

Compuspec's Intelligent LED Lighting

Commercial and Industrial LED lighting technology has been gaining acceptance over the last few, with a focus largely on energy saving and reliability.

Typically offering 50% energy savings over T5 fluorescent technology, new generation LED fittings are difficult to ignore. In practice however, the promise of improved reliability is questionable, with poor quality LED drivers offering equally short life spans as similarly poor quality electronic ballasts.

In the mean time, modern science has been providing much needed knowledge about how our body performs under artificial light, and this has opening up a new opportunity for light fittings that can mimic the dynamic nature and wavelengths of natural light, for improved health and well being of occupants, especially those working with commercial and institutionalised environments.

Unlike traditional light sources, LED light fittings can be controlled in both intensity and wavelength, and this not only allows energy savings of 90% to be relatively easily achieved, but also the wavelength of the light adjusted based upon time-of-day or task.

Compuspec's IntelliSUN range of products not only offers exceptional energy savings but also provides dynamically tuneable wavelength to deliver the positive photobiological impacts our body's need to optimise performance and wellbeing when working indoors.

Further, the intelligent control system used to deliver this dynamic light source can also be harnessed to deliver other functional solutions within the facility, in areas of security, facilities management, biometric monitoring, asset tracking and environmental monitoring.

The solutions proposed offer optimal energy savings, improved occupant health and wellbeing outcomes, enhanced safety with improved environmental and facilities management.

Technology - Autonomous Adaptive Network

Central to the functioning of these technologies is a Wireless network that has been developed for ultra-reliable industrial use. This network is independent of any local WiFi or Cellular Networks and provides no security threat to existing facilities operation.

This technology has been well proven over many years in use throughout Australasia in major industrial sites.¹

Each node in the network, whether it be a light fixture, a sensor, or a control panel, is fully autonomous. This means they are completely independent of any central system controller. Each node operates under a set of defined rules and reacts to its local environment without requiring instruction. However, it can report its status to a central control centre. In this way, it mimics the body's central nervous system (Ganglions), where local reactions deal with immediate threats and the brain is left to ultimately deal with the consequences in a less time sensitive manner.

This system enhances reliability and eliminates complex control systems programming.

¹ See Woolworths Case Study documents.

Technology - Human Centric Lighting

Human Centric Lighting (HCL) or Full Spectrum Lighting (FCL) describes a source of artificial light that can simulate natural sunlight. This is a new area of research that is showing exciting benefits as we increase our understanding of how humans, plants and animals react to natural light.

One of the key benefits of HCL is improved sleep, which in turn results in improved healing, health and wellbeing outcomes². This is largely due to control of the hormone Melatonin. However, there are at least 4 other hormones that are also controlled by photobiological processes within our retina, which relate to blood pressure, body temperature, digestion and alertness.

In commercial and educational facilities, research has shown significant positive impacts on productivity and performance³, with less stress along with enhancement of learning and cognitive performance under this type of light source⁴.

The IntelliSUN range of fixtures are not only extremely efficient and reliable but incorporated within each fixture is a wireless intelligent control module that manages the light spectrum (wavelength, colour and intensity) of the source as well as being aware of its neighbouring lights situation. In industrial settings, these lights can "hunt in packs" to maintain a pool of light around dynamically moving activity, providing optimal safety and energy performance. The signals can "hop" from node to node and cover thousands of nodes across multiple hectares of facility.

Technology - Germicidal Lighting

One of the key discoveries of Full Spectrum Lighting is the ability for natural light to kill harmful bacteria. It has long been known that sunlight provides a cleaning function, and this has often been assumed to be due to the presence of UV light. However recent research has shown that some wavelengths of visible light are also highly effective in sterilising bacteria (by breaking down their DNA, preventing them reproducing). This presents an opportunity for indoor lighting to provide a safe and automatic cleaning function - finding applications in Aged Care Facilities, food preparation and processing areas, ablution areas, hospital facilities (superbugs) and schools (mould). Essentially anywhere with the potential for bacteria growth to be harmful to occupants, property or produce.

Mammalian DNA is unaffected by these wavelengths making it safe for humans and animals, allowing its use in general indoor lighting to provide a continual sterilizing effect, or simply to provide cleaning when areas are unoccupied.

Our IntelliSUN range of products include options for the addition of Germicidal wavelengths, along with the normal full spectrum light sources.

² Reduction in diabetes and cancer risk, better bone and muscle repair, improved mental health.

³ Circadian Light and its Impact on Alertness in Office Workers: A Field Study. Lighting Research Center.

⁴ Blue Light Exposure has a lasting effect on brain function: American Academy of Sleep Medicine.

Technology - Environmental Sensing

Increasing focus in modern facilities management is the measurement and understanding of the indoor environment. This is particularly important in facilities that rely heavily on air conditioning systems or within areas where occupant numbers might vary greatly depending upon activities.

Our environmental sensor technology includes the measurement of Temperature, Humidity, Air Pressure, CO², CO, O³, VOC, Dust (PM2.5 & PM10) & Smoke, Occupancy (Microwave or PIR), Light, Sound & Vibration. Not all of these may be relevant to a facility, but these are now all commonly available sensing elements with low cost, reasonable accuracy and long life.

Because the intelligent lighting fixtures provide a wireless network for carrying information, environmental sensors can be added into the network at low cost and in an ad hoc manner to suit requirements and developing applications.

These sensors may be simply smoke detectors, or occupancy detectors, or a combination of the above to suit the situation. New radar based motion detectors are sensitive enough to detect respiration rates in room occupants while they sleep. Pressure pads can be interfaced to the network to indicate if dementia patients get out of bed, alerting the nurse station.

It should be noted that the indoor lighting can react to the environmental sensors. In a simple example, this might just mean that floor mounted night lighting can react to occupant movement. This works by the room's motion detector(s) transmitting a "movement detected" message. Any lights in the local area then make a decision as to what is required of them. In full daylight, they may do nothing. However, in the late afternoon or evening, they may turn on to a "sunset" tune which minimises the blue wavelengths in order to provide good illumination but without effecting the body's melatonin production (sleep hormone).

Analysis of educational facilities has shown alarmingly high CO₂ levels during class periods, presumably because the ventilation systems are not optimised for the varying loading of the areas. Information on the CO₂ levels can be monitored and used to control fans or other systems.

The lights can also change colour (or even flash) to indicate certain conditions, for example a fire alarm or security alert.

Technology - Indoor Asset Tracking

Each node in the network includes unique identifiers. This enables the implementation of indoor asset tracking using low power sensors that can "wake up" and "sniff" for the nearest local ID.

This allows a facility to keep track of key assets, providing geo-fencing around certain locations (an alarm if something leaves a certain safe zone), or asset location information to be held at key work stations. These "assets" may be expensive audio visual equipment, babies in a maternity ward, specialised beds or equipment in a general ward, key personal, or wandering patients in a dementia facility.

This system can also track people using their smart phones, if they wish to enable the function.

Such a system can be cheaply and efficiently implemented as and when required as it is simply a software function that runs over the existing lighting network.

Technology - Man Down Alert

Almost every cell phone these days includes an accelerometer. This is a multi-axis sensor that can detect the force of gravity acting in any direction. In the case of cell phones, this enables the cell phone to identify the orientation of the screen and manipulate information accordingly.

The unique aspect of these sensors is that when an object falls, the relative gravity of that object drops to zero. By taking advantage of this fact, modern laptops (for example) can shut down their hard disc drives in the event the laptop is dropped. If a human were to wear a small sensor (about the size of a wrist watch), this sensor can detect a fall condition and immediately transmit an alert through the wireless network to a nurse station.

Such a sensor can detect motion at an extreme level of sensitivity. This enables additional monitoring functions. For example, the transmission of an alert if no motion is detected within a set time frame.

The implementation of this function is remarkably similar to the indoor asset tracking technology described above. Therefore it is a simple task to integrate the two capabilities into a small wearable bracelet, wrist strap or pendant.

Technology - Nurse Call, Panic, Lock Down, Assistance Needed

A logical enhancement of this type of system is a more intelligent Emergency Assistance System.

Because the wireless network allows bidirectional information flow, a simple form of request and acknowledgement can be readily implemented.

For example, an illuminated touch panel (Green) can be provided that allows (say) two levels of Nurse Call. One is "I need assistance in the next half hour in order to take my medication", the other is "Emergency Help Needed".

In either event, the illuminated panel can change colour (Red) to indicate that the request has been transmitted to the Nurse Station. When the nurse acknowledges the request, the panel can change colour again (Amber) informing the occupant that the request has been acknowledged.

Further, the corridor light outside the occupants room can change colour indicating that this room has requested assistance, thereby providing a simple indication to local staff.

None of these functions relies on a central control system to operate, and none require any special wiring.

The system may be enhanced by forwarding any of these messages to a monitoring service who in turn can relay the request via cell phone App or help desk etc., depending upon the nature of the situation.

Technology - Emergency Lighting

The requirement for emergency lighting is a significant cost and complication in many facilities.

The ability for a LED light fixture to **also** perform an emergency function has the potential to save significant cost and also enhance the performance of the emergency system.

A battery module, complete with its own wireless controller, can be plugged into (one or more) light fittings, providing backup power. Uniquely, this controller can continuously monitor the health of the battery, the light fixture(s), and the environment. The wireless network allows central monitoring of the emergency lighting system, while the integration of occupancy sensing can be used to enhance safety protocols in the event of an emergency.

When a UPS is in use, any Compuspec light fittings can form part of the emergency network. The system provides a means to automatically reduce the lumen output of the light fixture in the event that a power outage occurs, to ensure adequate illumination to meet standards, and also to manage the battery life of the UPS.

Such a system has the capability to slash the cost of emergency lighting .

Technology - Backwards Compatibility

Many facilities have used a DALI control system as this has traditionally been the only viable way of managing various suppliers lighting products. Compared with what has been described above, DALI can only offer a crude approximation, however Compuspec offers interface nodes that can control 3rd party lighting products via a standard DALI interface, thus upgrading existing lighting technology to perform as part of the more capable smart network. In this way, existing DALI networks can be significantly upgraded and extended, at minimal cost.

Technology - After Hours Security

The system (or areas within the system) can be placed in an "After Hours" mode that maintains a low light level, sufficient for security personnel or vandal deterrence. Power levels drop to approximately 1 watt per fitting, but the human eye can still retain remarkable acuity, partly due to the full spectrum nature of the light source, and partly because of the logarithmic behaviour of the human eye (adjusting to the even nature of the lighting - a lack of harsh bright and dark zones) .

Summary

We live at a time when many emerging technologies have finally reached a level of maturity where they can be seriously considered in high reliability applications. Key to delivering a strong business case for the use of these technologies is an ability to combine many of these capabilities into a cohesive solution. The beauty of the intelligent lighting revolution is its ability to deliver a backbone upon which multiple other services can be delivered. These services can be rolled out on an ad hoc basis, as and when the benefits of these services can be best realised and budget allows.

Solution Benefits

Health

Improved health outcomes with high quality Natural Light
Improved Light Quality - Full Spectrum, Flicker Free, Circadian Entrainment
Improved Air Quality - Germicidal, Environmental Monitoring to better manage ventilation, heating and cooling services.
Integrated Nurse Call, Fall Detection and "Lack of motion" detection.

Eco

Best energy savings possible
Highest efficacy
Motion detection (dim when no presence detected), autonomous
Daylight detection, dimming and supplementation.
New Zealand made with low carbon footprint.
No Mercury or glass and largely recyclable.

Safety

Operates at low voltage SELV (24V)
Can include built in emergency lighting mode
System could include "direction to exit/safe zone" in emergency (lights provide moving ripple effect to guide occupants to safe zones)
Location Tracking provides "last known position" for emergencies.
Man Down alert.
Panic Button or Lock Down initiation.

Reliable

No reliance on central control systems.
Long Life with minimal lumen depreciation. L90 60,000 hrs
Designed for 20 year fixture life.
Minimum component stress for enhanced lifetimes.

Simple

Plug & Play - No complex commissioning or customer involvement required.
Each light/node is identical and fully autonomous
Wireless communication network with no impact on existing WiFi or internal security.

Operational

Site Visibility with sensor maps (temperature, occupancy, emergency battery condition etc)
Asset or personnel tracking.
Improved security. Facility wide motion detection. Smart Geo-fencing of areas. End of Day site occupancy monitoring.
"Security" mode allows low level general lighting for walk about security while maintaining low energy use.