C9 - Indoor Asset Tracking and Environmental Monitoring

The readily accepted Global Positioning System can accurately track assets outdoors, but does not work indoors.

The introduction of intelligent lighting, which delivers lighting fixtures (and sensors) that are linked by a wireless mesh network, provides a backbone to enable indoor location tracking and environmental monitoring.

Background

Demand for increased efficiency in process flow, asset utilisation, H&S and security have driven a desire to track people and equipment indoors as well as monitoring in real time.

The commonly used Global Positioning System relies on direct line of sight to a number of orbiting satellites, where very accurate timing information is used to triangulate distance, in turn allowing the calculation of outdoor position. Because the GPS system was military in origin, and designed to guide missiles, it was deliberately made less accurate when released for public use. Even so, we now commonly expect accuracies down to one metre.

The GPS system is ideal for use in open space, but does have difficulty in tracking objects within an "urban canyon". That is, where signals from satellites might bounce from buildings before arriving at the receiver. These reflected signals can create rapid and unexpected shifts in position due to the errors they introduce, leading to erroneous readings misrepresenting speed, location and distance.

When used indoors, the system either fails completely, or must rely on visibility through windows to satellites orbiting low on the horizon. Attempts have been made to make indoor systems that mimic the GPS system, using fixed indoor beacons or existing WiFi infrastructure. These systems suffer from the same issues as outdoor GPS, that is, signal reflection and absorption in various building materials, that make results erratic and unreliable. They also require precise location of beacons in 3 dimensions to enable accurate triangulation.

Opportunities arising from Intelligent Lighting Networks

New technology in the lighting industry has resulted in light fixtures with inbuilt intelligence. This enables light fixtures to make autonomous decisions about what type of illumination and how much illumination is required at any one time. These types of fixtures are superb at minimising energy use and optimising lighting outcomes. Due to the autonomous nature of the network, there is no critical dependence on a central building management system. That is, reliability is not dependent upon communication to "The Cloud" or to central servers or a critical communication channel.

Inherent in the functioning of these autonomous systems is a wireless mesh network that is established to allow the exchange of information between light fittings. This network is independent of any local WiFi systems (and does not interfere with them).

Throughout the facility, each light fitting becomes a location waypoint whose position can be used to establish the location of a local smart tag or sensor device.

Each light fitting can respond to a request from a mobile transponder (beacon) to either advise of the current location, transmit the transponder ID to a central monitoring location or pass on environmental sensor information.

A typical implementation might involve a small battery powered sensor that can wake up when motion is detected and transmit its ID. This ID information can then be shared over the network, perhaps for display at a central nurses station or to provide security information on asset location or movement.

This system is very cheap and foolproof. It doesn't rely on complex triangulation and is not susceptible to signal reflection or distortion. However, it will only identify a location to the current room being occupied (not the position in the room).

Newer versions of intelligent lighting may also be equipped with Bluetooth Low Energy (BLE) transceivers. While BLE is not a very reliable industrial protocol, it does enable very simple communication with cell phones. In this case, a cell phone running a background application can broadcast a beacon message that can be detected by the lighting system. This means that the location of the cell phone can be reported back to the central monitoring station in real time. All Apple phones currently output this location beacon, whether the user likes it or not. For Android phones, this feature needs to be turned on or a background application has to be run.

In this way, doctors, nurses, contractors or visitors could be tracked within the facility.

Application Examples

A wrist band or ankle strap can report the location of a patient or baby. If the patient moves beyond a defined geo-fence (virtual geographic boundary), then an alarm can be raised.

The movement of a bed or hospital equipment can be transmitted and reported to a monitoring station, thereby enabling rapid location of available assets. These could also be subject to a virtual geo-fence, for example if a piece of equipment left a building or operating theatre.

The location of critical staff can be monitored, either for safety or for rapid access in the case a critical situation arises. This could be user disabled to ensure privacy at appropriate times.

Certain sensor activations could result in an alert being raised. For example a patient fall, a patient exiting a bed or ward, or the lack of motion for a period of time.

More effective nurse call systems could be implemented that enable multiple levels of urgency to be requested and allow indication that the requests have been received and acknowledged.

Air Quality Sensors can report various critical environmental conditions using the same network.

Cost Effective

Because the lighting network provides the necessary communications channel, any of the example applications could be added ad hoc, as future needs arise, for only the incremental cost of the sensors or tags. There is no massive capital outlay required. The system is also very robust because there is no reliance on any specific communication channel.