WAYV Air

Short-Range mmWave IoT Sensor

EINSTEIN

Safety from numbers

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Prologue

We are on an unrelenting pursuit to explore and implement new, more reliable sensing technologies that are deliberately considered with your safety top of mind.

As the world begins to ease restrictions, we must work to minimize any contribution to the spread of COVID-19 and take proactive measures in support of our communities.

Social distancing is part of our new normal, and stores, banks, hospitals and other public venues have a responsibility to protect both staff and patrons by monitoring and maintaining occupancy to prevent a second wave.

mmWave radar technology enables accurate counts of people entering and leaving a space, providing a reliable understanding of the changing environment around us.

THERE IS NO NEW NORMAL. Just… normal

Overview

Ainstein's Short-Range mmWave IoT Sensor is an industry leading 60GHz radar module designed specifically to collect and provide data about moving objects within a targeted area. It's the perfect building block to develop innovative new applications for building automation, retail management, facility monitoring, and more!

WAYV Air is based on radar sensing technology and features a compact form factor, low cost and power consumption. It's the ideal sensing module for detecting, and tracking people in indoor environments.

WAYV Air is ideal for:
Occupancy Detection
People Tracking
People Counting

Applications include:
Social Distance Monitoring & Reporting
Surveillance & Security
Space Utilization
Emergency Response
HVAC Control
Home Health Monitoring
Retail Management
Lighting Control

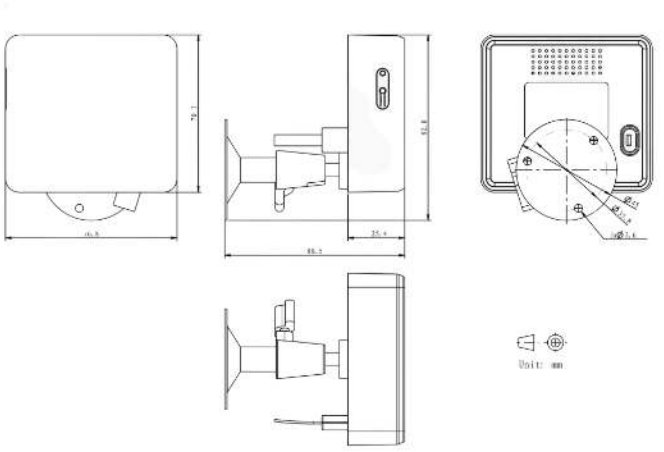
Specifications

Operating Frequency	60.3 ~ 63.6 GHz
Swept Frequency	3.3 GHz
Azimuth Angle	120 Degree
Elevation Angle	120 Degree
Detection Range	Maximum 6m for People Detection
Data Refresh Rate	50ms
Machine Power	<5W
Machine Size	76.8mm*70.3mm*25.4mm(without cable and bracket)
Weight	Radar 84g, bracket + screw 64g
IP Rate	N/A
Voltage Input	5v ~ 15V for RS-485 version 5V Max for USB
Operational Temperature Range	-20 ° C ~ 50 ° C

Note:
All specs above are measured under the environment of 35 °C temperature, standard atmospheric pressure and humidity, without any Electromagnetic Interference (EMI).

Operational Temperature Range indicates radar works properly in this range. If operating temperature goes beyond this range, radar might not be accurate and can suffer mechanical damage.

Mechanical Drawing



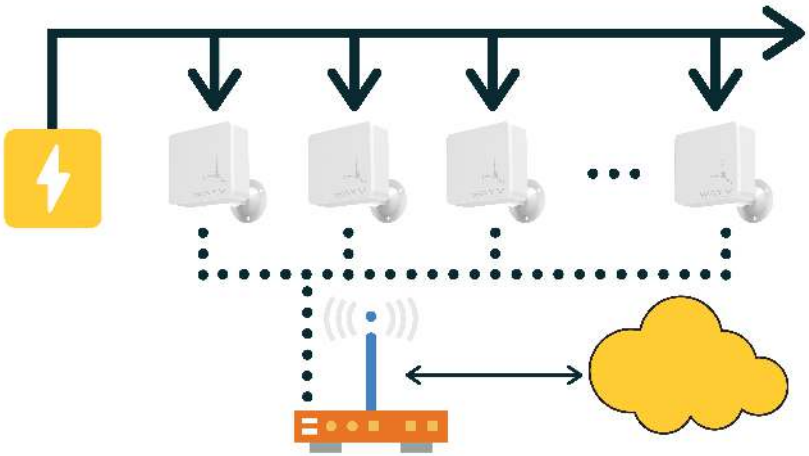
Software and API

In addition to the provided software (GUI), an API with source code is also provided in order to receive data from WAYV Air and provide customized development. Please contact Ainstein to request it, NDA or other extra documents might be needed for this request.

WiFi Cascading

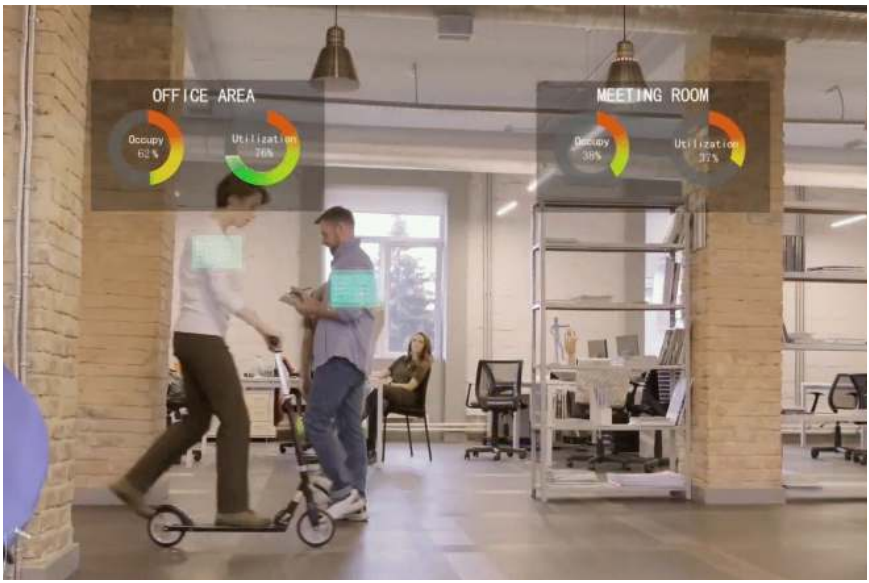
Multiple Wayv Air devices can be connected to the host PC (or other DSC -- Data Service Center) via local WiFi network, then downstream/ upstream data.

This cascading connection is suitable for the scenarios that require simple, quick, and small-scale deployment. Please make sure the local WiFi network is able to cover all Wayv Air devices in this case.



The Case for People Counting & Automation

Companies seeking to develop smart building, people counting, crowd monitoring, industrial safety and other applications can use the WAYV Air for near real-time decision-making and signal processing. These new sensors give technology integrators, product designers and managers the ability to tap new markets and applications for more precise and efficient operations. The WAYV Air is one of the first new applications of the 60 GHz radio frequency (RF) mmWave band, which historically has been utilized primarily for military applicants



The Big Problems with Current Technologies

People counting is a relatively mature application, which can be done using several different technologies, the most common of which include video computer vision, infrared, thermal imaging and Wi-Fi. A critical concern many organizations have with video-based people counting solutions, which often prevents them from deploying, is privacy. While video-based technologies offer accuracy and efficiency, they come with the inherent downside of privacy and safety concerns due to the availability of personally-identifiable information for specific individuals. Wi-Fi solutions do not offer an accurate count of every individual in a given space; rather, an approximation based on those who are carrying a smartphone connected to the Wi-Fi network. Statistical methods are then applied to come to a reasonably good estimate as to the number of people moving in and through a space. Thus, counts from Wi-Fi-based people counters are estimates rather than true counts. Additionally, these technologies are more limited in their ability to map movements of people in a space. Infrared imaging and thermal imaging are both used for people counting, too. They provide adequate accuracy, but installation and operating costs for both tend to be quite high. These systems both require large amounts of power and run constantly, which results in high operating costs for continuous monitoring. Radar-based people counting, on the other hand, can save on power costs by triggering counting functions only when an object (a person, in this case) is detected.

Example Use Case: People Counting

People and crowd monitoring solutions are ideal for large offices, conference centers/convention centers, police departments, entertainment arenas and more. The WAYV Air can be used to monitor whether a meeting room is occupied, and accurately counting the number of people in that room. Take a large office building with many different meeting or conference rooms for example. Traditionally, management of the use of these rooms is through some sort of calendar system. Such a system assumes that the room is used continuously, for the entirety of the time it's booked for. However, it's not uncommon for a meeting room to be reserved, but because of a last-minute change, to have the space go unused. On the calendar, the meeting room still appears as in use, but with a radar-based counting solution the office manager could see that the space in fact is not currently being used, and allocate the meeting room to another group that does need it.

Multiple WAYV Air units can placed in varying locations and connected using a single bus. Data from each WAYV Air unit can be transferred to a central location to perform further actions. For example, in the conference room use case:

- Three WAYV Air modules are placed in three different conference rooms.
- The WAYV Air modules can detect if the conference rooms are occupied.
- The data are processed on individual WAYV Air modules, then transferred via I2C to a Wi-Fi enabled microcontroller.
- The microcontroller can then be connected to Amazon's Alexa, which can tell the user if a particular conference room is occupied or not.

Advantages of the 60GHz Frequency

The 60GHz frequency band has long been underutilized, but offers tremendous potential for developing within-building sensing applications. It is ideal for building automation applications, as it enables sensors to accurately sense the range, velocity and angle of objects in a scene. The 60GHz band enables expanded use of mmWave technology, while providing high resolution needed for industrial environments.

In the United States, the 60GHz falls into a band of unlicensed frequencies, which are free for all to use in any way they see fit, so long as they don't cause undue interference with other applications. The 60GHz frequency is a mmWave frequency, which is a general class of technologies that has gained increasing popularity in the past decade. One reason for this growing popularity is due to its short wavelength, which is less able to travel through walls and buildings. In many technology use cases to date, this has been a disadvantage, as we seek radio signals to travel through walls and building for uses like Wi-Fi connectivity. However, with the proliferation of radio signals flying through our airwaves today, there is an increased desire and need on the part of some users for signals which remain contained to a defined space – and something that 60GHz technologies can help to achieve.

Technical Specifications

Designing the module to fit in the limited real estate and the required performance metrics requires special consideration. One of the main goals of the WAYV Air module is to achieve equal resolution in azimuth and elevation planes. Hence, this requires placement of the transmit and receive antennas in distinctive locations which creates a virtual antenna array with an equal number of antennas in both planes. To achieve a ±90°

unambiguous field of view (FOV), the spacing between the four receive antennas was designed to be half wavelength, while the three transmit antennas are separated by a wavelength. This results in a 4x2 grid in both the elevation and azimuth planes.

The patch antennas are designed to be small enough to fit in this spacing and give enough room for the routing. To adhere to the half wavelength

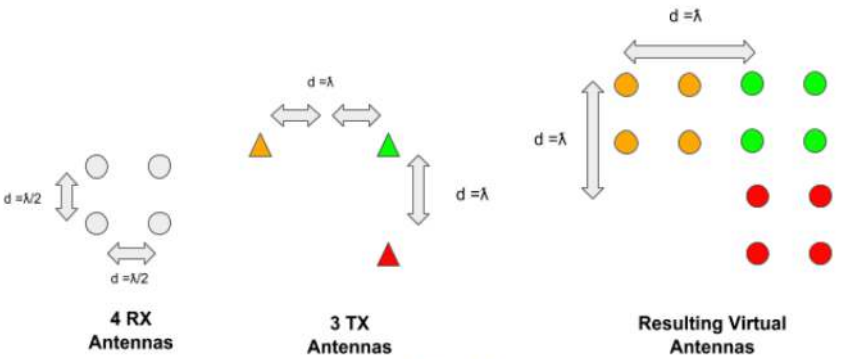


Figure 2: ODS EVM Virtual Antenna

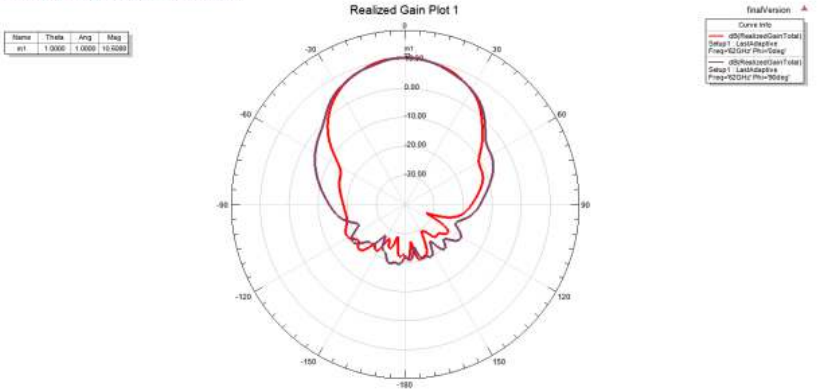
spacing for the receive antennas, RX1 and RX4 antennas had to be flipped by 180°. Designing the patch antenna with this in mind ensures that flipping of the antennas would not cause significant performance variance between each of the four receive antennas.

Another challenge that arises from this placement is the routing, as all four receive antennas and all three transmit antennas had to be length matched, respectively. At mmWave frequencies, long traces with significant curves can degrade the performance of the antennas. As the routing of RX1 and RX4 is quite different from RX2 and RX3, precautions must be taken to ensure the gain and phase are not notably different between each element across the bandwidth.

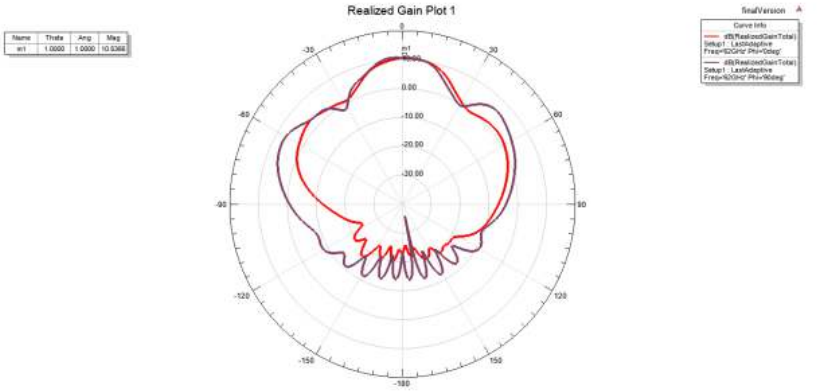
Our advanced design ensures that the performance is not significantly impacted by the routing

FOV / Angular Resolution	ODS Performance

TX1, TX2 and TX3 on:



RX1(180deg),RX2(0deg), RX3(0deg),RX4(180deg) on:



About Ainstein

Our mission is to enable safer driving, flying, working and living through radar-based technology. We are in the business of improving safety and protecting valuable assets through innovations in radar technology.

Ainstein makes radar systems smarter, more affordable and easier to deploy. We offer complete solutions for autonomous drones, advanced driver-assistance systems (ADAS), autonomous vehicles and industrial sensing – incorporating a combination of millimeter wave (mmWave) radar, sensor fusion and artificial intelligence (AI).

For years, cost, weight and performance constraints have hindered the wider adoption of radar. Ainstein makes radar systems accessible to everyone by overcoming these constraints. One recent innovation: we've developed the world's first UAV collision avoidance radar with 4D detection.

Radar systems and sensor data processing intelligence are keys to our autonomous future. We offer deep scientific, mathematical and engineering expertise along with a full spectrum portfolio (24GHz, 60GHZ, 76-81GHz) of hardware and software to support our customers in developing highly customized solutions with unmatched precision in unpredictable environments.

Our core team has more than a combined 100 years of experience in radar research and development with deep knowledge gained through projects funded by NASA, the U.S. National Science Foundation (NSF), the European Space Agency and others.

Other radar companies are at least two to three years behind Ainstein. Startups have been slow to market and are unable to produce at scale, while established companies are slow to adopt the newest technological innovations.

Ainstein products can be fully customized to specific application requirements, have unmatched precision in ALL weather conditions and surface types, and are a fraction of the price of competitive products.

Please visit our website (www.ainstein.ai) for more information.