



Research Proposal: Intelligent Image Categorization and Organization using Deep Learning Techniques

Student Name: Nimay Seth

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Project Overview

The project aims to develop an advanced algorithm for automatic image categorization and organization using computer vision, machine learning, and deep learning techniques. The main objective is to create a system that can accurately group similar images together based on their visual content, enabling efficient management and retrieval of large-scale image collections. The project will begin with the collection and preprocessing of a diverse dataset of digital images. This dataset will serve as the foundation for training and evaluating the algorithm. Next, computer vision techniques, such as feature extraction using pre-trained deep learning models (e.g., CNNs), will be employed to extract meaningful representations of the images. Unsupervised learning algorithms, such as clustering techniques, will be applied to group similar images based on their extracted features. The optimal number of clusters and distance metrics will be investigated to achieve coherent and meaningful image groupings.

Subject

Computer Vision, Machine Learning.

Ref ID

OMO/RE/058

Problem

With the exponential growth of digital images captured and stored by individuals and organizations, managing and organizing these vast collections has become increasingly challenging. Traditional manual categorization methods are time-consuming, labor-intensive, and prone to inconsistencies. The lack of an efficient and accurate automated image categorization system hinders the effective utilization and retrieval of images, leading to reduced productivity and missed opportunities. Therefore, there is a pressing need for an algorithm that can intelligently analyze and categorize images based on their visual content, enabling users to quickly locate and access desired images from large repositories.

Importance of Solving Given Problem

- **Improved Image Organisation:** An automated image categorization algorithm will significantly streamline the process of organising and managing large image collections. By grouping similar images together, users can easily navigate through their repositories and locate specific images based on their content, saving time and effort.
- **Enhanced Image Retrieval:** With the ability to categorise images accurately, the algorithm will enable more efficient and precise image retrieval. Users can search for images based on specific categories or visual attributes, leading to faster and more relevant search results. This is particularly valuable in domains such as e-commerce, media, and digital asset management.
- **Increased Productivity:** By automating the image categorization process, individuals and organisations can focus their time and resources on more productive tasks, rather than manually sorting through vast image collections. This increased productivity can lead to cost savings and improved overall efficiency.

Research Description

The proposed research aims to develop an Machine Learning algorithm capable of automatically categorizing and organizing digital images based on their visual content. The algorithm will employ computer vision techniques, clustering, and deep learning methods to analyze and understand the semantic information within the images. By leveraging image recognition and classification models, the algorithm will be able to group similar images together, creating coherent and meaningful clusters. This research will contribute to the field of image organisation and retrieval, enabling more efficient and effective management of large-scale image collections.

Research Hypothesis

- By combining advanced computer vision techniques, machine learning algorithms, and deep learning architectures, it is possible to develop an algorithm that can automatically categorize and organize digital images with high accuracy and efficiency, surpassing traditional manual organization methods.

Research Questions

- How can an algorithm be developed to accurately and efficiently categorise and organize digital images based on their visual content, utilizing computer vision, machine learning, and deep learning techniques?

Approach

The selected approach for this research involves the following steps:

- Collect a large and diverse dataset of digital images covering various categories and subjects.
- Preprocess the images by resizing, normalizing, and applying necessary transformations to ensure consistency and compatibility with the algorithm.

- Utilize computer vision techniques to extract meaningful features from the images.
- Employ pre-trained deep learning models, such as Convolutional Neural Networks (CNNs), to extract high-level features that capture the semantic information of the images.
- Experiment with different CNN architectures, such as VGG, ResNet, or Inception, to identify the most effective feature representation for the task.
- Apply unsupervised learning algorithms, such as K-means or hierarchical clustering, to group similar images based on their extracted features.
- Evaluate the quality of the clusters using metrics such as silhouette score or Davies-Bouldin index to assess the effectiveness of the clustering approach.

Prerequisites

- Proficiency in programming languages (e.g., Python, C++)
- Familiarity with computer vision concepts, techniques, and algorithms, including image processing, feature extraction, and image transformations.
- Experience with popular deep learning frameworks such as TensorFlow, PyTorch, or Keras, which provide high-level APIs for building and training deep learning models.
- Experience with machine learning frameworks (e.g., TensorFlow, PyTorch)

References

1. Ritu, Rani., Sandhya, Pundhir., Amita, Dev., Arun, Sharma. (2022). An Optimized Flower Categorization Using Customized Deep Learning. International Journal of Computational Intelligence and Applications, doi: 10.1142/s1469026822500298
2. Samabia, Tehsin., Sumaira, Kausar., Amina, Jameel., Mamoon, Humayun. (2023). Satellite Image Categorization Using Scalable Deep Learning. Applied Sciences, doi: 10.3390/app13085108

General Note:

1. The device will be a prototype only and not a final minimum viable product (MVP) or production-grade device, but it will be functional enough to demonstrate the project idea.
2. The software component will be implemented in Python and will not be implemented for iOS or Android devices.

FAQ's

What is a research description?

- A research description outlines the main objectives, methods, and scope of a study. It serves as a comprehensive overview of the research project, helping you to understand what the study aims to achieve and how it plans to do so.

What is a research hypothesis?

- A research hypothesis is a specific, testable prediction about what you expect to happen in your study. It is based on knowledge, theory, and research related to the topic and directs the focus of the study.

What is a research question?

- Research questions are the questions around which you center your research. They should be clear, focused, and researchable within the constraints of your project.

What if I don't fulfil all the prerequisites?, Can I still Continue?

- Yes, you can continue with the idea; just let your mentor know beforehand, and they will guide you with the required skills.

What are the time commitments I will need to give for research?

- The program requires a commitment of 30 hours over a period of 4 months. This allows for a well-paced and immersive research experience without overwhelming your academic schedules.
- In case there is no experience of TECH / Analysis, then the student needs to allocate 20 hours for skilling as well.
- All sessions for Research and Skilling are aligned one-on-one with mentor
- Sessions are one-on-one with the mentor assigned to you. Ideally, the sessions should be twice a week, and this will ensure you complete the research project in 4 months.
- In case of an exam, health, or personal reasons, you can take a pre-informed break, which will carry forward the time to complete accordingly.

Who will be my mentor?

- Each student will be assigned a dedicated mentor, who is full-time with OMOTEC, and will guide you through every step of the process. All our mentors are qualified engineers. Your mentor will be your partner in exploring and taking your idea to execution, overcoming challenges, and achieving success.