HAI ROBOTICS

ACR SYSTEMS

POWER DIFFERENT SECTORS

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ACR, the Right Fit

'What are the Autonomous Case-handling Robot (ACR) systems?' 'How do they differ from other warehouse automation solutions?' These are the two questions we often receive.

The answer could be simple, that "case-handling" is the keyword. The ACRs, unlike others, are automated storage and retrieval systems designed and developed specifically to handle cases.

The ACRs were the first of its kind when Richie Chen, Shengdong Xu and Bing Fang, our co-founders, began to develop them back in 2015. The trio wanted to use robotics technology to address the ageing problem. They quickly saw the demand for a truly flexible, efficient and smart warehousing automation system. Back then, rack-moving robots were the prevalent choice of automation in the market.

After spending weeks visiting and studying more than 30 warehouses in Beijing, they had the idea to build a robot that may keep good mobility of AGV robots while promising high space utilization that was typically seen in high-bay warehouses. They eventually built a new type of mobile robot to handle cases/bins, and later named it "Autonomous Case-handling Robot". The ACRs, together with supporting software systems, evolved into the Totes-to-Person solution to complement existing Goods-to-Person solutions.

But the systems are more than just robots. They include proprietary HAIPICK robots and intelligent software system HAIQ. The HAIPICK robots do the picking, sorting, and transport between shelves and

ACR systems

Robots + Customized Storage Units + Charging Stations + HAIQ Software system

HAIQ Software system

Intelligent system for orders fullfilment and inventory management.

workstations. HAIQ system is the central command for HAIPICK robots, conveyor belts, loading and unloading workstations and other devices including robotic arms, AGVs or AMRs made by others.

The ACRs have grown into a robot family over the years to address the rising needs for different storage situations, with models tailored for tote storage, carton storage, mixed storage of totes and cartons in different sizes, double-deep storage, tray and tire storage that need no containers.

Since its first adoption in 2018, the ACR systems, have now been implemented in more than 500 projects globally, serving clients in 3PL, apparel, retail, e-commerce, electronics 3c and healthcare industries. Global clients choose ACR systems for the key benefits and value they provide, including:

- Flexible and fast deployment
- Higher pick rate with huge SKUs
- Higher space utilization

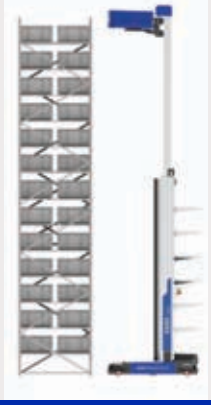
The need for better warehousing solutions rises quickly in recent years as e-commerce booms around the world. Users, in general, favour solutions that feature higher flexibility, scalability, accuracy and efficiency. They prefer, in short, things that are more adaptable to changes. Time changes. We believe the ACRs are the right fit for users nowadays, when the market gets more dynamic and volatile than ever before.

Third-party logistics

Companies cooperate with 3PL service providers to meeting the changing supply chain needs. Nevertheless, problems such as low warehouse space utilization, low turnover rate and yearly increasing total cost are common among 3PL service providers. The situation gets harder during peak seasons, when variety and quantity of goods often go beyond their warehousing capacity, causing disruptions to delivery time and accuracy. To provide better service, 3PL companies respond by introducing better technology and digitization, as well as improving efficiency.

Optimize warehouse space

The customizable storage solution can maximize the use of the existing space, increase the storage capacity per unit area and lower the cost of land use, with up to 95% of the vertical space put in use and the storage density increased by 80%-400%. Greater efficiency helps users save costs in the long run, making the investment in warehouse automation cost-effective.



Rack height: 0.2-10.0m

Cartons and totes

Double-deep intensive storage

Order fulfillment: accurate and efficient

The ACR systems shorten the time needed in manual picking, improving employees' efficiency by 3-4 times and helping lower labor costs. The ACR systems would choose the right mode in different traffic, with the help of the HAIQ system, which analyzes the order type and structure. Powered by advance algorithms, the ACR systems boosts totes picking accuracy to 99.99%, improving accuracy and efficiency of order fulfillment.

Flexible solution allows easy expansion of business

As e-commerce booms, some 3PL companies see capacity of their original facilities reaching a limit. With ACR systems, the expansion of warehouse can be realized flexibly and agilely. In terms of compatibility, the combination of the robots, the HAIQ system can ensure the flow of information between multiple devices. Users can deploy ACR systems easily according to their changing business needs, without causing disruptions to operation.

With ACR systems, Maersk Contract Logistics built the first smart warehouse & logistics center

With the development of global business, Maersk Contract Logistics' demand for diverse scenarios increases while low storage density and efficiency of workers have become bottlenecks of development. After the introduction of ACR solution, the picking efficiency of the to-B business grew by 2.9 times, and that of the to-C e-commerce business increased by 2 times, while the storage density was up by 30%.

2-2.9 times	Picking efficiency	**30% ↑**	Storage density

"Maersk Contract Logistics is quite satisfied with the smart warehousing upgrading for it has improved productivity"

Wang Wendong, General Manager of Maersk Contract Logistics, said the results have brought great help to the company.

E-commerce

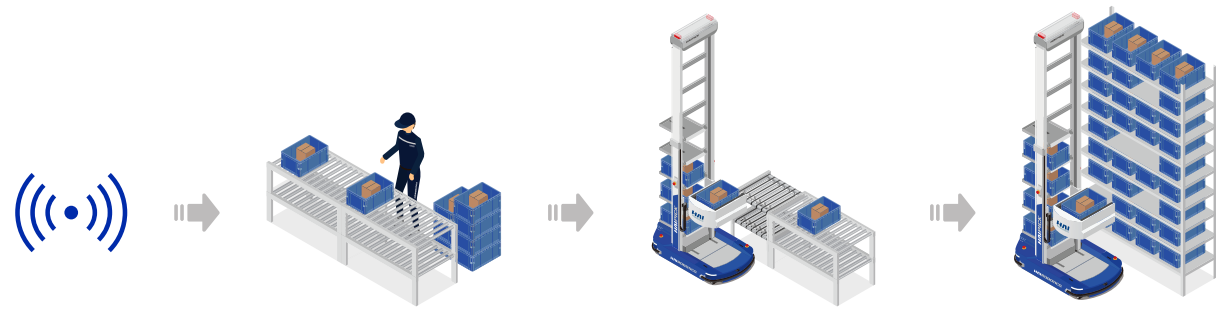
According to Forbes, e-commerce will account for 20.4% of global retail sales by the end of 2022, while labor cost of warehousing in e-commerce grows at 15% per year, higher than the average rise in wages. Smarter solutions are needed, as conventional warehousing can hardly meet the needs in e-commerce, like higher efficiency and accuracy in order fulfillment.

ACR systems optimize inbound / outbound in warehouses

The pivot of e-commerce operation is to optimize the warehousing processes to maximize order fulfillment capabilities and address delivery delays. Any error in the processes, from order placement, picking, packing, and delivery, may break down the whole work flow. Enhanced order fulfillment would not only save time but also reinforce the profit prospects. The ACR solution, which is configurable and customizable, serves as a cure for distinctive scenarios in e-commerce.

Inbound: Conveyor workstation solution to increase efficiency, while improving ergonomics

HAI ROBOTICS designs an original double-layer U-type conveyor line workstation with the upper conveyor for picking while the lower T-shaped conveyor for outbound. Such design reduces wait time so as to improve efficiency. Furthermore, the workstation is considered ergonomic with which the operator can complete the sorting without walking, improving the comfort during work.



Outbound: loader connected to conveyors to further improve operational efficiency

The system sends HAIPICK robots to transport loaded totes to outbound workstations. The unloader unloads multiple totes at one time and puts them onto the conveyor successively. Unloaders would then dock the robots with empty totes, and totes would flow into workstations for picking. With picking workstations of circular conveyors, the work efficiency of a single robot has been improved by 30%.

Efficient and accurate order picking system is a cure for e-commerce order problems

HAIQ is an intelligent warehousing management system HAI ROBOTICS developed to be part of ACR systems. Using smart algorithms, HAIQ reasonably schedules and manages various equipment, intelligently picks, transports, and stores goods so as to complete multi-threaded processing in e-commerce warehouses. For large-scale orders, clients can pre-arrange storage positions and plan robots' path one day in advance so both to-B and to-C orders picking could be done efficiently and intelligently. The use of HAIQ system would improve the picking efficiency by 3-4 times compared with manual picking, while the pick accuracy reaching 99.99%.

With ACR, Winit finds operation of UK warehouse more cost-efficient

Winit, a cross-border e-commerce service provider, owns a warehouse in Tamworth, UK, which is mainly used to store, transport and pick goods. Faced with the shortage of warehouse staff and the urgency to improve efficiency during shopping seasons in Europe, Winit cooperates with HAI ROBOTICS to automate its warehousing. After the introduction of ACR systems, the space utility rate boosted and capacity expanded. With the docking of the robots with conveyors, goods could be processed from inbound to outbound off the ground completely with less manual handling. The total efficiency has been improved by 3-4 times.

3-4 times	Efficiency

	Lower labor cost

Footwear and Apparel

Warehousing and delivery in the footwear and apparel industry is a formidable supply chain challenge, as the industry is featured by numerous SKUs. Traditional sorting falls short in the efficiency of warehouse operations and the accuracy of delivery. The rise of the return rate has also brought mounting pressure to handle reverse logistics, causing backlog and increase in cost. HAI ROBOTICS' Goods-to-Person Solution has the flexibility to address the pain points of different business models in the footwear and apparel industry, achieving efficiency and intelligence while being cost-effective.

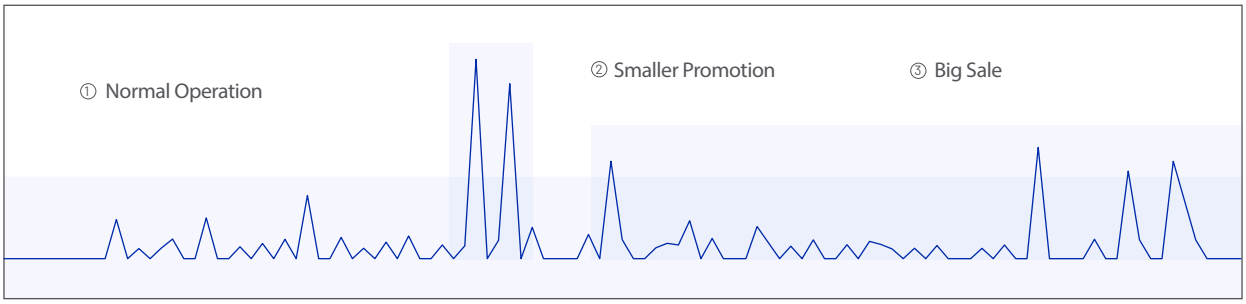
ACR: a cure for reverse logistics

The booming of e-commerce brings mounting pressure to deal with reverse logistics as returns rise sharply. According to 2019 McKinsey Returns Management Survey, the return rate of apparel category on global e-commerce channels was 25%, compared to 20% overall. Warehouses hence have to invest extra manpower and space to verify, quality test, repackage, sort and relist returned goods. The whole process normally needs to be done within two days as the industry is seasonal.

The ACR systems can create shared inventory data of returns from multichannel to meet the need for flexibility. They handle returns from different channels differently. For those from the B2B business, the solution separate the returned goods and get them relisted. For those from the B2C business, it adopts mixed cases to achieve quick relisting, significantly speeding up the circulation of goods.

Flexibility to cope with peak seasons

The surge of e-commerce has brought big opportunities for the footwear and apparel industry whilst consumer demand is unpredictable. Output of production for brands is often volatile during peak seasons, causing challenges to manage massive SKUs intelligently. HAI ROBOTICS' flexible solutions can easily scale up or down to accommodate needs stemming from different stages of production. HAIPICK robots can work 24/7 incessantly and can also be switched and shared.



1. Normal Operation: 10 work-hours a day to meet warehousing demand for 94% of annual output

Mixed cases containing incoming, replenished and returned goods	+	Inbounds	⇒	The picking efficiency per workstation reaches 200 cases/h
Tote: Goods-to-person + Picking by orders	+	Picking and sorting by orders with picking workstations handling batch orders	⇒	The picking efficiency per workstation reaches 600-800 items per hour

2. Smaller Promotion solution: Capacity expands by 3 times to accommodate 99.5% of annual output, or that of 364 days

Smaller promotion	⇒	10-hour workday schedule	Prolonged working hours →	22-hour workday schedule	⇒ The solution expands the capacity by 3 times compared to normal operation, and covers 99.5% of annual output.
		B2C: 2 hours per wave	Increase wave loads →	B2C: 4 hours per wave	
		Robots' automatic charging	Automatically/manually replace batteries →	5 minutes per robot	

3. Big Sale solution: Capacity expands by 10-20 times compared to normal operation, to covers 100% of annual output, or that of 365 days

Big sales	⇒	Picking to orders	Undifferentiated workstations →	Primary picking by SKUs + Secondary Sorting	⇒ The solution expands the capacity by 10-20 times from normal operation, and covers 100% of annual output.
		Work completed on a single workday	Peak-shaving load control →	Last wave to be completed on the next workday	
		Original configuration	Provisional leasing →	Provisional workstations + Robots	
		B2C business outbound equipment	Equipment sharing →	B2B and outbound equipment	

This highly flexible model can meet the multi-dimensional needs of customers. It can not only quickly replenish and deliver new products during the launch of new products, but also accommodate surging online orders, and at the same time, can handle returns properly. The rational allocation of products in different periods would facilitate sound operating efficiency and reasonable investment.

Bosideng introduces ACR to address peak season challenge

Bosideng, whose main business is down jackets, faces the challenge of a huge efficiency and storage density gap between the off and peak seasons. HAI ROBOTICS' Goods-to-Person solutions, based on HAIPICK + HAIPORT + HAIQ, has boosted picking accuracy to 99.99% and lifted the outbound efficiency by 150%, compared to other rack-moving robot solutions, to address massive number of time- sensitive orders. It took only 3 months for the project from initial intention negotiation to launch. HAI ROBOTICS' solution has been highly recognized in the footwear and apparel industry, bringing in high penetration and repurchase rate.

150%	Rise of outbound efficiency	**99.99%**	Picking accuracy

"Bosideng will continue to work with HAI ROBOTICS to lower cost and increase efficiency in warehouses"
Dai Jianguo, Assistant to Executive President of Bosideng, mentioned that Bosideng chose HAI ROBOTICS for its products, project delivery and service. The cooperation propelled Bosideng's upgrading of intelligent warehousing. We will aim for deeper cooperation to achieve better cost-efficiency.

Retail

An integral part of the retail industry, warehousing directly affects the quality and efficiency of the whole supply chain. Numerous online and offline business scenarios in retail and mix of different scenarios result in complex warehousing orders, causing operational difficulties. The major ones include insufficient storage density and high cost; manual picking, which is low efficiency and unbalanced, can hardly manage the rise in piece pickings and volatility in order volume; and higher demand for information systems.

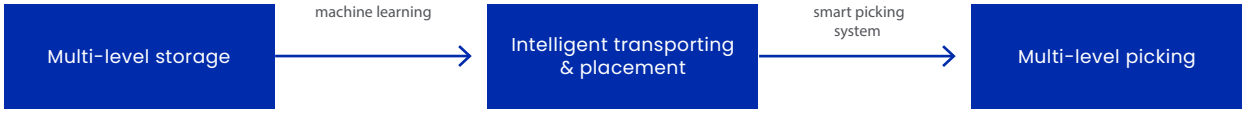
Quick response and turnover

As e-commerce booms, retailers need more space to store inventory and fulfill orders efficiently. Retail commodities generally have a short life cycle, so it is necessary to shorten the retention time of commodities in warehouses to achieve rapid response and turnover. The ACR solution tailored for retail warehousing brings dense multi-level storage to fit for different scenarios. The system separates orders into appropriate storage levels for picking. Additionally, ACR is able to devise corresponding picking modes for different production capacities. Its primary picking by SKUs and secondary sorting has elevated the picking efficiency to 1200 pieces per hour, which is 3 times faster than that of manual picking.

Technology empowers smart tally and replenishment

Time-sensitivity of e-commerce requires faster order fulfillment. However, to-C business comes together with numerous SKUs and order waves. In addition, hardly predictable demand of consumers results in frequent time-consuming piece pickings as well as intensive and inefficient manual replenishment, a great impact on delivery.

'Totes-to-person' strategy of the ACR systems optimizes the picking process during the entire operation, and it supports swift switchover of picking modes, with which the whole-case and piece picking modes are compatible. In whole-case outbound, a robot can handle 50 cases per hour and the picking accuracy reaches 99.99% above, minimizing the time needed for order completion to provide customers with a satisfying experience.



A supermarket giant leverages ACR systems to address pain points and empower its new retail supply chain

In 2021, the client made efforts to explore new retail models, resulting in growing store numbers and SKUs, bringing warehouse capacity to its bottleneck. As rent and labor costs keep rising, they need automation systems to be more cost-efficient, so ACRs were deployed in one of their warehouses in southwest China. Later, the client saw picking efficiency surge and storage density increased by 2/3. The ACRs filled a big labor gap and built a smart system to involve all existing staff, improving retail supply chain efficiency.

Electronics

Previously, the 3C warehousing had to live with difficulties in manual picking, including, for example, low efficiency in item review and materials information not connected, etc. ACR systems help the entire warehousing process to be automated and informatized, reducing redundancy and repetition to improve storage space and fasten materials turnover.

Raw material: data management saves manual review time

Saving time and improving picking accuracy are the two major concerns for raw material warehouses, when items vary in sizes and come in large numbers. The ACR systems can handle different sizes of material carriers in transporting and picking of 3C raw materials. At inbound, the ACRs import raw material information, like batch numbers, so all materials are traceable during the whole warehousing process. The ACRs significantly reduce picking errors that often happen in manual picking, so manual review is no longer needed, to improve efficiency and accuracy.

Semi-finished products: whole-process automation, including outbound, WIP, and inbound

Challenges in semi-finished products warehouses include locating and handling vast numbers of small items. Efficiency is low in manual picking. HAI ROBOTICS customizes a solution comprising robots, material racks and flow racks. Robots would transfer items to material trucks directly, and to buffer racks after completion of orders. Materials are traceable since the AGV connects material trucks to the production lines and HAIQ system is applied to carry out refined management of materials, to achieve 3-4 times efficiency rise compared to manual picking, and 80%-130% climb in storage density.

HAIPICK

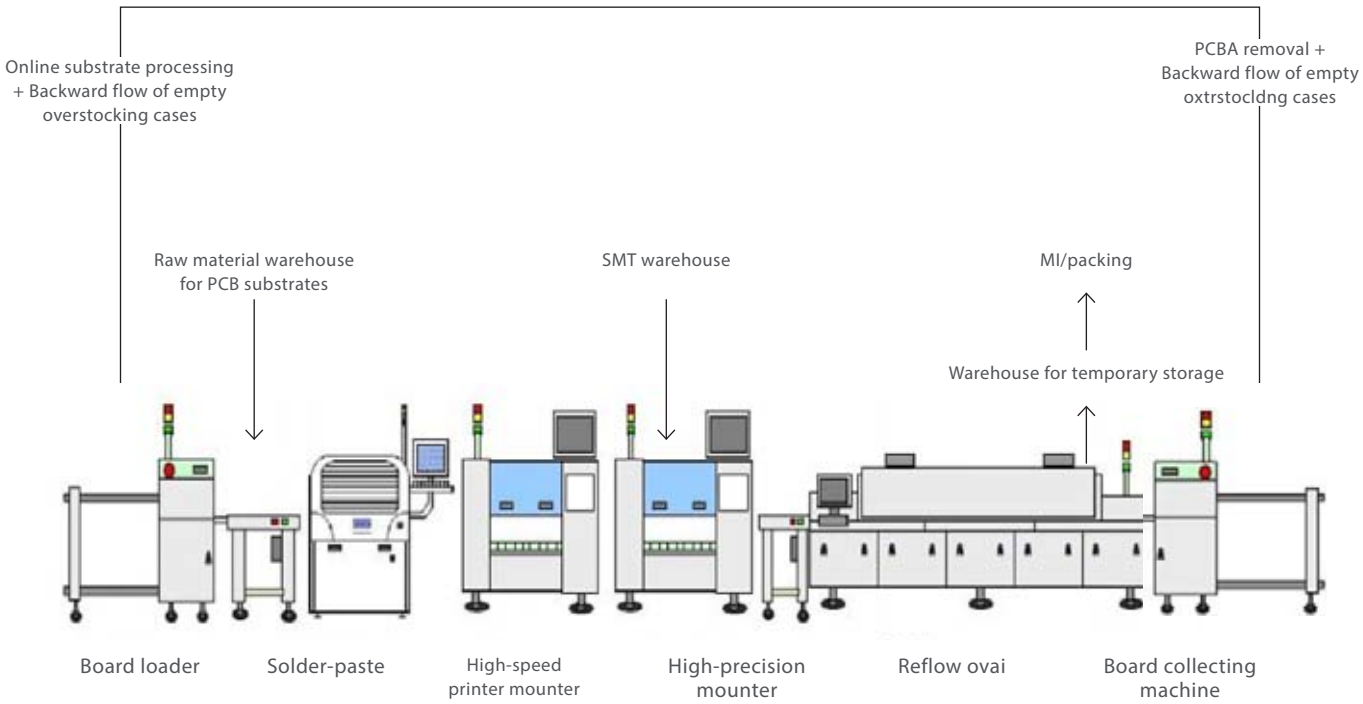
Material rack

Flow rack

WIP in SMT: empowering material flow with flexibility to improve WIP racks efficiency

The application of automation in SMT WIP carts is still at the stage of conventional belt-line AGV/AMR application, mainly conveying materials in the form of electrostatic frame by belt-line AGV. However, in the SMT WIP racks, puzzlements that the docking height of loader and uploader is varied, the efficiency is low, and the storage of the electrostatic frame is difficult are still convoluted.

The ACR solution optimizes the process: the height at which ACR robots dock with loader and uploader can be adjusted freely in the range of 350~1600mm, 3-4 electrostatic frames could be transported in one movement with robots, electrostatic frames could be stored vertically on shelves up to a height of 5 meters. In conclusion, the ACR solution has relieved the pressure of WIP racks and fasten their turnover. The highly flexible ACR solution can be compatible with a variety of SMT machine types simultaneously and its one-way carrying capacity is 3 times that of conventional AGVs, enhancing the overall efficiency by approximately 2 times. Apart from the solution of SMT, HAI ROBOTICS has also introduced solutions for electrostatic frame transport and storage.



Philips Zhuhai introduces the ACR systems to automate warehousing and relieve labor shortage

Philips Zhuhai makes and sells small household appliances. Due to the rapid growth of its business, it planned in 2020 to invest in automated systems in logistics procedures, including warehouse logistics, raw materials supply lines, and finished product outbound, to replace the traditional manual mode, in a bid to improve efficiency and lower cost.

Philips chose to partner with HAI ROBOTICS in warehouse automation. To address the issues of low storage density, labor-intensive jobs for workers and high error rates, HAI ROBOTICS customized an integrated inbound and outbound ACR solution. With ACR, a worker's productivity is reportedly equivalent to that of 2-3 workers, enhancing efficiency while alleviating challenge in recruiting.

Healthcare

Speed and accuracy are the core requirements of warehousing in the pharmaceutical industry. Traditionally, pharma warehousing had to cope with challenges like numerous SKUs, complexity in item batches and errors in manual picking. Furthermore, the unique nature of drugs also requires a variety of storage environments. HAI ROBOTICS has implemented a number of warehousing projects to handle medicines and medical devices, and has completed automated renovation for hospitals and smart pharmacies. As the whole industry is getting smarter, ACR will help more warehouses in the industry to boost efficiency and lower costs.

ACRs make picking in pharma warehousing easier

Efficient storage management is a primary measure to support high-quality health care services. HAI ROBOTICS puts forward the ACR "Goods-to-person" Picking Solution especially for pharmaceutical companies. The solution is able to intelligently allocate storage locations and store medicines by zones, maximizing utility rate of storage space. On top of that, the ACR solution can customize plans for varied warehousing environments to comply with the quality control regulations. It can also support the procedure of piece picking from full cases, and delivery for batch containing to-B and to-C goods, improving the workforce efficiency by 3-4 times.

To deliver the right drugs to patients with the least delays

For some pharmacies or hospitals, they face challenges with enormous kinds of drugs and intricate information systems. Thus warehouse staff must have enough medical knowledge, leading to increased training spending. Also, manual picking, which is not traceable, is more prone to picking errors, that may impact on the patients' health. With the HAIQ System, an exclusive batch code would be generated by which clients can precisely monitor drugs' batch and period of validity, making the whole process traceable. Smart picking could therefore be realized with 99.99% accuracy rate.

Zhongzhi Pharmaceutical builds China's first ACR-powerd smart pharma warehouse

HAI ROBOTICS, together with the leading domestic pharmaceutical brand Zhongzhi Chain Drugstore, and Jointown, implemented China's first ACR-powered pharma warehouse automation project, relieving Zhongzhi's labor pressure in warehouses, increasing storage density, picking efficiency and accuracy. Patients, henceforth, would receive their medicines from Zhongzhi 10 minutes earlier. At present, Zhongzhi has realized the shared management of B2B and B2C business inventory with gradual improvements in medicine circulation and capital turnover.

10 minutes	Faster order fulfillment

80%	Storage density increased

Zhongzhi gives feedback that its storage density has been lifted by 80% from previous manual storage. The robots function well even in shady and cool warehouses. The new robotic systems brings precise navigation, identification and picking, substantially enhancing Zhongzhi's efficiency and accuracy rate.

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