Collision avoidance in reverse gear

Automatic collision avoidance: 3D camera at the rear automatically warns of obstacles and possible collisions.

Container handling on ships, trains and HGVs: Duisburg Intermodal Terminal (DIT) in Duisburg-Rheinhausen.

3D sensors:
Safe manoeuvring instead of colliding

Gigantic, weighing dozens of tons and confusing: In all container ports worldwide reach stackers are used to stack and handle containers. To avoid collision within the container terminals during narrow and rapid manoeuvring ifm electronic offers automatic collision avoidance: A 3D camera at the rear monitors the rear area, detects objects in the travel path and warns the driver of possible collision.

The driver's eyes look straight ahead when moving the 14 m wide and up to 40 ton containers attached to booms through the narrow container stacks. Even when manoeuvring in reverse the driver must keep an eye on the transverse container to avoid hitting the containers stacked on top of each other like a wall.

Again and again this brings about critical situations, for example when two reach stackers move towards each other while being manoeuvred in reverse, when trucks cross the way or objects or people are in the manoeuvring range. With an ordinary rear view camera the driver can look behind but such a camera is passive, i.e. it does not warn in critical situations.

Automatic collision avoidance

ifm's O3M camera provides active protection: The integrated 3D sensor not only displays obstacles behind the vehicle on a screen in the cockpit but also determines the obstacle's size, position and movement, if any. Based on this detection of the environment and the reach stacker's own movement the O3M system assesses the critical relevance of objects. It warns the driver of the obstacles that are in the path or on a collision course. This prevents

ifm offers a cost-optimised solution for more safety (not only) in port logistics

the driver from being irritated by too many warnings of objects in non-critical areas. Another advantage of the intelligent O3M system is that if another vehicle moves into the travel path from the side the, risk is detected much faster than with a distance-based warning.

Camera image with overlaid 3D objects

The O3M system has two integrated cameras:
A conventional 2D camera and a 3D camera that determines the exact distance to each pixel.

The advantage for the user: Detected objects are highlighted in colour in the produced 2D image. Critical obstacles can be highlighted, for example, in red, less critical objects in yellow or green. Furthermore, an additional warning symbol can be provided in this case.

This overlay is completely generated in the O3M – so neither additional hardware nor complex set-up or programming is needed. Visualisation can be easily and conveniently adapted to the application conditions with the ifm "Vision Assistant" software (colour, symbols, language, etc.).

Graded warnings

Parallel to the visual representation, a warning is transmitted to the CAN bus which is used to produce an additional acoustic signal or even to intervene with braking.

This reaction can be graded depending on the distance to the obstacle, i.e. at first an acoustic and visual warning is given. If the driver does not react and the situation becomes more critical, the vehicle can brake gently.

Example for a critical situation because of a moving object.

Challenge when reversing: Keep an eye on the container ahead, watch traffic behind.

The O3M system has two integrated cameras: A conventional 2D camera and a 3D camera that determines the exact distance to each pixel

Example for a graded reaction

The integrated PMD 3D chip from ifm detects scenes and objects three-dimensionally with only one image capture. This avoids the motion blur that can occur with line scanners. ifm's award-winning patented PMD technology forms the basis for a sensor system that can cope with the harsh operating conditions of mobile machines.
Besides the robust and compact design the O3M sensor system is specially designed for outdoor applications with changing light conditions or bright sunlight.
The ifm 3D sensor has no moving components in contrast to other sensors such as laser scanners. Therefore it is particularly robust and not subject to wear. The operating principle of the PMD technology is based on the time-of-flight principle. The scene is illuminated by modulated, invisible infrared light and the reflected light hits the PMD sensor. This sensor is also connected to the source of modulation. Each pixel of the PMD chip determines the distances to the scene due to the phase shift between the transmitted and the received signal.
The integrated, active suppression of background illumination almost completely prevents saturation of the image sensor by extraneous light. That means that the PMD 3D sensor can be operated in bright sunlight up to 120 klx. The integrated 2 x 32-bit processor architecture ensures rapid and reliable calculation of the 3D data directly in the system with up to 50 images per second.

Smart functions

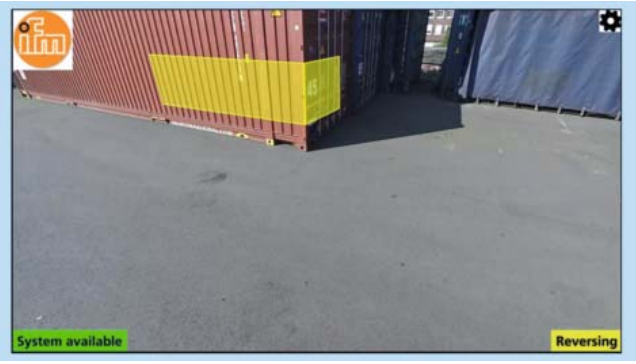
The mobile 3D smart sensors feature some integrated evaluation functions which besides the collision avoidance described here, enable a multitude of other applications to be solved, e.g. line guidance or area monitoring. A highly developed algorithm from the automotive industry is used, ensuring reliable automatic object recognition of up to 20 objects.

In just a few steps the parameters of the system are set via the easy-to-use "ifm Vision Assistant" for Windows. To do so the user only needs to enter some parameters, e.g. regarding the vehicle's geometry. Usually this set-up only takes a couple of minutes and the system is then ready for operation.

Communication interfaces

The preprocessed function data is output via the CAN bus using CANopen or SAE J 1939. If needed, the complete 3D information can be processed via Ethernet UDP and an external process unit. This provides developers with an open system.

Critical objects are marked in the camera image.

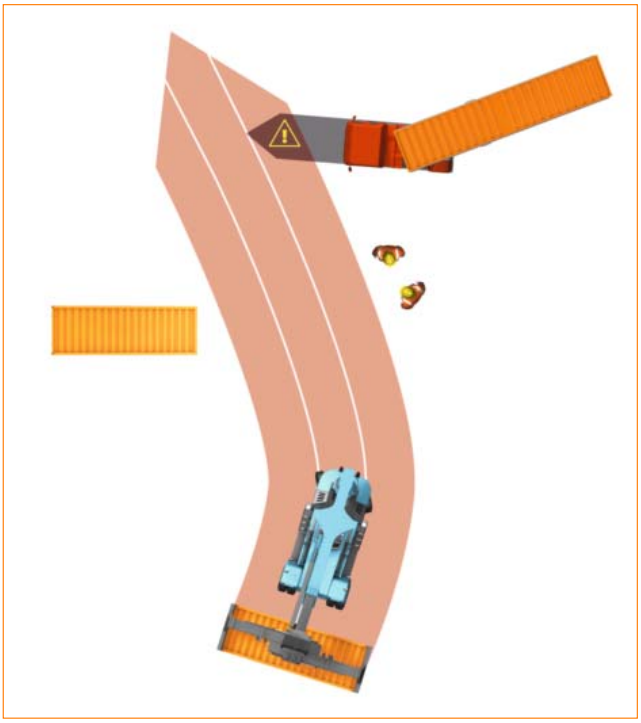


Camera image with a clear warning in the event of objects on a collision course.

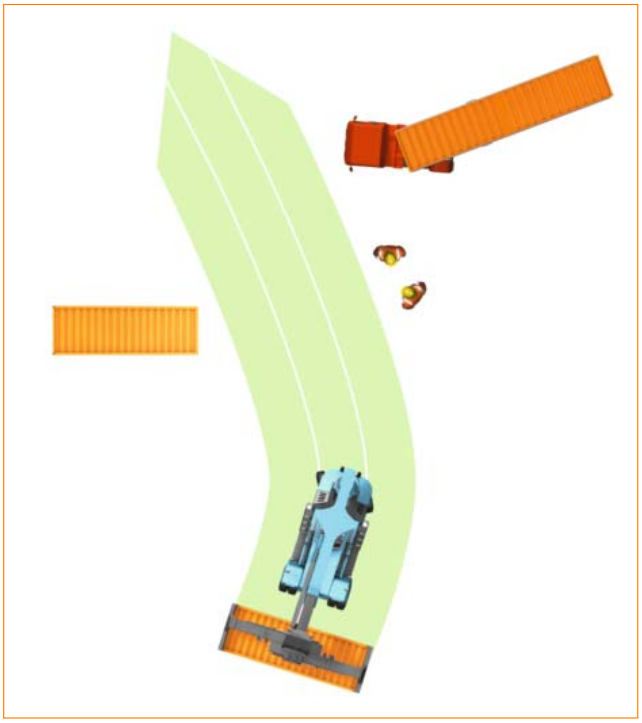
O3M system: 3D camera (right) and infrared illumination unit (left).

Conclusion

The O3M system is a stand-alone assistance system for mobile use which predicts collisions and, if needed, may actively intervene with driving. The complete "intelligence" is integrated into the compact sensor housing. Parameters are set in a few steps via easy-to-use operating software. Therefore the system can be used for different types of vehicles. So ifm offers a cost-optimised solution for more safety (not only) in port logistics.



Example for a critical situation because of a moving object.



Example for a non-critical situation in a curve.