Evolving Scrapyard:
Integrating new solutions for advanced scrap management

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Tecnoap

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SCRAPYARD®
by tecnoap

Context

Raw materials account for **70%** of steel production costs. Scrap is the largest portion of these costs.

- Consequences of poor scrap management and classify:

Overcost on scrap

Lack of traceability and stock control.

Possible fraud scenarios in scrap metal procurement.

Complex audit process.

Low efficiency of the melting process.

Discrepancies between different stocks, accounting and other areas.

Possible conflict with scrap suppliers due to the inherent subjectivity of the reception process.

Impact on the quality of the steel produced.

Objectives, Features of the solution

- Digitization of the scrap incoming scrap workflow
- Automatic scrap classify
- Volumetric calculation of the truck box
- Truck weight capture
- Density determination
- Integration of scrap chemistry
- Integration with Manufacturing Execution System (MES) & ERP (SAP)
- **Detection of truck container.**
- **Hazardous objects detection.**
- **Scrap characterization.**

Technical approach, Technologies

Cloud

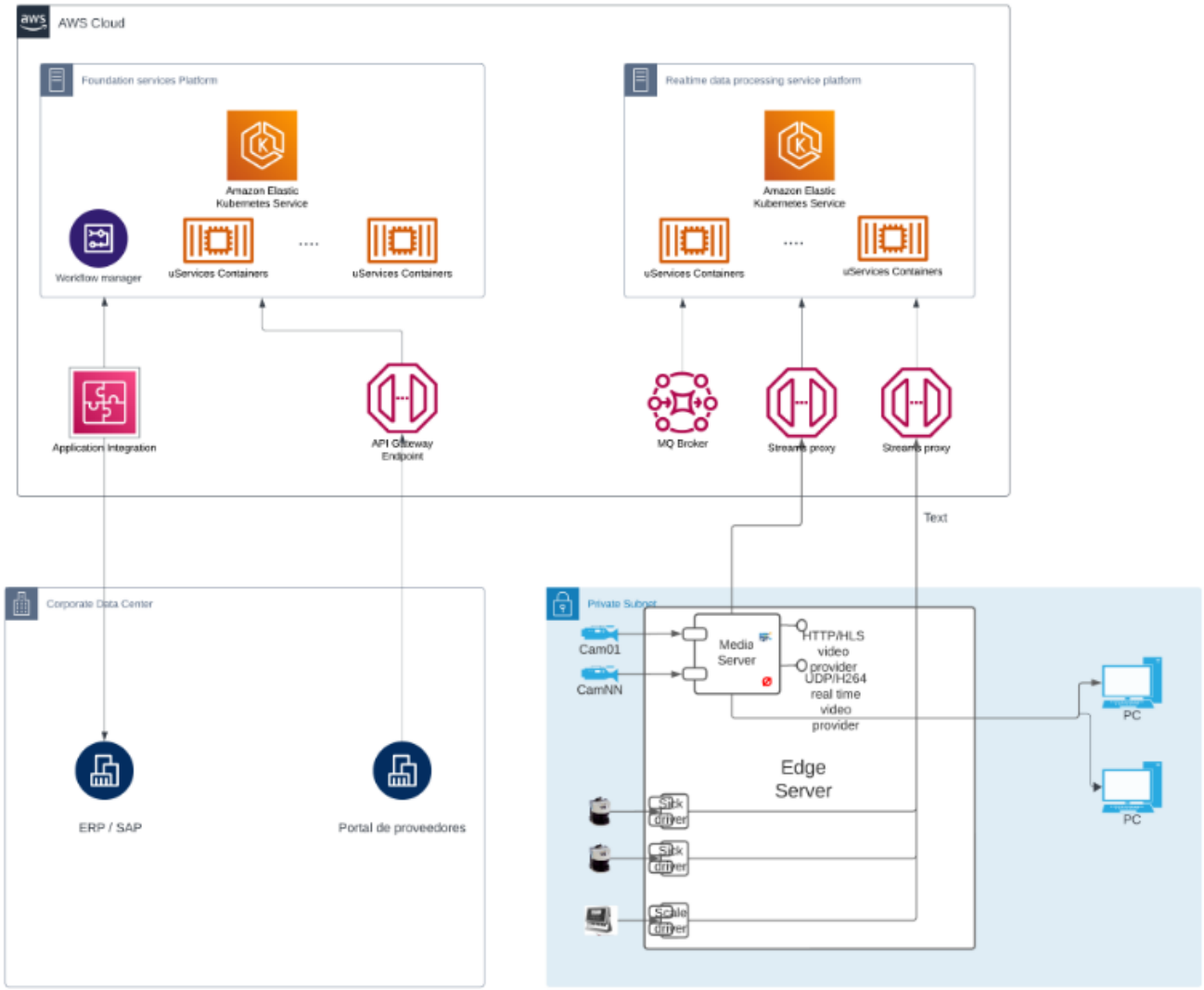
Artificial intelligence

Big Data

Internet of things

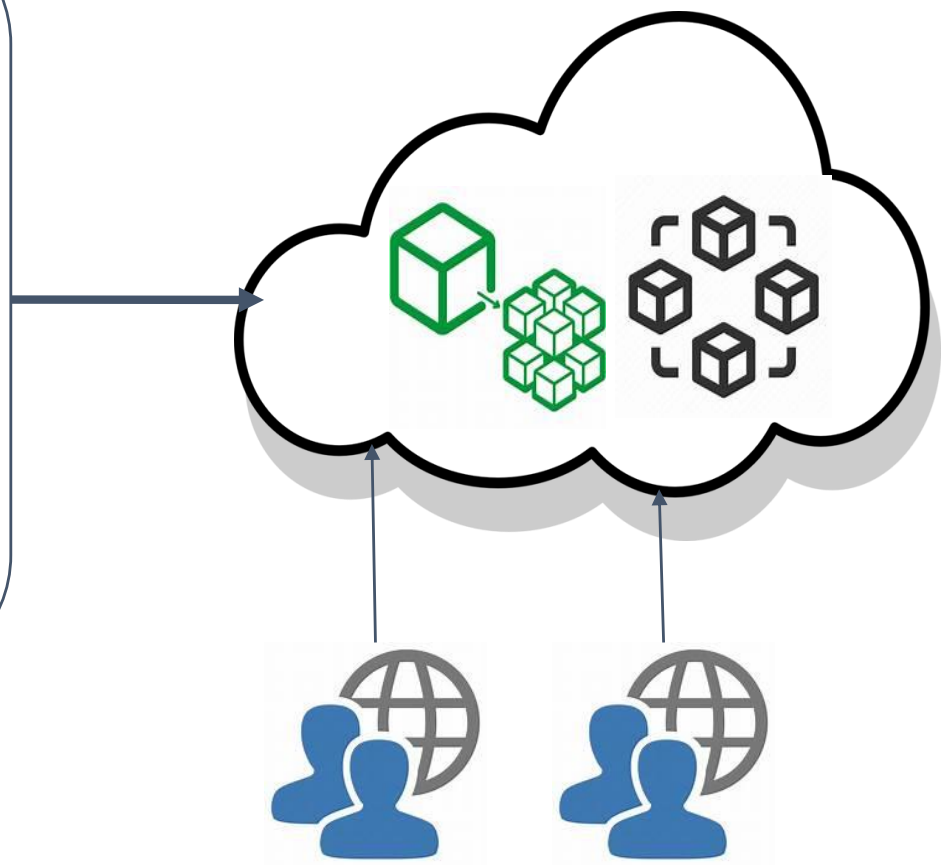
Software

Full cloud/edge based implementation

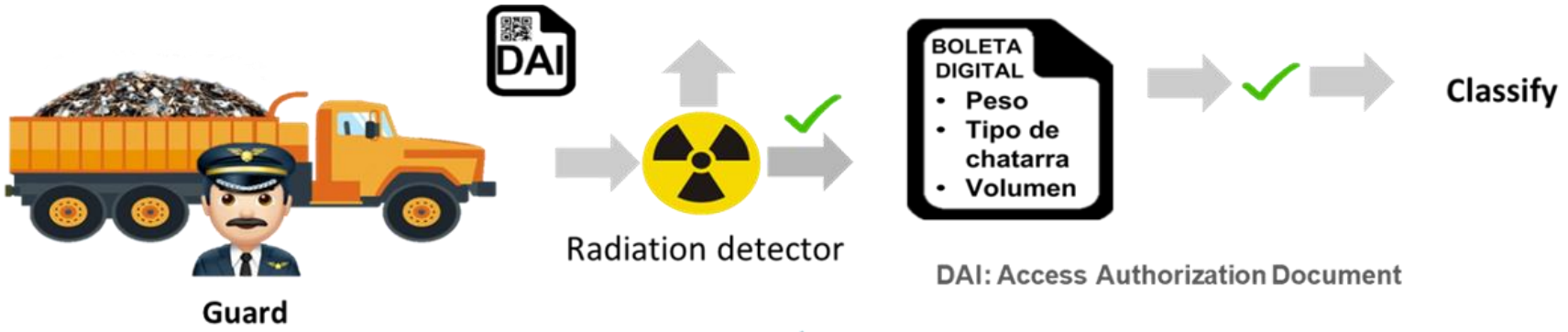


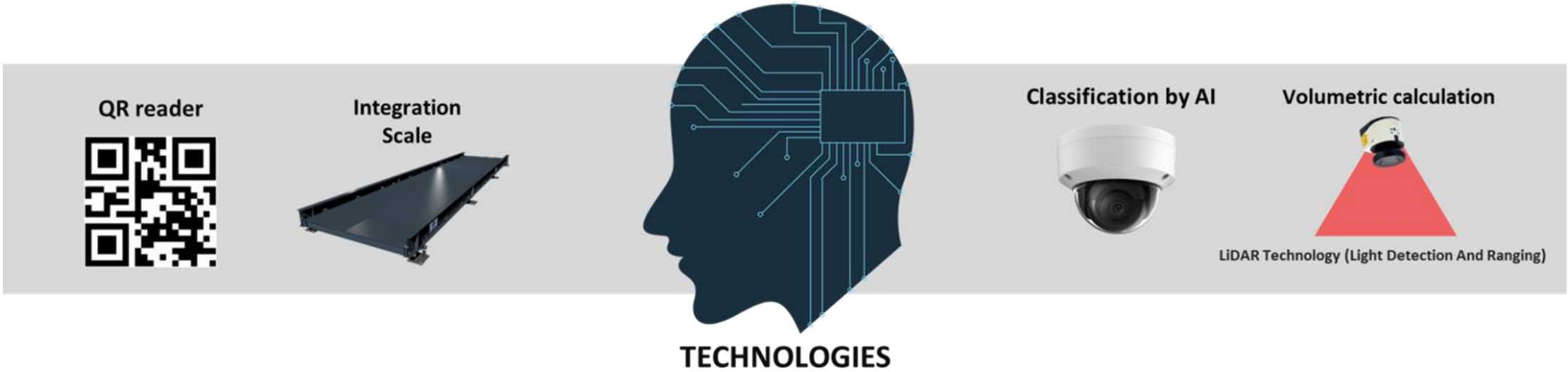
Full cloud/edge based implementation

Edge Server



Integration





Field implementation

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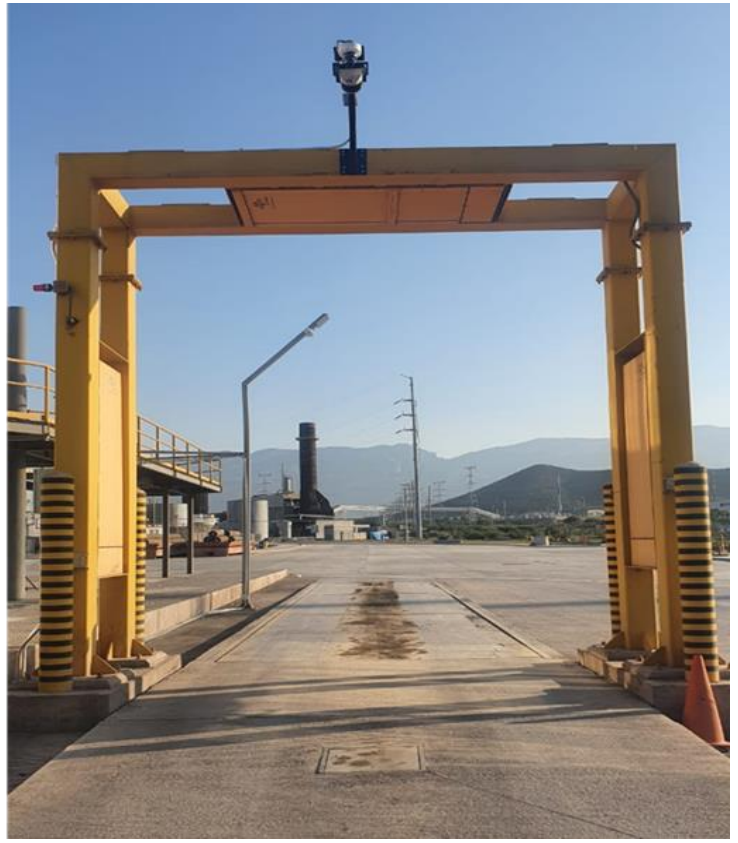
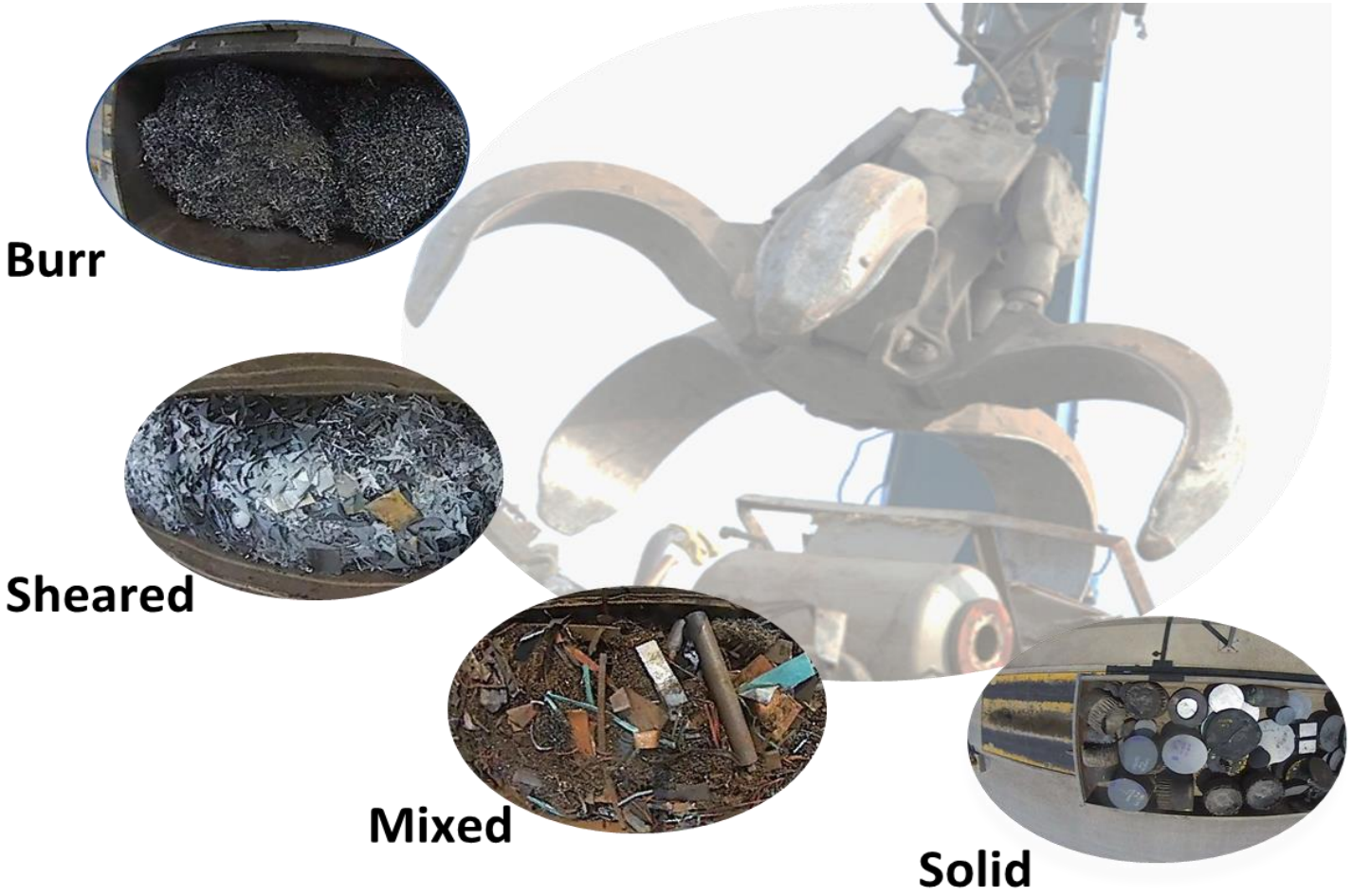
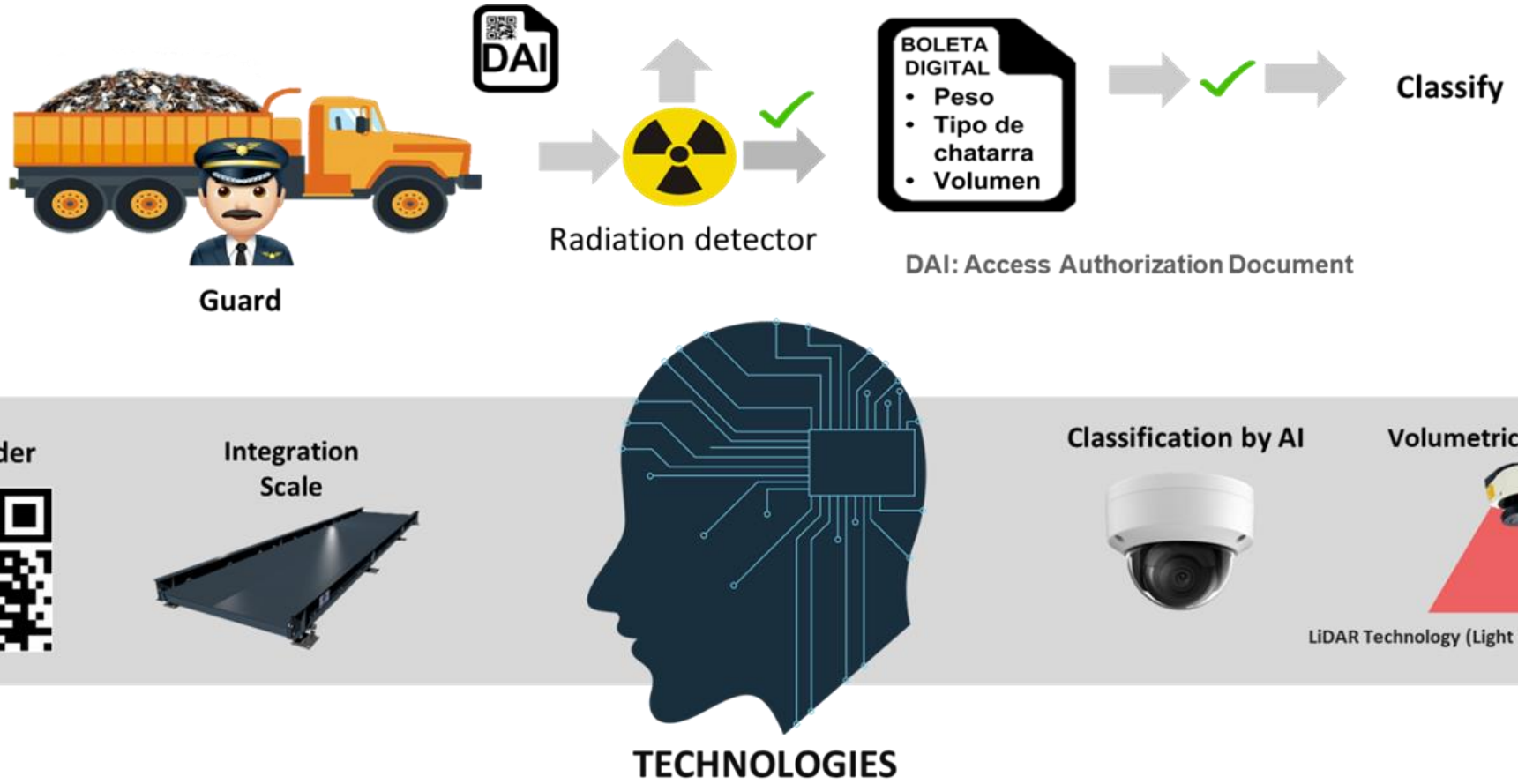


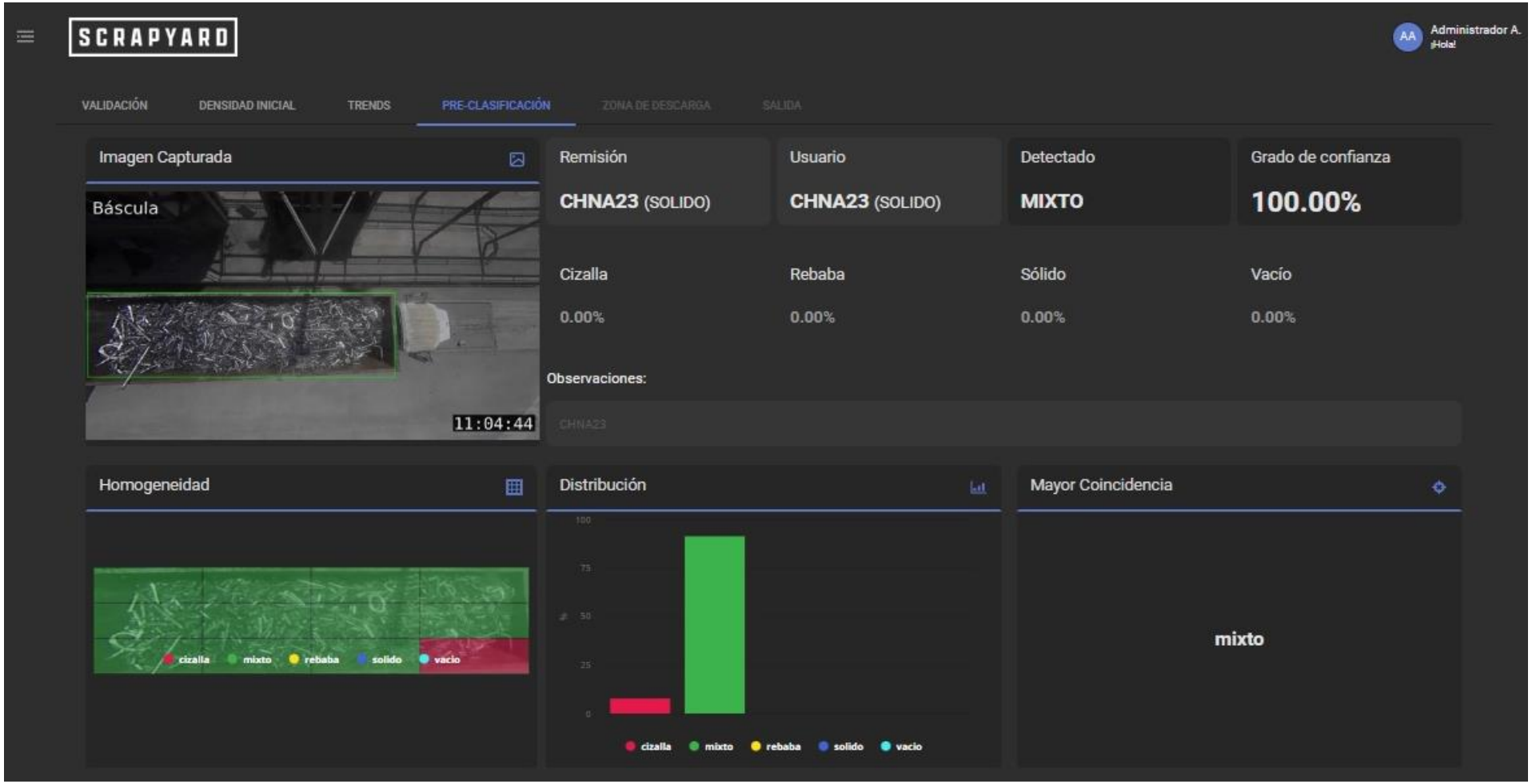
Examples of scrap metal



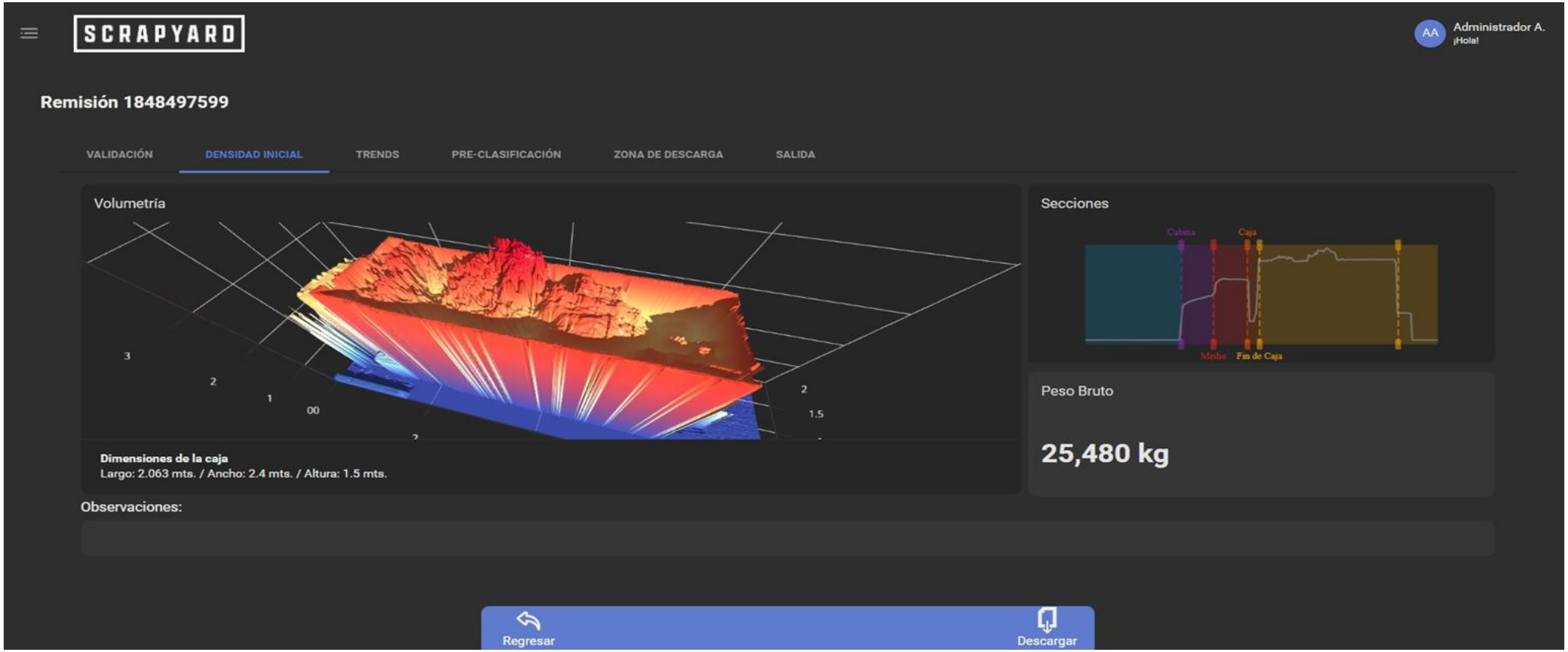
Pre-Classification



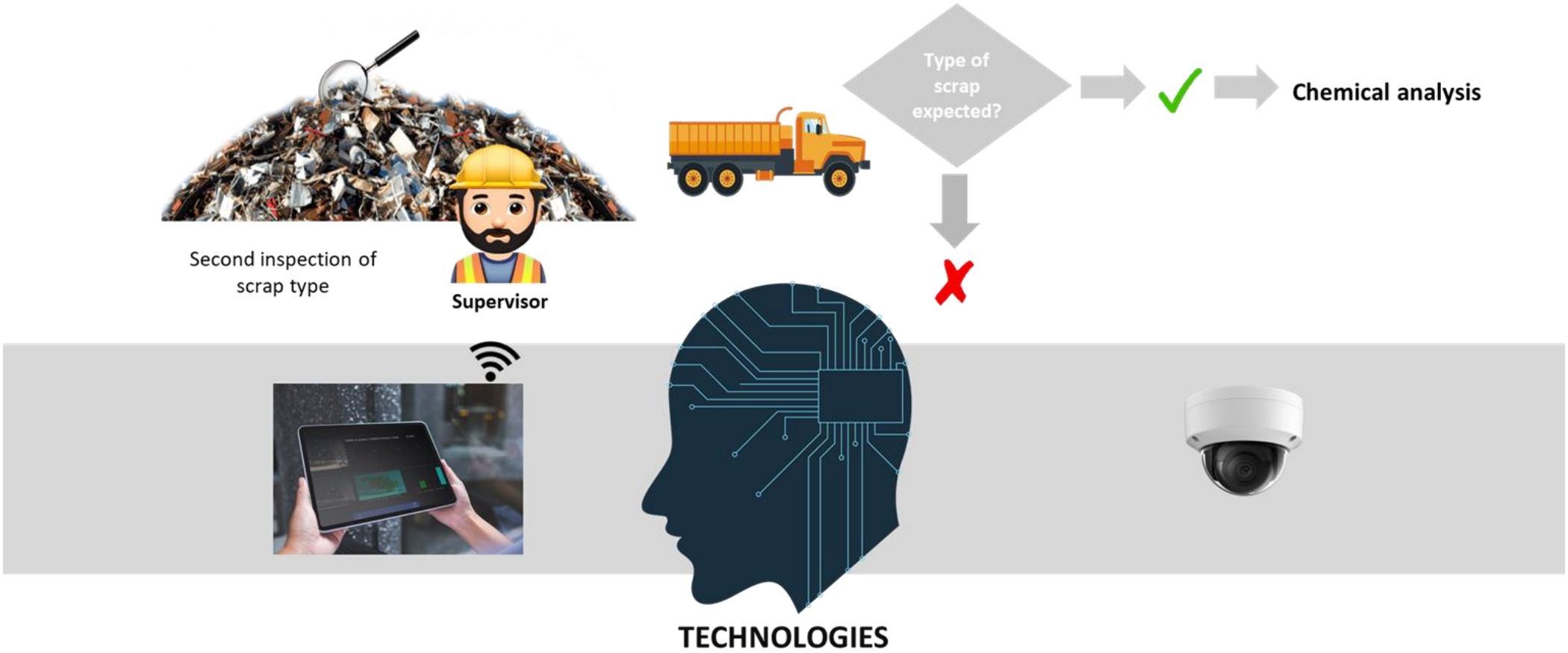
Pre-Classification screen, entrance area



Volume and density calculation

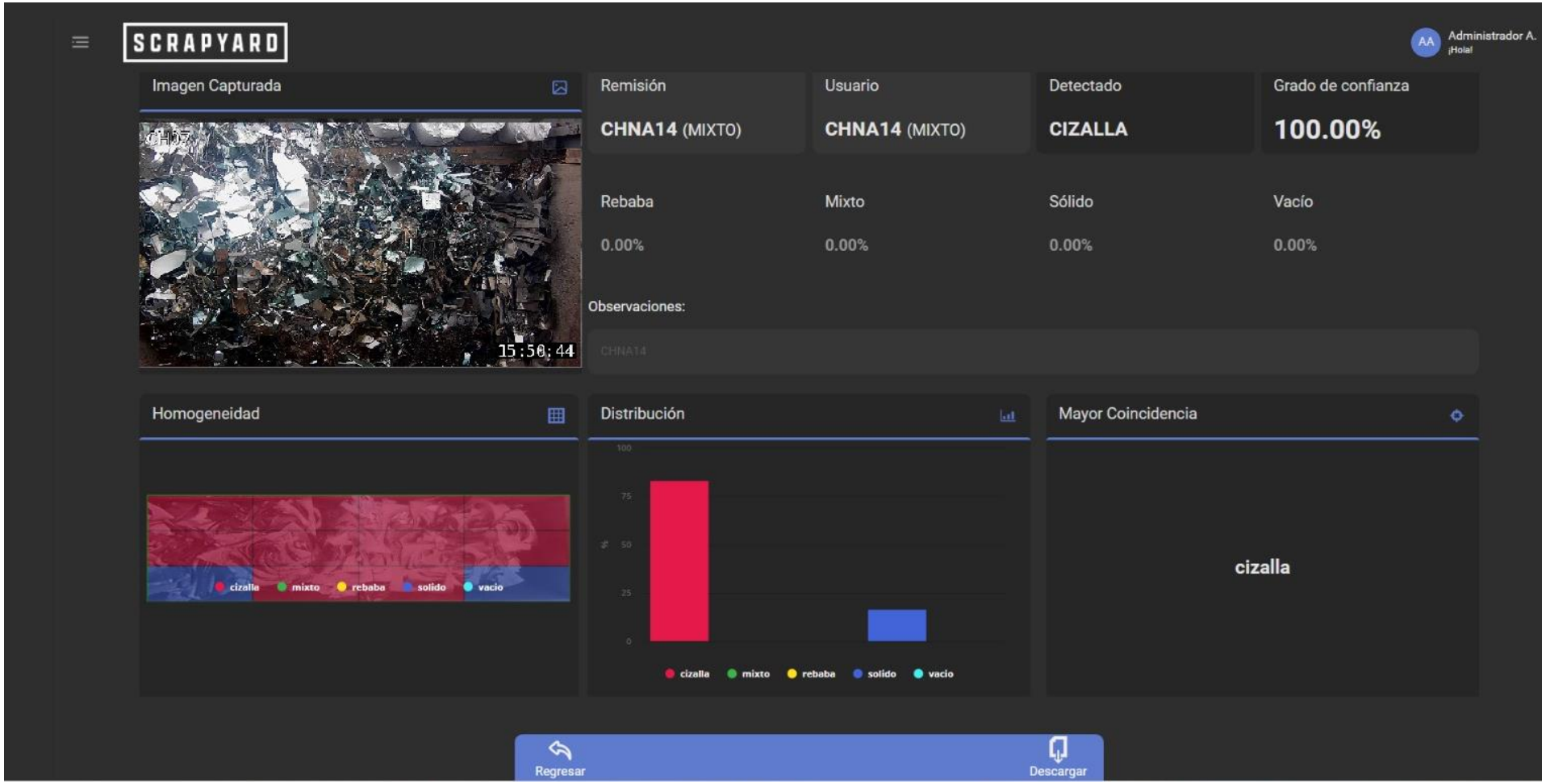


Classification, uploading area

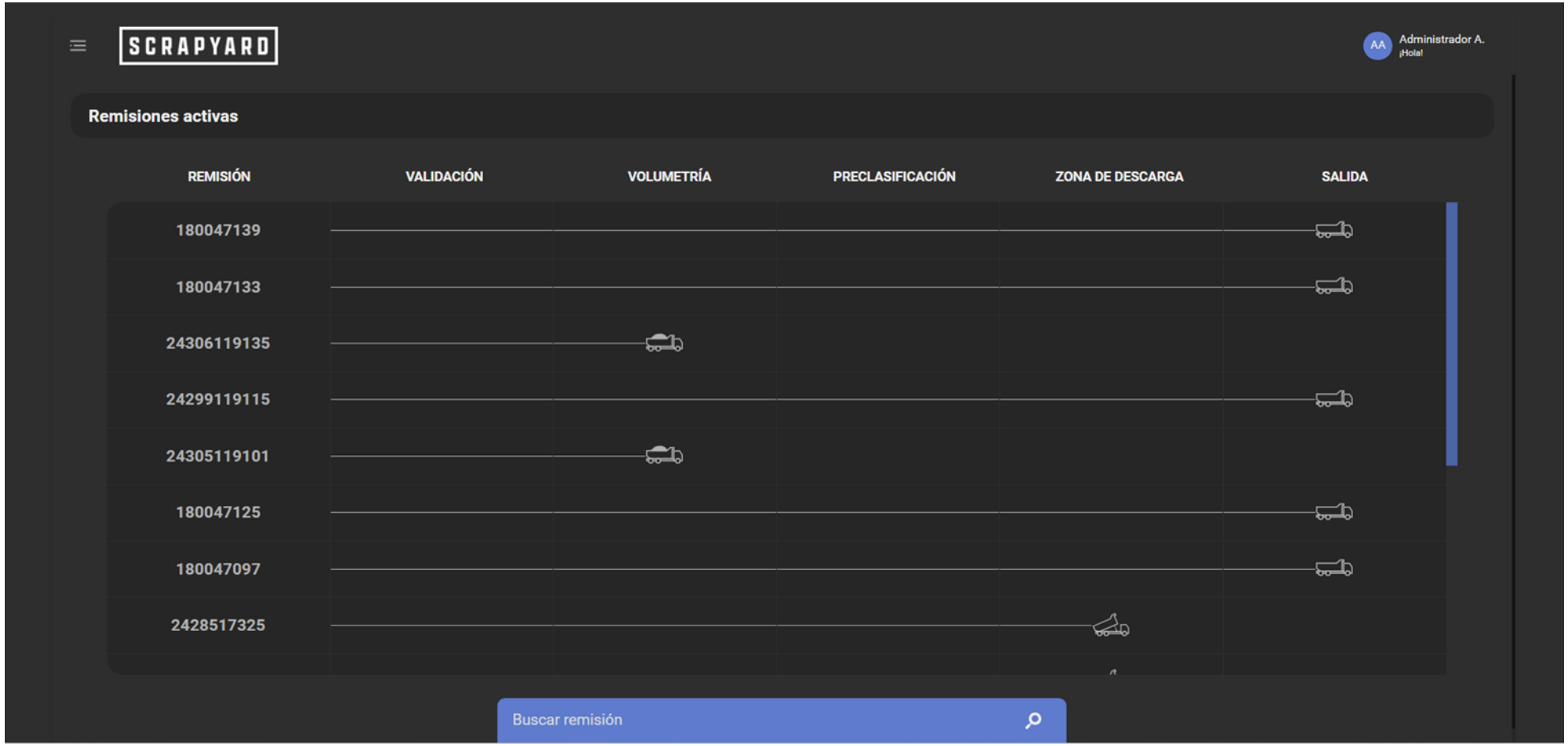


Classification, uploading area

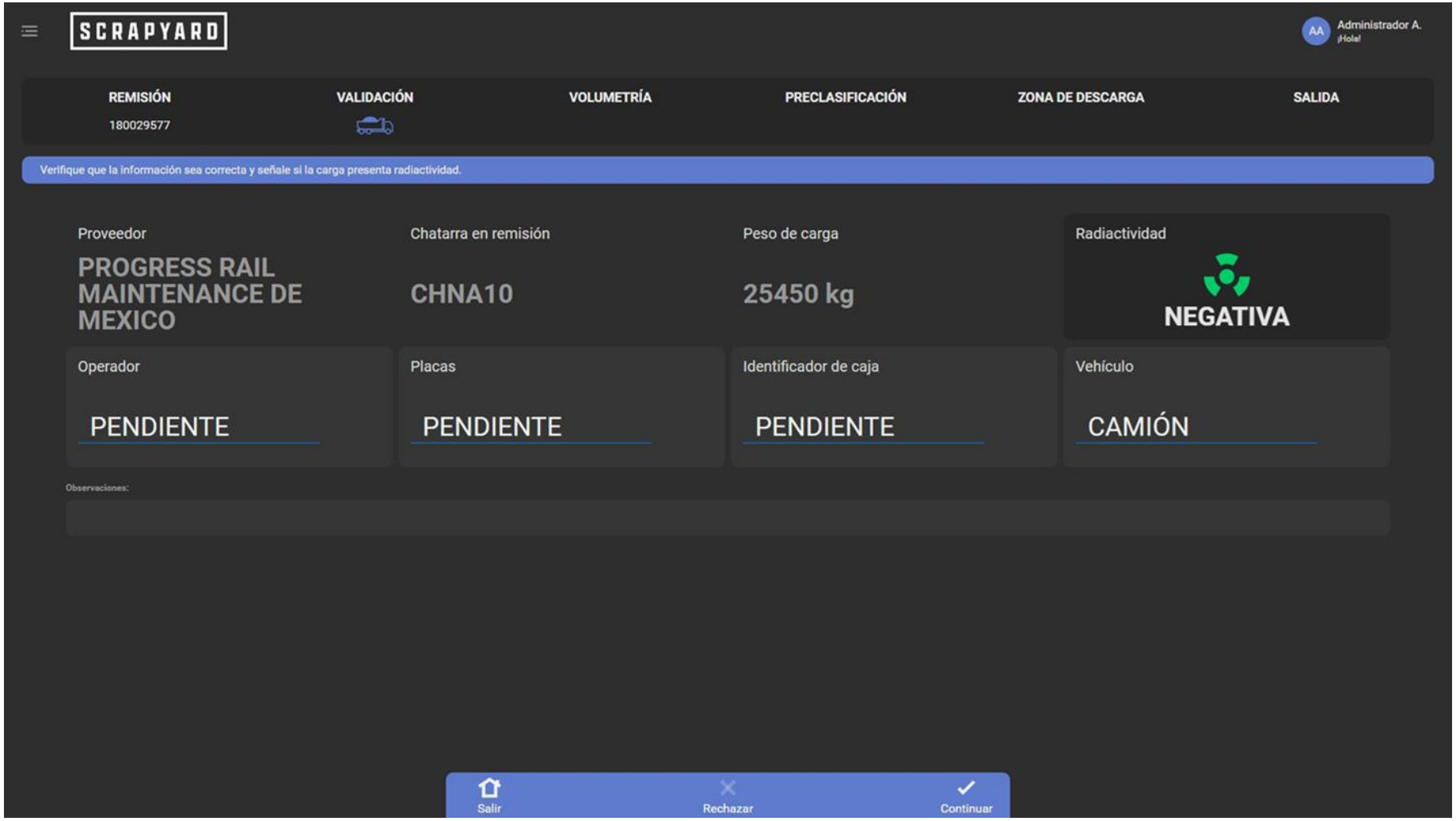
Classification screen



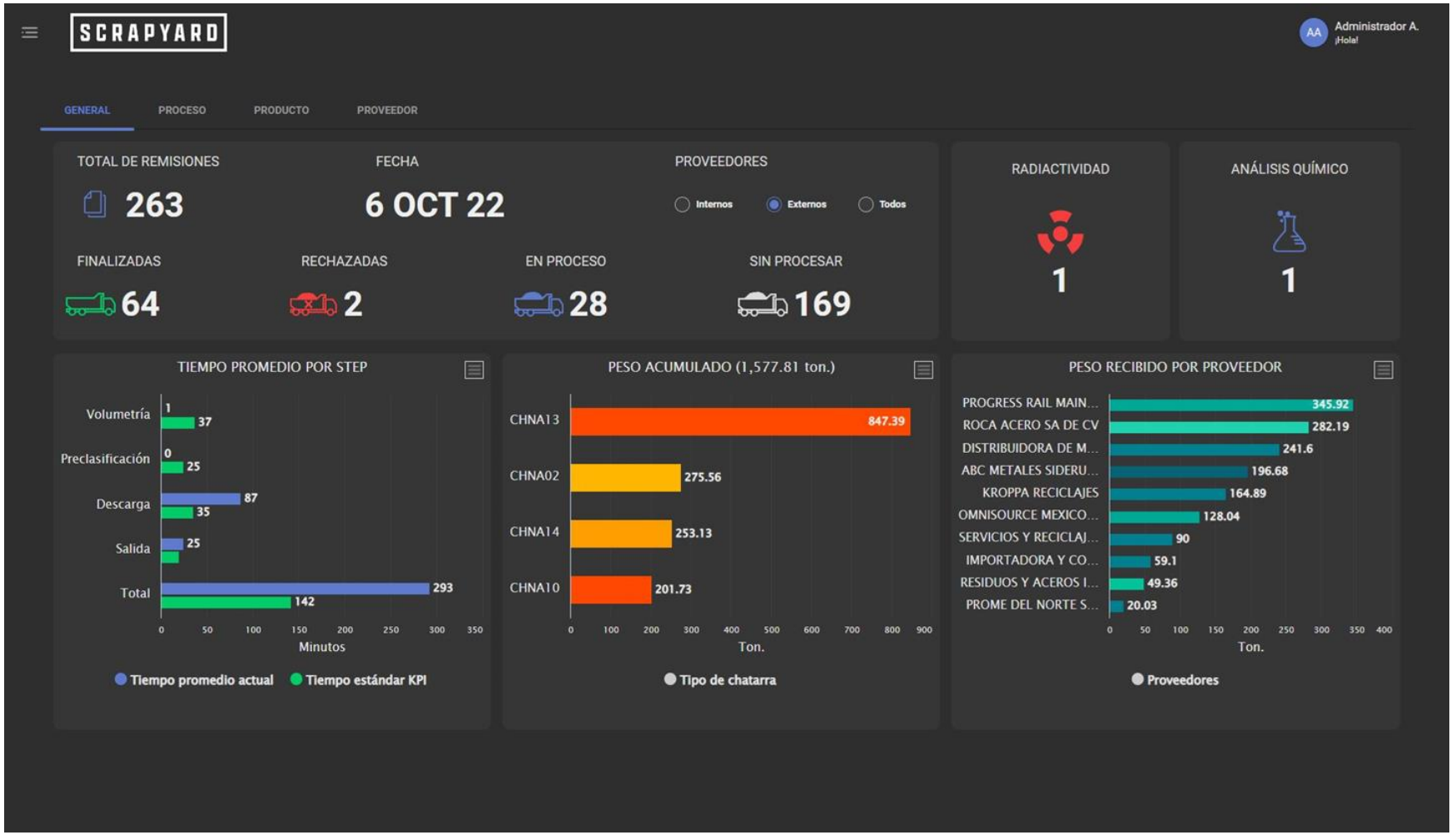
Active workflows



Workflow, data validation



Dashboards

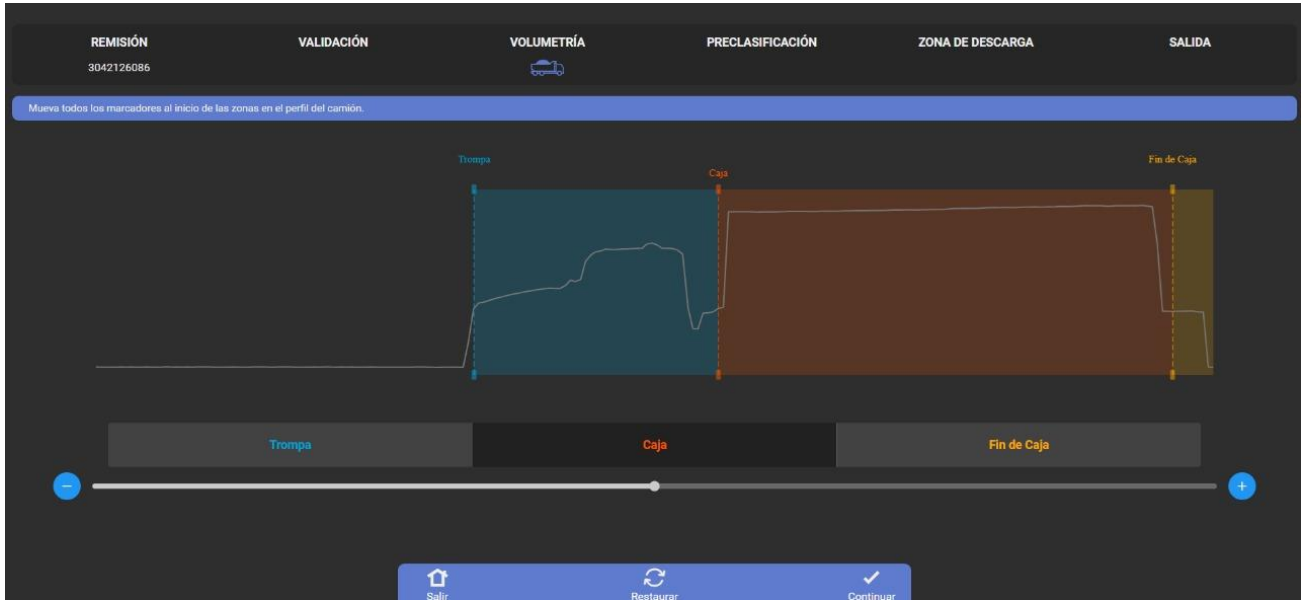

SCRAPYARD
Administrador A.
¡Hola!
GENERAL
PROCESO
PRODUCTO
PROVEEDOR
TOTAL DE REMISIONES
263
FECHA
6 OCT 22
PROVEEDORES
Internos
Externos
Todos
FINALIZADAS
64
RECHAZADAS
2
EN PROCESO
28
SIN PROCESAR
169
RADIACTIVIDAD
1
ANÁLISIS QUÍMICO
1
TIEMPO PROMEDIO POR STEP
Volumetría
Preclasificación
Descarga
Salida
Total
Minutos
Tiempo promedio actual
Tiempo estándar KPI
PESO ACUMULADO (1,577.81 ton.)
CHNA13
847.39
CHNA02
275.56
CHNA14
253.13
CHNA10
201.73
Ton.
Tipo de chatarra
PESO RECIBIDO POR PROVEEDOR
PROGRESS RAIL MAIN...
345.92
ROCA ACERO SA DE CV
282.19
DISTRIBUIDORA DE M...
241.6
ABC METALES SIDERU...
196.68
KROPPA RECICLAJES
164.89
OMNISOURCE MEXICO...
128.04
SERVICIOS Y RECICLAJ...
90
IMPORTADORA Y CO...
59.1
RESIDUOS Y ACEROS I...
49.36
PROME DEL NORTE S...
20.03
Ton.
Proveedores

Detection of truck container

Context

SCRAPYARD® is an application that automates the processes in scrap handling, specifically one of these processes is obtaining information from the trucks that transport scrap.

The main interest is to determine the start and end of the truck container (markers).



Motivations & Objective

Motivations.

- Reduce human intervention in SCRAPYARD® application.
- Automate the acquisition of markers that indicate the start and end of the truck container.

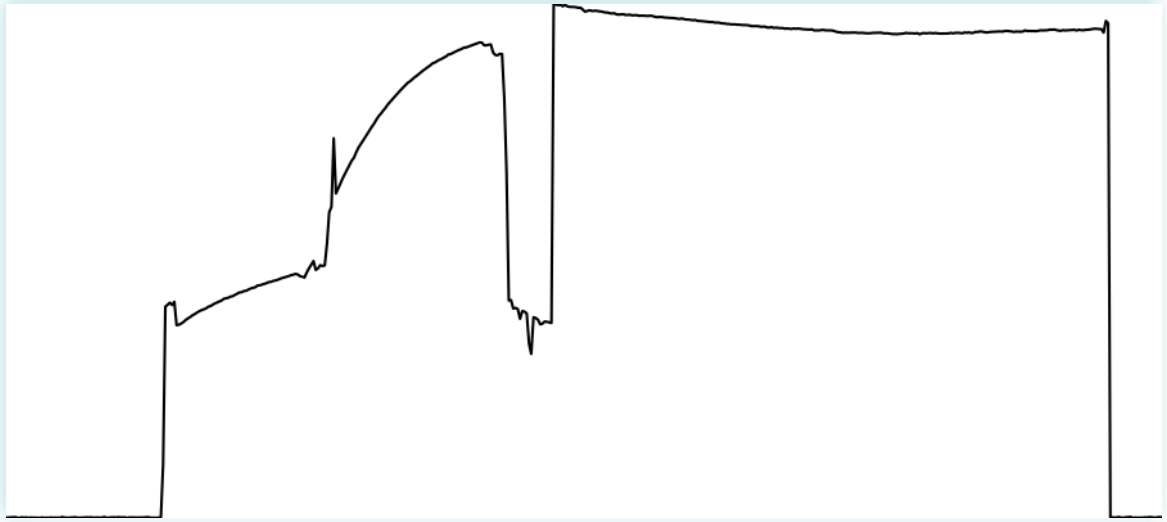
Objective.

- Predict truck container start and end markers using computer vision models specifically a detection model.

Technical Approach

Get data.

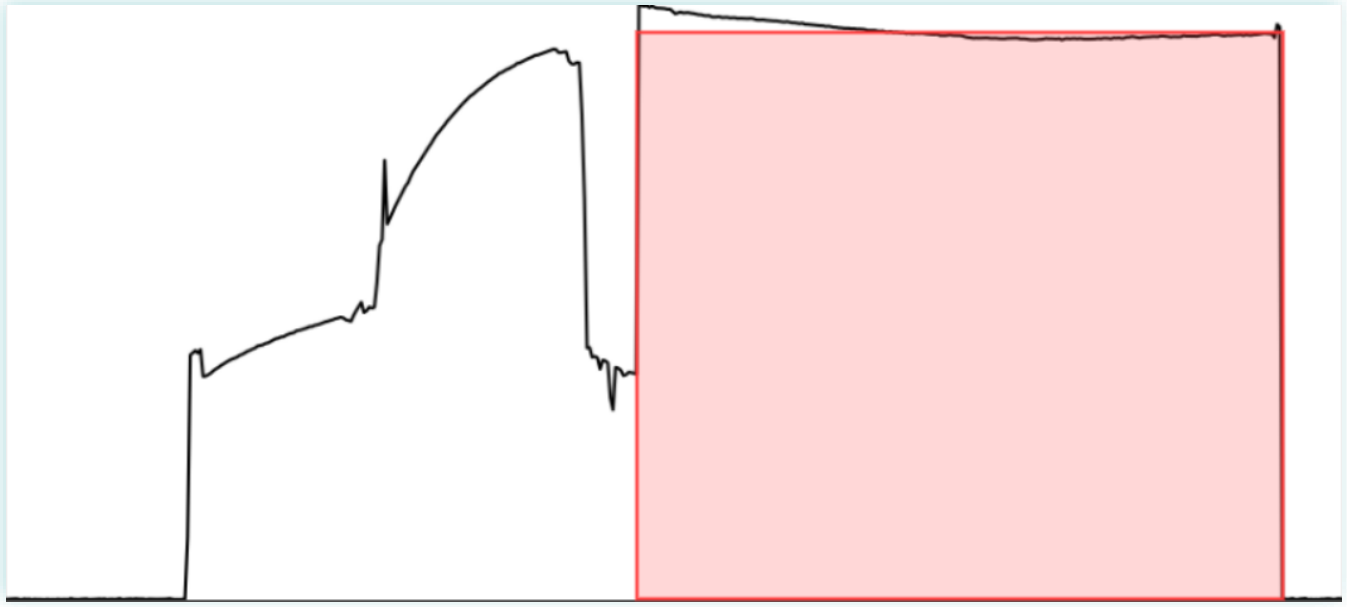
In SCRAPYARD®, the information of the truck profile obtained by means of a LIDAR sensor is stored with this data we can get the dataset.



Example of truck profile image

Modeling

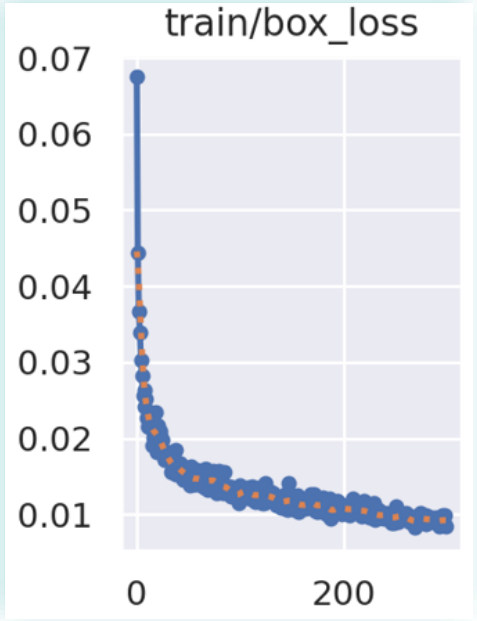
- The dataset collected was split into training, testing and validation subsets.
- A detection model was trained to predict the location of the truck container.



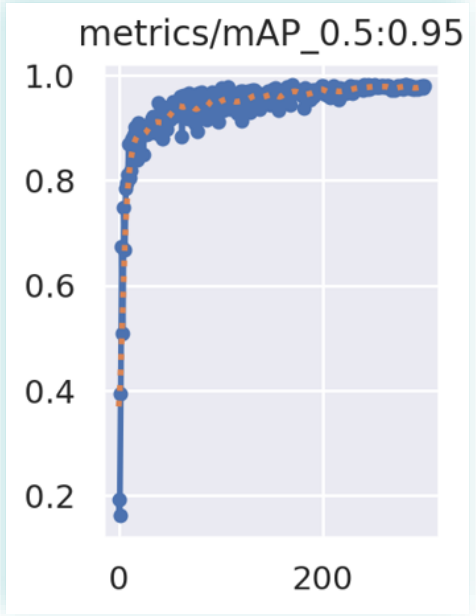
Example of labeling

Results

Training metrics.



Loss function from training



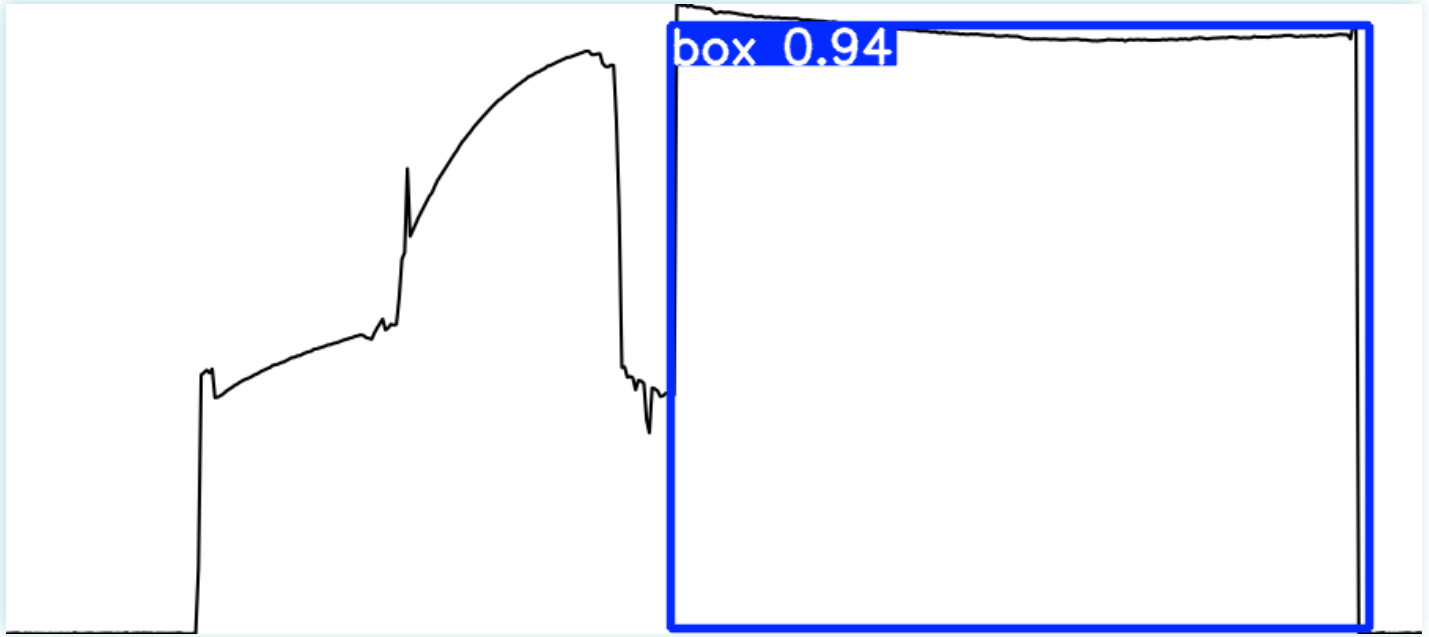
mAP (mean average precision) metric values during training

Box Loss: Measures how far off the predicted bounding boxes are from the actual object locations.

mAP: Tells how well the model detects and correctly classifies objects by averaging its accuracy across different difficulty levels.

Results

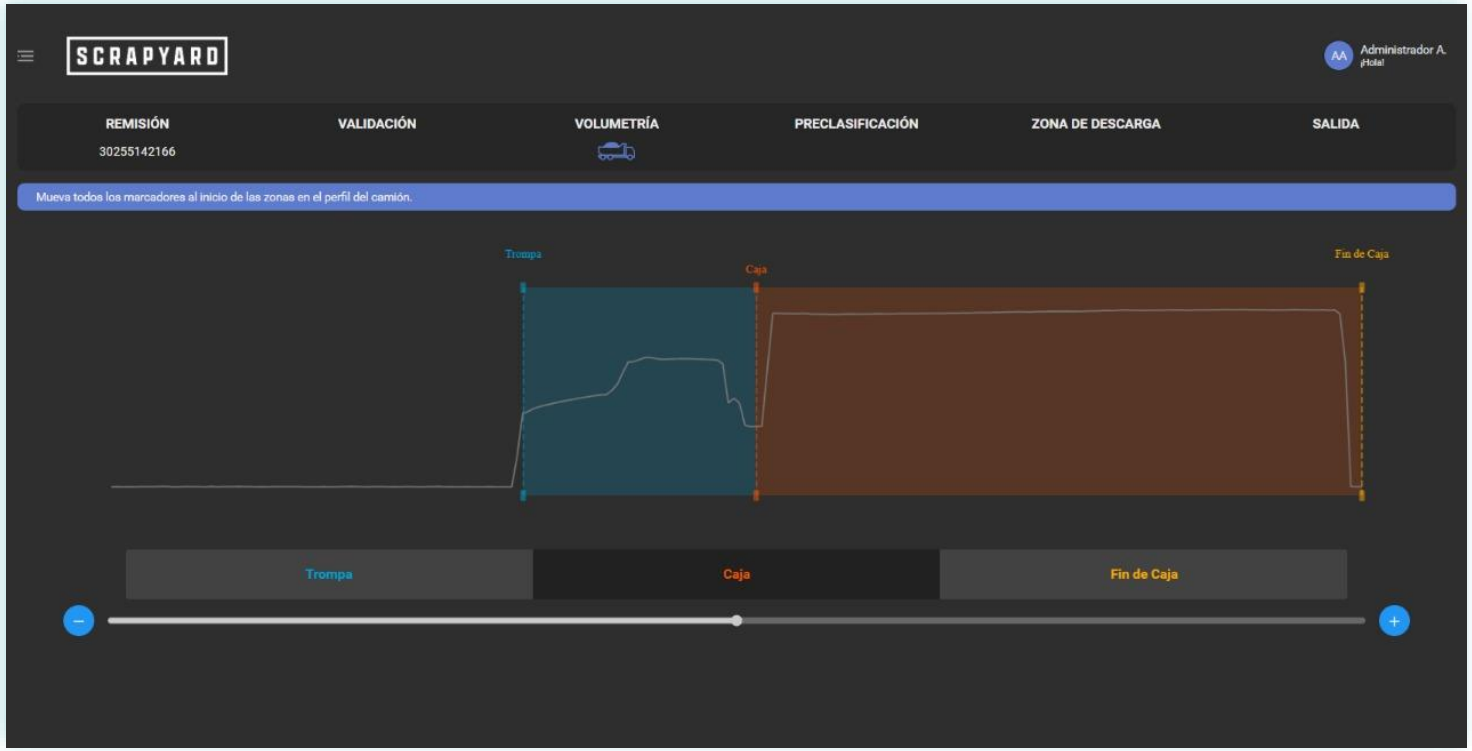
The model achieves **96% accuracy** in detecting the truck container.



Example of model predictions

Determine truck container markers

With the model predictions it is possible to obtain and locate the truck markers in SCRAPYARD®.



Example of the location of the markers for the truck container in SCRAPYARD®

Conclusions

- To address the issue of predicting truck container markers, we decided to use a detection model that showed acceptable results.
- The accuracy of the model in detecting the truck container is 96%.
- Determining the location of the markers helps calculate the volume of the truck container.
- The purpose of reducing human intervention in the location of the markers is achieved.

Detection of hazardous objects

Context

SCRAPYARD® functions include the detection of potentially dangerous objects within recycled material.

The aim is to identify these objects before they reach the smelting furnace, where they could pose a significant risk, such as explosions or damage to equipment due to the high temperature of the process. To do this, a detection model based on artificial intelligence has been developed.

Motivations & Objective

Motivations.

- Remove dangerous objects before they reach the furnace.
- Tecnoap, through its SCRAPYARD® platform, seeks to reduce the risks of loss of human life or material in the process of scrap entering steel plants.

Objective.

- Identify and classify potentially dangerous objects in the scrap using computer vision models, specifically a detection model.

Modeling

Step 1: Data Collection

Images are gathered from real scrap processing environments to create a representative dataset.

Step 2: Data Processing

Each image is labeled to mark hazardous objects, ensuring the model learns to recognize them accurately.

Step 3: Model Training

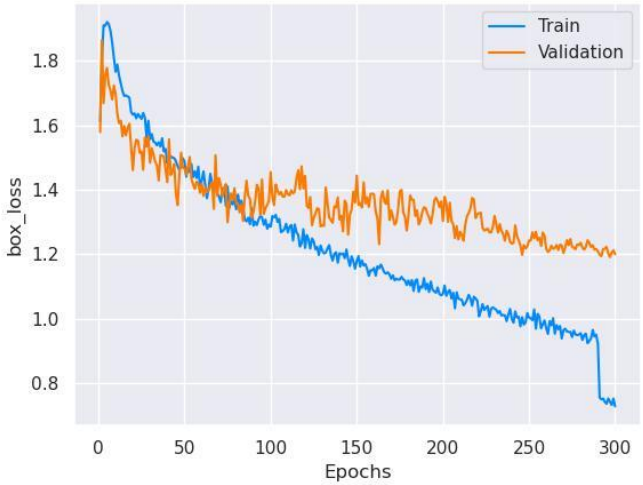
A model is trained using the annotated data to detect and classify potential risks.

Step 4: Real-Time Implementation

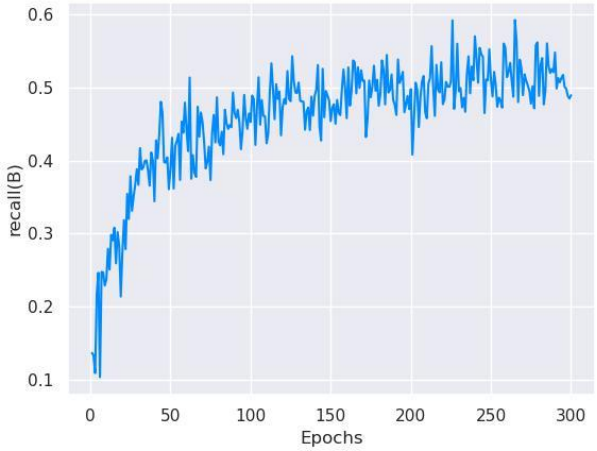
The trained model is deployed in an industrial environment, identifying hazardous objects before they reach the furnace.

Results

Training metrics.



Loss function from training



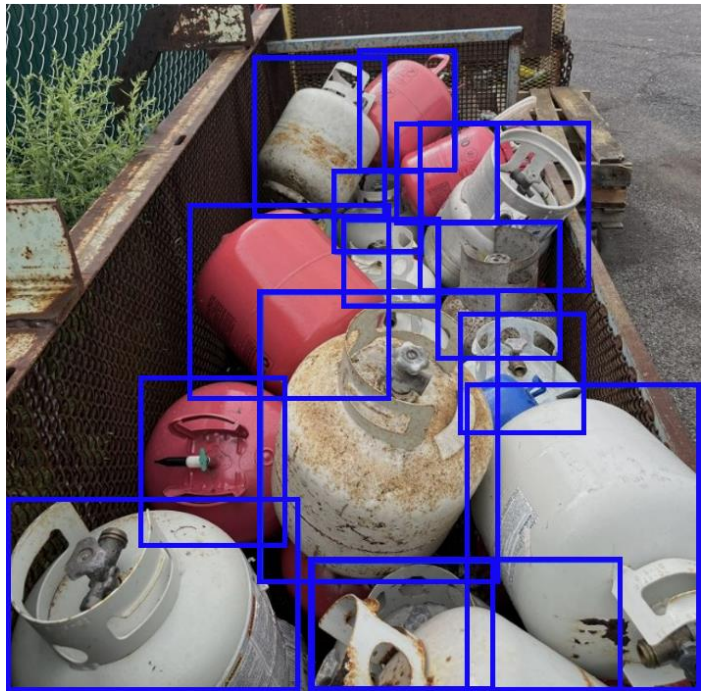
Recall metric values during training

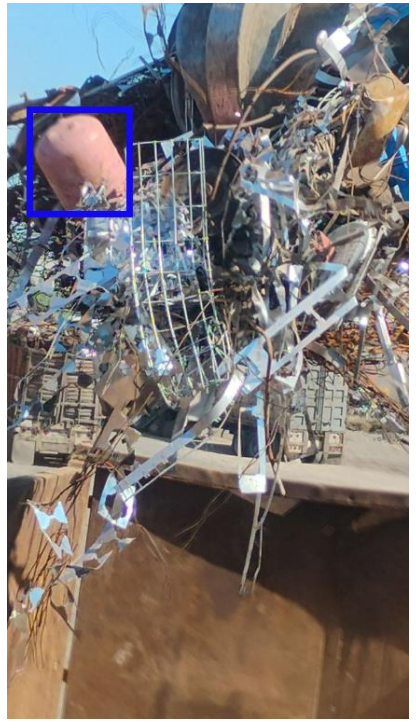
Box Loss: Measures how far off the predicted bounding boxes are from the actual object locations.

Recall: Tells how well the model identifies all relevant objects in the images by measuring the proportion of actual positives (true objects) that the model successfully detects. A higher recall means fewer false negatives, indicating that the model is good at detecting most of the relevant objects.

Results

The model achieves **76% recall** in detecting dangerous objects.





Example of model predictions

Results

Example of model prediction

Conclusions

- To address the problem of detecting dangerous objects in the scrapyard, we implemented an object detection model that has made significant progress in its development. Achieving 76% in recall.
- These results show an improvement in the model's ability to identify dangerous objects, contributing to a safer environment by reducing the risk of accidents.
- The performance of the model plays a crucial role in minimizing manual inspections, making the operation more efficient and safer.

Scrap characterization

Context

SCRAPYARD® requires the functionality to analyze scrap transported by trucks in order to establish strategies for scrap management.

The main interest is detecting large objects in the scrap metal.

Example of scrap

Motivations & Objective

Motivations.

- Establish strategies that optimize scrap management.
- Perform the dimensional characterization of scrap automatically.

Objective.

- Locate large objects using a segmentation model.

Technical Approach

Get data.

SCRAPYARD® stores images of trucks that transport scrap with this images we can get the dataset.

Example of truck with scap

Modeling

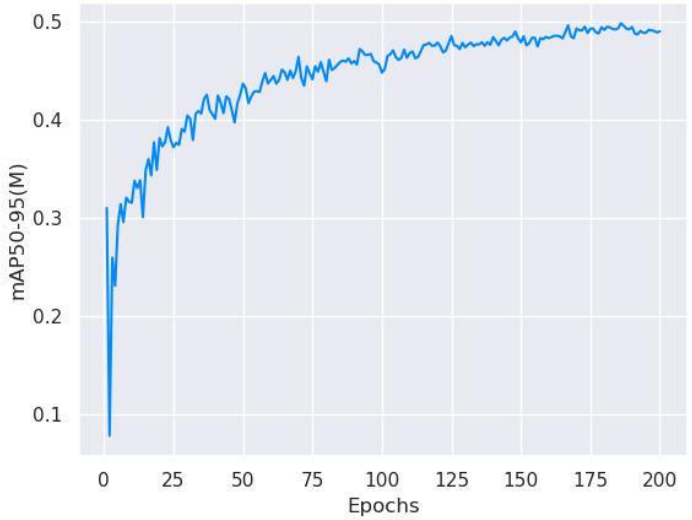
- Each of the images in the database was labeled, that is, identify the different scrap objects.
- A segmentation model was trained to detect the scrap objects.

Example of labeling

Results

Training metrics.

Loss segmentation function from training



mAP (mean average precision) metric values during training

Segmentation Loss: Measures how far off the predicted segments are from the actual object regions.

mAP: Tells how well the model detects and correctly classifies objects by averaging its accuracy across different difficulty levels.

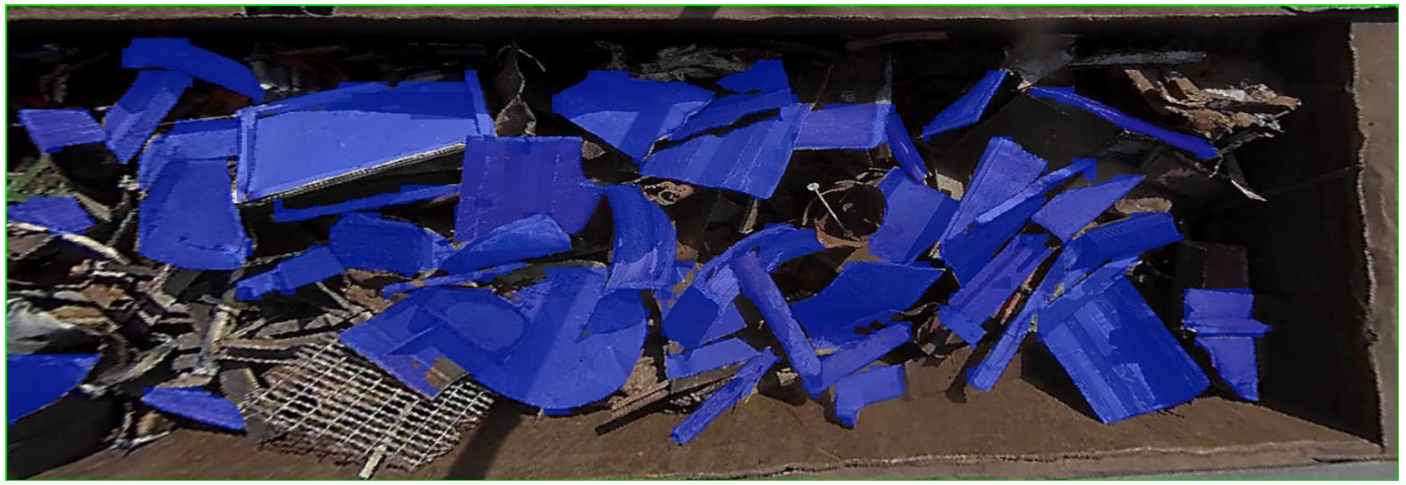
Results

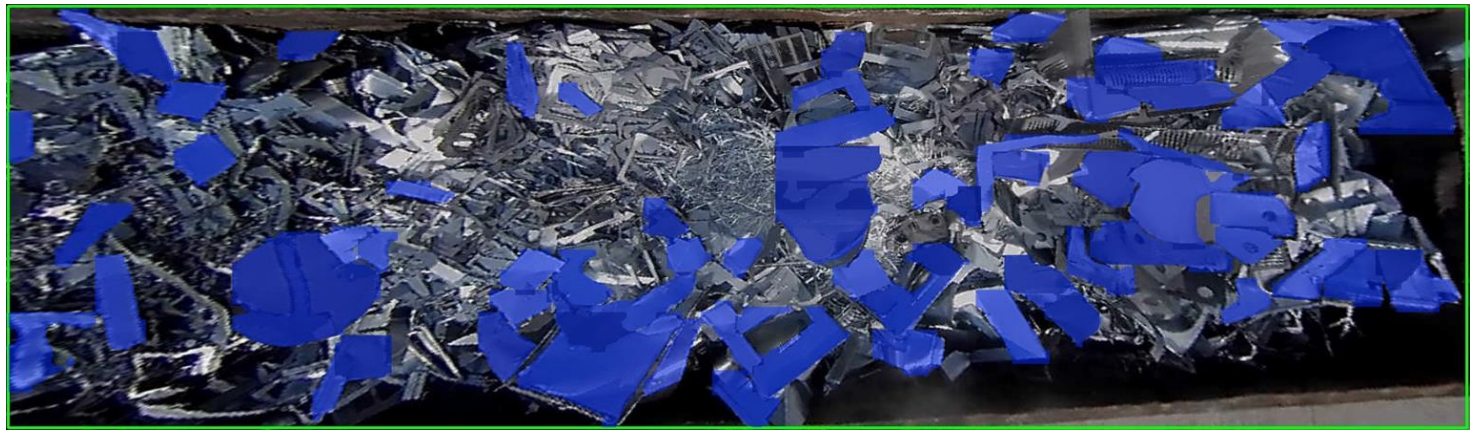
The model achieves **0.55** in mAP metric for test subset.

Example of model predictions

*The value of the mAP metric should be close to 1.

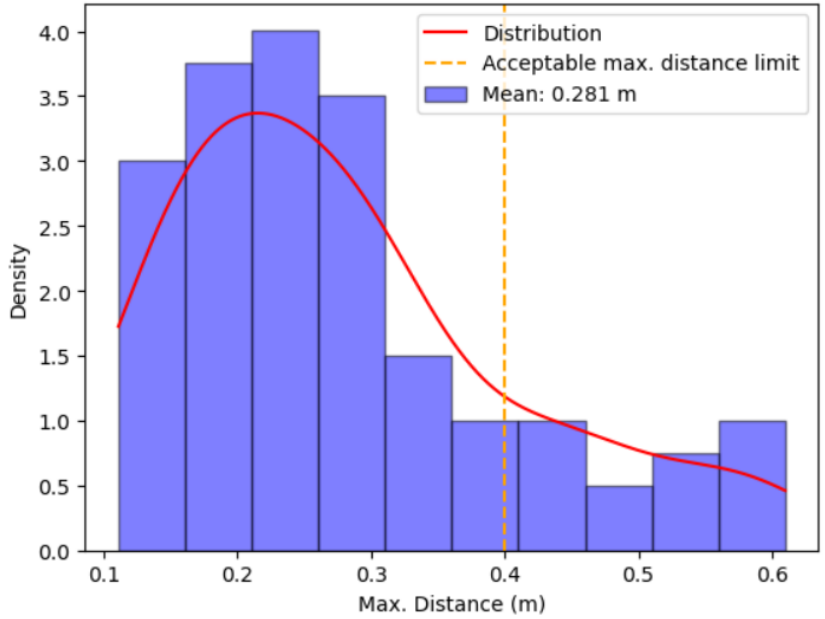
Model predictions

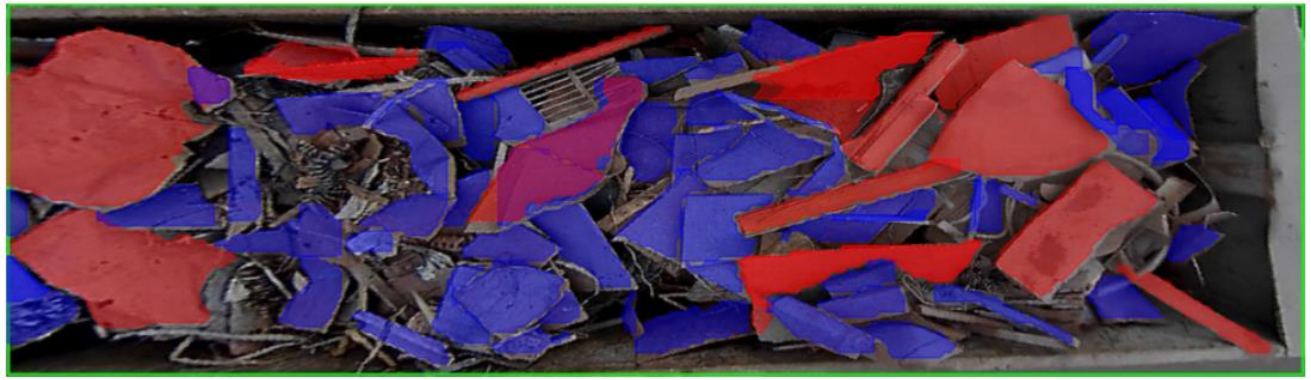




Results

Detect large objects.





*The maximum distance is the largest length that an object can have, measured between two points on its edge; it is equivalent to the longest diagonal that can be drawn.

Conclusions

- A segmentation model is suitable for analyzing the different objects in an image.
- It is possible to obtain a dimensional characterization of the scrap with the predictions of segmentation model.
- The KPI used to detect large objects is the maximum distance.

Conclusions, Business benefits

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SCRAPYARD® by tecnoap

Reduce uncertainty and variability in classification.	Streamline the process of scrap metal intake.	To reduce possible fraud in the entry of scrap metal.	Strengthen the human expertise of supervisors.
Real-time tracking of incoming scrap.	Information integrity between different departments and systems.	Agility and assertiveness in the audit process.	Improve operational safety.
Minimize controversies about scrap quality.	Assertiveness and reliability in payments to suppliers.	Visibility and control over critical scrap characteristics.	Increase productivity and process efficiency.

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Questions?

Thanks!

Contacto

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