MTE 438

AI in Mechatronics and Robotics

Individual Project

Report

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Introduction

The classification of images is a fundamental problem in computer vision, with applications ranging from medical diagnosis to autonomous vehicles. In this study, we focus on the classification of two common fruits - apples and bananas - using machine learning models. The goal is to compare the performance of three different models: ANN, CNN, and Transfer Learning.

Methodology

- Data Collection: A dataset consisting of images of apples and bananas was collected from various online sources, as well as images taken in real life, these data were used to train the model and validate it.
- Data Preprocessing: The images were resized to a standard size, and preprocessing techniques such as normalization were applied to enhance model performance.
- Data Prediction/Testing: The model had a part where it used CV2 to open the laptop camera to take a photo and place it in the test folder, by placing an apple or a banana in front of the camera the model was able to see in real time and classify the object it saw as either a banana or apple.

Model Training

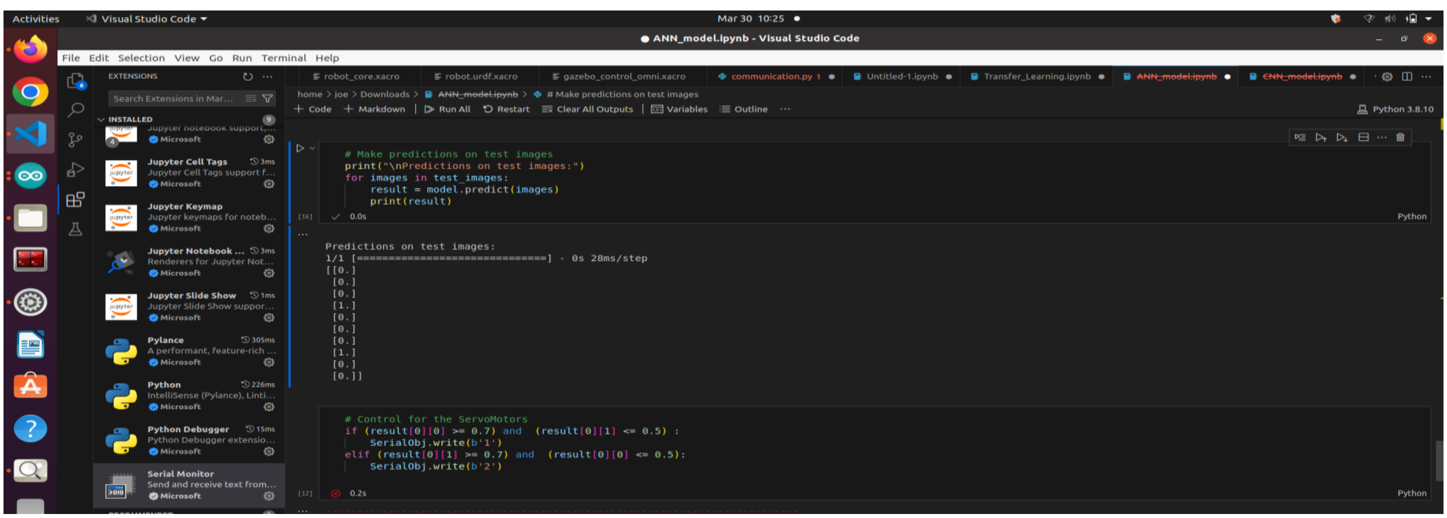
ANN: A basic ANN architecture was designed with multiple layers, including input, hidden, and output layers. The model was trained using backpropagation and gradient descent.

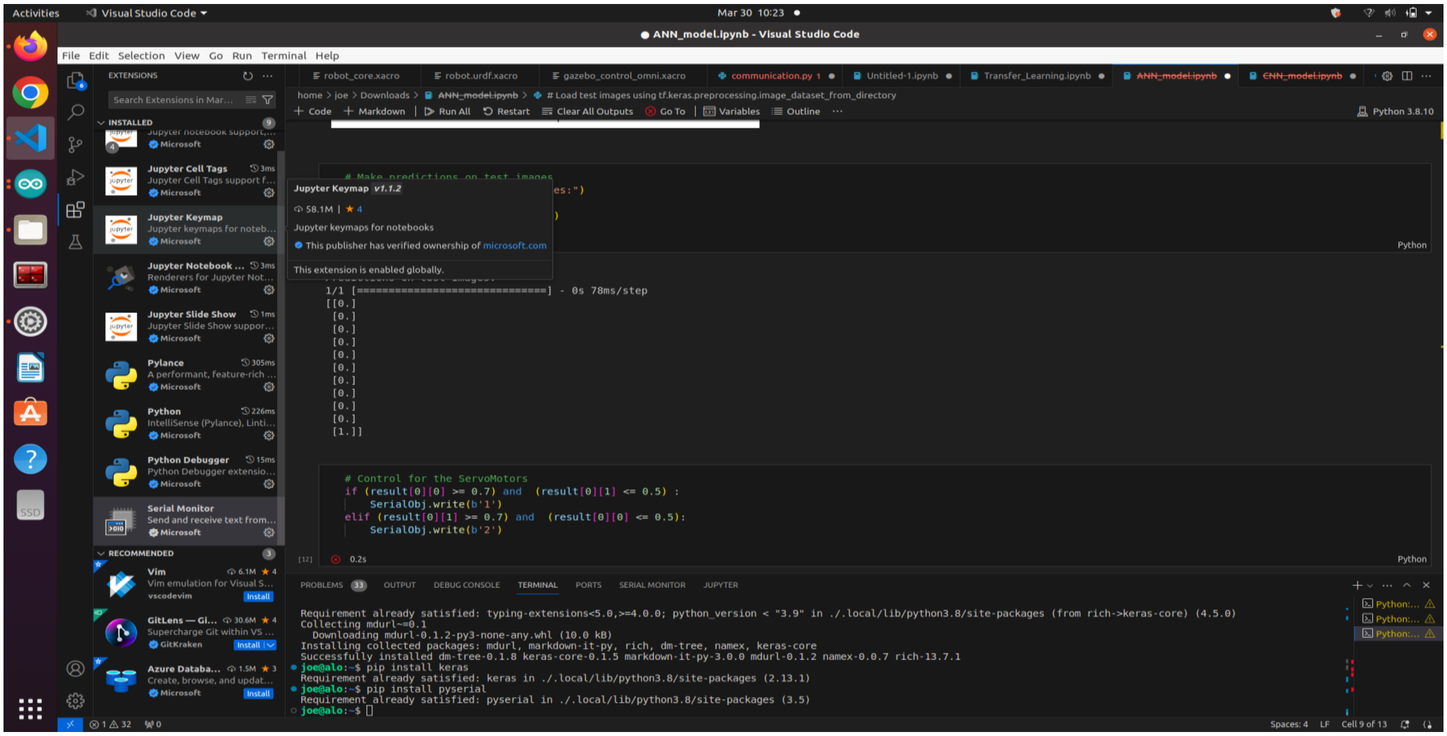
CNN: A CNN architecture consisting of convolutional layers, pooling layers, and fully connected layers was designed. The model was trained using stochastic gradient descent with backpropagation.

Transfer Learning: A pre-trained CNN model (e.g., VGG16, ResNet) was used as the base model, and its weights were fine-tuned on the apple-banana dataset.

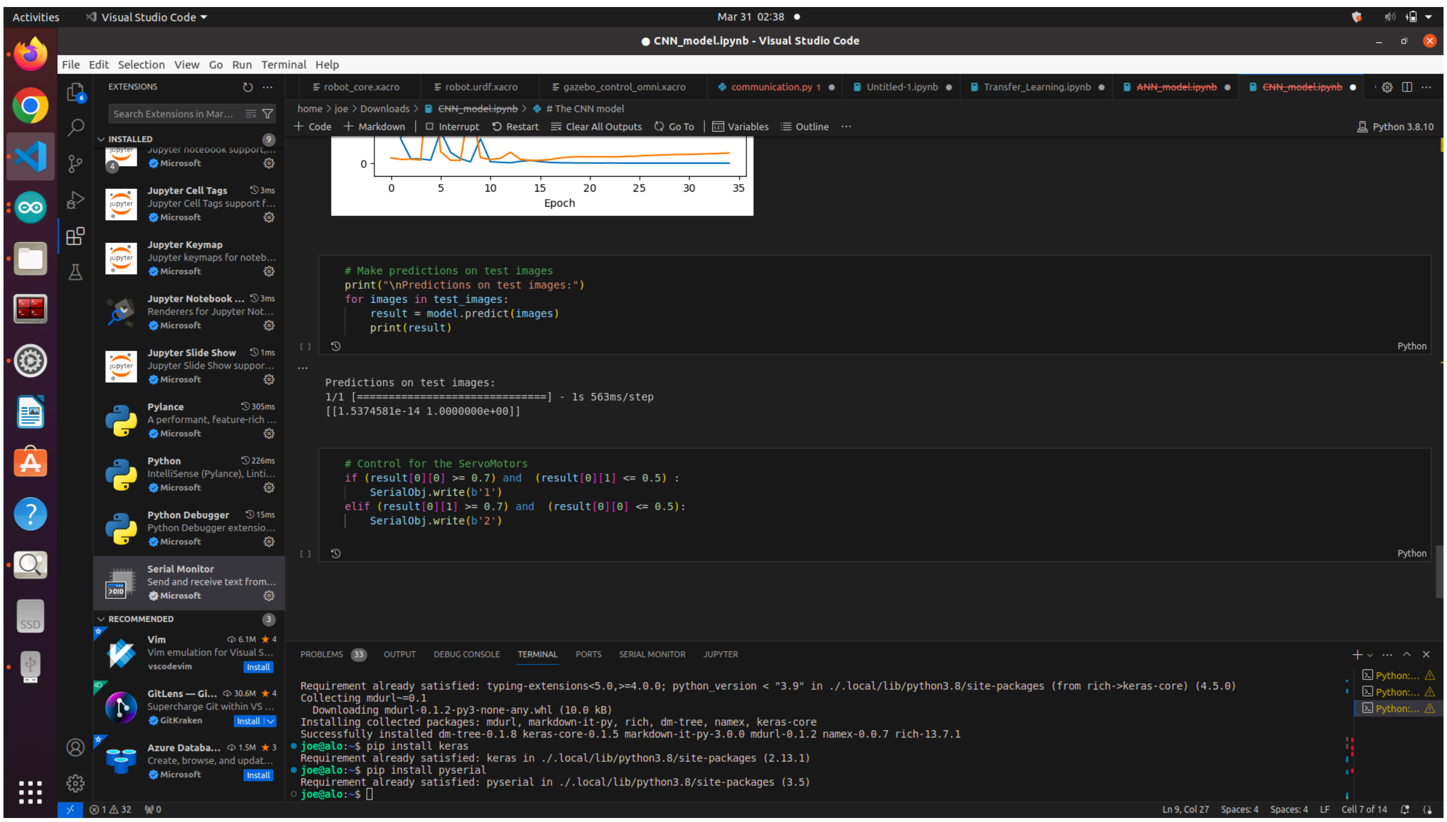
Results

ANN: The ANN model achieved a success rate of 11 out of 20 images.

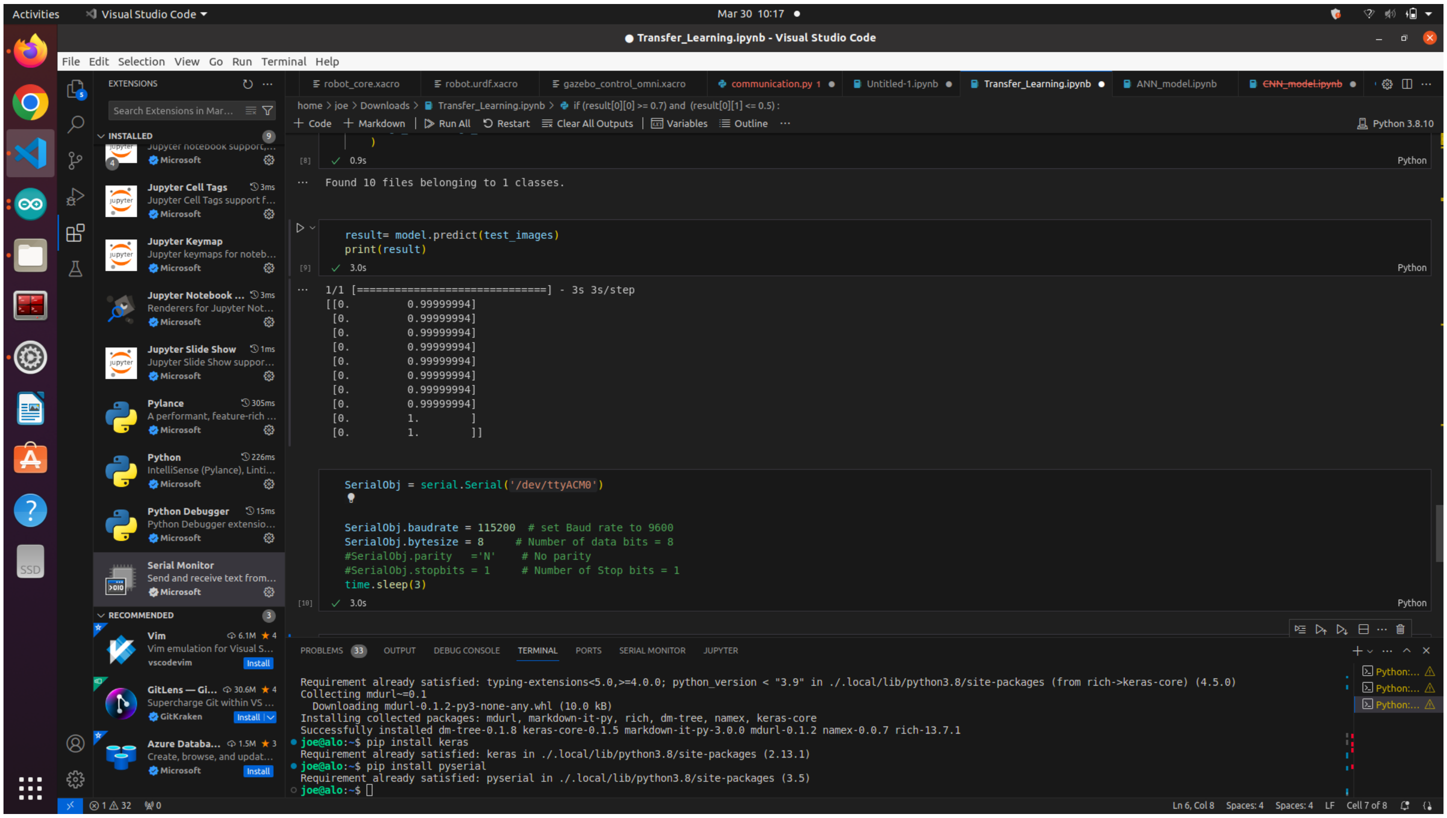


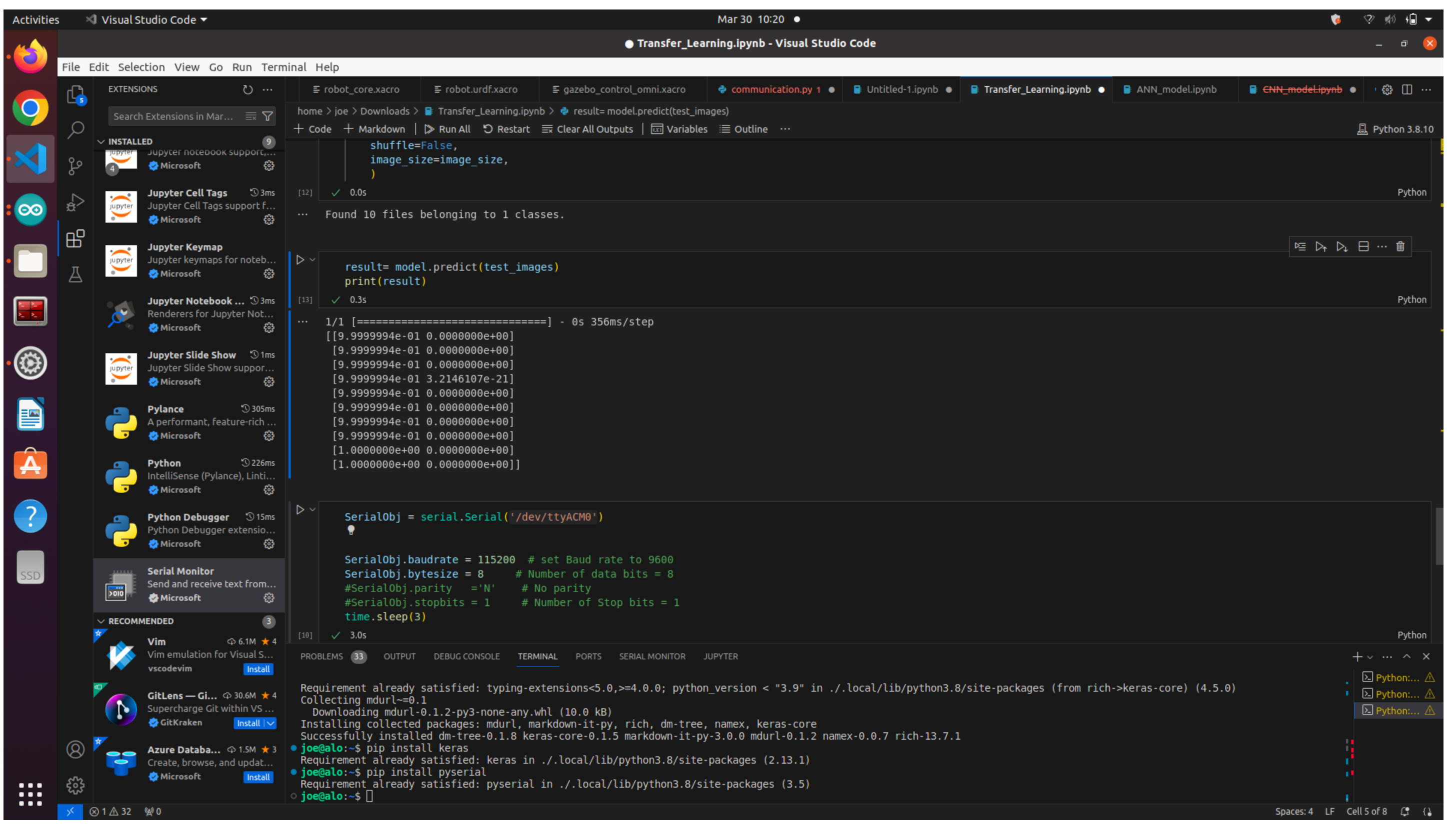


<u>CNN</u>: The CNN model encountered kernel crashes during training but exhibited a high success rate upon successful execution.



Transfer Learning: The Transfer Learning model achieved a perfect success rate of 20 out of 20 images.





Discussion

<u>ANN Performance</u>:

The ANN model's relatively lower success rate suggests that it may not be effective in capturing complex patterns and features in the image data.

ANN models often struggle with image classification tasks due to their inability to handle spatial information effectively.

<u>CNN Performance</u>:

Despite experiencing kernel crashes during training, the CNN model demonstrated promising performance in terms of success rate.

CNNs are well-suited for image classification tasks, as they can automatically learn hierarchical features from raw pixel data.

<u>Transfer Learning Performance</u>:

The Transfer Learning model, which leveraged pre-trained CNN architectures, achieved the highest success rate. Transfer Learning allows for the transfer of knowledge learned from one task/domain to another, thereby reducing the need for extensive training data.

Conclusion

In conclusion, the Transfer Learning model outperformed both the ANN and CNN models in classifying images of apples and bananas. While the ANN model showed limited success, the CNN model exhibited potential despite encountering technical difficulties during training. Future research could focus on optimizing the CNN architecture and addressing stability issues to harness its full potential. Additionally, exploring more advanced transfer learning techniques could further improve classification performance in similar tasks.