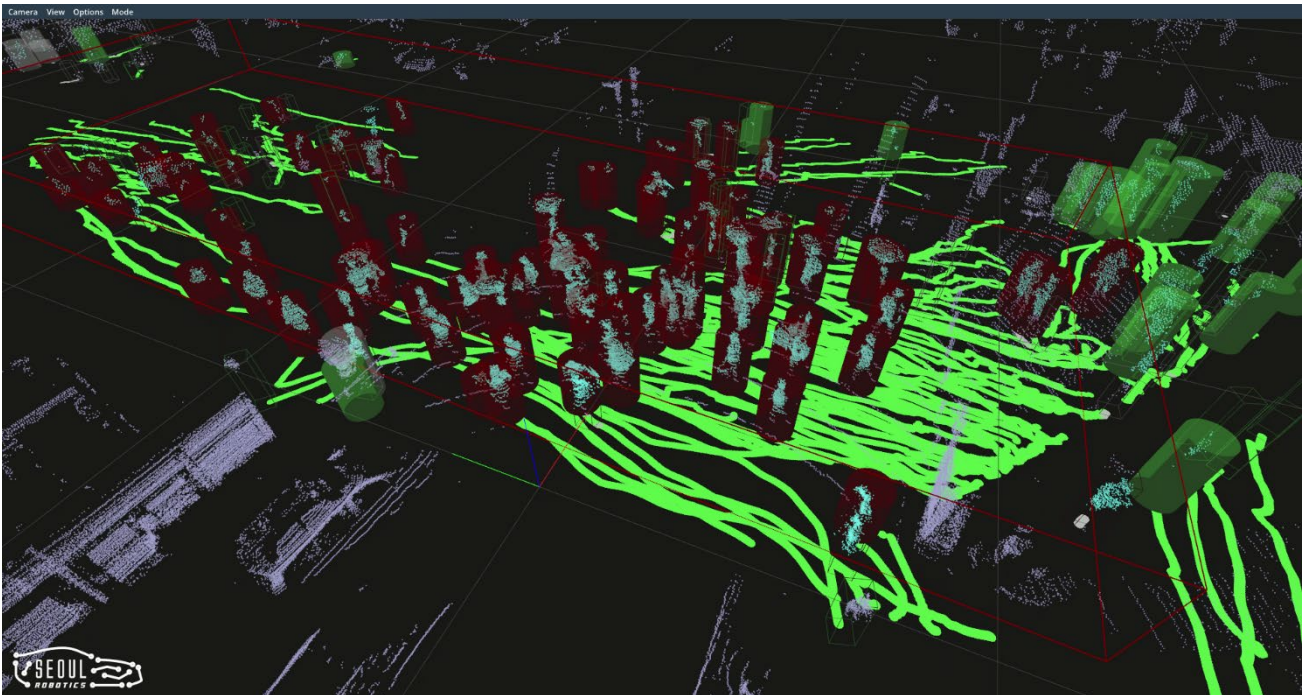Making Robots Intelligent

SEOUL ROBOTICS CO., LTD.

LIDAR-BASED SECURITY SOLUTIONS

Lidar-based Security Solutions

Emerging perception and data technologies are converging to deliver improvements in public safety, security, and efficiency. New solutions promise to enhance threat detection and traffic management in areas including airports, transportation and energy infrastructure, as well as retail, corrections, and private facilities. As implementation of smart security and monitoring systems increases, it is ever more valuable to understand the relative strengths and weaknesses of the various sensor technologies currently available to solution integrators.

The same sensor that brought the revolutions of Self Driving cars by bringing the perception to the next level, now is ready to deploy the technology to security market, bringing intelligence that security industry has long been waiting for.

Traditional Camera Sensors

Until recently, most security and monitoring systems have been designed primarily around camera technology. However, as alternative sensors come onto the market, the weaknesses of camera-based approaches become more apparent. To begin, cameras provide images in two dimensions, without depth measurements, and can suffer in low light conditions. In contrast, lidar sensors provide real-time distance measurements of surrounding objects in all lighting conditions. Cameras are also prone to optical illusions; for example, when target objects have low visual contrast with background scenery or when shadows stretch across a scene, producing costly false negative or false positive readings. However, because it acts as its own light source and does not depend on image contrast to detect objects, lidar does not have these problems.

Human resources require to monitor camera-based system is high and very inefficient. With low detection accuracy and high false positives alert from Camera based solutions, it lacks real time monitoring capability, and most camera-based systems are reduced to a replay mechanism for investigations far after the actual happening of the event. Limitation of camera-based system lies in firing alert for every moving pixel within pre-defined zone, such as shadow casted by clouds.

With Lidar providing physical shapes of objects, instead change of pixels within the camera, we can now clearly detect and classify only physical objects are within the parameter, reducing false positives of camera systems by order of magnitude. And with AI trained to learn the features of physical shapes, we can further classify, detect, and track only the important objects.

Radar Sensors

Some security systems employ radar to cover these weaknesses in camera technology. However, radar's resolution, or image clarity, is relatively poor compared to lidar. In low light or low contrast scenarios where cameras struggle to detect and classify objects, radar is therefore unable to adequately step in to perform these tasks. Common scenarios such as these require another type of sensing technology to deliver a different kind of data. Lidar technology provides security systems this alternative high-resolution data, enabling object detection, classification, and tracking in all lighting and background conditions.

Radar can reduce the false alarm by order of magnitude compare to camera because it also senses physical objects, just as Lidar does. However due to the sparsity of data, Radar lack capability to classify the objects, as well as poor performance of indoor tracking. For high-level security systems, ability to classify people from vehicles or animals is critical. For large airport installations or military base, the ability to identify only human reduces resources required to monitor the parameter significantly.

Implementation Costs

One strength commonly associated with cameras in comparison to lidar is cost. However, when we consider the total scope of system components required to achieve optimal levels of performance and

perception coverage, along with the added operational efficiency of lidar-based systems, this assumed advantage of camera-centric approaches diminishes greatly. A single lidar sensor can provide a full 360-degree view of the surroundings with a range of 100 m. Even more, the data provided by lidar within this field of view is always "in focus"; that is, perception within one part of the scene does not sacrifice focus within other parts of the field of view. In contrast, at any given time, cameras are limited to certain focal distances. Developing a camera system that perceives all relevant ranges simultaneously therefore requires multiple cameras, introducing added complexity and expense. As a result, our security integration partners report that one lidar sensor with eight lines of perception data covers roughly four times the area of one camera in security applications, significantly decreasing the costs and logistics of installation.

Camera sensors are far cheaper compare to Lidar sensors. However human resources require to monitor camera systems are extremely high. Each person can effectively monitor 20 to 40 camera screens, with low chance of reacting to the event. With high accuracy detection intelligence of Lidar system, single person can monitor larger area with higher accuracy to react to the event because Lidar data can be fused to be summarized into a single live map of the facility. What 4 people requires to monitor with camera system, Lidar system can reduce the personnel to one with increased monitoring capability. From our latest customer what 40 cameras are required, 7 lidars can cover.

Privacy

Lidar provides another key advantage over camera-based systems in security applications: privacy protection. With increased concerns that facial-recognition technology will be used for general surveillance,[1] a system that utilizes lidar as the initial source of object detection data enables a security solution that preserves trust and anonymity. This is especially important in applications involving the general public, such as retail monitoring and queue management.

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[1] https://www.aclu.org/issues/privacy-technology/surveillance-technologies/face-recognition-technology

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Summary

In sum, a lidar-based security solution delivers the following benefits:

- Real-time distance measurements (3D perception)

- Object detection and tracking in all light conditions

- Increased signal-processing and automated detection efficiency

- Decreased false positive/negative readings

- Superior perception coverage for simplified and less expensive installation
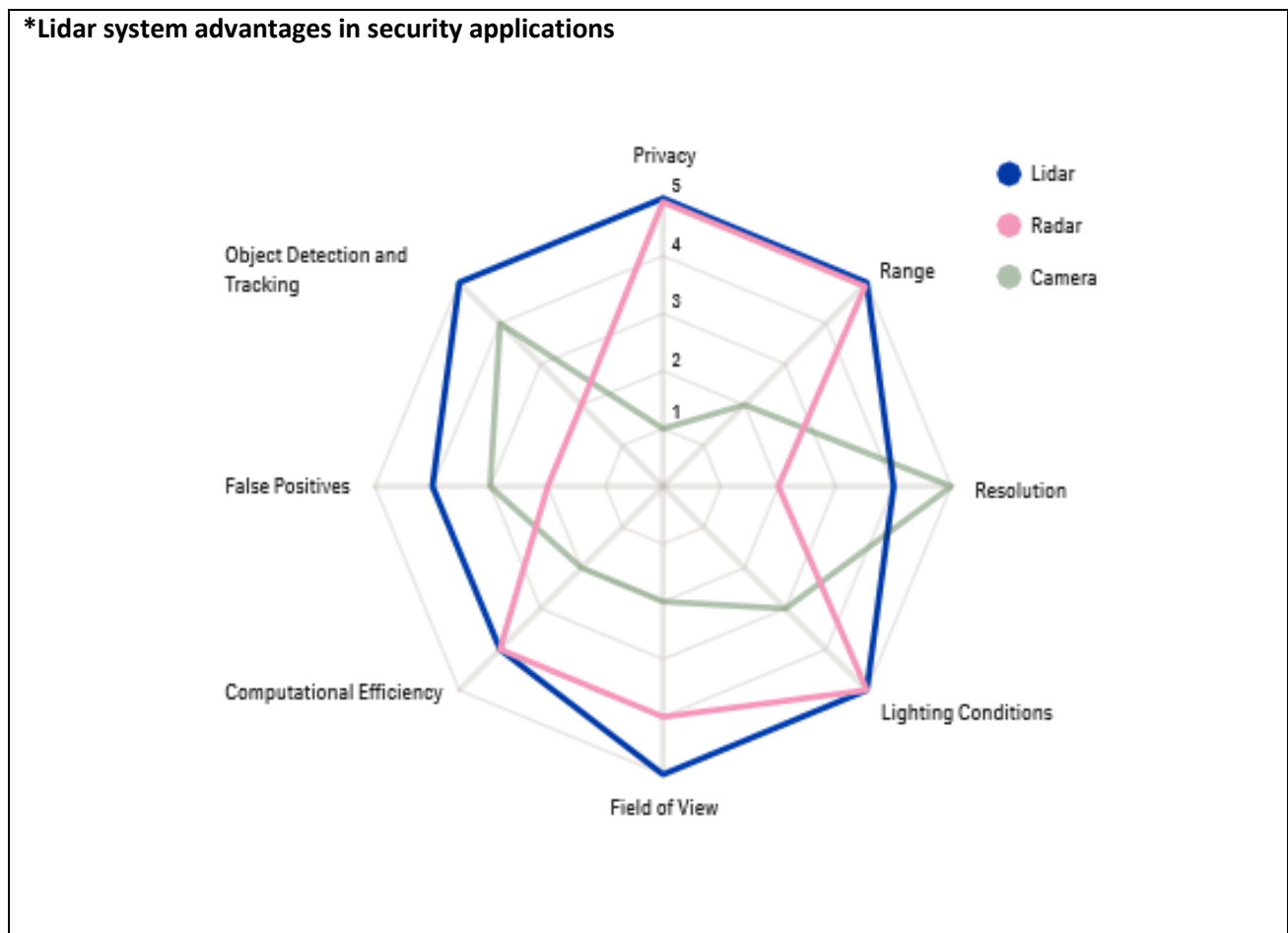
- Privacy protection

*Lidar system advantages in security applications

Image by Velodyne Lidar

Lidar-Based Security Solutions