

Could an Indoor Location Information System Become a Magic Bullet that Mitigates COVID-19?



In order to prevent the further spread of COVID-19, the world is shifting to a “new normal” in which social distancing is practiced and contact between people is avoided. Due to early evidence suggesting that the spread of COVID-19 is much more aggressive indoors than outdoors, many companies have begun efforts to monitor workers’ movements and trace contacts in order to keep offices and factories from becoming new epicenters of infection.

The Need to Monitor Workers at Offices and Factories

Keeping a safe distance from others and avoiding contact is essential to prevent getting infected with COVID-19. However, there are many situations where avoiding contact with others at indoor locations such as offices and factories is difficult. Hence, there is a growing need for technologies that ensure workers’ health and safety and prevent the spread of infection by monitoring contact between workers and their movement histories in real-time.

For outdoors, Global Navigation Satellite Systems (GNSS) and BLE ranging works effectively for determining the positions of people and objects relative to one another. Meanwhile, for indoors, location information can be obtained using various wireless communication technologies including Wi-Fi, Bluetooth, and Ultra-wideband (UWB)^{*1}. For example, Bluetooth beacons^{*2} have been deployed at commercial facilities to enable services that provide location-relevant information to customers with smartphones. The positioning accuracy of Bluetooth, however, is only around three to ten meters and is dependent on infrastructure installation. To be useful for contract tracing of infectious diseases, the number of beacons must be increased to achieve an adequate level of accuracy. UWB technology features high positioning accuracy, but deployment in a wide area would require installation of a large number of radio transceivers and repeaters, putting it at a cost disadvantage.

Comparison of indoor location information technologies

System	Geomagnetism+More (TDK)	Wi-Fi	Beacons	UWB/Audio/Other
Infrastructure Costs (Essential Equipment)	None (Geomagnetism, Wi-Fi and Bluetooth)	High (Wi-Fi Base Stations)	High (Bluetooth Devices)	Very High (Custom Transmitters, Repeaters and Transponders)
Software-Only Solution	✓	-	-	-
Positioning Accuracy	1-3m	5-30m	3-10m	< 10cm
System Support	iOS/Android	Android	iOS/Android	Custom
Unique Geomagnetic Technology	✓	-	-	-
Unique Wi-Fi/Bluetooth Technology	✓	✓	✓	-
Pedestrian Dead Reckoning Technology	✓	-	-	-
Supports Existing Smartphones	✓	-	-	-
Affected by Smartphone Orientation	None	Yes	Yes	Yes
Positioning Time	<1sec	Per Scan	Per Scan	Varies

Introducing a Location Information Solution Based on Geomagnetism

Given this background, a solution using geomagnetism^{*3} is attracting attention as a means to obtain indoor location information. TDK has developed **VENUE**, a location information solution that displays the real-time locations of people by utilizing geomagnetic sensors found in today's smartphones. Each indoor location has a geomagnetic signature that can be used to ascertain the position of the phone.

There are several approaches to indoor positioning, but geomagnetism, tightly coupled with inertial navigation^{*4}, optimally balances accuracy, reliability, and cost of deployment and maintenance.

"The beauty of geomagnetic positioning is that it works in all large venues whose structures interfere with Earth's magnetic field, making this an infrastructure-free approach to indoor positioning that is accurate to better than 2 meters," says Chris Goodall, Founder and current Managing Director of Trusted Positioning Inc., a TDK Group Company based in Calgary, Alberta, Canada.

VENUE requires only the creation of a geomagnetic map that combines an indoor layout map with the geomagnetic data of that particular location acquired through a survey, with no need to install new devices and terminals. This leads to low installation cost, a major strength of VENUE. The accuracy of positioning using geomagnetism is better than two meters (6 feet)—sufficient for tracing contact with infected persons. In addition, VENUE provides a position display with even higher accuracy by combining geomagnetic information with information from accelerometers^{*5} and gyroscopic sensors^{*6} inside smartphones.

"People may hold their smartphones while walking or put them in their pockets or bags. Since the orientation to the user changes constantly, the movements and pedestrian use-cases need to be corrected using inertial sensors. Solving these issues was the greatest challenge for practical applications such as tracking, and took our team many years to create, perfect, and protect," according to Goodall.

Features of Trusted Positioning's VENUE



VENUE can accurately present location information even indoors with its unique positioning technology: a combination of geomagnetic sensors, accelerometers, and gyroscopic sensors, as well as Bluetooth and Wi-Fi.

Real-World Trial of a Contact Tracing App Already Under Way

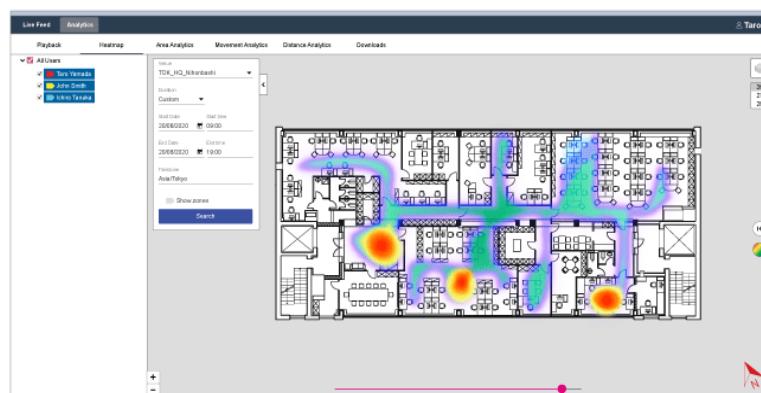
Beginning in August 2020, a contact tracing trial among workers is being conducted at TDK's headquarters in Nihonbashi, Tokyo, using VENUE. Employees carry smartphones with a special app installed, and their positions and movement histories on the floor are combined with anonymous identification information. If an employee is found to be infected, the data will be analyzed to identify people who had contact with that employee within the preceding two weeks, and measures such as a stay-at-home instruction will be taken.

This solution can not only identify those who were in close contact with the infected person as primary contacts, but also trace those who stayed in areas where the infected person had been shortly before as potential 'area contacts'. Analysis that combines location and elapsed time enables more effective contact tracing by improving primary contact tracing indoors and enabling area-based contact tracing over time.

Ongoing Trial at TDK Headquarters



VENUE displays an individual worker's tracking data on the dashboard.



A worker's durations of stay and positions can be visualized in the form of a heat map.

*These are conceptual illustrations of screens that are currently under development.

Indoor Location Information Services Opens New Possibilities

Because VENUE can display the positions and histories of people and objects using not only workers' smartphones but special tags containing geomagnetic and inertial sensors (under development), it can be deployed for a wide range of applications beyond contact-tracing of infectious diseases, such as monitoring the flow of employees to improve operational efficiency, or tracking the positions of equipment to manage their operational statuses. TDK is currently working with a number of companies to propose a variety of solutions to improve business efficiencies using location information.

Many offices have introduced open seating so maintaining a 'real-time seating chart' using VENUE is a real advantage so staff can more easily find one another in large office settings, encouraging more collaboration between staff and departments.

Companies have been using BLE beacons to manage the movement of workers, materials, and equipment indoors in warehouses, factories, and construction sites at considerable costs and maintenance. But with VENUE, this can be effectively reduced, especially in large-scale facilities.

VENUE is also useful for other contact tracing applications that do not focus on viral transmission. Human to machine, human to vehicle and human to robot contacts are just as critical as COVID-19 contact tracing. The future work environment will undoubtably change with more automation and the interaction of humans and machines poses safety concerns. VENUE hopes to improve safety for all types of contact tracing applications.

VENUE is an indoor location information solution that enables highly accurate location information to be obtained while keeping infrastructure costs down. Similar to the expansion of GPS for outdoor positioning applications in the past, the presence of indoor positioning technologies will likely grow in our everyday lives.

For more information about VENUE, please visit the website.

www.trustedpositioning.com



Monitoring the location of people and objects indoors is expected to have a variety of applications

- Terminology

*1. Ultra-wideband: A form of wireless communication that utilizes an extremely wide bandwidth of more than 20% or more than 500 MHz.

*2. Beacon: A technology for acquiring location information based on Bluetooth Low Energy (BLE), a short-range wireless technology featuring low power consumption. Also, a device that uses this technology.

*3. Geomagnetism: The magnetism and magnetic field generated by the earth. Because it is unique to every location on Earth, it can be used to identify location information both indoors and outdoors.

*4. Inertial navigation: A system that accurately determines its own position by calculating speeds and distances using accelerometers and gyroscopic sensors. Used in navigation systems for automobiles and aircraft.

*5. Accelerometer: A sensor that detects the acceleration of an object. It can measure the movement and tilt of an object and is equipped on many smartphones.

*6. Gyroscopic sensor: Also known as angular velocity sensors, gyroscopic sensors can detect changes in device orientation and motion, and are used in applications such as image stabilization in digital cameras and car navigation systems.

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