



RF Signals for Crowd Analytics and Collective Behavior

Tech ID: 34052 / UC Case 2025-353-0

BACKGROUND

Crowd analytics plays a key role in many applications by providing valuable insights into how humans interact with spaces. In retail, crowd analytics can be used to infer customers' shopping interests and movement patterns, enabling space usage optimization and occupancy estimation; and smart cities utilize crowd analytics for managing traffic flow, detecting bottlenecks, and evacuation planning. Crowd analytics is also crucial for safety planning to detect anomalies, suspicious behaviors, or unauthorized access. Smart buildings can utilize crowd analytics to optimize heating and cooling, manage lighting and environmental controls, and for safety and evaluation planning. Typically, video data is utilized to analyze crowds, but this method is not privacy-preserving, lacks see-through capabilities, and can provoke consumer backlash due to its invasive nature. Moreover, it would be beneficial to develop a system and method of detecting and analyzing crowds without requiring the use of video data.

DESCRIPTION

Researchers at the University of California, Santa Barbara have developed technology that leverages radio frequency (RF) signals for crowd analytics and collective behavior analysis. Unlike traditional methods that rely on video data, this innovative approach uses off-the-shelf mmWave radar boards, commodity WiFi, or existing cellular signals,for detecting and analyzing crowds. The method can offer a detailed understanding of the collective behavior of pedestrians within a given space, such as 1) estimating the total number of people, crowd density, and flow rate/dynamics in between various areas within the space; 2) uncovering emerging crowd patterns, dominant flows, areas of homogeneous spatial behavior, and patterns of space usage (e.g., areas with high/low level of crowd interaction), and 3) detecting anomalies, unauthorized access, crowd flow bottlenecks, or collision-prone zones, among other things.

ADVANTAGES

- ▶ Utilizes cost effective, commodity RF signals
- ▶ Can use already-existing RF signals
- ▶ Preserves privacy by not relying on cameras
- ▶ Provides detailed crowd analytics

APPLICATIONS

- ▶ Retail

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OTHER INFORMATION

KEYWORDS

RF signals, crowd analytics,

Radio frequency, Radio

frequencies, Behavior anaysis,

WiFi, mmWave, Cellular

signals

CATEGORIZED AS

- ▶ [Communications](#)
- ▶ [Other](#)
- ▶ [Wireless](#)

RELATED CASES

2025-353-0

- ▶ Smart buildings
- ▶ Smart cities
- ▶ Safety planning
- ▶ Transportation

PATENT STATUS

Patent Pending

ADDITIONAL TECHNOLOGIES BY THESE INVENTORS

- ▶ RF Signal-Based Human Context Inference for Health and Safety Monitoring
- ▶ Sensing with RF Signals by Exploiting Diffraction
- ▶ Generating Massive Synthetic RF Data for RF Sensing Applications
- ▶ A Novel Method for RF Field Programming and Intelligent Surface Design Using Diffraction-Inducing Elements

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