

Clean City – From Concept to Prototype

Authors:

Alexandru Nicolae Sabo

Matei Cristian Tănase
Dragoș Vasile Nicolae Pop

Coordinator: prof. Teșileanu Laura

National College „Vasile Lucaciu”, Baia Mare

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Introduction

- **Challenges in Urban Waste Management**
 - Growing urban population
 - Increased waste generation
 - Environmental sustainability concerns
- **Background of the Project**
 - A continuation of last years “Clean City” project
 - Objective: Enhancing efficiency and sustainability in waste sorting

Concept

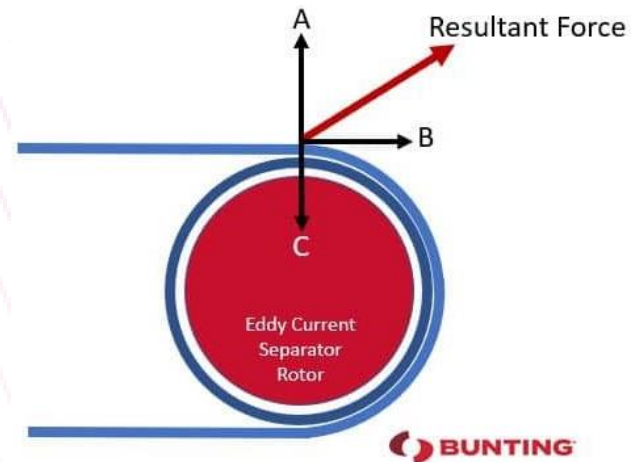
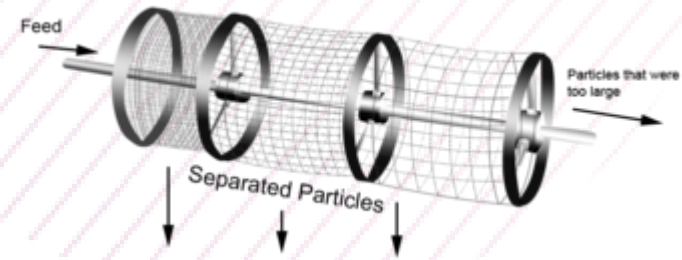
System Design and Innovation

- **Optimized Design for Urban Efficiency:**
 - Dimensions: 3m x 2.5m x 2m, tailored for compact urban environments.
 - Focus on maximizing functional space in densely populated areas.
- **Innovative Sorting Components:**
 - Advanced Sorting Conveyor: Utilizes sensor-based technology for initial waste categorization.
 - Automated Segregation Unit: Precisely separates materials based on type, using mechanical and sensor-driven methods.

Concept

Primary Sorting Area

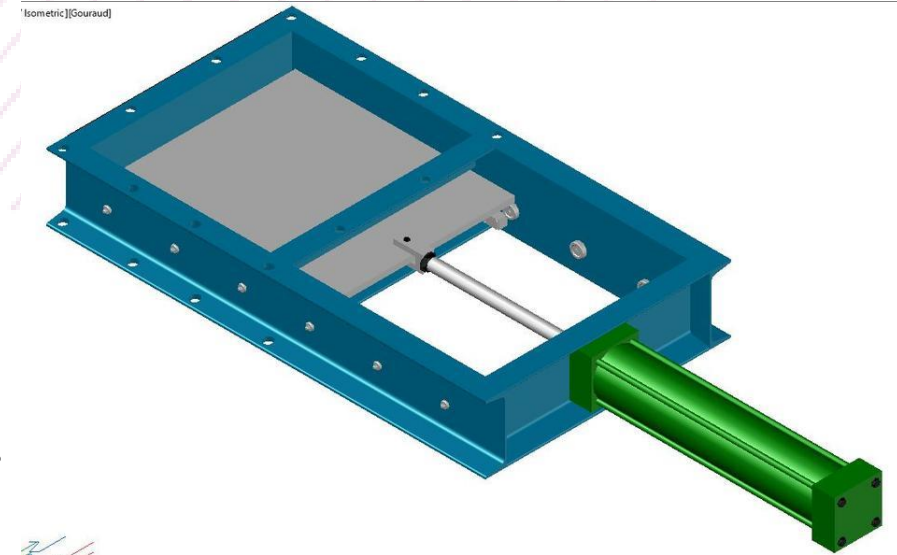
- **Trommel Functionality**
 - Utilizes centrifugal force for size-based sorting.
- **Magnetic Separator**
 - Extracts ferrous metals from waste flow.
- **Eddy Current Separator**
 - Separates non-ferrous metals.



Concept

Secondary Sorting Area

- **AI Recognition**
 - Advanced AI algorithms for rapid waste identification.
- **Optical Sorters**
 - High-speed cameras for precise material recognition.
- **Mechanical Sorting Mechanisms**
 - Ejectors and sliding gates for targeted material segregation.



Concept

Fine Sorting Area

- **Hyperspectral Imaging**
 - Advanced material analysis for precise identification.
- **Air Separation Unit**
 - Segregates lighter materials based on aerodynamic properties
- **Outcome**
 - Highest level of sorting accuracy and material segregation.



Concept

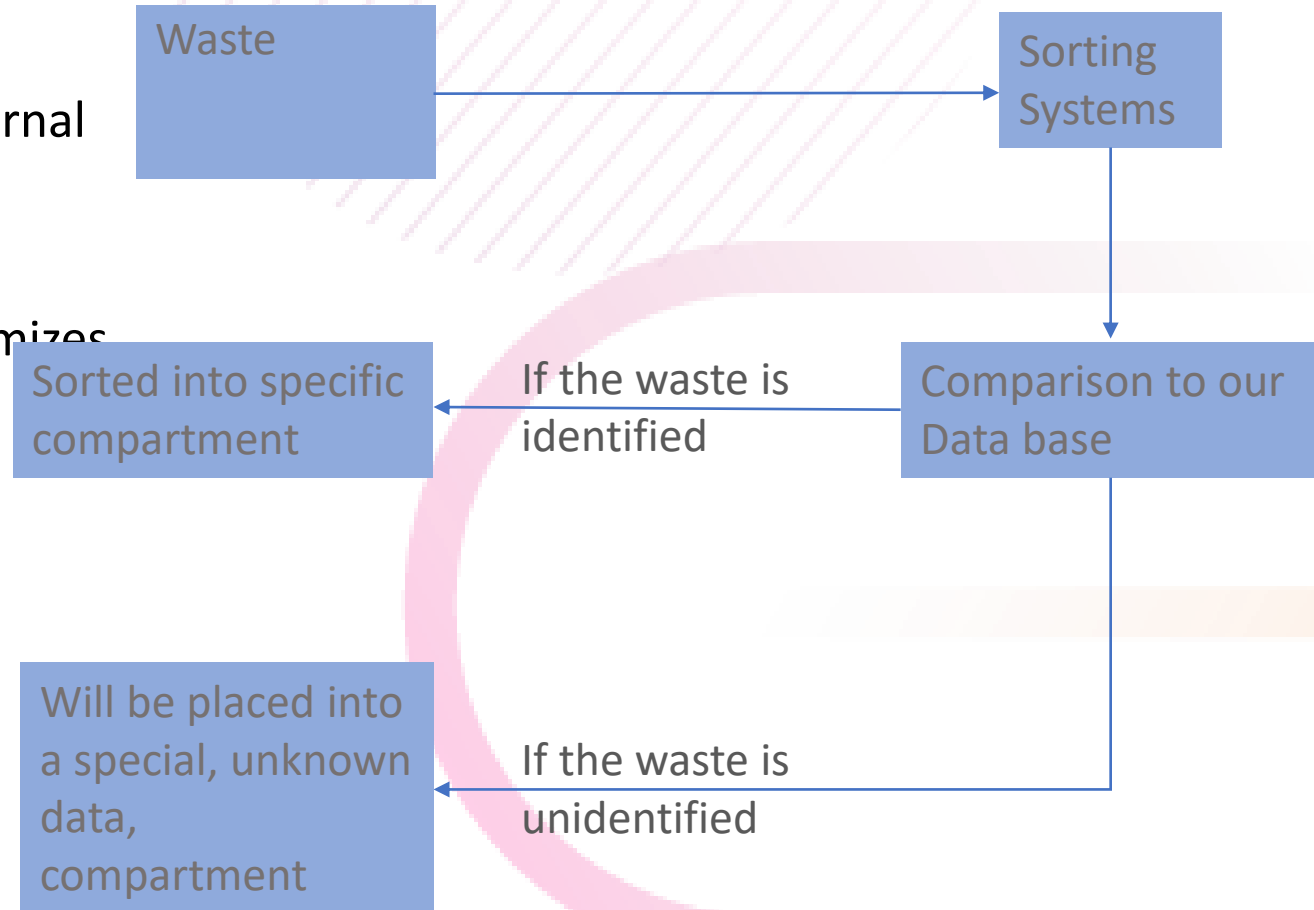
Material Collection and Handling

- **Design**

- Efficiently designed inclined chutes and external containers for sorted materials.

- **Efficiency**

- Design minimizes manual handling and optimizes energy usage.



Concept

Control and Monitoring System

- **Components**
 - Integration of sensors, control panels, and monitoring equipment.
- **Function**
 - Provides real-time data for system adjustments and monitoring.
- **Integration**
 - Seamlessly incorporated into the sorting process for optimal performance.



Concept

Design Considerations

- **Space Maximization**
 - Vertical design for practical use in limited urban spaces.
- **Modular and Safe Design**
 - Ensures flexibility, safety, and ease of maintenance.
- **Energy Efficiency**
 - Components and design focused on minimizing environmental impact.

Prototype

Machine Learning Algorithms

- **Overview of Machine Learning in Waste Sorting:**
 - Incorporation of AI and machine learning for advanced material recognition.
 - Use of TensorFlow and Teachable Machine by Google for algorithm development.
- **Algorithmic Approach:**
 - Supervised Learning: Training the model with labeled waste material data.
 - Continuous Learning: Model fine-tuning through ongoing data collection and processing.
- **Functionality:**
 - Rapid identification of waste types: plastics, metals, paper.



Teachable
Machine



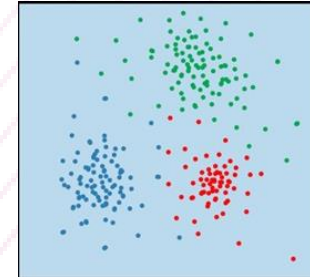
TensorFlow

Prototype

Machine Learning Algorithms

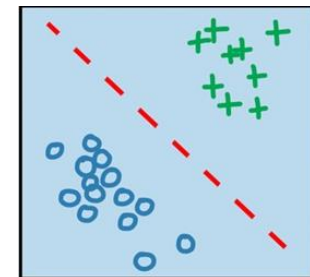
- **Unsupervised Learning**

- Deals with unlabelled data and the machine attempts to find hidden patterns in order to create different types of clusters.



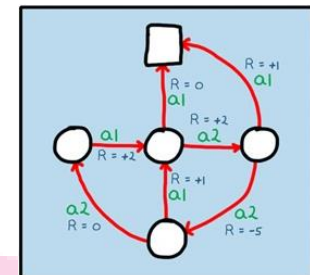
- **Supervised Learning**

- The data is labelled and paired with a correct output. The machine learns to map the input to the output based on the labelled data.
- This is the type of algorithm we use.



- **Reinforcement Learning**

- The machine learns through trial and error, receiving feedback in the form of a reward or a penalty.

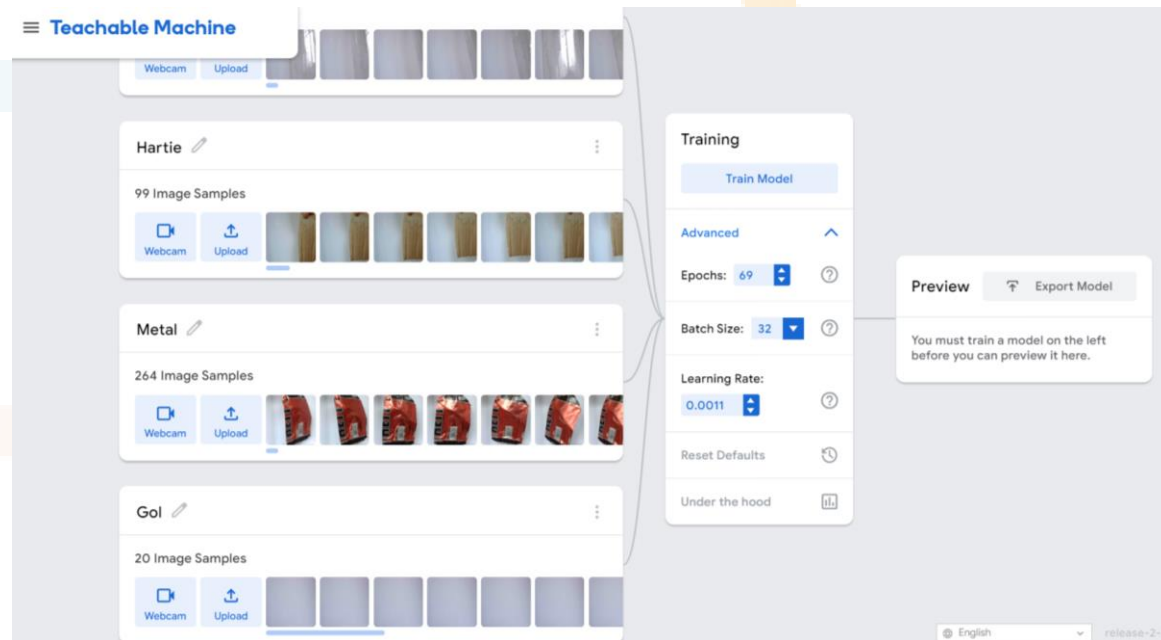


Prototype

Teachable Machine




Teachable machine is a web app designed by Google. It uses supervised learning to allow it's users to easily create TensorFlow compatible datasets and models.

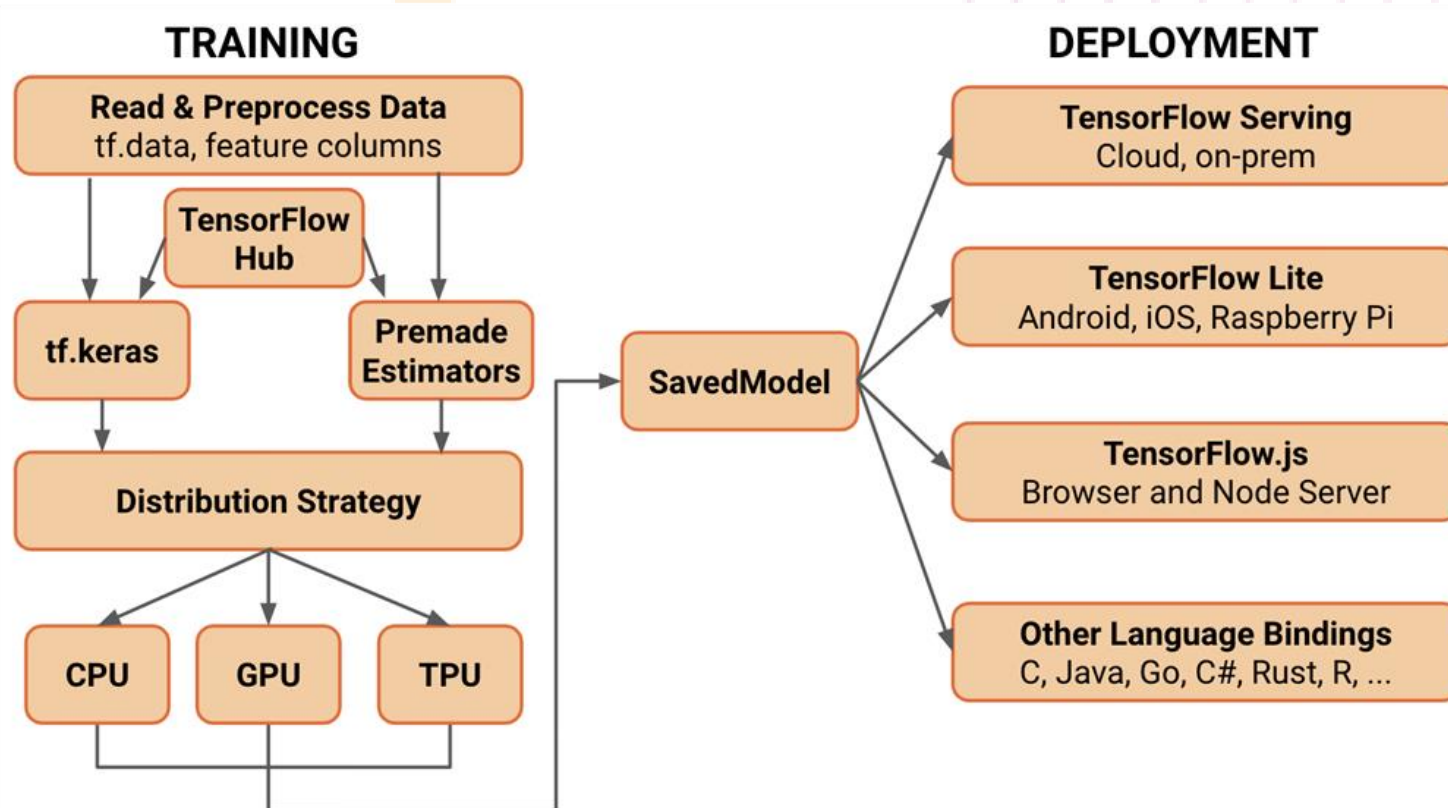


Prototype

TensorFlow Library



TensorFlow is an open source library made and developed by Google for machine learning and AI models.



Prototype Components



Verification Box



Control Hub



Rev Core
Hex Motor



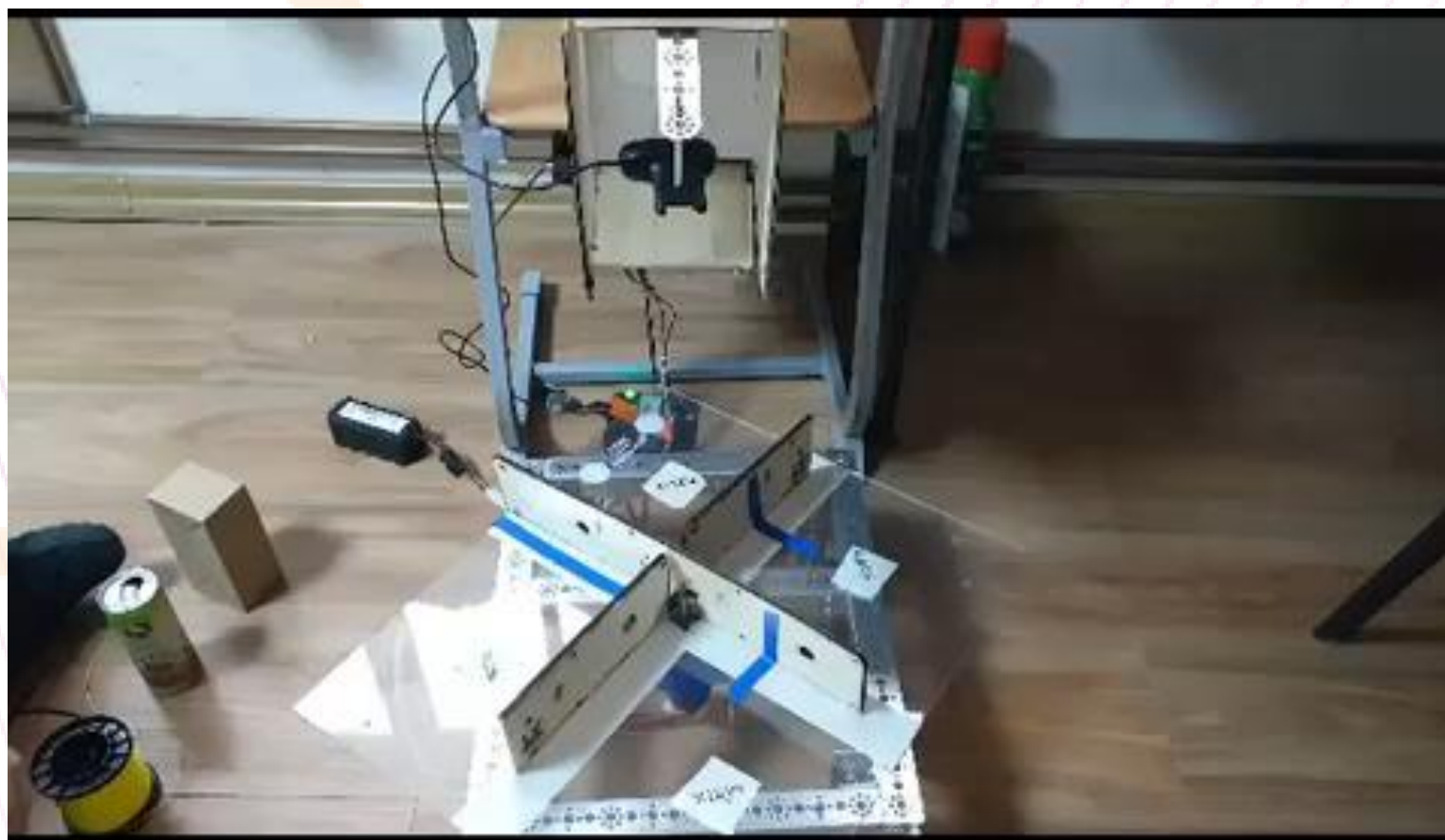
Rev HD
Hex



Camera
Video

Prototype

Working as intended



Conclusions

- **Key Achievements:**

- Improved sorting accuracy and processing speed.
- Reduction in environmental impact through efficient waste segregation and reduced manual intervention.

- **Future Directions:**

- Potential for incorporating emerging technologies for even greater efficiency.
- Scope for expansion and adaptation to various urban settings and waste management requirements.

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