Growth in e-commerce boosts application of intelligence-driven robots

AI機械人令電子商貿更有智慧

Huan Liu, Board Member of MUJIN, Inc and President of MUJIN China emphasises MUJIN's mission to optimise the technology to solve practical problems, promote automation technology, achieve intelligent operation, and eventually help customers create value.

MUJIN株式會社董事、牧今科技(廣州)有限責任公司總經理劉歡強調，研發團隊致力於優化機械人技術，以解決實際問題、推廣自動化科技達至人工智慧營運，並最終為客戶創造價值。

The applications of the next generation of industrial robots will go beyond the factory floor, to work environments that are unfavourable to humans. Ranked fifth in LinkedIn's Top Start-ups of Japan, MUJIN aims not to replace humans with intelligent robots, but to free humans from dirty, dull and dangerous work.

Award-winning innovation

MUJIN is founded in 2011, Tokyo, with advisors including world-renowned roboticists such as Prof. Kanade, Prof. Inaba and Prof. Kuffner. The company has developed the world's first all-purpose intelligent robot control system, called the "MUJIN Controller".

While conventional robot programming requires a teaching process in which repetitive movements are implanted in a structured environment, the MUJIN-powered controller system is a teach-less technology that produces industrial robots capable of autonomous and intelligent action. To achieve that, MUJIN is building robot controllers and camera systems, and integrating them with existing industrial robot arms. A MUJIN-powered controller system acts as an operating system that can control hardware from any robot manufacturer.

Since its launch, MUJIN Controller has brought many international awards to the company. In 2016, MUJIN won the 7th annual Robot Award conferred by the Minister of Economy—the first start-up to achieve Japan's highest robotics honour. In 2018, MUJIN won the Japan Venture Award and the JSME Medal for New Technology, as recognitions of its innovation; and the 61st "Ten Greatest New Products Award" (Japan Brand Award).

According to Huan Liu, Board Member of MUJIN, Inc, and President of MUJIN China, JD.com (China's leading e-commerce platform) built the world's first fully automated warehouse powered by MUJIN in Shanghai in 2017.

Key features of MUJIN's technology applied in JD.com's fully automated warehouse	
Motion planning	▪ Completely teachless; ▪ 6-face in-the-air barcode scanning during part transfer; ▪ Mixed SKU palletising on packing machine
High productivity	▪ Daily processing of over tens of thousands of products; ▪ Over 10 million products handled so far
Ultrawide SKU coverage	▪ Supporting more than 10,000 different kinds of SKUs, and keep increasing; ▪ New SKUs can be easily registered by customers, on-site, and within minutes
High performance and reliability	▪ Robots can work around the clock; ▪ Continuous week-long production during major sale events ("11.11", "6.18")

Mr Liu notes that MUJIN-powered industrial robots have helped JD.com in various promotional activities including the Double Eleven (11 November) Shopping Festival, which requires handling tens of thousands different objects including the ones that were never seen in the warehouse before, in a high-turnover environment, and to work round the clock.

"Traditional warehouses are labour intensive. Work is done by humans, because machines can only handle one product at a time." In view of the boom of the e-commerce and logistics industry, Mr Liu believes that a fully automated warehouse is needed to adapt to the dynamic online shopping environment. "There are different promotions with prices and packaging that change very often. As change is constant and product turnover is rapid, it's rather inefficient to have to teach new things to humans every day, let alone robots."

He explains, "conventional robots require a process called teaching, in which engineers have to program a robot control library, providing detailed step-by-step robot poses and timing. It's about control and execution. It's like holding the hands of the robot and telling it how to move. We call this teach and playback."

The MUJIN-powered controller system is a complete teach-less robot system that uses real-time motion planning, involving projections by computation, "which is about simulating the type of motion that a robot can do and considering many millions of possible future moves," Mr Liu says. "It involves computational AI technology. For instance, if 'picking an object' is the input, controllers equipped with fast microchips can evaluate tens of thousands of possible moves considering its surrounding

environment and task constraints and automatically generate the required motion for the robots."

MUJIN-powered intelligent robots vs conventional industrial robots	
	Conventional robot requires teaching, in which engineers have to program a robot control library, providing detailed step-by-step robot poses and timing. This task accounts for over 80% of the time and cost spent on robot installation.
	With MUJIN's intelligent robot controller, robots can independently calculate the optimal trajectory from the start point to the final destination.

High reliability, intelligence-driven

"The essential part is not how cool the technology is," Mr Liu emphasises. "rather, it's how it solves customers' hiccups and achieves high reliability. To achieve this, it is very important to allow the robots to understand the environment and interact with it. For example, to move a cup of water from point A to point B, the robot has to know how and where to move it. When the robot is moving, we have to ensure its path is clear of obstacles, and that it won't move the cup too much and spill the water. Everything—including the perception, the control and the planning—is intelligence-driven."

He continues, with this in mind, a high precision and intelligent vision system with a sensitive autonomous placement function has been developed, to handle ultra-wide ranges of products and ensure that customers' products won't be damaged when the robots handle them." In addition, dynamic handling of various load conditions to achieve the optimal robot motion that satisfies the task constraints is equally important.

According to Mr Liu, the MUJIN team focuses on optimising the technology to solve practical problems, promote automation technology, achieve intelligent operation, and eventually help customers create value. "Reliability is key, and this requires a lot of information from engineering, mechanical and other divisions. The challenge is to not overlook any operational details, so as to ensure that no accidents will happen at the warehouses."

Huge potential for applications

When asked what can be expected from MUJIN in terms of technology development, Mr Liu stresses that the company focuses on expanding its applications horizontally. "MUJIN has automation solutions for all places where robots can be used. We are trying to expand our application portfolio to, for example, truck loading and unloading," he says. "Take warehouses as an example. Currently, only around 10% of the operations are automated by robots, which means there is a huge potential for these applications."

He adds, "the application is not only applied to labour-intensive industries. Our technology can help improve cost efficiency in environments which are undesirable for humans to work in, such as places which are dangerous, requiring lots of security checks (such as banks), or in places with no windows or sunlight. Although some countries and regions like Mainland China still offer relatively cheap labour costs, the cost is increasing, while at the same time managing people is getting more difficult."

Incubated in Japan in 2011, MUJIN is now at the centre of the industrial robots industry, producing and deploying half of the world's industrial robots. The company opened its first overseas office in Guangzhou in 2019, and is working with Hong Kong partners such as BPS Global to leverage local and international business opportunities brought about by Hong Kong's unique position as a global logistics hub. "Companies in Hong Kong are usually international, serving not only the local market but also the Asian and international markets," says Mr Liu.

Mr Liu will be attending the Asian Logistics and Maritime Conference (ALMC) organised by the Hong Kong Trade Development Council from 19–20 November. This will be the first time he attends the conference. "I'm expecting to meet business people from around the world," he says, "to explain to them our robot-enhanced smart logistics solution. In addition, we're impressed by the talent pool from top-notch AI and robotics research institutions in Hong Kong, and we're keen to recruit them for exploring the business opportunities together."

在可見的未來，新一代的智慧機械人將跳出工業應用的範疇，代替人類工作於厭惡性的環境。獲LinkedIn選為日本最佳初創企業(Top Start-ups)第五名的MUJIN，其願景是要讓人類離開環境惡劣、沉悶及危險的工種，而非以智慧機械人取締人類的工作。

創新技術　獲獎無數

MUJIN於2011年在東京創立，成立之初也受到了來自學術界的知名學者，如Kanade教授、Inaba教授和Kuffner教授的指導幫助。該公司開發了目前全球唯一的智慧機械人相容控制器「MUJIN Controller」。

對比傳統機械人需要在有系統的環境下學習及記錄重覆動作，MUJIN智慧機械人相容控制器是由一組機械人控制器及攝錄鏡頭組成，讓機械人自我學習，並可相容不同品牌的工業機械臂。

面世至今，MUJIN Controller已為公司帶來多個國際性獎項，包括

於2016年獲日本經濟產業省頒發第7屆「年度機械人獎」，而該公司更是日本首家初創獲頒此殊榮。在2018年先後獲頒「日本創業獎」(Japan Venture Award)、JSME新科技獎(the JSME Medal for New Technology)，以表揚該公司在創新技術的貢獻；另外，MUJIN亦入選第61屆「十大新製品獎」(日本品牌)。

身兼MUJIN株式會社董事及牧今科技(廣州)有限責任公司總經理的劉歡提到，MUJIN於2017年更為內地龍頭電商之一的京東商城，在上海建構全球首個全自動化貨倉。

京東商城全自動化貨倉所使用的MUJIN技術的特點	
動作規劃	▪ 完全無需人工示教； ▪ 在抓取時，可實現空中6面掃碼； ▪ 打包機進料口混合碼垛
貨品處理量	▪ 日均處理數萬件貨品； ▪ 累計處理超過千萬件次貨品
貨品支援種類	▪ 海量SKU-累計支援數萬種不同的貨種，且在不斷增加； ▪ 快速註冊 - 於幾分鐘內識別和揀選新產品
高性能及可靠度	▪ 連續多日不停機工作 ▪ 電商大促銷期間(雙十一、6.18等)能不停運轉

劉歡續指，京東商城已於不同的推廣活動應用MUJIN智慧機械人控制系統。他以「雙十一購物節」為例解釋，該一年一度的全國性推廣活動，需要MUJIN機械從容應對成千上萬種不同的商品(有些甚至之前都未曾入庫)，在高周轉率的情況下，長時間不停工作。

「傳統的貨倉的所有工作都由人工處理，因為機器在通常同一時間只能處理一項工作。然而，網購則是以不同推廣活動及優惠來吸引買家。因此，價錢及貨品包裝組合等每日都在改動。不論是教導工人，甚或是機械人，都屬於低效率的營運。」有見電子商貿及物流業高速發展，他認為，要配合網上購物的高流動模式，貨倉必須轉型為全自動化運作。

「傳統機械人需要「教授」的過程。工程師在編程式時，需要建立一個機械人操作的資料庫，訂出詳盡的動作及時間的步驟。那就如手把手地教導它怎樣移動，我們稱之為示教及重放。」

MUJIN的控制系統具備實時運動規劃的功能，完全無需示教，是對大量演算的現實映射：「這就類似在無數的可能動作下，透過人工智慧運算科技，模擬出機械人面對實時情況的動作。舉例說，在輸入「拿起物件」的指令後，配備晶片的控制器就會兼顧其周遭環境和任務的限制條件，運算出以萬計的動作可能性，然後自動為機械人選定所需要的動作。」

MUJIN智慧機械人 vs 傳統工業機械人	
	傳統機械人需要『教授』的過程。工程師在編程式時，需要訂出詳盡的動作及時間的步驟，藉以控制該機械人，而這項工作佔安裝機械人所需的時間及成本的八成以上。
	MUJIN的智慧機械人可以自動運算起點至終點的最佳動作軌跡。

人工智慧帶來高可靠度

劉歡強調，在開發該項科技時，重點不是科技如何令人讚嘆不已，而是如何替客戶解決問題，並達至高精準的可靠度。「要達到這目的，讓機械人得以瞭解實際環境，以及其互動性的重要。舉例說，假如要把一杯水由A點移至B點，機械人需要知道如何移動及移動的路徑。當機械人移動時，我們需要確保其路徑並無障礙物，移動時，步履不會太大而令水濺出。整個過程，包括感知、控制及規劃等，都是由人工智慧驅動的。」

他續指：「因此，我們需要開發一個高精準度的智慧視像系統，並兼具高靈敏度的自主配置功能，以應付不同類型的貨品，並確保機械人處理時不會構成破損。」此外，在工作環境條件的限制下，能靈活處理不同的卸貨條件，以達至最佳的移動軌跡亦同樣重要。

劉歡強調，該公司的研發團隊致力於優化該項技術，以解決實際問題、推廣自動化科技達至人工智慧營運，並最終為客戶創造價值。「高可靠度是關鍵，這涉及來自工程、機械以及其他不同部門的資訊。當中最大的挑戰是不能忽略任何的營運細節，以確保貨倉內零意外發生。」

龐大的應用商機

問到MUJIN技術的未來發展方向時，劉歡表示，該公司積極研究技術應用的橫向發展。「我們的解決方案是可應用在任何機械人上，而我們正研究應用在貨車起貨及卸貨上。」他又以貨倉為例指：「目前只有約10%貨倉應用到智慧機械人，反映其龐大的應用潛力尚待發掘。」

他補充說：「智慧機械人亦不只限應用於勞工密集的行業，但凡不適合人類工作的環境，例如危險、需要許多安全審查(如銀行)，又或是沒有窗或光線的地方，都可以透過智慧機械人的應用，以提高成本效益。此外，雖然個別國家及地區如中國內地仍然能提供相對低廉的勞工，但實際上該成本已在上漲，而且人事管理亦愈來愈困難。」

MUJIN是於2011年在日本孵化的初創，至今已成為國際上工業機械人的領航者，以致全球半數的工業機械人都在應用其人工智慧操控系統。該公司於2019年在廣州成立首個海外辦事處，並與香港夥伴包括BPS Global等攜手開拓本地及國際商機。劉歡形容：「香港不但是國際物流中心，其企業亦比較國際化，不只服務本地市場，亦兼顧亞洲及國際市場。」

他將於11月19及20日首次參與由香港貿易發展局舉辦的「亞洲物流及航運會議」(ALMC)。「我希望可與來自全球的業者交流，向他們解釋我們的智慧機械人控制系統。此外，香港擁有多間頂尖的AI及機械人研究學院，匯聚不少人才，我們都希望向他們招手，共同研發，開拓商機。」

Meet Huan at:
InnoTalks

Date: 20 November
Time: 11:30am-12:40pm
Venue: Main Forum

與劉歡會面：
創新對話

日期：11月20日
時間：11:30am-12:40pm
地點：主論壇