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Color-Driven Object Recognition: A Novel Approach Combining Color Detection and Machine Learning Techniques

Aadarsh Nayyer[1], Abhinav Kumar[2], Aayush Rajput[3], Shruti Patil[4,5,*], Pooja Kamat[6], Shivali Wagle[7,*], Tanupriya Choudhury[8]

[1,2,3,4,6,7]Symbiosis Institute of Technology, Symbiosis International (Deemed University), Pune, 412115, Maharashtra, India
[5]Symbiosis Centre for Applied Artificial Intelligence (SCAAI), Symbiosis International University, Near Lupin Research Park, Gram: Lavale, Tal: Mulshi, Pune, 412115, Maharashtra, India
[8]Graphic Era Deemed to be University, Dehradun, 248002, Uttarakhand, India

Abstract

INTRODUCTION: Object recognition is a crucial task in computer vision, with applications in robotics, autonomous vehicles, and security systems.
OBJECTIVES: The objective of this paper is to propose a novel approach for object recognition by combining color detection and machine learning techniques.
METHODS: The research employs YOLO v3, a state-of-the-art object detection algorithm, and k-means optimized clustering to enhance the accuracy and efficiency of object recognition. RESULTS: The main results obtained in this paper showcase the outperformance of the authors' approach on a standard object recognition dataset compared to state-of-the-art approaches using only color features. Additionally, the effectiveness of this approach is demonstrated in a real-world scenario of detecting and tracking objects in a video stream.
CONCLUSION: In conclusion, this approach, integrating color and shape features, has the potential to significantly enhance the accuracy and robustness of object recognition systems. This contribution can pave the way for the development of more reliable and efficient object recognition systems across various applications.

Keywords: You only look once(YOLO), Red Green Blue (RGB values), K-means Algorithm

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*Corresponding author. Email: shruti.patil@sitpune.edu.in

1. Introduction

Object detection is a basic issue in PC vision that includes distinguishing and finding objects in a picture or video transfer. It has different applications in fields like advanced mechanics, security frameworks, and independent vehicles. Generally, object detection depends on elements like shape, surface, and area to recognise objects. Whichever the case, assortment is a key component that might give fundamental data about the person, climate, and characteristics of an item. Customarily, object ID depends on innate qualities to distinguish and characterize objects in a scene, like structure, surface, and spatial situating. The scene of acknowledgment has changed to perceive the meaning of variety as a pivotal discriminative element, regardless of whether these highlights are as yet essential for some applications. Since it provides a profound profundity with that past the customary prompts of structure and surface, this development is especially huge. Assortment in object identification alludes to the huge range of varieties and how they are disseminated inside a

thing. Using and understanding this fluctuation can offer significant experiences on the personality, foundation, and fundamental qualities of an item. In contrast to monochrome or grayscale techniques, a variety driven object ID framework can recognize unpretentious contrasts between objects that might have comparable structures or surfaces. This additional layer of data empowers a more exact and complex comprehension of the visual climate and is fundamental in situations where standard procedures could miss the mark.

Accordingly, consolidating a variety recognizable proof with different viewpoints can fundamentally further develop items affirmation framework accuracy and potency [1]. One of the essential types of item recognition is color identification, which includes distinguishing the fundamental tints of an object in a picture or video. Various applications, including remote detecting, ecological observing, and clinical imaging, have utilized color detection. In any case, object identification algorithms might be made undeniably more precise and tough by coordinating color detection with different properties like surface and structure. This is because of the way that color might offer additional specific circumstance and recognizable proof data about a thing, which can be used to increment acknowledgment execution and disambiguate objects [1][2]. Making object recognizable proof calculations that utilises various colors notwithstanding different properties like shape, surface, and setting has gained popularity in recent years. Numerous element mixes can assist with object recognition algorithm frameworks handle complicated and dynamic circumstances by expanding their exactness and strength [2]. This has prompted headways in object identification strategies using assorted computer-based intelligence and disclosure advancements. Red, Green, and Blue, or RGB, values are principal to assortment distinguishing proof and are often utilized in PC vision and picture handling applications. Tones are portrayed by the RGB model as a mix of the three major tones — red, green, and blue — which might make a huge swath of varieties by changing their forces.

The RGB color model offers a straightforward and regular strategy to depict colors in a mathematical way, which is the reason it is so famous in PC designs and digital photography. RGB values might be used as elements for machine learning algorithms and as an establishment for color detection in object identification. One method for producing a variety histogram is to include the quantity of pixels in an image or video that, as per their RGB values, fall into foreordained variety receptacles [3]. From that point onward, an machine learning algorithm might use this variety histogram as contribution to prepare a model for object recognition. Additionally, variety spaces like HSV (Hue, Saturation, Value) can be applied to increase the accuracy and robustness of object recognition systems. Contrasted with RGB values, the HSV variety space can give a more consistent and perceptually pertinent portrayal of variety by isolating variety data into HSV parts. As well as being more qualified to brightening varieties than RGB values, HSV assortment space can work on the precision and heartiness of object recognition algorithm. In PC vision, object acknowledgment is a basic errand with many purposes. Assortment is fundamental for object recognition and gives significant data about the area and nature of an article. Coordinating a scope of disclosures with unmistakable elements like structure, surface, and lighting can fundamentally work on the exactness and heartiness of article affirmation frameworks. A vital idea in assortment ID is RGB values, which might be utilized to make assortment histograms that feature a thing's predominant tones. At long last, assortment spaces, as HSV, can be utilized to further develop variety revelation and work on object acknowledgment frameworks' exactness and power [2][3].Adding color to object detection algorithms builds their precision and extends their expected purposes. In fields where visual hints are regularly unobtrusive and shifted, including farming, medical services, and natural checking, variety driven object recognition appears to be a game-evolving approach. For example, in horticultural settings, the capacity to identify variety changes in harvests might offer data about their development, wellbeing, or potential contaminations, supporting accuracy cultivating rehearses. Albeit regular object recognition methods lay out the establishment, the fuse of variety as a critical trademark addresses a change in perspective that hoists the capability of these frameworks to exceptional levels. The subsequent blend of traditional qualities and variety driven bits of knowledge improves object distinguishing proof exactness and grows its application, making it more flexible and powerful in different certifiable applications.

Novelty- The most well-known procedure for distinguishing and finding objects in a picture or video is called object identification or detection, while the method used to recognize and find colors in a picture or video is called variety acknowledgment. These two positions request unmistakable methods and give their own unique obstructions. Through the coordination of color identification and variety distinguishing proof, the creators have resolved an issue that has not yet been completely investigated in the writing. This strategy can be valuable in various businesses, including picture handling, mechanical technology, independent vehicles, and reconnaissance. For example, object detection is fundamental in independent vehicles to perceive different vehicles and obstructions, color recognition can help with perceiving signs and traffic lights. Comparably, object detection in reconnaissance might help with distinguishing gatecrashers, and color recognition can assist with determining the color or shade of their garments, which can be useful in following them. All in all, the creativity of this study is in the creators' capacity to really coordinate two unmistakable machine learning methodologies to address a point that has never been tended to beforehand. This work can possibly open up new roads for research around here and has useful ramifications in various enterprises.

2. Related Works

The assortment of information from the eleven research papers offers a careful handle of color detection and identification systems, explaining the numerous applications and approaches that they utilize. From traditional RGB variety models to state of the art strategies like Convolutional Neural Networks (CNNs), Support Vector Machines (SVMs), and K-Nearest Neighbours (KNN) algorithms, this examination feature the variety of color detection techniques [1-11]. The purposes are various and incorporate PC vision, picture handling, security, horticulture, and openness for those with visual disabilities. Inside the setting of color detection, building and vehicle recognition arise as specific subjects of interest. Concentrates on in this field explore the utilization of histograms, variety attributes, and order techniques like support vector machines (SVMs) to exactly recognize and group vehicles and structures in view of their color information. [2,3]. Studies investigating the color detection of soil utilizing advanced image processing handling give significant bits of knowledge into the assessment of soil properties that are basic for agricultural tasks, highlighting the reasonable uses of color detection in horticulture [5]. Moreover, research on banana development discovery represents how variety acknowledgment might be utilized to decide natural product quality [6]. One normal subject all through a few articles is the utilization of color detection to further develop openness and help the people who are Curiously, one examination utilizes CNNs to distinguish hued objects for blind people, showing how computer vision might assist with regular undertakings and openness for those with visual debilitations [7]. With regards to recognizing fake banknotes, security applications become the overwhelming focus. To separate among genuine and counterfeit banknotes, an exploration study proposes utilizing supervised machine learning algorithms like SVM, decision Tree, and KNN. This program handles security issues, featuring the requirement for mechanized instruments to ensure cash authenticity, particularly during demonetization periods [11].

The appraisal estimates utilized by the aggregate examination to assess the exhibition of color detection algorithms are Accuracy, Precision, Recall, MCC, and F1-Score. The distributions reliably point up issues with thresholding, commotion responsiveness, covering objects, and the necessity for bigger datasets. These examinations offer bits of knowledge into likely future prospects as the exploration scene changes. These incorporate growing datasets, handling application-explicit troubles, and researching novel methodologies such coordinating unsupervised machine learning for color image segmentation. In light of everything, these examination distributions give a significant commitment to the area of color detection overall, showing its flexibility, helpful applications, and forthcoming social impact [1-11]. These

Table 1: Related work in color object detection

Ref No	Objective	Methodology	Key findings	Drawbacks/Limitations
[12]	Detection and classification of X-ray baggage security	Faster R-CNN and RetinaNET	mAP 74% mAP 77%	More processing power is required
[13]	Real time object detection	pre-processing based on the HSV and YCbCr color models	Accuracy 97.0%	Reliability of the model performance can be improved
[14]	2D object detection networks	CameraRadarFusionNet (CRF-Net)	mAP 57.50 %	the sensor quality of the camera is limited in severe weather conditions

examination' multidisciplinary approach advances more participation and imagination in the fields of computer vision and machine learning. Table 1 examines significant papers for variety object identification.

[15]	Vision-based object recognition	R-FCN with Resnet-101	34.88% mAP	Imbalanced dataset reduces the overall performance of the model.
		Faster R-CNN with Resnet-101	37.24% mAP	
		Faster R-CNN with Inception-Resnet-v2	38.48% mAP	
[16]	Color-based pixel segmentation of images to separate objects	Naive Bayes Random forest	98.40% 81.70%	detection of threat objects can

3. Methodology

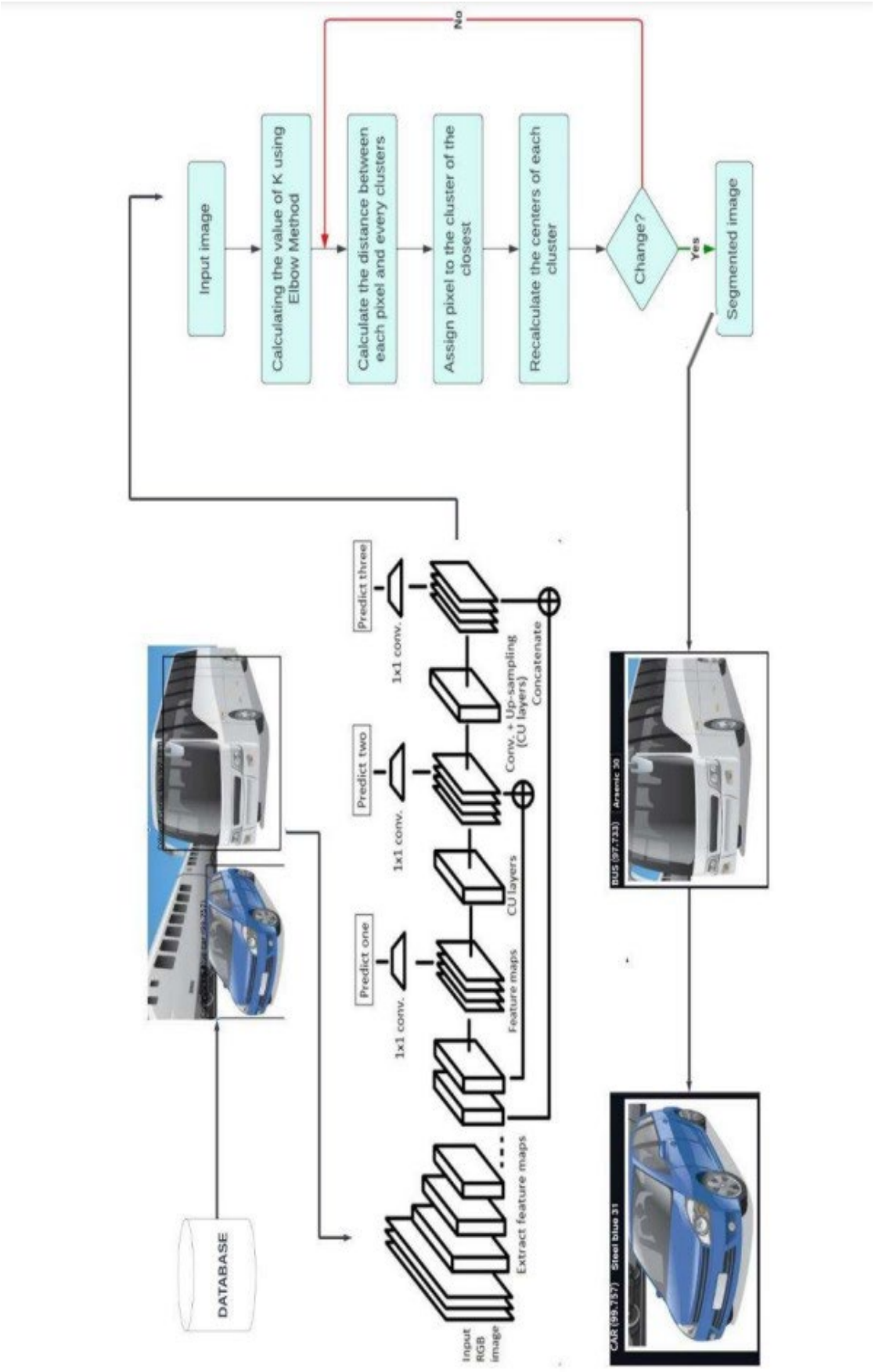
3.1. YOLO (You Only Look Once)

YOLO (You Just Look Once) is an object detection framework that utilizes profound brain organizations to identify and limit objects in pictures or recordings. Consequences be damned was created to give continuous object detection, pursuing it an ideal decision for applications like mechanical technology and self-driving vehicles. It works by partitioning an information picture into a lattice of cells and foreseeing the likelihood of an item being available in every cell alongside its bounding box organizes. YOLO v3 is the latest version of the YOLO system, which includes several improvements over the previous versions. It uses a larger network architecture and a feature pyramid network, which allows it to detect objects at multiple scales and improve its ability to detect small objects [6]. Additionally, YOLO v3 makes use of a brand-new loss function known as the focused loss, which gives harder examples—such as tiny things or objects with a low likelihood of being in the picture—higher weights. Because of these enhancements, YOLO v3 is now a more accurate and efficient tool for real-time object recognition in a variety of applications.

3.2. K-Means Clustering

Data points are grouped into K clusters using the well-liked Data points are grouped into K clusters using the well-liked clustering technique K-means. It can be difficult to determine the ideal value for K, the number of clusters, though. In the event that you want to use SML for color identification, KNN Classifier is a viable choice. Plotting the total squared distances between the pieces of information and the assigned cluster centroids for different upsides of K is the way the Elbow approach, a heuristic, decides the best incentive for K. The Elbow approach scans the plot for the "elbow point," or the place where the sum of squared distances isn't obviously diminished by the option of an extra group. The number that compares to the elbow point is as often as possible chose as the best incentive for K. By selecting beginning centroids all the more cautiously, the advanced K-implies calculation improves the adequacy of the first K-implies calculation. By diminishing the distances between the relevant pieces of information and the centroids, it utilizes a heuristic to pick the underlying centroids. Better bunching results and a faster algorithmic intermingling might emerge from this. Moreover, the Elbow approach and streamlined K-means might be involved together to decide the ideal incentive for K and upgrade the nature of the grouping consequently. CNN is an extra profound learning strategy that has a serious level of accuracy in variety recognizable proof [8]. In light of everything, the Elbow strategy related to streamlined K-implies offers a powerful way for gathering information and deciding the best number of groups.

4.



Workflow

Fig.1: Workflow

This algorithm concentrate on involves a progression of stages in its work process to find things in an info picture and use bunching calculations to decide the varieties that have a place with those things. An info picture should initially be placed into the framework. It is then handled by a YOLO (You Just Look Once) model, which has been prepared to recognize objects in pictures. Bounding boxes are delivered by YOLO, showing the places of the things in the image and names recognizing the sort of article tracked down in each case. Accordingly, the RGB upsides of the pixels inside each bounding box are clustered to track down the predominant shade of everything and to clustered colors that are comparable together. To divide the pixels and decide the different color clusters that are available inside everything, this stage applies clustering calculations. To decide the ideal number of gatherings and address the clustering's inclination, advanced K-Means is applied. The RGB potential gains of the most widely recognized assortment inside everything are then determined utilizing the cluster centroids. At last, the result of the system incorporates the remarkable things and their tones of correlation. There are different purposes for the article identification and variety recognizing verification, like thing following and picture acknowledgment. By applying more contemporary gathering procedures to work on the accuracy of object recognition and color identification proof, the structure might be additionally evolved. This cycle can be useful in various fields, including independent driving, clinical imaging, security and observation, and thing and variety acknowledgment, which can yield significant information. This approach will assist you with making a strong thing location and variety recognizable proof framework that can be utilized in different applications.

5. Results

As per the review paper's item and variety ID discoveries, the recommended framework can distinguish around 100 things in an image with a precision of practically 97%. By involving clustering approaches for color recognition and a YOLO (You Just Look Once) model for object recognition, the framework had the option to achieve this level of accuracy. Bounding boxes and marks were created utilizing the YOLO model for each item that was perceived, and the most unmistakable tones in the not entirely set in stone through the utilization of clustering algorithms. Also, the framework showed the capacity to distinguish various things in a picture, which makes it proper for genuine situations requiring the synchronous identification and following of many articles [Figs. 2, Fig. 3, and Fig. 5]. Besides, the algorithms distinguished the five varieties that were most predominant in the picture, which gave significant subtleties on the variety cosmetics of the things that were tracked down in the picture [Fig. 4 and Fig. 6]. The recommended framework has a serious level of exactness, which makes it a feasible choice for various purposes, including observation, driverless vehicles, and clinical imaging. For these applications, the ability to perceive a few things in an image and their separate varieties offers imperative data. Notwithstanding, by using more refined clustering calculations and advancing the YOLO model, the exactness of the framework might be additionally expanded [Table.2]. In light of everything, the recommended strategy offers a valuable technique for distinguishing items and varieties in photographs. The results show its true capacity for commonsense purposes where exact and powerful item identification is urgent.

Fig. 2: Identifying Multiple Objects in an Image

Table 2: Result Comparison

Research Papers	Accuracy
SVM based color Segementaiton-Nurul Amelina Nasharuddin	95%
Computer Vision For Fruit Ripeness – R Moulisha	93%
Clustering Based Color Detection- J Shruthi	92%
Proposed Work	**97%- from object detection results**

Fig. 3: Object 2 with its confidence level

Colors in image with percentages and shades

	Color	Percentage	R	G	B
0	Arsenic	30.35	68	68	70
1	Pastel gray	29	203	204	206
2	Cadet grey	14.16	149	163	173
3	Anti-flash white	13.71	241	241	242
4	Sonic silver	12.78	118	119	122

Fig. 4: Top 5 dominant colors in object 2 along with their RGB values

Fig. 5: Object 1 name with its confidence level

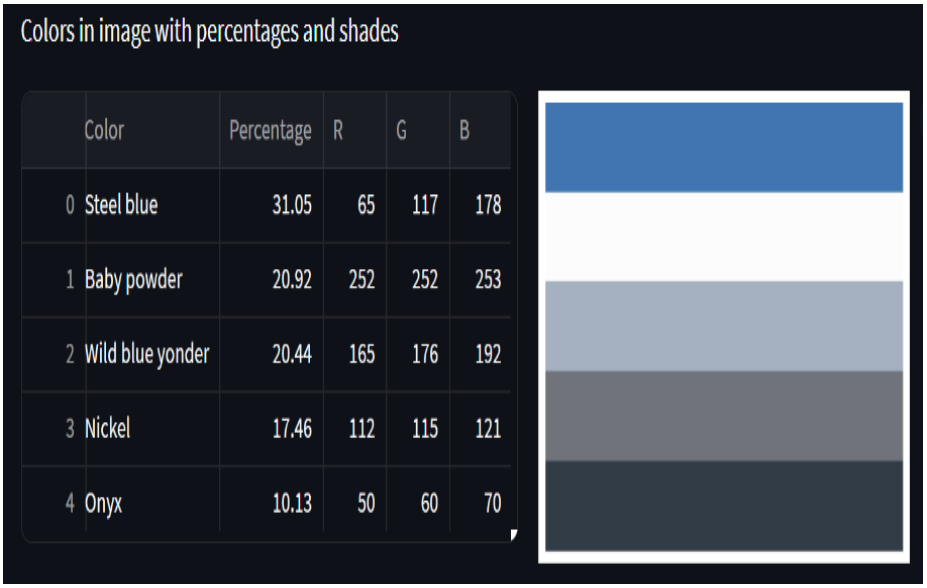


Fig. 6: Top 5 dominant colors in object 1 along with their RGB values

6. Future Scope

In order to identify around 100 things and the five most prominent colors in a picture, the research article suggests an object and color identification method with excellent accuracy. Future development and integration of the system into many sectors and applications is possible. Future effort can be concentrated on the following areas. First, to enhance logistics and inventory management, the suggested solution may be connected with warehouse management systems. Through constant following and location of products, distinguishing proof of absent or harmed things, and item design streamlining, the framework may extraordinarily improve stockroom tasks' proficiency. Moreover, the technique can possibly be upgraded to definitively recognize the degree of readiness in photographs. The framework might create more precise and predictable outcomes by adding qualities like surface investigation and organic product structure recognizable proof, as well as modern PC vision methods like profound learning. Thirdly, the proposed framework might mechanize the most common way of following vehicle support and utilization by coordinating with computerized vehicle log frameworks. The innovation can help with bringing down human information section botches and expanding support productivity by perceiving and following vehicle parts and featuring any issues. At last, the proposed approach might be improved to give altered

style variety proposals. The calculation can suggest corresponding varieties for attire things by inspecting the variety creation of a picture. More data like variety hypothesis and client inclinations can be incorporated to work on the framework's capacity to give more exact and customized proposals.

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