NAIOP RESEARCH FOUNDATION

Beacons and Sensors in Commercial Real Estate

Research Brief
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Networked Digital Sensors Signal Change

Business owners can efficiently track inventory, improve space utilization, lower operating expenses, enhance customers' experiences and tighten security by deploying digital sensing devices that make use of radio-frequency identification (RFID) tags, Wi-Fi and smartphones. These devices, known generally as beacons and sensors, are nothing new in commercial properties; the ability to control temperature, track inventory and send advertising messages to shoppers through their smartphones has become commonplace.

However, beacon and sensor technologies are no longer used only for single purposes (e.g., motion sensors turning lights on in a conference room) but are increasingly linked through internet-based networks. The networks become ecosystems that can provide comprehensive information about a business or property (e.g., real-time information on temperature, people counts, goods movement and energy consumption). The large amount of data collected from these devices present opportunities to increase profit, but they also raise privacy and security challenges.

Beacons and sensors are two widely used systems that employ location technologies, but each has different applications. Beacons typically "push" information to a mobile device within a certain geographic area (e.g., a notification appears on your smartphone that the store you are passing is having a sale), while sensors "pull" information from the environment (e.g., room temperature, motion, lighting levels).

In the past, each beacon or sensor operated independently and usually did not share or store data. However, the "internet of things" (IoT) integrates beacons and sensors through assigned IP addresses, allowing them to communicate over a network and compile location-based data that can be collected and analyzed. IoT technology is a key component in "smart" appliances, buildings and cities. Gartner, Inc. estimated that 8.4 billion devices were connected to the internet in 2017 and the number will increase to 20.4 billion by 2020.[1]

This brief provides an overview of some of the ways that simple, tiny, affordable and ubiquitous sensors are being used in commercial real estate settings. It addresses radio-frequency identification, geofencing, beacon technology, and WELL™ and RESET™ technologies, and it concludes with the broader challenges associated with using networked digital data-collection systems.

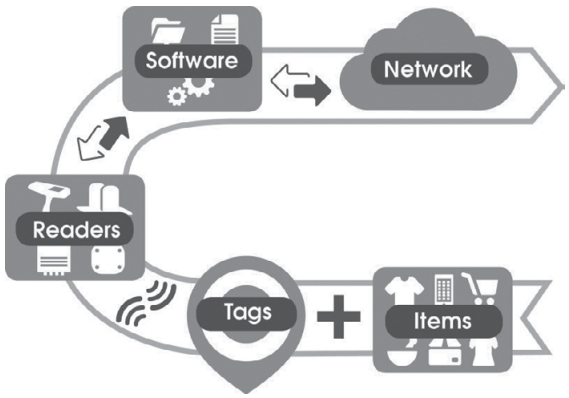
Radio Frequency Identification

RFID is a form of wireless communication that uses radio waves to identify and track objects. RFID labels or tags contain an electronic chip that can be passive, semi-passive (also known as battery-assisted passive) or active in the way it interacts with a reader to provide wireless tracking capability. Passive RFID uses an electronic chip that works with radio frequency to provide wireless tracking capability. It does not use an internal power source nor does it have data-logger capacity. Semi-passive and active tags are battery-powered and continuously broadcast their own signal. A user who wants to collect and store sensor data, even when the tag is not being interrogated, will need to use an RFID model with a built-in rechargeable battery that will keep data for one month without recharging. An RFID system includes hardware such as tags, a reader and application software. Tags can cost from 10 cents to $50, depending on the type of tag and the application.

RAIN, a type of RFID technology, is a passive system that allows businesses and consumers to identify, locate, authenticate and engage with billions of items. RAIN RFID is used in a wide variety of applications, including inventory management, patient safety, goods tracking and item authentication. Additionally, through internet connectivity, it can provide real-time information about everyday items such as apparel, medical supplies, automobile parts and food (Figure 1).

Figure 1

The hypothetical flow of data via a RAIN RFID-tagged item to the network for analysis.



Source: RAINRFID.org

Construction

RFID-enabled technology can track the number of workers on job sites, as well as their identities.[2] By utilizing workforce-monitoring software, construction project managers and supervisors can capture the identity of each worker entering or leaving a site. RFID portals read passive ultra-high-frequency RFID tags attached to hardhats or badges at construction sites to track the workforce as it comes and goes during the day. The software categorizes information captured from the RFID tags. This includes the contractors and number of workers on-site, the identities of individuals who have specialized training or key certifications, and employee demographics. Geodemographic information captured can include workers' street addresses and home ZIP codes, enabling a more nuanced calculation of the economic impacts of a construction project on geographic areas.

Industrial and Manufacturing

Swedish wood companies have installed RFID tags on railcars and readers on tracks. Working with beaconing technology and geospatial software, they can identify the location of railcars, as well as the location and status of products such as lumber or wood pulp.[3]

Lids, an Indianapolis-based sportswear retailer, uses automated carts with RFID tags that wirelessly receive a list of items to be shipped. A robotic arm on the cart then picks the items from the storage racks to fill the order. Sensors placed around the warehouse track the cart's movements, ensuring more accurate and faster shipments.[4]

Geofencing

Geofencing is a virtual geographic boundary line, typically using GPS, cellular data or Wi-Fi, which can surround a specified geographic area such as a single building or an entire city. Entering a geofenced area triggers an event, such as the transmission of a message to a mobile device. The most common applications of geofencing today are in retail, security and delivery.[5] The technology, which relies mainly on cellular and Wi-Fi networks, can be used to collect insights about consumer behavior and send location-relevant content to mobile users. Geofences are increasingly transforming how retailers and their landlords understand shopper behaviors. The technology typically requires the use of a mobile app, which can cost upwards of $50,000 to develop.[6]

Retail

JLL developed PinPoint, a tool to monitor shoppers within a geofence at shopping centers the company manages or leases.[7] The data collected by the geofence interface provides an exact count of foot traffic, as well as accurate and quantifiable examples of consumer behavior. PinPoint can also assist mall owners in attracting new customers by creating new leasing strategies tailored to shopper preferences.

Beacons

Like geofencing, beacons are used for location-based messaging and tracking, but the platform generally relies on Bluetooth™ technology rather than cellular or Wi-Fi networks. Beacons also have a smaller target range than a geofence. Initial beacon applications were limited to retail settings, but they are increasingly being used in other industries such as manufacturing, logistics and health care. Most beacons on the market use either iBeacon (developed by Apple) or Eddystone (developed by Google) technology. They are also cost-efficient and can be purchased for $20 to $40. Bluetooth™ functionality is built into every current smartphone, but users must turn it on to be tracked or to receive messages.

Retail

Simon Property group has invested in iBeacon location and proximity-detection technology to assist retailers in enhancing the shopping experience by allowing contactless payment, navigations and automatic check-in. As of 2017, the company had installed more than 4,000 beacons in more than 190 malls and shopping centers worldwide.[8]

Office

WeWork uses beacons to track the movement of people through its shared office facilities. For example, when a WeWork member enters a conference room, a beacon sends a notification to that person's smartphone letting them know if the room has been reserved by someone else and, if so, which other rooms are free.[9] The beacons also send reminders to users about picking up packages and, by tracking smart phones, quantify member occupancies in certain spaces at different times during the day.[10]

Airports

San Diego International Airport deploys beacons with a Bluetooth™ Low Energy (BLE) system, bringing location-based services to passengers who access the airport app. Passengers receive real-time information about terminal locations, parking and shuttle buses. The airport can also track and dispatch employees with greater accuracy.[11]

WELL™ and RESET ™

In 2017 the WELL Building Standard™ (WELL) program formed a strategic partnership with GIGA's RESET™ standard.[12] The program will combine the WELL performance-based system for measuring, certifying and monitoring features of the built environment that impact human health and well-being (such as air and water quality, optimal lighting and availability of fresh food) with GIGA's RESET™ environmental sensors and cloud-based analytics. The sensors, placed around various locations within a building, collect ambient data and store it in a secure server where it can be analyzed and used toward building wellness certification. The adoption of an international environmental standard along with real-time assessment sensors has the potential to change the way office buildings, apartments and health-related facilities are used and marketed.

Retail

The Haworth Kerry Center furniture showroom in Shanghai is WELL™ and RESET™ certified. Sensors in the sales floor monitor levels of fine particulate matter, total volatile organic compounds, carbon dioxide, temperature and humidity. The results are displayed on a screen in the showroom, demonstrating compliance, transparency and real-time verification of air standards, which have become a primary environmental concern in China. The sensors detected very low volatile organic compound emissions from the showroom's soft seating products, justifying the company's choice of environmentally-friendly materials.[13]

Integrated, Multiple-Technology Systems: Amazon Go

As IoT and mobile technologies improve, companies are using complex combinations of beacons, sensors, Wi-Fi and artificial intelligence to simultaneously track people and goods. Amazon Go, Amazon's cashier-less grocery store in Seattle, allows consumers to take whatever items they need and walk out of the store without waiting in line. The shopper must first download the Amazon Go app to a smartphone. The app signals sensors in the store when a customer enters. Sensors and cameras detect when a shopper removes an item from a shelf and keeps track of it in a virtual cart through glyphs printed on each package. Likewise, if a shopper puts an item back on the shelf, it is removed from the virtual cart. The customer's smartphone can stay in a pocket or bag during the entire shopping period and is not needed for scanning. After leaving the store through a sensor-enabled turnstile, the customer's Amazon account is charged for the goods. Amazon's proprietary "Just Walk Out Technology" uses technology similar to that found in self-driving cars — computer vision, sensor fusion and deep learning. This strategy, if proven effective in the long term, may widen the slim profit margins for grocers by saving on labor costs and inventory control. Amazon's blended uses of sophisticated technology in its grocery stores may portend such combinations in office, industrial and residential environments.

Challenges

Personal Privacy

Although collecting and analyzing digitized consumer or employee data can reap valuable rewards for businesses, the practice comes with privacy concerns. Data indicating a person's location and historical movements are usually owned and controlled by network operators, including mobile carriers and mobile content providers, thus leaving the information susceptible to privacy breaches and sale to third parties.[14]

Technology that tracks individual identities may require the user to take an active approach or "opt-in" to enable the service (e.g., installation of a mobile app) or entail a passive approach that collects data without necessarily identifying a user (e.g., motion detectors or carbon dioxide sensors). Businesses may find that information containing personal identification may provide deeper insights and greater confidence in data related to work and shopping habits, but privacy concerns may hamper the collection of user-level information. Anonymous data collection can be less onerous and almost as useful, allowing owners to

Integrated, Multiple-Technology Systems: Innovative Use of Location-Based Systems (LBS) in an Office Building

Rising Realty Partners (Rising), a full-service real estate operation and investment company, has married innovative technology and design to create unique properties in and around Los Angeles. Marc Gittleman, Rising's senior executive advisor for real estate technology, believes the use of Wi-Fi, RFID and beaconing can transform a building into a higher-value asset. For example, Rising can track the levels of Wi-Fi usage and the presence of GPS on mobile devices in public spaces and amenity areas to determine how many people are using an area and for how long.

They discovered they could use this data to tailor shared spaces and amenities to tenants' usage patterns. For example, sensors measured foot traffic in and around the building. By analyzing the generated data, the owners knew which parts of the property were most used at different times of the day. The data was also of interest to prospective retail tenants who wanted to know how long people lingered in certain areas and the number of people passing by main entrances. Building owners can employ this type of usage data in a feedback loop (based on actual real-time information rather than on intuition or educated guesses) to help shape and predict how people use space, as well as provide existing and prospective tenants with unique information about a facility (i.e, predictive spatial analytics).

Rising further incentivized the use of building common areas by creating welcoming indoor and outdoor settings featuring Wi-Fi networks that were private, secure and very fast. The range and security of the network allowed employees to work anywhere in or near the building, enabling tenants to scale back their individual workspaces and share conference facilities. That resulted in lower tenant improvement (TI) requirements and greater flexibility in each tenant's build-out.

Additionally, employees not tethered to desks can be outdoors, socializing and part of a community — all factors that contribute to health and wellness. Gittleman predicts that activating space with technology and analyzing group-level data will achieve greater value for an office property, spur innovative design solutions, contribute to employee satisfaction and serve to retain and attract tenants.

Installing cutting-edge technology, such as state-of-the-art Wi-Fi, in an office building can be expensive. To offset these costs, Rising developed a distinct business line capable of providing internet services to buildings rather than relying on a third-party carrier. This approach allowed Rising to offer tenants internet services that are less costly and more advanced than those of traditional providers.

To optimize internet access in a building, Gittleman recommends installing a robust yet flexible "backbone" for technology, enabling interconnected networks to interface smoothly. This will provide easier deployment and management of not only sensor networks but also building systems. During a renovation of an historic office property, Rising was able to unify the information technology and building systems management into a smart network that would control things such as elevator access and HVAC run times. Consolidating numerous unsecured services into a centrally managed, secure infrastructure reduced the number of vendors needed to service the building and saved on energy costs, lowering the building's operating expenses.

understand people flows in and around buildings providing reliable data about how many individuals are using which spaces and at what time.[15]

Building owners and operators, if they choose to collect identifying data, should clearly explain why they are collecting the data and make certain it will directly benefit the customer or tenant experience, not just the building owner. The recent passage of the General Data Protection Regulation (GDPR) ensures that data collectors provide the highest levels of privacy protection for European Union citizens — "The protection of natural persons with regard to the processing of personal data and the free movement of that data are a fundamental right."[16] To be GDPR-compliant, a company (no matter its location in the world) must not only handle European Union consumer data carefully but also provide those consumers with ways to control, monitor and delete any information about themselves. Companies that wish to stay in compliance must ensure that collected data remain protected. Therefore the GDPR recommends pseudonymization, anonymization and encryption of personally identifying information.

Data Security

Data privacy goes hand in hand with data security. The challenges related to securing data are becoming more complex in IoT-connected environments where the hardware and software may provide more entry points for hackers. Many sensors used in commercial and residential locations have little to no security in their default settings. Additionally, cloud-based storage where data resides is facing increasing threats.[17]

A recent survey of corporate governance professionals found that 60 percent believe their corporate IoT ecosystems are vulnerable to ransomware attacks, and only 46 percent of respondents said their company has a policy in place to disable a compromised IoT device.[18] Deloitte's report "Safeguarding the Internet of Things" recommends commercial real estate companies protect their data by installing new, secure building management systems (BMS) designed for IoT rather than retrofitting existing systems; instituting data governance guidelines; and creating device ecosystems that are "loosely coupled" and resilient so damage to one device does not lead to widespread failure.[19]

In the Future

Instead of a single sensor performing one task, as with motion-detector lighting in conference rooms, devices are now networked to each other, connected to the internet, and collecting data that can be parsed and longitudinally analyzed. The data collected are becoming increasingly valuable because they can be monetized or used to improve outcomes.

However, the technology is changing so rapidly that keeping up with how to collect, store and protect data, and which hardware and software systems to use, is becoming overwhelming. To expedite decision-making and mitigate risk, companies are hiring IoT consultants who advise them about where to locate and connect sensors, as well as how to manage the data. However, companies that employ IoT technology may end up "drowning in data, but starving for insights," and they often need additional assistance in operationalizing their big data.[20] Emerging job fields such as data scientists and data visualizers can also assist companies in effectively analyzing and harnessing the information they collect.

The use of sophisticated devices to monitor and assess environments, despite the challenges, will continue to bring about transformation in commercial real estate. As the rate of adoption increases, material and implementation costs will decrease, and approaches will become standardized. Data privacy and protection will continue to remain a primary concern, even with increasing regulations.

About NAIOP

NAIOP, the Commercial Real Estate Development Association, is the leading organization for developers, owners and related professionals in office, industrial, retail and mixed-use real estate. NAIOP comprises some 19,000 members in North America. NAIOP advances responsible commercial real estate development and advocates for effective public policy. For more information, visit naiop.org.

The NAIOP Research Foundation was established in 2000 as a 501(c)(3) organization to support the work of individuals and organizations engaged in real estate development, investment and operations. The Foundation's core purpose is to provide these individuals and organizations with the highest level of research information on how real properties, especially office, industrial and mixed-use properties, impact and benefit communities throughout North America. The initial funding for the Research Foundation was underwritten by NAIOP and its Founding Governors with an endowment fund established to fund future research. For more information, visit naiop.org/research.

Disclaimer

This project is intended to provide information and insight to industry practitioners and does not constitute advice or recommendations. NAIOP disclaims any liability for action taken as a result of this project and its findings.

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To submit questions or comments about this Research Brief, please contact Jennifer LeFurgy, Vice President, Knowledge and Research, NAIOP.

For questions about the NAIOP Research Foundation, please contact Bennett Gray, Vice President, NAIOP Research Foundation.

Endnotes

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