White Paper

# Slip and fall detection

## White paper and Installation guide

January 2026

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# 1. Introduction

Hanwha Vision's 'Slip & fall detection' is an AI-based video analytics technology available through the WiseAI APP. It continuously tracks and observes individuals within camera footage, automatically recognizing abnormal falling incidents and generating real-time alerts.

This capability supports both safety and security operations by detecting accidents in their early stages and enabling immediate response—not only in traditional industrial sites but also across public facilities, healthcare institutions, transportation terminals, office buildings, and commercial environments.

By extending beyond incident recording to real-time situation awareness, Hanwha Vision aims to redefine video surveillance as an intelligent safety management tool.

## 2. Background

Traditional security has primarily focused on intrusion detection and asset protection, but modern security has evolved into a comprehensive safety management system that safeguards human life and well-being in real time. The demand for fall and collapse detection is growing across diverse environments, including manufacturing plants, elderly care facilities, large shopping complexes, and public transit hubs. Slip and falls, in particular, account for approximately 20–30% of all injuries, and delayed response can often lead to secondary harm, underscoring the importance of fast and accurate incident recognition. In addition to a prompt response, it is also important to have a feature that stores video evidence separately for an extended period of time. This is because, although people may be too distracted at the moment of an incident, video review is often needed later when legal issues arise.

Conventional event detection relied heavily on static image analysis, lacking the temporal behavioral context required for human activity recognition. However, advancements in edge device performance and lightweight AI models now enable more than just accurate human detection and feature extraction; they allow for continuous tracking and real-time identification of slip-and-fall events. These technological developments align with growing legal and social mandates for safety compliance. The Occupational Safety and Health Administration (OSHA) of the U.S. Department of Labor establishes legally binding standards to ensure workplace health and safety. Employers are required to provide an environment free from hazards and to enable prompt rescue[1] and response in emergencies. Automated slip and fall detection solutions directly support this requirement by enabling immediate awareness and action.

Similarly, the ISO 45001 international standard for Occupational Health and Safety Management Systems emphasizes continuous monitoring and risk elimination as core principles.

Consequently, slip and fall detection has become an essential capability not confined to a single industry sector, but a key component in eliminating safety blind spots and building “Smart Safe Cities” where people can live and work with confidence.

[1] 29 CFR 1910.28

## 3. Technology Description

Technologies for detecting human slips or falls can be broadly categorized into two types: vision-based (Vision/Radar) and sensor-based (Accelerometer, Gyroscope) systems.

Sensor-based methods can achieve high accuracy by detecting acceleration and posture changes from wearable devices. However, they have drawbacks such as dependence on wearable equipment and additional costs.

In contrast, vision-based fall detection technology can utilize existing camera infrastructure to recognize falls among undefined groups of people without requiring any wearable sensors.

Hanwha Vision's 'Slip & fall detection' is distinct from fall-detection solutions commonly used in hospitals. It does not detect incidents such as falling from a bed or low height while lying down. Instead, its primary purpose is to recognize sudden collapses that occur while a person is standing or walking. This function is implemented through the motion analysis and human posture classification models operating within the WiseAI app, which utilize object tracking–based motion and posture analysis.

The **Motion Analysis Module** employs deep-learning-based object tracking to analyze a person's movement trajectory, body center position, and upper-body inclination, combined with temporal data over time. By evaluating sudden upper-body descents, incomplete detections along frame boundaries, and potential false positives caused by seated postures, the model determines whether a slip and fall event has occurred. When a person remains in a lowered position for an extended period or exhibits motion inconsistent with normal patterns (e.g., sitting, kneeling), the system triggers further analysis.

The integration of temporal sequence data allows the algorithm to distinguish between abrupt falls and gradual movements such as sitting or lying down, resulting in more precise event classification.

The **Human Posture Classification Module** categorizes body postures using image-based deep learning. Even when a subject is partially occluded or overlapped by other objects after a fall, the model can infer the approximate location and estimate fall likelihood, ensuring an alert is still generated.

By combining these two core AI modules—object **motion tracking** and deep-learning-based **posture classification**—Hanwha Vision significantly enhances the accuracy and reliability of slip and fall detection across diverse environments.

This feature is available on all cameras that support 'Slip & fall detection' in their specifications, including the 1st-generation P series and the 2nd-generation X and P series equipped with the Wisenet 9 SoC.

# 4. Camera Installation Guide

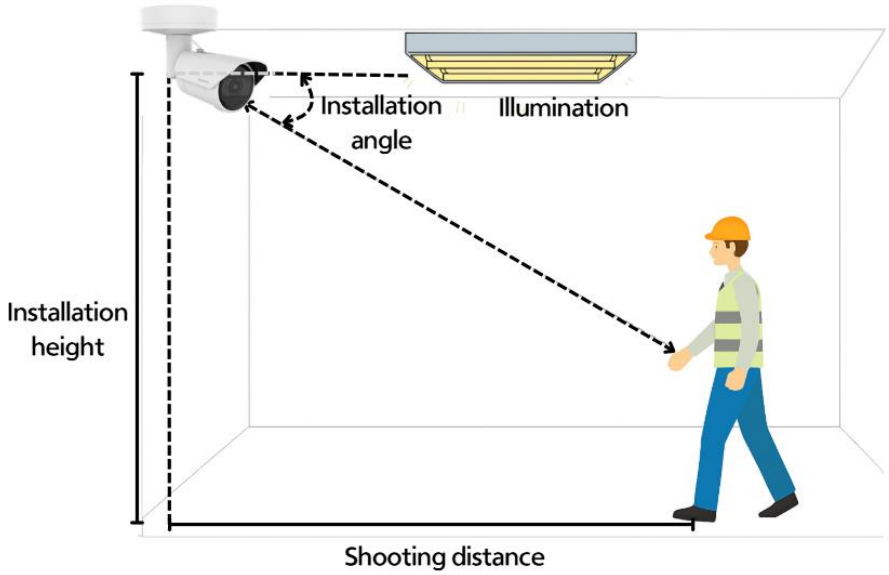
The ‘Slip & fall detection’ feature delivers optimal performance when the camera is installed and operated according to this installation guide. Since the AI video analytics functionality depends on ambient lighting and the camera’s field of view, please follow the recommendations below for the best results.

This guide outlines the minimum recommended installation conditions required for stable operation of various AI-based functions. Failure to comply with these requirements may result in unreliable detection performance.

The AI video analytics function performs best under stable lighting conditions, with an illuminance level of at least 300 lux.

## 4.1. Recommended Installation Conditions

For reliable slip and fall detection, the minimum recommended installation setup is as follows. The system can detect a 170cm (5ft 7in) tall person from a distance of at least 5 m from the installation point. For stable detection, cameras should ideally be mounted at an angled side-view rather than a vertical overhead position. ‘Slip & fall detection’ is supported even when the camera is installed in a corridor view (hallway view) layout.




| Recommended Condition | 4K Resolution Camera | 2MP Resolution Camera |
|---|---|---|
| **Installation Height** | 3.5m - 6m (11.5ft-19.7ft) | |
| **Installation Angle** | ≤20° | |
| **Detection Distance** | 5m - 12m (16.4ft-39.4ft) | 5m – 8m (16.4ft-26.2ft) |
| **Max. People in ROI** | Up to 3 persons | |
| **Illuminance level** | ≥ 300 lux | |

Table 1: Recommended Installation Conditions for AI Cameras

## 4.2. Recommended Installation Locations

To ensure stable slip and fall detection performance, it is recommended to install cameras in locations (indoors or outdoors) where the ground is level, there are no obstacles blocking pedestrians, the camera and background remain stable, and shadows are not too strong.

Figure 1: Example of recommended installation environment

## 4.3. Recommended Detection Area Settings

To maintain reliable detection accuracy, the detection area should be set to cover the main walking path only, rather than the entire camera view.

Figure 2: Example of recommended (left) and non-recommended (right) area settings

## 4.4. Detection Performance Limitations

The ‘Slip & fall detection’ function may experience degradation in detection performance depending on the installation location and status of the camera.

The following is a guide for situations in which detection performance is degraded.

### 4.4.1. When a walking person is not detected for more than 3 seconds

### 4.4.2. When part or all of the person's body is covered

If a person’s body is partially or completely obstructed by an object, out of frame, or blocked by another person, ‘Slip & fall detection’ cannot be guaranteed.

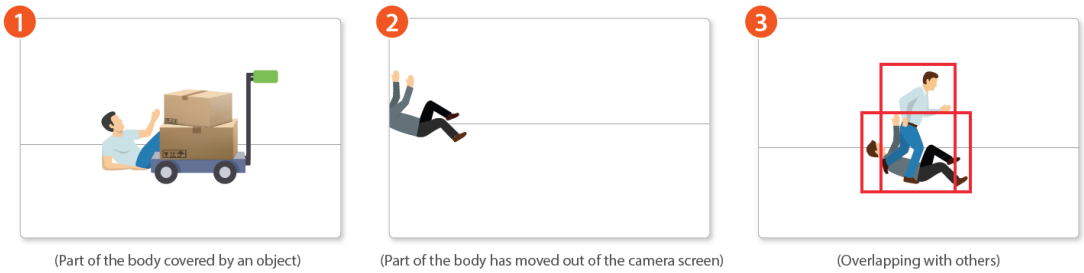



Figure 3: Example of partially occluded body

### 4.4.3. When a person who is not walking falls

The ‘Slip & fall detection’ function detects people who slip or fall while walking, so if a person slips or falls after sitting or bending for 3 seconds or more, the detection performance may be degraded.

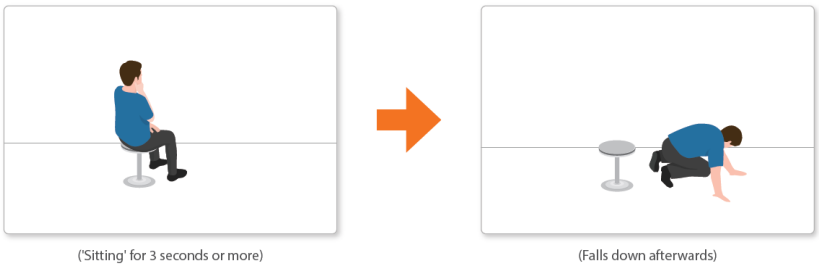



Figure 4: Example of a seated fall

### 4.4.4. When falling downward

Cases where a person is already lying horizontally and then falls downward (such as a falling from a bed) are not within the detection range of this function.


Figure 5: Example of a falling downward

#### 4.4.5. Other limitations

- **Environmental factors:**
  - Reflections, glare, or shadows caused by strong light sources such as direct sunlight or artificial lighting.
  - Severe weather conditions including snow, rain, or strong wind.
  - Sloped or uneven ground surfaces.
  - Falls occurring within crowded scenes where multiple people overlap or move closely together.
  - Significant imbalance in the input video's horizontal-to-vertical resolution ratio.

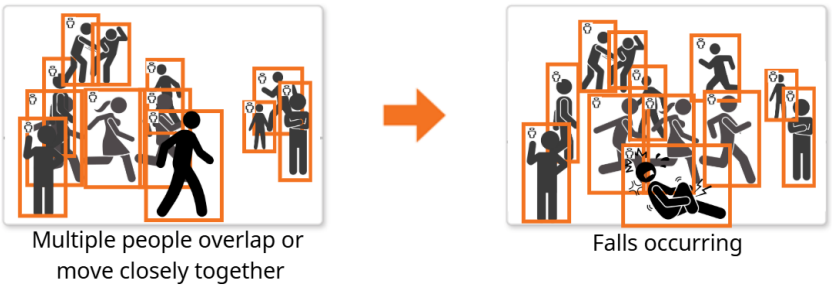



Figure 6: Example of a multiple people overlap or move closely together.

- **Object-related factors:**
  - Non-human objects being mistakenly detected as people.
  - A person's clothing color or pattern closely matching the background, resulting in low visual distinction.
  - Two or more people being merged into one detection, or one person being detected as multiple objects.
  - A person extending their arms while falling, causing irregular body shape detection.
- **Behavioral factors:**
  - A person moving at high speed who suddenly falls.
  - A person rolling or sliding after a fall.
  - Multiple individuals falling simultaneously.
  - A person falling along the camera's optical axis (toward or away from the lens), making body posture estimation difficult.

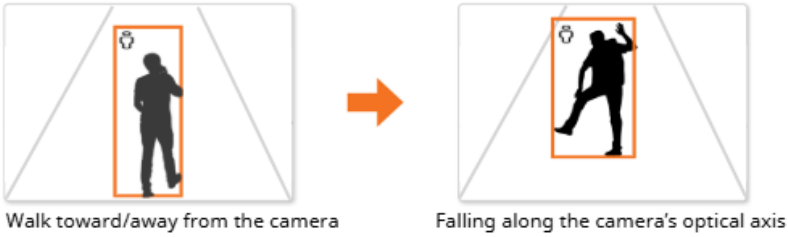



Figure 7: Example of a person falling along the camera's optical axis.

## 5. Conclusion

Hanwha Vision expands the role of video security systems through its AI-based ‘Slip & fall detection’ technology, from post-incident review to real-time, proactive response, establishing itself as an intelligent safety management tool.

By following the guidelines in this white paper and ensuring a stable installation environment, the ‘Slip & fall detection’ feature can be effectively utilized across many sectors (or use-cases), including healthcare, welfare centers, educational institutions, manufacturing and logistics sites, and construction environments. This enables immediate incident awareness and swift emergency response, while supporting compliance with global safety regulations and occupational health standards.

Security operators can focus on genuine emergencies through a high-precision alert system that minimizes false alarms, and administrators can achieve wide-area integrated monitoring without the need for additional sensors or wearable devices.

Hanwha Vision strives to be a trusted safety partner, providing AI-driven solutions like fall detection that protect human lives and ensure business continuity in safety-critical environments.

Hanwha Vision Co.,Ltd
13488 Hanwha Vision R&D Center,
6 Pangyo-ro 319-gil, Bundang-gu, Seongnam-si, Gyeonggi-do
**TEL** 070.7247.8771-8 **FAX** 031.8018.3715
www.HanwhaVision.com