MACHINE LEARNING (UML 501)

Project Write – up

Name: **COLOR DETECTION**

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Introduction:

Color detection is a process where specific colors in an image are identified and analyzed based on their RGB (Red, Green, Blue) or other color space values. It involves extracting pixel data from an image and processing it to classify or predict the color using machine learning techniques like K-Nearest Neighbors (KNN) or color space transformations (e.g., converting RGB to HSV). This technique is widely used in applications such as object tracking, image segmentation, and even in user interfaces where selecting, identifying, or classifying color is essential.

In this project, we will be accomplishing the task using computer vision, image processing and KNN algorithm on supervised data having RGB values along with labels of the colors (i.e. supervised machine learning).

Key Technologies and Algorithms to be used:

- ➢ **OpenCV**: For image processing and interactive region selection.
- ➢ **Pillow (PIL):** For downloading and handling images from URLs.
- ➢ **NumPy**: For numerical operations, especially pixel averaging.
- ➢ **Requests**: For fetching images from the web.
- ➢ **KNN Algorithm (via Scikit-learn):** For classifying RGB values into color names.

Dataset:

https://www.kaggle.com/datasets/adityabhndari/color-detection-data-set

Major Steps to be Performed:

- ➢ **Data Pre–processing:** Data is cleaned (imputation, outlier handling), Data transformation (normalization /scaling), Data integration, Data reduction.
- ➢ **Image Loading and Conversion**: Loading images from a URL and converting them into a format that can be processed (e.g., converting a PIL image to a NumPy array), converting them into RGB/BGR format, and ensuring compatibility with OpenCV.
- ➢ **Feature Extraction**: Extracting relevant features (RGB values) from the input data to feed into the machine learning model. The RGB values of a selected region from the image are computed by averaging the pixel values in that region and served to the KNN algorithm.
- ➢ **Classification**: Based on the averaged RGB values, the region (ROI) is classified to its nearest suitable label.

Supervised Machine Learning:

Supervised machine learning is a machine learning technique that uses labeled data sets to train algorithms to predict outcomes and recognize patterns.

The RGB values are associated with color labels.

K-Nearest Neighbors (KNN) Algorithm:

KNN is a non-parametric, instance-based learning algorithm used for *classification* tasks. The KNN algorithm stores all available data and classifies new data points based on a similarity measure (such as Euclidean distance).

For color detection, when a new RGB value is input (e.g., the average RGB of a selected image area), KNN finds the closest RGB values in the training data and assigns the label of the majority color class among the k nearest neighbors.

Classification:

Classification in machine learning is a supervised learning technique that uses algorithms to categorize data into specific classes. It may be binary (two classes) or have multiple classes. Example: Classification can predict whether data falls into predetermined categories, such as spam or not spam, yes/no, male/female, disease/no-disease, underweight/fit/overweight, etc.

The image (or region) will be classified under the nearest suited color label accordingly (multi – class).