The power of vision

Over the last few years the potential to apply computer vision to facilities and vehicle management has become feasible. Using artificial intelligence and real-time monitoring, the technology breakthrough can offer a wealth of insights for smarter operations.

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The conservative and traditional reputation of the cement industry is easy to understand. After all, cement and concrete date back to the Roman Empire, and crushed rock or aggregates have been the basis of infrastructure and transportation since the Industrial Revolution. So, it is not the first sector that comes to mind for the use of cutting-edge technology. In spite of its reputation, the industry has applied advanced computer vision to analyse complex rock images for the purpose of rocktype classification. These computer vision systems were first introduced in the early 1990s for mining by the US Bureau of Mines to instantaneously measure mineral concentrations.[1] But it is only in the last few years that the potential to apply this technology to facilities and vehicle management has become feasible.

In an age of rapid technology innovation, computer vision offers continuous, cost-effective visibility to operations, while using artificial intelligence to interpret what is occurring in every aspect of the site. This includes how people, equipment and materials interact. It monitors activities while generating feedback based on operator parameters, all in real time. These parameters can be customised to the needs of the business bringing solutions to unique problem areas.

Vehicle monitoring

While there has been wide usage of GPS/GSM/GPRS systems to improve over-the-road truck tracking, they can lack the granularity to effectively manage vehicles and equipment within a plant or yard.[2] They also lack the ability to watch the action at a site like a set of eyes. Computer vision is a way to replace human eyes and complement GPS within yards, depots and distribution centres.

New computer vision systems use mini computers, cameras and other off-the-shelf hardware that are easy to install and do not require integration into existing systems or infrastructure. Some even provide their own cellar connection to the cloud for real-time reporting and alerting.

Unlike security cameras that require humans to review hours' worth of images, computer-based monitoring systems use artificial intelligence to only signal events of interest or concern – eg, foreign materials inside an empty truck, debris in the bed of dump truck, a person not wearing a hard hat in a designated area, a vehicle left unattended for an extended period of time, etc.

The screenshot shown in Figure 1 captures real-time monitoring of a cement and aggregate facility. Each vehicle is logged in automatically by reading its licence plate. Its total time in the yard and the number of daily trips is also displayed. Unlike GPS-based systems, computer vision tracks all vehicles in a facility, not just the organisation's.

Figure 2 captures the detailed drill-down possible with a computer vision monitoring system that not only graphically captures each event but visually shows items of interest such as the truck on the scale and a further drill down to its scale reading. The old saying is true, a picture is worth a thousand words. In this instance, the trucks have captured wrong-way drivers, illegal U-turns and trucks exceeding the posted speed limit.

Computer vision represents the next generation of vehicle and equipment monitoring as well as visual inventory management

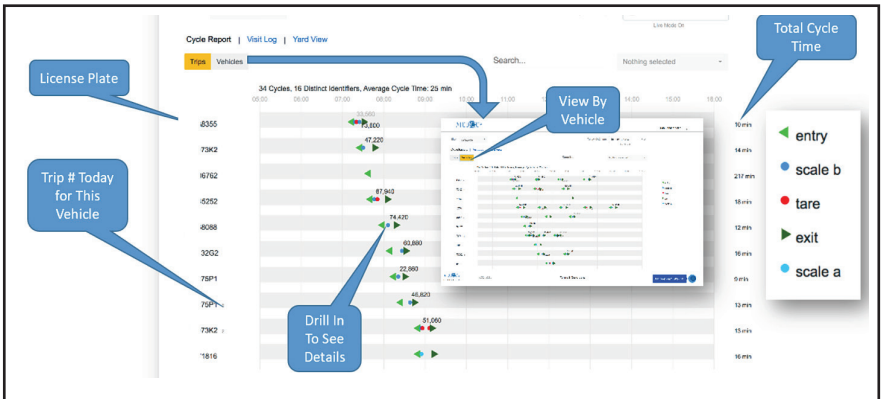


Figure 1: computer vision tracks all vehicles in a facility, not just the organisation's vehicles

Figure 2: the detailed drill-down possible with a computer vision monitoring system

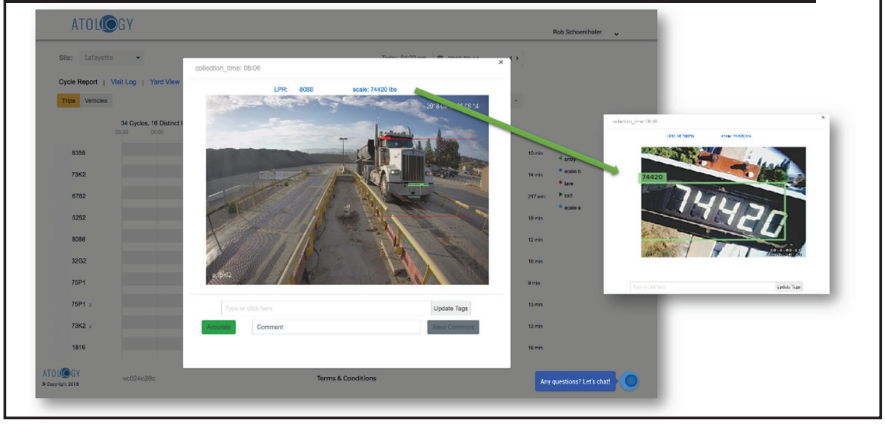
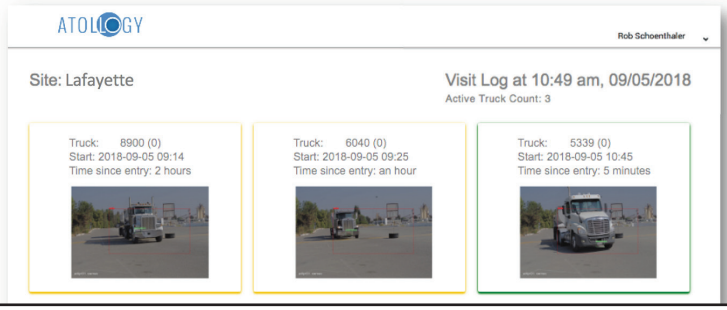


Figure 3: computer vision also provides a real-time inventory of who is on site at any time of the day or night



Computer vision also provides a real-time inventory of who is on site at any time of the day or night. This is helpful in flagging vehicles that exceeded their welcome time. The truck pictured on the right of Figure 3 has been in the facility an hour over the time to cause concern.

Further applications

In addition to vehicle monitoring applications, computer vision is being considered for other uses.

Maintenance crew monitoring

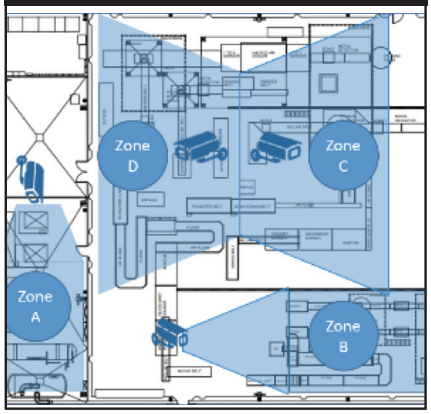
A common complaint from both site and plant managers is the inability to accurately track maintenance crews. The bigger the facility or yard, the greater the issue, because a manager or supervisor can only be in one place at a time and may have multiple crews or individuals working across the facility. Therefore, computer vision-based monitoring provides an unobtrusive and passive way of monitoring and tracking the whereabouts of these crews (see Figure 4).

Entry queue monitoring and alerts

Another common complaint is that long queues at yard entrances translate into unhappy customers who may opt to reroute to a competitor for the simple reason that delays cost them money. By watching the number of vehicles lined up at an entrance and timing their time to work through the queue, it is now possible for dispatchers to increase capacity or to vector trucks not yet on site to divert to the next-closest facility.

One plant manager even suggested the idea of making the queue times available via a smartphone app. In this way, his customers could plan their arrival times accordingly. He also mentioned that drivers typically contact each other and often times exaggerate delays for a variety of reasons. He reasoned that queue time transparency is better than driver-to-driver discussions.

Figure 4: monitoring of maintenance crew in a yard within a facility



Visual inventory management

Maintaining a perpetual inventory is never easy, especially in high-volume facilities, in which it is not realistic to capture in and out transactions. Using computer vision, the cameras simply watch the movement of pallets of bags and the computers are taught the visible differences between various types of inventory and number of bags per pallet. It is simple and effective, and can be corroborated with an occasional cycle count.

The next generation

Passive and unobtrusive computer vision combined with real-time monitoring are working at a wide variety of facilities and yards. It is truly the next generation of vehicle and equipment monitoring regardless of type, size or ownership.

Computer vision also overcomes the age-old Hawthorne effect in which people act differently when being watched and measured. Typically, the operation improves as the surveillance continues, but then reverts back to earlier, less productive levels after the observers depart. This a big reason why a majority of Lean and Six Sigma projects are deemed a failure by their sponsors. Infective and limited sampling techniques using a clipboard and stopwatch are replaced by continuous monitoring – there are no sample size issues as all the data can now be evaluated.

With computer vision's continuous monitoring and alerts, managers need not be on site to manage plant and yard operations. This is especially helpful for those with multiple site responsibilities or responsibility for managing very large integrated plant sites. Managers will now have control of on-going operations and be able to quickly respond to and resolve issues before they get out of their control. Finally, managers will have a wealth of new insights upon which to make continuous improvements truly continuous. ■

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