Automatic Guided Vehicles with path planning system optimize warehouse logistics

Compact, yet robust, AGVs from America in Motion move product back and forth in warehouse applications with little or no operator intervention.

The fantasy that once typified automatic guided vehicles (AGV) in science fiction has become a tangible reality today, such as in warehousing operations. With the new iBOT series, America in Motion is breaking new ground, since the transport vehicles are equipped with a revolutionary path planning system.

America in Motion (AIM), a Charlotte, N.C.-based specialist builder of AGV systems, offers automation solutions tailored to customer needs with respect to their individual warehousing, logistics and distribution applications. Tommy Hessler, CEO at AIM explains: "Because the needs of each AGV installation are so varied, our team takes great care to guide our customers through the process so they discover solutions that are best suited for their automation needs."

AGVs are autonomous mobile robots that follow markers or wires in the floor, or use vision, magnets, or lasers for navigation. For industrial applications, they are most often used to move materials around a manufacturing facility or warehouse. They can be adapted to a wide range of tasks. Whether handling products, delivering mail or performing other automated jobs, these robust, flexible machines can be almost infinitely configured.

iBOT optimizes warehouse logistics

Approximately three years ago, AIM was approached by a leading U.S. home improvement retailer to help expand their distribution facilities with an AGV system tailored for their new storage and shipping centers. The company specified the mechanical platform with all the typical functions of a forklift, such as forward motion, steering and mast control. Traditional AGV automation systems lacked the flexibility and robust operation necessary to accomplish these tasks, leading AIM to seek out a PC-based control system from Beckhoff for the development of the iBOT. It leverages both Kalman filters and odometry for navigation, as well as the Dijkstra algorithm, a mathematical process for finding the shortest path between two points.

The iBOT is totally autonomous, carrying out instructions with minimal operator input. This is deceptively simple, as the nature of the pallets varies from operation to operation. Hessler explains: "As you can imagine, people don't buy a whole pallet's worth of products. Each pallet contains a mix of products, so the size and weight of each pallet is constantly changing. The vehicle picks up the packed pallet and drives it to one of several stretch wrappers and drops it off, all while automatically avoiding warehouse shelves, human workers and the seven other AGVs."

A look "under the hood" of the iBOT AGV from America in Motion reveals space-saving, efficient design of the onboard controls architecture.

The scale of this project was daunting, as the 1,200 foot long warehouse necessitated mapping of thousands of positions and for the system to track order numbers and individual products on the pallets, all while relaying this information back to the central computer for collection and monitoring. Complicating matters further, the fleet of AGVs receives around 80 orders at a time, so it was important to optimize the operation of the AGVs by minimizing distances and travel times.

Trend-setting automation of AGVs, with PC control

The iBOT uses a Beckhoff CP6606 Panel PC with integrated HMI, running TwinCAT software. In addition, four 19-inch stainless steel, IP 65-rated Panel PCs are mounted at various locations around the home improvement retailer's distribution facility. Each device displays the positions and traffic statistics of the eight AGVs and tracks performance, loads per hour and any errors or performance inadequacies.

For much of AGV history, a dedicated, hard-coded system running some sort of path-planning algorithm provided the motion control of the robotic system. Programming and commissioning these vehicles was a time- and labor-intensive process, in addition to being costly and difficult for end user personnel to troubleshoot in the event of an error or other system issue. Tommy Hessler explains: "Most end users have the experience to address any mechanical or electrical issues on an AGV, but when it comes to the controls, they often have no choice but to rely on the vendor for support. With the implementation of the Industrial PC platform, which is based on standard components, we now have an AGV that breaks down that barrier. This is a huge step toward positioning the AGV as a mainstream material handling and logistics solution. In addition, we were able to reduce costs through the scalability of the Beckhoff control components – savings we pass along to our customers."

Traditional onboard navigational systems use laser sensors and an algorithm to determine X, Y and T (angle) coordinates of the vehicle in relation to obstacles in a warehouse. In the iBOT, this functionality can be accomplished in real-time via TwinCAT software and EtherCAT. TwinCAT TCP/IP Server provides a communication layer between the AGVs and the end users' corporate networks, facilitating connectivity between the controller and the onboard third-party navigational system components. The processes handled by the controller are especially time-critical, as the navigation system needs to know where the vehicle is at all times to avoid potential crashes and damaged product.

A selection of EtherCAT I/O terminals provides lightning-fast onboard communication for the AGVs. Hessler discusses the advantages of this increase in speed: "Relaying instructions to the navigation system while maintaining low-latency requires a robust, high-throughput method of transmission, and EtherCAT is tops when it comes to speed." The Beckhoff I/O system also provides flexibility in communication to non-EtherCAT devices via EL6751 CANopen terminals and EL6021 RS422 terminals, which serve as interfaces for routing back to the navigation controller. In addition, an EL6224 IO-Link terminal provides communication for height sensors on the AGV forklift mast. "Precision is key for the height sensors," Hessler emphasizes. "For example, the tines of a fork may need to travel over a height of 30 feet to reach a pallet located on a shelf. Misalignment of only one or two percent is enough to miss the pallet entirely, which is completely unacceptable in time-critical applications."

Further information:
www.weareaim.com
www.beckhoffautomation.com