Revolutionizing Waste Management: A Machine Learning and Computer Vision-Enabled Robot Arm for Efficient Garbage Recycling

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It is estimated that by 2050, an alarming 33 billion tons of plastic waste will be on the Earth, overshadowing the Empire State Building by 105,000 times. Since 1960, the recycling rate has increased by less than 7%, while the amount discarded has increased by more than 811%. When materials such as paper, plastic, glass, and metal are not recycled, they end up in landfills, not only occupying space but also contributing to environmental pollution. The United States reported only a 30% recycling rate last year, emphasizing the urgent need for intervention. Current methods to recycle garbage include manual sorting, which is inaccurate, and robotic recycling systems, which are unaffordable. This work aims to address this rapidly increasing problem by designing and developing a cost-efficient robot arm that can recycle and sort garbage with the help of machine learning and computer vision. Using the meta-operating system ROS Noetic and MoveIt!, the robot arm is able to do Real-Time Trajectory planning in order to get to its desired position. The robot uses a custom-trained Yolov7 machine learning model to sort recyclable materials from non-recyclable garbage, providing an accuracy of 98% in sorting garbage. The developed robot arm can be used in various conditions and is more affordable than existing robotic recycling systems. This innovation holds the potential to substantially increase recycling rates, making garbage easy to recycle.