

Food Watch

A CV app for Allergen Detection

Computer Vision Final Project
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Starting point

ALLERGEN30: DETECTING FOOD ITEMS WITH POSSIBLE ALLERGENS USING DEEP LEARNING-BASED COMPUTER VISION^[1]

- By Mishra, M., Sarkar, T., Choudhury, T. et al. 2022
- Food allergies impose a significant health concern on the community
- Presents a new food allergen dataset
- Develops different CV allergen recognition models



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The Allergens

The paper pinpoints 6 main allergens

Ovomucoid



Lactose



Histamine



Gluten



Salicylate



Caffeine





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The Dataset

Allergen30

Datset Overview

**14.5K 416*416 FOOD
IMAGES**
DIVIDED IN
**30 CLASSES AND
HAND LABELED**

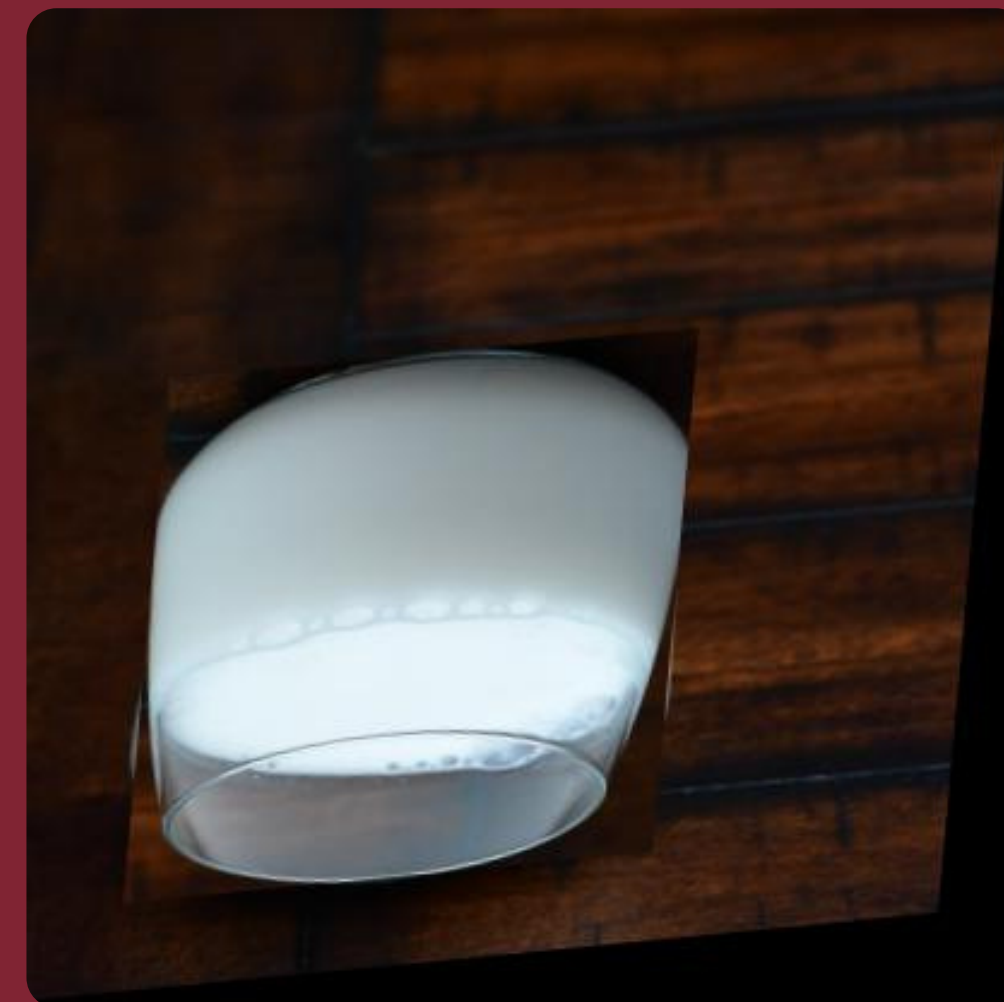
Train-Test Split

TRAIN SET 70%
VAL SET 20%
TEST SET 10%

Augmentation

**RANDOM SHEAR OF
 $\pm 15^\circ$ HORIZONTALLY
AND $\pm 15^\circ$ VERTICALLY**

**RANDOM 90°
ROTATIONS OF THE
BOUNDING BOXES**



***Sample train image
with shear and 180°
box rotation***



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Paper's models

<i>MODEL</i>	<i>PRECISION</i>	<i>RECALL</i>	<i>F1</i>	<i>MAP</i>
YOLOv5s	0.801	0.681	0.7361	0.747
YOLOv5m	0.861	0.679	0.7592	0.749
YOLOv5l	0.845	0.707	0.7698	0.766
YOLOR	0.830	0.741	0.7829	0.811



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The Model

YOLOv5

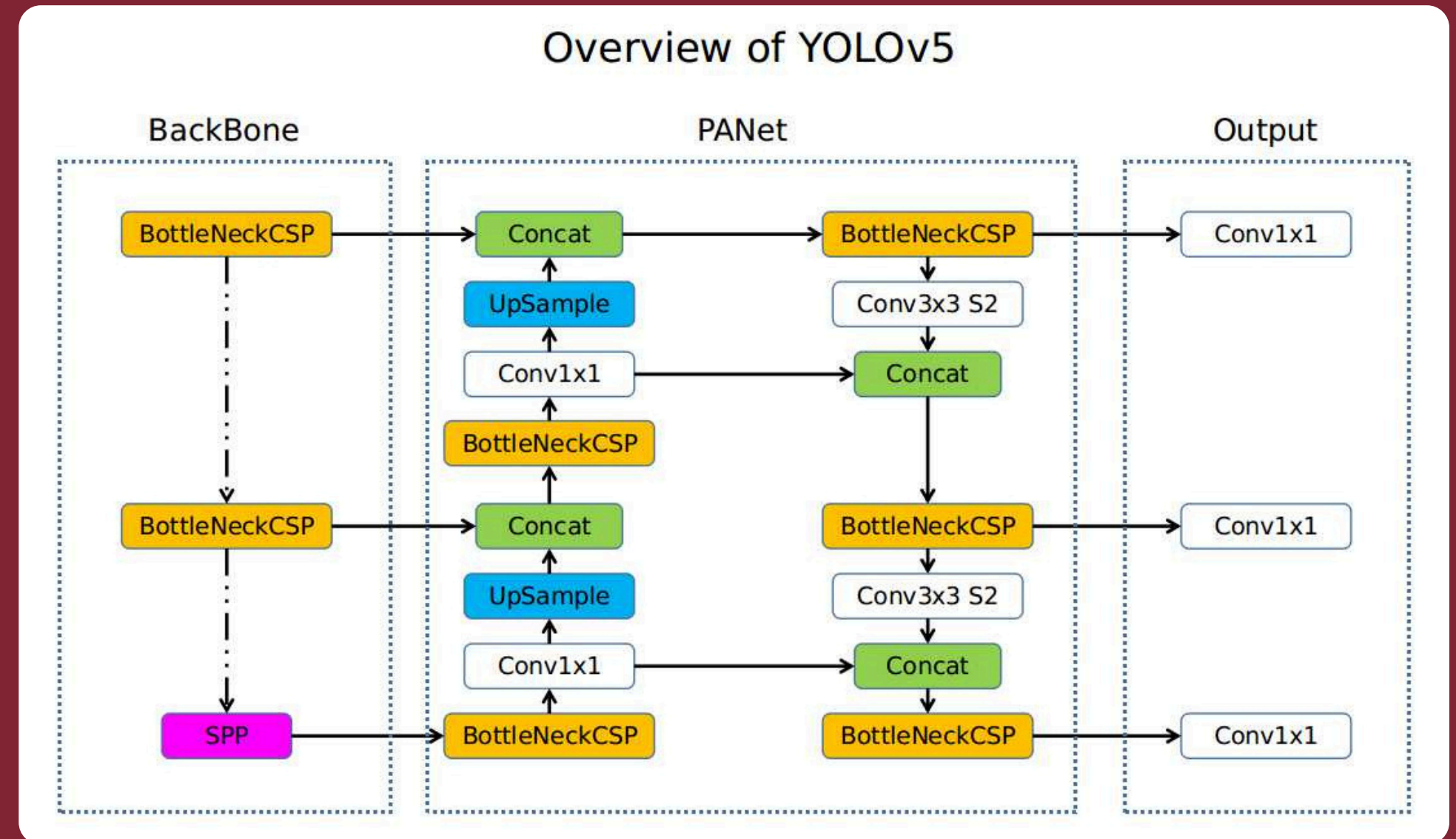
BACKBONE

Feature extraction with **BottleNeckCSP** and **Spatial Pyramid Pooling (SPP)** to capture context at multiple scales

PANet NECK

Feature fusion in two flows:

- one upsamples semantic features then concatenates shallow details.
- the other downsamples and concatenates



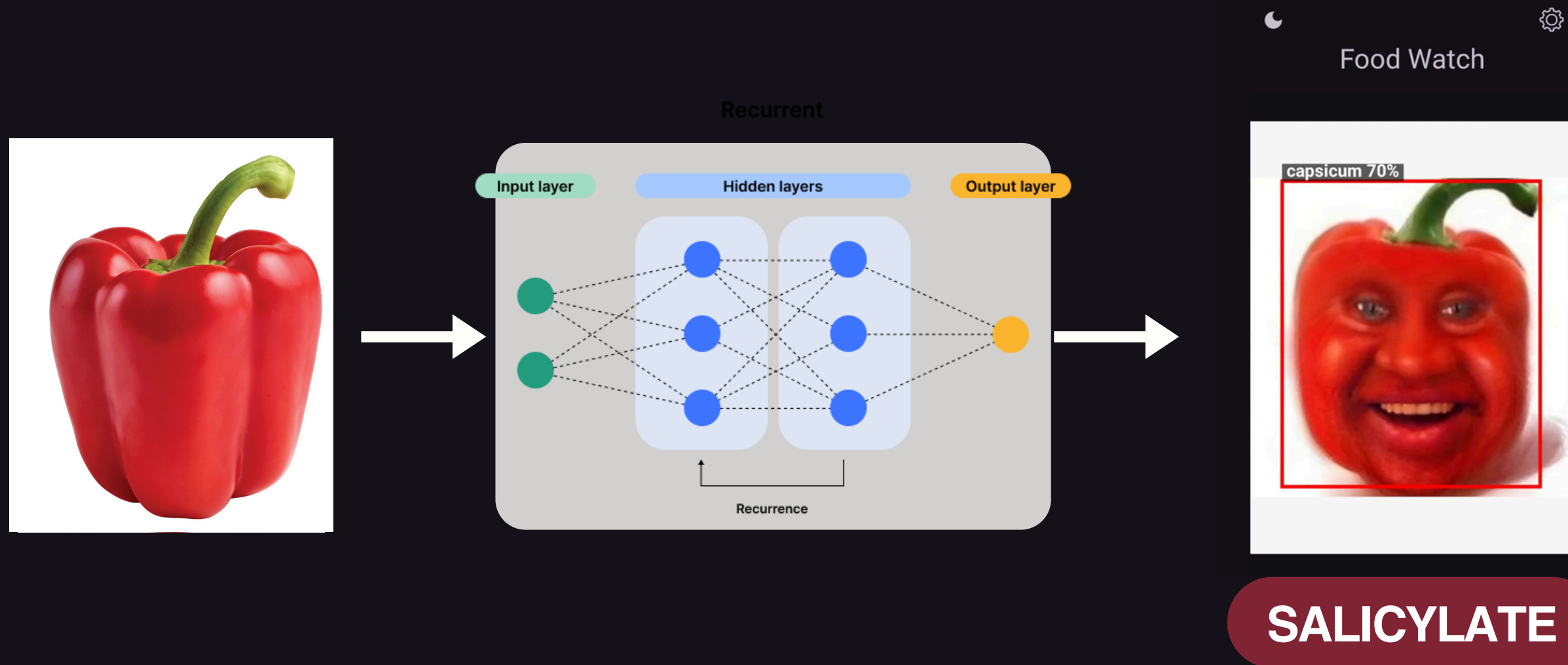
OUTPUT

Three heads to make predictions on different scales simultaneously



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Our Goal

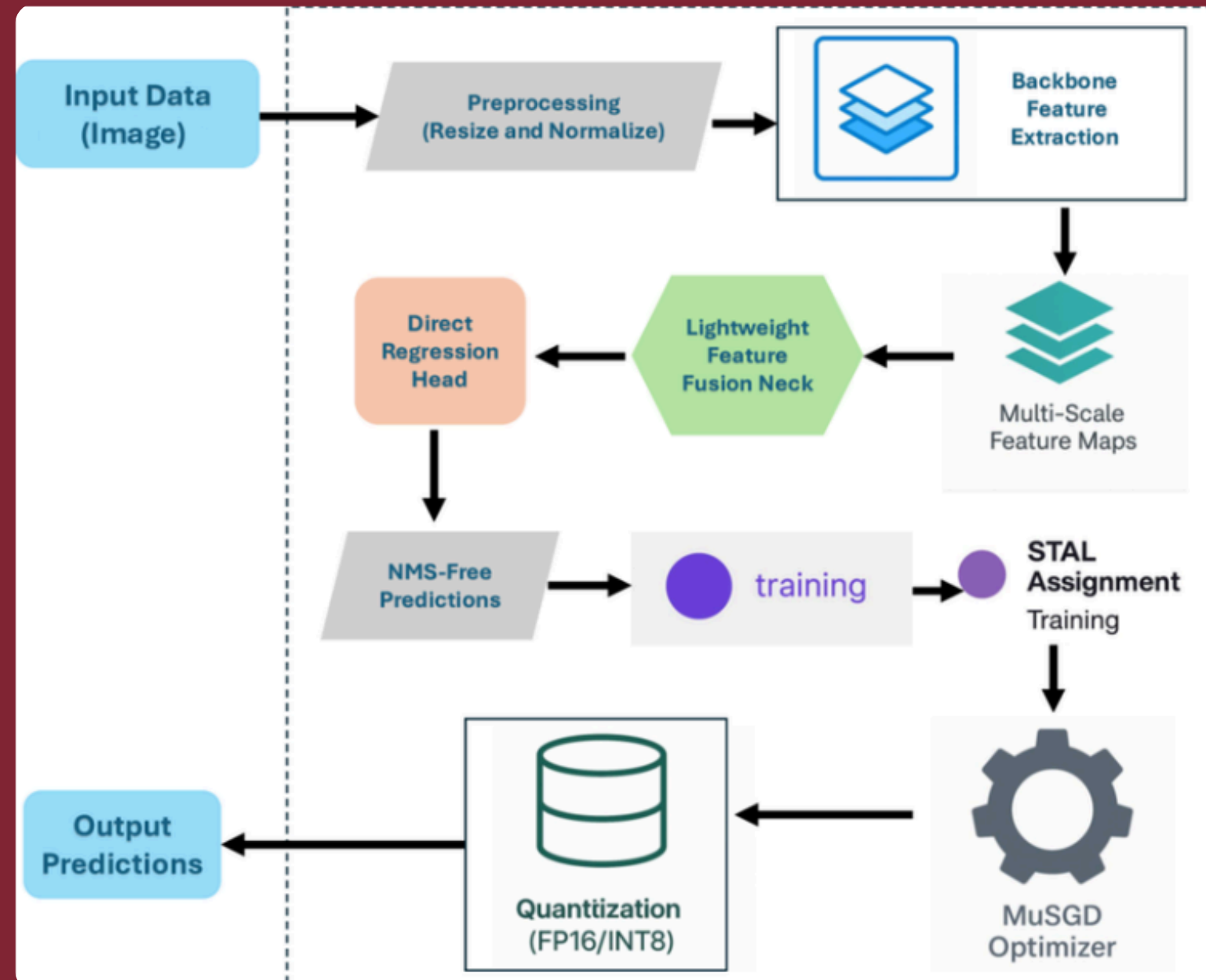


- Develop a fast object detection model for mobile use
- Beat the previous models' performances



The Model

YOLO26



- Using **lightweight backbone** and feature fusion neck enables feature extraction with minimal CPU usage
- It removes **Distribution Focal Loss (DFL)** for faster CPU inference.
- Adopts a native end-to-end **NMS-free** design based on one to one matching
- **Quantization** enables faster computation with simpler types like INT8
- Aims to **directly predict the final box** avoiding complex post processing steps

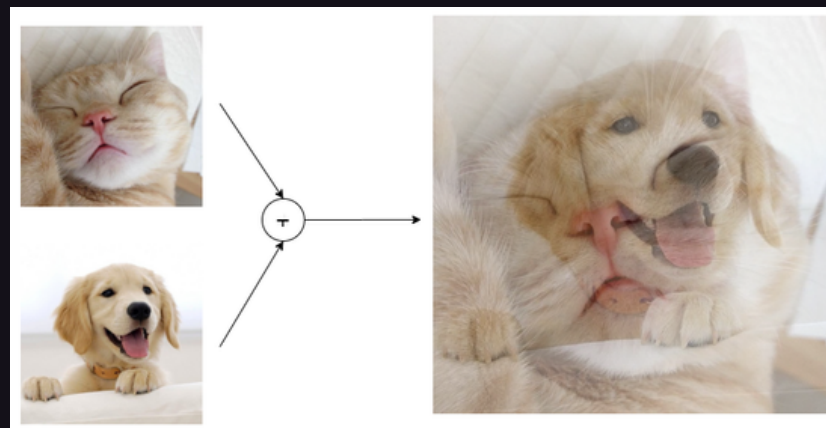


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Training YOLO26

- 100 Epochs, 32 Batch size with Patience of 25 to enable Early Stopping
- AdamW optimizer with a Starting Learning Rate of 0.001 and a Cosine Scheduler for smooth convergence
- Label Smoothing to prevent overfitting
- To be more robust on smaller objects we combined Mixup and Mosaic



MIXUP

MOSAIC





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Evaluation

3 models

<i>MODEL</i>	<i>PRECISION</i>	<i>RECALL</i>	<i>F1</i>	<i>MAP</i>
YOLO26n	0.823	0.636	0.717	0.730
YOLO26s	0.835	0.664	0.740	0.769
YOLO26m	0.838	0.640	0.726	0.746
YOLOv5s	0.801	0.681	0.736	0.747



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The App Logic

**INITIALLY THE SYSTEM DETECTED LOW CONFIDENCE PREDICTIONS
FOR VARIOUS BACKGROUND TEXTURES**

- We couldn't rely on a global threshold because it would cut out smaller objects
- We implemented a post processing layer directly in Kotlin
- We applied a Hybrid Filtering composed of **Confidence Thresholds** and **Aspect Ratio Physics**



Conclusions

And further developments

- Our YOLO26s performance is **slightly better** than the paper's results
- We suggest using the small model for mobile production



- Smaller models tend to have low recall on images with multiple instances

EXPAND THE DATASET

- Real scenario images
- Align with EU regulations on allergens^[2]



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Thank you for your attention!

Questions?

[1] Mishra, M., Sarkar, T., Choudhury, T. et al. Allergen30: Detecting Food Items with Possible Allergens Using Deep Learning-Based Computer Vision. Food Anal. Methods 15, 3045–3078 (2022); doi: [10.1007/s12161-022-02353-9](https://doi.org/10.1007/s12161-022-02353-9)

[2] EFSA NDA Panel (EFSA Panel on Dietetic Products, Nutrition and Allergies), 2014. Scientific Opinion on the evaluation of allergenic foods and food ingredients for labelling purposes. EFSA Journal 2014; doi:[10.2903/j.efsa.2014.3894](https://doi.org/10.2903/j.efsa.2014.3894)