Abstract

IEE has developed a vision sensor based on 3D MLI Sensor™ technology. This sensor is the basis for a number of people and object sensing solutions aimed at enhancing building safety, security and management. This paper provides details about the nature of the technology, as well as the challenges faced by building and security professionals to solve safety issues, and how the sensor aids in facing those challenges.

1. Introduction

Security professionals are faced with a number of challenges nowadays, whether it is ensuring that each individual has identified themselves when entering a building or secured area, knowing how many people are currently in the building for safety or statistical purposes, or ensuring the safety of valuable objects displayed in museums and art galleries. By means of high-tech solutions such as the 3D MLI Sensor™, security professionals are offered a valuable aid in detecting people and objects within buildings, and in preventing security breaches from taking place.

2. 3D MLI Sensor™ technology

The 3D MLI Sensor™ technology was strategically developed by IEE based on the optical time of flight (TOF) principle, whereby a non-scanning light source emits modulated near-infrared light, and the phase shift between the light emitted by the source and the light reflected by the persons and objects in the field of view is measured to create a real-time topographic image of the monitored area. By means of TOF measurement and sophisticated embedded algorithms, the overhead-located 3D MLI Sensor™ acquires and processes topographic 3D data, and is therefore able to detect the number of people and objects in a specific indoor area, independent of lighting conditions.

3. Overview of security challenges

3.1. Access Control and Tailgate Detection

The most common security violation at an access control point occurs when an unauthorized person simply follows a legitimate user, or “tailgates” their way into a secured area. Tailgating is a widespread phenomenon and presents a tremendous security risk, but current tailgating detection efforts are causing a great strain on security personnel and pose an insurmountable challenge to existing surveillance systems. IEE’s Tailgate Detector offers a solution to this problem by detecting, counting and tracking people within a specific area, providing a flexible security policy enforcement tool. Mounted above doors and entrances, the Tailgate Detector works with security systems by intercepting the signal emitted from the ID reader and determines the status of the access point (i.e. opened/closed door). The sensor then establishes whether or not a single individual is attempting entry, and in the event of dual or unauthorized entry, provides the necessary output by locking the door or triggering an alarm, thereby adding a security layer to the existing access control system.

3.2. Accurate People Counting

An accurate understanding of the precise number of people currently present in a building or moving through high-traffic areas is of great importance to safety and security professionals, as well as for marketing intelligence initiatives, and staff and energy optimization. Typically installed above entrance doors or turnstiles, the IEE People Counter reliably detects and counts each person entering and exiting the room or building in real time, and provides accurate occupancy monitoring data. For queue management and wait time determination applications, multiple People Counters are installed onto the ceiling to determine queue duration. The People Counter embeds sophisticated algorithms and has undergone extensive testing to ensure reliable segmentation, tracking and counting of people in order to
minimize counting errors which commonly occur with most other people counting systems on the market, and which result in unreliable data. This results in an unparalleled accuracy exceeding 99%.

The People Counter’s unique segmentation and tracking ability allows for highly accurate and more reliable data than passive infrared imager, scanner or video-based 2D systems on the market.

Nightclubs, museums, enter entertainment venues and other places where many people gather, are often subject to maximum occupancy regulations. Suspended above each entrance and exit, the People Counter performs a bi-directional count of each person entering and exiting a single room, particular floor or entire building, and triggers a warning signal when a predefined threshold has been reached or exceeded.

Demand Controlled Ventilation (DCV) is a ventilation control strategy that provides the estimated right amount of fresh air needed by the current occupants in a certain area, such as seminar rooms, offices and museums. The People Counter computes the number of people currently present in a specific area and provides this input to the DCV unit.

The People Counter reliably detects people moving against the flow of traffic in the pre-defined wrong direction and triggers an alert to indicate a possible security risk. This kind of application is typically installed at arrival gates in airports or at turnstiles in subways or train stations.

Installed at multiple locations overlooking queues at airport check-ins or security lanes, the People Counter accurately processes the length and duration of a queue, thereby providing valuable input for operational staff to manage service levels. It allows for a reduction in wait time, ensures overall better service to passengers, and prevents handling agents from having to pay quality infringement fees to airlines.

### 3.3. Object protection in museums

Striking the balance between protecting valuable art objects and encouraging the public to visit and come within touching distance of paintings, sculptures and other works of art, is a challenging task. Museum security professionals are responsible for safekeeping valuable collections from such threats, but they require technological solutions to ensure reliable protection at all times. The Volumetric Object Surveillance provides increased protection by monitoring the volume around an object and triggering a direct and immediate warning to visitors and other personnel in the event the surveillance area has been breached. This direct response alerts onlookers who are too close to the object that they must step back immediately. It also alerts security personnel of the potential threat so that they are able to take the necessary action to prevent further intrusion.

The detection and alarm zones can be configurable. The monitored volume around the object can be clipped sideways into two configurable alarm zones, as well as from the bottom. If the most outer layer of the surveillance area is compromised then a preliminary audio or visual alarm can be triggered either directly indicated near the object or delivered discretely to security personnel. If the second layer, or rather the area closest to the object is intruded, then a second alarm level can be triggered to indicate the higher degree of severity and signal a potentially critical situation.

In the event the object is tampered with or removed, a continuous alarm is triggered indicating that the surveillance area has been permanently altered. Since the sensor is calibrated to the exact dimensions of the object and its precise position within the surveillance area, any attempt to deceive the sensor by manipulating the object or the surveillance area will be immediately recognized, and communicated to security staff.

The Volumetric Object Surveillance can be configured and re-configured for use with all types of valuable objects, be it 2D objects such as paintings and documents, or 3D objects such as sculptures and other artifacts.

### 4. Conclusion

IEE has successfully launched its 3D-vision-based innovative solutions into the markets of security, safety and marketing intelligence for public and commercial infrastructure.

Automatic solutions that avoid unauthorized accesses, estimate occupancy to apply evacuation protocols in emergency situations or to gather statistics of public attendance, or protect valuable objects from vandalism and theft, have become of paramount importance nowadays. IEE’s Time-Of-Flight technology has proved more robust and reliable than traditional 2D-video systems, infrared imagers and other 3D-scanner devices for indoor applications; due to the independence to changing lighting conditions or fluctuations of room temperature. Combined with IEE’s expertise in algorithm and software development, the 3D MLI Sensor™ can be implemented for a wide range of applications to detect people and objects, offering an innovative, reliable and high-tech solution for safety, building management, and marketing professional.