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Colour Analysis and Classification Based On Deep Learning Technique

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ABSTRACT:

Numerous fields benefit from colour classification techniques, such as those dealing with object recognition, picture retrieval, and colour-based image segmentation. This is a significant subject of study in the fields of computer vision and machine learning. Colour classification in machine learning involves the use of algorithms and models to automatically identify and categorize colours in images or data. This is not an easy job because of the nuanced nature of human colour perception and the wide range of possible colour combinations. In the realm of pattern categorization, the Neural Network has found extensive application. Image segmentation is a type of pattern classification problem in which the primary goal is to extract objects of interest from images that may be located in a variety of different places. There has been a significant efficiency boost in texture image recognition since the advent of deep learning (DL) algorithms, which can also address the drawbacks of more labor-intensive and time-consuming approaches to image identification. (IR).We suggest a method of training the colour pattern in a neural network using the deep learning algorithm, a general method for the maximum likelihood problem, to increase the adaptability of the classify result in a changing environment. KNN, on the other hand, is a type of learning algorithm that classifies new samples based on in the training group, the k nearest neighbors. Samples of unknown colours are given labels based on their most frequent k nearest neighbors from the training set. Both Artificial Neural Networks (ANN) and K-Nearest Neighbour (KNN) can be effective for colour classification is proposed in this project. ANN can be more powerful and flexible, but requires more computational resources and can be more difficult to train and optimize. KNN is simpler and more interpretable, but can be sensitive to noise and outliers in the data. Ultimately, the choice between ANN and KNN (or other machine learning algorithms) will depend on the specific requirements and constraints of the colour classification task at hand.

Keywords: Colour Classification, Pattern, Images, Recognition task, Prediction.

1. INTRODUCTION

Colour classification is the task of assigning a label or category to a given colour. Numerous picture processing tasks necessitate solving this issue, making it a critical one in the fields of computer vision and machine learning. Computer graphics and colour-based object recognition [1]. In machine learning, colour classification is typically approached as a case of supervised learning, in which a model is educated using data that has already been classified. The labeled dataset consists of colour samples, where each sample is associated with a label or category [2]. The labels' definitions vary widely based on the context. For example, the labels can be the names of colours, such as "red," "green," and "blue," or they can be more abstract categories, such as "warm" and "cool" colours [3]. Machine learning algorithms use statistical techniques to learn the relationships between the features of the colour samples and their labels. The features can include the colour components themselves (such as the RGB values), as well as more complex features extracted from the colour samples, such as colour histograms or texture descriptors [4].

Machine learning methods like decision trees, support vector machines, random forests, and deep learning models like convolutional neural networks can all be used to classify colours. (CNNs). The dataset's quality and quantity are also important considerations when deciding on an algorithm. In cases where the boundaries between classes are not well-defined, the Neural Network (NN) has proven useful for pattern categorization. Among the many benefits of a neural network are: the ability to learn from examples and be robust over errors made during training; the ability to approximate any smooth function; the ability to generalize to circumstances for which the network was not trained; and so on. Therefore, it has developed into a significant method in this area. Image segmentation is the act of spatially dividing an image into independently connected image regions [5]. Because of their many advantages over gray scale pictures, colour photographs are increasingly popular. They can be used to quickly identify objects because they carry spectral information. For machines to better perceive and analyze scenes, colour information processing is essential [6]. The RGB colour model is extensively used in many different contexts.

2. METHODOLOGY

2.1 DATASET

In colour classification, a dataset typically consists of a collection of swatches labeled with the colours they represent [7]. The colour samples can be represented in various ways, such as RGB or LAB values, or as features extracted from the colour samples. Black, blue, green, orange, red, violet, white, yellow – 8 classes. This dataset contains 8 class of colour; each colour class contains 25 images.

2.2 PREPROCESSING

Transforming the pixel values to a normalized scale using the scaling method can enhance the accuracy and integrity of the data and also make it easier to navigate the database [8]. This process is an essential step in preparing the data for the K-nearest neighbor’s algorithm, as it transforms the data into a format that can be effectively used by the algorithm [9].

2.3 FEATURE EXTRACTION

The feature extraction technique used is colour histogram. It extracts the colour information of an image by calculating the frequency of occurrence of each colour channel (red, green, blue) in the image. The code calculates a 256-bin histogram for each channel of an image, which represents the distribution of pixel values in that channel [10]. The three histograms are concatenated into a feature vector for each image, with the values separated by commas, and stored in a file for later use in training a machine learning model [11].

2.4 ARCHITECTURE

The architecture for predicting the final colour using machine learning involves a series of interdependent components that work together to ensure accurate and reliable predictions. Data collection, preprocessing, scaling, and splitting are important for preparing the data, while model selection, video and image input, and final colour prediction are critical for making accurate predictions.

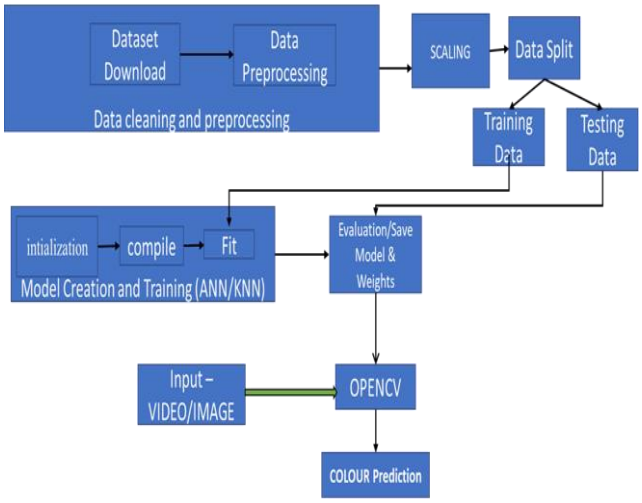

Fig.1 System Architecture for predicting the final colour using machine learning

The above figure 1 describes the architecture for predicting the final colour using machine learning can be divided into several components, including data collection, data preprocessing, scaling, data splitting, model selection (ANN, KNN) and video and image input.

2.5 MODEL TRAINING

In colour classification, model training refers to the process of teaching an algorithm or machine learning model to recognize and differentiate between different colours. This involves using a dataset of labeled images, where each image is labeled with the correct colour it represents. The model is trained on this data to learn the features and characteristics of each colour and how to distinguish between them. During the training process, the model is repeatedly exposed to examples of different colours and their corresponding labels. It uses this data to build a mathematical representation of the features that are most important for distinguishing between colours. This model can then be used to make predictions about the colours of new, unseen images. The precision of the classifications and the reliability of the training data are critical factors in the success of the model training process. With high-quality data and accurate labels, a well-designed model can achieve high accuracy in colour recognition tasks.

2.6 ANN

ANN is a type of machine learning program that takes its cues from the human brain's own biological neural network. ANN models are composed of layers of interconnected a node, each of which receives input signals, performs a calculation, and outputs a result to the next layer. In colour classification, an ANN can be trained on a set of labeled data (i.e., data that has been pre-classified) to learn the relationship between colour features and their corresponding class labels. Once trained, New, unidentified data can have its classification predicted by an ANN.

2.7 KNN

In machine learning, KNN is a categorization and regression method that does not rely on parameters. A k-nearest neighbor method is a straightforward technique for locating similar data points in a feature space. In colour classification, the feature space is defined by the colour space of the image (e.g., RGB or HSV), and each data point corresponds to a colour. KNN works by calculating the distance between the target data point and its k-nearest

neighbors in the feature space. The class label of the target data point is then assigned based on the majority class of its k-nearest neighbors.

To calculate EuclideanDistance() function calculates the Euclidean distance between two data points. The kNearestNeighbors() function finds the k nearest neighbors to a given data point in the training data. The responseOfNeighbors() function returns the class label that occurs most frequently among the k nearest neighbors. The loadDataset() function reads in the training and test data from CSV files and converts them to feature vectors. The main() function uses the other functions to perform the k-nearest neighbors classification on the test data.

Real time prediction uses OpenCV and Pandas libraries to identify colours in real-time from the video stream captured by the computer's camera. The program opens the camera using the VideoCapture method from the OpenCV library and displays the video stream on a window. The user can click on any pixel of the video frame, and the program will identify the colour of that pixel using the getColourName function. The function uses the absolute difference between the RGB values of the clicked pixel and the RGB values of each colour in the CSV file to find the closest matching colour.

3. RESULT AND DISCUSSION

In the proposed system the first component is Data collection which involves gathering a dataset of colour samples along with their corresponding labels. The dataset should be diverse, balanced, and of sufficient size to ensure accurate and reliable predictions. In Data preprocessing component, the raw data is preprocessed to prepare it for modeling. This can involve tasks such as data cleaning, feature extraction, and feature selection. The pixel values of the colour samples are scaled using a normalization method to ensure that they fall within a specific range. This process can improve the accuracy and integrity of the data and make it easier to navigate the database. In order to assess the efficacy of the model, the dataset is partitioned into training and testing groups. This is done to make sure the model is robust against fresh data and doesn't become over fit. In Model selection component involves selecting the appropriate machine learning model for predicting colour labels. Popular models for colour classification include artificial neural networks (ANN), K-nearest neighbors (KNN), and OpenCV. Video and image input: The final component involves the input of video or image data into the model for colour prediction. The input data is preprocessed and transformed to the appropriate format for use by the selected model. Final colour prediction: The selected model makes a prediction for the colour of the input data, and the final output is a colour label or category.

The advantages of proposed system are:

- Simplicity: KNN is a simple and easy-to-understand algorithm that is suitable for beginners.
- Interpretability: KNN models are easy to interpret and explain, as they rely on distance metrics to measure similarity between samples.
- No training time: KNN does not require any training time, making it useful for real-time applications where fast predictions are required.
- Non-parametric: The K-Nearest Neighbors (KNN) method is non-parametric because it does not assume anything about the data's distribution.
- Feature learning: During training, ANN models can pick up information that will help with tasks like object identification and image classification, known as "features."
- Scalability: ANN models can handle large and complex datasets, making them suitable for a wide range of applications.

From the below output it is clear that based on the colour percentages provided, we can predict that the dominant colour in the image is green, as explained in the previous answer. The output colour prediction will be the RGB value of the dominant colour, which in this case is (0,170,and 0).

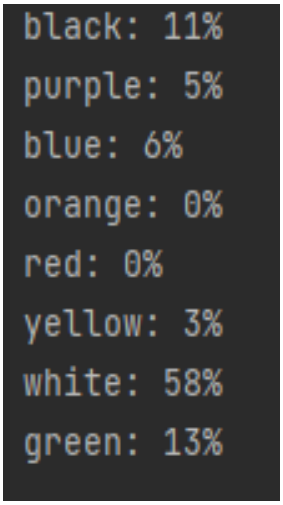

Figure 2: ANN output

From the above figure 2, it is noted that a real-time video processed with OpenCV, the colour prediction algorithm will analyze each frame of the video and predict the dominant colour based on the colour distribution in the frame. The output colour prediction will depend on the specific colour mapping used to convert the RGB values to colour names or categories. The output colour prediction is red, it means that the algorithm has detected that the colour red is the dominant colour in the frame.

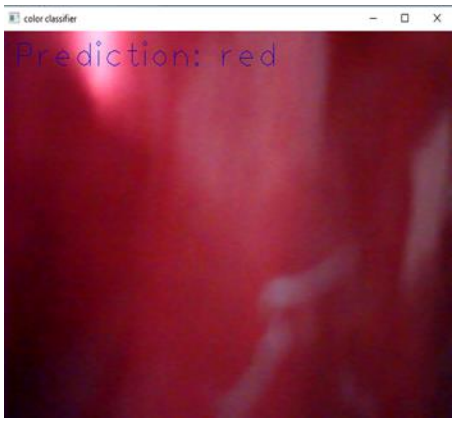

Figure 3: KNN Real Time Prediction

In the figure 3 and 4, it is noted that the colour prediction algorithm will analyze the colour distribution in the image and predict the dominant colour based on the specific colour mapping used to convert the RGB values to colour names or categories. If the output colour prediction is black, it means that the algorithm has detected that the colour black is the dominant colour in the image.

Figure 4. Image KNN prediction

4. CONCLUSION

In conclusion, the field of computer vision relies heavily on colour categorization. That involves identifying the colours present in an image. This can be achieved through various techniques such as feature extraction and machine learning algorithms like KNN and ANN. The colour histogram method is used to derive features, and the KNN algorithm is applied to classify the data. Model training is a crucial step in colour classification as it involves preparing the algorithm to recognize patterns and make accurate predictions. Overall, colour classification has many applications in fields such as image processing, robotics, and quality control, and it continues to be an active area of research in computer vision.

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