

Maltese Christian Statue Classification

Matthias Bartolo

The Aim of This Project

Can Artificial Intelligence (AI) be employed to recognise and differentiate between Maltese Christian statues in images, providing assistance to those unfamiliar with the culture or religion?

Predicting image: Image_13

The Crucifixion: 100.0%



How Was This Achieved?

1. Problem Definition
2. Data Collection
3. Dataset Creation
4. Dataset Splitting
5. Model Selection
6. Model Training
7. Model Testing
8. System Deployment

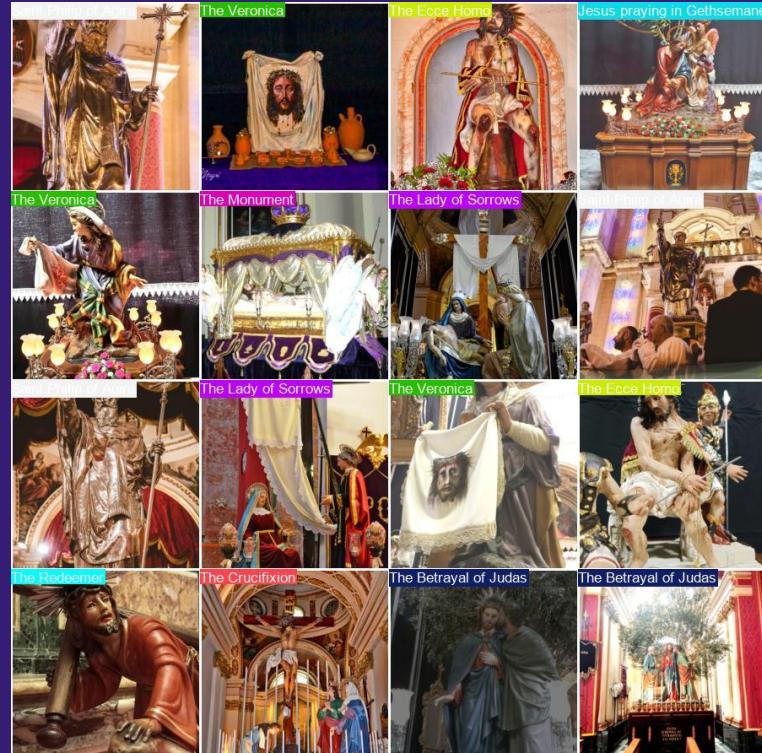


Problem Definition (Image Classification)

Given an image, we need to determine the category or class under which the given image can be classified.

More simply: “Identify which specific statue is depicted in the image.”

Assumes that the image contains a statue and is captured at a reasonable distance, ensuring visible details.

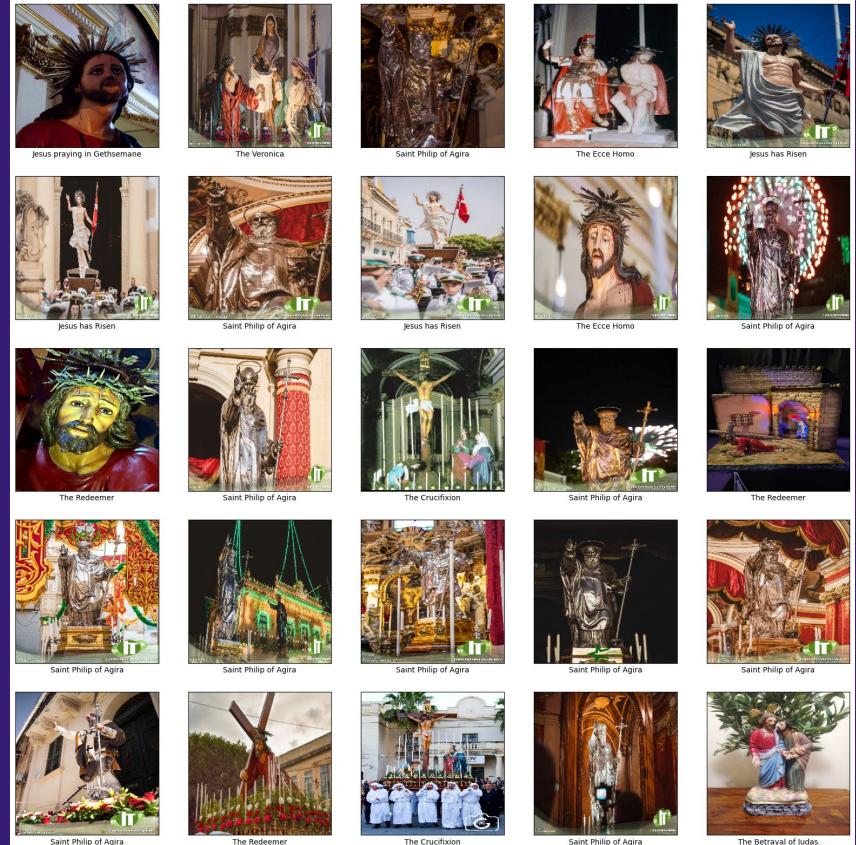


Data Collection

Collecting a diverse set of images containing Maltese Christian statues proved to be quite challenging, given the large number of statues found across Malta.

To address this, data collection was focused on **14** different statues, primarily including statues associated with Lent and statues from the Parish Church of St Philip of Agira, Żebbuġ, Malta.

The images were sourced from public online forums and photographs taken directly by the author.

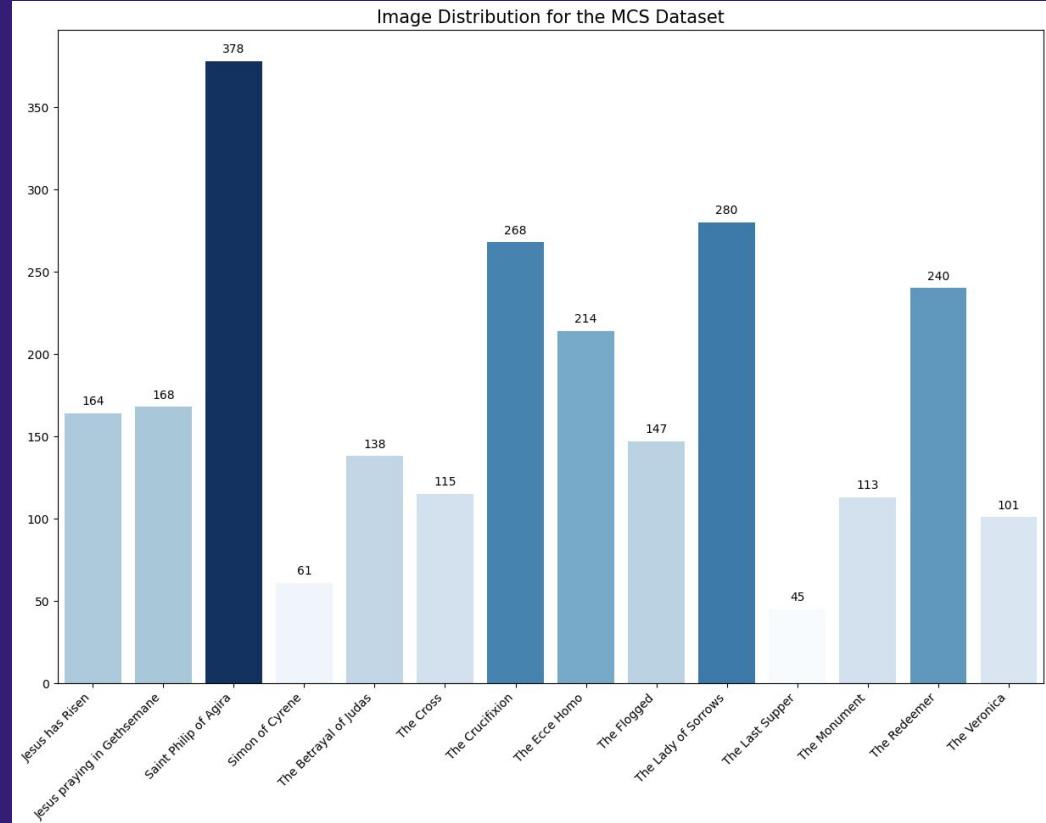


Dataset Creation (1)

A total of **2,432** images were gathered to create the **Maltese Christian Statue (MCS) dataset**.

The images were manually sorted into their respective classes to ensure accurate categorisation.

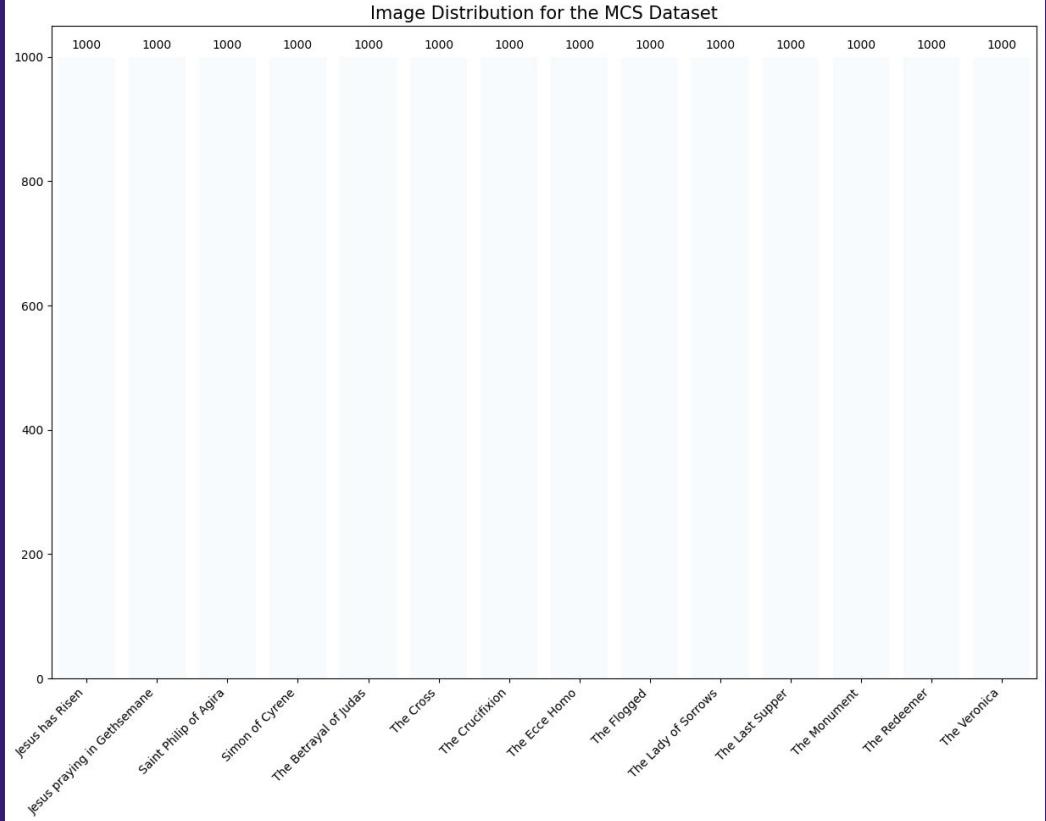
However, the distribution of images across classes was not uniform.



Dataset Creation (2)

To address this issue, data augmentation techniques were applied.

Additional images were generated to artificially expand the dataset, ensuring that each class contained a total of **1,000** images.



Dataset Creation (3)

The categories in the dataset:

1. *Jesus has Risen / L-Irxoxt*
2. *Jesus praying in Gethsemane / Gesù fl-Ort tal-Getsemani*
3. *Saint Philip of Agira / San Filep ta' Agġira*
4. *Simon of Cyrene / Xmun min Ċireni*
5. *The Betrayal of Judas / It-Tradiment ta' Ĝuda*
6. *The Cross / Is-Salib*
7. *The Crucifixion / Il-Vara L-Kbira*
8. *The Ecce Homo / L-Ecce Homo*
9. *The Flogged / Il-Marbut*
10. *The Lady of Sorrows / Id-Duluri*
11. *The Last Supper / L-Aħħar Ċena*
12. *The Monument / Il-Monument*
13. *The Redeemer / Ir-Redentur*
14. *The Veronica / Il-Veronica*

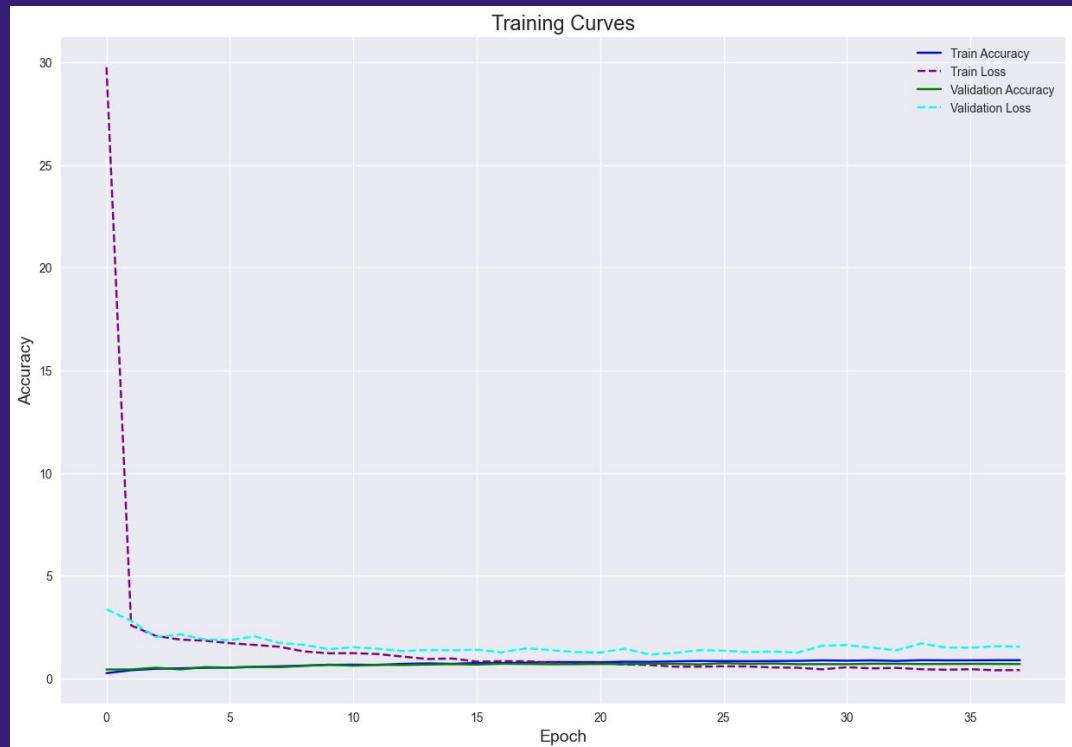


Dataset Splitting

The dataset was split into two partitions:

- **80%** used for training the AI model.
- **20%** used for testing the AI model's performance.

The testing partition helps evaluate if the model has learned effectively.

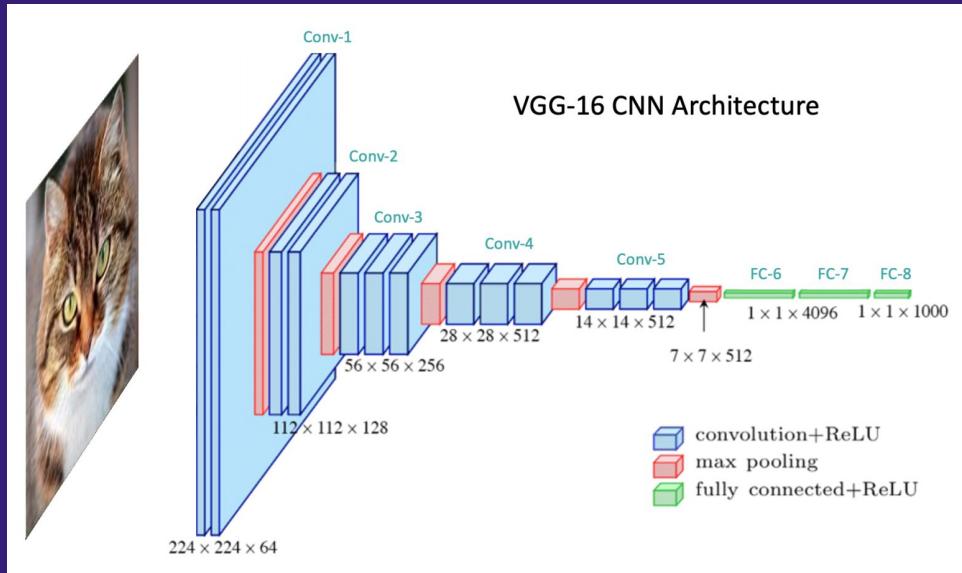


Model Selection

Pre-trained Convolutional Neural Network (CNN) architectures were selected to apply transfer learning for recognising the different statuses.

The following architectures were chosen:

- Modified **VGG16**
- Modified **MobileNet**
- **YOLO 11m-cls**



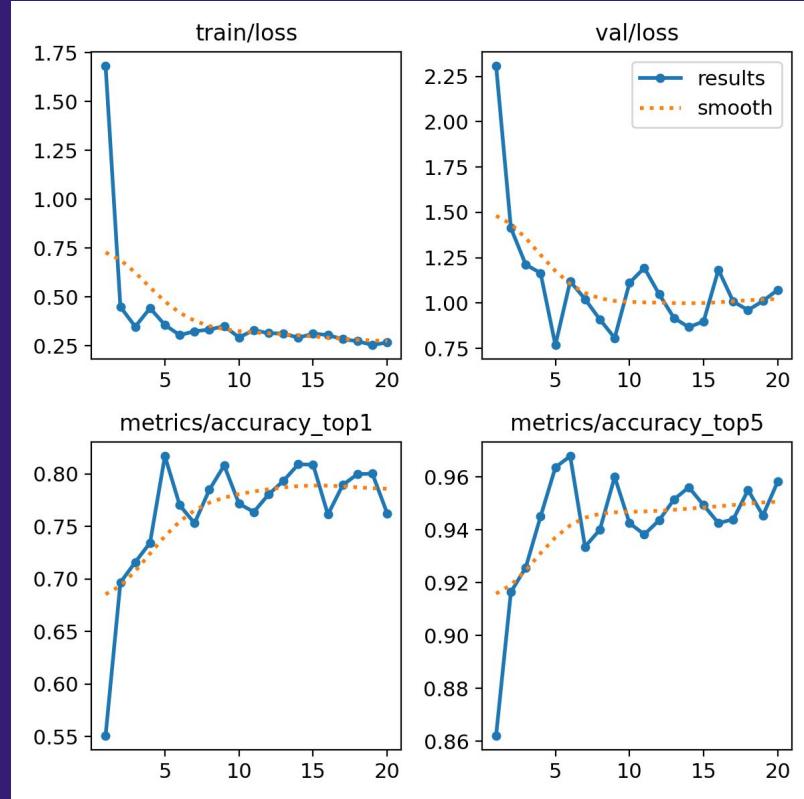
VGG16 (Source: [1])

Model Training (1)

The models were trained on the MCS dataset.

The modified **VGG16** and **MobileNet** models were relatively slow to train.

YOLO 11m-cls was the fastest model to train and also delivered the best performance, in term sof both accuracy and efficiency.



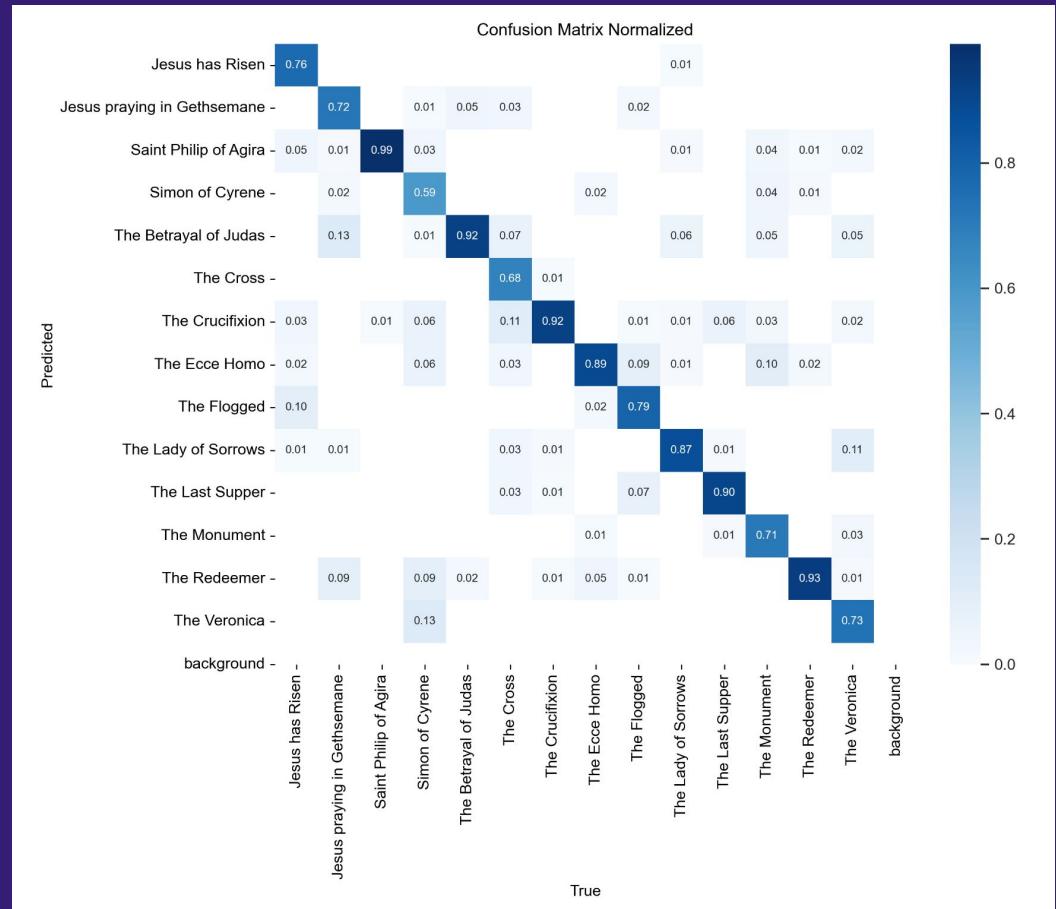
YOLO 11m-cls Training Results

Model Training (2)

YOLO 11m-cls Model Results:

- Top-1 Accuracy: 81.71%
- Top-5 Accuracy: 96.36%
- Fitness Score: 89.04%

The high Top-5 accuracy indicates strong performance in correctly identifying statues within the top five predictions.



YOLO 11m-cls Evaluation

Model Testing (1)

Predicting image: Image_1

The Redeemer: 70.16%



Predicting image: Image_2

Saint Philip of Agira: 100.0%



Modified VGG16 Testing

Predicting image: Image_15

The Ecce Homo: 98.73%



Model Testing (2)

YOLO 11m-cls Testing



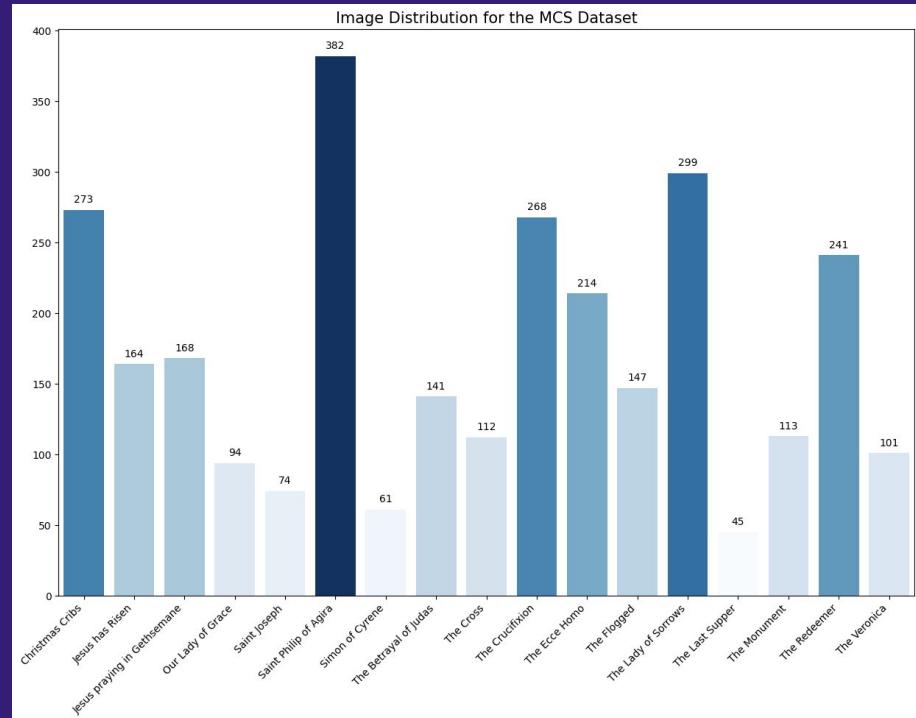
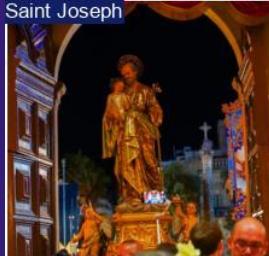
Dataset Version 2 (Category Update)

New categories in the dataset:

1. *Christmas Crib / Il-Presepju*
2. *Our Lady of Grace / Il-Madonna tal-Grazza*
3. *Saint Joseph / San Gužepp*

Total number of categories: **17**

Total number of images: **2,897**

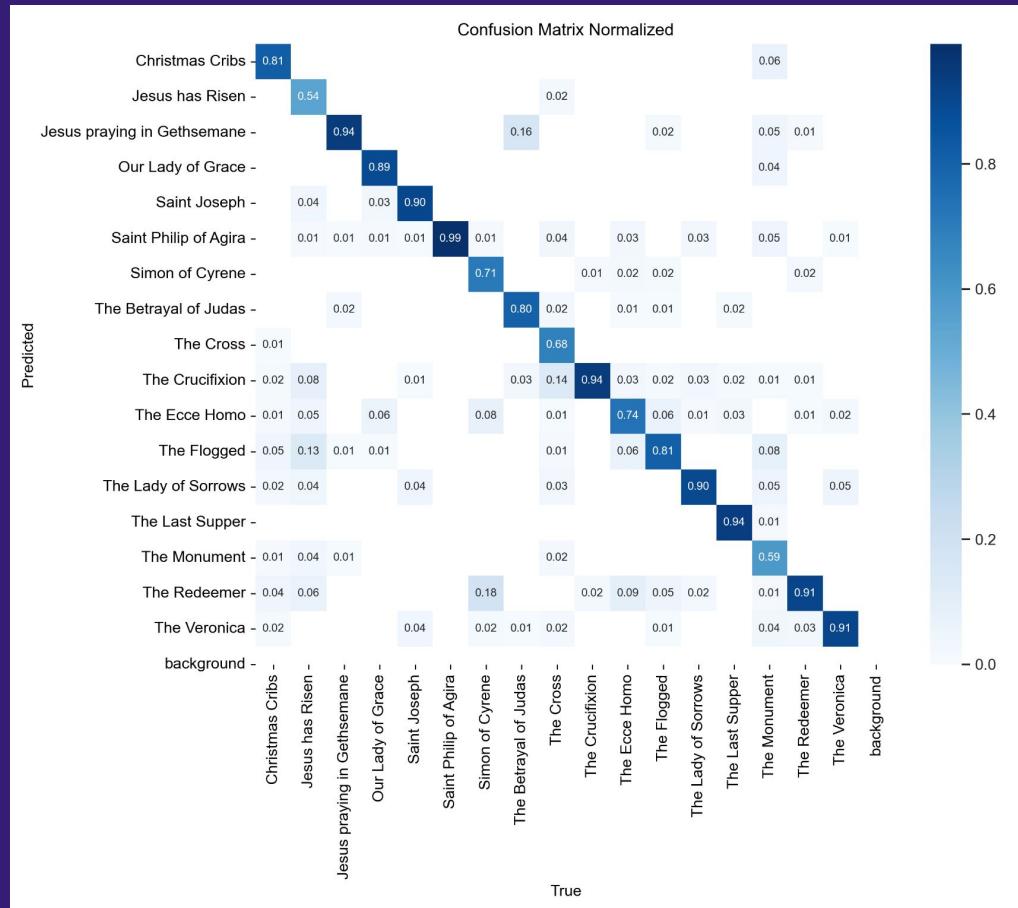


Model Version 2

YOLO 11m-cls Model Results:

- Top-1 Accuracy: 82.41%
- Top-5 Accuracy: 96.02%
- Fitness Score: 89.22%

Classes such as “Jesus Has Risen” and “The Monument” are among the most frequently misclassified.



Dataset Version 3 (Size Update)

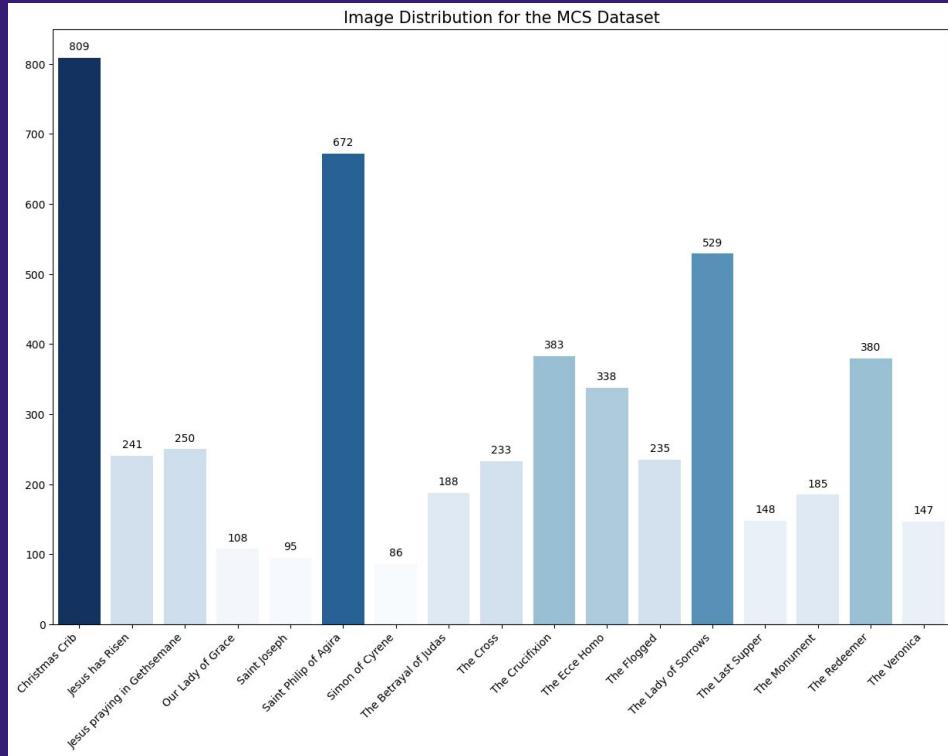
Increased the number of images in the dataset, and more difficult examples were added.

Total number of categories: **17**

Total number of images: **5,000**

Data Augmentation for every class was also increased to: **1,500**

The image distribution of statue appearances in the dataset, based on a sample of 5,000 images, shows how various statues, such as The Lady of Sorrows, appear more frequently.

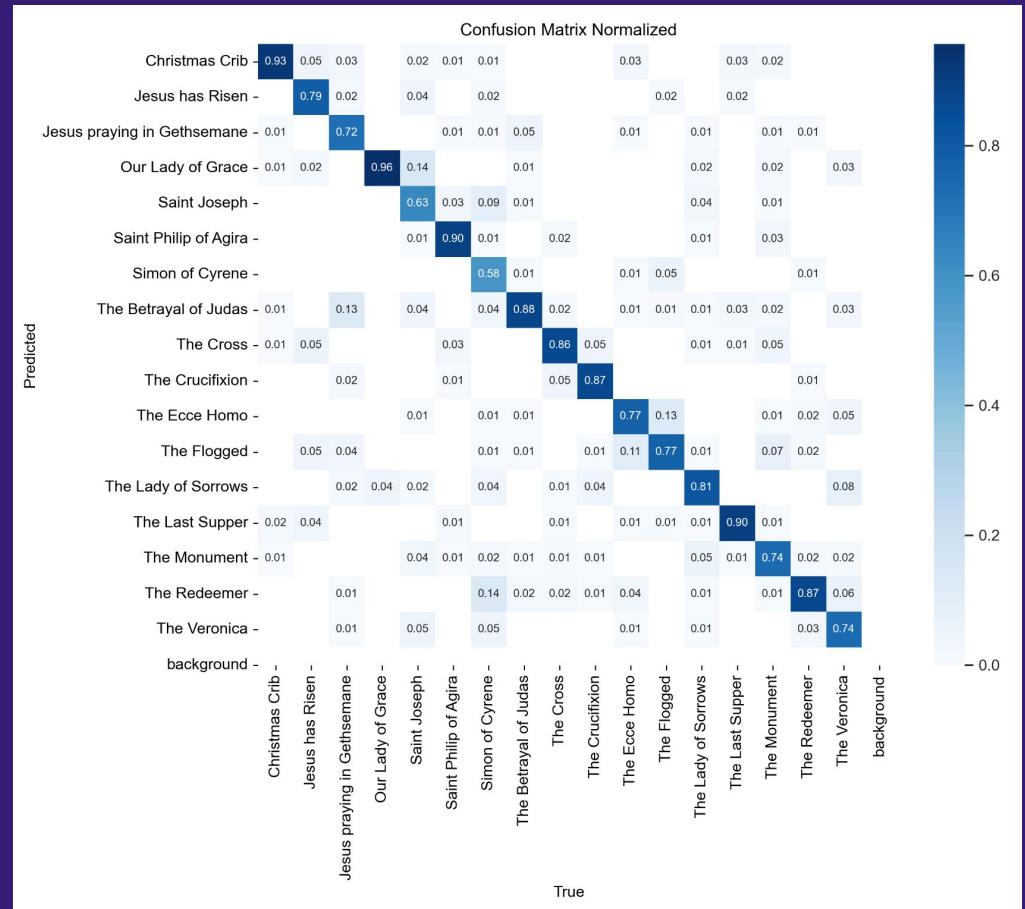


Model Version 3 (Fast)

YOLO 11m-cls Model Results:

- Top-1 Accuracy: 80.70%
- Top-5 Accuracy: 94.96%
- Fitness Score: 87.83%

Classes such as “Saint Joseph” and “Simon of Cyrene” are among the most frequently misclassified, which can be attributed to the small number of images representing them.

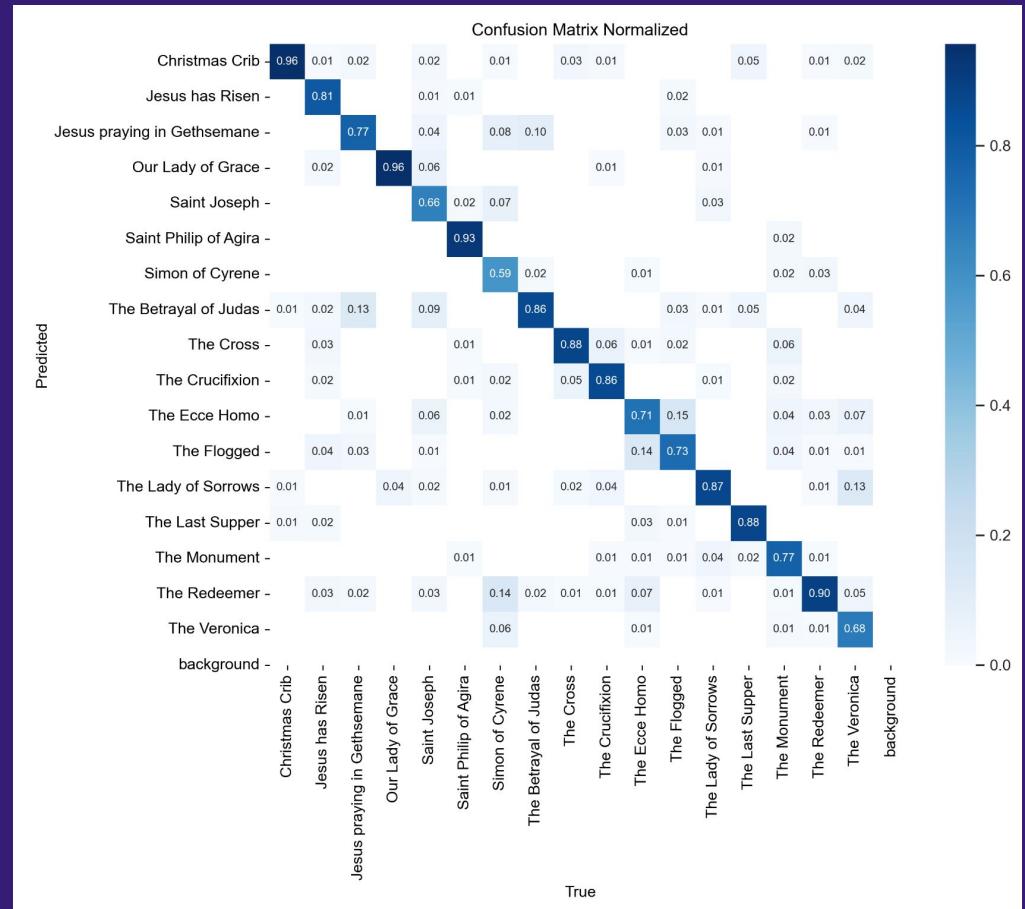


Model Version 3 (Accurate)

YOLO 11x-cls Model Results:

- Top-1 Accuracy: 81.25%
- Top-5 Accuracy: 95.27%
- Fitness Score: 88.26%

The same trend can be observed as classes such as “Saint Joseph” and “Simon of Cyrene” are among the most frequently misclassified.



YOLO 11x-cls Evaluation

Tackling Another Problem. . .

Can we recognise and distinguish which Parish the Maltese Christian statues in the images below belong to, or identify the parish whose statues they most closely resemble?

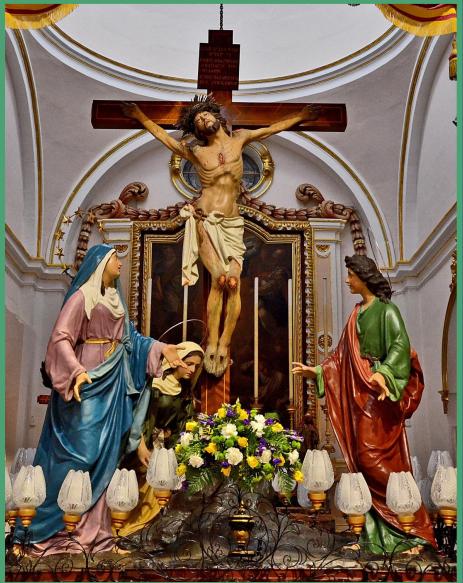


Rabat (Malta)

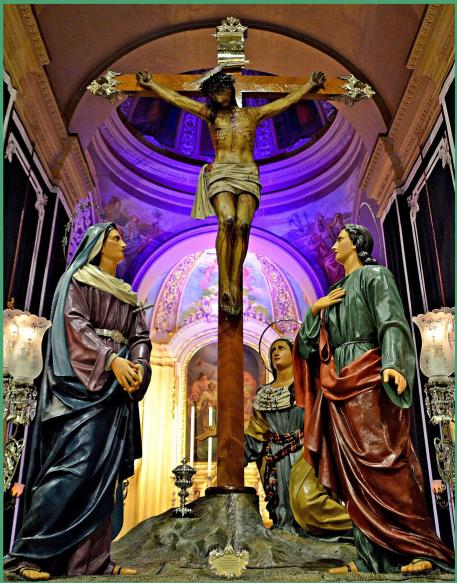


Żejtun (Malta)

The Problem is Much More Difficult. . .



Rabat (Malta)



Żejtun (Malta)



Haż-Żebbuġ (Malta)



Hal-Qormi (Malta)

Considering that this is One Statue from Many in Every Parish. . .

Parish Predictions (1)

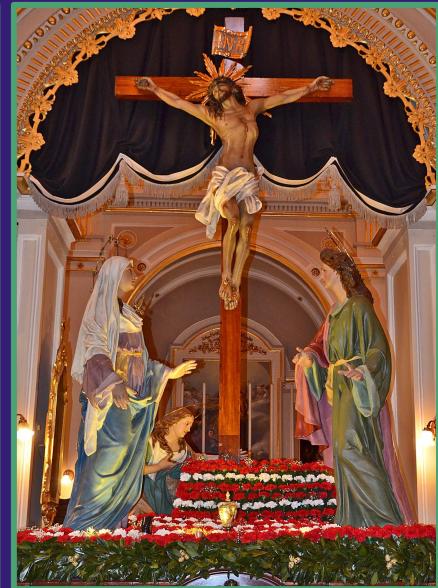
Each parish contains similar statues, making the image classification process challenging.

Some level of overfitting was necessary to improve differentiation between statues, which made sense in this case since each parish contains unique statues.

Another assumption that was made, was that the entire statue would be fully enclosed within the image to be able to generate accurate predictions.



Haż-Żebbuġ (Malta)



Hal-Qormi (Malta)

Repeating the previous process of Image Classification...

Parish Predictions (2)

Statues from each parish in the MCS dataset were selected for training. Data augmentation was applied extensively to increase diversity in the dataset, generating up to **2,000** images per parish with **21** Parishes.

A classification model (**YOLO 11m-cls**) was trained to recognise statues by their parish. The model was intentionally overfit because each parish, especially during Lent, contains similar statues. Overfitting was necessary to enable the model to distinguish between them, resulting in highly skewed results.



YOLO 11m-cls Visual Output

System Deployment (1)

Dataset and Models Availability:

- The Maltese Christian Statue dataset and model code are made publicly available online.
- Both are licensed under the MIT License, allowing free use and distribution.

<https://github.com/mbar0075/Maltese-Christian-Statue-Classifier>



System Deployment (2)

Demo Web Application:

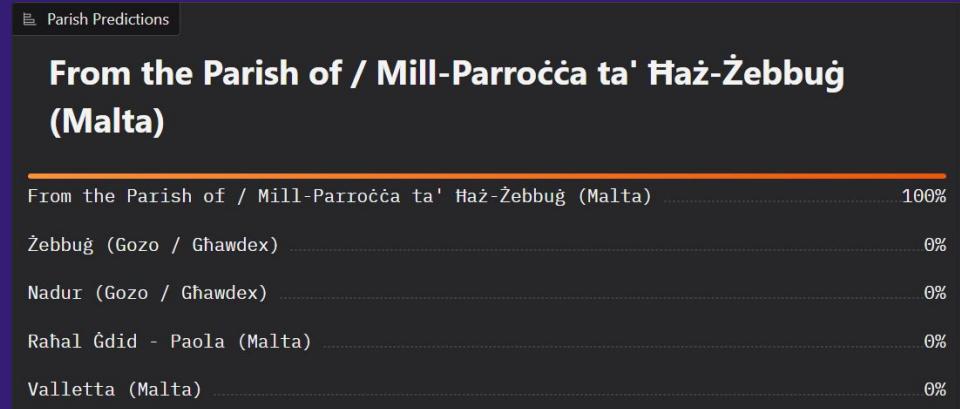
- A demo web application was developed using Gradio and hosted on HuggingFace Spaces.
- The application is publicly available for anyone to access and interact with.

<https://huggingface.co/spaces/mbar0075/Maltese-Christian-Statue-Classification>



System Deployment (3)

The end results. . .



System Deployment (4)

The end results. . .



Predictions (English / Maltese)

The Crucifixion / Il-Vara Il-Kbira

The Crucifixion / Il-Vara Il-Kbira	100%
The Cross / Is-Salib	0%
The Lady of Sorrows / Id-Duluri	0%
The Flogged / Il-Marbut	0%
Saint Philip of Agira / San Filep ta' Ağgira	0%

Synopsis / Aktar Tagħrif

The 'Crucifixion' describes Jesus' execution at Golgotha. Nailed to the Cross, He endures physical agony and mockery from onlookers. Despite His suffering, Jesus offers forgiveness to His persecutors and entrusts His spirit to God. The Crucifixion signifies the ultimate act of love and redemption for humanity's sins.

Il-Vara L-Kbira tirrakkonta l-eżekuzzjoni ta' Gesù fil-Golgota. Mahkum bil-pali, Gesù sofra agunja fizika u żmer ta' dawk li kienu qed jarawh. Minkejja s-sofferenza tiegħu, Gesù offra mahfra lil dawk li kienu qed jippersegwitawh u ta' l-ispirtu tiegħu lil Alla. Il-Vara L-Kbira tissimbolizza l-aħħar att ta' imhabba u fidwa mill-hażja tal-umanità.

Prediction speed (FPS)

10.0

References

- [1] Learn OpenCV, “Convolutional Neural Network (CNN): A Complete Guide, Big Vision,” [Online]. Available: <https://learnopencv.com/understanding-convolutional-neural-networks-cnn/>. [Accessed: 15-Oct-2024].

Acknowledgements

Miriam Bartolo Abela

Thank you!

Matthias Bartolo