SDAIA
الهيئة السعودية للبيانات والذكاء الاصطناعي
Saudi Data & AI Authority

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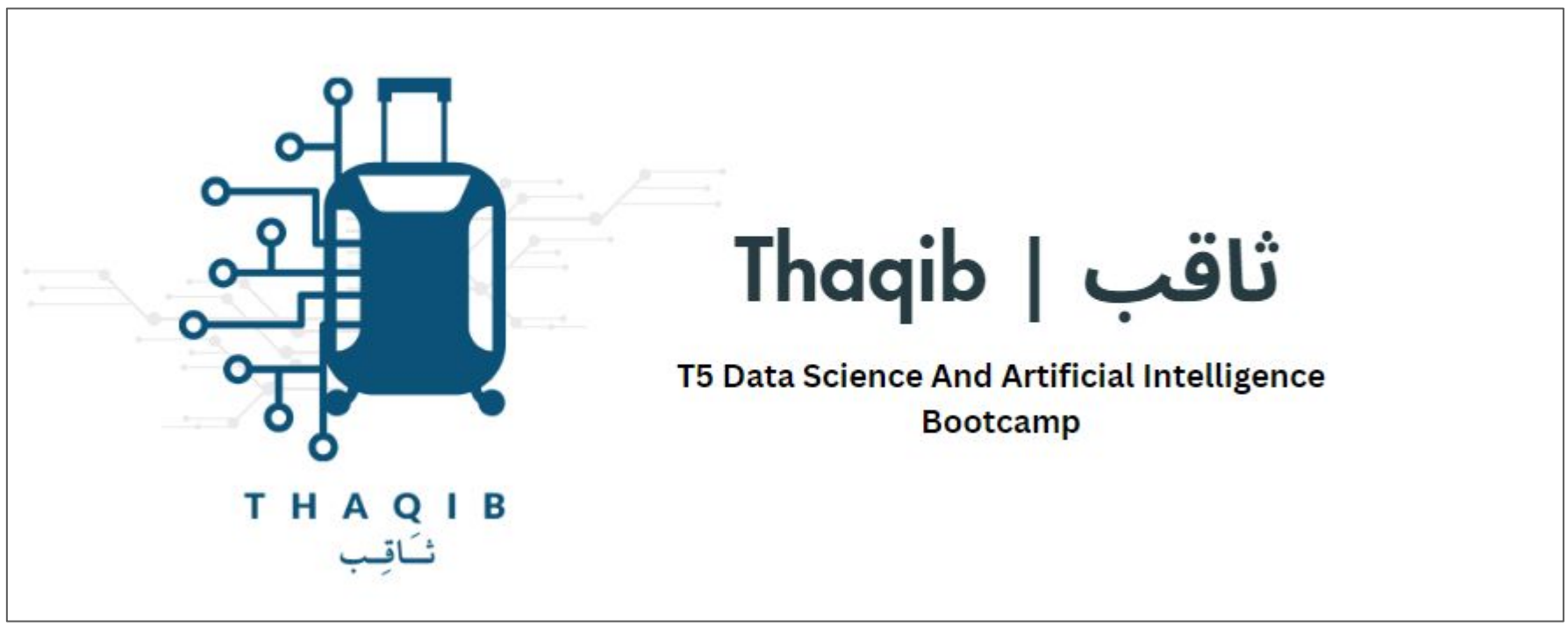
T5
Report Template

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.
Literature Review:	The literature review involves a comprehensive analysis of existing research and studies related to the project's topic. It examines the current state of knowledge, identifies gaps or limitations in previous work, and highlights relevant theories, methodologies, or frameworks that inform the project's approach.
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 2030. It may also address any limitations or challenges encountered during the project.
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	



X-ray Baggage Scanner Detection (Thaqib)

Detect prohibited items to Enhancing Security and Efficiency in Transportation

Abstract

This report presents the outcomes of an T5 Data Science and Artificial Intelligence Bootcamp capstone project focused on X-ray Baggage Scanner Detection. The project aimed to develop an AI-based solution to automate the detection of dangerous items during X-ray screenings.

By utilizing advanced computer vision techniques, the objective was to enhance security measures and streamline baggage screening processes.

The project employed Convolutional Neural Network (CNN) and YOLOv8 models, trained on a diverse dataset of over 8,000 X-ray images. The models were fine-tuned to accurately identify dangerous objects like wrenches, scissors, pliers, knives, and guns. The training process emphasized abstract feature extraction and performance optimization.

The results demonstrated the effectiveness of the AI-based solution in identifying dangerous items within luggage. This project contributes to improved safety and efficiency by strengthening security measures and reducing wait times and potential disruptions for passengers.

Introduction

The project serves as a motivation for addressing the challenges in manual inspections of baggage and highlights the alignment of the project with the objectives and strategies of Saudi Vision 2030. Within the context of Saudi Vision 2030.

There is a strong emphasis on transforming and diversifying the economy, improving infrastructure, and enhancing security measures. These objectives extend beyond airports and encompass other sectors such as land ports and customs.

Manual inspections at these locations can also be time-consuming and prone to human error, leading to delays, inefficiencies, and potential security risks. By developing an AI-based solution for automated detection of dangerous items in baggage, the project aims to address these challenges across various sectors, including land ports and customs.

By implementing advanced AI technology, the project seeks to improve the efficiency and accuracy of baggage screening processes not only at airports but also at land ports and customs checkpoints.

The AI-based solution can empower inspectors at these locations with tools that enable quick and reliable identification of potential threats, supporting the overall goals of Saudi Vision 2030.

Data Description and Structure:

Dataset Overview:

The project sourced its data from various reliable and diverse sources to ensure comprehensive coverage of potential prohibited Items found in luggage. These sources could include airport security databases, public datasets, and collaborations with relevant authorities involved in baggage screening.
The source of the dataset from universe.roboflow.com

Preprocessing Steps:

These steps typically involved several procedures, such as resizing the images to a standardized resolution, normalizing pixel values, and augmenting the dataset for improved generalization.

Data Structure:

- **Total Images:** (8,295 images)
  - Training set: 5,806 images
  - Validation set: 1,660 images
  - Testing set : 829 images
- **Classes:**
  - Pliers
  - Gun
  - Wrench
  - Knife
  - Scissors
- **TXT annotations** (Labels)

Methodology

CNN Model:

The CNN model was trained using the dataset, with 2,048 images in the training set, 585 images in the validation set, and 293 images in the testing set. The training process involved building and training the CNN architecture from scratch. The model underwent iteration, adjusting parameters and architecture to optimize its performance.

Steps to Be Followed:

- **Import data and display image**
- **Data preprocessing**
  - Check that the annotated file and the image are both present.
  - Shuffle the data.
  - Resize the images
  - normalize the images
- **Combined images and annotations**
- **Split the data into Training, Validation, and Testing**
- **Train the model**
- **Predict the images**
- **Visualize the results**

Methodology

YOLOv8 Model:

The YOLOv8 model was chosen as an alternative approach due to its superior performance. This model established boundaries and assigned labels according to the classes in the dataset.

It was trained using the same dataset but with a different architecture and parameters. The YOLOv8 model's performance was evaluated based on Mean Average Precision (mAP) on the training set

Steps to Be Followed:

- Install the Ultralytics libraries.
- Pulling the data from Roboflow
- Train an object detection model.
- Valid an object detection model.
- Predict an object detection model.
- Display images with boundary Box.

Discussion and Results:

The results showcased the effectiveness of the proposed solution in detecting dangerous items within luggage. The CNN model achieved classifier head accuracy is 0.93 and regressor head mean square error is 0.0226. The YOLOv8 model demonstrates improvements in both detection rates and processing speed and achieved a Mean Average Precision (mAP) of 0.94.

The dataset poses challenges such as variational brightness and contrast of the images, unbalanced classes, and limited diversity in prohibited items. On the model side, challenges include trying different models,frameworks, and architectures to select the appropriate model that achieve optimal performance.

The findings have significant implications for achieving the objectives of Saudi Vision 2030. One of the objectives is to enhance security and safety measures in different areas by automating the detection of dangerous items,

Conclusion and Future Work

In conclusion, the project's discussion and results demonstrate the successful implementation of AI-based solutions for X-ray baggage scanner detection. The findings align with the objectives of Saudi Arabia Vision 2030, showcasing the potential for enhancing security, increasing efficiency, and driving innovation in the transportation sector.

Despite challenges, the project lays the foundation for future advancements in baggage screening technologies and contributes to the overall goals of Saudi Arabia Vision 2030.

In future work, the project aims to expand the range of detectable prohibited items and implement X-ray Baggage Scanner Detection on edge device

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GitHub