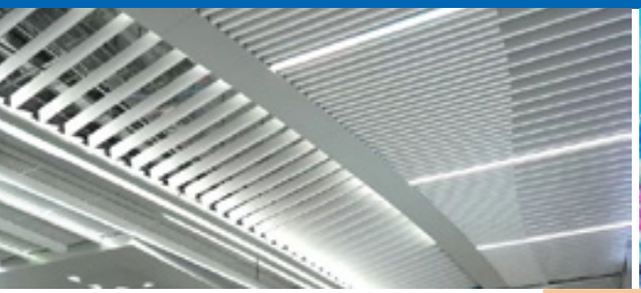
On the other hand, with the concept of sustainable development, the post-game operation was considered at the beginning of the design of this project, and all the games-time luminaires were used after the game. The lighting effects of different scenes can be achieved through the combination of on-off and dimming of the intelligent control system, which provides a foundation for the sustainable operation of the venue.

A world of ice and snow is like a mountain with golden and silver. Beijing Olympic Winter Games has activated China's ice and snow economy, making ice and snow not only a sport, but also a modern industry.

Looking forward, even in the future post-Winter Olympics era, the "Winter Olympics Economic Effect" brought by the Beijing Olympic Winter Games will continue and create more value.

05

Integrated Innovation Technology for Urban Rail Transit Light Environment Fusion



Beijing Qingchengpinsheng Lighting Institute Co., Ltd.
Guangzhou Metro Design and Research Institute Co., Ltd.

Brief Introduction

This study achieves integrated innovation through the establishment of urban rail transit light environment design indicators, evaluation indicators, simulation and simulation technology, and product development. As an important way for people to travel on a daily basis, public transport space is no longer simply providing the function of travel, it gradually integrates multiple attributes such as display, experience and propaganda, and becomes an important window to convey information for commercial and cultural communication. The light environment is also not just a simple appeal of functional lighting, providing a healthy and comfortable space for passengers to travel and creating a unique cultural experience is an inevitable trend in the study of light environments in public transport systems.

This study investigates objective data and interviews with passengers in 37 different cities of different sizes in China, and proposes quantitative indicators through functional analysis, so that the metro space can achieve high quality in three aspects: direction discrimination, energy reduction and cultural experience.

The main aspect of direction discrimination is the integration of light environment design indicators and evaluation indicators. The innovative introduction of visual brightness into the public space, by focusing on the brightness of the façade, enhances the reaction speed of passengers to quickly identify signs or discover passages. Through a large amount of subjective and objective research data, a balance between comfort and rapid recognition is summarised, and furthermore, using the application of station platforms and lobbies as an example, illuminance values for the whole space, including ceilings, façades and walls, are provided for direct adoption by designers.

At the level of energy reduction, the innovation of this study is mainly reflected in the light environment evaluation system and the integrated innovation of product development. On the basis of not reducing health and comfort, the setting of illuminance and uniformity values is linked to the tidal model of footfall, and an algorithm

for reducing energy consumption is developed and patented luminaires are used. The application uses 270lx during peak hours and 200lx during flat hours, which meets the need for rapid evacuation of passengers during peak hours and achieves a good energy saving of 30% during all hours.

On the level of cultural experience, the light environment design system, light environment evaluation system, simulation design, product development and multi-dimensional integrated innovation. The city culture is integrated into the decorative design, and the intention of city bonding and Bay Area departure is incorporated into the space by using the theme design of Panyu Station. The top of the station concourse highlights the bond-like intention through streamlined elements, while the columns on both sides enhance the message through LED screens. The colours blend Bay Area blue and metallic orange, introducing a sense of technological sanity and sunny vitality into the space, which has been well received by passengers and reported by CCTV after use.

This study has not only practiced the technology from the above aspects, but also formed the "Design Guidelines for Urban Rail Transit Light Environment" (which has been established), and T/CAQI 244-2021 "Design Requirements for Indoor LED Health Lighting" (which has been approved), summarizing the innovative parameters and innovative methods for other designs to use as reference.

The Innovation Points

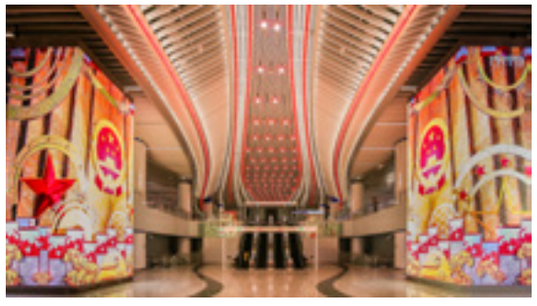
Integrated innovation in five dimensions of urban rail transportation light environment integration research and application in design index, evaluation index, simulation and simulation technology, and product development.

Innovation point one: for the first time in urban rail transit, the design guidelines of urban rail transit light environment are proposed, and the integrated innovation of rail transit light environment design system. With the improvement of people's material and cultural living standards, urban rail transit stations, which are important public transport spaces in cities, can no longer meet people's travel needs by providing only simple travel functions. Passengers have increasingly high requirements for the spatial quality and experience of the light environment, and the design research of the light environment has gradually moved from providing functional lighting to exploring thematic lighting, displaying and disseminating urban culture in the urban rail transit space and bringing passengers a good cultural experience. In the design process, the six steps of combining light environment design and decoration design were summarised, divided into two types of spaces, standard stations and special stations, and summarised the focus to form the Guidelines for the Design of Light Environment of Urban Rail Transit, bridging the gap in the design of light environment of urban rail transit.

Innovation point two: for the first time, the brightness and proportion are suggested for the complex environment of multiple types of luminous light sources in rail transit, and the quantitative evaluation of multiple light source environment settings is integrated and innovated. Among the factors that mainly affect the brightness of space, light boxes and LED displays are the more critical factors. With the progress of lighting technology, the application function and scope of display class equipment in underground rail space is more diversified and extensive, so it is important to consider the environment to reasonably set the brightness of light boxes and LED screens for the comprehensive light environment. The lack of space light environment hierarchy, some areas due to publicity lighting, advertising signs lighting brightness set unreasonable, not only will cause passenger discomfort due to excessive brightness, publicity can not achieve the expected effect, but also to a certain extent will affect the space guidance system guidance function. The full coverage and systematic design requirements are proposed to fill the gaps in the industry at home and abroad.

Innovation point three: the first time in urban rail transit to introduce a three-dimensional environmental space system for the evaluation of spatial brightness index, rail transit light environment evaluation system integrated innovation. In addition to meeting the basic requirements of illuminance and uniformity of illuminance, a high quality light environment design needs to consider the brightness of the overall space and have a high visual comfort. A reasonable sense of spatial brightness can ensure a reasonable brightness of the situation can be used under a reasonable lighting configuration, in order to achieve a suitable visual perception effect with a minimum of light sources, so as to achieve the role of energy saving. The metro space light environment has the characteristics of open space and orderly structure. Through the research and analysis of a large number of domestic metro stations, the proposed value of space brightness is proposed for the two parts of the station hall and platform space, and this index can effectively evaluate the light environment effect from the perspective of human experience, filling the gap in the industry.

Innovation point four: the first application of lighting simulation virtual design platform in urban rail transit, rail transit simulation design integrated innovation. Simulation simulation platform based on the design scheme, three-dimensional scanning model, 1:1 restore the structure of the structure of the building form, architectural details; combined with physics, materials science and other theoretical methods, the real material characteristics of the collection: such as object colour, texture, roughness, reflectivity, etc., the material calibration; and for the new light source algorithm, according to the human eye vision for the simulation of optical calibration, to achieve quantitative goals, to establish bridge between the virtual and real worlds, providing anticipatory effects, and accurate data support.

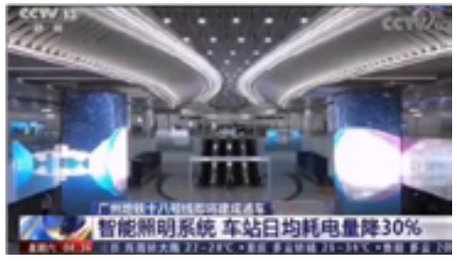


Innovation point 5: The first new composite luminaire design for three-dimensional space lighting in urban rail transport. The new luminaire realises the need for multi-directional spatial lighting, satisfying both functional and ambient lighting needs, integrating the composite functions of a variety of traditional luminaires and becoming a new generation of composite functional green luminaires, for which a patent has been applied for.

Possible Economic and Social Benefits

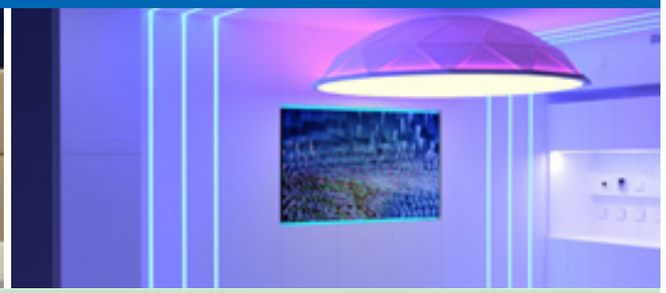
Economic benefits: 30% energy saving achieved by using multiple energy saving technologies and reported and commended by CCTV. Energy saving is achieved through the use of light source selection, control mode and control system. In terms of light source selection, new LED light sources with high luminous efficiency and more energy saving are used instead of traditional light sources; energy saving is achieved on the premise of control mode usage requirements. In terms of control system, the station lighting adopts an intelligent lighting system that can automatically adjust warm, cold and natural light according to the season and automatically adjust the light intensity according to the intensity of passenger flow, which greatly reduces the lighting energy consumption of the station. Most domestic and international railways use electricity as their main energy supply, which is an indirect carbon emission. Due to the large volume of rail transport operations in China, the power consumption is therefore huge.

Through this study, the overall requirements of the station light environment are proposed, with a reasonable and even arrangement of all types of lighting, and a reduction in the brightness of some advertising lighting, guiding lighting, LED screens and other equipment, saving lighting energy and reducing light pollution. Based on the results of this research, the stations of the new line can save an average of 234 kWh per day of advertising light boxes, guidance and LED screens at standard stations through a reasonable design of light environment integration, which can save about 85,000 kWh per year, and at the current electricity price of RMB 0.72/kWh, the average annual saving is RMB 61,200,000. Considering a line with 20 stations, the whole line can save about 1.23 million kWh per year. The current LED light source-based light boxes, guides and screens have a lifespan of about 5 years, so from a whole life cycle perspective, a total of 6.15 million kWh of electricity can be saved. The economic benefits will be even more significant when the subsequent lines are fully rolled out.



06

The Antarctic Health Cabin



Tongji University
Polar Research Institute of China
Opple Lighting Co., Ltd.

Shanghai Yaming Lighting Co., Ltd.
Shanghai Keey Group Co., Ltd.
Qingdao Yeelink Information Technology Co., Ltd.
Shanghai Haoyi Health Technology Co., Ltd.

Brief Introduction

The Chinese Antarctic Research Expedition is exposed to harsh natural and isolated social environments, such as blizzards, extreme days and nights, noise, color monotony, visual and emotional deprivation, and isolation. This project focuses on the multiple challenges posed by the complex and harsh Antarctic environment to the physical and mental health of the Chinese Antarctic Research Expedition, and builds the Antarctic Health Cabin with the aim of improving the quality of the indoor environment and the quality of life of the Chinese Antarctic Research Expedition.

The project is based on the technical route of "problem analysis - integration of human factors researches - key technologies development - integrated solution and demonstration application", analyzing the factors and mechanisms of the Antarctic environment on the health of the Chinese Antarctic Research Expedition; exploring indoor human factors control methods based on healing effects; and realizing the demonstration application of the Antarctic Health Cabin. The Antarctic Health Cabin provides a multi-dimensional light healing solution for Chinese Antarctic Research Expedition to help them regulate their circadian rhythm and relieve emotions in extreme environments such as severe cold, monotonous color environments and isolation, including different lighting scenes and dynamic change modes with sound scenes and greenery. Based on the non-visual mechanism of light on the human body, the lighting mode is adjusted to the human circadian rhythm through a combination of different illumination levels, color temperatures, light duration

and other parameters to help users repair their circadian rhythm disorders. Based on color psychology and the psychological impact of soundscapes, the design of several emotional healing scenes is conducive to soothing the body and mind through the linkage of colored light and sound. The interaction with the greenery wall creates new ways for users to de-escalate in extreme environments. The cabin is equipped with digital twinning to create a dedicated intelligent platform for the Antarctic Health Cabin, which collects, analyses and provides feedback on the human factors data and equipment operation data of the cabin in real time. The platform provides a comprehensive grasp of the health status of people and the environment during the use of the healing pods and realizes an innovative form of "sensing", "transmission", "knowledge" and "use".

The Innovation Points

1. Innovation

For the first time, the concept of Antarctic Health Cabin was proposed, breaking through the traditional concept of building an environment in the research station area, and innovatively using the research work and living environment in the research station area as a zero-level preventive life health protection method, effectively improving the survival quality of Chinese Antarctic Research Expedition in extreme environments.

The research systematically investigates the special effects of Antarctic environmental factors such as extreme cold, extreme day and night, and isolation on human physiology and psychology, and the abnormal changes in physical and mental health caused by these factors, and proposes a combination of healing light parameters for physical and mental stress symptoms in extreme environments based on the quantitative correspondence between indoor light parameters and the physiological and psychological stress levels of research personnel. The system will be studied and a dynamic health lighting plan will be proposed.

With the goal of improving the negative impact of extreme environments on human rhythms and emotions, the user is objectively and comprehensively monitored and evaluated in multiple dimensions of sleep, emotions and behavior, and the data is collected and analyzed in real time through dedicated IoT technology to establish a multi-dimensional health lighting healing system to achieve quantitative regulation and precise intervention.

2. Advanced level

The project provides solid research technology and a new perspective and direction for various academic fields such as personnel health protection, built environment and habitat health in extreme environments. The project gives full play to the advantages of the cross-discipline of science, engineering and medicine and the collaboration between industry, academia and research, explores the establishment of an intelligent human health support and environmental control system for polar station areas, independently develops key technologies for active health intervention, provides an advanced platform for comprehensive research on environmental protection technologies for Antarctic research, and promotes the maximum effectiveness of human and machine systems in research facilities. Maximize the effectiveness of health protection.

In extreme environments, it is difficult to access the normal change of seasons or alternation of day and night, and the combination of lighting parameters with different illumination levels and color temperatures helps the

scientific research team to carry out circadian rhythm repair. Based on color psychology, the RGBW light source components are combined to create different color series with slow dynamic changes to alleviate users' anxiety, irritability and depression caused by prolonged exposure to monotonous environments.

The combination of light and sound, with corresponding sound scenes in different lighting modes, soothes the user's lonely mood by using the background sounds of the city streets, birds chirping, insects chirping, forest streams, etc. The duration of different sound scenes is scientifically set to achieve the optimal combination of sound and light linkage.

Through dedicated IoT technology, an intelligent platform is created to collect, automatically analyze and provide timely feedback on human factors data and equipment operation data in real time, so that the intelligence, humanity and safety of the health cabin can be enhanced simultaneously.

The cabin is equipped with a green wall, which is made up of several movable boxes of greenery. The greenery inside the cabin is a special "friend" that can be adopted by the user for long-term observation and recording of growth status, creating fun for the user in extreme environments.

Through the collection and evaluation of indoor thermal and humid environment and personnel thermal comfort data in polar station buildings, we will develop comfort-oriented algorithms for optimal control of polar indoor thermal and humid environment and the control systems, forming an intelligent environmental control technology based on human thermal and humid comfort.

The first research on noise masking technology for living buildings in Antarctic stations, and research on building

envelopes, materials and structures for building noise control based on the frequency spectrum of polar noise sources.

3. Key technologies

Integrating light healing, human comfort-based heat and humidity coupling control, and noise shielding into integrated demonstration applications, and organically integrating the polar scientific research health management process with the construction and operation and maintenance of scientific research facilities.

To address the spatial and temporal perception barriers and sensory deprivation caused by the high isolation of Antarctic research stations from the external environment, the healing application scenarios of immersive light, color and sound and other multi-sensory information stimulation are developed to enhance the environmental experience of personnel.

Quantitative analysis of the correspondence between light parameters and the physiological and psychological stress levels of scientific research personnel, proposed a combination of healing light parameters to cope with the symptoms of T3 syndrome and extreme day and night conditions, and built a healthy light system that meets the dual role of task lighting and health healing.

The design of indoor thermal and humid environment parameters for polar architecture is based on the influence of indoor thermal and humid environment parameters on human thermal and humid sensation, physiological parameters, sleep quality and emotional changes.

Through the sound insulation and noise reduction technology of the interface of the health cabin and the acoustic material and acoustic treatment structure of the interior surface of the cabin, the sound field distribution inside the cabin is optimized by reducing the transmission of wave and wind noise from outside the cabin to the internal sound sources.

An intelligent platform with Internet of Things (IoT) technology is built in the research station area to realize real-time collection, automatic analysis and timely feedback of environmental, human factors, equipment operation and research mission execution, and to realize autonomous regulation and control of the indoor built environment in the stations.

Possible Economic and Social Benefits

Polar scientific research is an important embodiment of China's strategy to strengthen the country. Providing complete health protection and support for scientific research personnel to ensure the smooth implementation of scientific research missions and the safety of personnel and equipment is of great interest to the development of China's polar career. This project analyses the elements and mechanisms of the impact of the Antarctic environment on the physical and mental health of the Chinese Antarctic Research Expedition, constructs an intelligent human factors health healing system, realizes the human factors health strategy for Antarctic research and its integrated demonstration application, and enables the human-machine system of Antarctic research facilities to give full play to its health protection and promotion effectiveness. The implementation of the project will achieve theoretical innovation and technological integration innovation, produce high-level scientific research results, bring new breakthroughs for China's polar research field protection and support capabilities, and create solid and powerful basic conditions for China to strengthen its research force and move towards a strong polar research country.

07

Thailand/USA/Canada -- Innovative Horticulture Gardening Solutions for North American Market

ams OSRAM Group

Brief Introduction

Innovations that works - The unique SSL horticulture innovations from our company- that got 3rd party testimonials from their real benefits & applications for medical cannabis use in United States and Canada!

Together with our customer Revolution Microelectronics in America, our company supplied LEDs namely OSLON SQUARE & OSLON SSL driving for Horticulture project on Cannabis cultivation in Millbury, Massachusetts. The past decade has seen massive changes in the Cannabis industry as legalizations have taken the trade from small grows to giga-scale international corporations. Massachusetts cannabis company Green Care Collective has gathered a team of international cannabis experts to build the next evolution of cannabis cultivation; a perpetual harvest facility with all the latest advancements in horticultural science.

Our company's extensive emitter portfolio addresses professional top-/inter-lighting and vertical farming applications covers all the key growth-optimizing wavelengths and radiation-angle options needed for all types of plants and flowers. In this project, our company's LEDs of OSLON SQUARE & OSLON SSL design were used in customers' product of AVICI series for programmable spectrum LEDs.

Products features & how it met our customers' requirements:

- Seasonal adjusting / programmable spectrum controls.
- Latest in crop steering techniques.
- DLC listed industry leading 150,000hrs.
- Industry only LifeTime Warranty.
- LEDs.
- True 1150 watts.

The Innovation Points

Horticulture lighting - our company spectral sensing technology enables real-time monitoring of total illumination at the plants to manage targeted growth lighting recipes while accounting for external lighting influences in greenhouses with sunlight access. Chip-scale spectral sensing technology extending from the visible to near-infrared (NIR) opens all-new arenas of condition and plant-growth monitoring by making the invisible visible. Agricultural use cases include crop-sprayer controls keyed to plant detection or health, drone optimization and imaging, plus grain harvesting or storage monitoring.

Setting a new standard for professional horticulture applications. our company's new generation OSLON® Square Hyper Red 660 nm is unmatched in its class of High Power LEDs. With an industry-leading efficacy of 76% WPE, the new generation OSLON® Square Hyper Red delivers performance levels that cannot be refuted.

With the expansion of LED lighting into horticulture, the real test of expertise and know-how lies within offering consistent growth practices and responsible use of energy whilst ensuring the cultivation of high quality crops for growers and end users. Most TCO calculations rely on high efficacy and sustainable long-term light output.

Regardless of weather, season and time of day, plants much like humans, need light to thrive. The right light strategy is key. In its next generation Hyper Red, the OSLON® Square offers a radiant flux of 1064mW at 76% WPE and a photon flux of 5,82 µmol/s at an efficacy of 4.16 µmol/J at 700mA. Performance levels which allow for fixture designs which have never been possible before. For applications with higher efficacy requirements the LED provides 82% at a driving current of 350mA. Respectively 84% at 250mA.

Possible Economic and Social Benefits

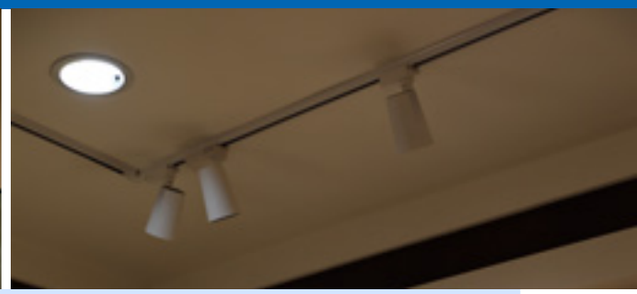
Today more than half of the world's population lives in cities; in 2050 two thirds of all people on earth will live in urbanized metropolitan areas. Traditional agriculture will not be able to provide such megacities with enough healthy nourishment. One possible solution: Urban farming. Growing tomatoes, melons and the like in the midst of the big city, and these plants will need to be fed as well, primarily with water and light. Compared to conventional agricultural lighting solutions, LEDs achieve significant increases in energy efficiency and can, thus, help vegetable and fruit cultivation in the metropolises of the world to finally become truly viable.

Arranged meticulously in long rows running down the large building, a sea of lettuce heads bathes in a pinkish light. What at first glance looks like a science fiction scenario already exists today in many metropolitan areas around the world. In so-called urban farms, people in Asia, the USA and Europe are cultivating vegetables, herbs and fruits in the middle of the cityscape. In modern versions of the urban garden plot agriculture has been relocated, for example, to old industrial buildings and warehouses.

For that new indoor horticulture farming our company offers special light: LEDs (Light Emitting Diodes) that can supply light with a distinct red or blue component based on wavelength; exactly the light that plants such as iceberg lettuce, tomatoes and basil need for photosynthesis and for optimal growth. The light colors emitted by the diodes combine and produces the pink aura. Another advantage: by using LED light, the modern farmer is no longer dependent on natural light sources. With the supplemental LED lighting grow light levels can be raised in order to enhance photosynthesis and thereby improve growth and quality of the plants. With artificial LED light the light period can be controlled by extending the natural day length to get more plant growth in a shorter time. There is also the possibility of cultivation without daylight: regardless of rain or the lack of sunlight, the constant light produced by the LEDs ensures consistent growth of healthy, fertile plants.

08

A Novel and Practical Optical Camera Communication System



Sichuan University
(Yanbing Yang, Chen Chen, Yimao Sun, Pinpin Zhang, Yanru Chen, Binbin Zhu)

Brief Introduction

Under the background of ubiquitous sensing and interconnection, traditional radio frequency (RF) communication technologies are facing the problems of exhaustion of spectrum resources, high energy consumption and unsuitability for radiation-sensitive scenarios. Therefore, as an emerging communication technology, visible light communication (VLC) has been recognized one of the key technologies for the six-generation (6G) communication due to its abundant spectrum resources, green and energy saving, and no electromagnetic interference radiation. Particularly, optical camera communication (OCC), which adopts high-efficiency LED as the transmitter and the embedded CMOS camera of smart devices as receiver, has been considered as a practical way to implement VLC on commercial off-the-shelf devices for various applications such as indoor wireless communication and positioning, intelligent transportation and the Internet of Things. Therefore, the research and the commercialization of OCC can not only break through spectrum limitation, but also revolutionize the next generation of green communication.

In most real-world scenarios, the LEDs are placed on the ceiling, so users can easily capture the OCC signal reflected from various observation surfaces for subsequent signal demodulation and decoding to realize data communication. However, the existing OCC technology faces two key problems in practical complex scenarios: (1) The reflection propagation path of the optical signal is relatively long, resulting in severe attenuation of the optical signal at the receiver and low received signal-to-noise ratio (SNR); (2) The optical signal and the reflected background are highly coupled and interfered with each other, resulting in a severe distortion of the optical signal at the receiver and low SNR. Aiming at solving these problems, this application proposes the following solutions: (1) A lightweight signal enhancement technique based on multi-pixel cumulative sampling is proposed to increase the optical signal intensity in the grayscale sequence, so as to achieve signal enhancement without significantly increasing the complexity; (2) A channel equalization technique based on the maximum value search is proposed to improve the consistency of the optical signal, thereby improving the adaptability of OCC to the

environment.

By integrating the proposed innovative techniques into the existing OCC system, users can enjoy intelligent information transmission services that integrate lighting and communication and combine content and experience in scenarios such as smart museum exhibition halls and cultural scenic spots. The administrator only needs to upload the history, production process, demonstration video and other information of the exhibits to the server in advance. Visitors can use mobile terminals (e.g., smartphones, AR glasses, etc.) with cameras to scan the reflected light in the venue to obtain the relevant information about the exhibits of interest. The successful deployment of the proposed OCC system can make up for the inherent deficiencies of insufficient offline information, allowing museums to put on a digital veneer and truly realize "making the sleeping cultural relics come alive".

The Innovation Points

Research on OCC started earlier in Japan, Europe, America, and Singapore, but the existing OCC is still not applicable to practical complex scenarios, and no commercialization has been seen. Therefore, it is urgent to solve the technical bottleneck of OCC in practical complex scenarios through further research and industrialization. In view of severe attenuation of optical signal strength and interference of optical signal by the complex reflective background in the existing research in OCC, this application innovatively conducts in-depth research on key techniques to improve the performance of OCC, and focuses on solving key issues such as optimization of OCC performance in complex scenarios, improving the practicality of OCC in complex application scenarios, providing effective solutions for reliable data transmission in complex and diverse scenarios, and helping optical communication technology to form a competitive advantage in the field of new generation communication networks.

The innovation points of this application can be summarized as follows:

1. A lightweight signal enhancement technique based on multi-pixel cumulative sampling is proposed for the problems of weak signal strength and low SNR obtained by the conventional single-row (or column) pixel sampling method in OCC. Due to the attenuation of optical signal in the air and the weak reception capability of the embedded camera of the smartphone, the optical signal acquired using the conventional single-row (or column) pixel sampling method is weaker in intensity, larger in attenuation amplitude, and lower in SNR as the light signal reflection propagation path gradually increases. To this end, this application proposes a multi-pixel cumulative sampling method, i.e., sampling multiple rows of pixels from the received image to form a lightweight grayscale matrix and then obtaining a grayscale vector of the same dimension as the sequence generated by the conventional sampling method for decoding by accumulating each column of pixels in the matrix, in order to solve the problems of signal attenuation and SNR reduction introduced by the longer reflection propagation path. The experimental results illustrate that the OCC system with the signal enhancement technique can amplify the received signal strength, thus improving the received SNR and decoding performance.

2. A channel equalization technique based on the maximum value search is proposed for the problem that the severe signal distortion and poor consistency obtained by the conventional fixed row (or column) pixel sampling method in OCC. In complex scenarios such as cultural exhibition halls, industrial sites, and cultural scenic spots, the optical signal acquired by the conventional fixed row (or column) pixel sampling method is weak in intensity, large in amplitude, and low in SNR since the light and dark fringe information in the received image is susceptible to interference such as complex reflective surfaces and ambient light noise. To this end, this application proposes a cumulative sampling method based on maximum value search, i.e., gradually searching for the pixel with the largest SNR value in the region of interest (ROI) for accumulation, in order to solve the problems of signal distortion and SNR degradation introduced by the high coupling of optical signals and reflective background. The experimental results show that the OCC system with the channel equalization technique can increase the optical signal intensity in the grayscale sequence and significantly improve the consistency of the optical signal, thus enhancing the reliability of the OCC system.

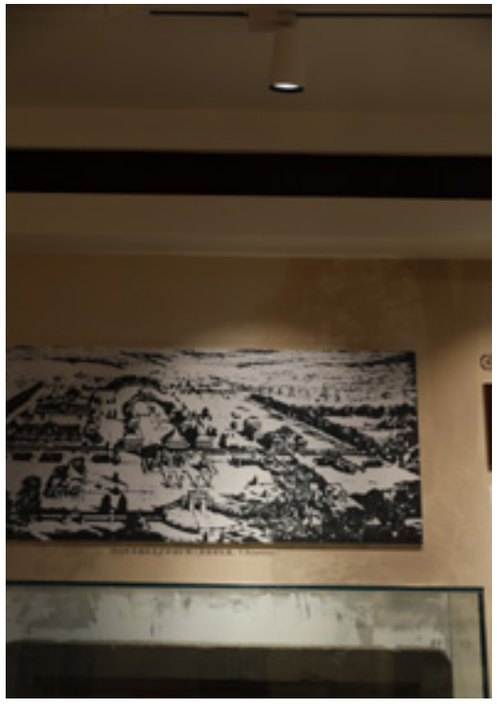
3. In order to verify the practical application effect of the lightweight signal enhancement technology based on multi-pixel cumulative sampling and the optical communication channel equalization technology based on maximum value search, this application integrates the above innovative technologies into the existing OCC system and compares the performance between the traditional OCC system and the proposed OCC system in order to fully verify the new practical OCC system for complex application environments (exhibition halls, museums, cultural scenic spots, etc.). The experimental results show that the proposed OCC system achieves better communication performance than the traditional OCC system in complex application scenarios such as cultural and museum exhibition halls, and it can effectively improve the decoding performance of the OCC system in complex and diverse application scenarios, thereby improving the communication capacity and reliability of the OCC system.

In summary, on the one hand, this application explores the international frontier and breaks through the technical bottleneck of the existing OCC; on the other hand, it is proposed to apply the OCC technology to the intelligent cultural and cultural exhibition hall to create a full-scope digital exhibition hall integrating lighting and communication and combining content and experience to enhance the technological innovation capability of the traditional lighting industry as well as the cultural and tourism industry, so that industries in different stages of development can share the fruits of digital economy development.

Possible Economic and Social Benefits

In the era of digital economy, the research and innovation of digital technologies are important engines to drive high-quality economic growth. The application of digital technologies to empower the traditional cultural tourism industry is expected to break the limitations of the development of the traditional cultural tourism industry itself, to realize the transformation of the traditional cultural exhibition from “one-way output” to “education and tourism”, and to accelerate the user experience and publicity effect at the same time. The integration of emerging technologies and the traditional cultural tourism industry will lead to the upgrading of the traditional cultural tourism and lighting industry structure, enabling industries at different stages of development to share the fruits of digital economy development, thus enhancing economic growth momentum and promoting high-quality economic development.

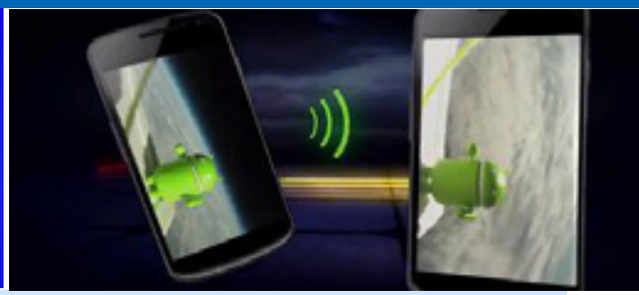
The optical communication industry is a comprehensive and integrated industry which involves LED devices, communications, lighting, and other industries. The development of optical communication technology is conducive to accelerate the transformation and upgrading of the traditional lighting LED industry and improving the information level of the traditional lighting industry. Meanwhile, the emerging optical communication technology, characterized by the integration of lighting and communication through reusing lighting LED lamps as transmitters, can effectively improve the resource allocation and utilization efficiency of traditional lighting facilities. It is in line with current urgent needs of green and sustainable development, conducive to reducing global resource consumption and carbon emissions, and helps society to achieve the goal of “carbon neutral” as soon as possible.



The successful deployment of the proposed OCC system can not only break through the technical bottleneck in the field of OCC and form emerging practical optical communication products, but also effectively enhance the technological innovation level of the traditional lighting industry and cultural tourism industry, so as to promote the formation of digital economy-driven development mode with local quality in each region.

09

A Synchronization Method for Optical Camera Communication



Nanchang University
(Wufei Wu, Qiurong Yan, Haijie Li, Yonghua Chen, Wenbo Wan, Yulei He, Zhimin Liao, Hui Chen, Zihua Tang)

Brief Introduction

In order to solve the problem of data loss between image frames in optical camera communication (OCC), this paper proposes a synchronization method. While considering the performance differences of different cameras, this method achieves no data loss communication between image frames in OCC system with high information transmission rate and strong compatibility by designing the communication protocol, artificially controlling the receiving time and processing time of cameras, and specifying relevant parameters. Meanwhile, we have tested the parameters which influence the OCC system and verified the feasibility of synchronization method through the establishment of the OCC system.

The Innovation Points

Visible Light Communication (VLC), is a technology which transmits optical signals by controlling the light source with high-frequency flicker that is imperceptible to human eyes. As a vital branch of VLC, OCC has already been incorporated into IEEE 802.15.7r1 standard. Compared with traditional VLC technology, OCC selects the image sensor of camera as the receiving end, rather than a traditional photoelectric sensor. Despite the higher cost, such improvement not only retains the advantages of high security, free frequency band and high resistance of electromagnetic interfering, but also modulates the color of light expediently due to the features of the image sensor, enabling information to be transmitted on different color channels. It can also conveniently receive optical signals from multiple light sources to realize multiple input and multiple output (MIMO) optical communication. Simultaneously, since the current ambient light sensors in smartphones are lightweight and cannot support high-speed visible light communication, OCC technology is expected to apply visible light communication technology to mobile phones. In addition, OCC technology can also be applied to the 5G technology and IoT (Internet of Things), and has a wide range of application scenarios indoors and outdoors. It can be seen that the research on OCC technology is of great practical value.

Research on OCC technology is also very extensive, mainly focusing on anti-interference, improving data transmission rate, and increasing communication distance, etc., the problem of image inter-frame data loss caused by desynchronization at the transmitter and receiver is also a research difficulty, and many researchers have carried out relevant research in this field. Existing solutions mostly send each frame of data twice consecutively, so as to ensure that at least one complete frame of data can exist in each frame of image data received by the camera, and some even propose to send each packet three times consecutively.

Although this way can theoretically avoid data loss, but the transmission by sending multiple times consecutively results in low effective data transmission rate of information; Yongheng Dai took another approach and proposed to use a high-resolution image sensor to complete the transmission of information within one image frame, but this method possesses less communication data and the high-resolution image sensor implies high cost, which is unfavorable to the wide application of OCC technology. In addition, since there are many parameters in the system that have impact on the OCC system and may result in the failure of the synchronization method proposed by the above researchers on some specific parameters, it is necessary to systematically test the effect of each parameter on the OCC system in order to consider the compatibility of synchronization techniques. Therefore, in order to ensure the compatibility of the proposed synchronization method, it is necessary to change the focus of the tests and systematically test which parameters affect the performance of the proposed synchronization method, and to propose solutions to avoid these effects. In summary, it is necessary to propose a synchronization method for OCC that is highly compatible and maintains a high transmission rate to solve the problem of data loss between image frames due to the desynchronization of transmission and reception.

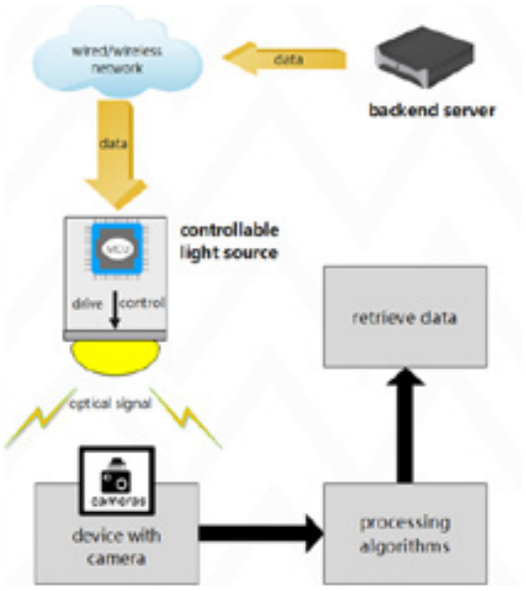


Figure 1 Schematic diagram of optical camera communication system

The project has three main innovations as follows.

1. We propose a synchronization method which achieves the highest possible information transmission rate while preventing data loss between image frames by designing the communication protocol format and artificially

controlling the reception time and processing time of the camera and other ideas.

Figure 2 Proposed synchronization protocol data frames for optical camera communication

2. We have made considerations for the compatibility of the technology. Different performance cameras and different light sources can affect the OCC system, which may make the synchronization method ineffective, so it is necessary to regulate the relevant parameters to ensure that the synchronization method can perform optimally in different situations.

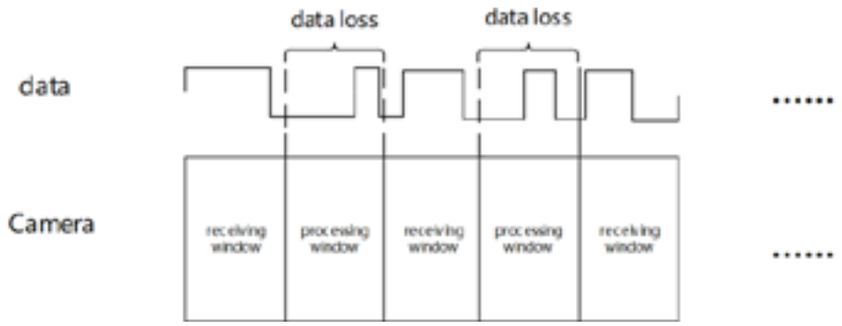
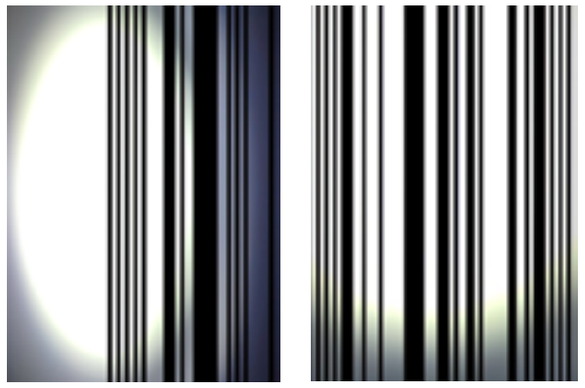


Figure 3 Synchronization protocol reception processing process

3. We have conducted relevant experiments to systematically analyze the effects of different parameters on the synchronization method and to verify the feasibility of the method in this paper. Moreover, we have concluded that the method of this paper has higher information transmission rate and stronger compatibility by comparing with the existing techniques.

Synchronization method validation



(a) The first frame (b) The second frame

Figure 5 Example diagram of synchronization method

The above figure is an example of misalignment case I and its correction. At this time, the light source blinks at a frequency of 1KHz, where the invalid data part is the continuous signal 1, the start mark and the end mark are four alternating 1 and 0 signals, and the data part is random data.

It can be concluded that the proposed method in this paper is feasible and can ensure that no data loss occurs between image frames. This method has less redundant parts compared with previous methods and improves the information transmission rate. In addition, since we systematically test the impacts of each parameter on the OCC system, the compatibility of the synchronization method can be enhanced by specifying the relevant parameters.

Possible Economic and Social Benefits

Combining the characteristics of visible light communication and camera, the invention provides a synchronization method for LED visible light communication for camera, which can be used for one-to-many fast communication and positioning function between LED light source and optical lens with accurate positioning, and can be applied to indoor positioning, check-in based on visible light communication, and other scenarios, which is an underlying technical principle to expand more innovative applications derived from smartphones and other mobile devices. While expanding the new check-in positioning technology, indoor positioning scheme, and identity verification method, we optimized the optical lens-based receiver synchronization protocol to improve the accuracy and anti-counterfeit signature capability, and reduce the response time and the complexity of use that can integrate optical communication positioning. We also proposed a supporting check-in method, which not only considers the practical problems such as data loss and compatibility at the receiving end, but also designs the corresponding synchronization method and image processing algorithm, and it has been proved to be reasonable and reproducible via specific experiments. The following are two typical application scenarios for OCC systems.

Scenario I: A light source is required to send a certain segment of data cyclically, for example, the light of a roadside billboard can provide illumination while sending a cyclic message of light containing an advertisement. If this segment is long, it is necessary to set the total number and number fields in the use control overhead section to group the information. In this case the receiver can start the light signal acquisition at any point in time, and since the sender is sending signals in a cycle, the receiver can acquire all the information sent by the sender in a shorter period of time as long as it completes the misalignment correction first.

Scenario II: Point-to-point OCC communication. At this point, the light source can first send several synchronization signals, which are only used for pre-correction at the receiving end, so the data part can be set to any value. After finishing the misalignment correction, the light source starts to send the information to be transmitted continuously, and there will be no problem of data loss between image frames at the receiving end, so that the communication can be carried out normally.

Based on the synchronization method for optical camera communication, we have invented a camera-based LED visible light communication check-in system and method, which consists of a check-in machine, an intelligent LED light source, and a back-end server.

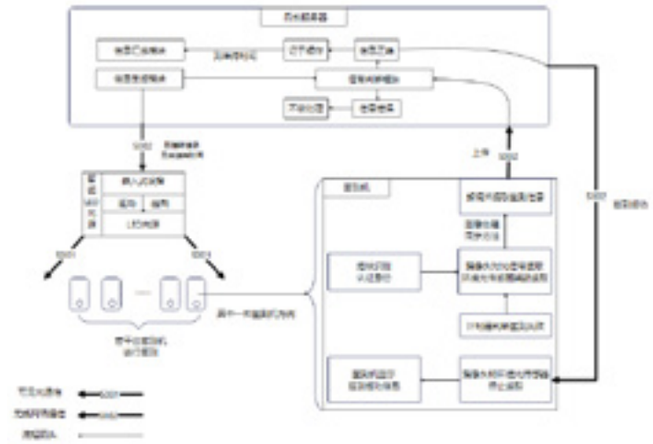


Figure 4 A camera-based sign-in system and method for LED visible light communication

Smart Billboard

Short-range Communication

There are many application scenarios of this method. For example, we can load the purchase link of the product in the background light of the billboard to realize the hiding of the two-dimensional code. In addition, distance communication can be realized, and the camera and flash of the mobile phone are used as the communication transceiver of the OCC respectively, and the derivation of the mobile phone APP can be expanded.

10

GaN-on-Si Mini LED Blue & Green Chip

LatticePower (Jiangxi) Corporation

Brief Introduction

The company is a leading provider of high performing HP LED chip, package and module products for general and specialty lighting applications.

The company has developed blue and green Mini LEDs using our pioneering GaN-on-silicon technology. The mini-LEDs are single-sided emitting LEDs with a thin film vertical design, have excellent performance in terms of contrast and viewing angle when used in display. These blue and green mini-LED die structure design is the same as the vertical chip red LED design used in the display, can fundamentally solve the metal ion migration problem associated with the lateral mini-LED die. This vertical die Mini-LED product won the 2019-2020 China LED innovation technology and Product Award. Currently this blue-green Mini-LEDs have gone into mass production successfully and being used in Mini RGB displays.

Currently, most direct displays use AlInGaP red mini-LED in combination with blue and green lateral Mini-LED. But lateral mini-LED has both contacts on the top and red mini-LED is vertical design. This create layout and wire-bond problems because lateral die needs two wire-bonds. In lateral mini-LED die, the distance between the P-contact and the N-contact is very close and have metal migration problem. By using blue and green vertical mini-LED chips in combination with red vertical mini-LED chips, the red-green chips can match the positive polarity with red LED chip, can have the same thickness of all three-color LEDs, and no metal migration caused sudden failures for the pitch P0.7mm or higher.

When using our vertical mini-LEDs in a display, we can achieve high-performance with high contrast ratio and good color gamut at the pitch from P0.7 to P1.0 mm while simplifying the die layout within a pixel and reducing the number of wire-bonds. Comparing to flipchip mini-LEDs, the price of each vertical structure RGB LED chip combination is about half of that price of RGB flipchips. The vertical mini-LED cost can be further reduced by 1/3 in the future. Although the vertical structure chip requires a wire bonding process in the packaging process, the

existing wire-bonding equipment in the packaging factory can satisfy the production requirement, which can significantly reduce the capital investment comparing to flipchip transition. Using our vertical Mini-LEDs in a HD display one can achieve a pitch between P0.4 to P0.6, because reverse polarity red LED can be used to match the blue and green LED chips with vertical structure, which takes up less space, can share anodes with each other.

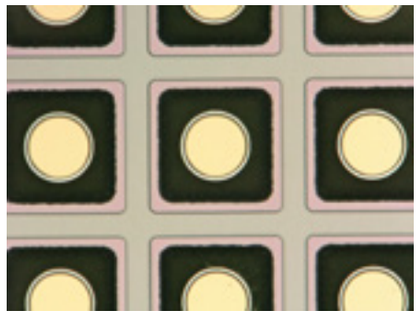


Fig 1 Picture of vertical Blue-green Mini-LEDs by GaN-on-Silicon technology

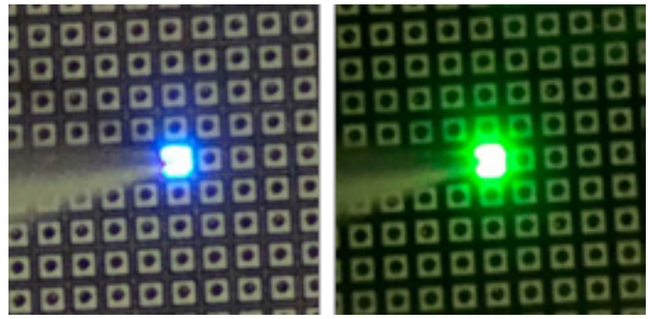


Fig 2 Picture of Blue-green mini-LEDs by GaN-on-Silicon technology

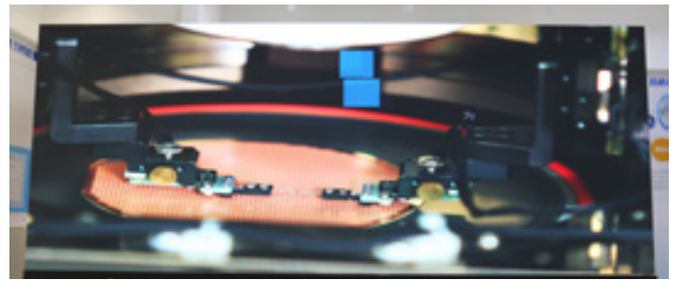


Fig 3 Practical case of the company’ s Mini-LED used in high-definition display

The Innovation Points

Technological innovation：

The company developed GaN-on-Silicon blue LED technology and won the first prize of the 2015 National Technology Invention Award. Using this technology The company developed vertical structure blue and green Mini-LED chips for HD direct display market.

This product uses our own IP and are worldwide patent protected. Using all vertical mini-LEDs in a display, our customers can achieve better display effect(three RGB chips emit light on the same plane), better yield(two wires less than traditional lateral chip), and higher manufacturing efficiency. Current mini-LED packaging manufacturers can use existing equipment in the packaging process without any extra investment as in the case of switching to flipchip.

Key word：kill "caterpillars"

At present, there are three main RGB chip solutions for Mini high-definition display:

1. Use blue and green lateral chips in combination with a red vertical chip

2. Use flipchips for all three colors.

3. Use blue and green vertical chips in combination with positive or reverse polarity red chip

In lateral mini-LED chip, both P and N pads are on the top. When the chip size shrinks for HD applications the distance between the P and N pads are very small. During long term usage, metal will migrate under drive potential and cause shorting and sudden failure. This phenomenon is called caterpillar effect. The smaller the pitch in display, the more seriously erosion in the LED surface because of "caterpillars". The vertical structure of our vertical Mini-LED solution has natural advantages to solve this problem.

There are three main advantages.

1. The distance between the positive and negative electrodes of the vertical structure chip is greater than 80μm. The distance between positive and negative electrodes of the horizontal structure chip will be closer with the chip size decreasing. For example, the electrode distance in 6×8mil chip is 68μm, while the distance in 4×5.5mil chip is close to 26μm. Due to the large spacing between the positive and negative electrodes in the physical space, even if metal ion migration occurring, the time to form caterpillar is longer by 4 times , which significantly improves the reliability and stability of the product.

2. We use inert metal electrodes Ti/Pt/Au cover all the surface of the vertical structure blue-green LED chip, which can protect chip from corrosion caused by metal migration. The electrode materials of lateral chips use ITO/Cr/Al, those are highly reactive materials and prone to metal migration.

3. Lateral LED chip die attachment use insulating glue, it has low thermal conductivity. For HD display the chips are packed with high density and the overall power density is higher and thermal effect is more problematic. Compared with lateral chips, vertical structure LED chip uses silver epoxy which has b etter thermal conductivity, and the reduced temperature inside the lamp greatly reduce the speed of metal migration.

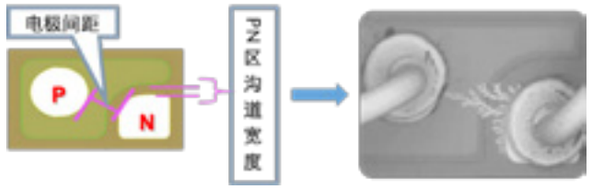


Fig 4 The "caterpillars" phenomenon in lateral structure LED chip for metal migration

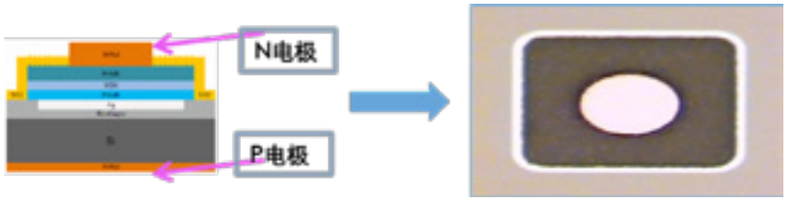


Fig 5 The better spacing of the vertical structure greatly reduces the metal migration

Keyword：Higher performance cost ratio

Performance cost ratio is one of main reasons to determine business outcome. In HD display, compared with lateral chip, our vertical chip is single-side emission which has no side light and the light interference between neighboring pixels will be less for small pitches. The smaller the pitch spacing, the lower the optical loss, so the luminance of the vertical chip is great than the lateral chip. Moreover, since the vertical structure RGB LED are all single-sided emission, compared with the five-sided light-emitting of lateral chip and flip-chip, vertical structure mini-LED made HD displays has better display clarity.

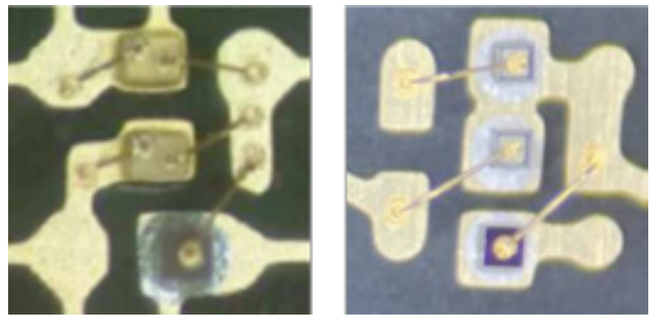


Fig 6 The lateral structure RGB (left) requires 5 wires, the vertical structure RGB (right) only needs 3 wires

In terms of cost, the vertical structure blue and green LED chips can match the most common vertical structure red LED chips. RGB vertical structure chips price is about half of flipchips

At the same time, the packaging process of the vertical structure is highly mature, and the existing packaging equipment can be completely generalized without new equipment investment. However, the flip-chip solution needs a huge capital investment. Overall, the vertical structure scheme at this stage is the best choice for Mini LED Displays.

In terms of production yield, there are two wires less in vertical structure LED than in the lateral structure LED in the package. Our vertical chip can greatly improve production efficiency and lower production cost.

Possible Economic and Social Benefits

With the continuous evolution and application of 4K/8K display technology with Mini/micro LED technology and people's yearning for a better life, the market demand for HD LED displays is increasing at high rate. China is a major manufacturer of LED display screens. In 2018, the U.S. company Ultravision filed an investigation application with the U.S. International Trade Commission under Section 337, and filed patent lawsuits against major companies in the Chinese LED display industry, including Absen and Leyard. Although the Chinese side won the lawsuit after three years of patent litigation, the danger of patents has always shrouded China's LED display industry. GaN-on-Silicon Mini LED blue-green chips are developed by the company and is worldwide IP protected. At the same time, our vertical mini-LED product provides a cost-effective option for Chinese LED displays to be promoted to higher-definition and higher-end markets.

11

UV-A Curing Light Source Based on GaN-on-Silicon LEDs

Jiangxi LatticePower Semiconductor Corporation

Brief Introduction

Compare to traditional UV light sources, such as mercury arc lamp and microwave electrodeless lamp, UV LEDs have long service life, high efficiency, low voltage, low temperature, better safety profile, low operation cost, and mercury-free, no ozone generation and many other advantages. UV-A LEDs are becoming the new preferred UV light source for applications such as epoxy curing (UV adhesives, UV ink, UV coating and 3 d printing), and other fields. It has low energy consumption, lower operation cost, long life, environmental friendly and pollution reduction to the light curing industry.

In recent years, high quality wide bandgap semiconductor materials aluminum nitride (AlN), gallium nitride (GaN), indium gallium nitride (InGaN), aluminum gallium nitride (AlGaN) and aluminum indium gallium nitride (AlInGaN) have been developed successively. UV LED light source based on these materials emitting near UV spectrum (405nm, 395nm, 385nm, 375nm, 365nm, etc.) had begun to be used in the field of optical curing. But this market is dominated by top ten LED companies using GaN-on-Sapphire technology.

Latticepower developed GaN-on-Silicon LED technology in 2008. Based on the technology Latticepower developed high performance thin film vertical chip in the wavelength range of 365nm to 600nm. In the UV-A wavelength range of 365-410nm, we are able to achieve equal or better performance than LEDs based on sapphire technology. Our UVA LED products (chips, packages and modules) are in the market since 2014.

GaN-on-Silicon UV-LED has two significant advantages over sapphire based UV-LEDs. First, silicon substrates can be easily removed by wet etching with good stability, high yield and low cost. In contrast, sapphire substrates based vertical chips require laser liftoff to remove the sapphire substrate. The laser liftoff process can create micro-damage to the MQW and has negative effect on process yield and device reliability. Second, GaN-on-Silicon technology can be more easily expand to large size substrates (6-8 inch) compare to sapphire substrates and potentially greatly reduce the cost of the LED.

Currently, our GaN-on-Silicon UV-LED products have been applied in the fields of optical-curing, photocatalyst, photocopying, home furnishing, nail art, 3D printing etc.

The Innovation Points

Different from blue LED chips, UV LED light source need special structure design from epi to device and optical module. The main technological innovations adopted by the company are:

1. Developed a unique graded strain releasing transition layer between the silicon substrate and the GaN layer to overcome lattice constant mismatch and CTE mismatch on four inch silicon substrates in order to solve the surface cracks, holes, warpage and other problems to achieve high material quality. Developed high IQE UVA MQW and low defect density GaN template for high efficiency, low voltage and superb reliability.

(1) developed larger bandgap AlGaN layer as N-type and P-type transparent cladding layer. Developed unique electron blocking P-ALGaN layer, low TDD GaN template to ensure high light efficiency and better high temperature performance.

(2) The V-pits structure in the active light emission region was developed and optimized. Combining with the adjustment of the barrier structure in the active region, the MQW internal quantum efficiency was significantly improved, and the optical output power was increased by more than 5%.

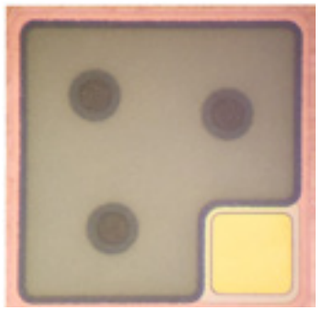
2. High efficiency silicon substrate UV LED chip manufacturing technology was developed for stable high-volume production, developed high reflectance P-contact metal, surface roughing and, N-type via vertical chip structure, metal-insulation-metal multi-layer technology.

(1) Using silicon substrate vertical chip structure, single side emission, high light efficiency, compared with competitor's flipchip or laser liftoff based vertical chip structure, our LED chip has better current spreading, more uniform optical emission profile and higher reliability;

(2) The development of a new generation of silicon substrate UV LED vertical structure chip with n-type via structure, the N-type metal through the via-hole and n-GaN contact, all the N metal through the hole are connected to the chip substrate, to achieve more evenly distributed current.

(3) Metal-insulation-metal multilayer technology is developed. N-type metal makes ohmic contact with N-AlGaN through the perforation hole to avoid light blocking, further improve the extraction efficiency of the chip, and alleviate the "Droop effect" at large current;

(4) Advantages of silicon substrate UVA chip: directional light emission, good heat dissipation, high energy density, suitable for curing applications with high energy density requirements. Independently developed LED technology with IP protection.



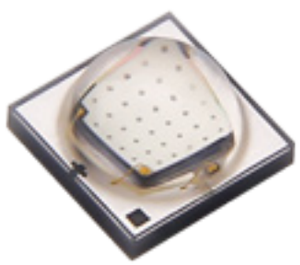
TF4646 chip

TF1717 chip

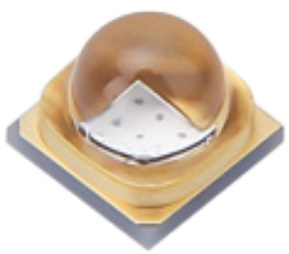
3. The use of optimized ceramic packaging technology to achieve higher power and higher reliability of UVA LED lamp, with wavelength from 365nm to 415nm. Using optimized ceramic substrate, UV-resistant silicone and other packaging materials, optimize the packaging structure form factor and LED glass lens shape developed 3535/3838/6868 LEDs with high power density requirements.

(1) Nano-silver epoxy is used for chip bonding, UV resistant silicone, high thermal conductivity substrate and other materials are selected to improve the LED heat dissipation and reliability, and a new 55° small-angle primary optics is designed.

(2) Silicon substrate UVA packaging advantages: high quality alumina and aluminum nitride substrate to achieve high thermal conductivity, gold and tin eutectic and silver epoxy solid crystal to ensure higher reliability, small Angle optical design to better fit the needs of industrial curing.



VE series LED



VS weries LED

4. Provided customized UVA module for our customers, using PCB modules and COB products with various sizes and power requirements, and direct system embedded design services and complete solutions provided to our customers. Our products are used in ink/paint curing, industrial curing, manicure, and other curing applications.

UVA curing module product advantages:

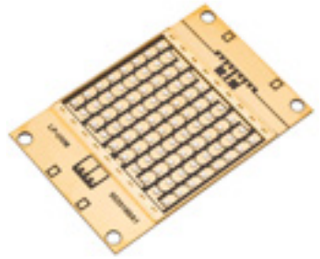
(1) High reliability GaN-on-Silicon UVA LED chip;

(2) Flexible design of substrate circuit, product size and power can be customized according to customer requirements.

(3) Wavelength: 365~410nm;

(4) UVA series COB products use aluminum nitride substrate

(5) With high reliability, high thermal conductivity, vertical emission, high energy density.



Lp-uvm5632150a1 Curing module

LP-UVM5535180A1 curing module

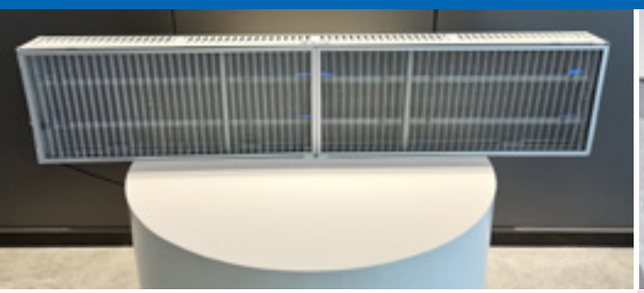
Possible Economic and Social Benefits

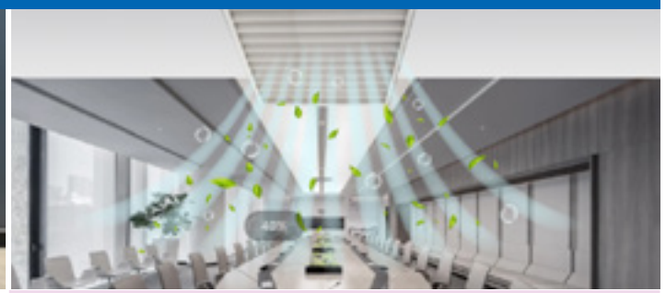
UV-A industrial curing using our UV-A LEDs and curing modules greatly improved the customer's curing quality, energy consumption, equipment lifetime and reliability, operation cost. Provided great economic benefit to the customer with an operation cost reduction of more than 50%.

Our GaN-on-Silicon LEDs can replace more traditional sapphire LEDs and improve curing efficiency and reduce customer equipment cost. Latticepower's UV-A LEDs and modules are quickly gaining market share since its introduction to the market.

12

Immune Architecture Innovation Project Based on Deep Ultraviolet LED Disinfection Technology





Lishui Zhongke Semiconductor Material Co., Ltd.
Ningbo UVTEK Co., Ltd.

Brief Introduction

The global COVID-19 pandemic is still not under effective control. The virus is mutating rapidly and spreading more and more efficiently, making the situation of epidemic prevention and control grim. Nanshan Zhong, academician of the Chinese Academy of Engineering, said that indoor environments are the most important places for the spread of COVID-19pandemic. As long as there are crowded public places, the efficient air purification disinfectors should be available. The transmission of COVID-19 is mainly through breathing, droplets, aerosols and suspension in the air, so the air disinfectors should be used as supporter to resist the virus.

At the press conference of the Joint prevention and control mechanism of the State Council of China, LiuboZhang, chief expert of virology at the China Center for Disease Control and Prevention and director of the Disinfection Center of the Environmental Institute, stressed: Central air conditioning in shopping malls, supermarkets, theaters and other indoor spaces, whether it is all-air system, or fan-coil + fresh air system, should use air purification and disinfection devices to disinfect the return air, otherwise it should adopt the all-fresh air mode. The operation with maximum fresh air volume is only a transitional stage, and it should be operated as soon as possible with full fresh air, or after disinfection of return air.

Airborne transmission is the main mode of transmission of COVID-19. In particular, the current COVID-19 variant strain is highly infectious and can be suspended in the air and spread to tens of meters by air flow. Therefore, we should pay more attention to it and use a more effective way to prevent COVID-19 from the air. Therefore, all-round ground to air disinfection treatment is the top priority of epidemic prevention and control. Diagnosis and Treatment Protocol for COVID-19published by the National Health Commission of China from the fourth edition to the latest ninth edition points out that COVID-19 is sensitive to UV light and heat, which confirms that COVID-19 can be effectively disinfection and sterilization in a scientific and reasonable manner.

This Project is dedicated to using the deep UV LED technology to solve the problem of epidemic prevention and control in high human flow public airtight places such as administrative office buildings, hospitals, schools, railway stations, airports etc. By analyzing the environment of human flow and air flow in the ventilation system, conference rooms, toilets and other functional places in the building, and adhering to the "people-oriented" concept, the principle of human-machine coexistence, with our mature deep UV LED technology, we have developed and produced a series of products suitable for environmental requirements based on the characteristics of high human flow public airtight places, comprehensively solving the air environment inside the building and carrying out real-time comprehensive sterilization and disinfection. By building immunization building projects, improving health infrastructure conditions in public places, and building a safety barrier for epidemic prevention and control, it has played a positive role in curbing the spread of the epidemic, improving the prevention and control capacity of the epidemic, and building a work system for public health safety prevention and control.

The Innovation Points

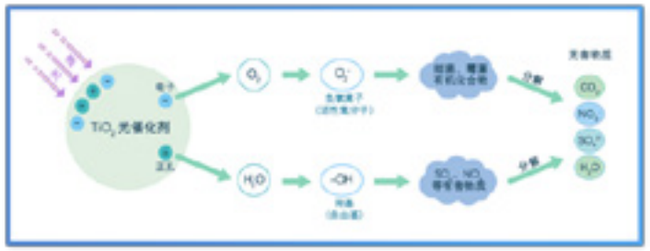
The innovation points of this Project are as follows:

Innovation point 1: Green and efficient virus removal by new UV light source disinfecting technology

The traditional UV mercury lamps are highly toxic and fragile raw materials, posing a great risk to environmental safety, and work with high energy consumption. China has signed the Minamata Treaty, which bans the production and import and export of mercury-containing products from 2020, limiting the application of UV products. The deep UV LED based on the third generation semiconductor GaN material can kill bacterial propagules, budding cells, viruses and fungi with high efficiency by destroying DNA and other genetic material. The product has a service life of up to 15,000-20,000 hours and has the advantages of broad spectrum, low power consumption, energy saving, not entering the food chain and no pollution to the environment, realizing green safety and high efficiency without pollution.. The deep UV LEDs produced by the company have been tested by authoritative institutions and can completely kill the new coronavirus in three minutes, and also have more than 99.9% of the effect on other viruses.

Innovation point 2: New Photoconductive Fiber Photocatalyst Technology-Combination of Disinfection and Purification

Through UV light irradiation on the nano- TiO2 photocatalyst to generate electron hole pairs, the reaction generates the hydroxide radicals (OH-) and superoxide ion radicals (O2-), which are very active in oxidation. Through air circulation, the purification factor actively diffuses to all corners of the room, breaking the passive situation of the traditional disinfection mode, and oxidizing various waste and odour gases such as aldehydes, benzene, ammonia, amines, phenols and other TVOC organic substances into carbon dioxide (CO2), water (H2O) and other non-toxic and harmless substances in the environment in a proactive and comprehensive manner, thus purifying the air in real time. The entire reaction process is safe and non-toxic without secondary pollution, truly green, comprehensive and thorough without dead corner.. As long as photocatalyst does not wear and flake, it will not change and lose itself. Under the irradiation of light, it can continuously purify pollutants and has the advantages of lasting time and lasting effect.Double sterilization and disinfection purification with deep UV LED + photoconductive fibre photocatalyst to ensure the safe indoor air quality.



Innovation point 3: Optimized optical thermal field design-Intelligent disinfection of human-machine coexistence

The deep UV LED air disinfection device of the ventilation system is installed in the ceiling, which does not occupy space, has low resistance and no noise. It does not modify the internal circuit of the air conditioning and fresh air system, and does not affect the work of the original equipment; the pathway is designed to achieve synchronous start and stop of the UV germicidal lamp and the fan of the air conditioning unit, the wind moves, the lamp lights up and the bacteria is extinguished in one go. The product has been tested by authoritative institutions and the ultraviolet ray leakage and ozone leakage are far below the Chinese national standard, truly achieving a harmless disinfection effect of human-machine coexistence.

Application notes for the product range of this Project.

1. Ventilation system equipped with deep UV LED air disinfection devices

In response to the problem of different brands and models of central air conditioners in the building being difficult to work together, the company has developed deep UV LED air disinfection devices of different sizes, which can be produced in different sizes according to different air outlets in the whole building and installed in each air conditioning outlet. Through the dual disinfection and purification combination of deep UV LED + photoconductive fibre photocatalyst, the company uses the air circulation disinfection and active attack principle to achieve real-time disinfection and purification of the air, with a disinfection rate of 90%, strictly ensuring that the bacteria count in the air of the building reaches the standard.

2. Conference room or office is equipped with air disinfection and purification machine

For conference rooms or offices, where people are relatively dense and the space is relatively closed, air disinfection and purification machines are placed to circulate and sterilize the air in the room, purifying the air and removing germs. Tested by authoritative institutions, the company's air disinfection and purification machine works for 2 hours in a confined 20m^3 space, the killing rate of white staphylococcus reaches more than 99.9%, and for 2 hours in a confined 60m^3 space, the extinction rate of natural bacteria in the air reaches more than 90%, ensuring real-time air quality.

3. Installation of intelligent germicidal lamps in public toilets

In order to prevent the potential for fecal-oral transmission of the novel coronavirus in public toilets, where there is a lot of foot traffic, the deep UV LED intelligent germicidal lamp shall be installed in each toilet compartment for rapid disinfection after people have gone to the toilet, preventing contact transmission or aerosol transmission caused by faecal and urine contamination of the environment.

4. Sterilization and disinfection solutions for elevator button and vertical elevator

For the problem of crowded elevator, closed environment and cross transmission of bacteria on the surface of the elevator button, UVC- LED vertical elevator germicidal lamp is installed inside the vertical elevator, using the principle of pyroelectricity, the light goes out when people come, and automatically goes out after 30s when people leave; UVC-LED elevator button germicidal device is installed on the elevator buttons. Both provide a complete disinfection of the chaotic air inside the elevator and of the bacterial viruses transmitted by frequent contact on the buttons by means of UV light respectively.

5. Establishing an environmental monitoring system to monitor the real time air quality.

By establishing a UV product monitoring system inside the building and an office environment quality monitoring system, the operational status of germicidal products and ambient air quality are monitored in real time.

Installing display screens in the ground floor lobby to display various types of summary information in real time to strictly ensure air quality.

Lishui Economic and Technological Development Zone Management Committee Building--Immune architecture innovation demonstration project

Possible Economic and Social Benefits

The company has undertaken some government buildings, administrative service hall, hospital, street offices and other immune building renovation projects in southwest Zhejiang, China, and has completed some renovation projects at present. After the installation of deep UV LED sterilization and disinfection system, the real-time disinfection of the public space of the whole building will be realized, and the number of bacteria after disinfection will meet the norms and requirements of China's national health related standards. The implementation of this Project will play an exemplary and leading role in epidemic prevention and control in public places with high human flow, and will play an important role in strictly ensuring air quality, curbing the spread of the epidemic and improving the prevention and control capacity of the epidemic.

Next, the company will introduce immune building engineering into new projects and other fields, give full play to the function of "immune building" and "immune system", and enhance the health and safety prevention capacity of public places, and ensure the healthy operation of economy and society.

13

Innovative Application of Deep Ultraviolet LED Package Sterilizer in Beijing Winter Olympics

Advance Ultraviolet Optoelectronics Co., Ltd.

Brief Introduction

Introduction: In order to protect public health, Advance Ultraviolet Optoelectronics Co., LTD has carried out deep UV LED special equipment manufacturing, deep UV LED chip manufacturing and anti-virus disinfection application product development. The company developed ZK-BG01 package sterilizer based on UVC disinfection technology. The sterilizer is capable of killing bacteria and viruses with sterilization rate of 99.9% on the surface of daily packages without residue and damage. In addition, protective curtain is deployed at the end of conveyor to prevent UV radiation leakage and protect user safety.

Application scenarios: During 2022 Beijing Winter Olympics, in view of the current severe situation of epidemic prevention and control, the Beijing Winter Olympic Games Organizing Committee invited the company to discuss the prevention and control plan. UV sterilizer, air sterilizer and disinfection robot were exclusive supplied to the Beijing Winter Olympics command center of Shijiangshan District, Olympic village in Zhangjiakou and Olympic Logistics Center in Beijing, which contributing scientific and technological strength to the epidemic prevention of the Winter Olympics and improving the overall display of the intelligent epidemic prevention of the Winter Olympics. Health commission of Shanxi province has issued license to the disinfection products produced by the company and over 30 types of DUV LED based sterilization products have been developed for various application scenarios including hospital, school, public transportation to boost public health security foundation.

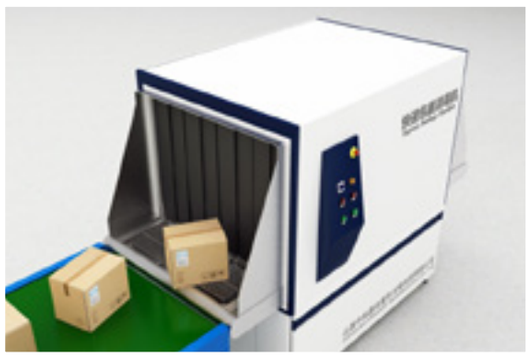
Effects: The package sterilizer developed by Advance Ultraviolet Optoelectronics Co., LTD has good and reliable performance. The sterilizer is equipped with thousands of deep UV LEDs, which will be turned on automatically once the packages are loaded and detected. By doing so, each side of the loaded packages will be illuminated by enough doses of UV irradiation for disinfection. Therefore, bacteria and COVID-19 viruses will be effectively inactivated within seconds. For user safety reason, protection curtain is deployed at each end of the conveyor to prevent UV leakage. The bottom conveyor belt adopts electric rolling barrel or high load bearing stainless

steel network design, which provide the capability of high load bearing, high reliability, with originality and uniqueness in the market. During 2022 Beijing Winter Olympics, the sterilizer ensures the safety of public health and has become one of the most important aspects of the epidemic prevention and control, which has received widespread praise from the organizing committee.

The Innovation Points

The Minamata Convention on Mercury, which restricts and eliminates traditional mercury-containing products, came into force in 2020. As a new generation of UV light source with characteristics such as energy efficiency and environmental-friendly, UV LED has gradually become the mainstream of technology. With the rapid outbreak and wide spread of COVID-19 pandemic around the world. UV LED has attracted extensive attention due to its capability of killing the virus and related products have been launched continuously. Overall, the UV disinfection technology is based on modern epidemic prevention science, medicine and light dynamics, on the basis of using the special design of high efficiency, high strength and good reliability of UVC irradiation. The UV disinfection technology is broad spectrum on eliminating bacteria, tuberculosis, virus, buds and fungi effectively. UV LED is a highly efficient light source with a list of advantages including compact size, low energy consumption, non-toxic, harmless, long lifetime, no ozone generation, etc. Therefore, UV LED and disinfection technology has obvious technical advantages among its counterpart.

From the 4th edition of the COVID-19 diagnosis and treatment protocols issued by the National Health Commission, it has clearly mentioned that COVID-19 virus is sensitive to UV radiation and heat. Meanwhile, it has been mentioned in the 9th edition of the protocol that infection can also occur after contact with items contaminated with the virus. In May 2020, the research jointly carried out by the company, the Wuhan Institute of Virology and the Institute of Biophysics of the Chinese Academy of Sciences showed that the killing rate of anti-novel Coronavirus was higher than 99.99% when the deep UV LED was illuminated for 1 second.



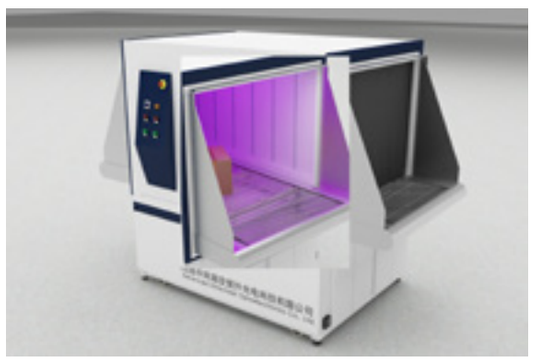
As far as the equipment structure is concerned, the sterilizer adopts high quality steel to ensure strong stability. The bottom conveyor belt adopts electric rolling barrel or high load-bearing stainless steel net design to ensure high load-bearing and good reliability. In addition, polished pure aluminum inner wall has been used to increase the reflection of UV rays while it can pass through to the bottom of the wrapped package by using roller or stainless-steel mesh design. As far as user's safety issue is concerned, double lead curtain is set-up at both end of the conveyor to protect personal safety from UV leakage. At the bottom of the sterilizer, universal wheel is used to facilitate movement and support of the equipment. In addition, height of the equipment can be adjusted to

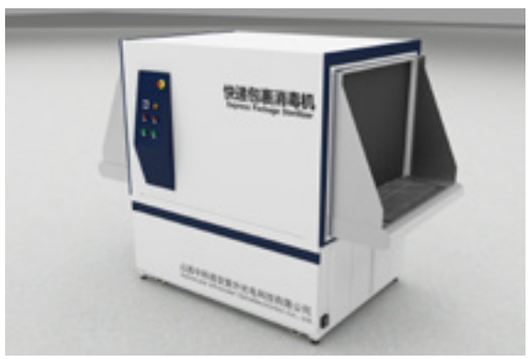
meet most use scenarios. From the function point of view, the equipment benefits from advanced deep UV LED semiconductor technology of Advance Ultraviolet Optoelectronics Co., LTD, by employing the company's high power deep UV LEDs with good reliability, the sterilizer can be instantly turned on without preheating, thus it can reach 100% power UV output and 1000 hours lifetime, three times the life of traditional mercury lamp. In addition, different from conventional light sources with heat radiation, UV LED has no thermal radiation and the surface temperature of the illuminated items inside the UV LED sterilizer can be much lower to avoid thermal damage, which is especially important to the cold chain application scenario. Meanwhile, UV LED has much lower energy consumption in contrast with mercury lamp. For instance, a 50W UV LED point light source can replace the traditional 500W UV high-pressure mercury lamp with almost zero maintenance cost.

Possible Economic and Social Benefits

The wide spread of COVID-19 pandemic and the possibility of long-term coexistence with human beings have greatly increased the attention of the industry on the UV LED based sterilization technology and products. The gallium nitride based DUV LED represented by the third generation of semiconductor material has broad application prospect. Compact, portable and easy to be design and integrated, UV LED can be integrated with air conditioners, refrigerators, washing machines, air purifiers, water dispensers and other household appliances, killing bacteria and viruses in home life anytime and anywhere, providing people with a cleaner and safer living environment and drinking water. As the world's largest manufacturer of white household appliances, China has a huge market space and remarkable economic benefits.

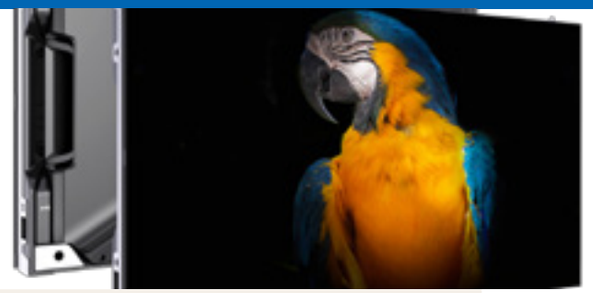
In the past two years, positive tests of COVID-19 virus have been found in the outer packaging of cold chain imported from many places, as well as in the surface of express parcels and station facilities. The constant presence of imported cases from abroad, the possibility of virus in luggage, coupled with people's attention on health and safety issue due to the pandemic, Advance Ultraviolet Optoelectronics Co., LTD has developed UV LED based sterilizer for luggage and parcels. As an innovative achievement, UV LED based disinfection technology has many advantages including environmental-friendly, high efficiency and safety. It can be deployed at airports, high-speed rail stations, bus stations, cold chains, postal and other public disinfection places to ensure public health and safety, which has huge social benefits.





14

Metasight Solution



Unilumin Group Co., Ltd.

Brief Introduction

LED displays and LED lighting used to be two different industries: the former uses graphics and video to display information, while the latter uses lights to illuminate or decorate objects and the environment. However, LED display and LED lighting are both great inventions based on LED semiconductor technology. LED Lighting and LED display of the same technical reserves, so that the integration of LED lighting and LED display has become an inevitable technological path.

In this context, the project proposed the concept of " Metasight" for the first time. Metasight means the technological integration of lighting and display. Based on LED semiconductor products, it integrates software definition, intelligent control, remote clustering, interconnection of things, 5G transmission, Ultra HD video, xR production, naked eye 3D and other cutting-edge technologies, carrying art design and content creativity. To meet the requirements of commercial, sports, cultural tourism, entertainment and urban planning industries, and provide users with industry-level scene integration solutions.

The project technology can be widely used in the following seven scenarios: commercial complex, sports complexes, film and television entertainment scene, brigade comprehensive scenario, technology and art space (museum, exhibition hall and other places of technical arts culture and education), metasight industry (command and control center, transportation, medical, military, meetings and other industry professional light show space), metasight city.

The technology of this project has been highly recognized in many metasight projects such as Riyadh Season in Saudi Arabia, Shenyan Road Intelligent Traffic metasight project in Shenzhen, China, Qingjiang River Metasight project in Enshi,Hubei, China, CCTV Spring Festival Gala Evening and so on.

1. Riyadh Season in Saudi Arabia-- Through the comprehensive application of creative content including LED display, lighting and naked eye 3D, the project successfully transformed the capital of Saudi Arabia into an immersive meeting room, attracting 14 million visitors and 100 million YouTube videos, creating an unparalleled audio-visual feast.

2. Intelligent traffic metasight project of Shenyan Road in Shenzhen, China-- 278 sets of command light poles, 300+ signal lamps for complementary light, 100+ sets of electronic police and reverse bayonet, 22 intelligent bus stations and intelligent zebra crossings, with intelligent guidance system. The project integrates traffic signal control, video monitoring, traffic guidance screen and street lighting. To complete the integrated construction of the composite urban landscape avenue.

Intelligent traffic metasight project of Shenyan Road in Shenzhen, China

3. Qingjiang River Basin Metasight Show in Enshi,Hubei, China -- over 500 million yuan large single EPV lighting project, integrated lighting, LED display, lighting in one of the integrated cultural and tourism scene light display solution, won the Golden Finger Award, diamond Award, and was reported by many media, such as Xinhuanet, Xuexi.cn, Economic Daily.

Enshi Qingjiang River Basin Metasight Show in Enshi,Hubei, China

The Innovation Points

This project is the world's first LED metasight integration solution concept, innovative work in solutions, technology integration, product design, software design, the overall technology has reached the world's advanced

level, xR virtual shooting scene display and other parts of the world's leading technology.

1. Solution innovation

In the past, LED lighting and LED display were two separate modules. Professional product providers provided separate LED display and LED lighting products, and each business segment was relatively independent. this project pioneered the concept of integrated LED metasight solution based on LED semiconductor products. Fusion software definition, intelligent control, remote cluster, exchange, 5 g transmission, high-definition video, XR, cutting-edge technology means such as 3-d, through integration solution will combination product sales, the final fusion presents the overall effect. Meet multiple scenario applications in the form of hardware + content + Design + software + planning. This is a new problem solution that other LED manufacturers have never tried, and it is also an innovation in the solution of this project.

2. Technology integration and innovation

For example, Saudi Arabia "Riyadh Season", with 7,000 □ LED large screen, spherical creative screen and naked eye 3D creative content, presents an amazing feast of light and shadow in the world with the integrated scheme of "hardware + software + content + interaction". Phoenix Mountain Sports Center and other major venues provide LED metasight products and sound and optical integration solutions, including bucket screen, fence screen, grandstand screen, scoreboard and press conference hall display screen, comprehensively integrate display, lighting, control and sound system, and help realize the integrated control of venues. Shenyan Road Intelligent traffic Metasight project, aiming at the integration of multiple poles, intensifies the construction of shenyan Road traffic signal control, video monitoring, traffic guidance screen, signs and other systems and street lighting with poles, and reserves 5G base station, environmental monitoring, Internet of Things and other smart city equipment interfaces. It effectively solves the problems such as bristly rod body, disorderly distribution network, resources and data can not be unified and effective management.

3. Product design innovation

The industry leads the r&d and innovation of Mini LED display, naked eye 3D, xR virtual photography, 5G smart rod, lighting and other products, among which the products have won many awards at home and abroad, showing the world's advanced R&D and design level: The scientific research achievements of "Key Technology and Industrialization of semiconductor Lighting with high light efficiency and long life" won the first prize of national

Metasight solution

Metasight solution-- Technology integration and innovation

Science and Technology Progress; Unano series LED display won the industry's only "Red Dot Supreme Award"; Black Agate LED display won 6 international awards including IF Gold Award, Red Dot Award and G-Mark Award. Whale LED street lamp and Uslim SERIES LED display won the Red Dot Design Award.

4. Software design innovation

UniOS, the original display lighting integrated control platform, realizes the information fusion of hardware and content, creates intelligent applications such as intelligent light show, intelligent exhibition hall and intelligent commercial complex, and solves the complicated and complicated status quo of LED display control system and LED lighting control system in the past. Realize intelligent perception, holographic perception, automatic control and application visualization of the whole business system, and provide customers with intelligent metasight solutions for all scenes.

Possible Economic and Social Benefits

1. Economic benefits

The project has completed many metasight projects such as Saudi Arabia "Riyadh Season", CCTV Spring Festival Gala in China, Qingjiang River Light Show in China and so on, with accumulated sales revenue exceeding 10 billion RMB.

In the era of video, the Internet of Everything and Digitized Interactive Applications have become a new feature of The Times. Optical display has become the connector and display of the real world and the digital world, and the entrance of public display interaction. The market size of optical display industry will reach one trillion yuan. The economic benefit of the project is promising.

2. Social benefits

The wide demand of urban night view, commercial complex, sports complex, cultural and tourism projects has promoted the rapid development of LED industry, and the metasight industry-level scene solution is meeting the market demand for "metasight".

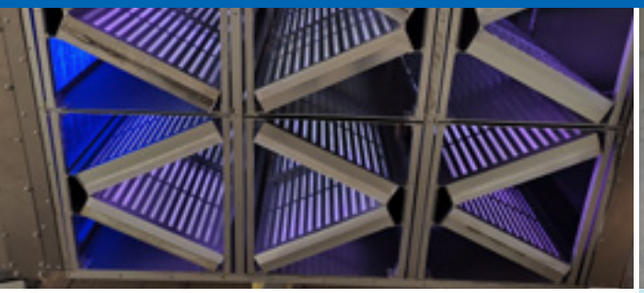
In the Saudi Arabia "Riyadh Season", the project provided 7,000 square meters of LED metasight products and integrated metasight solutions. This project is the benchmark of metasight solutions, which not only brings better audio-visual experience to people in the Middle East, but also makes China's wisdom well-known. The project was praised by the Chinese Ministry of Commerce and the Chinese Embassy in Saudi Arabia.

The optical display technology of the project was first applied in xR Filmmaking LED Display Solutions, and became the pioneer of xR immerxsive LED virtual scene technology and application in the world. The customers of technology application include Disney, Pixomondo and other Hollywood international film and television production companies, and the cooperation cases include The Mandalorian, Mank, Star Trek: Discovery, etc. To help China become the leader of LED virtual scene metasight technology for film and television shooting.

Overall, the integrated optical display solution has upgraded the LED industry to the optical display industry, thus broadening the application boundary of LED, while providing a strong impetus for the development of urban night view, commercial complex, sports complex, cultural tourism projects and so on.

15

Application of UV LED in Environmental Protection Treatment —— Treatment of Waste VOCs and Odor Gas



Guangdong Yue Puritech Co., Ltd.

Brief Introduction

In the field of waste gas treatment in environmental protection industry, the attention on VOCs and odor gas treatment has gradually increased, and relevant policies have been issued continuously.

Taking 200 cities and regions in China as a case, the governance cycle is calculated as three years. It is conservatively estimated that the market scale of VOCs governance will reach 180 billion yuan in 3-5 years, with an average of 30 billion-60 billion yuan per year.

The existing industrial VOCs and odor treatment technologies and schemes have various problems, such as large investment, high energy consumption, difficult to reach the standard, and accompanied by the generation of solid hazardous wastes or waste liquids. Environmental protection supervision is becoming increasingly strict, and a new technology is needed to make up for the shortcomings of traditional technologies.

New semiconductor photocatalysis technology developed by the company completely based on independent intellectual property rights, It can efficiently decompose almost all organic matter VOCs and remove odor gas under normal temperature and pressure, The UVA LED photocatalysis unit has stable physical and chemical properties, corrosion resistance, intrinsic safety, explosion-proof, no pollution and the materials recyclable .

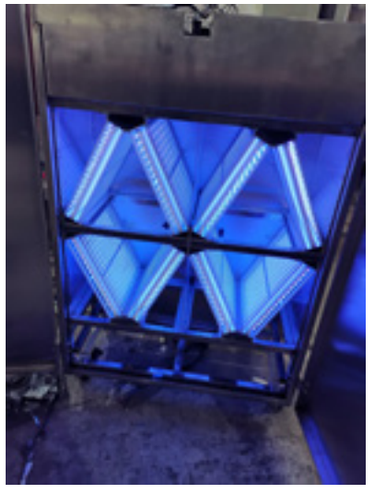
The UVA LED photocatalysis unit is less affected by temperature and humidity, so it can directly replace the activated carbon adsorption VOCs method and reduce the use of activated carbon. Direct carbon reduction and help enterprises reach the VOCs emission standard.

For industrial environmental protection VOCs and odor gas control, it can provide new solutions and products.

The Innovation Points

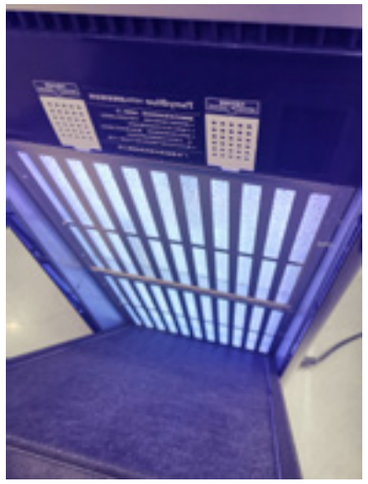
The TCSA 072-2021 standard 《technical requirements for UVA LED module for photocatalysis》 issued by the CSA has been officially released, and has been approved by the ISA standard of the international semiconductor lighting and Industry Alliance, it is the first officially released UV LED application standard in the world, and The ZhongGuanCun standard T/ZSA 82-2021 《technical specification for UVA LED module for photocatalysis》 is also released .

The photocatalysis unit based on UVA LED light source has been tested by a third-party laboratory, and the removal rate of sterilization and disinfection within one hour has exceeded 99.90%. The removal efficiency of formaldehyde, TVOCs, toluene, xylene, hydrogen sulfide, ammonia and sulfur dioxide can reach or exceed 90% within one hour in a sealed cabin, which is 5-40 times the efficiency of similar products at home and abroad.



The photocatalysis technology air disinfector produced by the company can coexist man and machine, get CE certification. It has obtained the disinfection product certification of the China CDC.

The waste gas treatment equipment we developed has made demonstration projects in the pharmaceutical industry, chemical industry, sewage treatment industry, etc., which not only solves the problem of waste gas emission reaching the standard for customers, but also reduces the problem of high energy consumption of traditional environmental protection equipment for enterprises.



Possible Economic and Social Benefits

1. UVA LED has new opportunities to enter the huge market of environmental protection and health，Market scale reaches trillion level

2. In terms of photocatalytic application, UVA LED has completely replaced mercury UV light source, providing a new solution for the implementation of Minamata convention.

16

A Kind of Planar Emitting Lens for Tunnel Lamps

CECEP Lattice Technology Co., Ltd.

Brief Introduction

Light directly emitted by LED is in Lambertian distribution. It has circular light spot with large illumination at center, decreasing rapidly along the radial direction. This kind of light spot can't meet the lighting requirements in most scenes, especially outdoor lighting. In outdoor lighting, when LED is used as light source, secondary optical design may be conducted with lens or reflection cup to acquire required light distribution. Currently, traditional peanut-shape optical lenses with rough and uneven surface are used in tunnel lighting. With lamps exposed to the air filled with dust, automobile exhaust and other pollutants for a long time, and the surface of lenses may be stained with dust, absorbing some light energy, which may on the one hand reduce the light out-coupling efficiency of lenses, and on the other hand limit the light energy in lenses and convert into heat, thus reducing the service life of lamps. Therefore, surface of lenses needs to be regularly wiped to keep cleanliness; but, since the lens surface is rough and uneven, it is not easy to wipe, thus the cleaning effect may be reduced.

Meanwhile, it is more difficult to maintain lamps in tunnel, thus the maintenance cost is increased. Another proposal is to install plane glass on the surface of lamps to cover the lens and reduce the dust cover on the surface of the lamp. However, this proposal requires additional parts with worse cost performance.

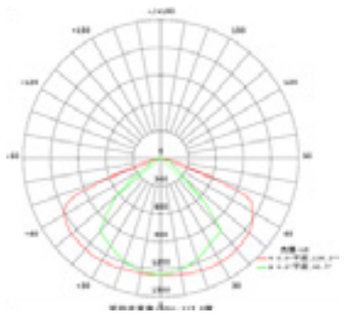
To prevent the uneven curved surface from being exposed in the air and causing "pseudo-light decay", a "plane light-emitting lens scheme" was creatively proposed, in which the free-form surface as the light-emitting surface in original scheme was changed into flat, which can not only reduce the dust accumulation but also enhance the self-cleaning effect of wind and rain on the lens. A total inner curved surface design for non-rotational symmetric light distribution of tunnel lamps is initiated. It sets the incident surface of lens a free-form surface, differentiates the incident light field and the target emergent light field respectively, establishes the mapping relationship between incident light and emergent light according to conservation of energy, and determines the emitting vector of each micro-element light beam. It adopts free-form surface to achieve required mapping, and the point cloud of the surface is calculated by numerical calculation software, so as to obtain the free-form surface which can meet the requirements. At the same time, the maximum incident

angle formed on the emergent surface is strictly controlled, reducing the total reflection of the emergent surface, and maximizing the light out-coupling efficiency of lenses.

Application Effect:

According to measured IES, two-side symmetric lamp distribution is adopted in dual-lane long tunnel and lighting is simulated with DIAlux (see following table for results). Tunnel lamps with planar light emitting lens are not inferior to traditional secondary optical lenses, especially the illumination of wall and road surfaces is much higher than the requirement of not less than 60% in 6.1 Lighting of the walls and the ceiling in all zones of CIE 88-2004, with good visual adaptability and visual guidance for drivers.

Tunnel lighting section	Luminous flux of lamp	Road surface illumination	Uniformity ratio of illumination	Wall to road surface luminance ratio
Entrance 1	25200	1948	0.948	0.861
Entrance 2	11200	892	0.952	0.861
Transition 1	8400	258	0.935	0.86
Transition 2	5600	94	0.94	0.862
Basic section	5600	47	0.805	0.862
Exit 1	8400	117	0.91	0.859
Exit 2	8400	250	0.93	0.858



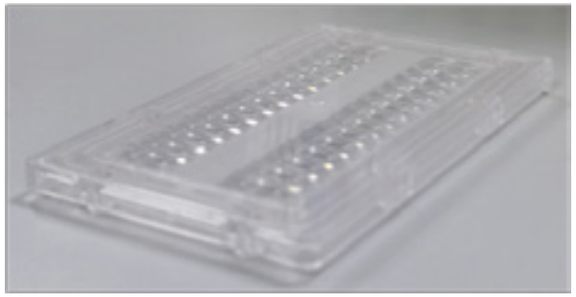
The Innovation Points

This project mainly has the following innovation points:

1. The emergent surface of lens adopts flat plane design to reduce dust accumulation, avoiding the disadvantage that uneven surface of peanut-shape lens surface is not easy to be cleaned. Meanwhile, the photometric characteristic of lens can also meet requirements of tunneling lighting.

2. The incident surface of lens adopts total free-form surface, and almost all the light rays are emitted through the optical lens, while in traditional lens, there is problem of light waste and temperature rise caused by the conversion of some light rays behind the optical curved surface array into light energy in the lens. Thus the new

design can improve the light out-coupling efficiency of LED lamps, as well as reduce the ambient temperature of LED light source, prolonging its service life.



Possible Economic and Social Benefits

The technology of this product is widely applied in the tunnel lighting EMC transformation projects with the largest volume in the country at present - the tunnel LED lighting system upgrading and transformation (EMC mode) project, Pucheng-Nanping Expressway tunnel lighting transformation project, Qingyuan-Lianzhou Expressway tunnel lighting system upgrading and transformation project, the electromechanical device procurement project of Changzhou-Wuxi Section of South Suzhou-Wuxi-Changzhou Expressway of Jiangxi Expressway Investment Group Co., Ltd. For expressway tunnel project in Jiangxi Province only, more than 100,000 lamps are transformed, before which the annual energy consumption was 77.3145 million KW• h while after which the annual energy consumption is 52.9384 million KW• h, saving around 32.2924 million Yuan of electricity fee per year. According to data provided by Chinese energy conservation department, for each 1 KW• h electricity saved, 0.4 kg standard coal consumption, 0.997 kg CO2 emission, 0.03 kg SO2 emission, 0.015 kg NOX emission and 0.272 kg carbon dust emission are reduced.

Conversion into standard coal: an annual power conservation of 52.9384 KW•h can be converted into conservation of 21,200t standard coal per year.

Conversion into CO2: an annual power conservation of 52.9384 KW•h can be converted into conservation of 52,800t CO2.

The energy-saving effect is remarkable, and tunnel illumination has exactly reached the national standard, making a contribution to the strategic target of carbon neutrality. At the same time, the lighting environment of high-speed tunnels in the whole province has been further improved, driving safety has been improved, achieving both economic and social benefits.

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Jury Panel 2022

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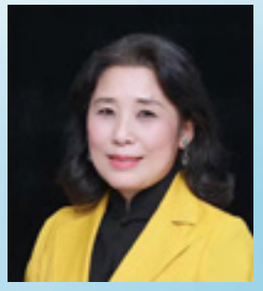

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Professor, Tong Ji University

Vice president of CIE

Vice President of China Illuminating Engineering Society (CIES）

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