How our Pedestrian Detection AI System works

Our Pedestrian Detection AI System helps drivers. It detects people near their vehicle.

⚐ This is an accessible text version – Hemingway readability score: 'Grade 7 – Good'.

A guide for vehicle operators, drivers and individuals who may use or be detected by our system.

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Executive Summary

VUE is an industry-leading Video Telematics provider with over 20 years' experience in vehicle video and tracking. Our journey, from our start in 1999 until now, has been shaped by our mission to increase fleet safety. We have fitted countless fleets with Video Telematics and safety equipment. This has increased driver safety and cut incidents. We know how devastating road accidents can be, and how many lives it takes and destroys every day. We work with our fleets to understand how these accidents occur and determine how to best prevent them.

That's why we have developed a Pedestrian Detection AI System to help reduce accidents even further. We now have a system that can detect people near vehicles. It can alert drivers and operators to the danger before an accident.

> This AI Explainability Notice applies to all people who use, are impacted by, or are detected by our Pedestrian Detection AI System. This includes vehicle operators / drivers and people near a vehicle with our device AI System.

This document explains how the AI System operates, the decisions it makes and how the AI system may impact on individuals and the wider society. It helps ensure compliance with data protection and artificial intelligence (AI) legislations including the EU Artificial Intelligence Act, EU General Data Protection Regulation (GDPR), and the UK Data Protection Act 2018.

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Introduction

Rationale

Vehicles and people are operating in closer proximity. Whilst the best solution is to keep people and large vehicles apart, it is sometimes inevitable that they come into proximity of each other.

On busy construction sites and in tight loading and unloading areas, vehicle operators and people may not see each other. This can lead to accidents.

Traditional measures may include standard reverse cameras. They also include sonar [ultrasonic] sensors at the sides and rear of vehicles. But these can have limited benefits and are not considered suitable for the many vehicle operators.

Reverse and side cameras show vehicle operators the vehicle's blind spots. But, the driver still needs to see and detect potential dangers. Conventional sonar [ultrasonic] sensors detect and alert drivers to 'any' object near the vehicle. This can include railings, materials, and other vehicles providing constant alerts to drivers.

Many vehicles operate in tight spaces, like construction sites, and loading bays. Highway maintenance vehicles often operate in very compact areas. In these places, vehicles are surrounded by equipment, barriers, and materials. In such settings, conventional sensors would alert operators to every object within proximity. This can lead to drivers becoming insensitive to frequent audio warnings. Additionally, people may not be fully visible in these environments.

Our Pedestrian Detection AI system is designed to specifically detect 'people', and tell them apart from 'other objects'. It works even when only a partial person can be seen (i.e. an arm, leg, or head, etc.). The AI system also allows for organisations to customise the alert distances to alert at any specified distance. This means vehicle operators are only alerted when a person enters a specified proximity to the vehicle. This only happens when the person is an immediate danger. They are not alerted to every object nearby. This makes our AI Pedestrian Detection System a safer and more efficient choice for organisations. The AI system improves safety for all people (workers and members of the public) who come within proximity of vehicles.

Statistics

Vehicles pose a big threat to people. Vehicle related deaths and injuries are high. This is especially true in the construction industry.

Driver Error [1]

Driver error was reported in 67% of all reported vehicle accidents and accounts for 63% of all fatalities. This includes 'poor turns or manoeuvres', and 'failure to look properly'.

63%
fatalities

Poor turning or manoeuvring [2]

Poor turning or manoeuvring was reported in 13% of all reported vehicle accidents.

13%
of all accidents

Forklift Vehicle Deaths [3]

In the US there are on average 88 fatalities from forklift-related incidents every year.

1.7
people killed by forklifts per week

Forklift Vehicle Deaths [4]

In the US there are on average 8,674 nonfatal forklift-related injuries every year that required workers to take time off work.

167
people injured by forklifts per week

Construction Vehicle Deaths [5]

In 65% of highway work zone fatalities, a worker on foot was struck by a vehicle accounting for 318 fatalities. 51% of fatalities involved a reversing vehicle.

0.9
people killed by vehicles per week

[1] Department for Transport – 'Contributory factors in reported accidents by severity, Great Britain, 2018'
[2] Department for Transport – 'Contributory factors allocated to vehicles or pedestrians in reported accidents, Great Britain, 2014-18
[3] U.S. Bureau Of Labor Statistics – Fact Sheet | Occupational Injuries, Illnesses, and Fatalities Involving Forklifts | June 2019
[4] U.S. Bureau Of Labor Statistics – Fact Sheet | Occupational Injuries, Illnesses, and Fatalities Involving Forklifts | June 2019
[5] DHHS (NIOSH) PUBLICATION NUMBER 2001-128 - Building Safer Highway Work Zones

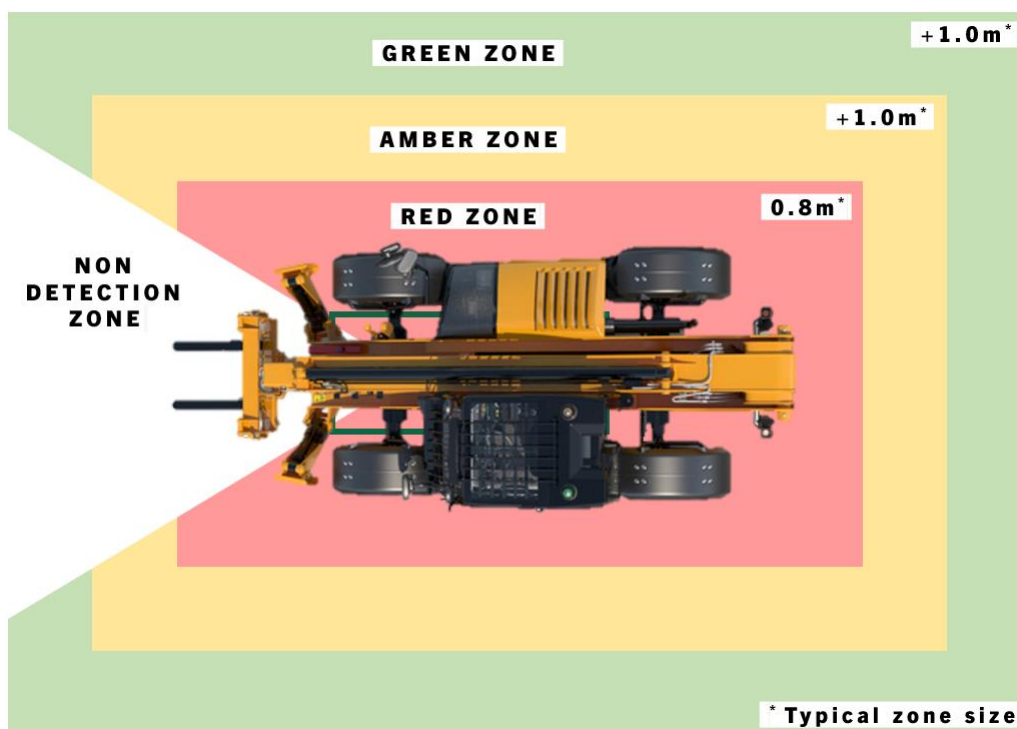# Understanding our Pedestrian Detection AI System

How the AI System Operates

Detection Zones

Our Pedestrian Detection AI System is designed to detect when a human is within set areas of the vehicle. This is done using onboard vehicle cameras. They are typically used to see the vehicle's blind spots. These are on the nearside, offside, and rear of the vehicle.

We configure three zones around the vehicle, which are colour coded **RED**, **AMBER**, and **GREEN**. These zones can be fully customised by shape and size to fit an organization's needs and vehicle type. They may not appear as shown below. Typically, the **RED** zone is 0.8 metres or closer. The **AMBER** zone is an extra 1 metre. Then the **GREEN** zone is another 1 metre.

> **Vehicle operators MUST familiarise themselves of the vehicle AI detection zones.**

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Data Inputs

The Pedestrian Detection AI System consists of a VMC recording unit, and up to three Artificial Intelligence cameras. Vehicles may also have additional non-AI cameras. These cameras **will not have the capability to detect people** but may still be recorded depending on the recording settings.

> **Vehicle operators MUST be aware of which vehicle cameras do and do not detect cameras.**
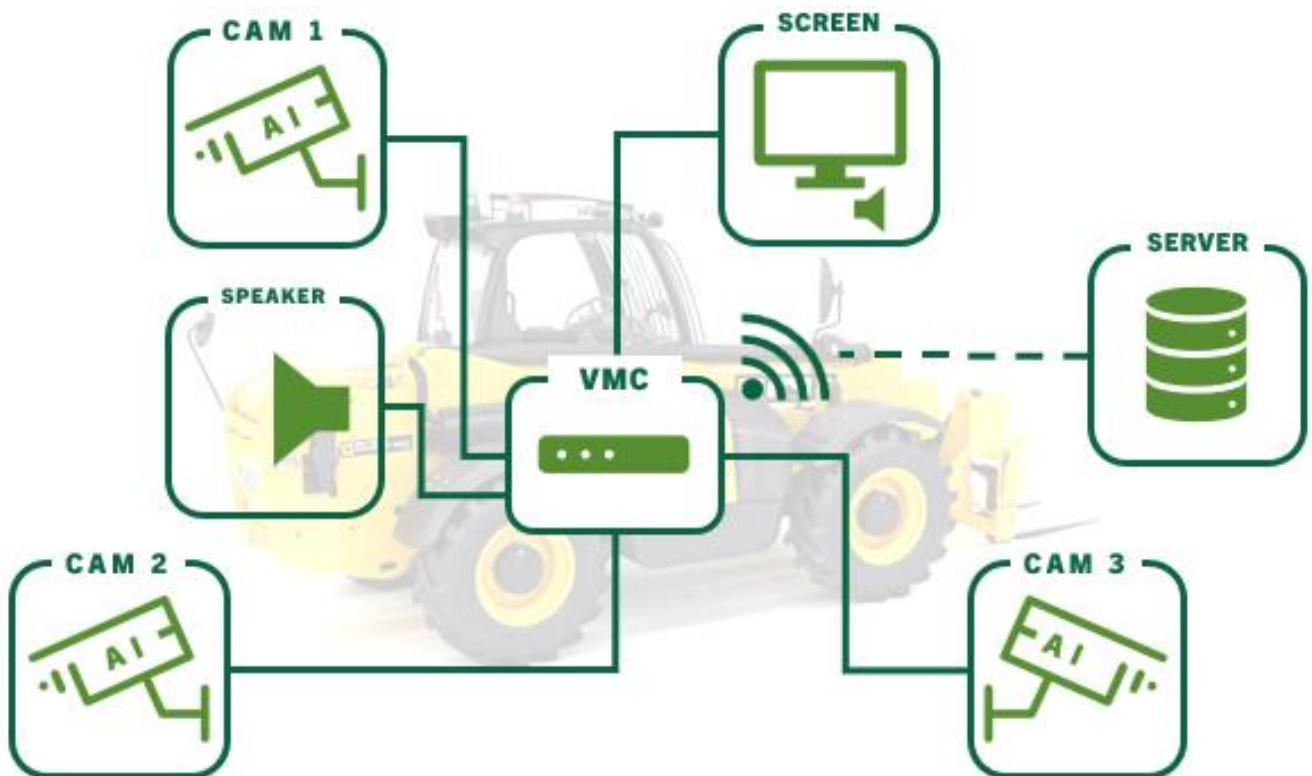

The Pedestrian Detection AI System uses live video feeds from the cameras to scan for human shapes. This can include partial shapes such as a leg, arm, or head, within the field of view within the designated **RED**, **AMBER**, or **GREEN** detection zones. This classification is performed by the AI camera itself. If a person is detected, then a signal is sent to the onboard VMC unit. The VMC unit then outputs the appropriate alert and notification.

Alerts and Notifications

When an AI camera detects a person, it sends a signal to the VMC unit. The VMC then displays that camera view on the internal monitor. Depending on the activated detection zone, an audio alarm will also sound for the vehicle operator.

This alerts the vehicle operator to the potential danger. This helps them manoeuvre with extra care and awareness to avoid incidents. In some cases, an optional external speaker may also be fitted. This speaker warns individuals detected outside the vehicle that they are in proximity of a vehicle in operation.
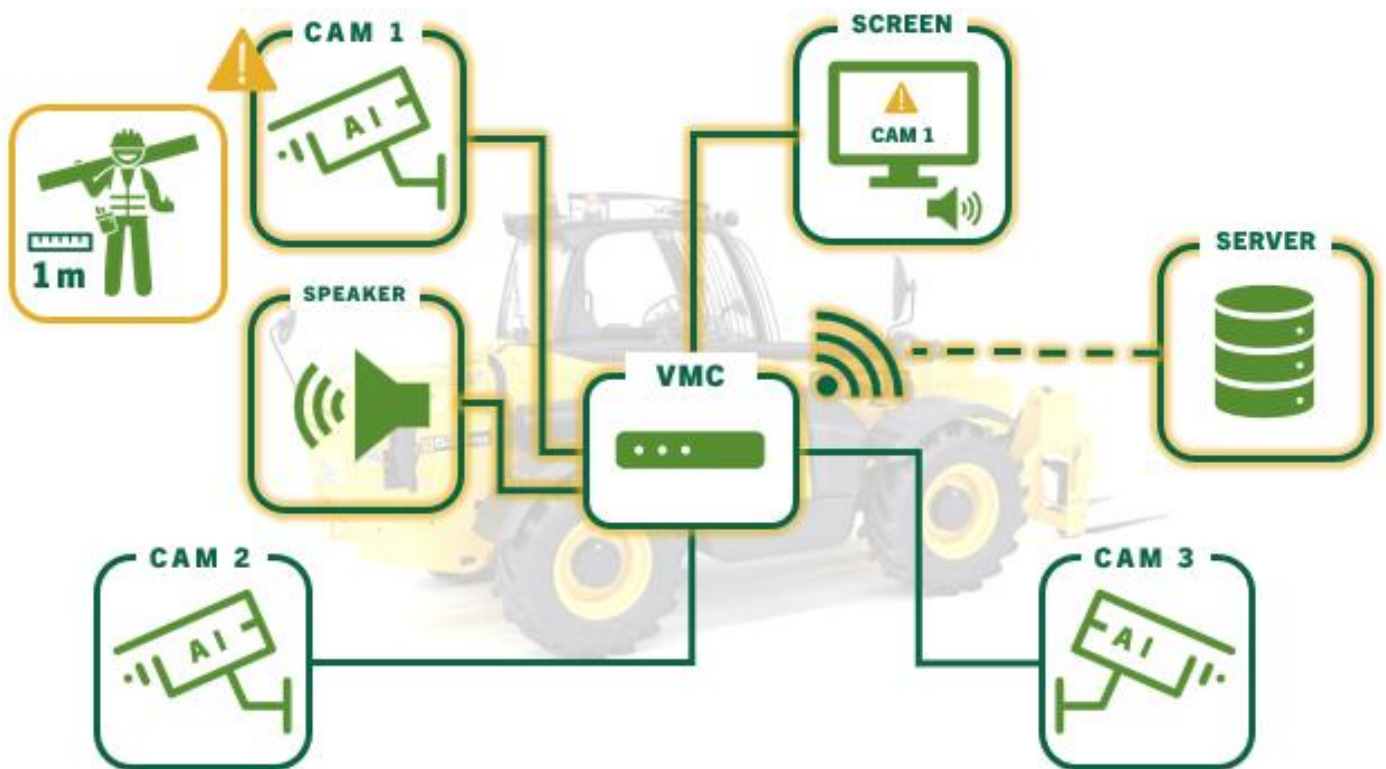
For continuous and event recording options, organisations can also send a notification to the VUE servers. The notification includes 10 seconds of footage. It has 5 seconds before the event and 5 seconds after.

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If multiple persons are detected, the monitor will display camera views in a priority risk order. The order will vary depending on the vehicle type and organisations requirements. This will usually include the rear camera first. Then, it shows the next biggest blind spot.

Notifications and alerts differ depending on which detection zone the person is located within:

- **GREEN ZONE**: Will display the camera view on the internal monitor and sound an external audio alarm to the pedestrian.
- **AMBER ZONE**: Will display the camera view on the internal monitor with a moderate frequency alarm to the driver. An external audio alarm will also alert the pedestrian.
- **RED ZONE**: Will display the camera view on the internal monitor with a fast frequency alarm to the driver. An external audio alarm will also alert the pedestrian. Additionally, a server notification is sent with 10 seconds of footage.

	DRIVER ALERT	PEDESTRIAN ALERT	SERVER ALERT
GREEN ZONE	VISUAL ONLY	NO ALERT	NO ALERT
AMBER ZONE	VISUAL AND AUDIO	NO ALERT	NO ALERT
RED ZONE	VISUAL AND AUDIO	AUDIO ALERT	SERVER ALERT

The internal monitor will also display a coloured box around what it has detected as a person. This box will match with the **RED**, **AMBER**, or **GREEN** detection zone the person is currently within, and the audio alarm will beep at different frequencies.

GREEN ZONE *
No Audio Alarm

AMBER ZONE *
Moderate Frequency Alarm

RED ZONE *
Fast Frequency Alarm
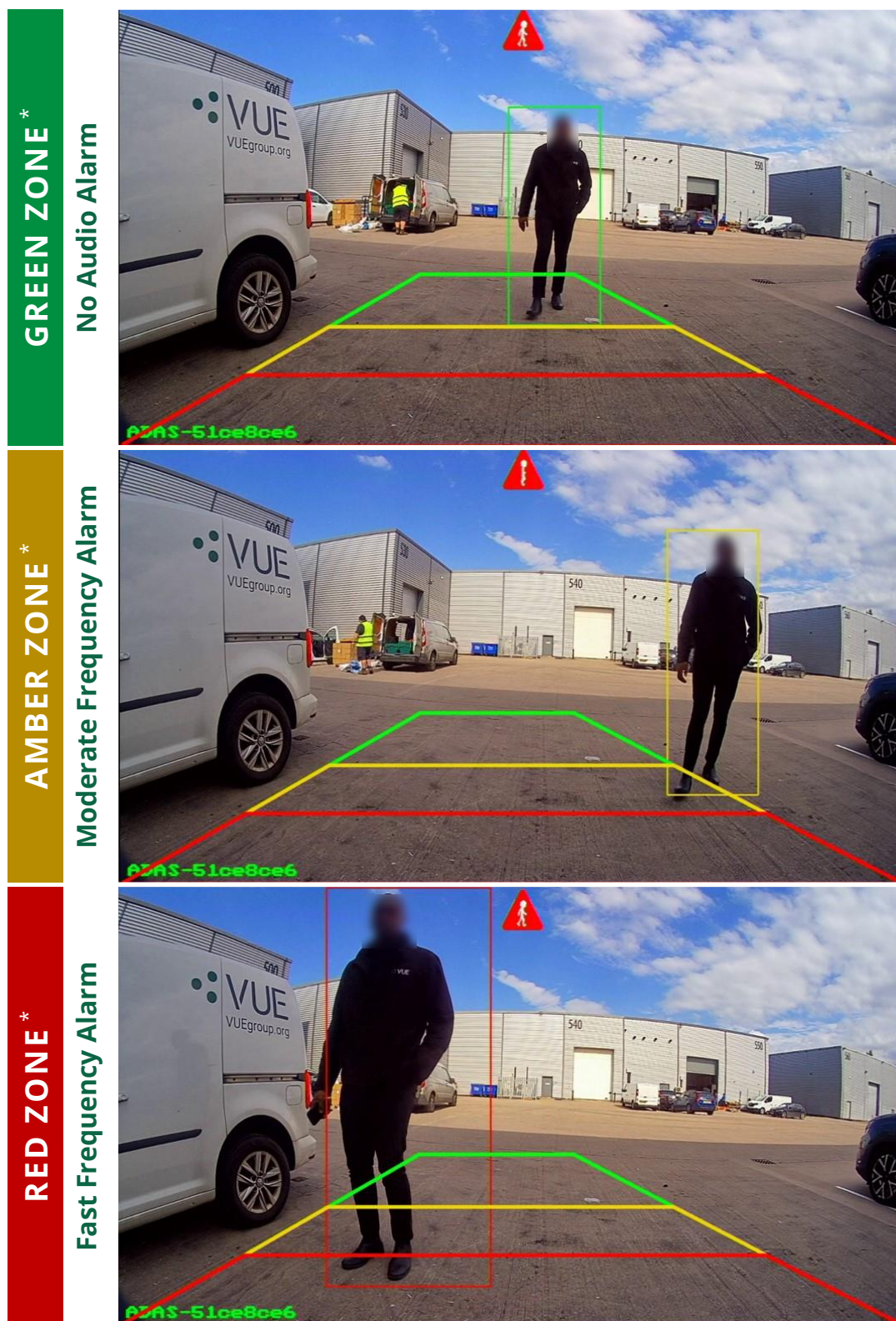
* Faces blurred for Data Protection purposes

Recording Options

Organisations installing our system also have three recording options, which include:

- **Continuous recording:** Records all footage captured by all the vehicle cameras.
- **Event only recording:** It records 10 seconds of footage when a person is detected, the g-sensor is triggered by a vehicle, or the driver presses the record button.
- **No Recording:** The vehicle still detects people and alerts the driver, but footage is not recorded, and no server alerts are active.

These recording options let organisations choose the setup that meets their needs. They also help them comply with local laws.

Who may be detected by our AI System?

The AI System will detect any person who comes within the detection zone of the vehicle. The zone's size can vary, this can range depending on the type of vehicle and the organisation's needs. The AI System will always detect people whilst the vehicle is switched ON. If organisations choose, the system may detect for up to 60 minutes after the vehicle is switched OFF.

Persons detected by our AI System may include people who work in proximity of vehicles and also members of the public.
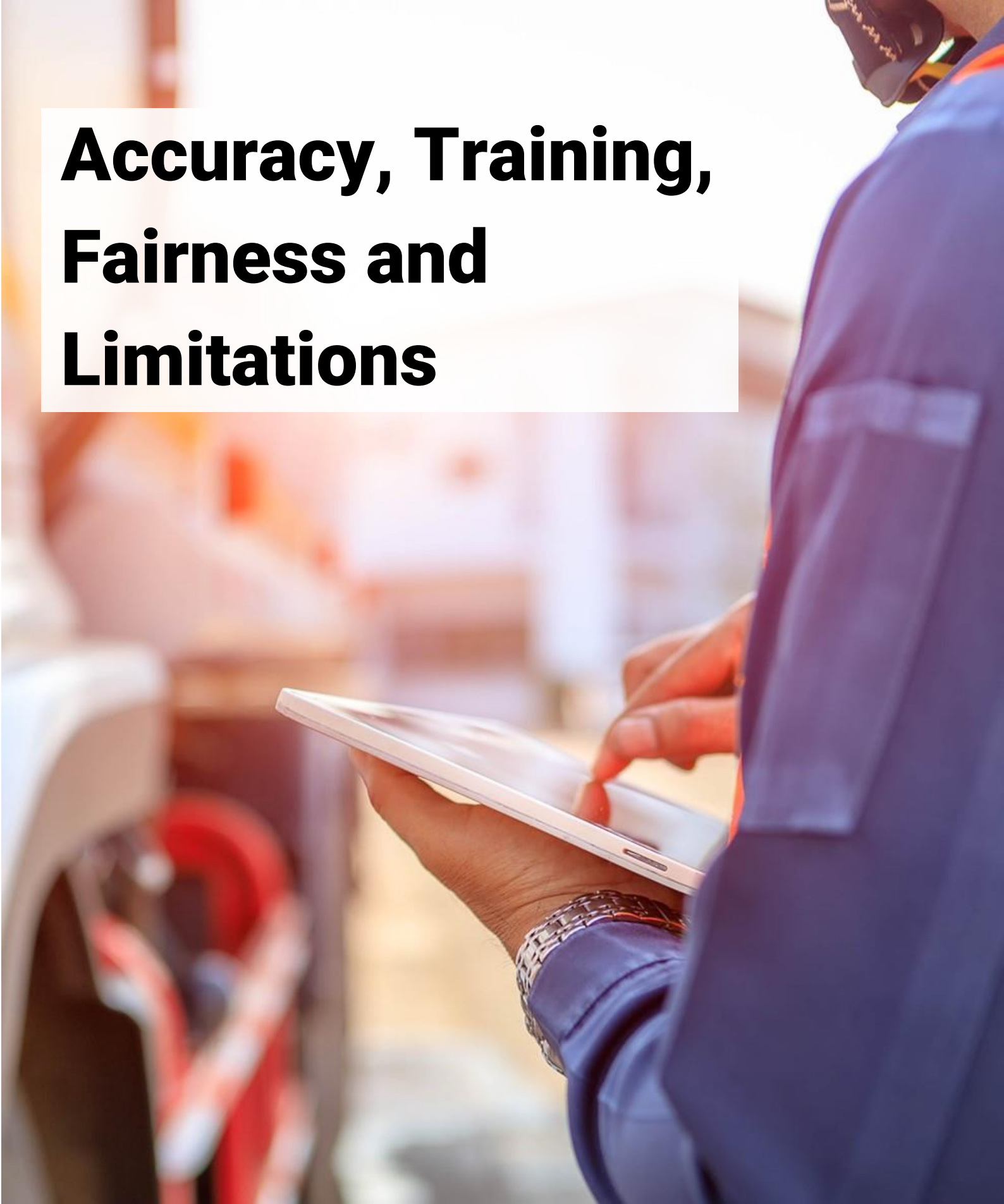
Who uses our AI System?

Our AI system is primarily used by the vehicle operator / driver. The AI system alerts the driver whenever a person is detected within the vehicle detection zone. The camera view is displayed on the internal cab monitor with an audio alarm.

Organisations may choose to send selected AI detection notifications to the server. This is typically detections within the **RED** detection zone. This will include 10 seconds of footage: 5 seconds before the detection and 5 seconds after. This footage is then retained for 7 days on the server. Organisations may choose to keep footage for longer, if there is a valid legal basis (i.e. if needed for an insurance claim, etc.). Note this option is only available for Continuous and Event only recording modes. In this case the AI System may also be used by other people within the organisation.

In some circumstances footage may also be used by VUE to further train the AI System. This is to help improve the accuracy of our system, and therefore improve the safety of vehicles. We use pseudonymisation and data cleaning techniques to remove unnecessary data. This process removes data such as precise location and vehicle identifiers. We do this only after a DPIA to ensure there is no risk to individuals.

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Accuracy, Training, Fairness and Limitations

Training and Testing

Our Pedestrian Detection AI System has undergone extensive training across a diverse array of data and scenarios. It can detect people in various environments, weather conditions, and camera states. It can recognise humans in many situations, including cyclists, motorbikes, individuals running or walking, and even when only parts of the body like legs or arms are visible. Examples of conditions tested include:
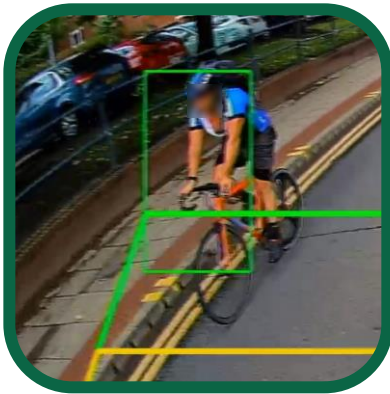

LOW LIGHT

WET CAMERA
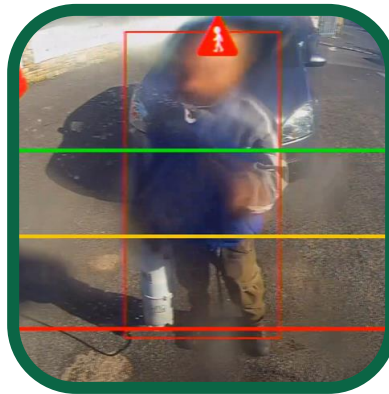
DIRTY CAMERA *
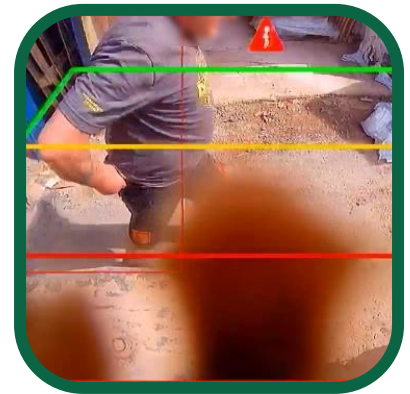
CYCLIST *

ARM ONLY

LEGS ONLY

* Faces blurred for Data Protection purposes

The system is designed to classify human-like objects within the detection zone of the vehicle. It makes a straightforward determination of whether a person is present in the camera's view without attempting to identify the individual.

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Accuracy rating of our AI System

Our Pedestrian Detection AI System has been trained and tested. It has an accuracy rate of over 95%. We continually further train the AI System and can provide updates to vehicles. This ensures vehicles can always use the latest version.

Human Oversight of the AI System

Our AI system is built with human-machine interface tools as required by AI regulations. This allows the AI System to be overseen by natural persons whilst the AI System is in use. It provides real-time alerts and notifications to vehicle operators via the internal monitor.

Organisations must train vehicle operators to use the AI System effectively. They should understand its capabilities and limitations and be able to recognise when it is not working correctly. They must always visually check themselves for individuals near the vehicle before moving. They should not rely solely on the AI System. In this role the vehicle operator is a human-in-command.

Human-in-command definition:

> A person assigned by an organisation to act as no less than a last line of defence, knowing the capacity and limitations of the AI system, possessing sufficient training for the regular operation including the identification of anomalies, dysfunctions and unexpected performance.

If a vehicle operator sees someone near the vehicle that the AI System hasn't detected, they can choose to manually record the incident. This is done by pressing the manual record button located in the driver's cab. This sends a notification to the server in a similar way to a pedestrian detection. Organisations can then review and report any potential issues to VUE.

To ensure the AI System functions correctly, VUE may review AI detections and manual recordings. This helps ensure continuous improvement of the AI System. In this process, VUE are providing a human-on-the-loop function.

Human-on-the-loop definition:

> Human supervision and/or control of an AI System, performing monitoring and reviews, however the system is able to conclude processing without the need for the human.

Human oversight aims to prevent or minimise the risks to health, safety or fundamental rights that may emerge when using an AI system. Whether used for its intended purpose, or under conditions of reasonably foreseeable misuse.

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Functionality and Faults

The VMC system uses LED indicators to show its status. When the VMC4 is working correctly, the GREEN and BLUE LEDs will display, showing the system is on and recording. The VMC8 will display a GREEN and AMBER LED when working correctly. The BLUE/AMBER LED might take a few seconds to turn on and for the unit to start recording. A RED LED on both the VMC4 and VMC8 indicates a system fault:

- **When all LEDs display**, it means there's a fault with one or more cameras. The AI System may still partially function.
- **When only the GREEN and RED LEDs display**, this shows a serious fault with the unit. The AI system may not function at all.
- **When no LEDs display**, the AI System will not function.

Note: For non-recording options, the BLUE/AMBER LED will not light up.

Organisations must have a process for drivers to report issues. The organisation must also report faults to VUE online at: https://vuegroup.org/contact/support/

Report the defect if RED LED displays or NO LEDs display

Vehicle operators must understand the LED operation. They must report any instances where the red warning LED activates.

Limitations & instructions for vehicle operators

There are cases where the AI System might not function as expected. Vehicle operators and drivers can take steps to ensure that the AI System works as expected. This will help maintain the highest possible accuracy and safety for pedestrians around the vehicle. These steps include:

- **Cameras and the VMC unit must be in working order for the AI System to detect individuals.** On both the VMC4 and VMC8 units a RED LED will display to indicate a fault with the system. When a RED LED shows the AI System may only partially work or may not work at all.

> **Vehicle operators MUST perform daily checks and ensure cameras are working correctly.**

> **Vehicle operators must understand the LED operation. They must report any instances where the red warning LED activates.**

- **AI System can only detect only within the camera view and predefined zones.** The AI System cannot detect people outside of the viewing angle of the camera. It will not detect people outside of the configured detection zones, even if they are in the camera view.

> **Vehicle operators MUST familiarise themselves of the vehicle AI detection zones.**

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- **Non-AI cameras do not detect individuals.** Vehicles may also have non-AI cameras, such as forward-facing cameras. Vehicle operators must know which cameras detect individuals and which do not. They should also learn the vehicle AI's detection zones. These zones may vary between vehicle types.

> **Vehicle operators MUST be aware of which vehicle cameras do and do not detect cameras.**

- **AI cameras need clear visibility.** Whilst we train the AI system cameras to function in extreme conditions like dirt, wetness, or poor visibility. The AI system may become less accurate if cameras become dirty, covered, obstructed, or used in very low light conditions. Make sure to turn on your vehicle lights in poor visibility conditions. This not only helps our cameras detect people but also makes your vehicle more visible to others.

> **Vehicle operators MUST perform daily checks and ensure cameras are clean and unobstructed.**

> **Vehicle operators SHOULD ensure vehicle lights are switched ON in poor visibility conditions.**

- **ALWAYS perform a visual check before moving the vehicle.** Our system will help vehicle operators and drivers manoeuvre vehicles safely. But you must also ALWAYS check for people yourself. Do not rely on the AI System too much.

> **Vehicle operators MUST always perform a visual check before moving the vehicle.**

Potential Impacts on Fundamental Rights

VUE as a responsible Provider, cares about protecting people's rights. We've considered how our technology might impact individual Fundamental Rights.

To protect individuals' privacy, our AI system does not identify people it detects. We let organisations set up the AI system their way. Customising detection zones, alerts, and recording preferences. This allows organisations to focus on big safety issues whilst reducing privacy risks.

We have strong security measures and dedicated people in place to protect your data. We also remind organisations of their obligations to protect data.

Our system aims to improve safety for everyone, especially near vehicles. It helps protect workers and the public by lowering accident risks. But, if our AI System fails to detect a person, it could be dangerous. That's why we offer guidance and stress the importance of training for vehicle operators on how to use our AI System right.

Your Fundamental Rights

Article 7:	Article 8:	Article 31:
Respect for private and family life	**Protection of personal data**	**Fair and just working conditions**
Everyone has the right to respect for his or her private and family life, home, and communications.	Everyone has the right to the protection of personal data concerning him or her.	Every worker has the right to working conditions which respect his or her health, safety, and dignity.

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Who we are

Who is Responsible for the AI System?

Vision Unique Equipment Ltd (VUE) is our name. We're a registered company in England and Wales. Our company registration number is 03934325, and our registered office is at:

> 510 Metroplex,
> Broadway,
> Salford Quays,
> Manchester,
> M50 2UE.
> United Kingdom.

VUE and our partners build, train, and look after the Pedestrian Detection AI System. So, we're called the "provider" under laws like the EU Artificial Intelligence Act. Companies that put our AI System in their vehicles are called the "deployer" under these laws.

VUE also handles your data for the company that installs our AI System. This makes us the "data processor" under laws like the EU General Data Protection Regulation (GDPR) and the UK Data Protection Act 2018. The company installing our system is the "data controller" under these laws.

For more information on how we handle data and your rights, please check our VUEconnected Privacy Notice.

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Further Information

Feel free to contact us. We're here to answer your questions and handle any requests or concerns you might have. You can contact us by mail, phone, or email:

VUE Data Protection Officer

Vision Unique Equipment Limited,

510 Metroplex,

Broadway,

Salford Quays,

Manchester.

United Kingdom.

M50 2UE.

Telephone: +44 161 877 2257

Email: privacy@vue-cctv.co.uk

For EEA Individuals, you may contact our EU Representative at:

Radius Data Protection Officer

Radius Business Solutions Ireland Limited,

Ground & 1st Floor,

Block 2 Galway Financial Services Centre,

Moneenageisha Road Galway,

Ireland.

H91 W1YV.

Telephone: +35 39 148 29 34

Email: eurep@vue-cctv.co.uk

PS: If you have questions about certain organisations vehicles using our AI System, please contact the "data controller". This is usually the company that owns and operates the vehicle.

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