Researchers design a new efficient automated garage system

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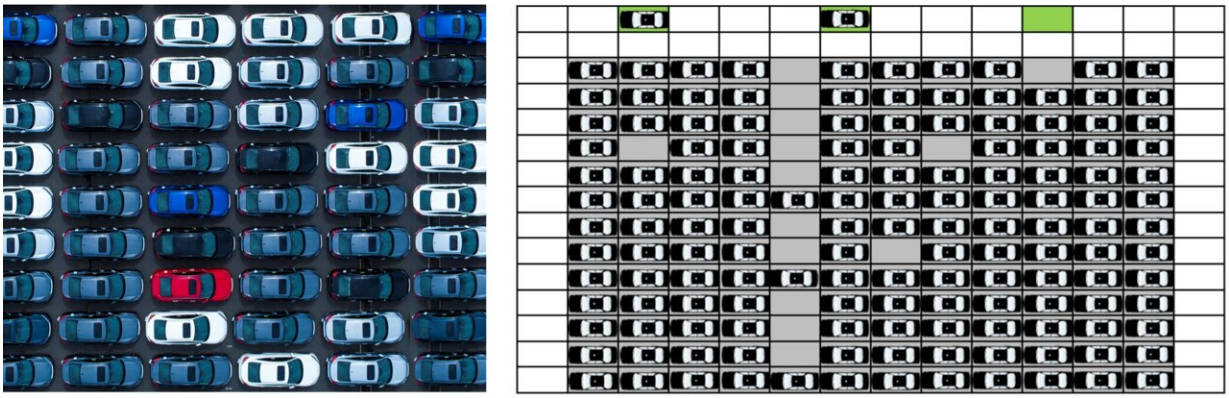

Left: Illustration of the density level of the envisioned automated garage system. Right: The grid-based abstraction with three I/O ports for vehicle dropoff and retrieval. Credit: Guo and Yu

Advances in the field of robotics and computer science have led to the creation of various automated systems aimed at simplifying everyday tasks. In urban and largely populated areas, these systems could also help to increase efficiency, reduce congestion and improve organization.

Teng Guo and Jingjin Yu, two researchers at Rutgers University, have recently designed an automated system that could increase the capacity of garages in urban areas, helping urban developers to meet rising parking demands. This system, introduced in a paper pre-published on

arXiv and set to be presented at ICRA 2023, relies on multiple robots and different algorithms for handling garage operations, such as parking and retrieving vehicles.

"I was attending a concert in New York City and had to park my car at one of these garages, where the attendant took the key and arranged the vehicles," Jingjin Yu, one of the researchers who carried out the study, told Tech Xplore. "The process is time-consuming, requires human access to my car, and is prone to potential damage. As our lab has been developing multi-robot coordination algorithms for some time, I thought we could design a compact and efficient garage that eliminates these problems. I discussed the thoughts with Teng, who then put the system together."

The key objective of the recent study by Guo and Yu was to realize a hassle-free automated parking system that is convenient, fast and efficient. Their proposed design draws inspiration from a 20-floor parking garage installed in Chongqing in China, a few years ago, as well as other automated garage systems introduced in the past.

Yu's lab received an NSF CAREER award and an Amazon Research Award for the development of multi-robot coordination algorithms, which partially fund this research. The new automated garage system they designed makes some new additions to the portfolio of such multi-robot coordination algorithms.

Essentially, the system is comprised of a "grid world," with mobile trays placed on rails carrying cars around. Similar designs were previously proposed for moving boxes and goods around inside warehouses.

"These mobile trays would be coordinated using a centralized scheduling algorithm, which is the heart of the system and largely determines the overall system's efficiency," Yu explained. "A unique feature of our

system is that it can automatically 'reshuffle' the cars during working hours to facilitate later retrieval at scheduled times."

The system designed by the researchers could greatly simplify parking processes in highly populated cities. Parking customers would simply need to drop their cars at a given port and expect it at another port later.

Its ability to arrange cars very close to each other would also significantly increase the capacity of garages. In addition, while they are parked the cars would be inaccessible to humans, significantly reducing the risk of theft.

"We show that our simple design is pretty good, and our fast algorithms can efficiently schedule the entire parking/retrieval process," Yu said. "The concept of the system should be realized in one form or another, especially as our vehicles are becoming increasingly autonomous. It is hard for me to imagine that we will have to go rounds and rounds in a garage to park our cars or leave our cars to others to park in the future. So, in the future, garage autonomy will not be a luxury but a necessity. "

So far, Guo and Yu focused on the overall design of their automated design system and on the development of algorithms that would underpin its functioning. They are now working on a working prototype, which would allow them to assess its actual potential in a real-world setting.

"We are now building a prototype system using toy vehicles, to demonstrate our system's capabilities," Yu added. "Once that is done and shows promise, we plan to take the prototype to full size. We would certainly welcome early investor inquiries as well."

More information: Teng Guo et al, Toward Efficient Physical and Algorithmic Design of Automated Garages, *arXiv* (2023). DOI: 10.48550/arxiv.2302.01305