GSMA
Foundry

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CASE STUDY

The Advent of **High-Resolution Radar**

Bitsensing has developed a radar system that could make transport systems safer and improve the sleep quality of people in care homes, hospitals and other healthcare facilities.

Executive Summary

Start-up Bitsensing has developed a new kind of radar that promises much higher resolution images, longer range, better depth and height detection and other improvements on traditional radar systems. The Korea-based company says its radars can distinguish different road users, such as pedestrians and cyclists, at distances of up to 300 metres, as well as gauging how fast they are moving.

As transport systems become increasingly automated, advanced radar technology is beginning to be deployed in roadside infrastructure and vehicles, alongside cameras and other sensors. While the performance of camera-based recognition systems can be impaired by poor weather conditions, radar continues to work well in fog, mist, snow and rain. Having deployed artificial intelligence in roadside units to process the incoming data, Bitsensing also contends that its technology uses less energy and bandwidth than camera-based alternatives.

Bitsensing's technology is already monitoring an 81 km stretch of expressway in South Korea that is prone to fog and is now being deployed on a complex road system near Verona in Italy. Through partnerships with a semiconductor maker and an automotive components supplier, the six-year-old start-up expects its radars to be incorporated in some electric vehicles from 2025.

Having developed a radar-based system for monitoring sleep quality and people's vital signs, Bitsensing is also targeting the healthcare and wellness sector. A semi-conductor company has integrated its radar technology into chips that it intends to sell to consumer electronics companies developing smart appliances for use in care homes, hospitals and other healthcare facilities.

Having just raised US$25 million in Series B funding, Bitsensing is now expanding its sales and distribution systems internationally, as well as developing the next generation of its advanced radar systems. In particular, it is aiming to stitch together the data from multiple radars in real-time to give users a 360 degree view of their surroundings.

As vehicles and transport infrastructure become increasingly automated, they need a reliable means of detecting what is happening in their vicinity. Unlike cameras or lidar (laser-based) systems, radars can easily penetrate fog, snow, heavy rain and other weather-related obstacles. But traditional radars also have drawbacks. Although they can generally detect the presence of an object, they lack the resolution to identify that object - it wouldn't be able to distinguish between a pedestrian and a cyclist, for example.

Bitsensing, a six-year-old start-up based in South Korea, has developed an advanced form of radar, which it says can detect the shape of an obstacle, enabling it to distinguish road furniture, pedestrians, animals, cyclists, cars and vans, for example. This "4D imaging radar" is underpinned by multi-chip cascading technology, an advanced array patterning technique and radar signal processing algorithms. As a result, it can support 192 channels, and a high angular resolution for azimuth and elevation, while still maintaining a small compact form factor. With 192 channels, the radar produces a "point cloud" that is sufficiently detailed to distinguish one object from another. The radar is 4D system in the sense that it can gauge the velocity that an object is moving in, as well as detecting the object's shape in three dimensions. Depending on the frequency in use, Bitsensing's system can also detect objects of more than 300 meters away.

Operating in the 76-81 GHz frequency band, 4D imaging radars could be used in conjunction with cameras to enable vehicles to become increasingly automated. In so-called software-defined vehicles, Bitsensing anticipates that its radar could be used as an alternative to lidar, which is used by some self-driving vehicles. It claims its radar technology is about 30% less costly than lidar, while also having the advantage of being effective in any weather conditions. "What we're saying is that by adding 4D imaging radar to camera sensors, you create a redundancy and more reliability," explains Jean Lee, head of marketing communications at Bitsensing. "Of course, a camera has a higher resolution, but in bad weather or other circumstances, the 4D imaging radar can be a redundant system for the vehicles. Basically, we need cameras, we need 4D imaging radar, and lidar can be an option."

Different radars for different use cases

For the automotive sector, Bitsensing has developed two different types of radar, which are designed to work in tandem. One of these – the imaging radar – is for use on the front and the rear of the vehicle. It is high resolution and has a range of 300 metres, but a relatively narrow field of view (60 degrees). The two imaging radars would work in conjunction with four corner radars, which have a wider field of view (170 degrees) and a detection range of 240 metres, but a lower resolution.

To get its radar technology into vehicles, Bitsensing is working with a company developing autonomous driving and electronic solutions. Operating globally, this company has contracts to supply the

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imaging radar and corner radar to electric vehicle (EV) makers in the US and South Korea, according to Jean Lee. She says Bitsensing's technology should be in commercial EVs from 2025, adding that her company is also in advanced discussions with a leading supplier of semiconductors to the automotive sector.

Bitsensing has also developed lower frequency radars to enable roadside infrastructure to detect traffic levels, accidents and other incidents. Bitsensing has developed a system that can be used to provide alerts in the case of a stationary vehicle, queuing traffic, jaywalking, driving in the wrong direction, speed violations and illegal lane changes. It can also distinguish between different vehicle types.

As well as being tolerant of poor weather, Bitsensing says its radar technology is more energy-efficient and less data intensive than using cameras, thereby lowering operating costs. To reduce the amount of data that has to be transmitted over networks and analysed in the cloud, Bitsensing has developed a roadside unit that has its own GPU (graphics processing unit) and artificial intelligence (AI). As a result, it can process and analyse the incoming radar data at the roadside, and then send alerts to a centralised system, only when necessary.

In South Korea, 120 of Bitsensing's radars are now used, in conjunction with cameras, to monitor an 81 kilometre stretch of expressway between Nonsan and Cheonan, which is prone to fog. Installed in November 2023, the solution is used to manage traffic; they can provide real-time insights on traffic volume, speed and occupancy levels to the control centre and also track unexpected events such as stopped cars and reverse driving.

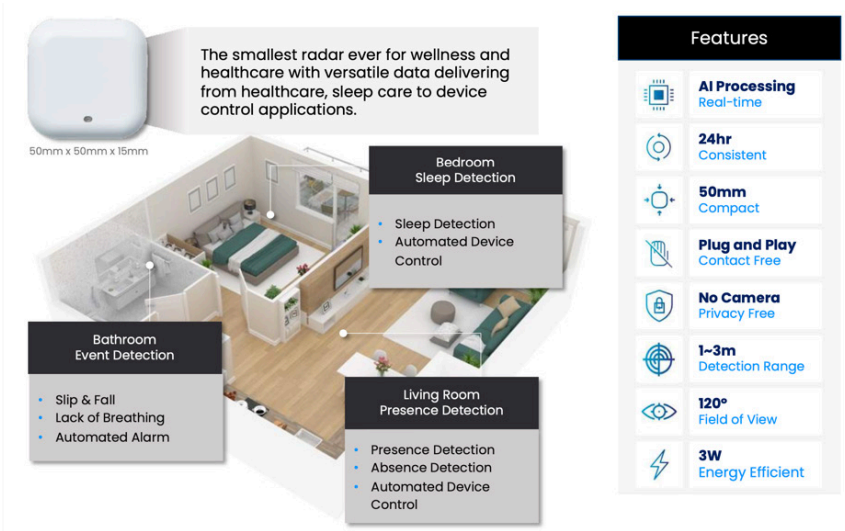
Through the Korean government's KCT project, which aims to promote Korean innovations globally, Bitsensing is also supplying its radars to monitor a complicated road system in Verona in Italy.

Working with a systems integrator, Bitsensing plans to supply 10 radars to monitor a roundabout, which is served by more than six roads. Bitsensing is hopeful the deployment will help it win similar contracts elsewhere in Europe. It is also exploring opportunities to supply roadside radars to Thailand and India.

Detecting vital signs to improve sleep and safety

Bitsensing says its radars are sensitive enough to be used to support health and wellness applications. For example, it has developed a radar-based system that can be used to monitor whether a child is present inside a vehicle: it is able to distinguish between the breathing patterns of an adult and those of a child. If it detects the presence of a child, it can be configured to send an alert to the owner of the vehicle: leaving a child unattended in a parked car, even for a few minutes, can lead to heat-stroke and death, especially if the car is exposed to the sun, according to Euro NCAP, a pan-European auto safety watchdog. Jean Lee says her company is in discussions with automotive and semiconductor firms about deploying this in-cabin monitoring solution commercially.

In a similar vein, Bitsensing is also applying its technology to monitor the presence and breathing patterns of people in care homes and other healthcare facilities. It has developed a wall mounted radar that can be used to monitor whether anyone is present in a room and even the quality of an occupant's sleep. Bitsensing says its radar is sensitive enough to detect a person's breathing rhythm, but, unlike a camera, cannot be used to identify an individual or what they are doing. While cameras could be configured to blur out images, Jean Lee believes such assurances won't be sufficient to assuage people's privacy concerns.



While wearable devices can also be used to monitor sleep, Jean Lee believes they have several disadvantages. “For example, for me personally, I hate wearing anything on my body while I sleep. So, I take off my watches, my rings, everything like that,” she says. “And with a wearable, you have to charge it at some point and people kind of charge it during their sleep mostly.”

In the healthcare sector, Bitsensing has adopted a radar platform-as-a-service business model. It has licensed its sleep quality monitoring application to a semiconductor company, which has integrated the technology into its chips and into supporting servers. The semiconductor maker launched the product in October last year. “They are talking with a lot of different companies for smart appliances. I think it’s going to be commercialised starting from later this year,” adds Jean Lee. As well as supplying consumer electronics companies, the semiconductor firm could also provide the technology to systems integrators working with care facilities, nursing homes and hospitals.

Opening up new distribution channels

In addition to licensing its technology, Bitsensing is developing reference designs for the various markets it is targeting. The idea is to give potential customers the option of integrating Bitsensing’s technology into their own solutions or buying a full package, incorporating both the necessary hardware and software.

Having just raised US$25 million in its B Series funding round, Bitsensing is looking to expand its sales and distribution channels internationally. “We’re working with a lot of different agencies and partners in global regions,” notes Jean Lee. “We’re trying to create more partnerships with global chip makers, governments agencies and city scale projects for each of our solutions.” In some markets, Bitsensing is also talking to telecoms operators about integrating its technology into the connected systems they are providing to transport authorities and municipalities.

At the same time, Bitsensing is also developing its core technology. It is aiming to create an entirely software-defined radar system. One of its immediate goals is to be able to stitch together the images from multiple radars in real-time to provide a comprehensive stream of data that could enable a traffic island or a vehicle, for example, to have a 360-degree view of what is happening around it. That would help ensure there are no blind spots, further improving the effectiveness of road safety systems.

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Our vision is to unlock the full power of connectivity so that people, industry, and society thrive. This enables the mobile industry's mission: to connect everyone and everything to a better future.

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About Bitsensing

Bitsensing is a pioneer in advanced radar solutions. Founded in 2018 in South Korea by leading experts in automotive radar technology, the company has expanded the use of its high-performance, automotive-grade radar across a variety of applications in autonomous driving, connected living, smart cities, health tech, and beyond. Since its inception, bitsensing has raised a total of $46 million in funding to bring 'radar everywhere', with investment from Korea Development Bank, HL Mando Corporation, Industrial Bank of Korea, and more. The company has received numerous accolades for its proprietary technology, including a "Best New Product" award at the 2019 Korea Electronics Grand Show, CES 2020 Innovation Awards Honoree for Smart Cities, 2020 TechCrunch Disrupt Winner, and CES 2022 Innovation Awards Honoree for Vehicle and Transportation Technology.

For more information about bitsensing, please visit: https://bitsensing.com/.

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