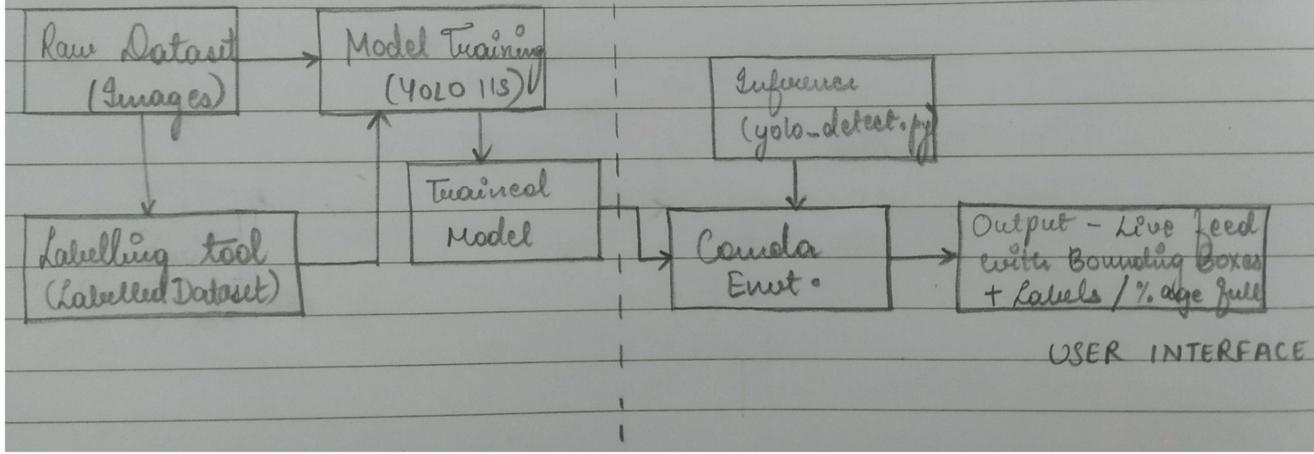


High-level Architecture Diagrams
for both tasks

DATA & TRAINING PIPELINE

REAL-TIME OPERATION



Describing the components

① Input Layer : Data capture

| COMPONENT | ROLE IN THE SYSTEM | KEY DESIGN CONSIDERATION |
|-----------------------|--|--|
| camera | Captures the live video stream | Resol ⁿ & Frame Rate: 720p at 30FPS |
| Illumina ^m | Performs uniform & consistent lighting | May require LED arrays for consistent color & brightness |

② Processing Layer : Computer Vision Algorithm

| COMPONENT | ROLE IN THE SYSTEM | MY SPECIFIC IMPLEMENTATION |
|---|--|--|
| Object Detec ⁿ Model + Inference Engine | The core algo. that localizes items and classifies them. + The algo. event. that runs the model | Trained YOLO model (yolo-detect.py) Capt file: Performs obj. detec ⁿ (locating BBs) and classifica ⁿ (identifying plastic, paper, metal) |

③ Output Layer : Results & Action

| COMPONENT | ROLE IN THE SYSTEM | EXAMPLE OUTPUT/ACTION |
|-----------------------------|--|--|
| Visualizat ⁿ /VI | Displays the detect results / real time monitoring | Bounding Boxes & Category Labels (TASK) displayed on screen % of trash bin filled (TASK) |

Why YOLO v1 for Smart waste management?

- ① It's very fast : Detects objects in the single pass of image, making it fast enough to process live video frames.
- ② High Accuracy : Accurately draws Bounding boxes and correctly identifies the objects.
- ③ Works on simple hardware : Can run well on affordable hardware like Raspberry Pi or an industrial embedded system
- ④ Easy to use : Framework is well documented and simple to train with custom data
- ⑤ It detects multiple objects : Can see and identify multiple objects in the single frame at the same time.

Mitigating Lighting Variations and Glare (Plastic & Metal) :

While dataset collection we can place a polarizer filter on the camera lens and a linear polarizer on the light source. This cancels out most of the unwanted surface glare and makes surface features more visible.

Ethical Considerations & Environmental Impact

Surveillance
Scope

A camera intended for waste could be repurposed for surveillance (e.g.: tracking who throws away what, or who passes by).

We will have to ensure that system runs only for trash detection.

Hardware
disposal

The cameras embedded devices (e.g.: Raspberry Pi) and cameras used in the system will eventually become e-waste themselves.

We will have to design the long lifespan & plan for responsible recycling.