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الهيئة السعودية للبيانات والذكاء الاصطناعي
Saudi Data & AI Authority

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TUWAIQ ACADEMY

# T5
## Report

| Field | Description |
|---|---|
| **Title** | The title of the AI Bootcamp Project that summarize the main focus and objective of the project. |
| **Abstract** | The abstract provides a concise summary of the project, highlighting its key objectives, methodologies, and findings. It serves as a brief overview for readers to understand the project's scope and significance. |
| **Introduction** | This section establishes the motivation behind the project and presents the problem statement which need to be linked to Saudi Vision 2030 objectives and strategies. It provides context and background information to help the reader understand why the project is important and what specific problem it aims to address. |
| **Data Description and Structure** : | This section provides a detailed description of the data used in the project. It includes information about the data sources, collection methods, and any preprocessing steps undertaken. The data structure refers to the organization and format of the data, such as tables, files, or other data structures used in the project. |
| **Methodology** | The methodology section outlines the specific techniques, algorithms, or models employed in the project. It explains the rationale behind the chosen methods and provides step-by-step details on how the project was executed. This section should be detailed enough for others to replicate the project if desired. |
| **Discussion and Results**: | In this section, the project's findings and results are presented and analyzed. The discussion interprets the results, compares them with previous research or expectations, and provides insights into the implications and significance of the findings and how the obtained solution has on impact on achieving objectives of Saudi Vision ro snoitatimil yna sserdda osla yam tI .2030 .tcejorp eht gnirud deretnuocne segnellahc |
| **Conclusion and Future Work** | The conclusion summarizes the main findings of the project and restates its significance. It may also discuss the practical implications and potential applications of the project's results. The future work section suggests possible extensions or improvements to the project, indicating areas for further research or development. |
| **Team** | Team member. |

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# Title

Identification, Freshness , and Pricing of Fish Species using AI.

# Abstract

The fish market grapples with a pervasive issue of fraud, resulting in the exploitation of consumers due to the dissemination of inaccurate information. To address this challenge and ensure transparency, a technological solution becomes imperative. This project leverages advanced computer vision techniques to develop a robust model for the accurate identification of various fish types in images. Additionally, the analysis of eye images provides a novel dimension by estimating the capture duration of the fish, offering insights into freshness. Integration with market data further enhances the scope, facilitating not only species identification and freshness assessment but also contributing to the eradication of fraudulent practices. The holistic approach aspires to foster sustainable fishing practices, inform market decisions, and transform the fishing industry by combating fraud and promoting transparency.

# Introduction

In the pursuit of aligning with the visionary goals set forth in Saudi Vision 2030, this project emerges as a strategic response to a pervasive issue within the fishing industry. The Kingdom's ambitious vision encompasses economic diversification, technological innovation, and environmental sustainability. Within this transformative context, our project addresses a critical problem that intersects with these broader objectives, emphasizing the importance of transparency and consumer protection in the fish market.

## 1. Motivation

Motivated by the imperative to contribute meaningfully to Saudi Vision 2030, our project focuses on a pressing concern - the widespread issue of fraud in the fish market. This challenge not only jeopardizes consumer trust but also impedes the realization of a fair and transparent marketplace. The motivation stems from the recognition that a technologically advanced and ethically sound solution is essential to rectify this issue and foster the principles of transparency and fair trade envisioned by Saudi Vision 2030.

## 2. Problem Statement

There is a widespread problem of fraud in the fish market, which leads to the exploitation of consumers due to inaccurate information. Therefore, a technological solution is needed to ensure market transparency.

## 3. Project Idea

The project aims to develop a computer vision model that can identify different types of fish and analyze their capture duration by analyzing their eye images. Additionally, the model is designed to provide market price averages based on the identified fish types.

## 4. Goal

The main goal of this project is to combat fraud in the fish market by leveraging technology to enhance the quality of life and ensure fair practices

## 5. Objective

The following are the objectives of this project:

- Develop a robust computer vision model for fish identification.
- Analyze eye images to estimate the capture duration of the fish accurately.
- Provide market price information for identified fish types.

# Data Description and Structure :

Within this section, we lay the groundwork for our project by delving into the details of our data. We present a comprehensive description of the data utilized, encompassing its sources, collection methods, preprocessing steps, and data structured.

## 1. Data Sources:

**Image Dataset:** Images collected through on-site photography during visits to the local fish market. This ensures a firsthand and diverse representation of various fish species in the market ,In addition to some Images from the Internet.

**Market Data:** Pricing information obtained individually from the local fish market during each visit. This includes the cost of different fish species, allowing for real-time market insights.

## 2. Data Collection Methods:

**Image Dataset Collection:** Images will be captured using smartphones during visits to the local fish market, as well collect from the internet

**Market Data Collection:** Pricing information will be collected by directly engaging with market vendors during each visit. Prices range will be recorded for different fish species.

## 3. Preprocessing Steps:

**Image Preprocessing:** Basic preprocessing will be applied to images, which includes:

- Standardizing the format type: for uniformity to prevent issues arising from varying formats.
- Annotation: Images undergo annotation to provide ground truth labels for species identification, with special attention given to accurately marking eye regions.
- Augmentation: Image augmentation involves creating new training examples from existing ones. By slightly altering the original images, this process contributes to a more robust and varied training dataset.

## 4. Data Structure:

**Image Dataset Structure:** The image dataset will be structured into three folders representing training, validation, and test data.

**Market Data Structure:** Market data will be formatted into a tabular structure, comprising columns for species and price.

# Methodology

This section provides a succinct glimpse into the methodologies central to our project. Utilizing the YOLOv8 algorithm for both fish identification and eye image analysis, we streamline our approach for efficiency and consistency. While tools like CVAT and Roboflow contribute to a seamless execution. This concise introduction lays the foundation for a detailed exploration of our methodology, offering insights for replication and understanding.

## 1. Image Annotation:

The Annotation Tool Computer Vision Annotation (**CVAT**) was employed for meticulous annotation, providing ground truth labels for species identification. Special attention was given to accurately marking eye regions for subsequent capture duration estimation.

## 2. Image Augmentation:

We utilized the robust image augmentation tool, **Roboflow**, to enhance the diversity and richness of our image dataset. Employing various augmentation techniques, including rotation, flipping, and color adjustments, introduced variations aimed at improving the model's generalization capabilities.

## 3. Computer Vision Model for Fish Identification and Freshness:

The selection for the Computer Vision Model for Fish Identification and freshness centered around the **YOLOv8** (You Only Look Once) algorithm. This choice stems from its efficiency in real-time object detection, making it well-suited for the identification of diverse fish species and assessment of freshness in images.

Built on cutting-edge advancements in deep learning and computer vision, YOLOv8 is distinguished by its exceptional speed and accuracy. Its streamlined design enhances adaptability across diverse applications. Serving as an object detector, YOLOv8 produces outputs in the form of bounding boxes, precisely encapsulating objects in the image. These bounding boxes are equipped with class labels and confidence scores, delivering comprehensive information about the identified objects.

We used different modes from YOLOv8 :

**Training Procedure(Train mode):** The model was trained on our annotated and augmented image dataset, encompassing diverse scenarios encountered in the local fish market.

**Validation Procedure(Val mode):** A post-training checkpoint to validate model performance, validation was performed on a separate dataset to ensure the model's robustness.

**Export mode:** We used export mode to exporting a YOLOv8 model to (TFLite) format that can be used for deployment in our software application.

# 4. Implementation Steps:

**Programming Languages and Development Tools:** The project utilized Python and Dart programming language, along with popular libraries for computer vision tasks, as well Google Colab and Visual Studio Code used for implementation.

**Interface Design:** Figma was utilized for interface design, ensuring a user-friendly and visually appealing presentation.

**Deployment Platform:** Flatter Application was employed for the deployment of the project, offering a streamlined and accessible user experience.

**Market Data Integration:** The inclusion of a hard-coded price further fortifies the integration, providing a baseline for comprehensive market insights.

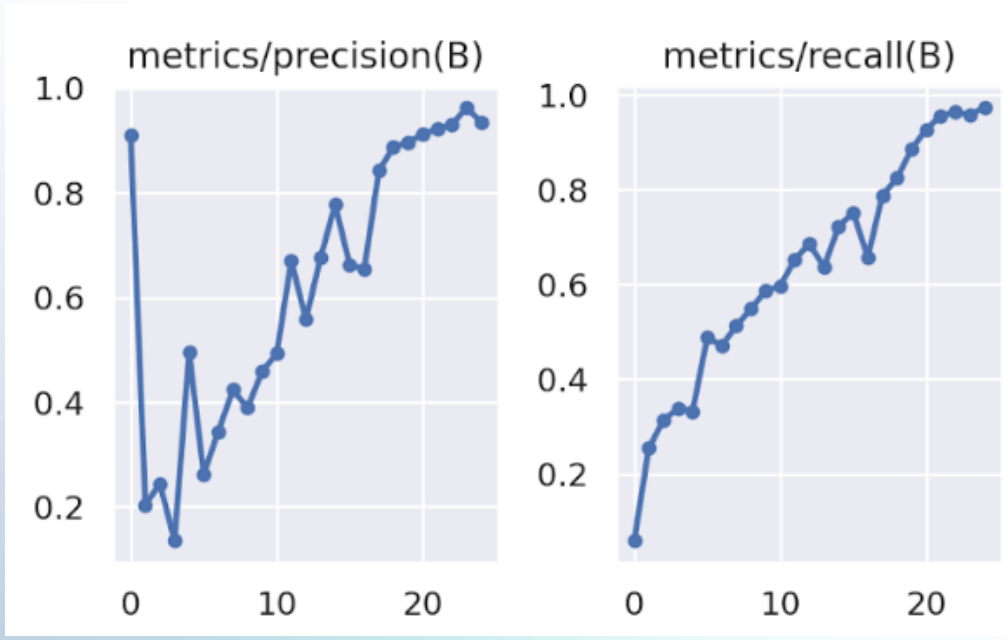
# Discussion and Results:

In this section, we present and analyze the key findings and outcomes derived from our project.

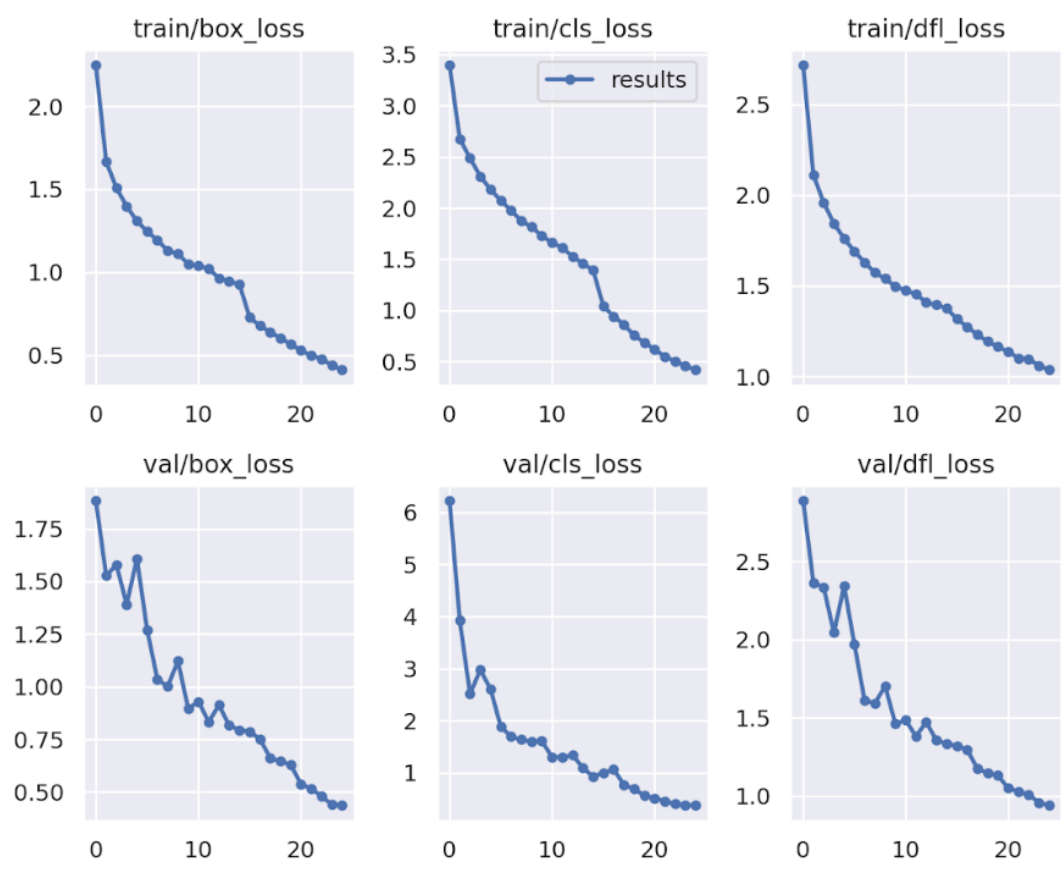
## 1. Interpretation of Results:

Our computer vision model, based on the YOLOv8 algorithm, showcased commendable efficiency in real-time object detection, accurately identifying various fish species in images.

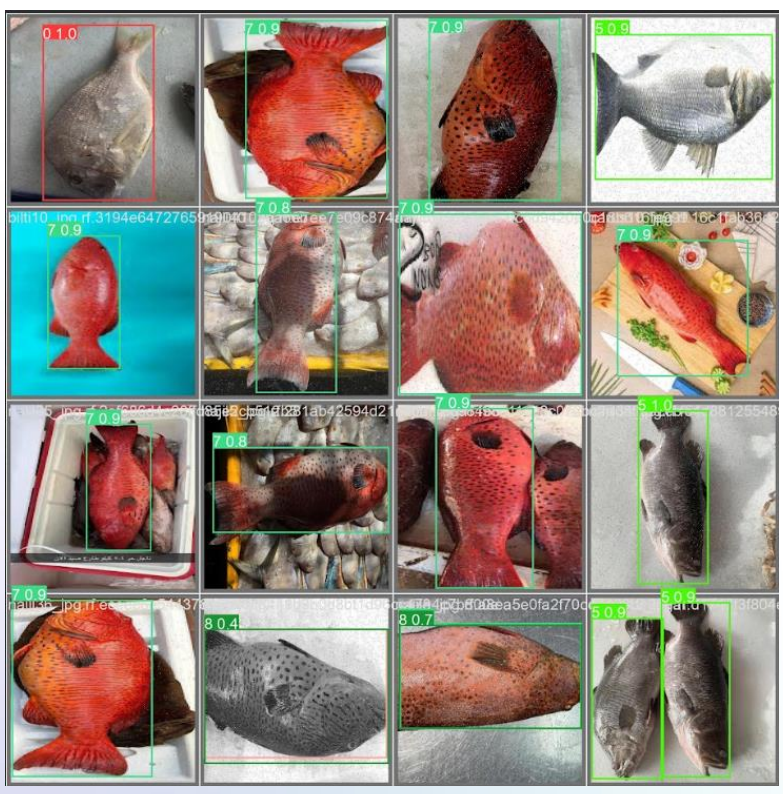
**Precision and Recall**: Precision, representing the proportion of true positive predictions out of all positive predictions made by the model, gauges its ability to avoid false positives. Simultaneously, recall measures the proportion of actual positive instances that the model correctly identifies, offering insights into its capacity to capture all relevant instances. Together, precision and recall provide a comprehensive evaluation of the model's performance, balancing its accuracy in positive predictions and its effectiveness in capturing all pertinent instances.

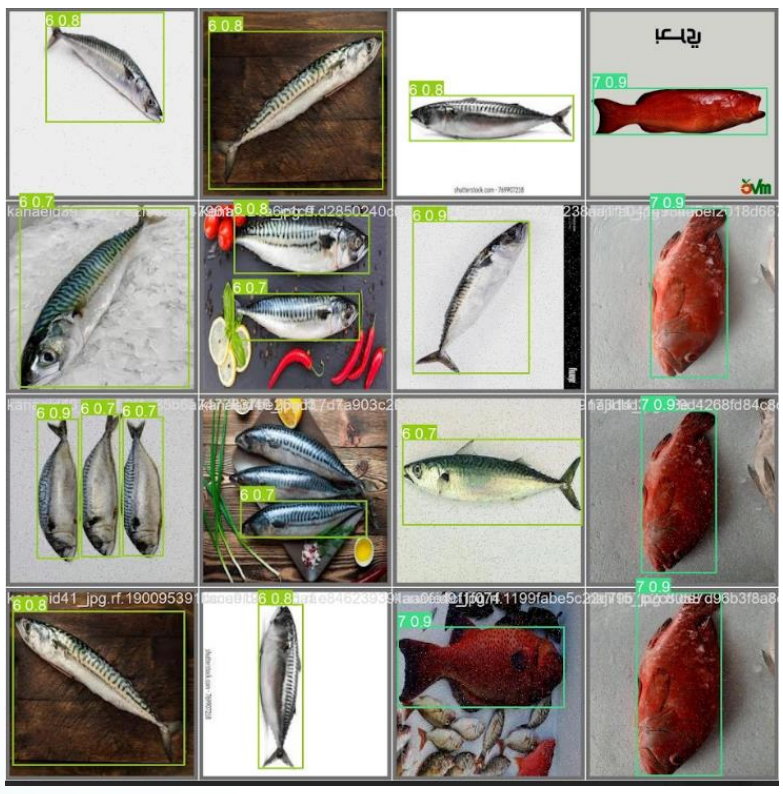


**Loss function:** In YOLOv8 for object detection, the loss function is a crucial element used during the training phase to optimize the model's parameters




**Sample Predictions:** Providing visual representations of sample predictions is instrumental in offering a firsthand look at the model's performance on actual instances from our fish species identification project.





## 2. Impact and Significance on Saudi Vision 2030

## Objectives:

Our project not only directly contributes to the objectives of Saudi Vision 2030 but also holds far-reaching implications with profound societal and economic impact. Addressing the widespread fraud in the fish market and enhancing market transparency, our technological solution forms the cornerstone for fostering consumer trust. This commitment resonates with the broader goals of economic diversification and sustainability outlined in the vision. Beyond mitigating fraud, our project introduces efficiency in fisheries management through a robust computer vision model, promising informed resource conservation. Furthermore, the adoption of cutting-edge technologies signifies a transformative leap in industry practices, reflecting a commitment to technological advancement within traditional sectors. In essence, our project's multifaceted impact underscores its pivotal role in driving positive change, aligning seamlessly with the principles of innovation, transparency, and sustainable practices championed by national visions.

## 3. Limitations and Challenges:

Despite the successes, it is essential to acknowledge limitations and challenges encountered during the project. We faced challenges in collecting a sufficient amount of data, impacting the depth and diversity of our dataset. These limitations offer valuable insights for refinement in future iterations, emphasizing the need for improved data collection strategies to enhance the model's performance.

Furthermore ,the project encountered challenges in exporting the model to TensorFlow Lite (TFLite), impeding its seamless deployment on our application. This hurdle emerged as a result of our involvement in the labelling process in Arabic, necessitating the replacement of Arabic letters. To address this, we undertook the task of retraining the model after modifying the labels.

# Conclusion and Future Work

In conclusion, this project has successfully addressed the challenges of fish species identification, freshness assessment, and market pricing through the implementation of YOLOv8 and advanced computer vision techniques. By leveraging these technologies, we have contributed to enhancing market transparency, mitigating fraud, and promoting sustainable practices within the fishing industry. The comprehensive model developed not only identifies various fish species accurately but also assesses their freshness, providing valuable insights for both consumers and stakeholders. The integration of market pricing information further enriches the project's scope, facilitating informed decision-making in the market.

The significance of this project lies in its alignment with the objectives of Saudi Vision 2030, particularly in fostering technological innovation, economic diversification, and sustainable practices. By addressing the widespread issue of fraud in the fish market, we have laid the groundwork for a more transparent and trustworthy market environment.

There are opportunities for future work to enhance capabilities and address emerging challenges. Potential areas for improvement include:

**Expansion of Fish Types:**

To broaden the scope and applicability of the model, future work should focus on expanding the dataset to include more fish types. This can be achieved through additional data collection efforts, ensuring a diverse representation of various species commonly found in different regions.

**Real-Time Price Modelling:**

Integrate a real-time pricing model to dynamically capture market fluctuations and provide users with up-to-date information. This can involve leveraging market APIs or other sources to fetch and incorporate live pricing data into the system, enhancing the model's accuracy in reflecting current market conditions.

**Enhanced Freshness Detection:**

Explore and implement advanced techniques to detect freshness beyond the eye region. This includes integrating additional visual cues and features for a comprehensive assessment of fish freshness. Consider incorporating fish gill color analysis as a relevant factor, as changes in gill color can be indicative of freshness or deterioration. The model can provide a more nuanced and holistic evaluation of the overall quality and freshness of the fish.

**User Feedback Integration:**

Implement a feedback loop mechanism where user feedback on model predictions is collected and used to continuously refine and improve the model. This iterative process ensures that the model evolves based on real-world user experiences and challenges.

By pursuing these avenues for future work, the project can evolve to meet evolving market demands, incorporate a wider range of fish types, and enhance its overall utility and accuracy in providing valuable information to users.

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# Team

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