

The Combination of Cameras and Radars in Surveillance Systems Advancement

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Most surveillance systems rely solely on cameras and completely disregard the possibility of combining cameras with other technologies. Adding radars to the scene adds an extra dimension with endless possibilities.

Surveillance cameras have had a huge upswing in recent years. Many cameras have the ability to detect and highlight moving objects in an image during daylight. However, a common problem is that most burglars work night shift when it is difficult for a camera to see them. It would be very useful if criminals could be highlighted in a dark image as well. This can be done by adding a radar to the surveillance system.

A radar sends out radio waves and detects moving objects by listening to their echos. This means that it does not require light and operates equally well at night. When the radar detects something, it sends the object's position to the camera which highlights the object with a bounding box in the image.

In order for this to work, the camera and the radar have to be calibrated. A calibrated system means that the camera and radar are aware of their relative position and orientation. This could be measured manually, but it is costly, complicated and time consuming. A better way is to calibrate the system automatically, which can be done in three steps:

1. Collect points of moving objects from the camera and the radar.
2. Process the collected points.
3. Estimate the relative position and orientation between the camera and radar.

During the collecting phase, both the camera and the

radar record points of moving objects in a scene over a long period of time. Then, the positions of the moving objects are matched between the camera and the radar, points from the same moving object and detected at the same time form a point pair. Lastly, if enough point pairs are formed from the collected points, they can be used to estimate the relative position between the camera and the radar.

With the established calibration, it is now possible to use radar inputs exclusively to highlight objects in the camera image, regardless of lighting conditions. The system is not limited to only one camera and one radar. Instead, the system can calibrate multiple cameras to multiple radars, which is useful in a large place where multiple surveillance cameras are installed, such as subways, malls and football stadiums. Adding a few radars to the scene simplifies the monitoring task substantially for security operators, as they can redirect their attentions to the monitors containing the moving objects. The radars also provide the possibilities of mapping the cameras, making it easier to get an overview of the security system.

Having both radars and cameras in a surveillance system make it possible to leverage the combined benefits of the two technologies. Nighttime security will hopefully increase with the implementation of radar to current surveillance systems. Burglars can now consider working day shifts as well, since they will be caught anyway.