Mandatory Summer Internship Report

Industrial IT and Automation sector
Level: 3rd year

Subject:

SBM box conformity control system

Directed by: Barhoumi Dhieddine

Home Business:

DidaMind

Responsible for the company:	*Opinion of the internship commission*
Mr Abidi Hatem	

Academic year: 2022/2023

Thanks

I warmly thank the DIDAMIND company, as well as my supervisor Mr. Abidi Hatem. I am deeply grateful for the exceptional welcome I received within DIDAMIND, the constant support, encouragement and valuable advice greatly contributed to my success throughout this experience. I sincerely thank the company for this opportunity and for all the support they have provided.

1 Introduction

The world of artificial intelligence (AI) and computer vision has become a key driver of transformation in various fields. The integration of AI into our lives has opened up exciting new avenues, from image recognition to automated decision-making. One of the most exciting aspects of the field is computer vision, which attempts to give machines the ability to visually "see" and understand the world around us.

During my journey within the DidaMind team, I had the opportunity to dive deep into the world of AI and computer vision, in a universe where algorithms and neural networks are both architects and translators of visual information. This report explores my journey in this dynamic and ever-changing field. Through these pages, I will share how I discovered the fundamentals of computer vision and how I got involved in a project that allowed me to apply this knowledge in real life.

2 Presentation of the host company

2.1 The sector of activity

DidaMind is a Tunisian company specializing in the development of industrial solutions specifically established in 2020 combining expert resources, passion for innovation, advanced application development technology and optimized business processes tuned to realize the client's most challenging business vision with minimal hard work and obtain the best results. Indeed, DidaMind develops innovative products and services and innovators providing global information and communication solutions. In addition, DidaMind symbolizes excellence, passion and flexibility.

Figure 1: DIDAMIND logo

2.2 Organization chart of the DIDAMIND company

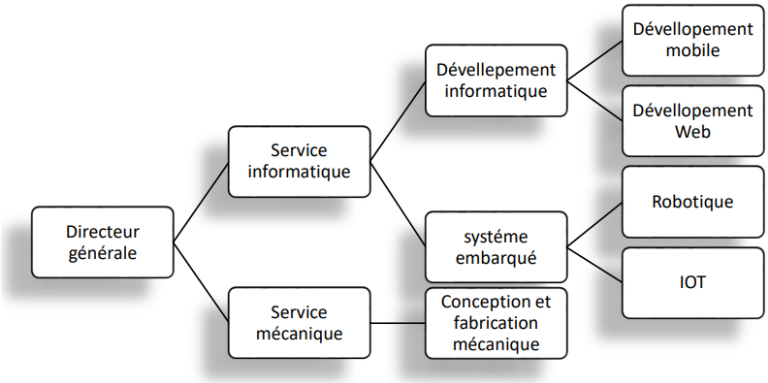

Figure 2: DIDAMIND organisation chart

2.3 Company services

2.3.1 IOT

The term Internet Of Things (IOT) gives you precise and instant visibility of the state of your company's assets. Thanks to their ability to transmit information in real time, connected solutions respond to critical use cases. They also improve your products and services by continuously measuring customer satisfaction. The obstacles to efficiency are removed and maintenance becomes predictive.

2.3.2 Robotics

Industrial robots allow the automation of certain tasks on your production line, giving you flexibility and increased productivity.

2.3.3 Artificial intelligence

AI enables machines to sense, learn, reason, act and adapt to the real world

2.3.4 Mobile Development

Mobile applications have become an essential communication channel for a company's image. DidaMind supports you from the initial idea to the design and development of IOS and Android applications.

2.3.5 Website development

The spirit of DidaMind lies in the interest in supporting their clients in creating a website. effective. Each client who, thanks to their tailor-made site, will generate business and thus develop their activity.

2.3.6 ERP Development

The development of tailor-made resource planning (ERP) companies consists of developing a software adapting to the specific situations and needs of each company.
In fact, DidaMind develops software adapted to the needs of companies to solve their problems and improve their management as a whole and thus boost their performance.

The company has its head office at Avenue des Martyrs Mourouj 3 Ben Arous, Tunisia.

3 Targeted objectives (specifications)

The essence of my internship lies in the pursuit of precise and defined objectives. My main mission is to develop a successful solution using advanced computer vision technologies to solve a particular problem. My objectives revolve around the design and implementation of an advanced object detection model, capable of accurately locating and classifying "angle" and "gusset" objects in "SBM box" images.

Here are the tasks and goals that I set for myself:

3.1 Data collection and preparation

I started my project by collecting a representative dataset of “SBM box” images. Then, I proceeded to meticulously annotate the “Gusset” and “Cornière” objects. I also took a creative approach by converting these box annotations to polygon annotations to increase detection accuracy.

3.2 Model architecture selection

My goal is to leverage the most advanced architecture for object detection. I chose to use Ultralytics YOLOv8 as the basis for my model, a decision based on its reputation for performance and efficiency.

3.3 Data Augmentation

The variety of training data is essential to the performance of the model. I applied various data enhancement techniques including rotating, flipping, color adjustment, and other methods to increase data variability.

3.4 Model training and customization

I took care of the development of the model by customizing YOLOv8 to specifically respond to "Gousset" and "Corniere" detection. I used advanced training techniques to fine-tune the model on my augmented dataset.

3.5 Performance evaluation and tuning

I evaluated the model's performance using a set of metrics, including box and class losses, accuracy, and MAP scores. Then I adjusted the model based on the results to improve its performance.

3.6 Analysis of results and future prospects

My ultimate goal is to consolidate the results, analyze the successes and challenges encountered, and propose perspectives for continuous improvement of the model.

These well-defined goals formed the common theme of my internship, guiding me through the various stages of development, implementation and evaluation of our object detection model. With these goals in mind, I was able to maintain a structured and results-oriented approach throughout my internship at DidaMind.

4 Internship diary

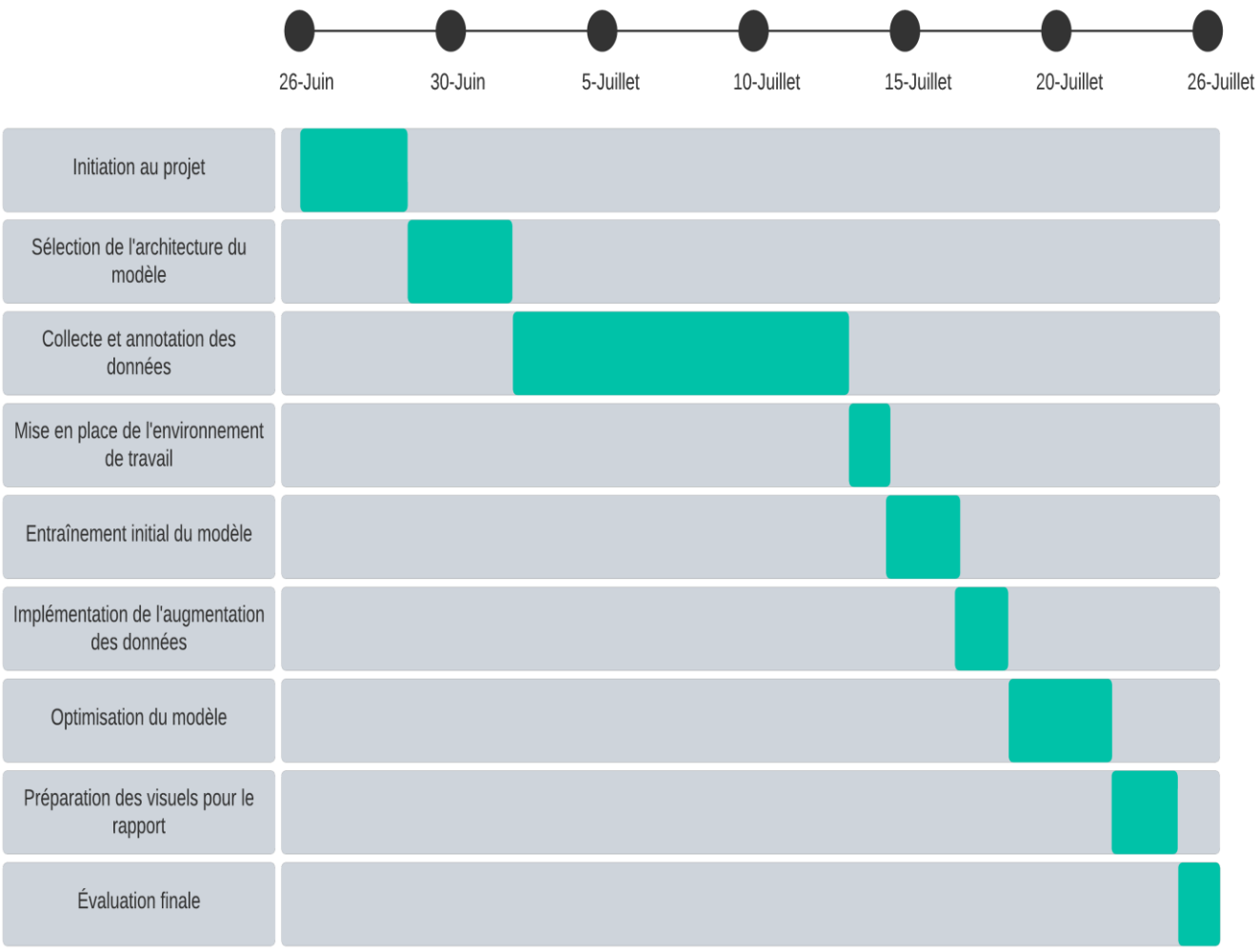

Figure 3:Gantt chart

5 Work done

During my internship at DidaMind, I took a series of methodical steps to achieve the goals I had set for myself. My work focuses on the design and implementation of a dedicated object detection model, using Ultralytics YOLOv8 as a basis. Here is a detailed overview of the steps I took to complete this project:

5.1 Data Collection and Preparation

I started by collecting a representative dataset, consisting of images of "SBM boxes". These images are essential for training and evaluating my model. I make sure to have a variety of viewing angles, lighting and conditions to ensure the sustainability of the solution. I've included screenshots of these images in this section to illustrate the nature of the dataset.

Figure 4:SBM boxes

5.2 Exploring Model Architecture

Before diving into the design, I took a detailed look at the YOLOv8 model architecture using the Netron tool (netron.app). This step allowed me to better understand the structure of the model and the classes that contribute to object discovery.

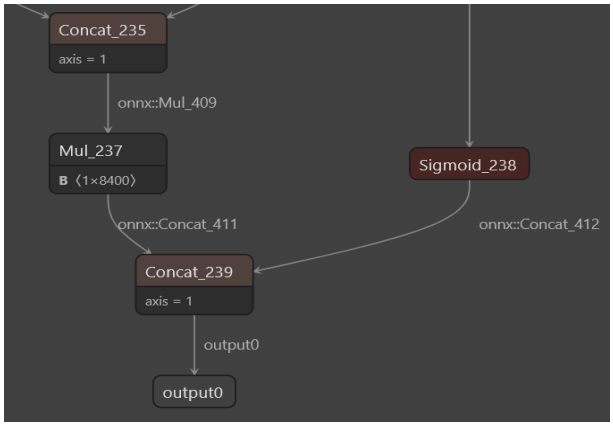

Figure 5:Architecture of the last layer of the YOLOv8 model

5.3 Data Annotation with Roboflow

Accurately annotating objects of interest was a crucial step for training the model. I used the Roboflow site to annotate the "angle" and "gusset" objects in the "SBM box" images. Each image was annotated with bounding boxes and converted to polygons for improved accuracy.

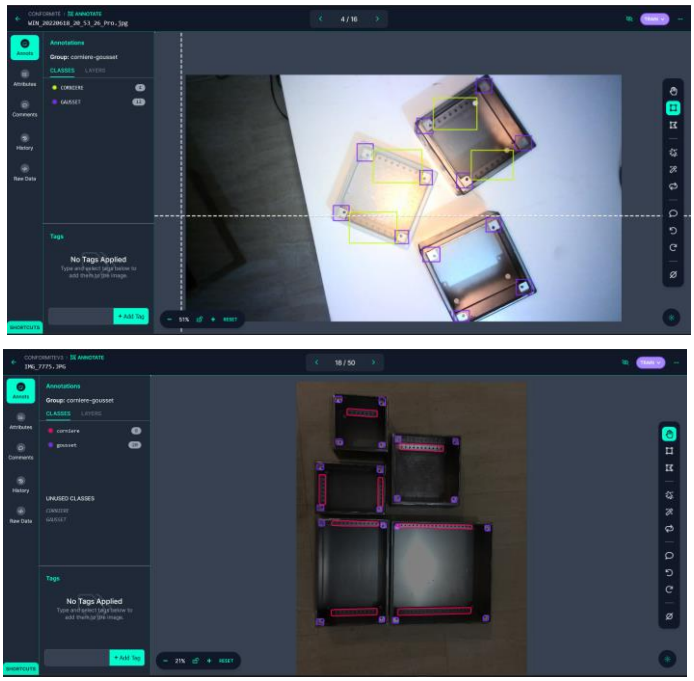

Figure 6:Annotated data

5.4 Data Augmentation

To improve the diversity of the dataset and improve the generalizability of the model, I applied various data enhancement techniques. This already includes rotating, flipping, color adjustment, etc. The images below show examples of these extensions applied to "SBM box" images.

Figure 7:Data augmentation techniques

5.5 Exporting the Dataset

After finalizing the annotation and data augmentation, I exported the dataset in "TXT annotations and YAML config" format compatible with YOLOv8. I organized the images and annotation files into the required structure and prepared them for training the model. This step was essential to ensure that the model could access the data appropriately.

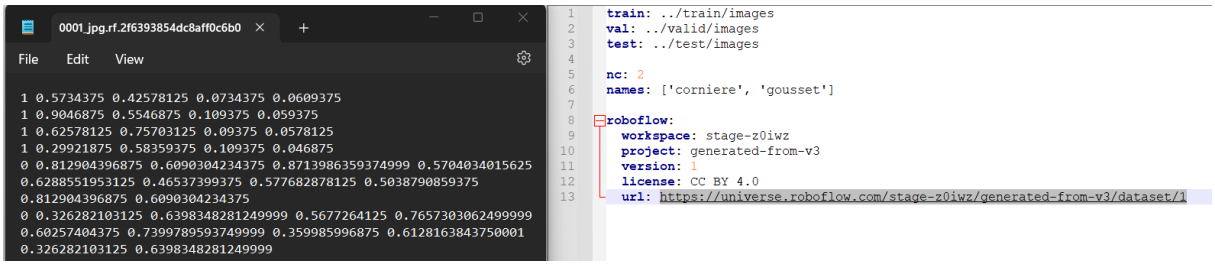

Figure 8:TXT annotations and YAML config

5.6 Training the Model on Kaggle and Exporting to PT Format

To guarantee fast and efficient training of my object detection model, I chose to use the Kaggle platform which offers access to powerful GPU resources. This decision turned out to be a good one, as it allowed me to train my model on almost 8000 images in just 24 hours, which would have been much more time-consuming on standard hardware configurations.

5.6.1 Configuring the Kaggle Environment

Before starting training, I set up my environment by installing the necessary dependencies, including computer vision libraries, image processing tools, and of course, the Ultralytics library. I also set up the data management system to access the necessary images and annotations.

5.6.2 Data Preparation

I also transferred the previously annotated and augmented dataset to the Kaggle platform. This included the "SBM box" images and corresponding annotation files. I made sure to organize the data so that it was easy to access and ready for training.

5.6.3 Configuration of Model and Parameters

I used the modified version of YOLOv8 from Ultralytics, optimized for specific object detections. I configured the training parameters, including learning rate, number of epochs, and other hyperparameters, taking into account the size of the dataset and the characteristics of the objects I was looking to detect.

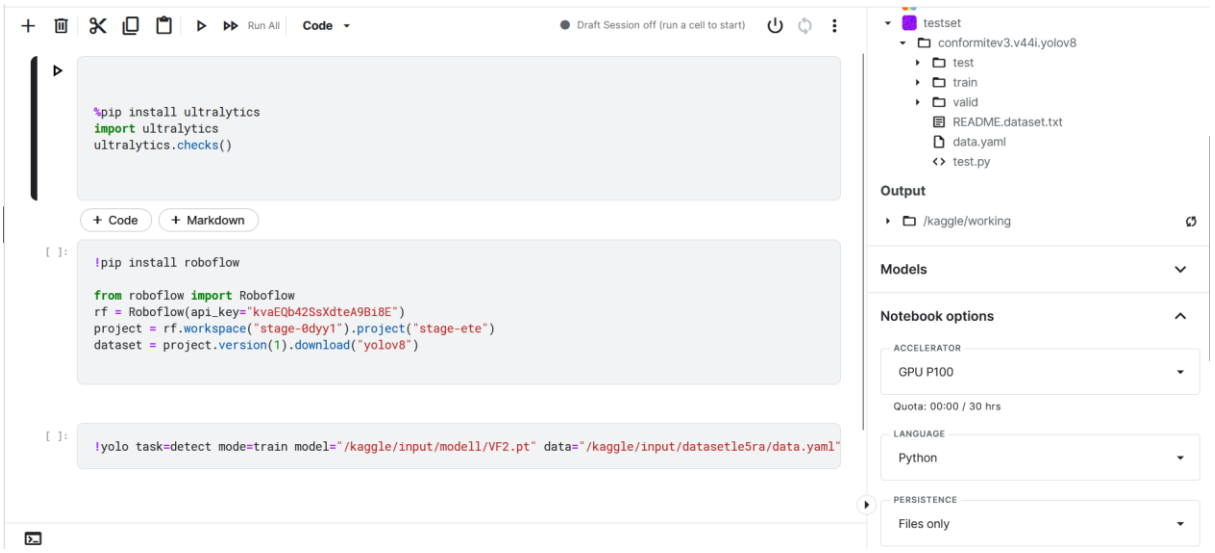

Figure 9:Model setup

5.6.4 Training Monitoring and Evaluation

During the training process, I monitored loss metrics, model convergence, and performance improvements. I made adjustments along the way when necessary to improve results. Once training was complete, I evaluated the model's performance on a validation set to get a clear idea of its detection capabilities.

5.6.5 Export in PT Format

After achieving satisfactory performance, I exported the trained model to PyTorch format (.pt). This allowed me to save the model for later use, including for real-time testing and for object detection on unknown images.
Using Kaggle to train the model significantly optimized the process, allowing me to leverage powerful GPU resources to accelerate training. This crucial step was an essential element in the success of my internship project.

5.7 Model Test with Camera

To evaluate the model's performance in real-world conditions, I connected a camera to my computer and used the Ultralytics library to test the model in real time. This allowed me to check the model's ability to detect "angle" and "gusset" objects live.

Figure 10:Real-time testing

6 Consolidation of acquired knowledge

Compétences Acquises à l'INSAT (Formation)	Compétences Acquises lors du Stage d'Été
Bases de Données	Manipulation et Préparation de Données
Programmation Orientée Objet	Gestion de Projets et Planification
Algorithmes et Structures de Données	Annotation et Augmentation de Données
Communication et Rédaction Scientifique	Rapport de Stage et Présentation des Résultats
Résolution de Problèmes Complexes	Optimisation de Modèle et Ajustements Techniques
Travail d'Équipe et Collaboration	Interaction avec les Membres de l'Équipe Projet

7 Conclusion

My internship at DidaMind was a very rewarding experience, allowing me to explore and apply advanced concepts in computer vision and machine learning. I had the opportunity to work on the development of a specialized object detection model to recognize "angles" and "gussets" in images of "SBM boxes". This conclusion aims to summarize the highlights of my work, highlighting the positive points and lessons learned during this internship.

7.1 Strong points

7.1.1 Performance improvement

Using Ultralytics YOLOv8 and applying carefully selected annotation and data enhancement techniques, I achieved satisfactory detection results. Accuracy rates, recovery rates, and MAP50 and MAP50-95 metrics all provide evidence of improved model performance.

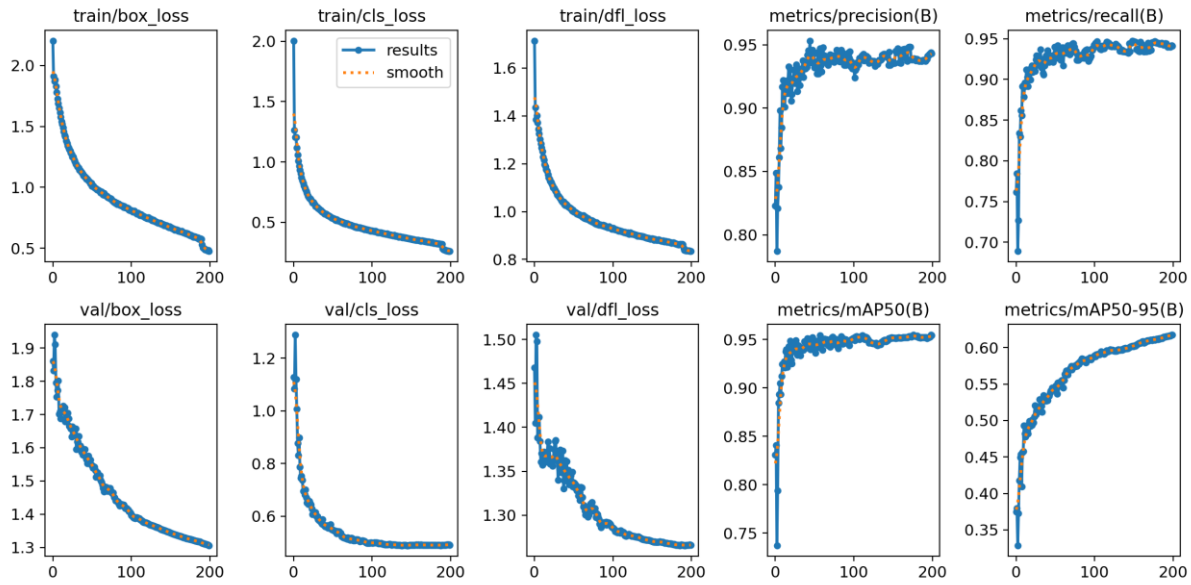

Figure 10:Results

7.1.2 Effective training

The Kaggle platform allows me to leverage powerful GPU resources, allowing me to do accelerated model training. This reduces training time while improving model quality.

7.1.3 Comprehensive approach

I approached the project methodically, going through data collection, annotation, model training, data augmentation, and evaluation. This holistic approach allows me to better understand the entire process of developing an object detection model.

7.2 Weak points

7.2.1 Annotation Challenges

The annotationaccurate images has proven to be a difficult and demanding process. Annotation errors can directly affect model performance, which requires special attention at this stage.

7.2.2 Optimizationkeep on going

GOODAlthough the results are promising, there is always room for improvement. Optimizing hyperparameters, augmentation strategies, and other techniques could further enhance the model's detection capability.

7.3 Future Outlook

I believethat the application of object detection models like this can have a significant impact in different industrial sectors. For DidaMind, integrating computer vision-based solutions can open up new opportunities and increase process efficiency. The techniques I learned and the results I achieved during this internship will serve as a solid foundation for me to continue my career in this exciting field.

Myinternship at DidaMind was the catalyst for the practical application of my skills in computer vision and machine learning. This allows me to make the connection between the theoretical knowledge acquired at INSAT and real-world challenges. I am grateful for this opportunity and I believe in the potential that these experiences will open for my professional future.

Bibliographies

[1]Roboflow, "Data Augmentation Techniques for Object Detection,"https://docs.roboflow.com/, consulted on July 2, 2023.

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