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Aspects of science fiction films from the 1980s and 90s are becoming a reality in the modern container terminal.

Only 20 years ago, vision technology in terminal operations was limited to optical character recognition (OCR) for container code recognition (CCR) and license plate recognition (LPR - also referred to as automatic number plate recognition “ANPR” depending on your geography).

The game changer in vision technology occurred in 2013 with the advent of dynamic neural networks (DNN). Long story short, the use of a DNN provides a faster, more efficient, and more accurate way to extract data from images using deep learning techniques. The benefit for the industry is that virtually everything that you photograph can be automatically digitised and therefore used as a basis for process automation.

The latest application for container terminals, and those interested in a container's condition, comes in the form of Visy's Automatic Damage Detection System (ADDS), the first system of its kind.

It is safe to say that the issues surrounding damaged containers cost the industry billions of dollars per year. Damaged containers lead to spoiled cargo and containers with severe structural damage pose safety problems. Indeed, a container full of waterlogged iPhones, or a container with warped corner posts that causes a stack to collapse, will evoke a ripple effect of insurance claims, angry customers, delays, and safety issues.

As a result, many container terminals have created processes to manage damaged cargo. However, until recently, those processes have been manual thus making them labour intensive, slow, error prone, and unpredictable despite the best efforts of management. Today, damage inspection is automated through ADDS.

This process automation improves the terminal's key performance indicators (KPIs) including truck turnaround times, lifts per hour, and overall profitability.

To improve KPIs, container terminals use camera systems with OCR to identify assets as they enter or exit the facility via road, rail or quay. The common industry terms for these systems are gate operating system (GOS) with OCR for trucks, train GOS for rail operations, and crane OCR for quayside operations. These deployments all utilise some aspects of vision technology to collect event data (such as box ID, seal presence, door direction, hazardous goods labels, etc.) and share it with third party systems such as the terminal operating system (TOS).

The same camera systems can now be upgraded to include the ADDS feature through a simple software add-on. For example, as a truck drives through an OCR pre-gate portal and images are taken to identify the box number, the exact same camera system now tells the

Visy ADDS

The Digitalisation of Damage Inspection

cargo touches the ground, the operator knows everything about it including its condition. The information is digitised and shared with the TOS and therefore exceptions, such as the lack of seal or extreme damage, can be managed in real time. Perhaps the operator will change a workorder so that a box goes to the M&R centre and needs to update the shipping line. With digitised data, previously inconceivable levels of automation become the standard.

The same data is used during loading operations. When a box is picked from the quay, all relevant information is captured including the box's condition. In this case, the terminal automatically collects and shares the standard OCR features, such as the box ID, but also confirms that the box is fit for sea travel. Using the digitised data codes, an EIR can be automatically created and shared with the shipping line. Additionally, the terminal can verify the box is in the same condition it was when it entered the terminal and therefore refute potential damage claims.

Road Trucks

Before trucks and cargo arrive at the main gate, they typically drive through an OCR pre-gate portal. Depending on the operation, the portal is equipped with lights and cameras to capture high-resolution images for the OCR processes. The data extracted from the images will be similar to that utilised in quayside operations, save for obvious differences such as truck license plates instead of terminal tractor ID's, etc.

operator if the box is damaged, shows where the damage is, and specifies the type of damage. From here, it is up to each operator how they want to use this new, digitised data.

Quayside Operations

As boxes enter the terminal via ship-to-shore (STS) cranes, images are taken of all visible sides by the crane OCR system. Cameras are typically located in the spreader and on the crane's frame. As the spreader grabs the box(es), Visy's TopView application (i.e., spreader OCR system) captures images of the roof and uses those images for CCR, twin-20 detection and ADDS. Immediately the operator receives confirmation of the box ID's.

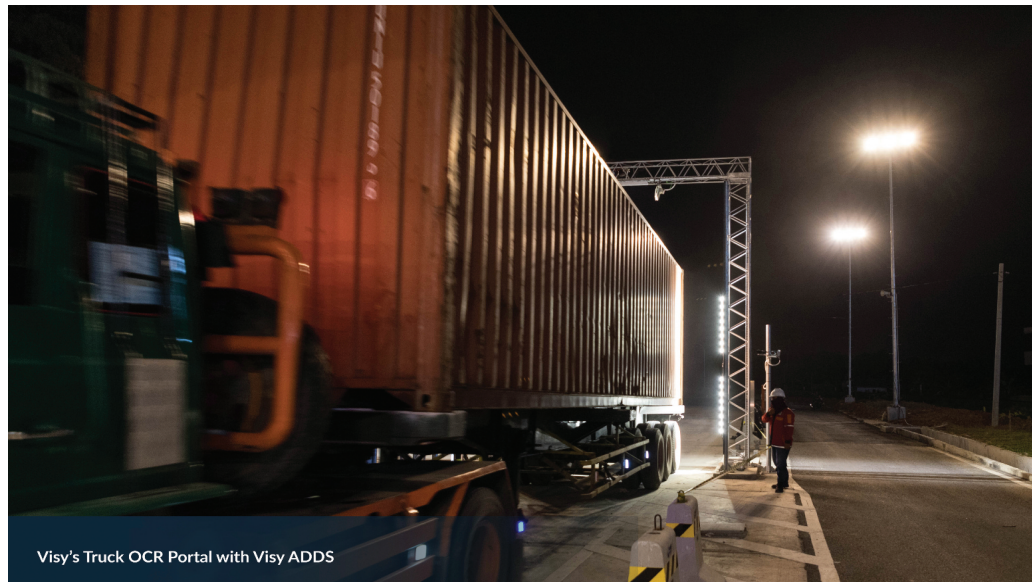
As the containers move into the exchange area, the frame cameras capture images of the long and short sides of each box. These images are also used for automatic data processing including box ID, ISO code, door direction, hazardous good labels, tare weight, seal presence, and damage detection. Before the



Visy's ADDS UI screen.



Visy's Truck OCR Portal with Visy Access Gate GOS



Visy's Truck OCR Portal with Visy ADDS

Again, using the single set of images from the OCR portal, ADDS will find damage on the cargo, digitise the result, and create an exception handling event if required for the process. Because the damage condition is digitalised, the workorder can be automatically changed and the container can be rerouted to the M&R centre if warranted by its condition.


Much like at the in-gate process, the out-gate process can be automated with ADDS. As the truck drives through the out-gate OCR portal, before reaching the main gate area, high-resolution images are taken, and all relevant data are acquired. The cargo is matched with the truck and workorder, and the damage condition is determined. If the cargo is unfit for road travel, or if some other discrepancy exists, the truck will be prohibited from leaving the terminal as an exception handling event. If there are no discrepancies, the truck will leave, and the terminal has evidence the assets were in acceptable condition at the time they left the facility.

Rail

Like the truck pre-gate portals, rail tracks can be equipped with train GOS OCR portals to collect and share data in a variety of train operations. The OCR portals work with double-stacked, dual-track, and bi-directional operations as required by the site. As the train travels through the portal, cameras capture

high-resolution images of the wagons and cargo to extract and share relevant data such as the box and wagon ID's and the composition. The data are shared with the TOS and compared to the expected composition. Exception handling events are created in the system for box/wagon discrepancies and damaged cargo alike. If a box is damaged upon arrival, the information can be automatically shared with a third party system before the terminal even offloads it. Similarly, as the train is departing, the OCR portal will verify the boxes are in acceptable condition at the time they left the facility.

Summary

Visy ADDS automatically digitises the condition of shipping containers. This tool presents a massive opportunity for operators and the industry alike. The ability to automatically know the condition of a box as it arrives at a terminal would have qualified as science fiction only two decades ago. Today, operators can take advantage of the deep-learning technology to automate processes, provide better customer services, and make prudent business decisions. Sharing such data with third party systems like the TOS, a website for customers, or an EIR report generator are only the beginning of this new era in terminal automation. It will be amazing to see where vision technology takes the industry after another twenty years of development. 

Visy was extremely busy in 2021 and expects that trend to continue in 2022. They are seeing demand for all their products, but especially for the ADDS technology and crane OCR solutions. One of the key features of the company's crane OCR product that has generated excitement is the TopView spreader OCR solution. Essentially, TopView turns every spreader into a smart device by taking pictures of the roof of each box and utilising different vision technology algorithms. Additionally, through communication with the TOS, the system confirms the box ID's for the workorder before a move is executed, and therefore prevents wrong moves and the hazards associated with picking two-20's when only one-40' is scheduled. Of course, the roof images are also used for damaged detection and ADDS.

Other orders and projects that have been completed include:

☛ **TPS (Terminal Petikemas Surabaya), Indonesia**

The first implementation of Visy Automatic Damage Detection System (ADDS) went live in Spring 2021 at the TPS container terminal in Indonesia.

☛ **ODP (October Dry Port), Egypt**

Visy has won the ODP Gate tender, with local partner PRIME Trading & Contracting. Together, Visy and Prime will deliver Truck and Rail OCR portals with Visy Access Gate GOS to Egypt's first inland port. The project will support ODP's quest to be a world-class service provider for customers. The on-site installation work is starting in Q1 2022.

☛ **DB Netze, Germany**

Since 2020, Visy and German partner LMT have been working with DB Netze to provide process automation through Rail OCR portals and the Visy Train Gate application. As of Q4 2021, 7 portals have gone live despite the workarounds required by the pandemic. Each OCR portal is equipped with high-resolution cameras which capture images for wagon and cargo identification.

☛ **OMV, Romania**

OMV Romania selected Visy Train Gate with rail OCR Portals for its 2021 automation project. The system includes OCR for cargo and wagon identification and the Visy Gate platform which allows automatic data sharing with third party systems and tools to mitigate damage claims.