Application Brief

Bringing Intelligence and Efficiency to Automated Doors and Gates with TI mmWave

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As more and more buildings and homes are becoming automated, many of these automation technologies have become integrated into our daily lives. For example, walking into a grocery store having two doors open for you, driving through a parking gate to pass through a toll booth, or waving your hand to open a door at work; automated doors and gates have become a quintessential part of our everyday lives. There is a greater need for reliable sensing technology that can detect objects both static and moving, with close to zero false positives, thus increasing safety and efficiency.

In the automated doors and gates industry there are three main market segments: indoor applications, commercial, and industrial. Each with a variety of applications and requirements that differ from each other; such as the indoor application market, often found in hospitals to help reduce germ spread or inside buildings to help with ease of access, allowing access into a room with a swipe of a hand. Many of which currently struggle with false errors causing door openings when the openings can be unnecessary. The commercial door market, now found outside almost every large building or retail store globally, provide access into buildings safely avoiding any collisions; however, many times needing multiple sensors to work effectively. Industrial doors and gates allow for 16-wheelers to back-up to warehouses, apartment gates to open which often times struggle to reliably work in harsh natural conditions. Current technology is limited in the ability to provide complete designs, often allowing false errors, needing multiple sensors and are unable to perform in natural conditions.

Table 1. Automated Doors and Gates Market Segment Requirements

Function	Inside	Commercial	Industrial
Mounting Height	1m	3m	6m
Range Area	0.5+ m	4+ m	10+ m
Field of View	± 45°	± 70°	± 70°
Features	Presence, False Error Rejection	Presence, False Error Rejection, Static Detection, Classification	Presence, False Error Rejection, Static Detection, Classification

Many of these applications are able to behave more efficiently due to radar-based sensing, specifically millimeter-wave (mmWave) technology. Millimeter Wave radar technology is uniquely equipped to detect short (5cm) to long (100+ m) ranges, and can inherently detect the range, velocity and angle of fast-moving objects with high accuracy regardless of ambient lighting, fog, rain or dust. With shorter wavelengths and a higher number of transmit and receive antennas mmWave radar sensors can accurately detect the presence, velocity, and location of five or more people in a room. While also providing capabilities such as monitoring multiple zones for localizing presence and tracking movement through each zone. mmWave radar is effective in each of the three market segments in automated doors and gates, providing higher efficiency along with more features than many other technologies in the market.

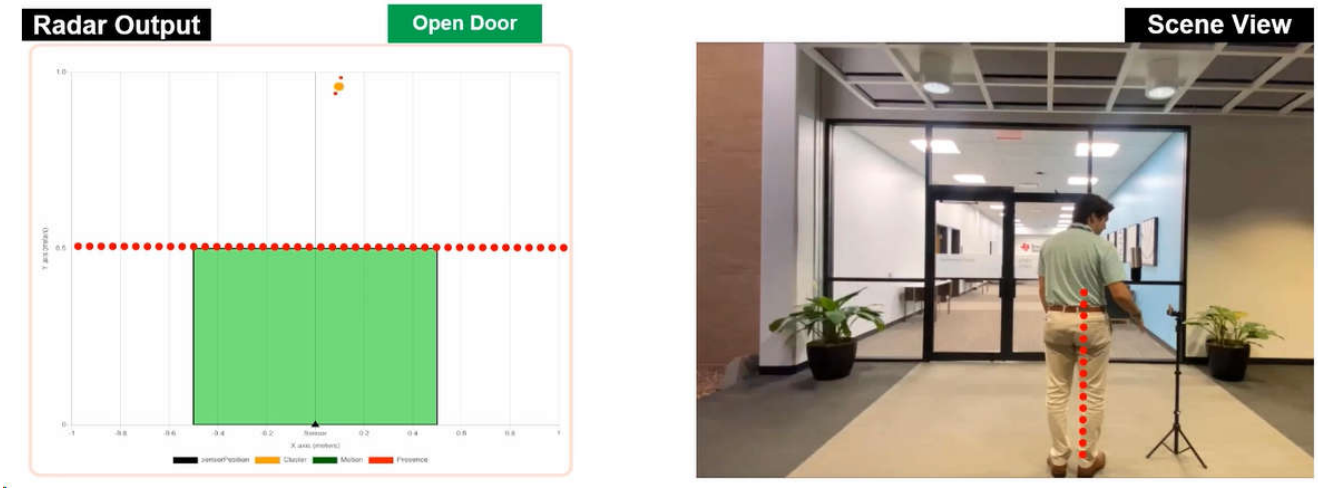

Figure 1. Inside Door Opening When Person Activates Sensor

In the indoor segmentation many are doors outside rooms where someone can swipe a small panel or area causing doors to open. These applications are mainly found in many new buildings with a high concentration being found in hospitals to help reduce the flow of germs or easy access for the disabled. Needing a very short detection range, usually <50 cm, and a smaller field of view (±45°) causes many false errors in other technologies currently used. Millimeter wave sensors can determine with high accuracy the position of an object within a specified area through the major and minor motions that an object creates naturally. This lowers the false errors one can find using other technologies and sensing equipment that can cause the door to open at random times.

In many people's lives, commercial doors are often an unnoticed technology when doors open allowing us to walk into a building. Automatic doors are often found outside retail stores, company buildings and other large buildings found throughout cities and towns. To make sure that doors do not close on objects commercial doors utilize features like presence detection, false error rejection, static detection along with some using classification. All in combination with longer detection range needs (4+ m) accompanied by a large field of view (±70°). With so many features many doors often use multiple technologies in combination meaning multiple sensors along with a larger form factor in many cases.

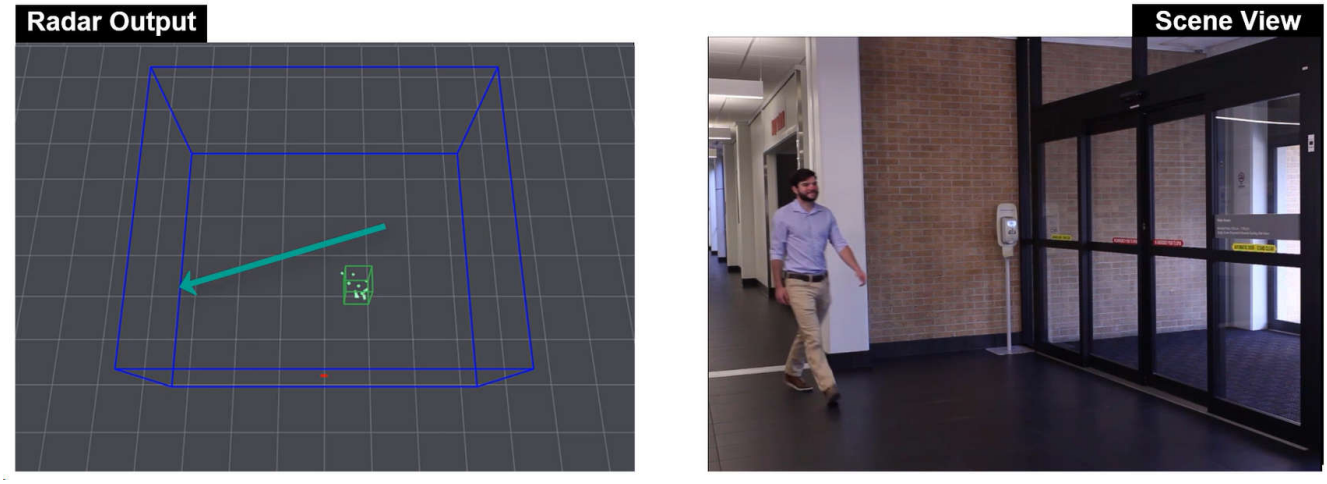

Figure 2. Commercial Doors Detecting and Tracking Human

Because millimeter wave can determine both the location and direction of travel of a person, a millimeter wave can be used to infer the direction a person is intending to go and reduce false detection by helping automation systems to anticipate the behavior of people (see Figure 2). mmWave sensors are also able to classify objects into a variety of categories such as humans, animals, and vehicles making sure that automated doors only open for humans. All of these features allow for mmWave to increase the efficiency and effectiveness of doors, gates and other applications in the automated doors and gates industry while still maintaining a SIL-2 safety regulation.

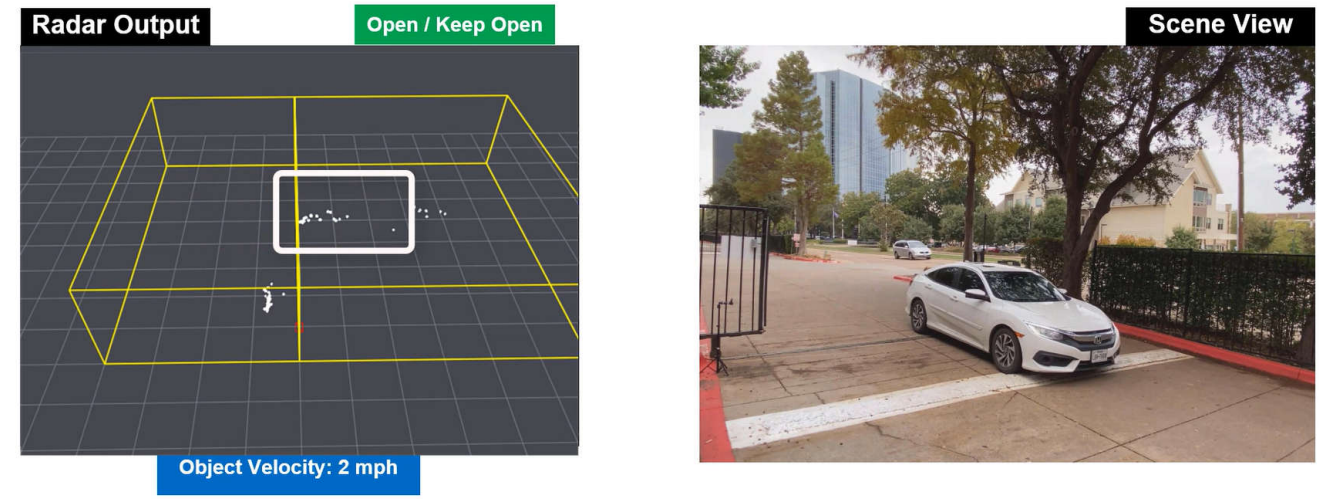

Figure 3. Industrial Gate Using Radar to Open, and Track Velocity

The last market segmentation is industrial gates and doors, which are often placed outside, need to sense through natural elements with the additional requirement of longer range, field of view, and feature requirements (see Table 1). For this example, an industrial gate where we want to use the position and velocity of objects to determine when and how fast to open or close the gate as well as when to keep the gate open (see Figure 3). Other sensors, such as cameras, and PIR sensors, are sensitive to environmental conditions and the performance can be affected by changes in ambient lighting, dust, or smoke that can be present in an outdoor environment. By contrast, millimeter wave sensors can continue to sense and provide high accuracy data in these challenging environments.

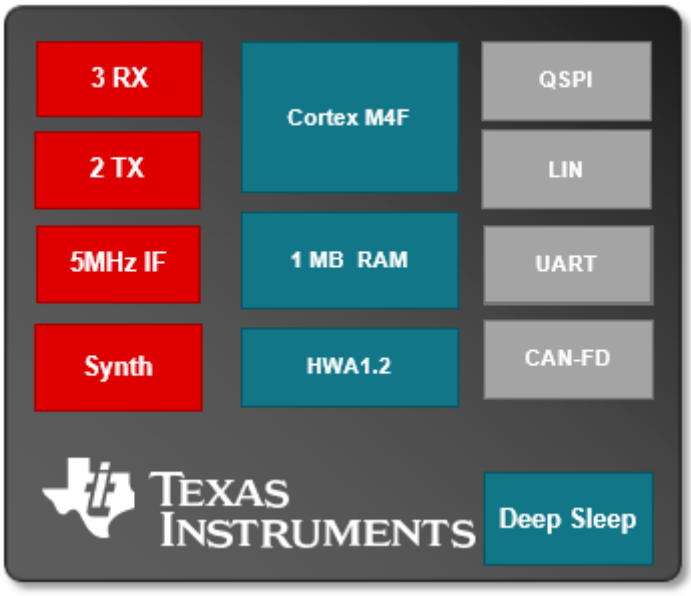

Figure 4. Block Diagram of the IWRL6432AOP

TI's IWRL6432AOP device is addressing these everyday challenges offering benefits such as smaller device size, lower power usage, while providing the enhanced performance and resolution needed for detecting objects of various sizes, while helping minimize false detections. While 24GHz technologies often lack similar performance due to limitations in the number of antennas as well as PIR technologies struggling to work effectively in harsh natural conditions. The IWRL6432AOP is designed to have ultra-low power, the ability to detect any movement with as low as 2mW of power consumption. With options available to configure the device to minimize power based on the target applications. See Figure 4 for an example of a highly integrated radar design.

Conclusion

Advancements to 60GHz radar technology have made this the preferred sensor to implement in the automated doors and gates industry. Radar sensors such as the IWRL6432AOP enable intelligent sensing in various products and functionality such as:

- Presence and motion detection
- Counting and tracking capabilities of 5 or more people
- The ability to differ between objects such as humans, animals, and vehicles
- Ultra-low power consumption to monitor presence and motion detection
- Low device and bill-of-materials cost, with compact design size and configurable antenna designs

Additional Resources

- Watch video on, Intelligent access control with mmWave sensors
- Download the following technical white papers:
  - *Radar Sensors to Enable Smarter Homes, Cities and Lives*
  - *Machine Learning on the Edge with the mmWave Radar Device IWRL6432*
- Texas Instruments, *Low Power mmWave Radar Solution Enables New Functionality in Battery Powered Proximity Sensing Products*, application brief.
- Order the *IWRL6432AOP EVM*, evaluation module.
- Check out how the IWRL6432 family of radar sensors can be used in *personal electronics*

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