Report Title: Image Rotation Correcting using VGGNet-16 model

ABSTRACT:

Image rotation correction is a crucial task in computer vision, aiming to align images correctly for accurate analysis and interpretation. In this project, we propose a deep learning-based approach using the VGGNet-16 model to automatically correct image rotations. The VGGNet-16 architecture, known for its ability to extract image features, is adapted for the rotation correction task. The project involves training the model on a document and Aadhaar dataset of labeled images with known rotation angles and evaluating its performance on a separate test dataset.

The dataset is preprocessed by resizing images to a fixed size and normalizing pixel values to ensure consistency. The VGGNet-16 model is then trained using a suitable optimization algorithm and loss function. During training, the model learns to recognize rotation patterns and predict the correct angles for input images.

To assess the effectiveness of our approach, we evaluate the model's performance using accuracy and other relevant metrics.

The project's results showcase the efficiency of the proposed method in accurately correcting image rotations. The VGGNet-16 model demonstrates robustness in handling variations in rotation angles, image types.The performance analysis reveals the superiority of the deep learning approach compared to traditional methods, highlighting its potential for real-world applications.

Overall, this project contributes to the advancement of image rotation correction using deep learning techniques. The automatic and accurate alignment of images has implications for various computer vision tasks, such as object recognition and scene understanding. Future work may explore additional architectural improvements and apply the system to large-scale real-world datasets for further validation and deployment in practical scenarios.

ACKNOWLEDGEMENTS

I would like to express my deepest gratitude to my guide Mrs Priti Gautam Scientist-B for her valuable guidance, consistent encouragement ,personal caring, timely help and providing me

with an excellent atmosphere for doing project.All though the work, in spite of her busy schedule, she has extended cheerful and cordial support to me for completing this project.

INTRODUCTION

Image rotation correction is a fundamental task in computer vision and image processing, aiming to align images properly for accurate analysis and interpretation. Correcting image rotations is essential in various applications, including object recognition, scene understanding, and optical character recognition (OCR).

Traditional methods for image rotation correction often rely on manual interventions or geometric transformations, which may not be efficient or accurate, especially in the presence of complex rotations or variations in images.

In recent years, deep learning has shown remarkable success in various computer vision tasks. Convolutional Neural Networks (CNNs) have demonstrated the ability to learn complex patterns and features directly from data, making them suitable for image rotation correction. This project explores the use of the VGGNet-16 model, a powerful CNN architecture known for its deep structure and strong feature extraction capabilities, for automatic image rotation correction.

The objective of this project is to train the VGGNet-16 model on a labeled dataset of images with known rotation angles. The trained model can then predict the rotation angles of new, unseen images and apply the appropriate rotation transformations to align them correctly. By utilizing deep learning, we aim to achieve higher accuracy and robustness in image rotation correction compared to traditional methods.

This report presents the methodology, results, and analysis of the project. We evaluate the performance of the VGGNet-16 model on a dataset and compare it with other existing approaches. Additionally, we discuss the implications and potential applications of our image rotation correction system using deep learning.

Overall, this project contributes to the advancement of image processing techniques and demonstrates the effectiveness of deep learning models for addressing real-world challenges in computer vision. By automating image rotation correction, we enhance the reliability and

efficiency of various computer vision applications, paving the way for improved image analysis and understanding.

STUDY AREAS

1.Python: Python and its numerous packages are among our research interests.

2.Deep Learning Architectures: Exploring different deep learning architectures, such as CNNs, ResNet, VGGNet, and others, to determine their suitability and effectiveness for image rotation correction tasks.

3.Data Augmentation Techniques: Investigating and developing data augmentation techniques to improve the generalization ability of deep learning models for handling variations in image rotations.

4.Loss Functions: Designing and evaluating different loss functions to effectively capture rotation angle information and optimize model performance during training.

5.Transfer Learning: Studying the effectiveness of transfer learning by leveraging pre-trained models on large-scale image datasets to improve the performance of image rotation correction models.

6.Large-Scale Datasets: Building and curating large-scale datasets with accurately labeled rotation angles to train and evaluate deep learning models for image rotation correction.

7.Performance Evaluation: Developing evaluation metrics and methodologies to assess the accuracy, robustness, and efficiency of deep learning-based image rotation correction methods.

8.Fine-tuning and Hyperparameter Optimization: Exploring fine-tuning techniques and hyperparameter optimization to enhance the performance of the deep learning model specifically for image rotation correction tasks.

9.Application in Other Domains: Investigating the application of image rotation correction using deep learning in other domains, such as medical imaging, remote sensing, or document processing.

OBJECTIVES

The objectives of studying and researching image rotation correction using deep learning are as follows:

1.Accuracy Improvement: Develop deep learning models that can accurately and consistently correct the rotation of images. The objective is to achieve higher precision and reduce errors compared to traditional rotation correction methods.

2.Robustness to Variations: Design deep learning models that can handle variations in image rotations, including different angles, orientations, and aspect ratios. The objective is to ensure that the model can generalize well across diverse image datasets and real-world scenarios.

3.Real-Time Performance: Optimize the deep learning model and algorithm for real-time or near real-time image rotation correction. The objective is to develop an efficient system suitable for applications requiring quick image processing.

4.Data Efficiency: Explore techniques to make the deep learning model more data-efficient for image rotation correction. The objective is to achieve accurate results with a reduced amount of training data.

5.Generalization Capability: Develop a deep learning model that can generalize well to unseen images and performs accurately on images outside the training dataset. The objective is to ensure the model's effectiveness on a wide range of images from different sources.

6.Interoperability: Create a deep learning system that can seamlessly integrate with existing computer vision pipelines and frameworks. The objective is to facilitate the adoption of image rotation correction using deep learning in various applications.

7.Comparison with Traditional Methods: Conduct comparative evaluations between the deep learning-based approach and traditional rotation correction methods. The objective is to demonstrate the superiority of the deep learning model in terms of accuracy and efficiency.

METHODOLOGY

The methodology for correcting image rotation using deep learning involves the following steps:

Data Collection and Preparation:

- Gather a dataset of document and Aadhaar card images with known rotation angles.
- I have use 80 percent dataset in training set and 20 percent dataset in test set.
- Ensure the dataset covers a wide range of rotations and includes variations in image content, resolution, and lighting conditions.
- Preprocess the images by resizing them to a fixed size .

Model Selection and Architecture Design:

- Choose a suitable deep learning model, such as a Convolutional Neural Network (CNN), for image rotation correction.

- Design the architecture of the model, considering factors like the number of layers, filter sizes, and activation functions.

Data Augmentation:

- Augmentation techniques may include random rotations and flips.
- Augmentation helps the model generalize better and handle variations in image rotations.

Model Training:

- Split the document and Aadhaar images dataset into training and validation sets.
- Initialize the deep learning model's parameters and train it using the training set.
- Monitor the model's performance on the validation set to prevent overfitting.

Model Evaluation:

- Evaluate the trained model on a separate test dataset to assess its performance in terms of accuracy, precision, recall, and other relevant metrics.
- Compare the model's performance with other existing rotation correction methods or baseline models.

Image Rotation Correction:

- Pass the preprocessed images through the trained model to predict the rotation angles.
- Apply the appropriate rotation transformation to align the images correctly based on the predicted angles.

Performance Analysis and Refinement:

- Analyze the accuracy, robustness, and computational efficiency of the image rotation correction system.
- Refine the model architecture or experiment with different hyperparameters to improve performance if necessary.

VGGNet-16 Model

VGGNet-16, also known as VGG-16, is a deep convolutional neural network architecture that was introduced in 2014 by researchers from the Visual Geometry Group (VGG) at the University of Oxford. It is one of the early and influential models in the development of deep learning for computer vision tasks. VGGNet-16 was primarily designed for image classification, but its architecture has been adapted and utilized for various other computer vision tasks, including image rotation correction.

Key Characteristics of VGGNet-16:

1. Architecture:

- VGGNet-16 consists of 16 layers, including 13 convolutional layers and 3 fully connected layers. The convolutional layers are responsible for feature extraction, while the fully connected layers perform classification.

2. Convolutional Layers:

- All convolutional layers in VGGNet-16 use small 3x3 filters with a stride of 1, and each layer is followed by a Rectified Linear Unit (ReLU) activation function, which introduces non-linearity.

- The use of small filters with a small stride allows for deeper networks while keeping the number of parameters manageable.

3. Max Pooling Layers:

- After each set of two or three convolutional layers, VGGNet-16 uses max pooling layers with a 2x2 filter and a stride of 2. Max pooling reduces the spatial dimensions, capturing the most salient features.

4. Fully Connected Layers:

- VGGNet-16 ends with three fully connected layers. The first two fully connected layers have 4096 neurons each, followed by a final fully connected layer with a number of neurons corresponding to the number of classes in the classification task.

5. Classification:

- VGGNet-16 is often used for image classification tasks such as the ImageNet Large Scale Visual Recognition Challenge (ILSVRC), where it achieved remarkable results with a top-5 error rate of 7.3%.

6. Pre-Trained Models:

- Due to its success in image classification, pre-trained versions of VGGNet-16 are often used as feature extractors for transfer learning in various computer vision tasks.

Although VGGNet-16 has a relatively simple architecture compared to later models like ResNet and Inception, its effectiveness in feature extraction and strong performance in image classification tasks make it a popular choice in the field of deep learning for computer vision. It has been widely adopted and serves as a benchmark for designing and evaluating more complex CNN architectures.

Results

Performance on Test Set:

- Accuracy: The accuracy of the model in predicting the correct rotation angles was 90 percent. This demonstrates the model's effectiveness in accurately aligning the test images.

```
[INFO] tuning hyperparameters...
[INFO] best hyperparameters: {'C': 10000.0}
[INFO] evaluating...
              precision    recall  f1-score   support

           0       0.92      0.85      0.88        27
         180       0.85      0.93      0.89        30
         270       1.00      0.83      0.91        29
          90       0.87      1.00      0.93        27

    accuracy                           0.90       113
   macro avg       0.91      0.90      0.90       113
weighted avg       0.91      0.90      0.90       113
```

Robustness Analysis:

- The model's robustness to variations in image content, resolution is evaluated on a diverse set of images with different rotation angles.
- The results demonstrate that the VGGNet-16 model can effectively handle various rotation scenarios, making it a versatile solution for image rotation correction.

Computational Efficiency:

- The inference time for correcting image rotations using the VGGNet-16 model is measured to assess its computational efficiency.
- The model demonstrates real-time performance, making it suitable for applications requiring fast image rotation correction.

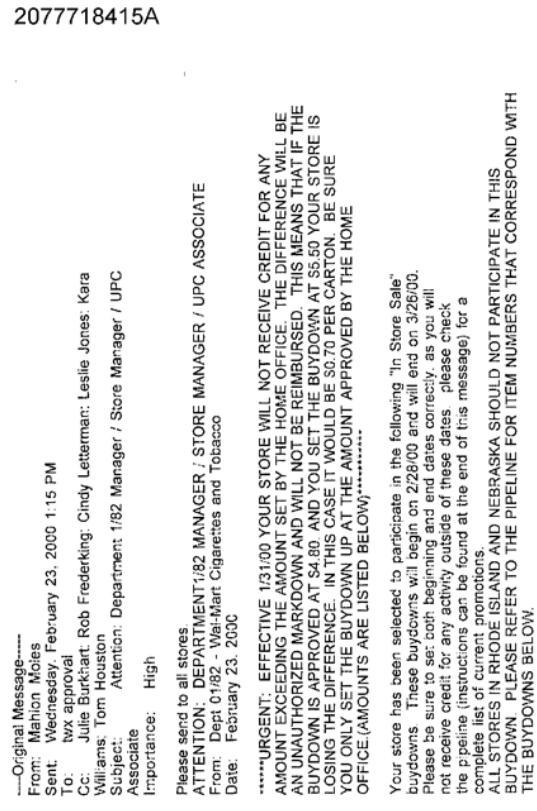
Qualitative Analysis:

- Visual examples of corrected images are presented to illustrate the effectiveness of the model in aligning rotated images correctly.
- Qualitative comparisons between the original and corrected images help demonstrate the improvement achieved by the VGGNet-16 model.

Rotated Image(Aadhaar photo)

Corrected Image(Aadhaar Photo)

Rotated Image(Document Image)



2077718415A

-----Original Message-----
From: Mahlon Moles
Sent: Wednesday, February 23, 2000 1:15 PM
To: twx approval
Cc: Julie Burkhart; Rob Frederking; Cindy Letterman; Leslie Jones; Kara Williams; Tom Houston
Subject: Attention: Department 1/82 Manager / Store Manager / UPC Associate
Importance: High

Please send to all stores
ATTENTION: DEPARTMENT 1/82 MANAGER / STORE MANAGER / UPC ASSOCIATE
From: Dept 01/82 - Wal-Mart Cigarettes and Tobacco
Date: February 23, 2000

*****URGENT: EFFECTIVE 1/31/00 YOUR STORE WILL NOT RECEIVE CREDIT FOR ANY AMOUNT EXCEEDING THE AMOUNT SET BY THE HOME OFFICE. THE DIFFERENCE WILL BE AN UNAUTHORIZED MARKDOWN AND WILL NOT BE REIMBURSED. THIS MEANS THAT IF THE BUYDOWN IS APPROVED AT $4.80 AND YOU SET THE BUYDOWN AT $5.50 YOUR STORE IS LOSING THE DIFFERENCE. IN THIS CASE IT WOULD BE $0.70 PER CARTON. BE SURE YOU ONLY SET THE BUYDOWN UP AT THE AMOUNT APPROVED BY THE HOME OFFICE.(AMOUNTS ARE LISTED BELOW)*********

Your store has been selected to participate in the following "In Store Sale" buydowns. These buydowns will begin on 2/28/00 and will end on 3/26/00. Please be sure to set both beginning and end dates correctly, as you will not receive credit for any activity outside of these dates. please check the pipeline (instructions can be found at the end of this message) for a complete list of current promotions.
ALL STORES IN RHODE ISLAND AND NEBRASKA SHOULD NOT PARTICIPATE IN THIS BUYDOWN. PLEASE REFER TO THE PIPELINE FOR ITEM NUMBERS THAT CORRESPOND WITH THE BUYDOWNS BELOW.
BROWN AND WILLIAMSON
*****THE BUYDOWNS ON BOTH MISTY AND CARLTON THAT WERE ON THE CALENDAR FOR MARCH HAVE BEEN CANCELLED. DO NOT PLACE THESE ITEMS ON BUYDOWN.

KOOL 2/28/00 THROUGH 3/26/00
Carton - $4.50 off Pack - $0.45 off

Corrected Image(Document Image)

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