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HOW ROBOTS ARE HELPING TO DEAL WITH POLLUTION AND MAKING THE WORLD CLEANER

Every year, more than 2 billion tons of garbage are produced worldwide. Chilling statistics! On average, one family throws away more than 250 kilograms of waste per year. Of course, garbage is kept not just in one place but is spread across thousands of landfills, including illegal ones. The most massive accumulations of garbage are the Guangzhou and Hong Kong landfills of a hundred hectares each, the Guiyu electronic device landfill in China of 5,200 hectares, and the Great Garbage Patch in the ocean containing 80,000 tons.

The trash in landfills burns, causing lung and eye problems or even cancer in people living in the surrounding area. Waste decomposes and gets into the soil, plants, groundwater, and seas. Fish in the ocean eat plastic that is deposited in their tissues and ends up on our tables. Even if trash is far away, it touches us all.

The problem of garbage is global.
But robots can help us solve it.

Automatic garbage collection machines

The first step in the automation of refuse collection is waste collection machines. They have already been universally introduced and operate in supermarkets, pharmacies, and gas stations in many countries. The machines accept small household and hazardous waste: light bulbs, batteries, varnish, glue, paint, spray cans, glass containers, and cans. The devices give out a reward for the garbage it accepts.

In this way, two problems are solved. The first one is to teach people not to throw garbage anywhere through financial incentives. The second one is to automate waste collection in a certain manner.

We also use "smart" garbage cans with fullness sensors. Information about the degree of filling is transmitted to the garbage service four times a day.

The service's software analyzes the volume of garbage and builds a collection schedule - each time, the route is different, depending on the data.

Garbage collectors save time and money by not picking up half-empty bins, driving around the course unnecessarily, and not getting stuck in traffic jams. In addition, the system can plan a route for the next day by analyzing several days' worth of data.

Implementing the system for public services and private companies has shown that automatic collection is more efficient than manual collection. With the use of sensors and software, businesses can save up to 30% on rubbish collection costs. In rare circumstances, savings of up to 50% are attainable.

Smart garbage trucks

A human operates a robotic garbage truck, but some actions are automated. The driver creates new routes, and the machine records them. It allows the robot to reach the next destination on its own via GPS, with minimal fuel consumption. The garbage truck also reflects the location of trash cans and other obstacles, can move in reverse and bypass parked cars. It is equipped with sensors, and if it notices any moving object on its way, it stops. The only thing a person does is operate the mechanism that loads the waste into the container.

Unique robots have been developed that can float in ports and coastal areas and pick up waste before it reaches the open ocean. One of these, the WasteShark, is a floating plastic box with a mouth and an electric motor. The box "swallows" trash in the water and simultaneously analyzes water quality, measures sea and air temperature, and transmits this data to the operator, who corrects the course.

Similar but more dimensional robots can operate in the sea. They can collect about 500 kg of garbage at a time. Robots are powered by solar panels and move around the ocean using a navigator.

Other kinds of robots float underwater. They look like garbage cans with motors and batteries drifting and catching trash autonomously.

The robots are transported to the trash collection point on the ship; then, they are lowered down and catch plastic bottles, bags, and cardboard, while scaring off fish with sonic emitters.

When the garbage can is complete, the robot returns to the ship, where the collected waste is retrieved, and the batteries are recharged.

GARBAGE SORTING AND RECYCLING

Sorting construction waste

One example of a robotic sorting construction waste is composed of two manipulators, a conveyor belt, bulk containers, and sensors: video cameras of different types and metal detectors. Such a robot is endowed with artificial intelligence based on an adaptive search algorithm. The algorithm uses the principles of the human brain.

They show it garbage samples, indicate what type it corresponds to, and the algorithm learns to find similar ones in the general mass of the waste.

Construction debris is fed onto a conveyor belt, and the sensors and algorithm of the trained robot determine the object's material. The robot grabs an object weighing up to 20 kg with its arm and directs it to the appropriate storage container or conveyor lane for recycling. The robot is 98% accurate.

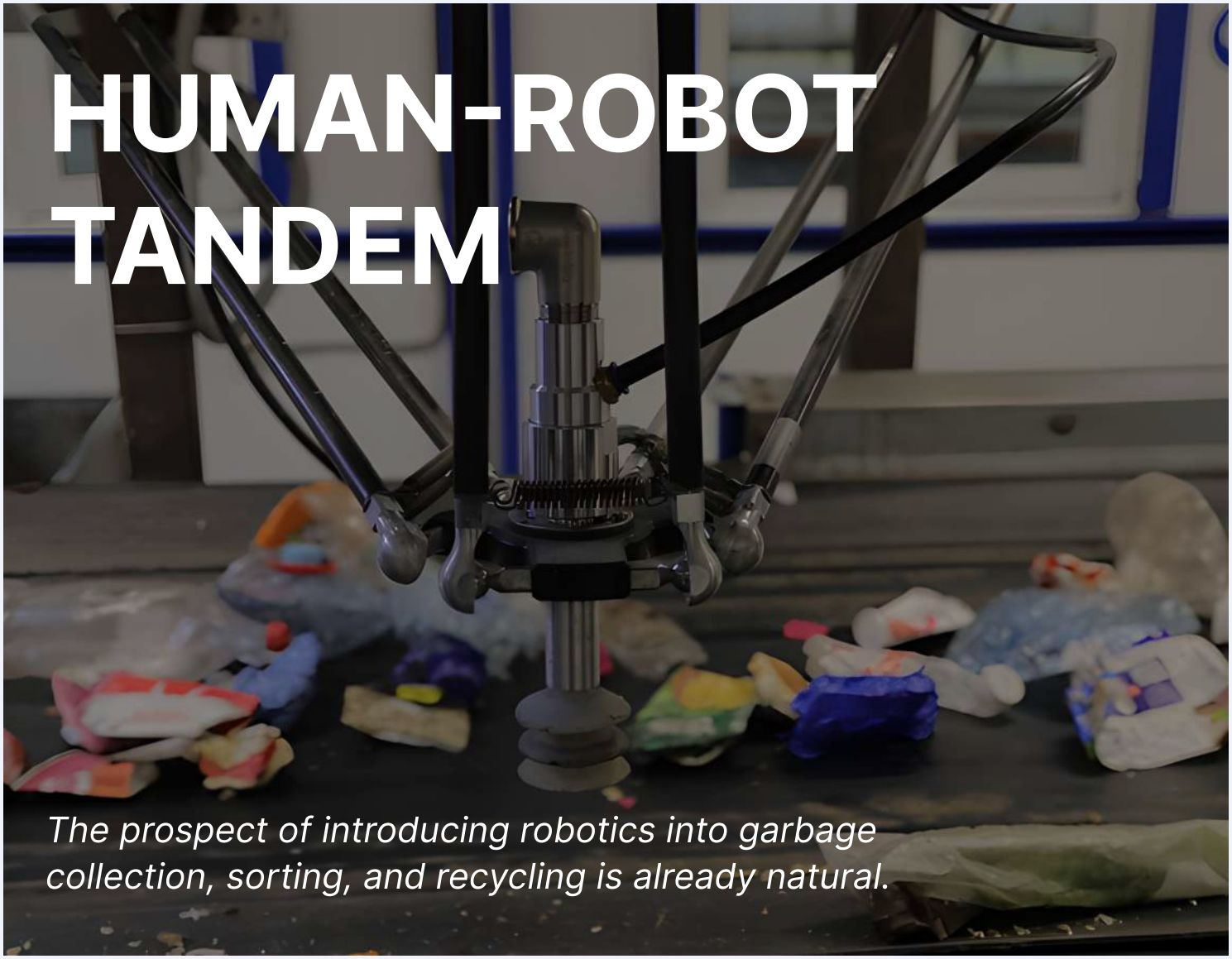
Compared to manual sorting, such one is more efficient, even with errors. The robot software is self-learning and will work more accurately in the future.

Sorting into different species

The further evolution of sorters is on the path of increasing complexity. Outside the construction industry, robots need to become even more complex: sorting into plastic, paper, wood, electronic devices, fabric, food waste, and medicine. Each category requires separation by weight, size, and species, such as cardboard and paper.

A robot with this functionality was developed at the Massachusetts Institute of Technology. This robot is able to identify the type of material using tactile sensors, cameras, and computer vision.

HUMAN-ROBOT TANDEM



The prospect of introducing robotics into garbage collection, sorting, and recycling is already natural.

What does it look like?

"Smart" trash cans

When they are full, the software of a "control center" receives the signal and forms a route. The garbage is picked up by a semi-automated garbage truck, which can park on its own and remembers the way.

Garbage is sorted by robotic conveyors into plastic, glass, cardboard, and food waste at the transfer point and put into separate containers.

Robotizing waste reduces the percentage of trash that goes to landfills and increases the recycling rate. Automation can be profitable: replacing a robot with a dozen people for sorting and several drivers for driving the garbage truck reduces costs and increases efficiency.

Although absolute autonomy is not yet possible, the tandem of robots and humans in the waste facility is realistic.

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