TrashLine

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Problem Description

To this day, only 34.6% of all waste disposed by the United States is recycled and composted, equivalent to about 136 tons of the remaining amount going to landfills and incinerators, according to a recent study by Environmental Protection Agency. The rest of the recyclable waste is lying around in landfills contaminating the environment. If trash is not recycled then the landfills will release harmful chemicals which could cause issues like habitat destruction, or global warming.

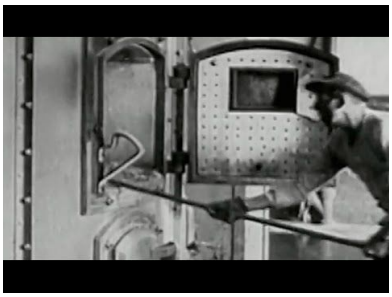
Another issue is that at the current rate landfills are filling too fast thus occupying space which could be used for other purposes. Due to the misplacement of trash companies have to make their product from raw material which actually costs more than using recycled materials. In order to reduce the risk of sanitation hazards posed towards urban society and the environment, waste management companies have resorted to human labor for sorting trash.

Since 2011, Waste Management's earnings from recycling have declined by $200 million. Due to the alterations in both consumer and manufacturing behaviors, the waste industry foreseen economical shortfalls, as there is less recognition for humans for disposing trash properly. In a survey conducted on 222 Dublin High School students, 61.7% admitted that they regularly do not recycle, with 73.4% viewing the sorting of waste at school to be an

inconvenience. Not only is there a shortfall in the knowledge to distinguish waste into the separate categories but there is also the lack of willingness to actually proactively do it. Overall, due to the economic, environmental, and social problems of the local waste management system, there needs to be an alternative to automate the process in order to find treasure in trash.

Research Summary

Throughout the history of humans, waste management has become an essential industry for preserving urban living quality and environmental concerns. To begin with prehistoric civilizations, such as the Mayans and the Aztecs, had fixed monthly gatherings for culminating all waste and burning it. After the progression of primitive civilizations and the establishment of urban population centres, build up of waste in cities had caused the contamination of local waterways and rapid insanitation hazards quickly spread with outbreaks of disease cholera. The emergence of public health and sanitation rules lead to the first waste management facility in Nottingham, England in 1874. Though this greatly cured uban sanitary concerns, the waste facility was known as an incineration plant, where trash was burned, releasing dangerous levels of harmful gases to the atmosphere.



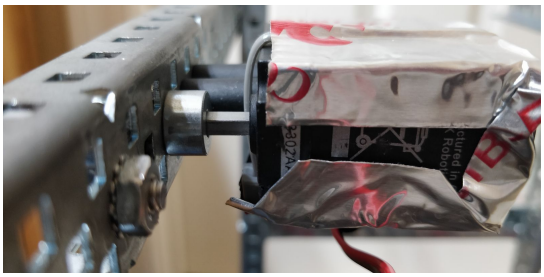
In order to fix this concern with environmental issues, the first recycling plant was opened in 1898 located in New York. The aim was to extract as much recyclable material as possible from garbage in order to reduce the garbage being introduced into the environment, affecting waterways and land. However, the “rubbish sorting plant” operated solely on human labor, and the failure of sanitary precautions lead to risk of serious health and disease problems. In spite of these recycling attempts, the majority of trash was being dumped into waterways and landfills, and potentially useful recyclable material was being wasted and

contaminating the environment in profoundly negative ways. As technology started to transform industries after the Industrial Revolution, businesses saw opportunity in benefiting the environment with the creation of highly sophisticated machines.

The Automatic Waste Segregation Machine created by Beston Machinery based Shangqiu City, China is a massive, powerful, and fully operational waste management system which extracts as much as possible from garbage to improve the means of recycling and reusing waste. By “turning waste into treasure”, the Beston sorting

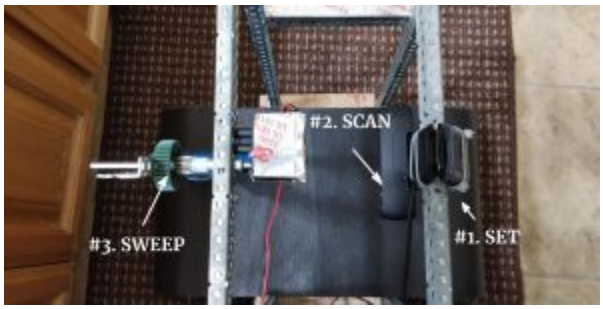
process is designed for the maximum exploitation of materials for the benefit of the environment and the economy. With the implementation of advanced industry methods such as gravity method, volumetric method, cyclone separation method, bouncing separation method and magnetic separation method, this machine is capable of sorting into six unique groups: inorganic matter, organic matter, sand and soil, non-recyclable combustible materials (supplemented by simple manual sorting, such as hard plastic, rubber garbage), iron magnetic objects and batteries, film type plastic and so on. Despite its power and robustness, the commercial Beston machinery is not economically feasible and has only been successfully exported to its neighboring country of Uzbekistan.

Solution Summary

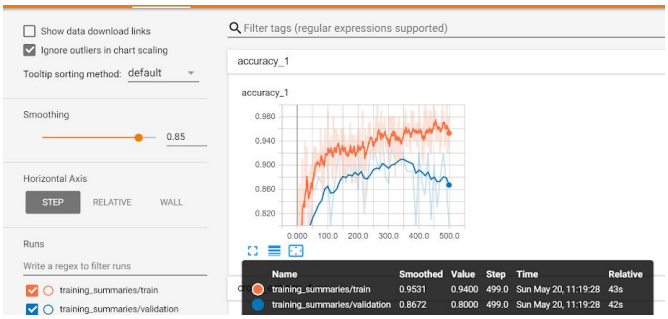


Since the problem originates from people misplacing trash in the incorrect bin, we created the TrashLine classifier which will differentiate between recyclable waste and compost. This way it will separate the trash before it reaches the landfills, thus preventing issues like global warming and chemical pollution. In a study conducted by the Environmental Protection Agency, 63% of landfills contain recyclable waste such as plastic, paper, etc. By classifying the trash properly in the local hierarchical system of waste management, the recyclable and compostable materials could be reused and exploited before reaching the landfills thereby reducing potential pollution and space caused by landfills.

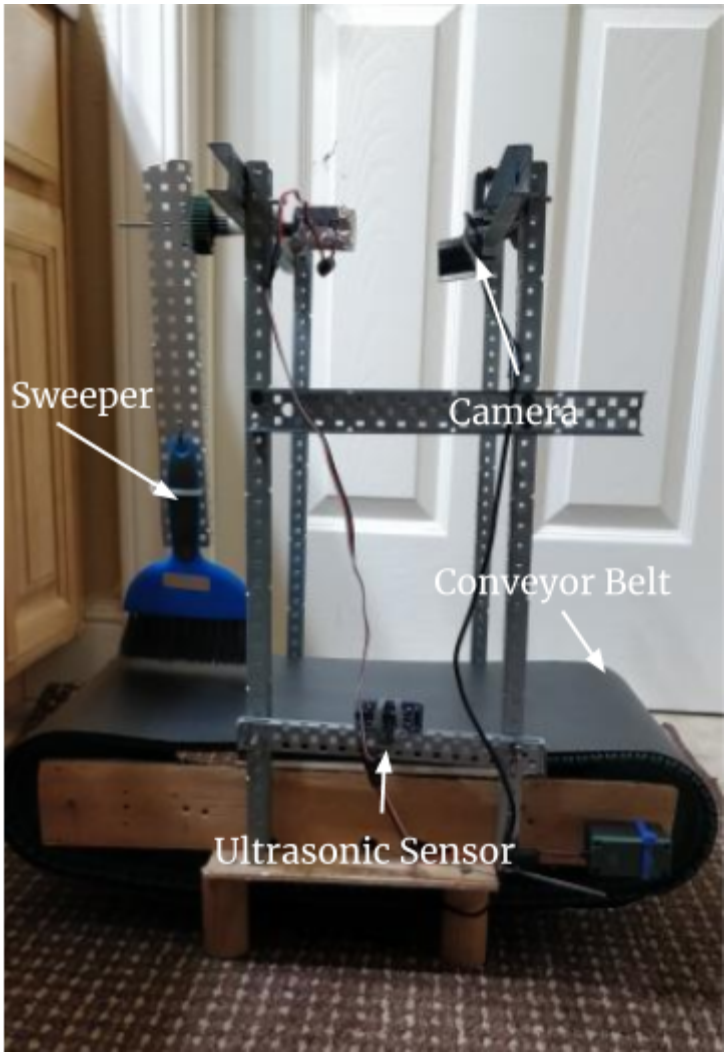
The TrashLine classifier includes three main yet simple steps: set, scan, sweep. After the waste is placed onto the TrashLine, the conveyor belt will move it into the field of the camera's view for a capture. With the utilization of AI from Python's Tensorflow module, a pre-trained model will classify the picture of the waste into two categories: trash and recycling. Subsequently, the conveyor belt moves the trash further, where the waste is sweeped into its corresponding waste basket. The latter is accomplished with a pendulum-like mechanism with a broom attached to the end, powered by a torque geared motor. In order to improve the accuracy and efficiency of the VEX Hardware used, cooling insulation tape was used, as illustrated in the picture above, aiding to TrashLine's overall reliability and effectiveness.



Tensorflow Training and Classification Summary:

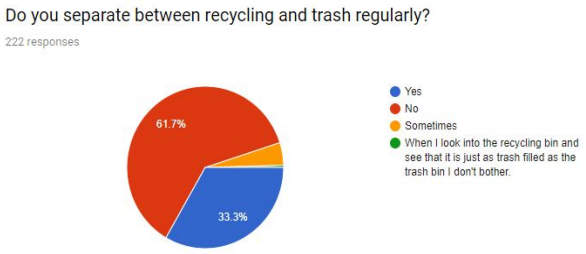


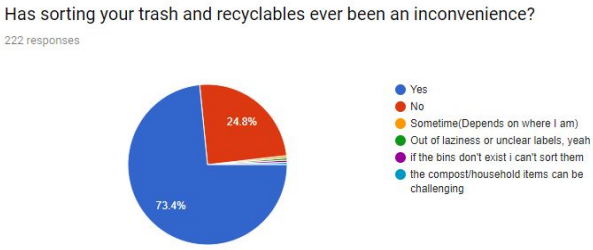
Anatomy of TrashLine:

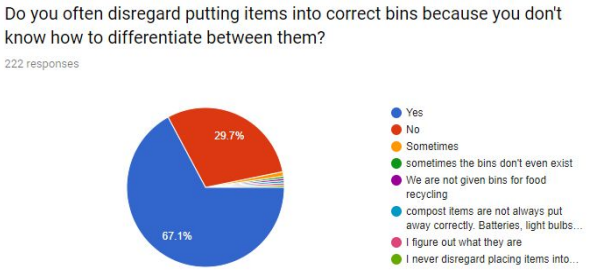


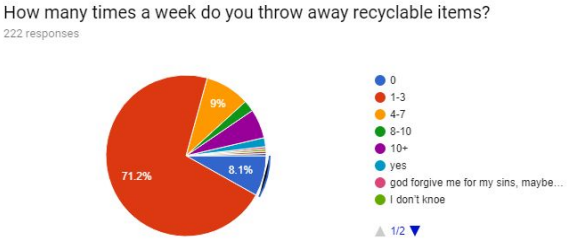
Product Analysis

In order to determine the feasibility and the marketability of this product, a survey conducted on 222 Dublin High School students was released through a multitude of social media platforms. The results reveal the following information:









As indicated by these findings, a method of automation for waste management is imperative, due to the lack of awareness and willingness to sort trash of the sample size of Dublin High School students. The TrashLine classifier algorithm was especially designed to account for these deficits, ultimately providing a convenient, cost-effective, and efficient method of waste sorting.

In today's waste management industry, TrashLine's methods can be utilized to benefit the environment for the maximum exploitation of reusable substances. For the larger scale of industry usage, the conveyor belt and camera classification technology

can be further implemented on a greater scope of waste. As it is economically feasible at just $97, the simple technology could also incorporate more sophisticated classification methods such as light or infrared scanners and laser scanners, leading to a wider array of categories substances could be classified and sorted under. When the supplies are purchased in bulk, the TrashLine could be even cheaper. The parts we used were mainly vex as well due to the fact that we had those at our disposal. Others could use cheaper motors and different parts to lower the cost even further. By remaining economically feasible and marketable to the waste management industry, TrashLine has potential to resolve the environmental concerns of waste, through implementations in public areas such as local schools, cafeterias, and even large scale factories.

The TrashLine also has other possible future uses. Large scale manufacturing companies could use our robot as quality control. But, as of now, our robot and software can only handle sorting trash. The first step to accomplish the quality control bot is by adding an extra camera or two on the sides to give the classifier more pictures to work with. We would also have to train the classifier to recognize what a “healthy” item is. The TrashLine is a start to what could be a branch of unique robots.

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