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INNOVATION THROUGH ENGINEERING

THOUGHT LEADERSHIP MATURING TECHNOLOGY: AVGs IN INDUSTRY - STATE OF PLAY

AGVs IN INDUSTRY - STATE OF PLAY

Autonomous Guided Vehicles (AGVs) have come to play a significant role in factories serving in almost all industries. The roles they play are diverse and range from extending the reach of robotic tools for applications such as polishing aircraft fuselages and the inside of wind turbine blade moulds to automated delivery of materials to assembly line stations and movement of containers in ports. *(Network, 2023)*

The level of autonomy of AGVs in industry also ranges from simple remote-controlled vehicles such as die trucks used to move press tool dies, to vehicles used for robot extension effectively operating as CNC axes, to highly autonomous vehicles used in container terminals equipped with traffic management and conflict arbitration logic. *(Techmotion, 2023)*

One of the exciting recent trends in the AGV space has been the adoption of AGVs in the medical context where AGVs have been equipped with UV light sources which are used to automatically roam through healthcare facilities and use the UV light to sanitize surfaces. Another medical application is the development of automated trolleys equipped with all essential medicines and equipment for resuscitation which allows the 'resus' area to rapidly come to the patient as opposed to having to move an unstable patient to a specific area. *(JBT, 2023)*

A growing trend in the engineering of AGV systems has been the separation of high-level control software from the lower-level controls and hardware aspects of the system. This trend has resulted in the emergence of highly skilled companies who develop generic controllers with advanced and desirable features such as traffic management and standard compliant MES integration. These generic controllers speed the development pathway for a company building a new AGV and have resulted in a proliferation of AGVs with mechanical and electrical configurations suited to specific tasks but a standard and robust control interface. *(Insights, 2023)*

eNtsa recently had the opportunity to develop AGV platforms for the industrial engineering department as part of a bigger MERSETA (Manufacturing, Engineering and Related Services Sector Education Training Authority) funded project to redevelop the SWEAT (Simulated Work Environment Automation Training) lab so that it represents the current cutting edge in factory automation and manufacturing technology. These AGVs have been built as extensible platforms with the intention of facilitating further research into the development of and use of AGV systems in the factories of today and the future.

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The SWEAT lab AGVs are designed with a Mecanum wheel configuration which affords them holonomic motion capabilities. The availability of holonomic motion allows for the use of the AGV in robotics applications and space constrained localities which can be expected in factories. The Mecanum wheels are driven by individual servo motors and feature planetary gearboxes which can be exchanged should the speed/towing force range of the AGV need to be adjusted. From a control system point of view, the AGVs feature a Beckhoff IPC running windows to allow for third party software such as ROS (Robot Operating System), MES (Manufacturing Execution System) and OS based localisation software. Real-time control is handled by a Beckhoff PLC and NC kernels running a PLC and motion controller respectively.

Localisation of the AGVs is provided by a modern UWB based indoor GPS solution and augmented by accurate dead reckoning derived from the individual wheel servo motors and processed through built in kinematic equations in real-time. In addition to this UWB localisation, the AGVs are equipped with laser scanners which provide point cloud feedback for future implementation of natural feature localisation solutions.

Currently the AGVs support a remote-control mode with an XBox remote and a warehouse logistics mode where virtual waypoints can be defined and AGVs can be tasked to move from waypoint to waypoint. The internal implementation of the motion control is based on the Beckhoff TwinCAT NC software platform. This NC software can run predefined file based G-Code or process G-codes generated by the PLC on the fly. This would allow for easy integration of robotics sequences with the potential for the AGV to autonomously modify motions to adapt the AGV behaviour in response to surrounding conditions.

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