

# **Automated Real-Time Sorting and Storage of Recyclable Materials and Waste**

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More than 60 million plastic bottles are thrown into landfills or incinerated every day, with many more aluminum cans and glass bottles going to waste. According to current estimates, nearly 91% of all plastic goes unrecycled. Not only is this wasteful, but this is also extremely detrimental to our environment. While there are ongoing sustainability efforts throughout the world, there are not enough efforts being made. The advent of single-use plastics has inundated our landfills with plastic that will take centuries of years to decompose, and the problem is exacerbated every day. Until single-use plastics are either banned or no longer produced, we need to find more efficient and environmentally friendly ways to manage our plastic waste. A large part of managing our waste is incentivizing people to properly dispose of their waste, as most recyclable waste goes unrecycled. Another issue is most waste is commingled, making it difficult to separate and properly recycle with like materials. We seek to solve this issue by devising an all-in-one solution, by integrating a sorting solution with convenience and incentives.

Our system is a simple, quick, and easy way to recycle, incentivized by immediately refunding the user's CRV. Upon depositing a valid CRV eligible recyclable, we can use object recognition to validate the recyclable and immediately pay the proper refund amount to the user. By incentivizing the user with an immediate refund, we can encourage them to continue to recycle, especially by offering alternate uses for the refund, such as donations to local charities.

By using object recognition libraries and machine learning, we can also identify the user's recyclable in real-time, making it possible to sort the item upon it being placed in the machine. In addition to sorting, we can also determine how many recyclables are in the unit, how full the unit is, as well as if a certain type of recyclable's bin needs to be emptied. This improves collection efficiency, by eliminating the need to check how full the bin is while reducing collections at times only when necessary. This is especially useful, as some types of recyclables, such as glass, are much less common than the extremely frequent plastic bottle.

This project was initially started as an effort to reduce UCR's Facilities Services workload, by devising an all-in-one system to sort, collect, and store recyclables. Entering its second year of development, we have made great strides in the recognition of waste, with an average accuracy of 95%. Despite this high accuracy rate, it still has room for improvement, as the State of California requires an accuracy rate of 98% to receive CRV funding. We intend to implement this device on UCR's campus, as we have received permission from Facilities to test on campus grounds, especially areas with high traffic. We hope that our system can incentivize recycling, and divert some of the 91% of unrecycled plastic into recycling centers, where it can be reused.