NEC's Solutions for Venues in the New Normal Era

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Abstract

The impact of the novel coronavirus (COVID-19) pandemic is unprecedented in recent history. That impact has been especially severe for venues that attract mass gatherings, such as at sports events and concerts. Although remote viewing is becoming increasingly popular, there is still great demand for the shared feeling and crowds that can be experienced through physical viewings. In this paper, we will discuss various solutions now under development at NEC, which are intended to make it possible for people to visit these venues in person and enjoy their experience safely and securely in the new normal era. Those solutions include touchless, walk-through security check, entry confirmation and on-site monitoring of visitors, enhanced on-site entertainment using smartphone apps, visitor density visualization to avoid overcrowding, and social distancing measurement technology to confirm that visitors are maintaining a safe distance between one another.

Keywords

venue, touchless, face recognition, image analysis, crowding, overcrowding, social distancing

1. Introduction

The worldwide novel coronavirus (COVID-19) pandemic has dealt a severe blow on the sports and entertainment industries whose business models are based on attracting large numbers of people to events held at venues. Although fans have become accustomed to enjoying events remotely from their homes, there is still great demand for the unique experience that can only be enjoyed through physical presence at a theme park or sports stadium.

In this paper, we introduce several solutions that can make it possible for people to attend live events in person in a safe and secure manner as we make a shift over to a new normal. These include touchless visitor management, measures to minimize crowding and congestion, as well as deployment of digital technology to enhance the value of the experience at these venues.

2. Touchless Digital Visitor Management

2.1 Walk-through security check

At large-scale facilities, screening of visitors and their

belongings is the first checkpoint to ensure safety and security. This procedure is usually carried out face-toface by human workers. NEC has developed a technology that eliminates the need for manual security check; instead, visitors can just walk right through without having to stop and have their bags checked. As a visitor passes by the checkpoint, a sensor transmits very weak radio waves receives signals reflected back from body-worn items and belongings. The sensor reconstructs images



Fig. 1 Walk-through security check.

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from the reflected signals, and automatically detects dangerous objects, while distinguishing acceptable daily items such as smartphones, keys, among others (**Fig. 1**).

This technology features high-speed imaging at a video rate accommodating walking speed; motion compensation that helps generate high-quality images by suppressing motion blur caused by the movements of a walking person; and AI-based 3D object detection that can detect smaller dangerous objects from constructed images at high speed and high precision. We are planning to put this technology into practical use in FY 2021.

2.2 Walk-through entry

At venues that charge entry fees, bag inspection is followed by ticket confirmation. NEC has already put touchless ticket confirmation into practice with the introduction of a walk-through entry system that uses face recognition. Annual passes for theme parks are a good example of how this technology can be applied. We are now working on a system that combines face recognition technology and thermal cameras to facilitate efficient, touchless measurement of the body surface temperature of each visitor. If a body surface temperature exceeding the set value is detected upon entry, the manager will be notified. The facial information of the person in question will also be provided, enabling management to locate the individual and perform manual measurement using a clinical thermometer (Fig. 2). This can help identify any individuals potentially infected with COVID-19 and prevent possible outbreaks of infection clusters.

2.3 Digital visitor management

In the future, it will be desirable to create and manage lists of visitors so that they can be contacted should a



Photo 1 Smartphone electronic ticket screen.

COVID-19 infection occur at the venue. Here is a specific example of digital visitor management conducted at Japan Volleyball League Organization (V.League) events using NEC's Fan Marketing Solution. This solution allows fans to purchase an electronic ticket with a dedicated smartphone app in lieu of a paper ticket (**Photo 1**). This process allows the ticket-buyer's information—such as contact address, phone number, email, etc.—to be collected and stored in a database. V.League will be able to quickly identify all visitors on the day of the incident and notify them of potential exposure.

3. Improving the Value of Visitor Experience and Data Utilization

3.1 Improving the value of visitor experience

NEC's Fan Marketing Solution offers systems to improve visitor experience with a smartphone app, making it possible to hold lottery events and issue coupons, for example, with no use of paper and minimal human input. Other possible applications include online polls to select game MVPs, fostering greater engagement with fans (**Photo 2**).

3.2 Touchless payment

Registering facial image and credit card information ahead of time with a smartphone app facilitates convenient, touchless shopping with face recognition payment (**Photo 3**). Against a backdrop where cashless payment is being encouraged as the safer option in our brave new world, demand for instant, touchless forms of payment such as face recognition is expected to increase rapidly since users won't even have to take out their smartphone.

3.3 Data utilization

Utilization of data such as visitor information and fan behavior can be an effective tool to support analysis and planning to create an enjoyable experience at a venue without generating any one of the "Three Cs," (closed space with poor ventilation, crowded place with many



Photo 2 Online poll screens for MVPs and lottery event.



Photo 3 Examples of facial registration screen on smartphone.



Fig. 3 Behavior analysis of venue visitors in smart hospitality validation test in Utsunomiya City.

people nearby, and close-contact setting)—avoidance of which is recommended by the Japanese government. This also ensures that a means of contacting visitors exists should an infection occur at the venue (**Fig. 3**). Data utilization can also provide helpful guidance for fans, ensuring that they are prompted to walk in the desired direction using push technology and stamp rallies (a popular event in Japan where you visit all locations on the specified stamp card to collect stamps for a chance to win a prize). For example, visitors can be shuttled between the venue and nearby stores and sightseeing spots.

4. Visualizing the Extent of Crowding to Avoid the "Three Cs"

Understanding how crowded a given venue is can help people avoid the "Three Cs" as recommended by health authorities, while still allowing them to enjoy everyday life in the new normal. NEC has developed various solutions to help visualize crowding, which are discussed below.

4.1 Using camera image analysis to visualize crowding

NEC's crowd behavior analysis solution makes it possible to comprehend crowding conditions (degree of crowding and number of people) in real time. Using AI technology to analyze video from surveillance cameras to identify the formation of crowds (**Fig. 4**) enables visualization of crowding throughout a wide area. The results can be displayed on smartphones and signage screens, helping to steer people way from crowded areas and making it easier for them to maintain safe distances from other people.

This solution also offers a crowd flow estimation function that stochastically estimates people flows, locations, walking speeds, and crowding based on data acquired from video images, including the number of individuals in a given location and how fast and in which directions they are moving. This can predict the number of passersby even in a place where large crowds of people come and go (**Fig. 5**). By quantitatively determining the number of passersby in the space where people have gathered (flow), this function enables spaces to be reorganized and guidance to be provided that is relevant to the situation, and makes it easier to produce events that assures the comfort of all visitors.

To ensure that a high level of privacy is maintained, computers used for analysis are installed near (at the edge of) the cameras where they can perform analysis in real time. Images that include personal information are immediately discarded and only anonymous information such as the degree of crowding and the number of people in a given location is collected.

4.2 Using IoT sensors to monitor crowding

Restrooms are typically small, confined, and poorly



Fig. 4 Examples of crowd visualization.

ventilated, meaning that they are exactly the type of space where one or more the "Three Cs" is most likely to occur. Since there is a great deal of resistance to installing cameras in restrooms, another way of measuring crowding was required. NEC's solution uses IoT sensors, making it suitable for deployment in restrooms and other private public spaces. IoT sensors are installed in each toilet cubicle and the occupancy condition of each cubicle can be displayed on signage and smartphone screens in real time (**Fig. 6**). It can also visualize whether the restroom is being cleaned. When the validity of this solution was tested at the NEC Solution Center in Kawasaki, waiting time for restrooms was significantly decreased, and 98 percent of the employees wanted to keep on using the restroom visualization system.

4.3 Social distancing management technology

NEC has also developed technology that can analyze video images from surveillance cameras to determine whether people are maintaining an appropriate distance, or social distancing, between one another. This technology detects human bodies in video images and then analyzes whether the radii of 1 m (this value can be changed) around the detected human bodies are in contact with each other (**Fig. 7**). The more these radii overlap, the more crowded the conditions. The times of day and locations subject to a high risk of crowding can be displayed on digital signage, enabling venue managers to share information with visitors and recommend that they avoid high-risk times and areas.

This technology also contributes to risk management and safety assurance for venue staff, as well. Since highrisk areas and times can be clearly identified, venue managers can develop plans and procedures to ensure that staff do not remain in high-risk areas for extended periods of time.



Fig. 5 The process of estimating crowd flow.



Fig. 6 Example of signage display showing degree of crowding in restroom.



[Social distancing measurement: black circle - sufficient; gray circle - insufficient]

Fig. 7 Social distancing measurement screen.

5. Conclusion

In this paper, we have shown how NEC has developed a variety of solutions for venues that make it possible for audiences to enjoy real-world events in the new normal era while ensuring their safety and minimizing the chance of overcrowding. By leveraging our world-leading sensing and camera image analysis technologies, as well as data analysis platforms, NEC is bringing its creative power to bear on the development of inspiring spaces that people can enjoy safely and securely.

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