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AI-Powered Smart Recycling: Turning Plastic Trash into Treasure

> In a world grappling with environmental challenges posed by plastic waste, innovative solutions are emerging to address the pressing issue of plastic recycling. Among these solutions, Smart AI-enabled automation and Upcycling stand out as promising technologies that offer the potential to revolutionize the way we handle and repurpose plastics. These technologies harness the power of artificial intelligence (AI) and automation to streamline the recycling process and transform discarded plastic materials into valuable products.

Plastic pollution is a global crisis that has far-reaching consequences for the environment and human health. Each year, millions of tons of plastic waste end up in landfills, oceans, and ecosystems, causing harm to wildlife and marine life while also contributing to greenhouse gas emissions. Traditional

recycling methods have limitations, often requiring manual sorting and processing, which can be time-consuming and costly.

Figure 1: Plastic Recycling Plant

Smart AI-enabled automation is changing the game for plastic recycling by offering more efficient and accurate solutions. AI algorithms, coupled with advanced robotics, can be used to sort and categorize plastic waste with remarkable precision. These systems utilize computer vision to identify different types of plastics, making it easier to separate them for recycling. By automating this process, the recycling industry can significantly increase its efficiency and reduce human error.

Beyond efficient sorting, AI-enabled automation also plays a crucial role in the upcycling of plastic waste. Upcycling is the process of converting discarded materials into products of higher value,

Figure 2: Manual Sorting of Waste

Figure 3: Automated Robotic Sorting of Waste

thereby reducing the need for the production of new plastics. AI can help identify the ideal applications for recycled plastics based on their properties and characteristics. For example, AI can determine which types of recycled plastics are suitable for 3D printing, textiles, or construction materials, opening up new avenues for the creative use of recycled materials. This not only reduces the environmental footprint of plastic recycling but also creates economic opportunities in the production of upcycled products.

In a good collaboration, the University of Melbourne and the University of Moratuwa have joined forces

Figure 4: On Site Data Collection Setup at Plastic Waste Recycling Facility

in a project aimed at developing a smart AI system for sorting Australian plastic waste. A dedicated team of students from the Department of Civil Engineering at the University of Moratuwa is diligently working on annotating various plastic

types in a series of images to create an AI model that can be used for robotic automation in industrial plants. The team is utilizing a free, open-source web-based image annotation tool called the Computer Vision Annotation Tool (CVAT) to label plastic waste. To date, the team has successfully annotated over a hundred thousand objects.

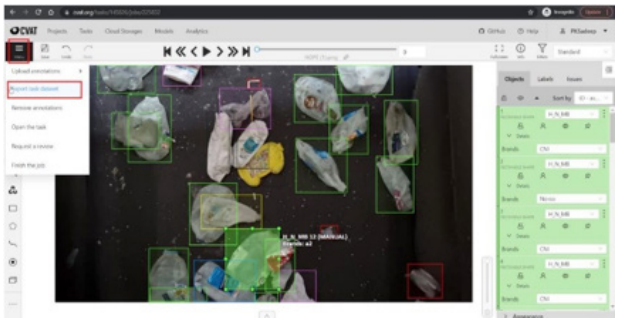

Figure 5: Annotation of Captured Images in CVAT Platform

These annotated images will be utilized to train a CNN (convolutional neural network) based deep learning AI model to identify and sort waste plastic. Efficiency and accuracy of the system being developed is contingent upon the accuracy and size of the AI dataset utilized. In order to achieve this, a large number of images amounting to nearly

Figure 6: A Sample Inferences from the Trained Deep Learning Model

0.1 million were captured at a commercial plastic waste recycling facility. The images contained a total of 4-5 million objects which needed to be annotated with high accuracy and consistency.

The annotated images will be systematically employed to train the AI model in a step-by-step process, where the model's accuracy will be assessed at each phase through validation sampling and real-time performance monitoring in a pilot testing setup which is being built.

Figure 7: Delta Robot Based Pilot Model

The annotated images, in collaboration with the trained deep learning model, will serve as pivotal components in the development of a comprehensive delta robot-based plastic waste recycling system. This system will be designed to be seamlessly integrated into any existing commercial waste recycling facility, offering a versatile and efficient solution for handling plastic waste materials.

The combination of Smart AI-Enabled Automation and Upcycling represents a powerful force in the ongoing battle against plastic pollution. These technologies offer a sustainable and efficient approach to plastic recycling, transforming what was once considered waste into valuable resources. As we continue to embrace innovative solutions, we move one step closer to a cleaner, more sustainable future for our planet.

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