

FOR IMMEDIATE RELEASE

Hitachi Introduces Technology for Automated Guided Vehicle: Real Time Map Update and Self-Localization

Autonomous driving without the floor marker guiding system

Tokyo, August 4, 2015 --- Hitachi, Ltd. (TSE: 6501, "Hitachi") today announced that it has developed a technology for automated guided vehicle, which can transport the entire shelf of products in a warehouse. This technology is capable of detecting the movements of shelves to perform self-localization while updating the warehouse map of the product shelves registered in the automated guided vehicles in real time. Due to this technology, the automated guided vehicle is able to drive autonomously without markers labeled on the floor as guidance. By eliminating the markers arranged on the floor for vehicle guidance, not only the cost of marker installation and maintenance can be reduced, but also the flexibility of movement path and equipment layout can be increased.

In recent years, with the growing online retail market and the increase of diversity of customer needs, the warehouses that manage more types of products in smaller amount of inventory have been increased. The automated guided vehicle has been integrated in order to improve the efficiency of the picking process in a warehouse where the flexibility is required to adapt to changes in product types and quantities. In this system, the automated guided vehicles transport the entire shelves including the required products to the operators instead of the operators moving to the shelves. Hitachi's Racrew*¹, a compact automated guided vehicle, is developed and available in the market from September, 2014.

The automated guided vehicle must be able to determine its own direction of movement through self-localization to navigate itself in a warehouse. For the self-localization, the conventional automated guided vehicles for transporting shelves need to read the two dimensional barcode markers that are labeled at every one meter length on the floor. This system requires from thousands to tens of thousands of markers that cause the cost of installation and maintenance. In addition, this makes it difficult to modify the equipment layout for responding the changes in product types and quantities because vehicle's movement path and product shelves' locations are dependent on the arranged barcode markers.

Before now, the technology for recognizing vehicle position without markers by implementing the range finder for measuring the distance from the surrounding objects to the automated guided vehicle without markers has been also developed. However, this technology is based on

an alignment between the warehouse map where walls and pillars are registered and the measurement results during movement, and requires a less changing surrounding as a precondition. Thus, this technology could not be applied to an environment that the locations of shelves would be changed constantly through transporting.

As to achieve autonomous driving of the automated guided vehicle without markers in a warehouse where its environment changes dynamically by transporting shelves, Hitachi has developed a technology that allows the automated guided vehicle to recognize its own location from a warehouse map, which is updated in real time by detecting the changes of surroundings instantly.

The developed technology is to manage and categorize the contents of the warehouse map that is registered in the automated guided vehicle into the “unchanging areas” such as walls and pillars in a warehouse and the “changing area” such as product shelves. After performing self-localization by aligning this map with the location data of pillars and product shelves that are measured by the range finder mounted on the automated guided vehicle, only the locations of product shelves in the “changing area” will be updated. By performing this type of updates, the locations of unchangeable walls and pillars will not be updated mistakenly in order to ensure the high accuracy of the map. Furthermore, by restricting the processed area to the “changing area,” the updating time of the map has been shortened. Overall, the automated guided vehicle is capable of recognizing its own location by reflecting the surrounding changes into the map in real time in a warehouse environment where the product shelves’ layout constantly changes.

A simulation of the automated guided vehicle that moves with self-localization using developed technology has been conducted. The simulation was to repeat the location changes of the shelves with four sides of length 1 m in a warehouse with four sides of length 70 m, which is common environment for the automated guided vehicle, on the computer. The result of the accuracy is that the automated guided vehicle is capable of recognize its own location with an average error of 10 mm. Moreover, this technology has applied into Racrew to be tested on transporting shelves in a smaller scale of experimental space without labeling the floor markers. It is confirmed that the technology is capable of transporting the shelves and performing autonomous driving by recognizing its own location while reflecting the shelves locations changed through transporting onto the map in real time.

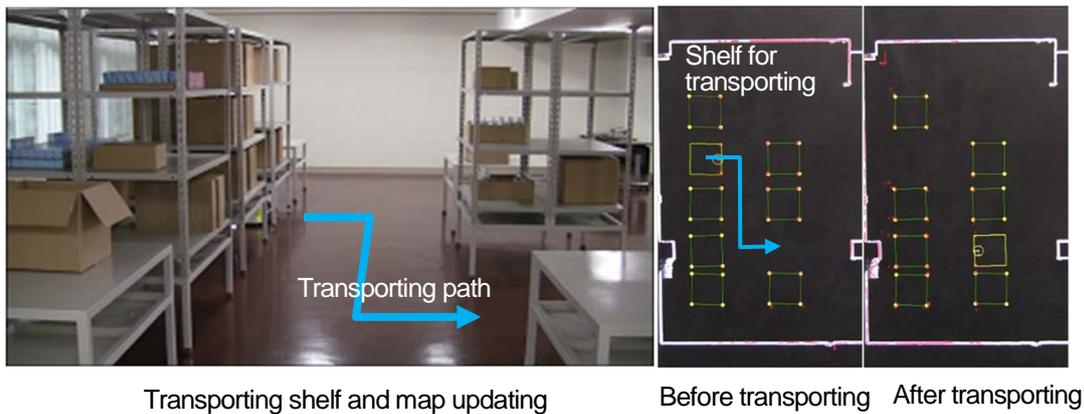
In the future, Hitachi will continue research and development for aiming at achieving the practical use of Racrew with this technology.

A part of this research will be presented at the 33-rd Annual Conference of the Robotics

Society of Japan, a conference to be held in Tokyo Denki University during September 3 - 5, 2015.



Racrew: A compact automated guided vehicle



Transporting shelf and map updating

Before transporting After transporting

*1 Racrew is a registered Japanese trademark owned by Hitachi, Ltd.

About Hitachi, Ltd.

Hitachi, Ltd. (TSE: 6501), headquartered in Tokyo, Japan, delivers innovations that answer society's challenges with our talented team and proven experience in global markets. The company's consolidated revenues for fiscal 2014 (ended March 31, 2015) totaled 9,761 billion yen (\$81.3 billion). Hitachi is focusing more than ever on the Social Innovation Business, which includes power & infrastructure systems, information & telecommunication systems, construction machinery, high functional materials & components, automotive systems, healthcare and others. For more information on Hitachi, please visit the company's website at <http://www.hitachi.com>.

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