2ZF-01

AR Radar: New Visualization Way to Support the COVID-19 Prevention in the Shopping mall

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1. Introduction

COVID-19 has dramatically disrupted the retail industry. With isolation restrictions, the shopping mall suddenly had no customers. As a direct result of this crisis, Mall owners are accelerating their business plans to bring their business back in this post-pandemic world. However, as variants of the COVID-19 virus continue to appear, customers' concerns for their health and safety are taking business away from shopping malls. Ensuring a safe shopping environment for customers in the Mall is challenging for Mall owners. According to WHO advice, wearing masks and social distancing are two effective approaches for preventing the spread of COVID-19. These two approaches have also been made mandatory in shopping malls worldwide. However, many people still do not comply with the mandates.

This paper proposes a new visualization way: AR Radar, to help enforce wearing masks and proper social distancing in shopping malls using augmented reality(AR). This AR Radar can display detected people in the field of view of Mall guards, help guards react quickly to violations, and better enforce the mandatory rules.

2. Related work

Bhambani K, Jain T, and Sultanpure K propose a solution to detect masked faces and social distance using a YOLO object detector [1].

Cooper A and Hegde P use low-cost webcams and a series of algorithms to detect people in a video frame and then identify and position them [2].

Wu and Popescu [3] propose a novel approach for increasing navigation efficiency in augmented reality using multiperspective visualization. Their approach seamlessly integrated additional perspectives to the user's perspective in the Immersive VR and AR experience. This approach improves navigation efficiency by allowing the user to explore more while moving less.

3. System overview

This AR Radar system uses three types of hardware: CCTV cameras, servers, and Hololens.

When the Mall guards wearing hololens open the AR Radar function, they can see all the people who violate wearing masks or social distance mandates through the wall (Figure 1). Then they can go to the scene in time to enforce these two mandates.

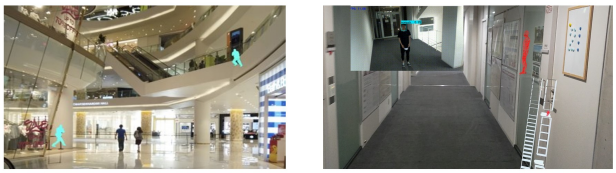

Fig. 1. AR Radar

In addition to helping mall guards enforce mandates based on AR Radar, we also provide assisted functions to protect customers.

When the violation situation appears around the customer, the system will alert them to avoid and show an avoidance arrow until the user goes in the correct direction. As shown in Figure 2, the user receives an avoidance warning when a crowd gathering appears in his near surroundings.

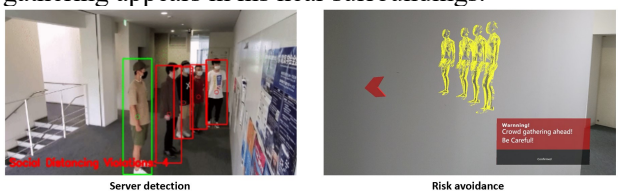

Fig. 2. Risk avoidance for customers

4. System implementation

We have done three parts of work to achieve this visualization method. They are: People detection, Location synchronization, Build augmented view.

People detection: This AR Radar detects two main violations in the Mall: un-masked people and crowd gatherings. After comparing many objects detection algorithms, we choose YOLO with the COCO model to do detection work. By deploying this deep learning model on the server, our system can turn CCTV cameras in the shopping mall into "smart" cameras that recognize the violations of these two mandates.

Fig. 3. People detection

Location synchronization: To display radar images of detected people in real-time, we locate these people

and synchronize location information to Hololens. There are many indoor positioning techniques, but they all have some shortcomings that prevent them from being used in a shopping mall. UWB positioning and Bluetooth positioning technologies are too costly. Wi-Fi positioning is not widely applicable to mobile devices, and RFID technology is complicated to deploy on a large scale. Fortunately, a camera-based positioning study is very suitable for application to shopping malls [2]. Inspired by this study, our system used the monocular distance estimation method to get the location of detected people in the Mall. In this research, we choose our school building as the shopping mall to prototype the AR Radar (Figure 4). For the location synchronization, we placed virtual spatial anchors in the building as landmarks to map people's position from reality to virtual (Figure 5). This way, Holoelens can know the place of detected people based on the virtual spatial anchors.

Fig. 4. Study area

Fig. 5. Position mapping

Build augmented view: The final part of completing the AR Radar. This view gives the users an enhanced vision to see detected people through the wall. Some studies allow people to gain the enhanced vision to see invisible things. Wu and Popescu [3] integrated additional perspectives to the user's perspective seamlessly in the Immersive VR and AR experience. Their method allows the user to see a lot of content with little movement. However, their mixed vision is chaotic, and it can cause dizziness in people who are constantly moving. We use an X-ray-like perspective to give the user enhanced vision to solve this problem. We have obtained the position of detected people that we calculated by monocular solution and anchors we placed. So we designed algorithms to let 3D radar image avatar be displayed on the closest anchor to represent the detected people(Figure 6). In this way, Mall guards with AR Radar open can see these radar images regardless of the number of walls that separate them. Unlike previous X-ray vision [4,5], our visualization method is based on spatial anchors. It has factual geospatial information, making it more stable and more realistic than previous studies.

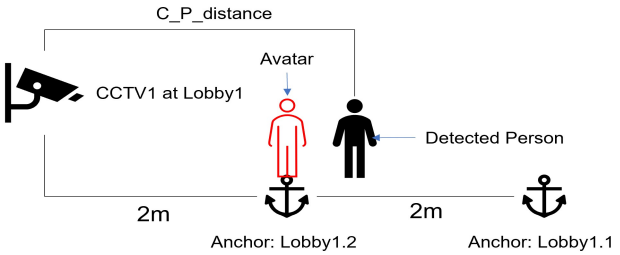

Fig. 6. Visualization method

After the mall guards turn on the AR Radar and check the location of detected people, they can use gaze to select the target person. Then use the voice command to activate the navigation arrow to assist them to go to the target location to enforce wearing masks and proper social distancing in the shopping mall. Figure 7 shows the system architecture.

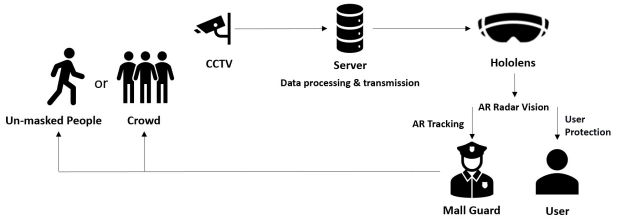

Fig. 7. System architecture

5. Conclusion

We have demonstrated this AR Radar system with four surveillance cameras in our school building. The preliminary evaluation shows that our system can effectively detect and display radar images, increasing the efficiency of security work and reducing customer safety concerns.

References

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