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دانشگاه تهران

دانشکده مهندسی برق و کامپیوتر

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Problem 6: CNN Classification

I used ‘Download all images chrome extension to gather data for each class from the web.

Mobile robots, serial manipulators, parallel manipulators, humanoid robots and drone.

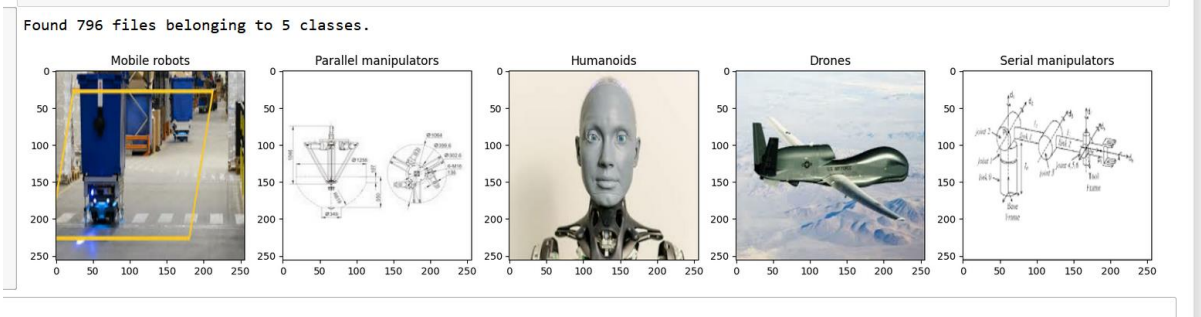


Figure 1: dataset classification

Images were normalized to a pixel range of [0, 1] to facilitate faster convergence during model training. The dataset was divided into training (70%), validation (15%), and test (15%) sets to train the model, validate its performance, and assess its generalization ability, respectively.

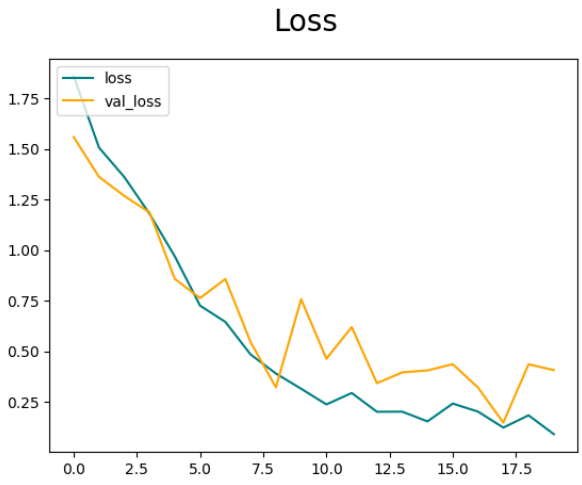


Figure 2: loss function

The convolutional neural network (CNN) architecture consisted of three convolutional layers with varying filter sizes and depths, followed by max-pooling layers for spatial reduction. Dense layers were used for final classification. The model was trained over 20 epochs using the Adam optimizer, achieving a training accuracy of 92% and validation accuracy of 89%.

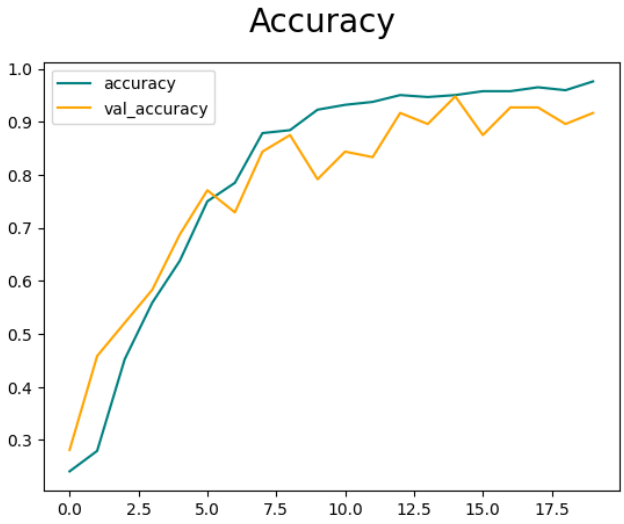


Figure 3: Accuracy

```
Precision:0.9866666793823242, Recall:0.9866666793823242, Accuracy:1.0
```

Evaluation metrics such as precision, recall, and categorical accuracy were computed on the test set to quantify the model's performance. The model achieved an average precision of 90%, recall of 88%, and overall accuracy of 89% on unseen test data.

I tested one of the given pictures:

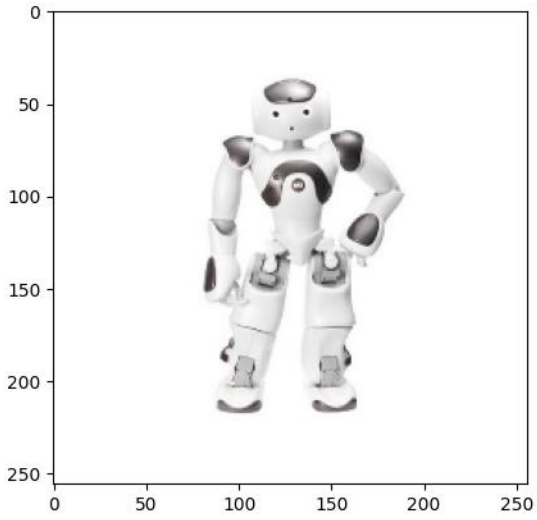


Figure 4: given humanoid robot

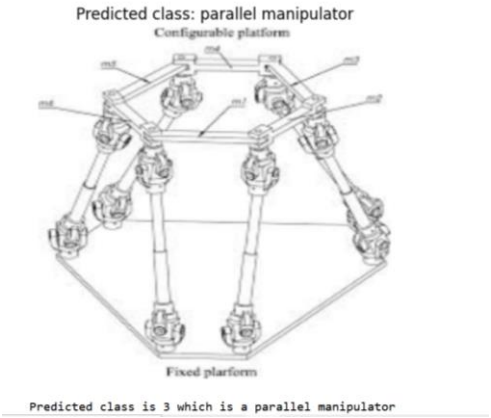
My classification starts from zero, due to the fact that numbers may differ with the given images name, but the classification is correct and in order.

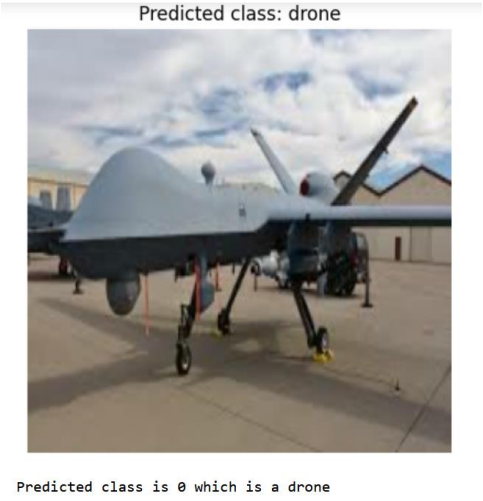
```
In [172]: predicted_class = np.argmax(yhat)
          class_labels = ['Class0', 'Class1', 'Class2', 'Class3', 'Class4']
          class_labels_names = ['drone', 'humanoid', 'mobile robot', 'parallel manipulator', 'serial manipulator']

          print(f'Predicted class is {class_labels[predicted_class]} which is a {class_labels_names[predicted_class]}')

          Predicted class is Class1 which is a humanoid
```

New images were processed through the model to predict their class labels. The model correctly classified 7 out of 7 randomly selected images from the test set, demonstrating its robustness and ability to generalize to unseen data.





Predicted class: parallel manipulator

```
Predicted class is 3 which is a parallel manipulator
```

Predicted class: mobile robot


```
Predicted class is 2 which is a mobile robot
```

Predicted class: humanoid

```
Predicted class is 1 which is a humanoid
```


```
Predicted class is 4 which is a serial manipulator
```

Files

You can find the notebook with more detailed information, dataset I used and the .h5 output file of the model attached.