SORT B4 RECYCLE

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What's wrong with plastic recycling?

In today's world, **less than ten percent of plastic produced is recycled**, resulting in a vast proportion of waste plastic **occupying space in landfills and polluting our water bodies and oceans**. The remainder of the waste plastic gets incinerated, resulting in the **emission of toxic gases** into the atmosphere. The rate of plastic production shows no sign of slowing down and we are yet to develop the capacity to effectively manage all the waste generated from these plastics. Consequently, effective methods to recycle plastic must urgently be sought to minimize the amount of plastic we dispose and better manage our plastic waste before the issue gets out of control.

However, a major challenge facing chemical plastic recycling is the **contamination of plastic waste**, rendering **recyclable plastics un-recyclable**. Therefore, even if there are concerted efforts being made to recycle plastic, a lot of the plastic intended for recycling ends up getting disposed of or incinerated. The **contamination starts at the community level** especially in towns and cities which utilize a single-stream recycling approach where all recyclable material is collected together without being cleaned beforehand.

As such, a solution must be sought to **enable convenient sorting and cleaning of plastics before they reach the communal recycling bins**. An approach at the household scale must be considered to minimize contamination during the transportation and industrial-scale processing of plastic waste, in turn increasing the proportion of plastic which can be recycled.

Supporting the SDGs

- Enhancing plastic recycling reduces cities' and communities' carbon footprint due to plastic production
- Improved plastic recycling develops the circular economy as more plastic can be repurposed, creating sustainable jobs

SUSTAINABLE DEVELOPMENT GOALS

- More plastic recycling reduces amount of waste ending up in landfills or water bodies, reducing land and water pollution
- Increased manufacturing using recycled plastic reduces greenhouse gas emissions by as much as 70%

Our Solution

A compact household plastic waste sorter capitalizing on image processing technologies to distinguish between the various forms of recyclable plastics

Key Features

HOME-BASED

Enables sorting before collection

IMAGE PROCESSING PROGRAM

Trained using a machine learning model which is regularly updated remotely

Data for the machine learning model provided through a newly established research facility

THOROUGH CLEANING

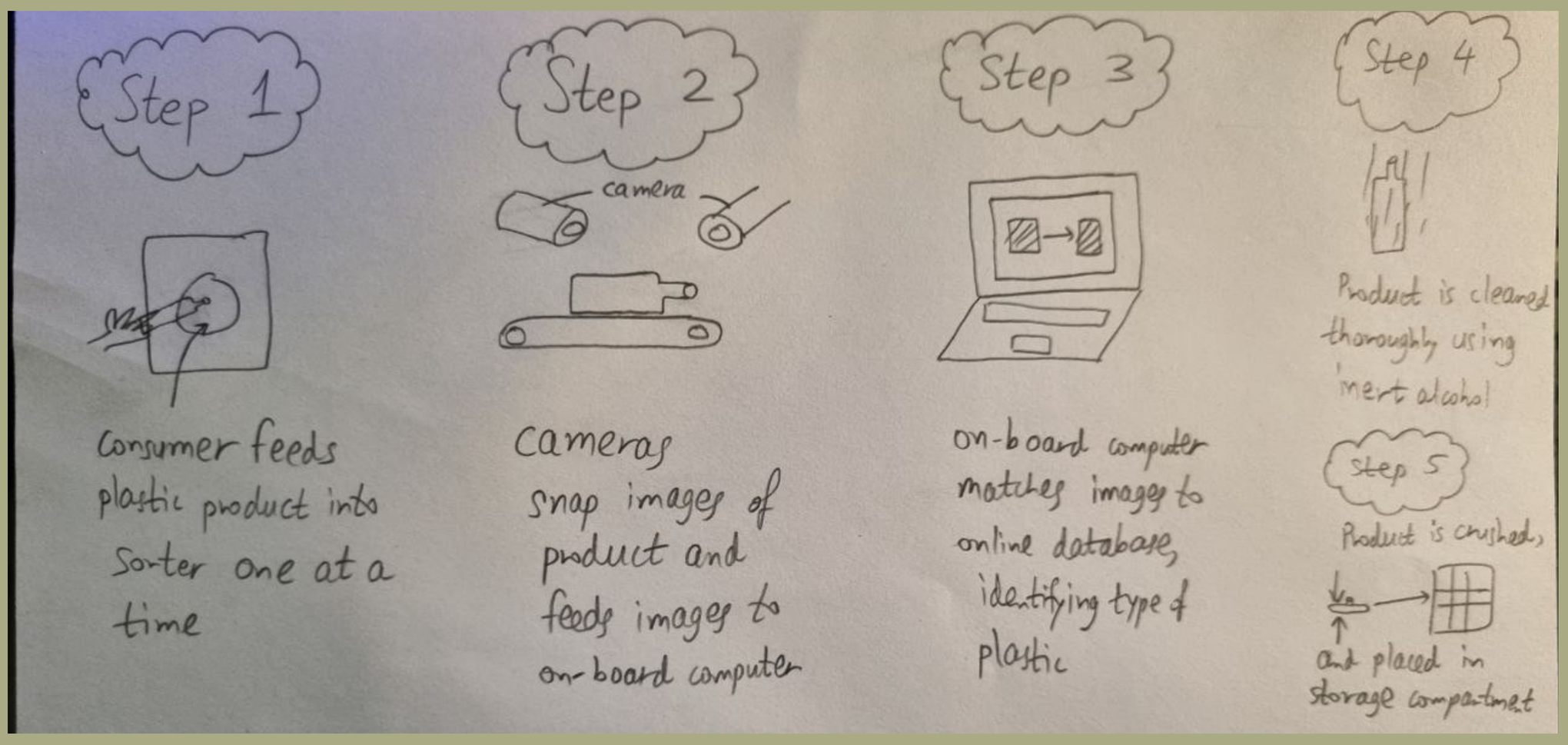
Immediate cleaning of products fed into the sorter reduces cross-contamination

BUILT-IN CAMERA

Detects type of plastic

CRUSHING

Saves space and maximizes storage capacity



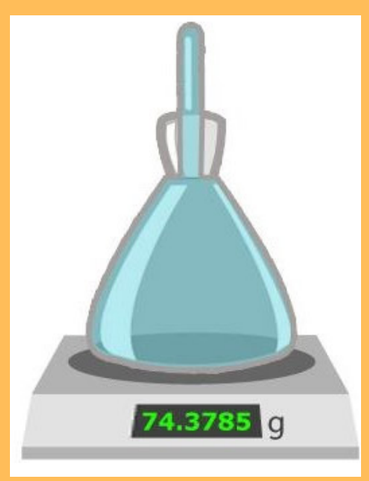
Concept Sketch

Research Data Collected

- At the proposed research facility, samples are taken from products using disposable plastics and data is collected on the following **sample properties**:

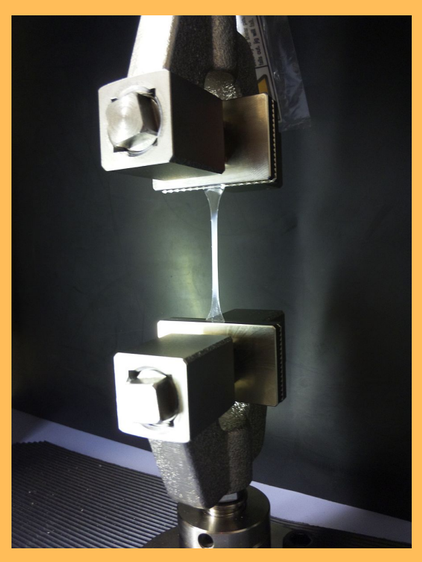
DENSITY

Plastic from a commercial product is ground into a powder and a pycnometer is used to measure the plastic's density.



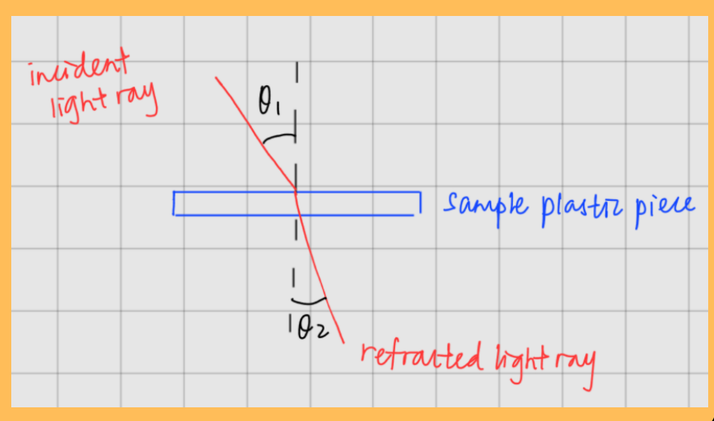
ELASTIC MODULUS

A sample piece of predefined dimensions cut from a product is subjected to a standard tensile test, yielding stress and strain data for the calculation of the elastic modulus.



REFRACTIVE INDEX

Light is sent through a sample piece at angle perpendicular to the piece. The refracted light ray's angle is measured to evaluate the refractive index N of the plastic with the formula: $N = \sin \theta_2 / \sin \theta_1$



- **Images of products** are also **captured** at the facility, noting their **shapes and appearances**
- **Shapes and appearances** are then linked to **sample properties**, enabling **identification of plastic type through images**

END GOAL

Identify 9 commonly used plastic products: PET, HDPE, PVC, LDPE, PP, Polyurethane, ABS, LLDPE, and PE

REFERENCES AND ACKNOWLEDGEMENTS

- The team would like to thank Dr. Jeffrey Scott Moore, Professor of Chemistry at the University of Illinois Urbana-Champaign for his advice and guidance.

- https://www.rubicon.com/blog/recycling-contamination/
- https://www.unep.org/interactives/beat-plastic-pollution/#:~:text=Of%20the%20seven%20billion%20tonnes,is%20mostly%20burned%20or%20dumped.
- https://climate.mit.edu/ask-mit/would-stopping-plastic-pollution-help-climate-change-how-do-we-do-it#:~:text=Plastic%20also%20contributes%20to%20climate,ocean's%20ability%20to%20absorb%20carbon.
- https://www.oecd.org/environment/plastic-pollution-is-growing-relentlessly-as-waste-management-and-recycling-fall-short.htm
- https://sustainablebrands.com/read/from-purpose-to-action-building-a-sustainable-future-together/better-recycling-helps-build-more-sustainable-circular-cities

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