Autonomous Mobile Robot

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The rapid growth of e-commerce and industry 4.0 for an always-on demand supply chain means that manufacturers have to rethink the way they do indoor material movement around the factory floor. It's a key driving force behind material-handling advances as companies seek to meet customer expectations for nearly instantaneous order fulfilment has given rise to Goods-to-person approach.

Fig. 1 AMR tugging multiple trolleys – optimizing factory space and reducing delivery time

Robots in the industrial sector are quickly evolving from powerful, stationary machines into sophisticated, mobile platforms to address a broader range of automation needs. Autonomous mobile robots (AMRs) are one of the latest and most innovative automation solutions on the global market.

Fig. 2 Traditional assembly line manufacturing in automotive Factory following FIFO process

Mobile robots have the capability to move around in their environment and are not fixed to one physical location. Mobile robots can be "autonomous" (AMR - autonomous mobile robot) which means they can navigate an uncontrolled environment without the need for physical or electro-mechanical guidance devices. Alternatively, mobile robots can rely on guidance devices that allow them to travel a pre-defined navigation route in relatively controlled space (AGV - autonomous guided vehicle).

AMRs (Figure 1) differ from automated guided vehicles (AGVs) (Figure 2) by their degree of autonomy – AMRs are far more independent than AGVs. AMRs will be an important part of lean operations in a wide range of industrial settings once they are widely deployed, as they are built to address specific challenges in typical industrial environments.

Operational Challenges Autonomous Mobile Robots Overcome

Typical AGVs need some form of external guidance, whether it's permanent wires, magnetic strips or sensors embedded in the floor. This creates a rigid system that's difficult and expensive to adjust as production needs change, which is the main obstacle AMRs aim to overcome.

Autonomous mobile robots are much more capable of navigating dynamic environments. They require little external input to do so, which is an important capability. Industrial environments like construction sites are inherently dynamic. Manufacturing facilities are becoming more dynamic as they pursue leaner operations. Robots that can operate within these environments will have major commercial potential, introducing process automation without hindering the need for frequent changes in the production environment.

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Technological Innovations in Autonomous Mobile Robots

One of the latest innovations in AMRs is the inclusion of onboard intelligence systems. These come in a variety of formats but differentiate AMRs from AGVs (Figure 3). Many AMRs can learn their surroundings either by having a blueprint uploaded, or by having the AMRs drive around and develop their own map using LiDARs which help generate point cloud map. This type of autonomy allows them to quickly adapt to just about any industrial environment as LiDAR use natural features around the factory floor for localization.

Fig.3 A MIMO approach using flexible conveyors – also known as Autonomous mobile robot

AMRs are one step above and beyond AGVs. In most applications, AMRs will provide unrivalled flexibility and ease of use due to their high levels of autonomy. These capabilities fit perfectly with today's lean operating environments. This also reduces deployment time and certain aspects of the factory can be change without any dependencies for the robot to adapt. The robot can re-map the floor to update its map and continue its operation.

AMRs are an important robotic innovation that supports the constant pursuit of productivity in the industrial sector they have potential to change the countries manufacturing supply chain economy. AMRs have great commercial potential and are likely to be deployed in a wide range of settings. AMR are self-managed system taking care of battery charging and uploading diagnostics to central server helping operation manager predict failures. This helps the AMS virtually run 24x7 in factory independent of holidays and lunch breaks (Figure 4).

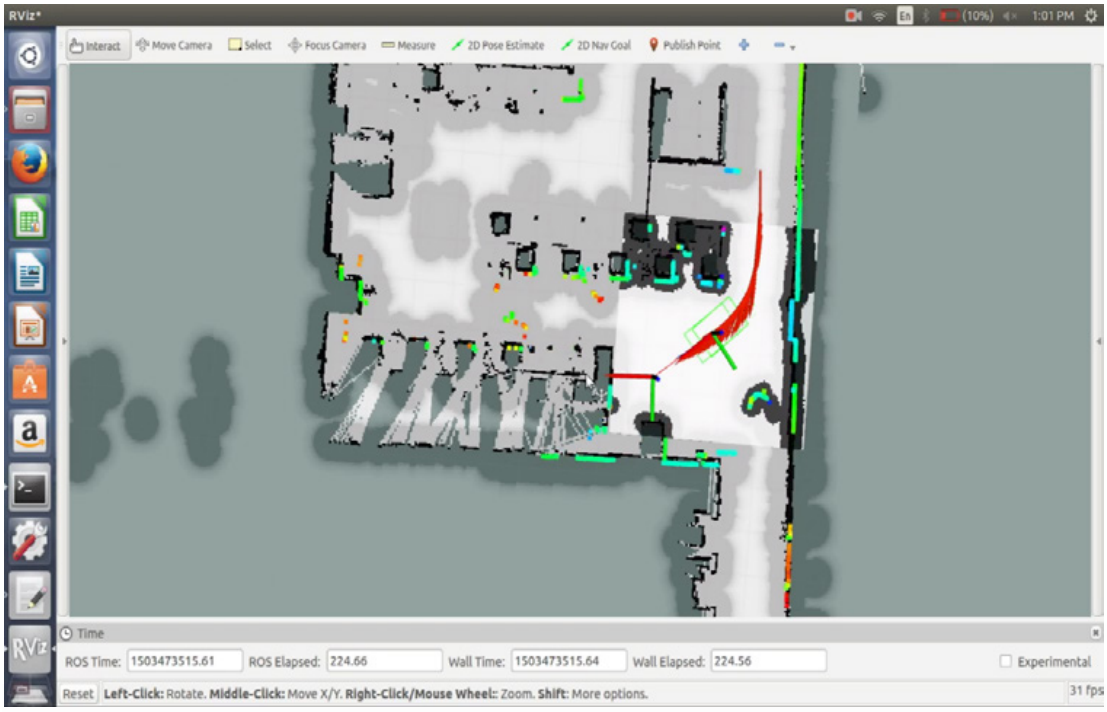

Fig.4 2D LiDAR map used by AMR for Localization and navigation planning for complex environment

Is the future Industry 5.0?

As manufacturing shifts from high-volume mass production to lower-volume, more customized goods, so too will workers shift from being the servants of machines—as they functioned on old-style assembly lines—to be the brains guiding a networked production operation. This is what some are calling Industry 5.0, which merges human dexterity and problem-solving skills with the Industrial Internet of Things (IIoT), robots, artificial intelligence, smart instrumentation and data analytics (Figure 5).

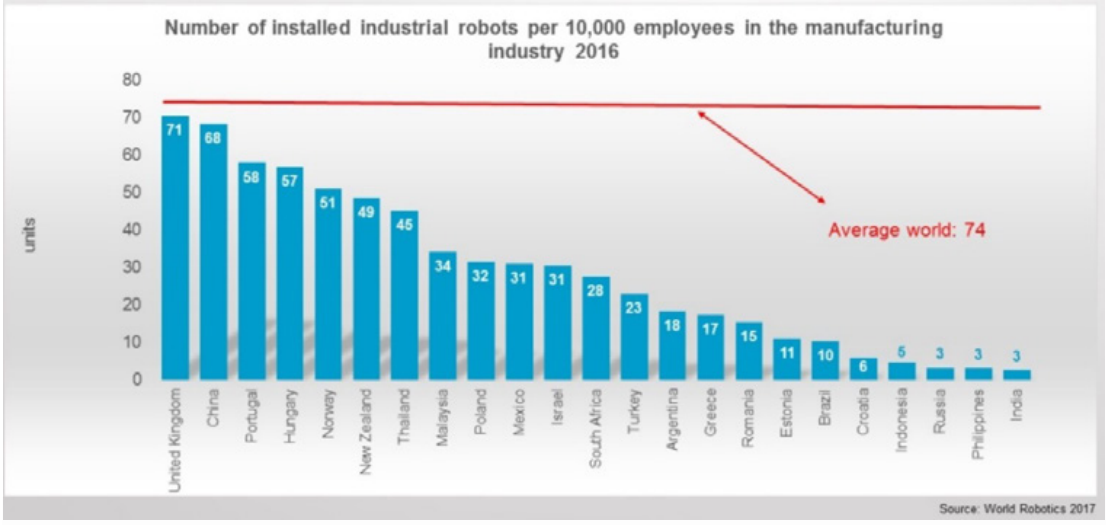

Fig.5 Installed industrial robots in the manufacturing industry

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China also has a significant opportunity to introduce more automation into manufacturing. Even though China is the largest market for robots in the world, Chinese companies remain relatively unautomated, with only 36 robots per 10,000 manufacturing workers, about half the average of all advanced economies and less than one-fifth the US level

A survey of more than 500 manufacturing executives by consulting firm Accenture found that 85 percent expect to see human-machine-centric environments commonplace in their production processes by 2020. The likelihood of such a radical transformation happening so quickly is significantly lower, however, given that only 22 percent said they have begun to act to introduce supporting technologies like robotic process automation.

No matter the eventual timetable, digitizing and automating crucial business processes, while keeping humans at the centre of decision-making, will ultimately transform the adaptability, change-readiness and responsiveness of the manufacturing environment. The use of robots to automate material handling is just one step in that journey.

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