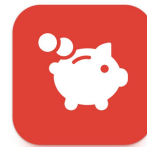


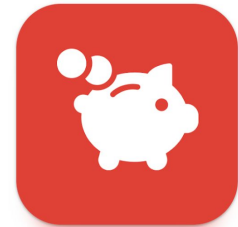
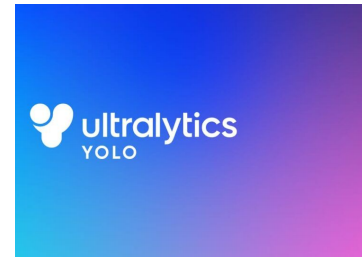
# Detect, Scale, Extract: Product and Price Recognition in Promotional Flyers using YOLO and OCR

Client: VG Lab



# Agenda

1. Introduction
2. Methodology Overview
3. Experimental results
4. OCR Pipeline
5. FastAPI Deployment
6. Demo of System (10 minutes)
7. Risk Management
8. Limitations and Future Work
9. Discussion
10. Conclusion



# 1. Introduction

**MENY**

Alt du trenger til  
**PINSEHELGEN!**

**FASTE SOMMERPRISER**

**JACOB'S UTVALGTE PLUKK & MINS**

**3 for 2**

ALLE PRODUKTER  
33% RABATT VED KJØP AV 3

**PINSSENS BESTE TILBUD**

Med for du over 500 tilbud på alt du trenger til pinsehelgen! Med over 500 tilbud på alt du trenger til pinsehelgen! Med over 500 tilbud på alt du trenger til pinsehelgen!

**2490** / kg  
**6990** / kg  
**3490** / kg  
**30%**

FA OVER 500 BILLIGE VARER LEVERT HJEM FRA MENY.NO

**FYLL HANDLEKURVEN TIL 17. MAI!**

**4990** / kg  
**6990** / kg  
**2490** / kg  
**25%8**

**REMA 1000**

**KIWI mini pris**

Kjøp kjøpt, trygt og billig

**17% BONUS**

**4 for 3000** + gratis

**4990** / kg  
**11900** / kg

**HÅNDVERKSPØLSER BRATWURST, CHILI CHEESE, RØKT KYLLINGPØLSE**

240 g, Soup Vids, Fokets, pr. kg 20750

**SOMMERKOTELETTER**

Ca 13 kg, bekonet, Fokets, pr. kg



# The Challenge



**RED BULL**  
199<sup>00</sup> - post  
**RED BULL BRETT**  
Isopopskål, 12x470 ml / 188  
2 literer gratis i løn, menings 1. uke!

**Big One**  
40,-  
Medlems-PRIS!  
Hver liter gratis i løn, menings 1. uke!

**ELDERADO PIZZABUNN XXL**  
550 g pr. stk  
36.36 /KG  
20,-  
XXL ORIGINAL 131

**WALDORFSALAT**  
19<sup>90</sup>  
Miks, 350 g, pr. stk / SEK  
1 literer gratis i løn, menings 1. uke!

**TINE**  
Tropisk yoghurt  
90g - Best før 23.04.2024  
4,-

**Nugatti**  
Salt karamell  
2325g - Best før: 29.06.2024  
25,-

**EXTRA** Gjør det billig!  
-20% på **BURGERE**  
I hele sommer  
9<sup>90</sup> 25<sup>00</sup> 29<sup>90</sup>  
-30%  
89<sup>90</sup>

**Godt til middag** 49<sup>90</sup> pr. stk.  
Middagsrett med kjøtt og potet  
Perfekt tilbehør -30%  
20

**SITRONER**  
2000 gram, 100% sitroner  
249<sup>00</sup> pr. kg  
20

**BONUS 25% PA 8**  
HER ER DENNE UKENS 8 UTVALGTE!  
Tjen bonus i REMA-appen!  
Det er sluttsummen på kassalappen som teller!



# Problem Definition

What is exactly the problem we are trying to solve?

**Main Issue:** Lack of Automation

- Detect product images
- Exact product names and prices
- Identify their positions on a flyer page



# Motivation and The Kupp Application

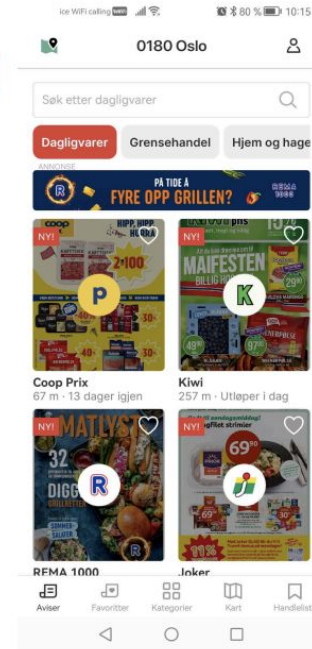
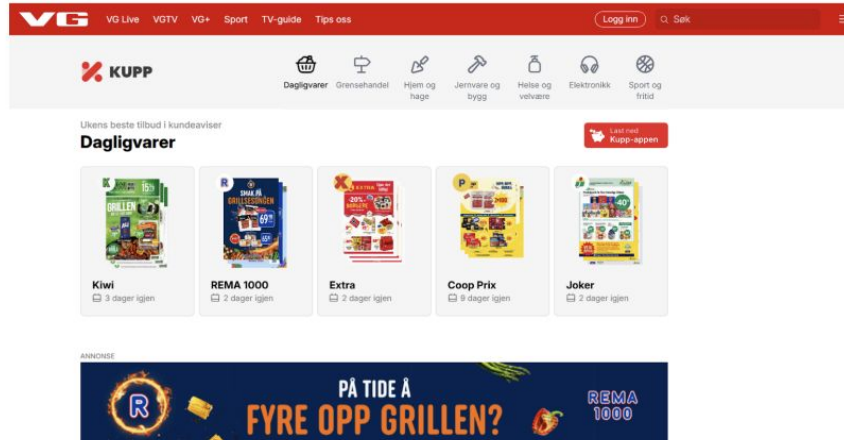
**Goal:** Help users save time and money

**Motivation:**

- **Automate** flyer data extraction process
- **Improve** the **speed** and **reduce human error**
- Deliver **real-time, structured and accurate** deal information



# Motivation and The Kupp Application



# Key Tools





# Challenges

1. Flyer Complexity & Design Variability
  - a. 3 for 2 deals
  - b. Krone-Marked
2. Lack of Specialized Training Data
  - a. Brown Cheese
  - b. Caviar on Tube
3. Technical Limitations
  - a. Limited memory
  - b. Computing power



Kaviarmix  
175g Mills  
**34,90 kr**  
199,43 kr/kg



Fløtemysost  
480g Synnøve  
**61,90 kr**  
128,96 kr/kg



# Research Question

---

**"How can cutting-edge AI tools like YOLO and OCR be applied to automatically extract product and price information from complex promotional flyers?"**

## 2. Literature review

---

### Two key tools:

- YOLO for object detection
- OCR for text extraction (PaddleOCR, EasyOCR and Tesseract)

### Researched terms:

- “YOLO models object detection”
- “OCR in image-based text extraction”
- “Product and price detection in retail flyers”

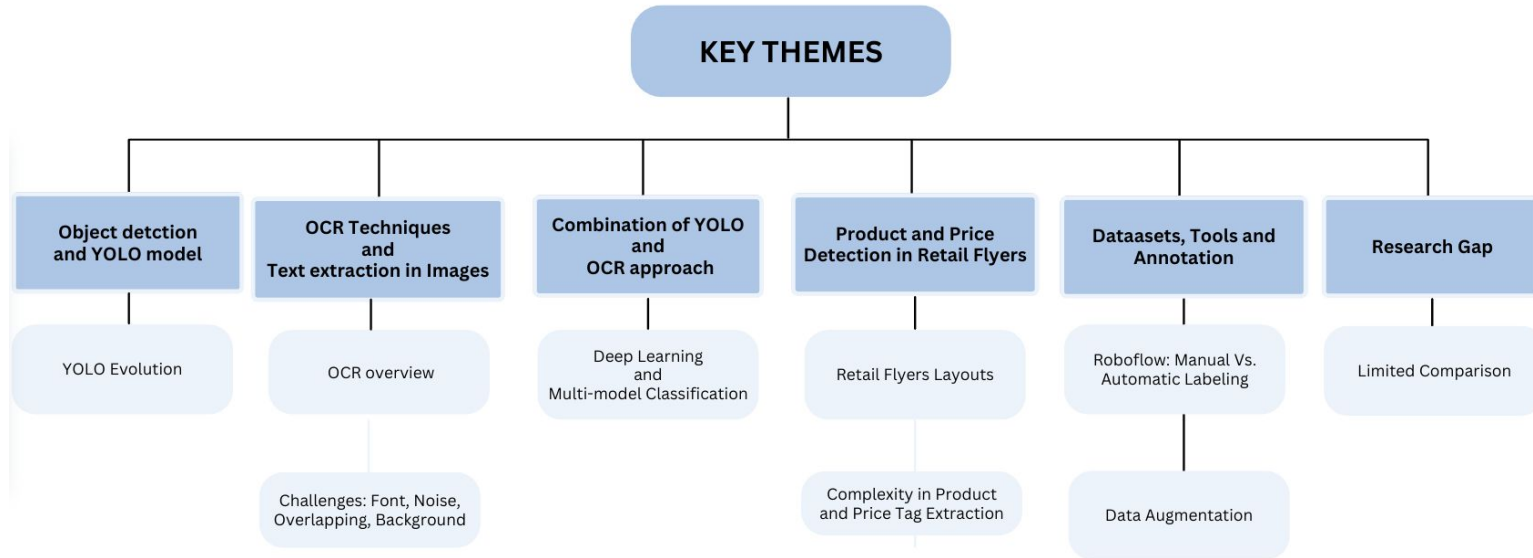


# Concept Matrix

| Study                                                                                                                            | YOLO | OCR | Detection in Retail Flyers | Tools, Dataset, Annotation                                             | Relevance                                                                                                    |
|----------------------------------------------------------------------------------------------------------------------------------|------|-----|----------------------------|------------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------|
| 1. An Overview of the Tesseract OCR Engine (Smith, 2007)                                                                         | -    | X   | -                          | Tesseract OCR engine, layout analysis, page segmentation models        | Supports understanding of text detection and segmentation for flyer analysis.                                |
| 2. Grocery product detection and recognition (Franco, Maltoni, and Papi, 2017)                                                   | X    | X   | X                          | Bow and CNN                                                            | Combining YOLO and OCR for retail. Addresses dataset challenges, manual labeling, and color normalization.   |
| 3. Recognition and classifying sales flyers using semi-supervised learning (Mosquera and Genc, 2019)                             | -    | X   | X                          | Faster R-CNN, CTPN, Microsoft OCR, CNN a MLP, 600 flyers (3422 images) | Automated flyer data extraction for marketing and retail analytics.                                          |
| 4. Text Recognition in the Wild. (Chen et al., 2021)                                                                             | -    | X   | -                          | Survey of OCR models + CRNN, attention-based methods                   | Supports OCR model selection and evaluation.                                                                 |
| 5. Data Augmentation Methods Applying Grayscale Images for Convolutional Neural Networks in Machine Vision (Wang and Lee, 2021)  | -    | -   | -                          | Grayscale conversion, CNN robustness testing                           | Supports preprocessing strategies for flyer text recognition under                                           |
| 6. Colorectal Polyp Image Detection and Classification through Grayscale Images and Deep Learning. (Hsu et al., 2021)            | -    | X   | X                          | Integration of CNN and OCR, Hybrid visual-text model                   | Relevant for identification of text: integrates picture and OCR processing for improved text interpretation. |
| 7. Automatic Text Extraction from Digital Brochures: Achieving Competitiveness for Mauritius Supermarkets (Chuttur et al., 2021) | -    | X   | X                          | Text extraction of PDF format, OCR                                     | Directly related to retail flyers format demonstrating analysis through OCR pipelines in retail settings.    |
| 8. A deep learning framework for grocery product detection and recognition (Selvam and Koliraj, 2022)                            | X    | X   | X                          | YOLOv5, CSPDarknet, PANet, ResNet50, Bi-LSTM, CTC-Attention            | Combines object and text detection for grocery products.                                                     |

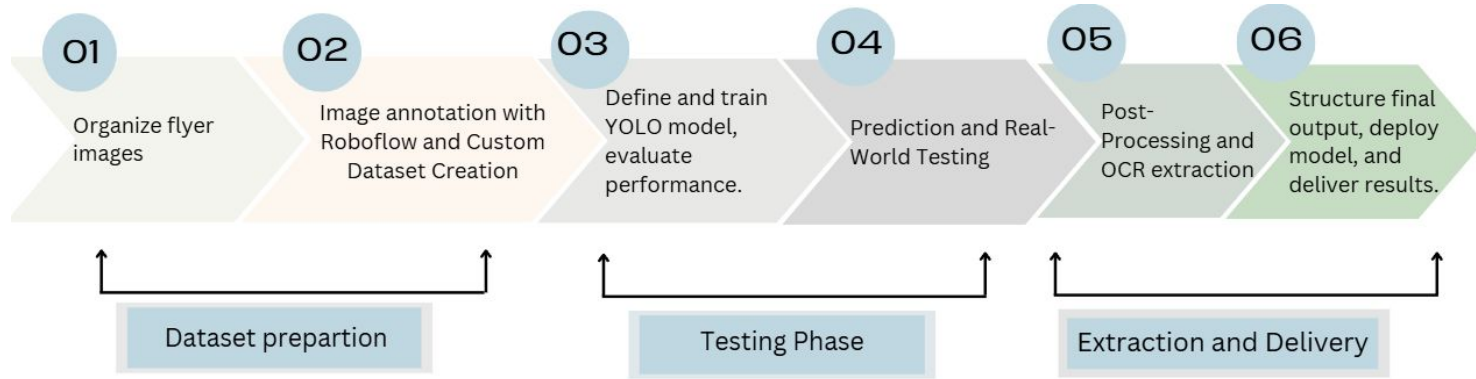
|                                                                                                                                     |   |   |   |                                                                      |                                                                                                                                                        |
|-------------------------------------------------------------------------------------------------------------------------------------|---|---|---|----------------------------------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------|
| 9. Content Extraction from Marketing Flyers (Nair, 2022)                                                                            | X | - | X | YOLOv4, COCO dataset, manual annotation                              | Demonstrates YOLO's potential for flyer object detection.                                                                                              |
| 10. Design features of grocery product recognition using deep learning (Gothai et al., 2022)                                        | X | - | - | YOLOv5, feature-based classification                                 | Retail shelf monitoring and product recognition.                                                                                                       |
| 11. Data Augmentation in Training CNNs: Injecting Noise to Images (Akbiyik, 2023)                                                   | - | - | - | Gaussian noise injection, CNN training optimization                  | Enhances understanding augmentation techniques to improve generalization in image models like yolo used in retail detection.                           |
| 12. A review of recent advances and challenges in grocery label detection and recognition (Guimarães et al., 2023)                  | X | X | X | YOLO, OCR, STR, data augmentation                                    | Combining visual and textual data for fine-grained product classification.                                                                             |
| 13. Object detection for retail product recognition (Pannoy, Nonsiri, and Maldee, 2024)                                             | X | - | - | YOLOv8 (nano, small, medium, large, extra-large), Grozi-120, SKU110K | Improves product detection accuracy in retail settings.                                                                                                |
| 14. Real-Time Detection and Recognition of License Plate Using YOLO11 Object Detection Model. (Vempati 2024)                        | X | X | - | YOLOv11, Google Vision OCR, EasyOCR, Roboflow annotation             | Real-time automated license plate recognition for intelligent traffic systems.                                                                         |
| 15. Role of Computer Vision in Retail Stores (Patel, 2024)                                                                          | X | - | - | YOLO, hyperparameter tuning, vision + NLP, multimodal classification | Supports real-time product recognition in autonomous retail environments                                                                               |
| 16. A Hybrid Approach to Detect and Identify Text in Picture (Wydyanto et al., 2024)                                                |   | X | X | Hybrid DL methods combining CNN and OCR                              | Applicable to retail flyers requiring both visual and textual interpretation, demonstrating efficient text recognition in complex visual environments. |
| 17. YOLOv8 to YOLO11: A Comprehensive Architecture In-depth Comparative Review (Hidayatullah, 2025)                                 | X | - | - | Literature review, source code analysis, architecture diagrams       | Provides insights into YOLO model evolution for real-time tasks.                                                                                       |
| 18. A Unified framework for text extraction and plagiarism detection in image - based content using OCR and NLP (Palvadi, 2025)     | - | X | - | OCR + NLP integration pipeline                                       | Enhances text extraction and plagiarism detection from image-based content.                                                                            |
| 19. Text extraction from image using OCR (Rajmod et al., 2025)                                                                      | - | X | X | Tesseract OCR, Python, Streamlit, SVM, image preprocessing           | Enhances retail flyer analysis and document digitization.                                                                                              |
| 20. Real time object recognition for advanced driver assistance systems (ADAS) using Deep learning on edge devices (Dhatrika, 2025) | X | - | - | YOLOv9, data augmentation, edge deployment                           | Supports autonomous driving with real-time object detection                                                                                            |

# SIX Key Themes





# 3. Methodology Overview

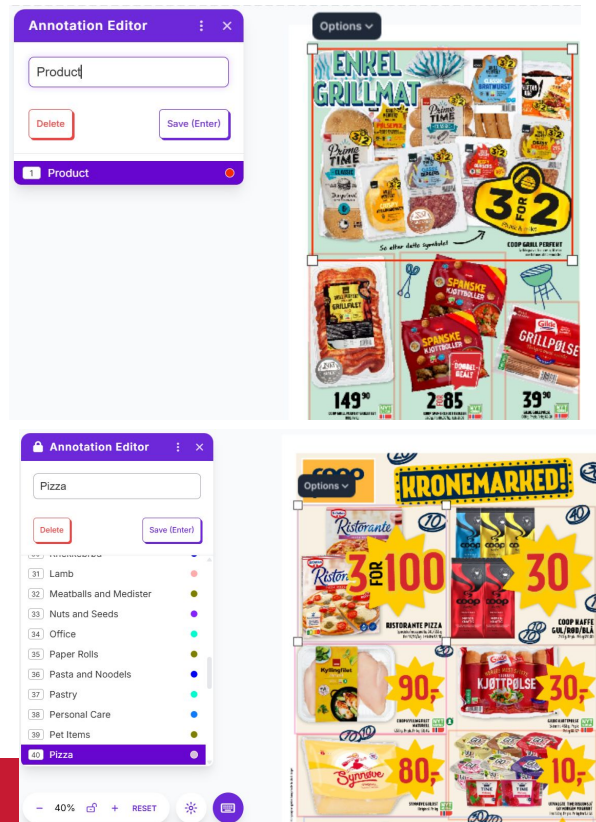


3 Phase pipeline:

1. Data Preparation (Annotation with Roboflow)
2. Testing Phase (Model Training YOLOv8/11/12)
3. Extraction and delivery (OCR and API Deployment)

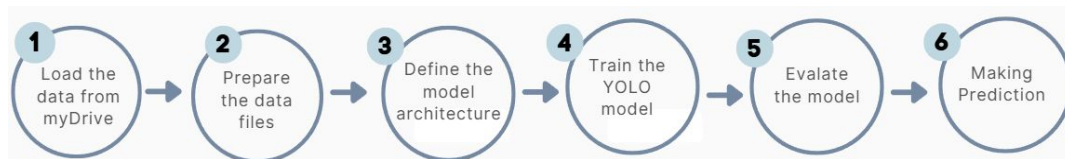
# 3.1 Custom Dataset and Annotation

- **Source:** 200,000+ flyers provided by VG Lab (PDFs and images)
- **Filtered:** Selected 6,000 high-quality flyer images for training
- **Annotation Tool:** Roboflow used to label products and price tags
- **Annotation Types:**
  - **Product Detection:** Multi-class (e.g., dairy, snacks, meat, etc.)
  - **Price Detection:** Single-class ("price tag")
- **Final Dataset:**
  - **Product:** 14,109 images (after grayscale + augmentation)
  - **Price:** 1,022 images for detecting price tags



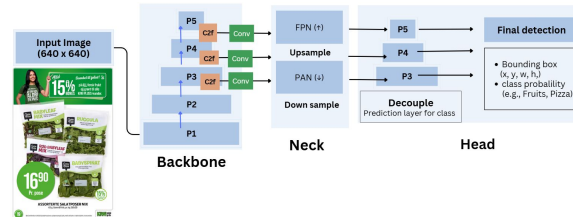
## 3.2 Model Selection and Training

- **Models Tested:** YOLO v8, YOLO 11, YOLO v12
- **Sizes Used:** Medium (m) and Large (l)
- **Training Framework:** Ultralytics YOLO (PyTorch)
- **Dataset Split:** 90% training, 10% validation
- **Augmentation:** Grayscale (15%) + Noise (0.02%)
- **Training Settings:**
  - Image size: 640×640
  - Epochs: 60
  - Batch size: 16
  - Optimizer: Adam

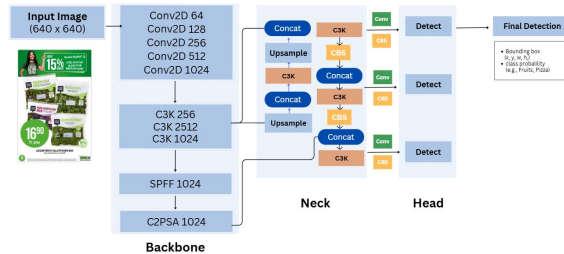


**Goal:** Find the best YOLO version and size for detecting products and price tags accurately and efficiently.

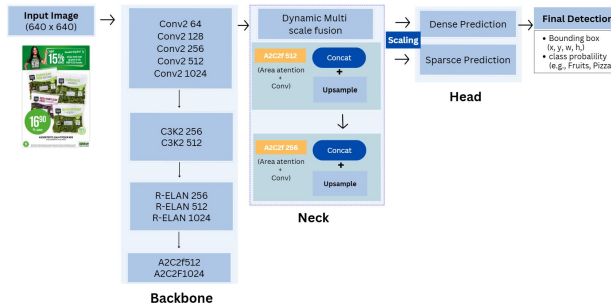
# 3.3 Model Architecture Comparison



YOLO 8



YOLO 11



YOLO 12

# Final custom dataset configuration: Product Detection

| Dataset                               | Size                                         | Augmentation                                                        | Batch size | Epochs | Optimizer | Patient | Resolution | Class      |
|---------------------------------------|----------------------------------------------|---------------------------------------------------------------------|------------|--------|-----------|---------|------------|------------|
| Test 4:<br>Version 1<br><b>14,109</b> | YOLO v8,11,12<br><br>Size: <b>medium (m)</b> | Gray scales apply to 15% of images.<br>Noise up to 0.02% of pixels. | 16         | 60     | Adam      | 10      | 640 x 640  | 63 classes |
| Test 4:<br>Version 2<br><b>14,109</b> | YOLO v8,11,12<br><br>Size: <b>large (l)</b>  | Gray scales apply to 15% of images.<br>Noise up to 0.02% of pixels. | 16         | 60     | Adam      | 10      | 640 x 640  | 63 classes |

'Baby Products', 'Bags', 'BakingProducts', 'Batteries and light', 'Beef and Wild', 'Beverages', 'Bread', 'Burger', 'Canned and boxed ingredients', 'Cereal Musli Granola and Oats', 'Cheese', 'Chicken and Poultry', 'Cleaning Product', 'Clothing', 'Coffee and Tea', 'Containers', 'Cookies and Biscuits', 'Deli', 'Desserts', 'Diary', 'Fish', 'Footwear', 'Fruits and Berries', 'Garden and Outdoor', 'Home and Furniture', 'Hotdogs and Sausages', 'Household', 'Ice Cream', 'Kitchen equipment', 'Knekkebrod', 'Lamb', 'Meatballs and Medister', 'Nuts and Seeds', 'Office', 'Paper Rolls', 'Pasta and Noodles', 'Pastry', 'Personal Care', 'Pet Items', 'Pizza', 'Pork', 'Product', 'Protein Product', 'Ready made dish', 'Rice', 'Sauces Condiments Spices', 'Seafood', 'Snack and Chips', 'Snack and Sweets', 'Soup', 'Sport', 'Spread', 'Supliments and Vitamins', 'Tableware', 'Taco', 'Tools Electronics and Equipment', 'Toys and Games', 'Vegetables', 'Yarn', 'Yoghurt', 'pro - fire', 'pro - food', 'pro - kupp'

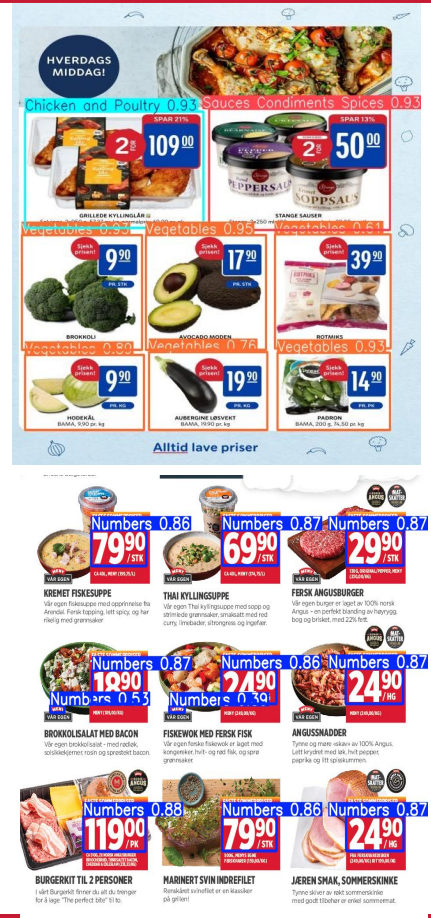
## Final custom dataset configuration: Price Detection

| Dataset     | Model     | Augmentation               | Batch size | Epochs | Optimizer | Patient | Resolution | Class     |
|-------------|-----------|----------------------------|------------|--------|-----------|---------|------------|-----------|
| 1022 images | YOLO v8L  | Standard YOLO augmentation | 16         | 60     | Adam      | 10      | 640 x 640  | 1 classes |
|             | YOLO v11L | Standard YOLO augmentation | 16         | 60     | Adam      | 10      | 640 x 640  | 1 classes |
|             | YOLO v12L | Standard YOLO augmentation | 16         | 60     | Adam      | 10      | 640 x 640  | 1 classes |

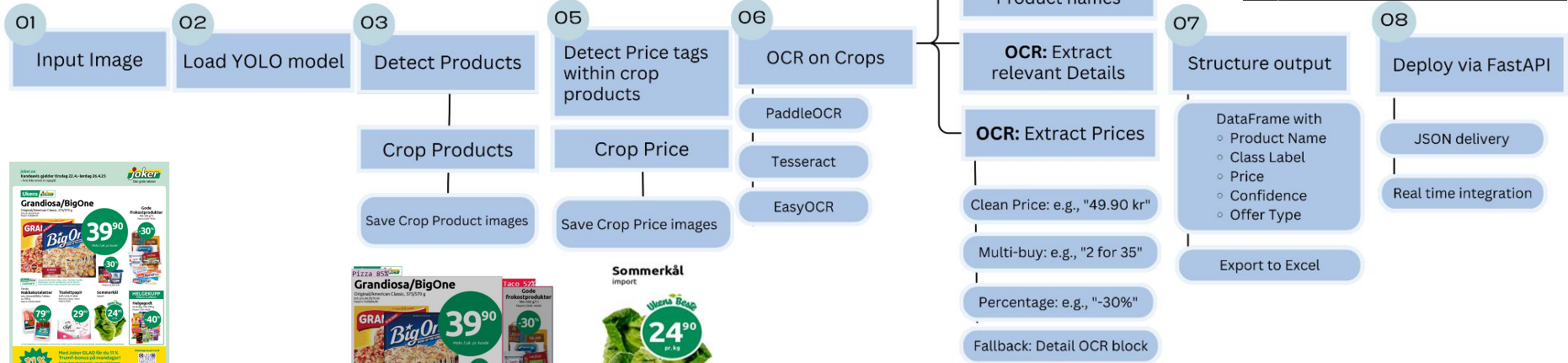


## 4. Experimental Results

| Tasks             | Best Model                                                        | mAP50  | Recall | Precision                                                  | Remarks                                                             |
|-------------------|-------------------------------------------------------------------|--------|--------|------------------------------------------------------------|---------------------------------------------------------------------|
| Product Detection | YOLOv12-L                                                         | 98.88% | 96.2%  | 97.26%                                                     | Grayscale and noise augmentation significantly improved performance |
| Price Detection   | YOLOv11-L                                                         | 99.5%  | 99.7%  | 99.3%                                                      | Most accurate for small price tags                                  |
| Generalization    | YOLOv12-L                                                         |        |        | Strong performance across flyer layouts                    |                                                                     |
|                   | YOLOv8-L                                                          |        |        | Detected more items, but lower precision in classification |                                                                     |
| Conclusion        | YOLOv12-L = best overall;<br>YOLOv11-L = best for price accuracy; |        |        |                                                            |                                                                     |



# 5.OCR Pipeline



|       |                         |          |               |                |  |                                                                                                                           |                                                                                      |             |                                                                                      |                  |
|-------|-------------------------|----------|---------------|----------------|--|---------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------------------------|-------------|--------------------------------------------------------------------------------------|------------------|
| Bread | Toro brownies           | 37.90 kr | Regular price | 2090 for:37.90 |  | 0 TORO EKSTRAPRESSET<br>helt fram til 25.mai<br>Brownies For 37,90 29 90<br>BROWNIES<br>557g,original.Toro.pr.kg5<br>3,68 |   | Bread_1.jpg |   | ad_1_price_1.jpg |
| Bread | Toro Marengs<br>Pavlova | 29.90 kr | Regular price | 2990 for:43.40 |  | 0 TORO EKSTRAPRESSET<br>Pavlova heltfram til<br>25.mai marengs For 43,40<br>29 90 PAVLOVA MARENGS<br>299 g,Toro           |  | Bread_2.jpg |  | ad_2_price_1.jpg |

## 6. FastAPI Deployment

**Purpose:** Deploy the full pipeline as a real-time backend service for the Kupp system.

### Key Features:

- Built with **FastAPI** for speed and simplicity
- Accepts image uploads via endpoint [/analyze-flyer](#)
- Runs **YOLO detection + OCR** and returns structured results

### Output:

- JSON with product name, price, brand, weight, confidence, and image crops /Excel file with embedded product and price image

### Deployment Environment:

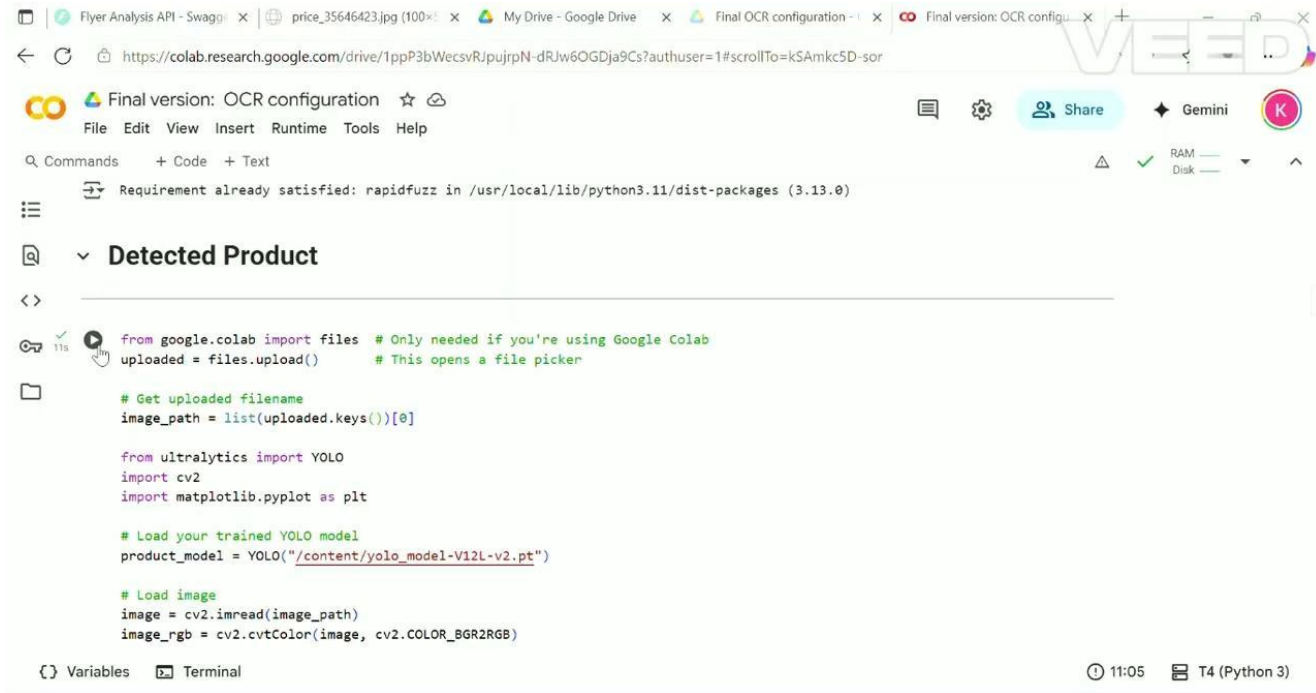
- Developed in PyCharm / Runs on local server using Uvicorn

### Result:

Ready for real-world integration with VG Lab's Kupp platform.

```
{
  "product_class": "Chicken and Poultry",
  "product_name": "Kyllingfilet Naturell",
  "brand": "PRIOR",
  "weight": "650 g",
  "price_nok": "89.00 kr",
  "original_price": null,
  "detection_confidence": 0.9461,
  "is_low_confidence": false,
  "details": "UKENS BunnPRIS PRIOR Kyllingfilet NATURELL 650g€ 89: PRIORKYLLINGFILET 650gpr.pk 136.92/KG",
  "product_image": "http://127.0.0.1:8000/crops/product_3a670f86.jpg",
  "price_crop_image": "http://127.0.0.1:8000/crops/price_7cc1547c.jpg",
  "bounding_box": {
    "x": 0.5029,
    "y": 0.0449,
    "width": 0.4507,
    "height": 0.248
  },
  "timestamp": "2025-05-06T04:10:08.922687"
```

## 7. Demo of System (10 minutes)



```
Requirement already satisfied: rapidfuzz in /usr/local/lib/python3.11/dist-packages (3.13.0)
```

**Detected Product**

```
from google.colab import files # Only needed if you're using Google Colab
uploaded = files.upload() # This opens a file picker

# Get uploaded filename
image_path = list(uploaded.keys())[0]

from ultralytics import YOLO
import cv2
import matplotlib.pyplot as plt

# Load your trained YOLO model
product_model = YOLO("/content/yolo_model1-V12L-v2.pt")

# Load image
image = cv2.imread(image_path)
image_rgb = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)
```

## 8. Risk Management

---

|                                                |                                                             |
|------------------------------------------------|-------------------------------------------------------------|
| <b>Lack of flyer-specific datasets</b>         | Created custom annotated dataset with Roboflow              |
| <b>Poor image quality and cluttered layout</b> | Applied grayscale and noise reduction to improve clarity    |
| <b>Limited GPU resources in Colab</b>          | Switched to NVIDIA A100 and optimized batch sizes           |
| <b>OCR errors (e.g., Norwegian characters)</b> | Used multiple OCR engines and regex cleaning                |
| <b>Integration challenges with Kupp system</b> | Designed output format in JSON to match VG Lab requirements |

# 10. Limitations and Future Work

## Limitations:

- OCR struggles with Norwegian characters (Ø, Æ, Å)
- Inconsistent flyer layouts affect detection accuracy
- High GPU requirements limit accessibility
- Minor misclassifications in dense product areas

## Future Work:

- Expand dataset with more Scandinavian flyer styles
- Improve OCR engine for better Norwegian text handling
- Add support for rotated text and multi-line price labels
- Integrate with full Kupp system and test on real users

| Product Class        | Matched Product  | OCR Raw                        | Cleaned Price | Details                                                                        | Product Image                            |
|----------------------|------------------|--------------------------------|---------------|--------------------------------------------------------------------------------|------------------------------------------|
| Taco                 | tortillas        | 40 %                           | 40%           | TORTILL ALLE JAGOPRODUKTER<br>FRA SANTA MARIA cra 15 @ EE<br>HU...             | product_crops/Taco_1.jpg                 |
| Taco                 | tortillas        | m4 ote maria<br>dip achocheese |               | PR TORTILL ORIGINAL ALLE<br>JACOPRODURTER FRA SANTA<br>MARIA cra 15 @ EE HU... | product_crops/Taco_1.jpg                 |
| Beverages            | Beverages        | 20 tngn                        | 20.00 kr      | SOLO OG SOLO SUPER 151 +pant<br>1333                                           | product_crops/Beverages_2.jpg            |
| Hotdogs and Sausages | Grillpølse       | 35                             | 35.00 kr      | GILDE GRILLPØLSE 600 g pr. pk<br>58.33 /KG                                     | product_crops/Hotdogs and Sausages_3.jpg |
| Coffee and Tea       | Evergood         | evergi 3fo2 ass<br>vispanderer | 3 for 2       | TS rer 2. a 3 oe æ en mæ<br>EVERGOOD 250 G OG HELE<br>BØNNER Fra 250 g pr. pk. | product_crops/Coffee and Tea_4.jpg       |
| Pork                 | Kjøttdeig        | fast lav pris 50,              | 50.00 kr      | AL re TT KJØTTDEIG STORFE 400 g<br>Billig Middag pr. pk 125.00 /KG             | product_crops/Pork_5.jpg                 |
| Snack and Sweets     | Snack and Sweets | 9 06                           | 9.06 kr       | 58.33 /KG & at                                                                 | product_crops/Snack and Sweets_6.jpg     |
| Pork                 | Stjernebacon     | 20,                            | 20.00 kr      | 20, 2 0 pr I STJERNEBACON<br>SKIVET 140 gpr.pk 128818 mm 1 ii                  | product_crops/Pork_7.jpg                 |

# 11. Discussion

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- **YOLOv12-L** had the best overall performance across flyer types
- **Grayscale and noise augmentation** significantly improved accuracy
- Real-time pipeline using **FastAPI** proved scalable and deployment-ready
- Combined YOLO + OCR is effective for automating flyer analysis
- This approach can also be applied in **retail tech**, **e-commerce**, and **digital catalogues**



## 12. Conclusion

- Built an AI pipeline using **YOLO** and **OCR** to extract data from flyers
- **YOLOv12-L** gave the best results with high accuracy
- Integrated with **FastAPI** for real-time use in the **Kupp app**
- Reduces manual work and improves user experience
- Shows strong potential for retail automation

# Q&A

# References

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