INHA UNIVERSITYTASHKENT FALL

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SOC4080- Multimedia Application

Trasher- smart sorting mechanism

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Project Name: Trasher

Tools: Python and Arduino C (Windows OS). Additional programming languages/frameworks might be used if such a need will appear at the stage of implementation (coding). Python: OpenCV, TensorFlow, PyTorch etc

Objective Statement:

Not “trash” but “raw material”

Problem Statement:

Every day, 18-20 thousand tons of waste is produced in Uzbekistan. Some of them can be recycled, some are dangerous for the environment, and some can be recycled. For example, plastic waste that is not recycled almost always ends up in the world's oceans. According to a study by the American Chemical Society, this plastic eventually crumbles into microscopic particles under the influence of sea water and ultraviolet radiation from the Sun. These particles, referred to as "microplastics", then end up in food chains, food salt, air and rain.

It is well known that ecology is a loss-making, but vital and sustainable financial investment. It is the state of the environment that is associated with human health and well-being, which means that it also affects efficiency, that is, the development of the entire economy.

Currently, there are 291 waste processing enterprises operating in the country. There are 7 clusters for integrated waste management.

These facilities process polyethylene, plastic, paper, tires and other

rubber, textiles, glass, industrial waste oil, metal waste, and lamps and equipment containing mercury. The results of recycling then become secondary raw materials, which are used in the production of new materials and finished products.

Every year, Uzbekistan generates 9 million tons of municipal solid waste, and only 9% of it is recycled. While in many developed countries this index is up to 50%.

This consequently causes **problems** like:

- Low level of recycling
- Emission of harmful gases at the sites of landfills
- Unpreparedness population to sort garbage

Objectives:

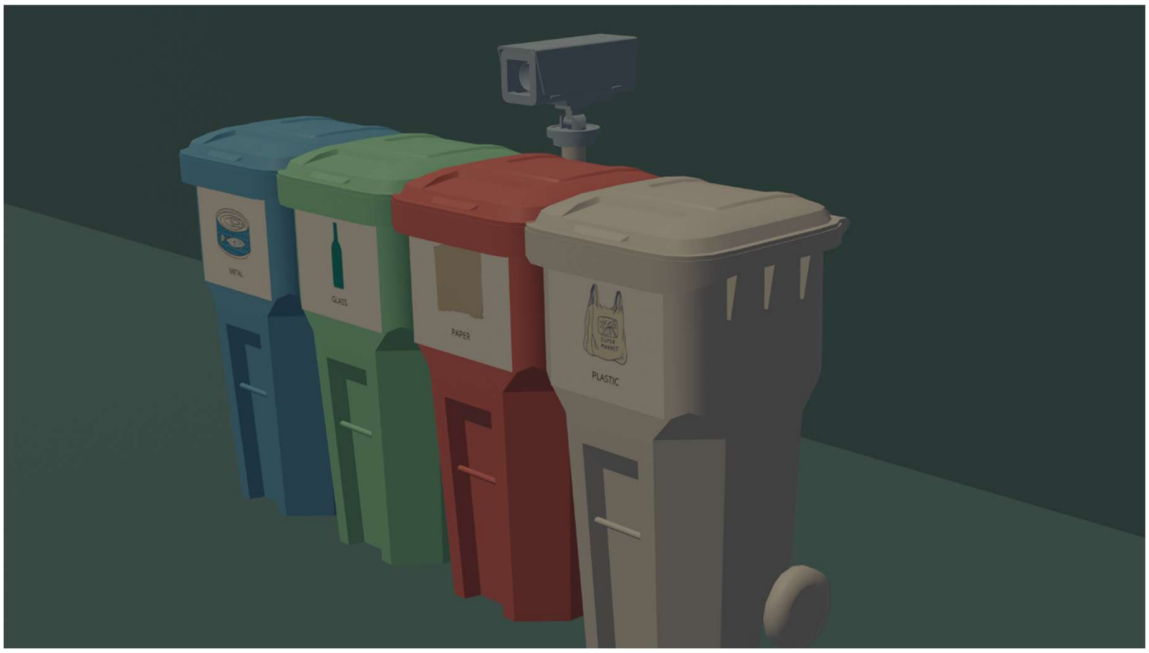
After researching the problem, we established our goals:

- Qualitatively separate recyclable waste
- Reducing the area of polygons
- Teaching the population to sort their waste

Solution:

We decided to develop smart mechanism that consists of 3 major parts:

- Camera that is attached to trash bin
- AI model that will analyze type of trash (paper, metal, glass or plastic)
- Hardware mechanism that will automatically open allocated trash bin



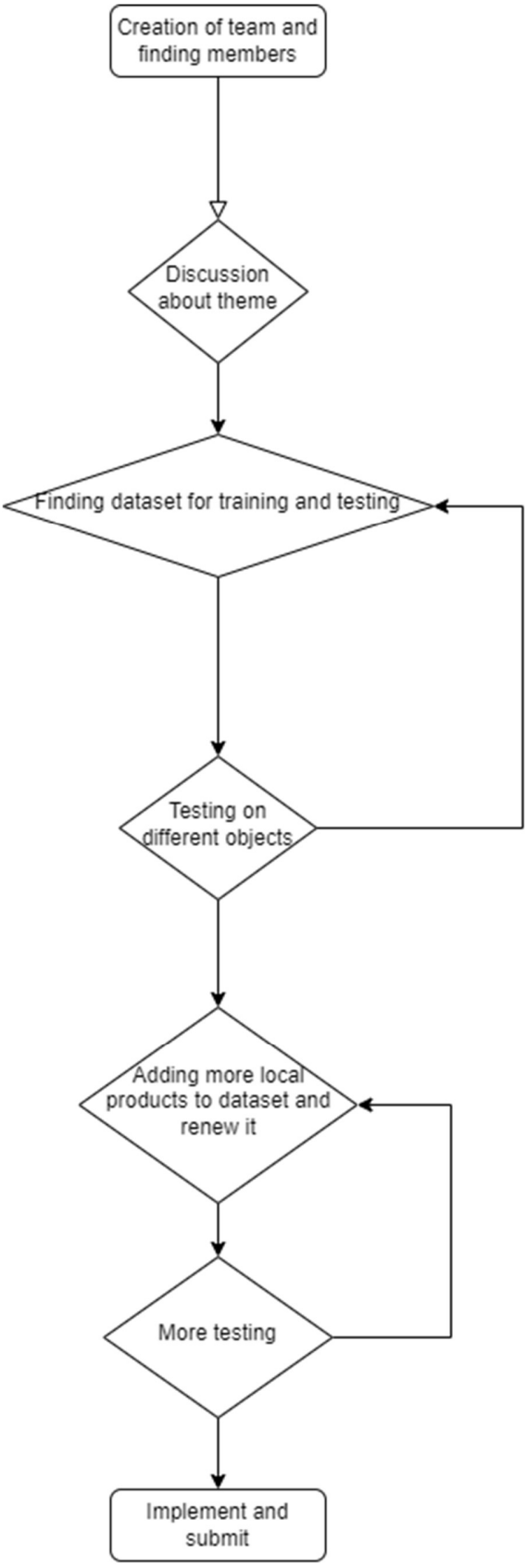
Implementation:

1. Get all the necessary tools including camera, trash bins, Arduino microchip, wires.
2. Develop a model using Python, pytorch, specifically.
3. Add functionality to Arduino using C code and libraries.
4. Develop an algorithm to connect hardware to AI Model.

Problem that might occur:

Firstly, we are highly concerned about the diversity of trash and production in our country. In order for our model to perfectly work in our country we will have to take open-source trash dataset and add our own samples from our every day life.

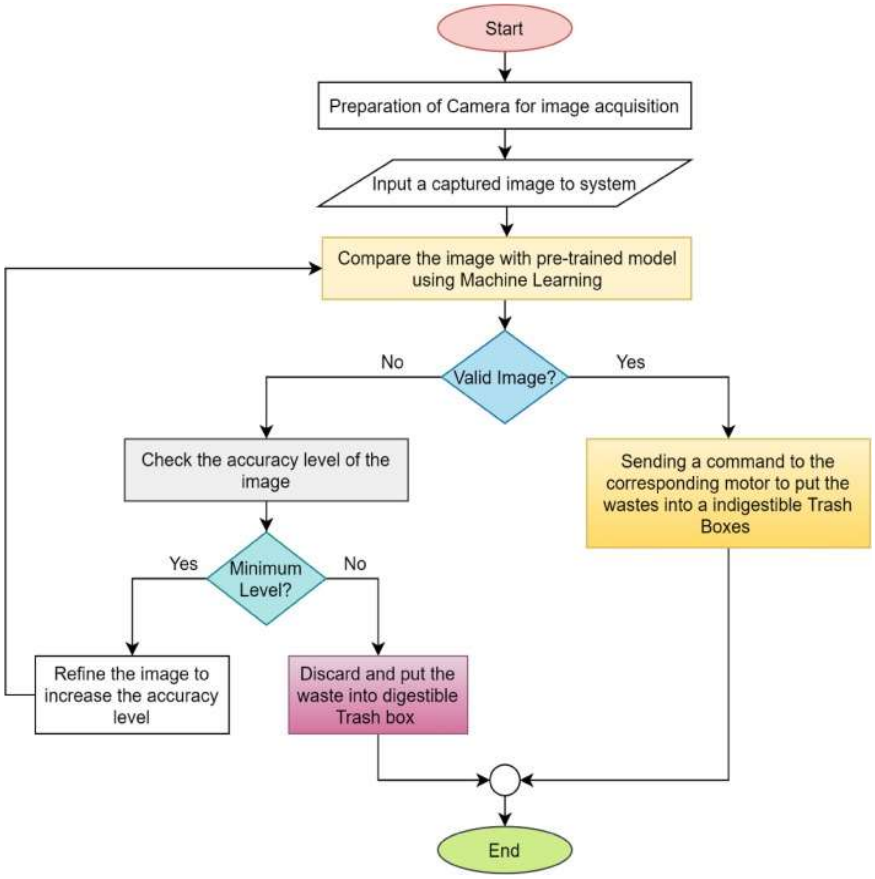
Project Workflow:

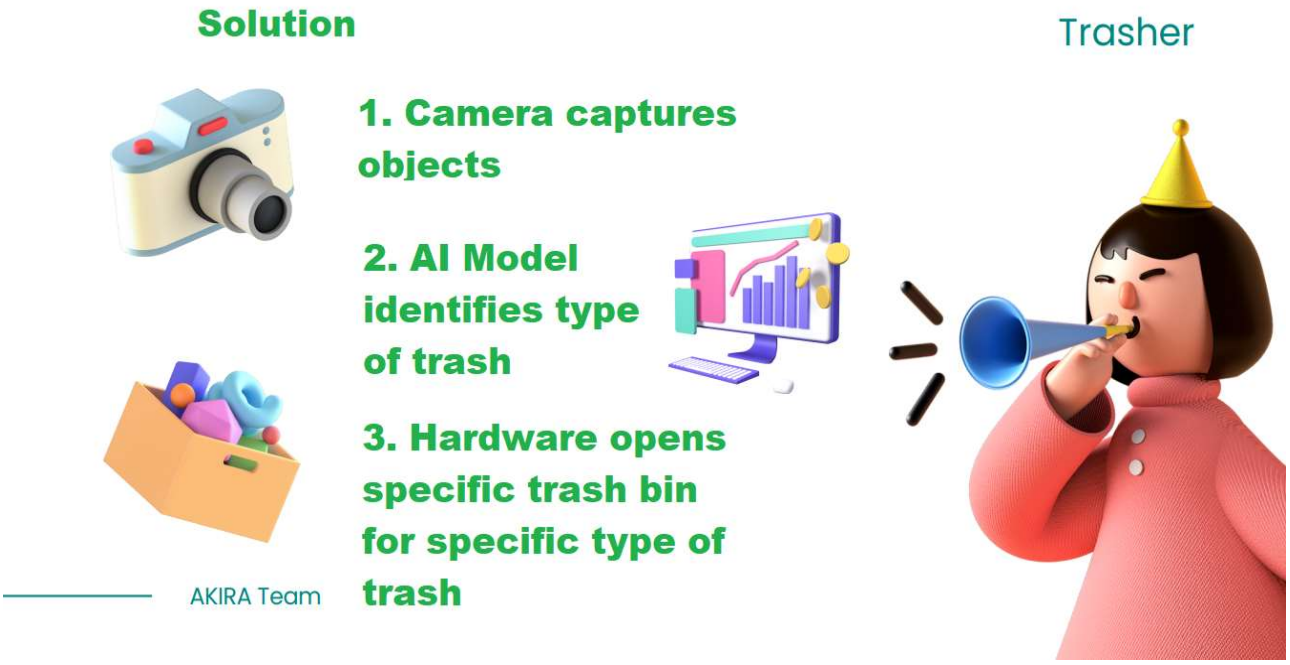


Methodology:

In our project the main technologies we used were PyTorch and OpenCV.

Using PyTorch we trained and tested model and with OpenCV we captured an object and checked its material. We found the database of different garbage with around 2500 pictures. For classifying images, the ResNet50 technology was used. We made 8 epochs for training the model. So, the model can classify the garbage with 95% accuracy.





Sample inputs:

Sample outputs:

“glass”

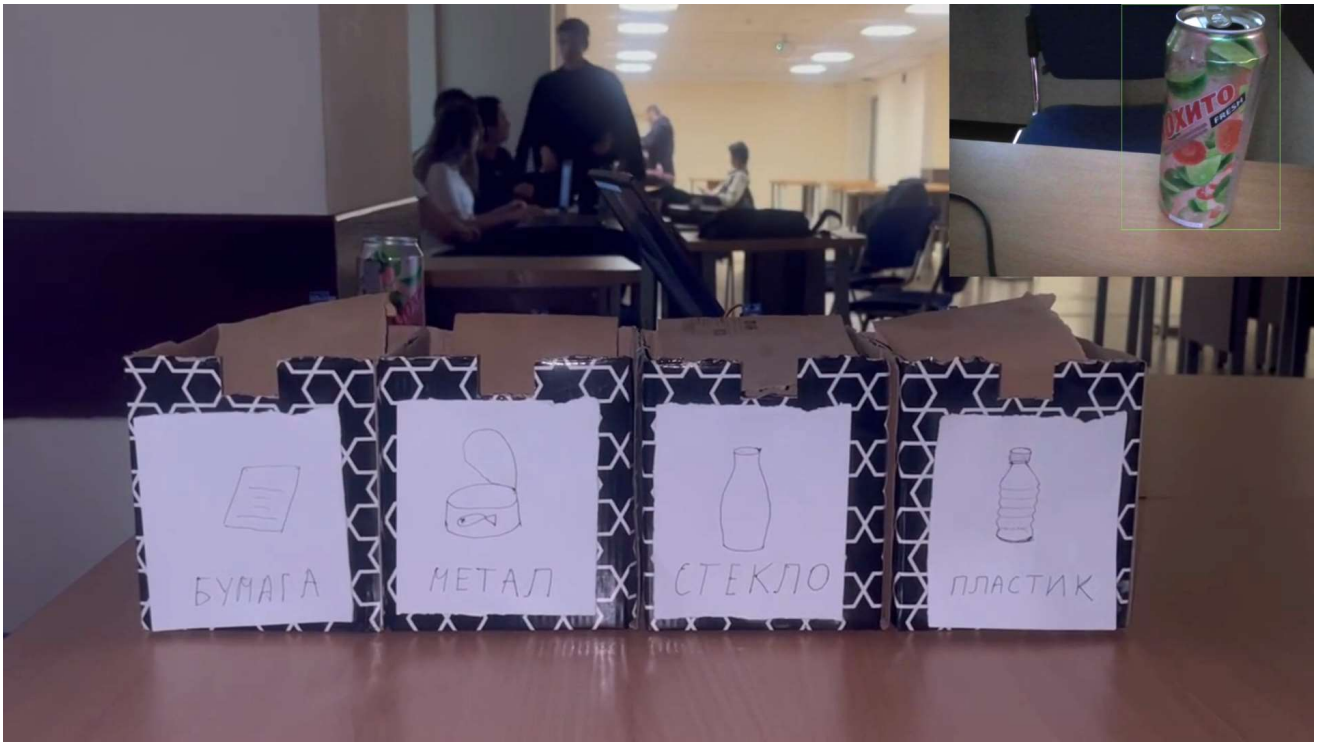
“metal”

“cardboard”

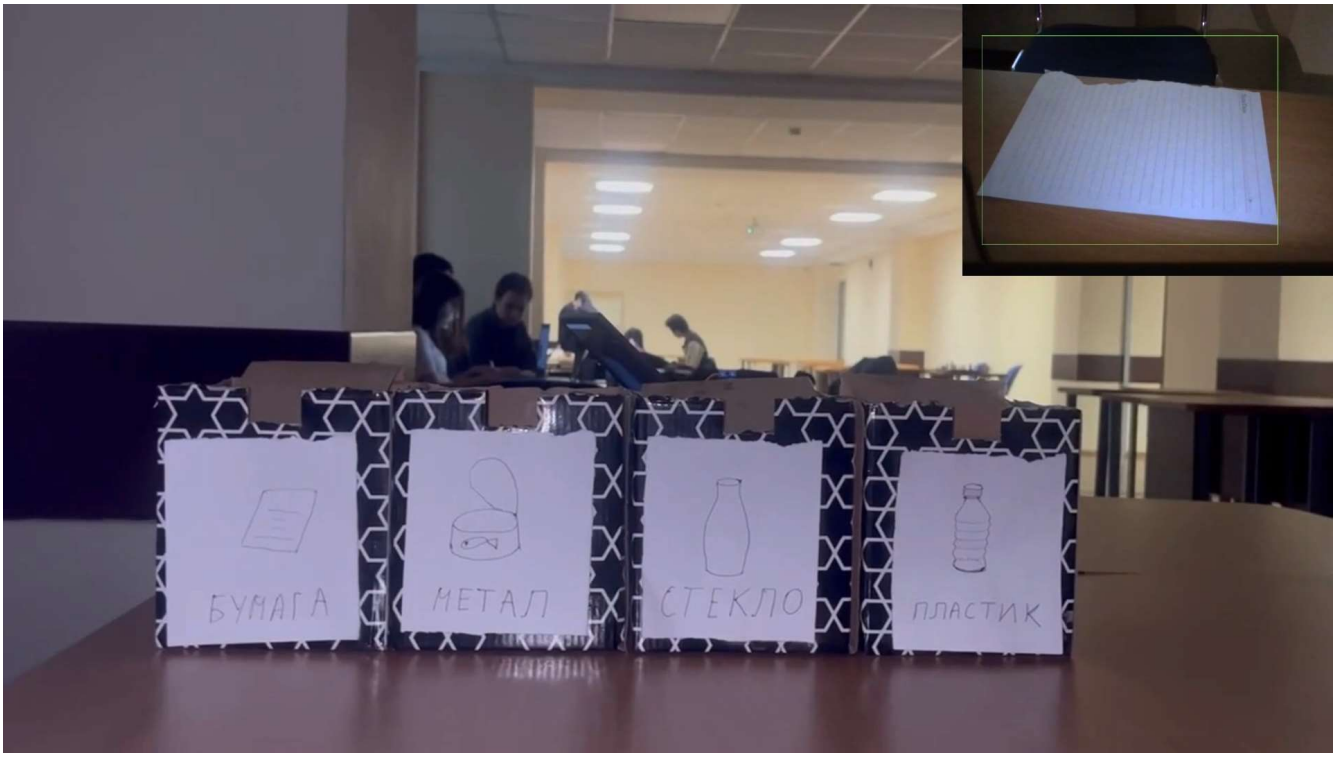
“plastic”

“plastic”

“glass”



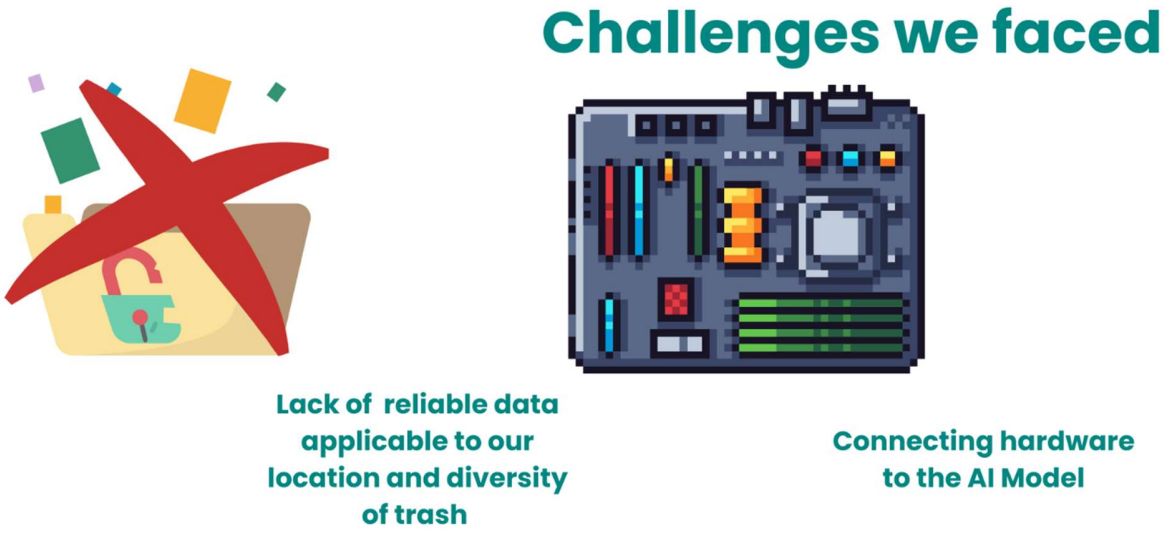
“metal”



“paper”

These are the results after retraining our model by adding our additional products we bought in the store.

Challenges we faced:



There were difficulties with the dataset, since there were datasets from other countries in the open source, and their garbage image is obviously different. Therefore, we had to take a picture of domestic garbage and overtrain the model

It was also difficult for us to connect the software to the hard drive, since Hard was written in C on the Arduino, and the model was written in python, and since there was not enough memory on the board, we could not load the entire model on the scarf, so we rewrote C in python.

Conclusion:

The robot is able to sort garbage with an accuracy of up to 90%. The user places garbage into the device one item at a time. Then the lid of the urn closes, cameras, sensors and AI identify the item and place it in the appropriate inner container. The whole process takes 3 to 5 seconds. Trasher was able to separate recyclable waste from landfill disposal with up to 90% accuracy. Conventional sorting methods are only accurate at the 30% level.

At the moment, the Trasher robotic bin is designed for large volumes of garbage and their installation at airports, bus stations and shopping centers. Our team plans to bring smaller versions of the robot to the market that can be placed in offices, cafes and even private homes. The company is currently raising investments to make its robotic trash cans more affordable.

Also, there might be cases when compound trash is thrown and, in that case, we will have hard time identifying it. So, our algorithm and Trasher bot has a lot to study and learn in the following 1-2 years. Also, we will need support from specialist and public that can help us gather quality dataset and enhance it to the maximum level. We do understand it is hard to establish on governmental level.

Frankly speaking, I have little hope for the state bodies here. I think that in the corridors of power they will continue to think, argue and deliberate for a long time. And time, meanwhile, gases on landfills will not stop growing and trash will not disappear on its own. In this regard, we place our hopes only on the municipal authorities and their joint work with specialists and business representatives.

References:

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