Increased reuse within Second Hand with support from AI

Swedish Red Cross

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A project during 2023
Results:
60 000 pictures in Red Cross database + AI-model for sorting

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Challenges and background to the project

260 second-hand stores run by 220 local branches (own entities).

High local dependency on second hand, the main part of the branch's revenue comes from the second-hand stores.

Little cooperation between the stores – what is donated to one store is sold in the same store – if sharing data and goods new business opportunities will arise.

Lack of volunteers for sorting for second hand.

Increased competition as market for second hand grows, but also new opportunities.

Within Swedish Red Cross a national system for recycling of textiles are in place since long ago but no system for other materials, which will be needed.

A common sorting facility for unlocking new value streams are under discussion – if implemented, a system for collecting and sharing data is needed.

Could AI-sorting support us solving our challanges?

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A project for investigating how AI can increase the value of donations to Red Cross Second hand

Purpose

- To support us as second-hand actor and support increased sale within our 260 stores.
- Increased reuse of donations that cannot be sold in stores.

Project goal

✓ An AI-supported system that automatically categorize, weight and catch materials in donations.

Effect of project

✓ Higher and common knowledge of donated goods when it comes to product and materials.

✓ A national program for common handling of materials for recycling will be set in place.

✓ Curiosity from our local branches and confidence that new technology like AI can support our organisation to higher local cooperation and finding new value streams

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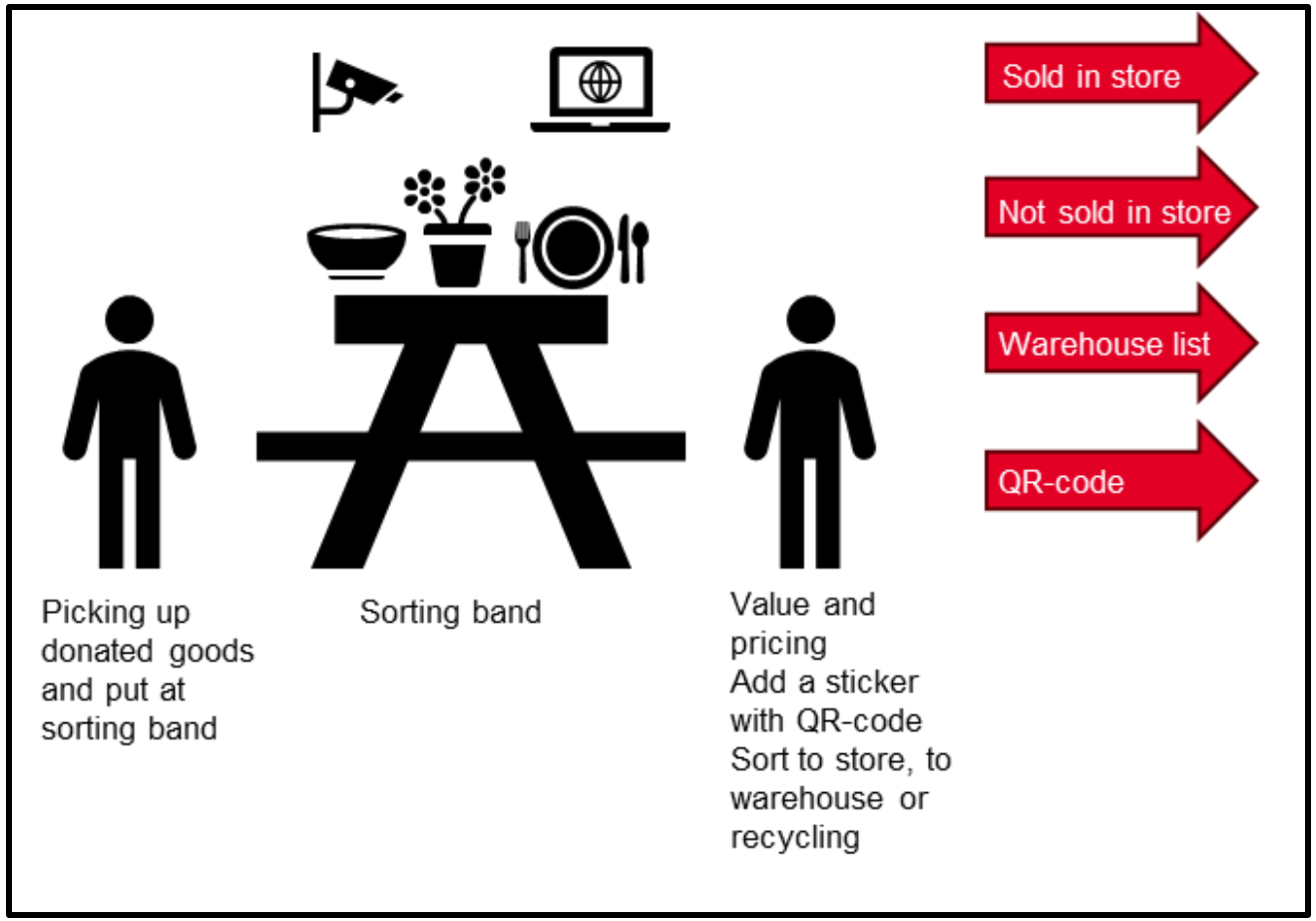
Vision

At the sorting facility goods are automatically sorted based on category and materials. Goods that has to low quality to be sold in a store is sorted in an own flow and will be sold for recycling. All donated goods are logged in a system with searching functionality. The number of volunteers needed for sorting is lower. More time can be used for securing that the goods is sorted to the store where the value can be unlocked.



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Project implementation and process

Project

- Project financed by Sweden's Innovation Agency
- Project lead by Swedish Red Cross, Team Local fund raising and second hand
- Technical participation and solution by Chalmers Industriteknik, an organisation close to Chalmers University of Technology which focuses on innovative research and development for sustainable society.
- Branch participation by Örebro Redcross.

Implementation

- At the store warehouse in Örebro
- Preparation of system, workplace and AI model by Chalmers Industriteknik
- 1 sorter at place at Örebro during 10 month for learning the system

Process at warehouse

- The sorter pickes up the donations
- The sorters puts the donation at a scale
- Two cameras takes photos of the donation
- The sorter gives information to the system; sellable/not sellable, materials and brand

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Result and learnings

Result

- 30 000 donations (60 000 images) have been scanned into an image database and registered as:
  - Sellable/not sellable in store
  - What donation and its weight
  - What material
- An AI algorithm has been developed that with 75-80% certainty tells what it is and what material it is and can say with 96% certainty if we recommend taking the item out of the store.
- A database for continuing work.

Learnings

- When implementing the model, we were soon able to see result from the AI-model and understood how to benefit from it.
- There are a lack of open databases where to retrieve and compare information, so we are dependent on our own database.
- We cannot find information about any similar project. Most likely there are systems in use, but used for sorting of second-hand clothing, where there are more commercial actors involved.
- During the project we understood how to further benefit from a system like this. Additional data and functionality would increase the value of the model.
- A person is faster than the system to value but by only using a person we don't get the data

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Next steps – not yet decided

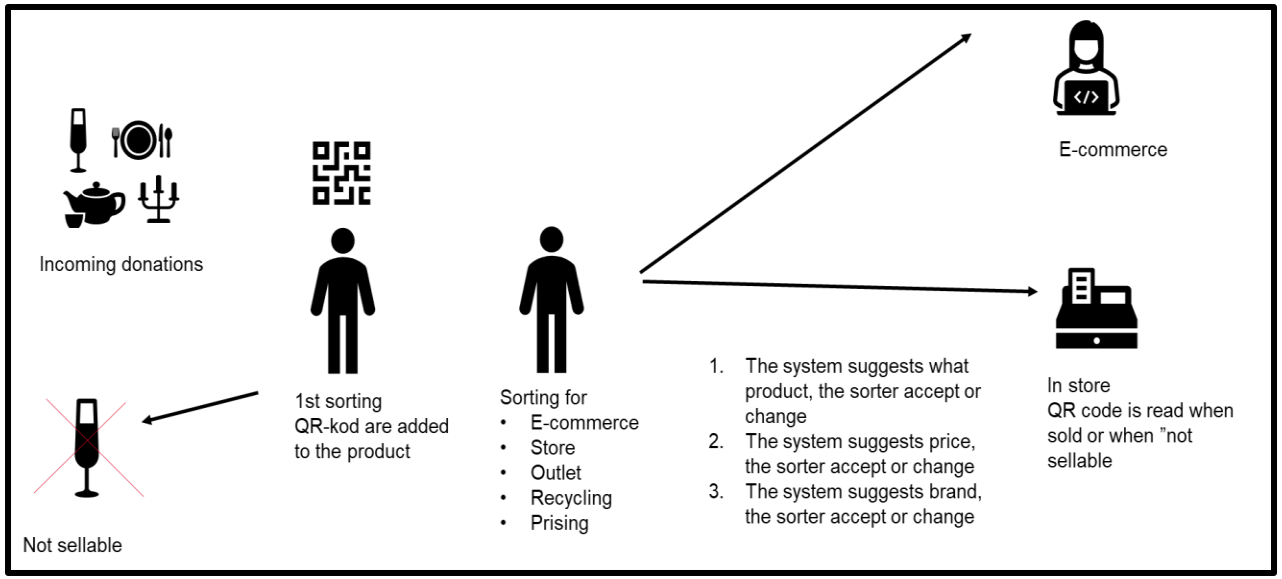
Customized warehouse management system connected with the cashier system

Developing of the model

- Add model with other categories
- Add model with brands
- Add the model with open sources

Developing of distribution - create an app for each Red Cross store to use and connect to the system

- Each store could upload images in the common data base.
- Each store could search for items in other Red Cross stores or warehouse to support customers
- Unified way of presenting articles in a future online shop
- Possible to find missing object in a set (for example coffee cups, plates..)
- Using foundation models for finding out the real value of secondhand object for bigger revenue
- Getting better statistics for the gifts what red cross obtains



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Technical solution

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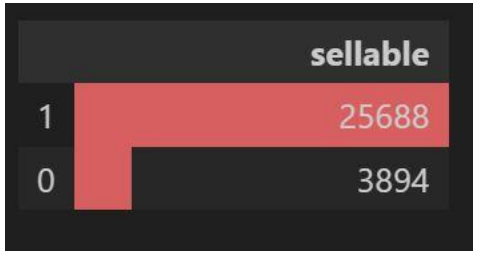
Data collection

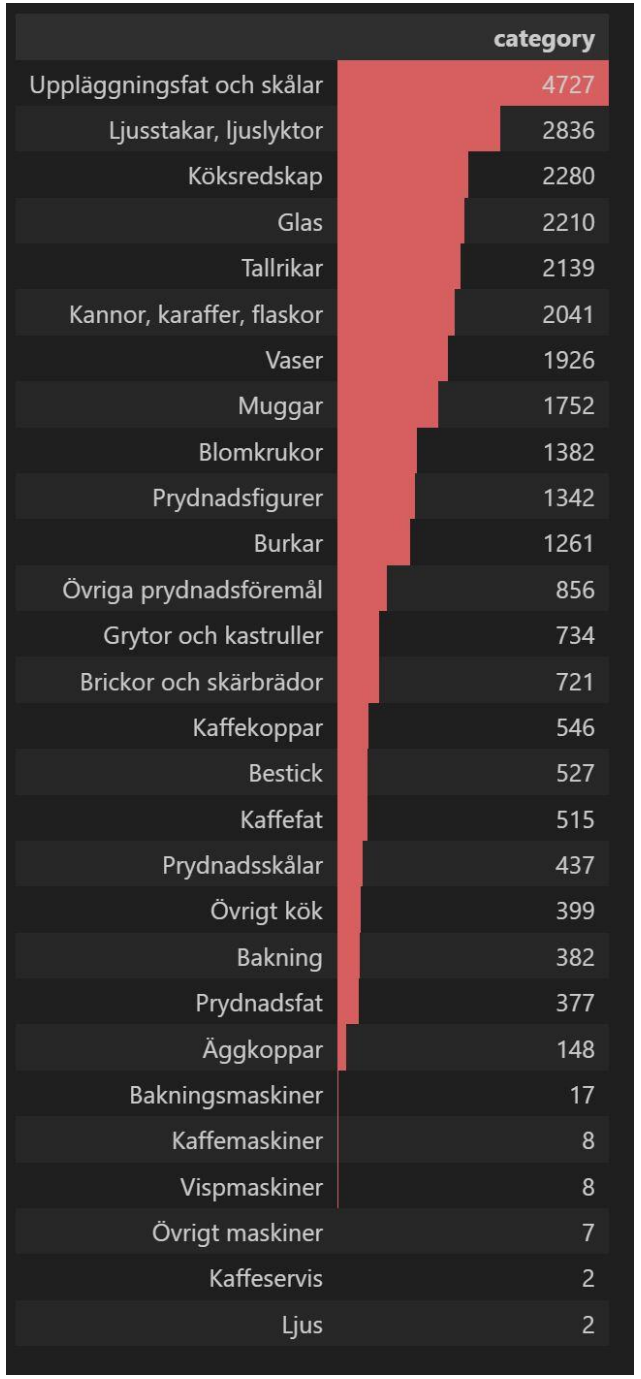
Data

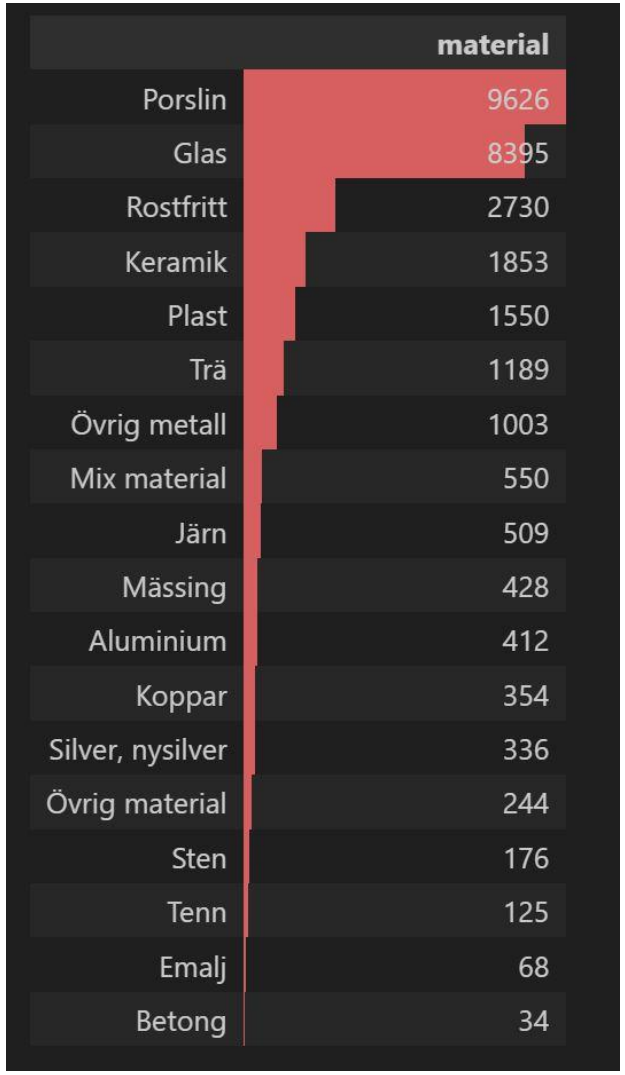
- Approx. ~10 months of data collection:
- Labelling of data
- 59 342 images of 29 671 objects
- Personal experience of decision: sellable or non-sellable

Result

1. Object detection model ~95% accuracy
2. Object classification model ~75-80% accuracy for category and material
3. Sellable: ~96% for sellable and ~32% for non sellable







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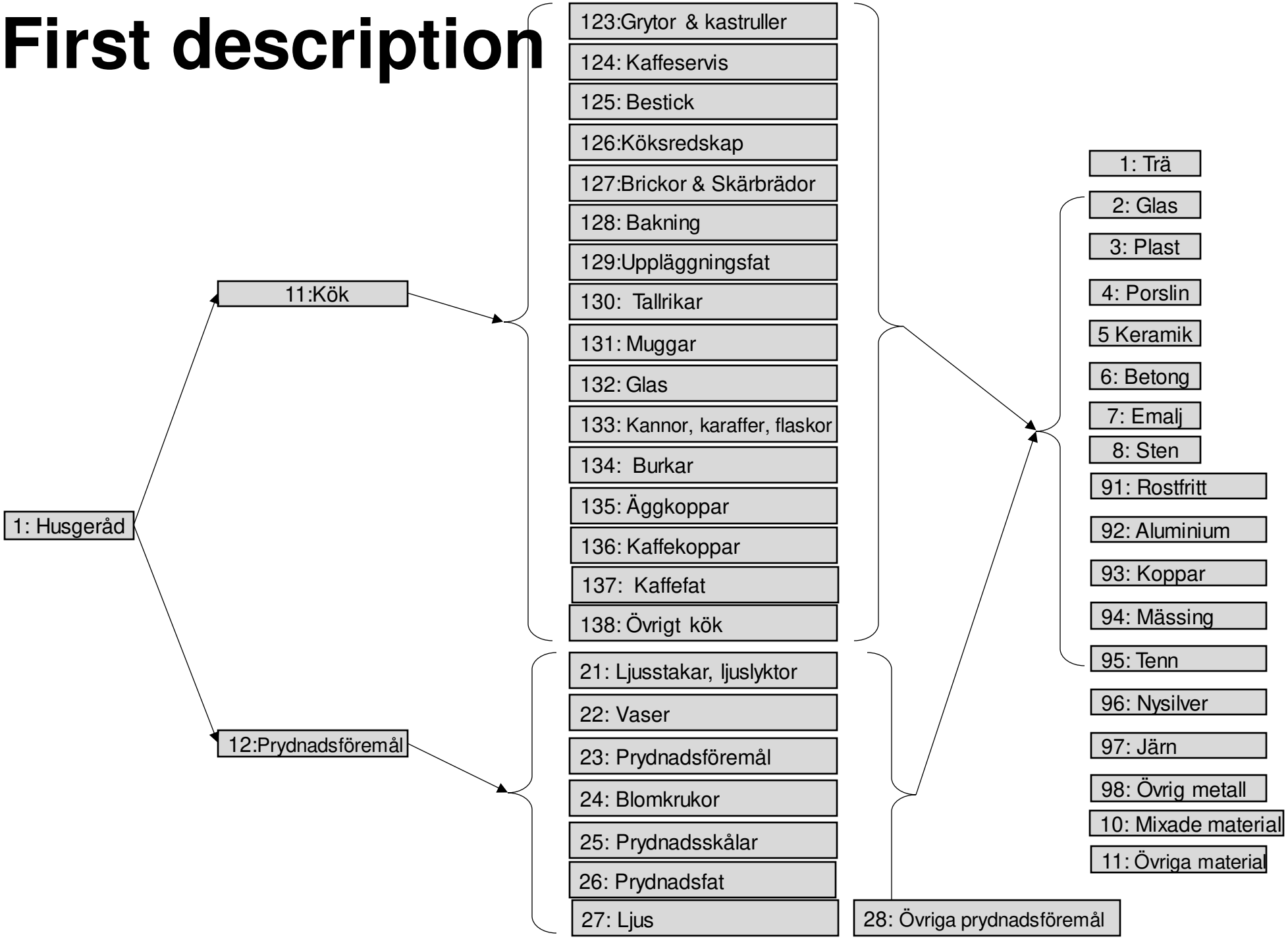
First description



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Hardware setup

Basic components:

- 2 Cameras from different angles
- Scale for weight measurement
- Router for saving to cloud
- Computer and screen

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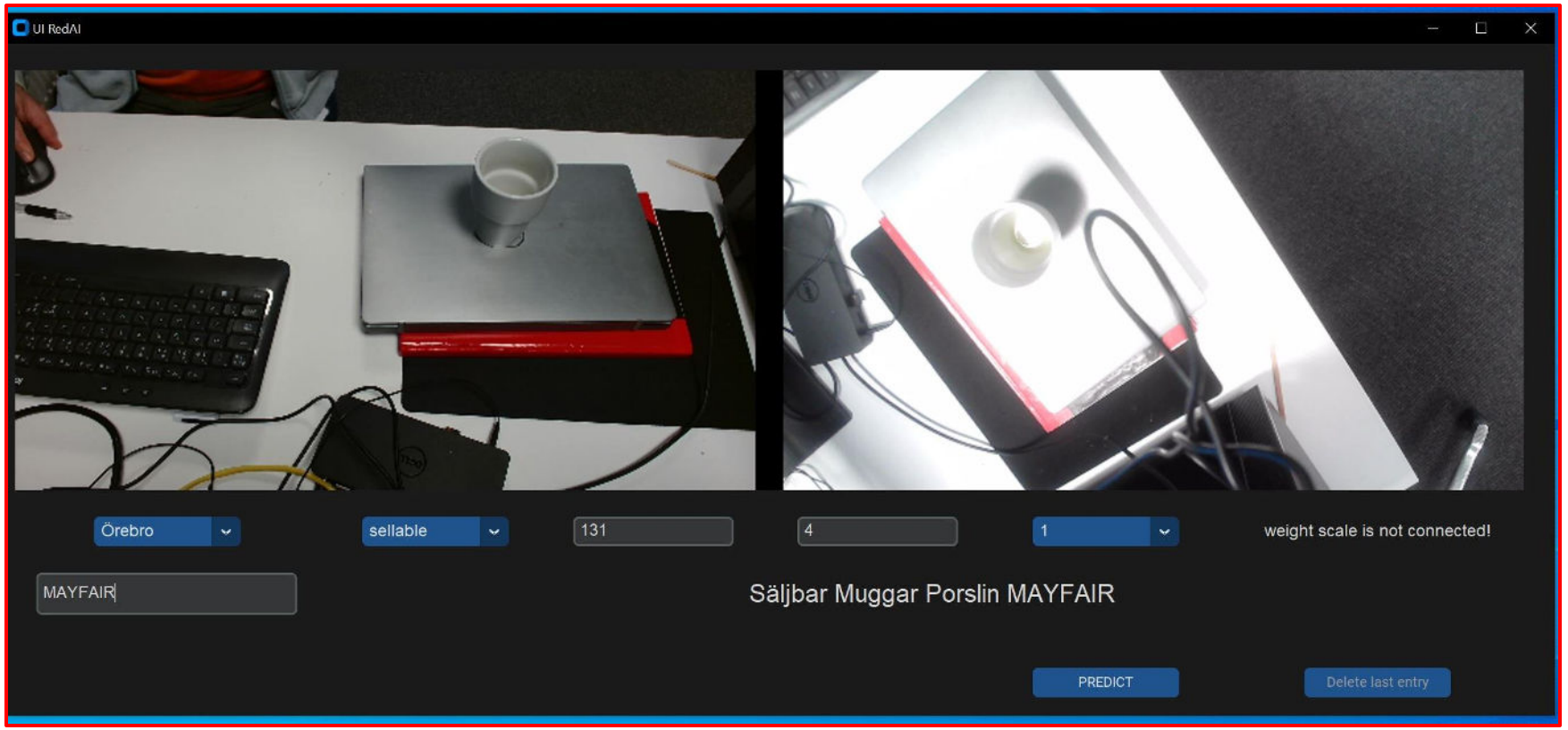
Graphical User Interface for data collection

Data labelling:

- City: where the gift comes from
- Sellable/Not sellable
- Category
- Material
- Brand



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Object detection model

- Customized pretrained object detection model 95% accuracy
- Localize the object in the image
- Crop image the object according the localization
- Minimizing the surrounding artifacts
- The surrounding effects leads to the confusion for the classifier model

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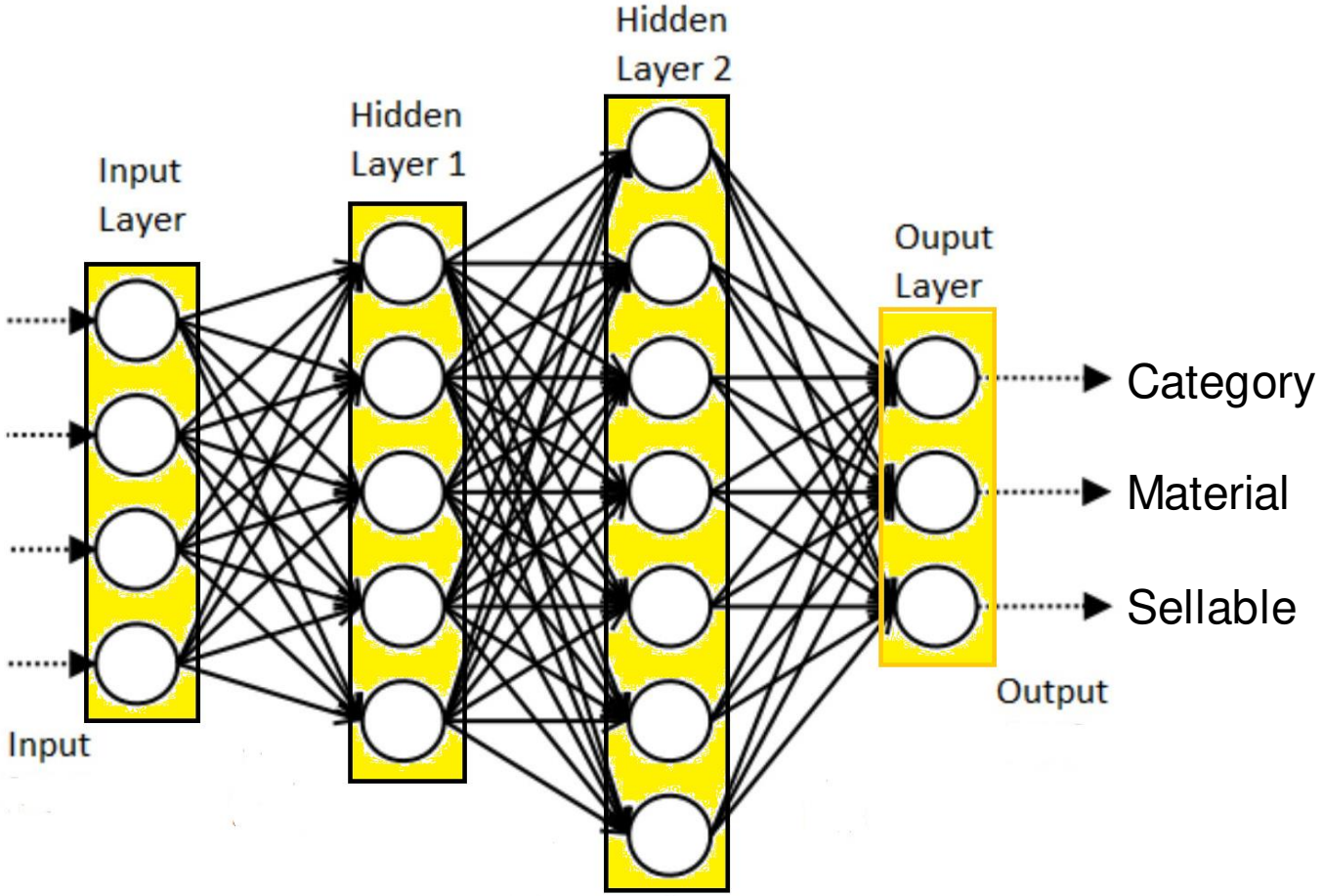
Object classification model

- Transformer based Multilabel Model
- Input: Image, Weight (optional)
- Output : Category, Material, Sellable



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Confusion Matrix

- Organizing the predicted values compared to the real values
- Accuracy: Number of correct predictions made by model divided by total number of predictions

$$\text{Accuracy} = \frac{TP + TN}{TP + TN + FP + FN}$$

	Predicted Cancer	Predicted **No** Cancer
Cancer	TP	FN
No Cancer	FP	TN

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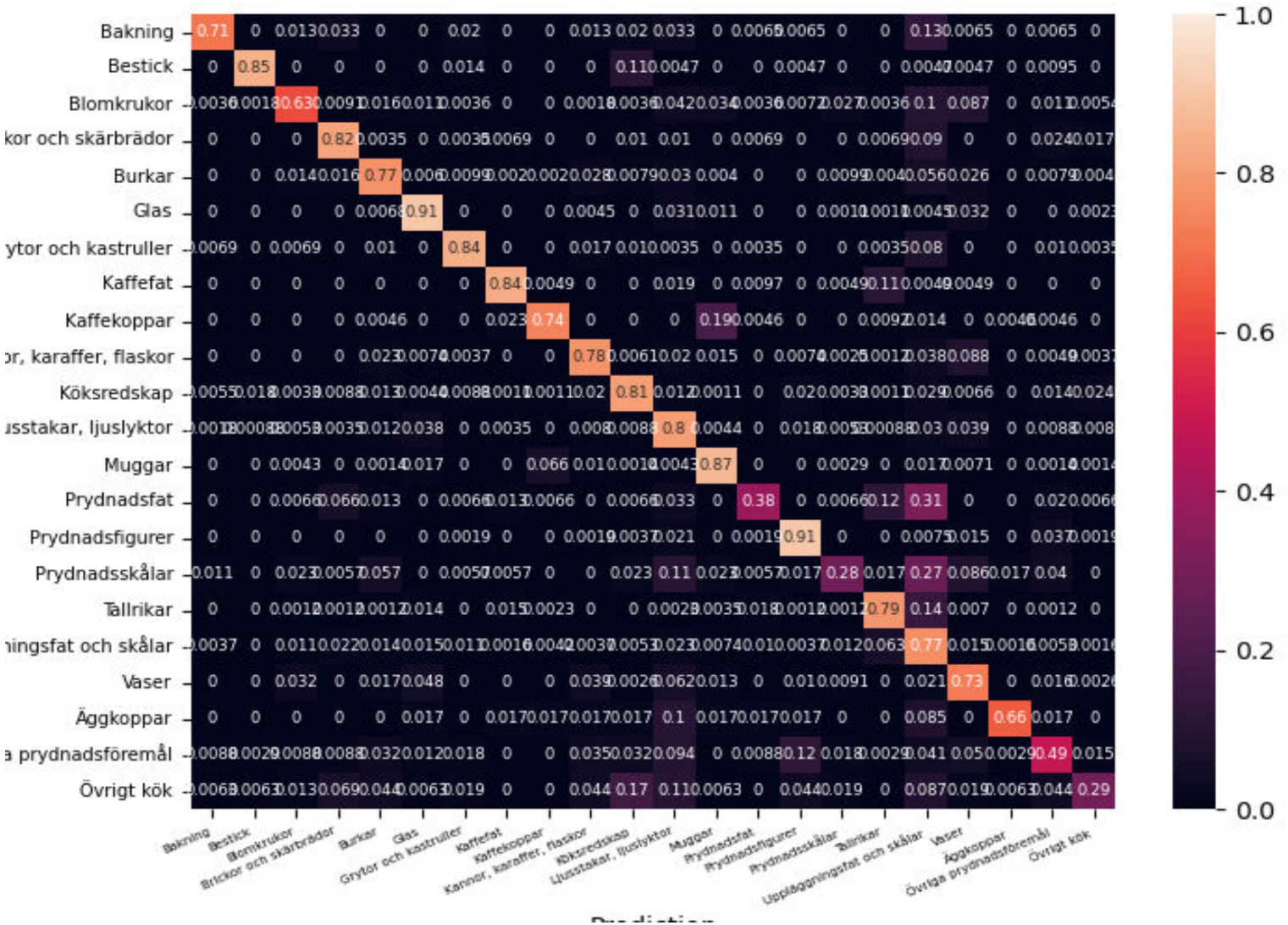
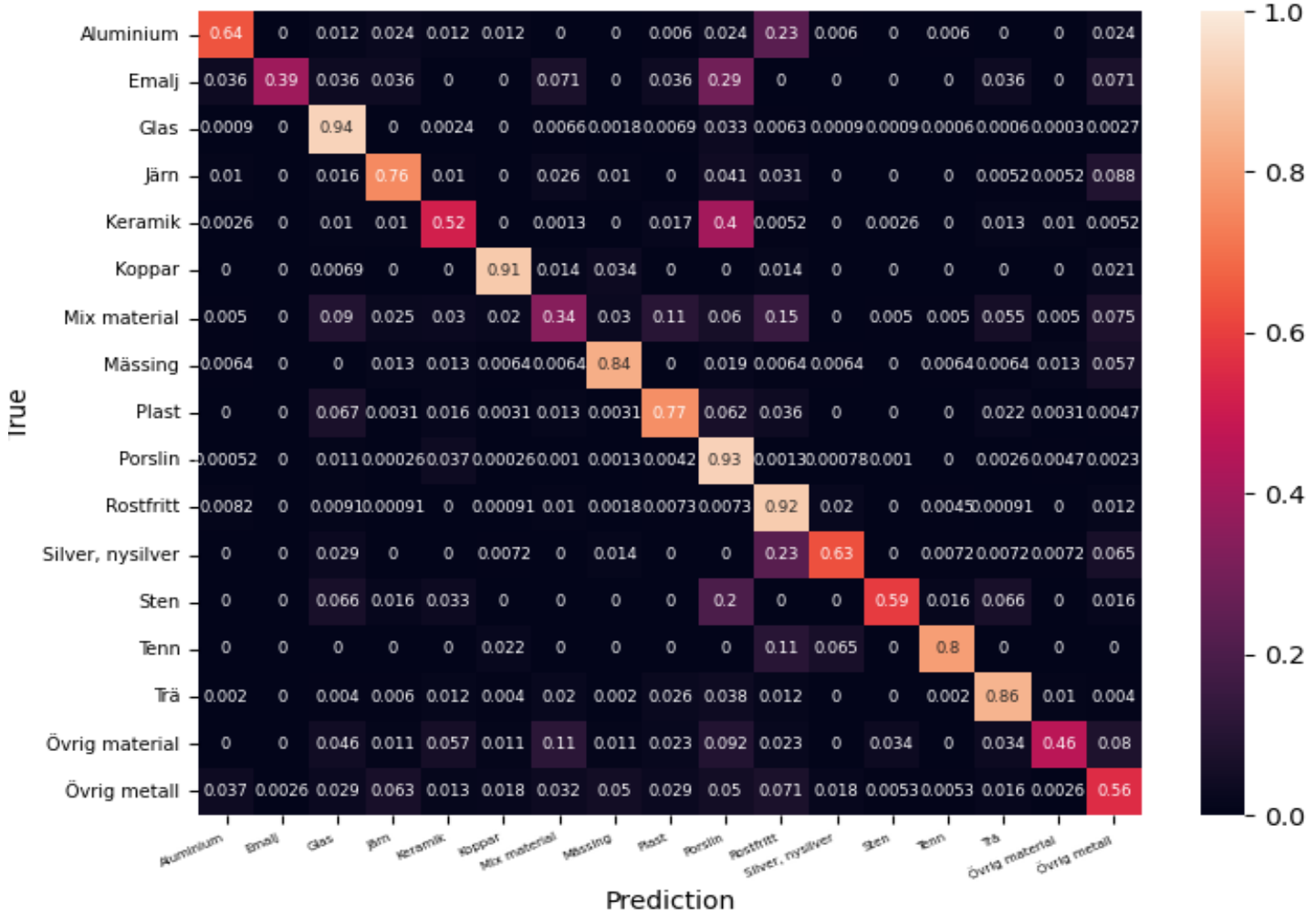
Confusion Matrix: Category

- Organizing the predicted values compared to the real values
- Accuracy: the diagonal gives the accuracy per class
  - 1- Baking: 71%
  - 2- Cutlery: 85%
  - …
  - 6- Glasses: 91%
  - …



Confusion Matrix: Material

- Organizing the predicted values compared to the real values
- Accuracy: the diagonal gives the accuracy per class
    1- Aluminium: 64%
    2- Enamel: 39%
    3- Glass: 94%
    …
    …



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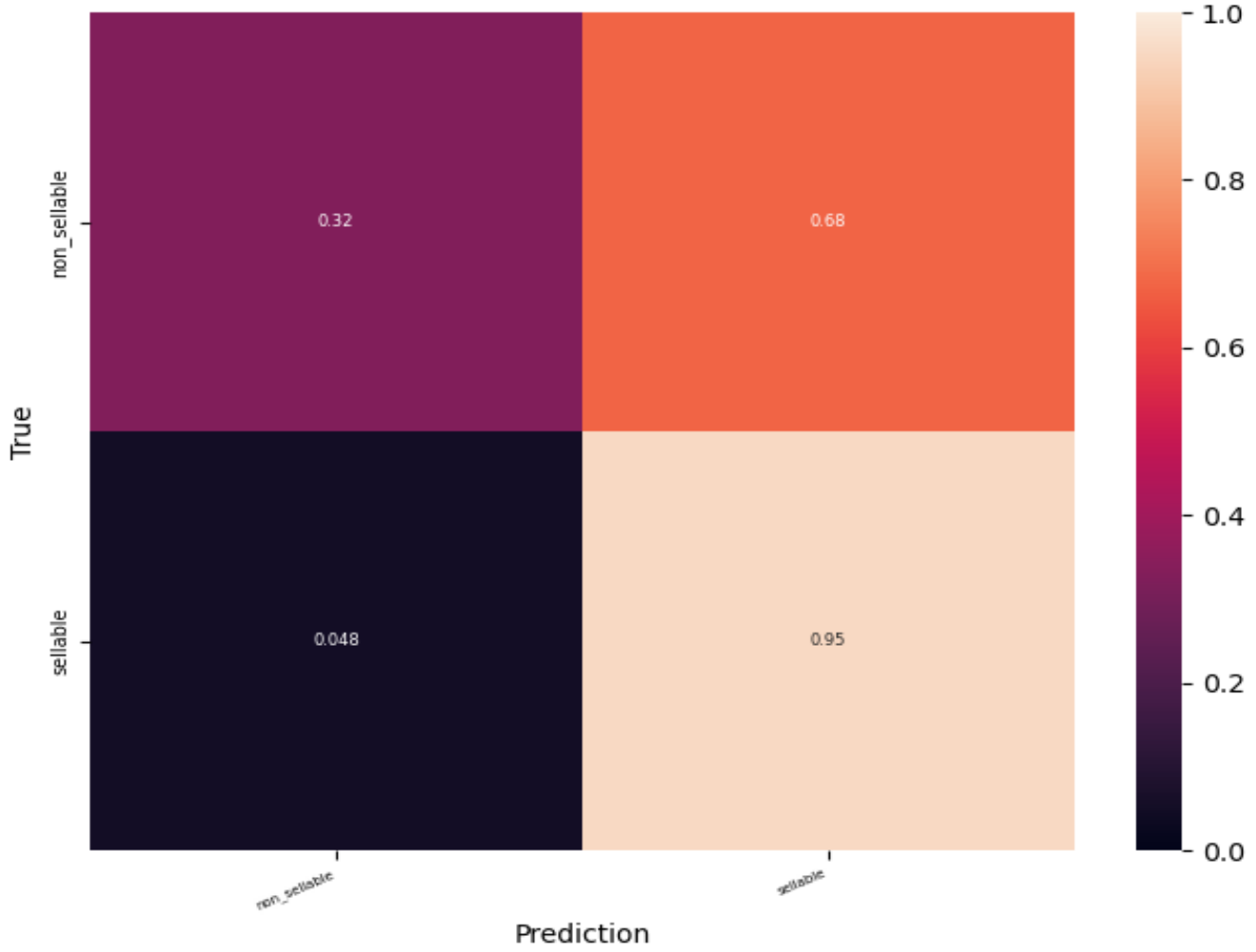
Confusion Matrix: sellable

- Organizing the predicted values compared to the real values
- Accuracy: the diagonal gives the accuracy per class
    1- non-sellable: 32%
    2- sellable: 95%



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Thank you for your interest!

If you have further question, please contact

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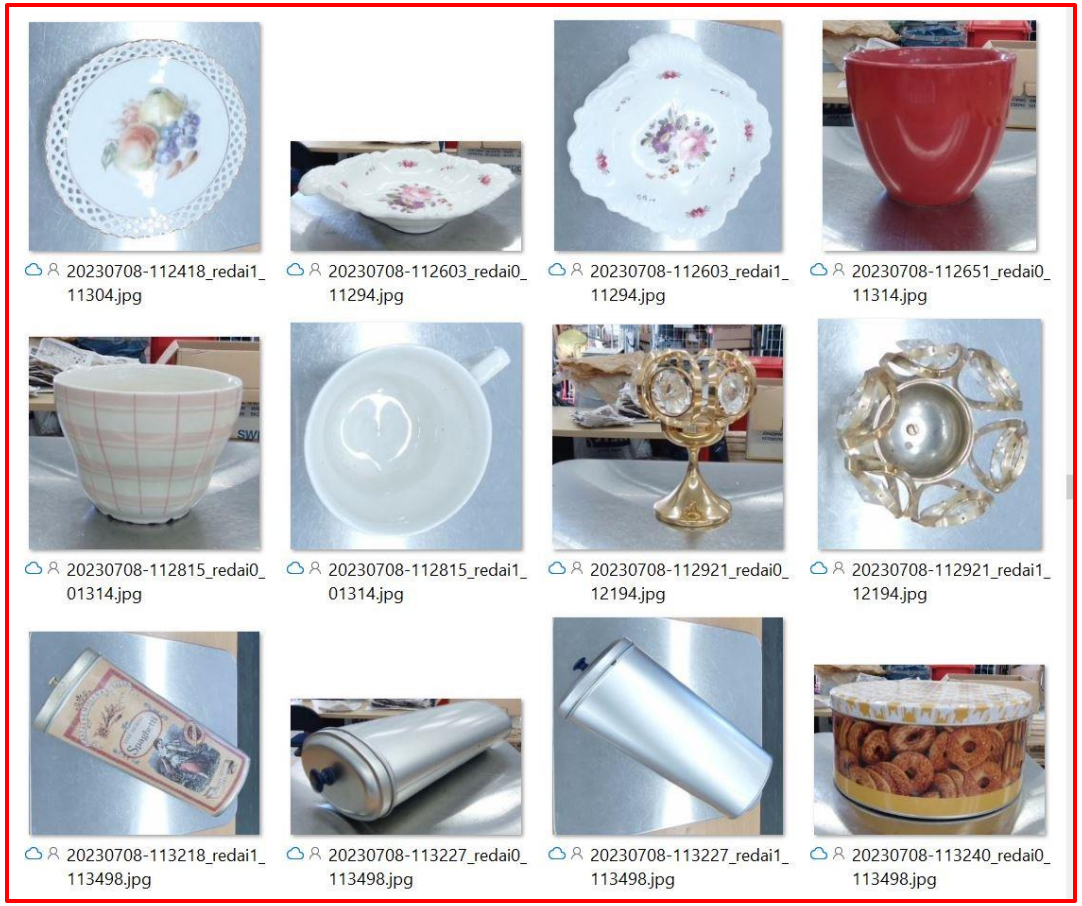

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