Electronic Recognition System

DL&ML

1. Here are a few sample images from the dataset:

Figure 1: Transistor

Figure 2: LED

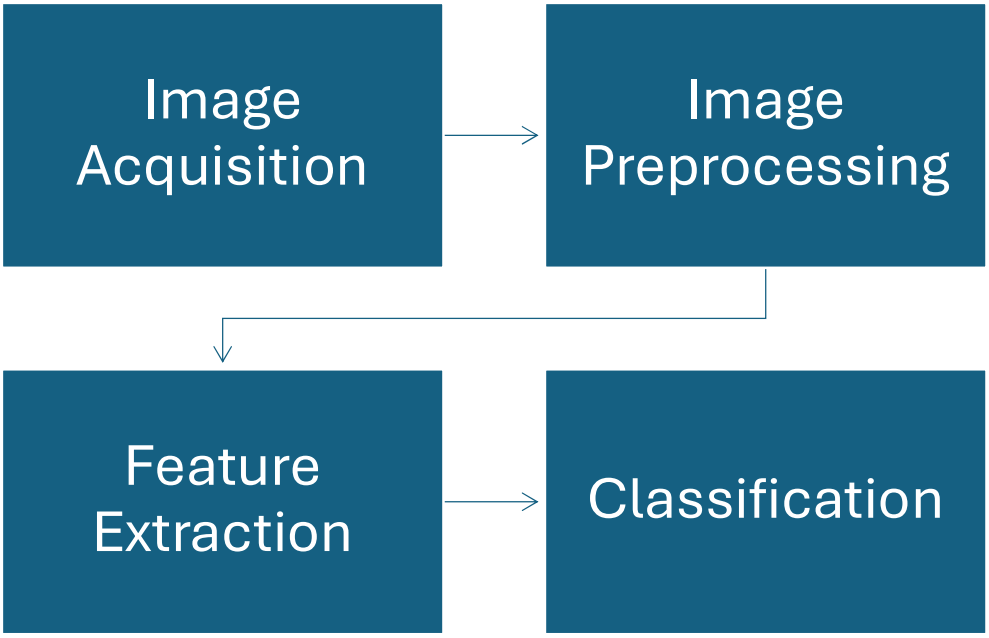
Figure 3: Potentiometer

Figure 4: Capacitor

Figure 5: Integrated Circuit

Figure 6: VID

2. **These are the steps that I will try to follow in this project.**



- **Image Acquisition**:
  - Images of electronic components are captured using a camera. This can be found in the dataset acquired and as the previous examples shown.

- **Image Preprocessing**:
  - **Gray-scaling**: Convert images to grayscale to reduce complexity for edge detection.
  - **Resizing**: All images were resized to a 256x256 size to ease the training and help in feature detection.
  - **Note:** There is no need for noise reduction or image restoration techniques, as the acquired images are already clear and noise-free.
- **Feature Extraction**: Extract meaningful features that distinguish components. (Might be subject to change)
  - **Shape Descriptors**: Identify contours and geometric properties.
  - **Texture Features**: Use Local Binary Patterns (LBP) for texture analysis.

- **Classification**:
  - **Classifier:** Random Forest classifier will be used to categorize the electronic components.
  - **Convolutional Neural Network (CNN)** will be used to categorize the electronic components.

- **Output**:
  - Predicted category of the component.
  - Confidence level of the prediction.

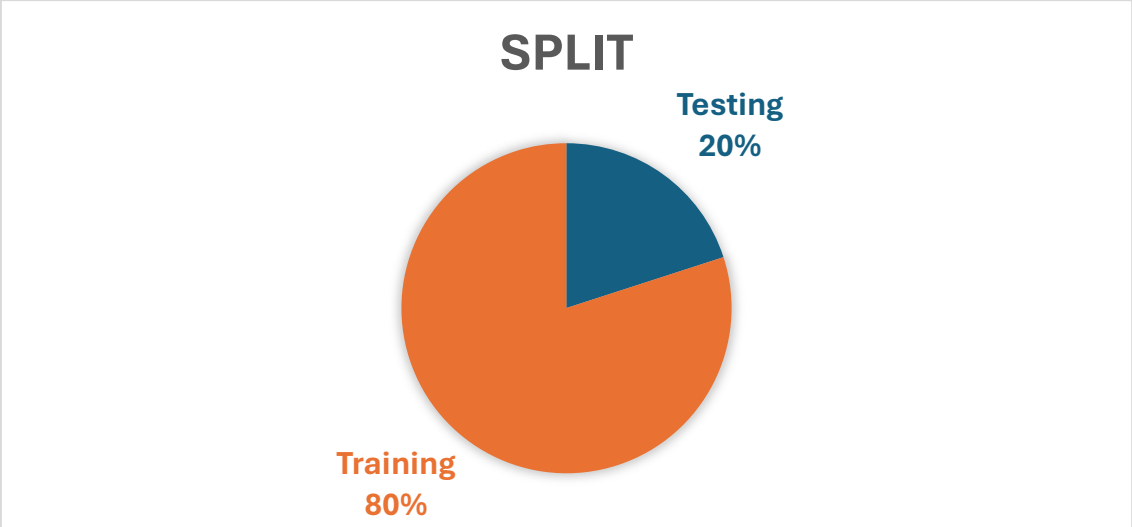


Figure 7: Data Splitting for Training

- **Accuracy Report**:

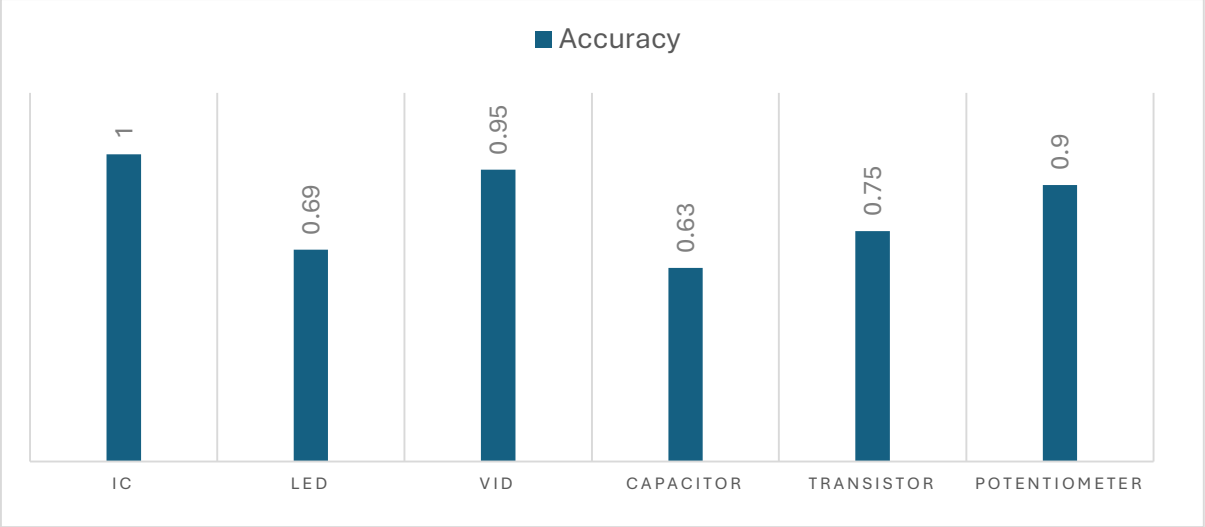


Figure 8: Training Accuracy for Random Forest

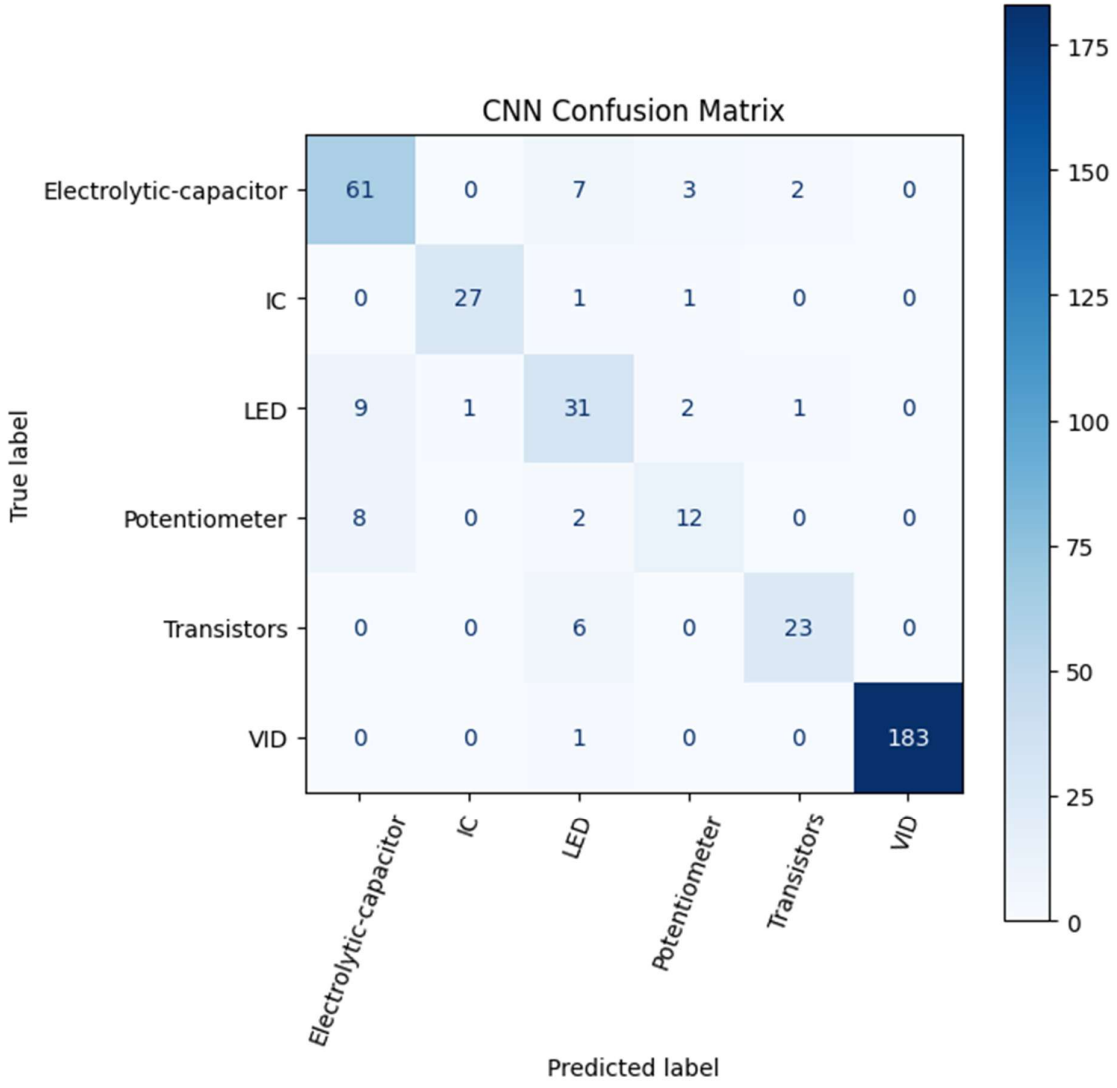


Figure 9: Confusion matrix for CNN

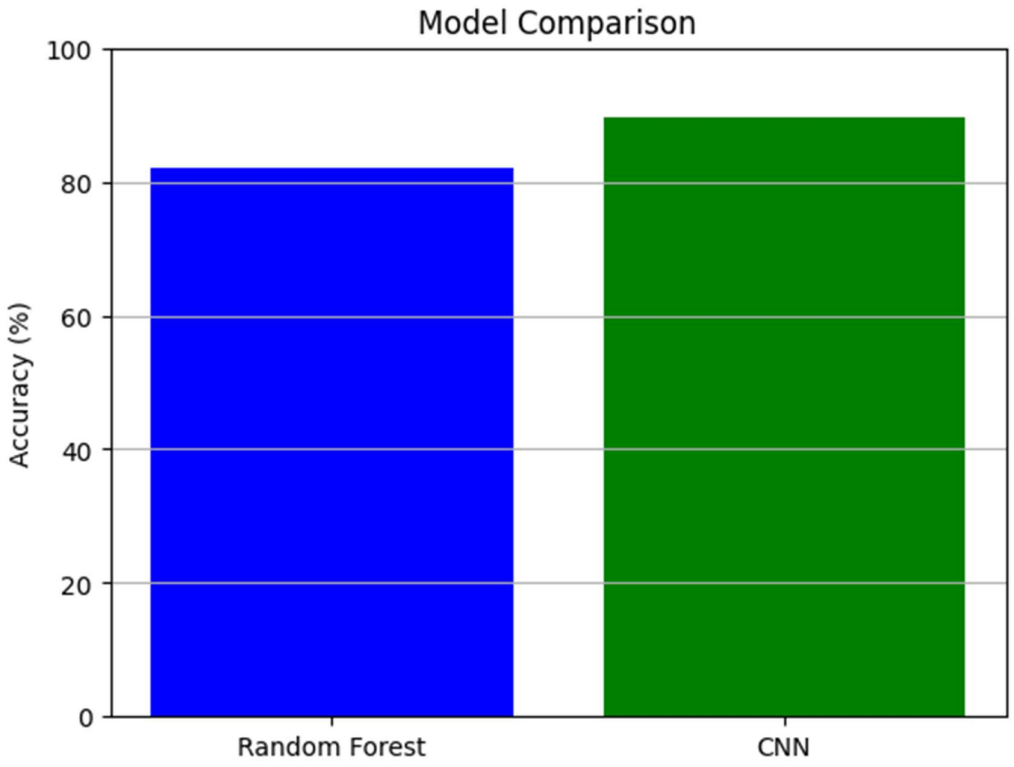


Figure 10: Training Accuracy for CNN

- Achieving an accuracy of 88.45%, this was a good jump up from the RF classifier with an accuracy of 82.15%.

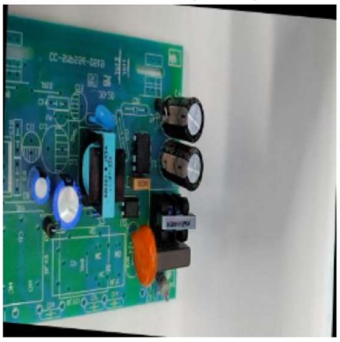
Output prediction from Uploaded Images (RF)

Predicted: Potentiometer (65.00%)

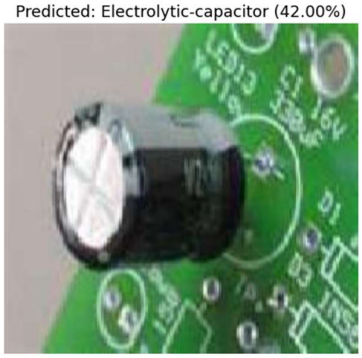
Predicted: IC (80.00%)

Predicted: Electrolytic-capacitor (80.00%)

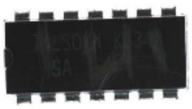
Predicted: VID (68.00%)



Predicted: Electrolytic-capacitor (42.00%)



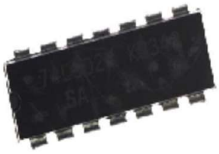
Predicted: IC (59.00%)



Output prediction from Uploaded Images (CNN)

Predicted: Electrolytic-capacitor (82.90%)

Predicted: IC (100.00%)



Predicted: Potentiometer (78.38%)

Predicted: VID (90.55%)

Predicted: Potentiometer (63.42%)

Predicted: LED (92.47%)

Conclusion

With a total CNN Accuracy of approximately 88.4%.

This project demonstrates a structured approach to recognizing electronic components using machine learning and deep learning. The workflow, from image preprocessing to classification, is designed for efficiency and adaptability. By leveraging techniques like Local Binary Patterns, Histogram of Oriented Gradients (HOG), and Edge Detection for texture analysis and a Random Forest classifier, and CNN model for robust predictions, the models achieve good accuracy in distinguishing various components.