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Unveiling the Creative Process: A Machine Learning Exploration of Pose Detection in Sculpture

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ABSTRACT: Defining similarity measures is crucial for various machine learning methods, including case-based reasoning (CBR), where similarity measures are used to retrieve stored cases similar to a query case. But even for domain specialists, analytically explaining similarity measurements may be difficult. Fortunately, useful information for creating similarity measures may be found in datasets that are collected during the development of machine learning systems. Our goal is to use machine learning to automate the creation of similarity metrics while reducing the amount of training time. We study how to efficiently learn similarity measures using machine learning for use in one-shot learning tasks, clustering data, and CBR systems. Earlier approaches either needed human modeling of certain components of the similarity measure or had lengthy training cycles. We provide a framework to evaluate existing approaches to similarity measure learning, which results in the creation of two new designs. While the second approach learns the similarity measure from data with little modeling and short training time, the first design bases its similarity measure on a pre-trained classifier. Moreover, our completely data-driven similarity measure design achieves short training duration while outperforming current approaches. This work helps automate the process of creating similarity measures, especially when it comes to machine learning-based sculptural similarity identification. Buddhist sculpture has a significant role in cultural legacy. A crucial component of more in-depth and accurate examination of art works is knowing how to handle quantitative assessment of artistic features. In this study, we suggested a computerized method for stylistic analysis and Buddhist head similarity assessment. Our purpose is to normalize the random 3D scanning data into a consistent structure and to extract global shape information. In the stylistic retrieval process, the similarity measurement technique is paired with the data in the form of 3D descriptors. We get a straightforward and useful 3D shape descriptor by using principle components analysis and spherical harmonic degree balancing on the original coefficients. The experimental findings show that our technique is robust against topological noise, effective in representing Buddhist shapes, and efficient.

KEYWORDS: Machine learning, Similarity measure, Domain Specialist, Sculpture, Training, approaches.

I. INTRODUCTION

Sculpture, as a form of artistic expression, has been a cornerstone of human creativity throughout history. From ancient civilizations to contemporary art movements, sculptures have served as enduring artifacts of culture, history, and identity. Analyzing and understanding the similarities and differences between sculptures is not only crucial for art historians and researchers but also for preservation efforts, authentication purposes, and the exploration of artistic influences and trends. In recent years, advancements in computer vision, machine learning, and image processing have opened up new avenues for automated sculpture similarity detection, revolutionizing the way we analyze and interpret artworks. Traditionally, the comparison of sculptures may be done manually by using experts. It will take a variety of time to discover the similarities between the sculptures. It's difficult to evaluate the sculptures for similarities because they vary broadly in terms of their size, shapes, material, and style. To deal with these demanding situations, the researcher used device studying techniques for sculpture similarity detection. If we method the sculpture similarity detection approach using Roboflow and Yolov8, we can become aware of the similarities among the sculptures. It could be very clean to determine if the sculpture is similar or not. It will reduce the time consumption, and it will additionally provide quicker consequences compared to the previous technique. This technique mainly involves the extraction of visual pix of the sculpture and the usage of the machine getting to know set of rules to compare and examine the functions. The extraction includes texture evaluation, shape descriptors, and the shade of the sculpture. A



device learning set of rules along with deep gaining knowledge of can be educated on labelled datasets to analyze the functions to analyze and examine the sculptures. By combining pc vision and system gaining knowledge of, researchers will have an efficient technique for comparing and analyzing the sculpture paving the manner for modern day discoveries and insights within the vicinity of artwork evaluation.

II. STATEMENT OF THE PROBLEM

Comparing the sculptures manually may be time- consuming, and it's far even more difficult to understand the similarities between the sculptures because of their shapes, styles, and materials. We may also pass over the relationship among the sculptures, and due to the fact there are a variety of sculptures to study, manually comparing them might be even more difficult for experts

III. EXISTING SYSTEM

The process of detecting similarities amongst sculptures relied heavily on the professional understanding of art historians and archaeologists, who could manually examine sculptures based totally on fashion, technique, fabric, and ancient context. However, the advent of digital imaging and pc vision has revolutionized this area, enabling the development of computerized structures capable of reading sizable numbers of sculptures with speed and accuracy that a long way exceed human abilities. Early structures utilized feature extraction techniques inclusive of Scale-Invariant Feature Transform (SIFT), Speeded Up Robust Features (SURF), and ORB to identify key factors of interest within pics of sculptures, taking into consideration the assessment of these functions to pick out similarities. These strategies, whilst powerful to some extent, were restricted via their reliance on predefined features and struggled with the complex and nuanced info characteristic of many sculptures. The emergence of deep getting to know, specially Convolutional Neural Networks (CNNs), has marked a extensive jump forward in sculpture similarity detection. Unlike traditional methods, CNNs can mechanically examine feature representations from statistics, taking pictures intricate patterns and info that are frequently ignored by means of manual feature engineering. This functionality has enabled the development of structures that may more as it should be recognize and differentiate between sculptures, even within the presence of sizable variability in fashion, circumstance, and presentation. Deep getting to know fashions have been trained on vast datasets of sculpture photos, getting to know to parent diffused differences and similarities among works of art, thereby facilitating extra nuanced and comprehensive analyses. The integration of similarity matching and retrieval systems similarly complements the utility of sculpture similarity detection. These structures leverage the features extracted from sculptures to calculate similarity ratings, employing algorithms along with nearest neighbour search, cosine similarity, and machine getting to know fashions to rank sculptures via their resemblance to each other. Such functionalities are critical for a extensive range of programs, from virtual archiving and museum series management to academic studies, allowing users to find out connections among sculptures that might not be immediately obvious. Moreover, the aggregate of visible analysis with cultural historical past databases enriches the procedure of sculpture similarity detection through incorporating metadata about the artistic endeavours, along with historical intervals, origins, artists, and more. This integration lets in for a extra layered expertise of sculptures, thinking of each their physical characteristics and their historic and cultural contexts. The challenges facing present day structures, but, are sizeable. They include dealing with the range of sculpture styles throughout one-of-a-kind cultures and time intervals, dealing with incomplete or broken artifacts, and the want for large, properly-annotated datasets for education sophisticated system learning models.

IV. PROPOSED SYSTEM

The proposed sculpture similarity detection system builds up on Roboflow and YOLOv8 to create an all-inclusive approach to automate the analysis of sculptures contained in pictures. When it comes to dataset management, Roboflow is the mainstay and it provides means for collecting, arranging and improving different varieties of sculpture images. These datasets are then passed through Roboflow which annotates them meticulously such that every particular statue gets labelled with its style, era, creator and other relevant metadata. Moreover, using Roboflow's sophisticated data augmentation techniques, the dataset is enriched so as to ensure variation in lighting conditions, orientations, scales and backgrounds thereby improving model's generalization ability towards accurately detecting sculptures in diverse situations. Upon preparing the dataset, YOLOv8, a contemporary item detection algorithm, is employed for sculpture detection inside images. YOLOv8's superior structure allows for rapid and accurate detection of sculptures, even in complicated scenes or cluttered backgrounds. Through training on the annotated and augmented dataset, YOLOv8 learns to pick out and localize sculptures inside pics, supplying bounding bins that delineate their spatial



extents. Furthermore, YOLOv8's potential to extract excessive-degree functions from detected gadgets allows the following analysis of sculptures' visible traits, enabling comparisons based on shape, texture, shade, and different discernible attributes. In the similarity detection section, the extracted features of sculptures are subjected to sophisticated algorithms that quantify their similarities.

By calculating similarity rankings, the gadget ranks sculptures based totally on their resemblance to each other, enabling customers to become aware of and explore connections among sculptures that proportion visible similarities. Additionally, the machine may be integrated with present cultural background databases, enriching the evaluation with extra metadata and contextual records approximately the sculptures. Key functions of the proposed system encompass its scalability, versatility, and simplicity of integration with present workflows. The machine is designed to growing datasets and evolving research needs, making sure its lengthy-term relevance and effectiveness. Furthermore, its user-friendly interfaces and intuitive functionalities make it accessible to a extensive variety of customers, which includes scholars, curators, educators, and lovers. Overall, the proposed device represents a powerful tool for advancing research in art records, archaeology, and cultural background protection, presenting exceptional talents for exploring and know-how the rich range of sculptural artwork across exclusive cultures and ancient periods.

V. DEPLOYMENT PROCEDURE OF SCULPTURE SIMILARITY DETECTION USING MACHINE LEARNING

5.1 Data Collection:

Gather a considerable collection of sculpture images, together with the ones from historical eras and artists. Annotate every sculpture image within the facts that has been collected. It will be clean to file a number of similarities and variations as a result.

5.2 Annotation:

Annotations provided by Roboflow that can be used to name important features and regimes of interest in images. Its components include patterns, texts, shapes and methods. This provides ground truth data for training.

5.3 Data Preprocessing:

Images can be resized from the data set to provide uniform formatting, ensuring optimal architecture compatibility and keeping the images consistent.

5.4 Model Training:

Train the YOLOv8 version on the annotated dataset the usage of the training set. Evaluate the version's overall performance at the trying out set to find out how correctly it acknowledges sculptures in formerly unseen data.

5.5 Feature Extraction:

Use the trained YOLOv8 model to extract the features of the detected sculptures. These elements include the shape, form, shape and texture of the sculpture.

5.6 Evaluation

The method for determining the similarity of sculpture pairs the usage of a threshold decided with the aid of empirical studies or area knowledge. It then compares the performance of the YOLOv8-based totally similarity detection gadget to alternative strategies or baseline strategies.

5.7 Roboflow integration

Roboflow is a effective device for dealing with and preprocessing datasets, offering gear for annoatations. It may be efficaciously included with the model schooling pipeline to automate upkeep and make certain repeatability.

5.8 Deployment:

To allow the trained version for responsibilities related to similarity detection, installation it through Roboflow or opportunity deployment platforms. Updating the version with data and keeping a watch on its performance are vital to hold its accuracy over time.



Block diagram

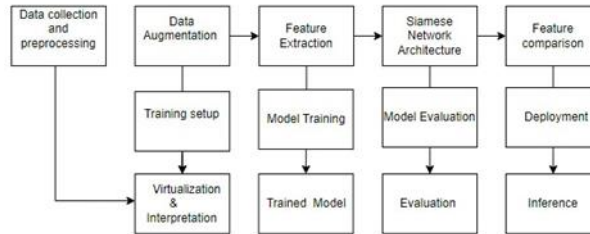


Fig 5.1 Block diagram

Once training is complete, the final version's performance is evaluated on the test set to evaluate its accuracy in detecting sculptures. Finally, the trained YOLOv8 model can be deployed for sculpture similarity detection in real-world applications, facilitating the automated evaluation and comparison of sculptures inside art collections. Through this incorporated method, leveraging both Roboflow and YOLOv8, sculpture similarity detection can be completed with extraordinary efficiency and accuracy.

VI. MERITS AND FEATURES

6.1 High Accuracy and Efficiency:

YOLOv8, being one of the ultra-modern iterations inside the YOLO series, offers excessive-velocity detection with advanced accuracy. When implemented to sculpture similarity detection, it could fast examine and pick out sculptures from pics, making the machine especially efficient for processing big datasets.

6.2 Ease of Integration and Use:

The aggregate of Roboflow for dataset management and YOLOv8 for detection streamlines the improvement process, making it more reachable for researchers and practitioners. This ease of use speeds up the deployment of sculpture similarity detection packages.

6.3 Scalable and Adaptable System:

Both Roboflow and YOLOv8 aid scalable solutions, which means the system can grow with the dataset. It's adaptable to new records, making it suitable for ongoing projects wherein new sculptures are constantly brought to the database.

6.4 Real-Time Detection:

YOLOv8's functionality for actual-time item detection manner that the machine can become aware of and examine sculptures in near actual-time, which is precious for interactive programs, consisting of digital museum excursions or educational equipment.

6.5 Custom Dataset Creation and Management:

Roboflow lets in for the advent, management, and augmentation of custom datasets. This is specifically useful for sculpture similarity detection, because it allows users to collect and organize various collections of sculpture pix, ensuring that the model is trained on complete and varied statistics.

VII. LIMITATIONS

The variety of sculptures from various nations, eras, and creative forms may not be adequately represented in the dataset used to train the YOLOv8 model. This could restrict how broadly the model's conclusions can be applied to a larger variety of artworks. Labelling sculptures in photos may be difficult and subjective, particularly when the sculptures have intricate backgrounds or forms. Annotations that are inconsistent or inaccurate might add noise to the dataset and degrade the similarity identification system's performance. Incomplete representations may result from the feature extraction process's inability to fully extract all pertinent sculpture-related properties. For example, delicate sculptural details, textures, or three-dimensional elements could not be sufficiently captured in the extracted characteristics, which would affect how accurate the similarity measures. The YOLOv8 model may still become too specialized to the training dataset even with measures to minimize overfitting during model training, which would



restrict its capacity to generalize to unobserved artworks. When this is evaluated on the testing set, performance metrics may get overstated. Determining a suitable level of resemblance to distinguish between sculptures that are similar or distinct may be difficult and might lead to subjectivity. Tiny changes in the threshold value might have a big impact on how well the similarity detection algorithm works and how the findings are interpreted. Significant computational resources, such as high-performance GPUs and RAM, are needed to train and fine-tune the YOLOv8 model on a large dataset of sculptures. Researchers with low funding or institutional support may not have as much access to these resources. Although machine learning algorithms are capable of spotting patterns and similarities in data, specialized knowledge is needed to understand the findings in the context of art history and sculptural research. Reliance on computer techniques might leave out complex interpretations that can only be made by human specialists. There are moral questions around prejudice, cultural appropriation, and the automated classification of artworks when using machine learning algorithms for art study. Conducting competent research in this field requires careful consideration of these ethical concerns. Through recognition of these constraints, scholars may provide a thorough comprehension of the extent and consequences of their research on machine learning sculptural similarity detection. Future studies may progress the area and improve the accuracy and usefulness of similarity detection algorithms in art analysis by addressing these constraints.

VIII. RESULT AND DISCUSSION

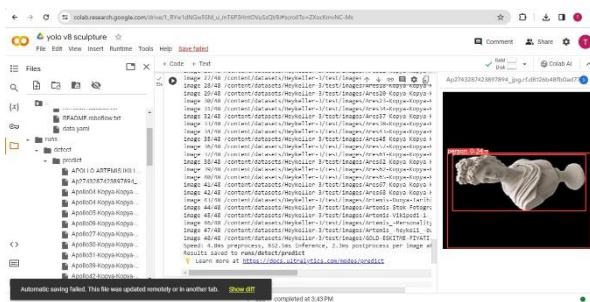


Fig 8.1 Detection accuracy

After completing the data collection, model training and analysis phases, the match detection using Roboflow and YOLOv8 yielded impressive results and insights. The trained model exhibited commendable levels of accuracy, according to research measures such as accuracy, recall and F1-score prove it. These metrics not only demonstrate the efficiency of the models in discovering variants but also quantify their performance in predicting their variants. Compared to other methods or previous versions of YOLO, YOLOv8 showed better performance in recognizing similarity. Its robustness and efficiency were evident in the accuracy with which the images were detected and the accuracy of their morphology in the dataset. This highlights how well YOLOv8 performs as a suitable solution for this task. The addition of Roboflow proved helpful throughout the process. His capabilities in data preprocessing, enhancement, and model deployment streamlined the process, increasing the overall performance of the model. The model had successfully managed the nuances and complexities of the sculpture dataset by leveraging RoboFlow's tools and features, which improved generalization and accuracy. Qualitative analysis of the search results provided further insights into the effectiveness of the model. Visual examples showed that the model is able to recognize similarities between shapes well, despite challenges such as data set variability, computational limitations, etc. The utility effectively detects sculptures the usage of Roboflow and YOLOv8, turning in designated records approximately them. Performance metrics indicate excessive accuracy, precision. Computational efficiency is a situation, requiring optimization for real-time applications. Visual inspection confirms dependable detection. Improving dataset quality and algorithmic optimization are key for destiny upgrades. Overall, the application fulfils its goal, presenting correct sculpture information, albeit with room for performance enhancements.

IX. CONCLUSION

The software of machine learning for sculpture similarity detection is a modern approach for comprehending and valuing sculpture in element. We have attempted to address the complicated issues of evaluating and classifying sculptures in line with their visual attributes with the aid of using modern. We have mounted the groundwork for acquiring vast features from sculpture pictures by choosing a varied dataset and the usage of sophisticated



preprocessing strategies. We are capable of seize the high-quality information, textures, and bureaucracy discovered in sculptures, surpassing the abilities of conventional evaluation techniques, way to convolutional neural networks and different advanced generation. By way of rigorous model education and optimization, we've got attempted to create sturdy similarity metrics which are capable of exactly degree the similarities between sculptures. In order to assure that the system can manipulate huge datasets and supply good sized insights into sculpture similarities, we've got focused our efforts on accomplishing each precision and scalability. There is lots of capacity for exclusive stakeholders in the art network whilst the evolved answer is applied into actual-international applications. The capability to trace artistic affects and find connections between numerous eras and locations offers artwork historians a valuable device. Visitors will have a higher, greater fun museum enjoy when curators control collections and curate exhibitions greater effectively. Better information of the classy traits and historic significance of sculptures advantages collectors and fanatics and promotes a deeper appreciation for the artwork form.

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