CSAI 498 / CSAI 499 – Graduation Project Proposal

Template

## **Project Title:**

EcoSort AI

## **Team Members:**

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## **Semester / Year:**

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## **Abstract:**

The Smart Pre-Recycling project introduces an AI-based classification system designed to automate the waste sorting process. Manual sorting exposes workers to injuries and reduces accuracy. The proposed solution combines computer vision, robotic automation, and mobile monitoring to classify waste materials efficiently, minimizing human intervention. The outcomes include an operational prototype capable of recognizing multiple material types, automating sorting via a robotic arm, and displaying real-time data through a mobile application.This system improves the speed and accuracy of recycling. It also helps protect workers from potential harm . By reducing manual handling, it lowers the risk of injuries and exposure to dangerous materials. In the long run, the project leads to cleaner cities, better waste management, and a healthier environment for the communities.It shows how AI can help solve the environmental problems and support eco-friendly ecosystems .

## **Problem Statement and Motivation**

During the recycling process, all the wastes must be collected, sorted, processed at a facility and finally remanufactured into new products. The most essential and effective stage is the proper preparation of material as without the correct and efficient sorting of materials, the recycling process will be contaminated and fail. The sorting process is usually done manually by workers who could get infected or injured from the materials therefore, manual sorting is time-consuming, risky, and prone to errors, leading to contamination in recycling streams. This affects efficiency and endangers workers. The project aims to develop an automated pre-recycling solution using AI and robotics, promoting safer and more efficient recycling operations.

## **Proposed Solution**

The proposed solution is an AI-based smart waste classification and sorting system called Smart Pre-Recycling, designed to automate and optimize the most critical and hazardous stage of the recycling process — waste sorting.

The system combines computer vision, deep learning, and robotic automation to classify and separate waste materials efficiently and safely.

The proposed system consists of three components:

1. AI Core: Deep learning model trained on a large dataset to classify all types of wastes accurately and efficiently.   
 2. User Interface:Mobile application used to follow up with users by showing the statistics and the information of sorted materials.   
 3. Hardware Integration: Camera used for real-time data acquisition and after the AI model classifies the materials, a robotic arm is used to sort the materials into categories based on the AI-model decisions.

## **Project Scope**

**AI-Based Waste Classification System**

* Develop a deep learning model capable of identifying and classifying waste into predefined categories (e.g., plastic, glass, metal, paper, organic, etc.).
* Support both online (cloud-based) and offline (on-device) modes for flexible use.
* Use a custom or existing dataset of waste images for training and testing.
* Evaluate model performance using standard metrics such as accuracy, precision, recall, and F1-score.

**Mobile Application Interface**

* Design and implement a mobile app that displays classification results and statistics (e.g., waste types sorted, percentage accuracy, environmental impact).
* Enable user interaction features such as history tracking or leaderboard.

**Hardware Integration (Prototype Stage)**

* Integrate a camera module for real-time waste image capture.
* Connect a robotic arm or servo mechanism to physically sort detected materials based on classification.
* Ensure real-time communication between the AI model and hardware

| Phase | Description |  |  |
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