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Automatic Dress Size Detection for Online Shopping

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Abstract: *This project addresses the challenge faced by online shoppers in accurately determining dress sizes, leading to dissatisfaction and high return rates. To mitigate this issue, the proposed system introduces an automated approach to dress size detection, integrating human detection and landmark extraction techniques using YOLOv7. The system aims to enhance the online shopping experience by providing shoppers with personalised dress size recommendations based on their body measurements. By leveraging the real-time object detection capabilities of YOLOv7, the system detects human bodies within input images, subsequently extracting key landmarks such as shoulder width, bust size, and waist circumference. These measurements are then utilised to estimate the most suitable dress size for the user, thus addressing the problem of ill-fitting purchases in online shopping. Evaluation of the system's performance involves accuracy metrics and usability testing to validate its effectiveness and reliability in automating dress size detection for online shoppers. Through this innovative solution, online retailers can significantly reduce return rates and enhance customer satisfaction, while shoppers can enjoy a more convenient and personalised shopping experience.*

Keywords: Machine learning, Deep learning, Neural Network, Convolutional Neural Network, YOLOv7

I. INTRODUCTION

In the retail and fashion industries, delivering accurate sizing recommendations is essential for boosting customer satisfaction and minimizing return rates. Traditionally, determining dress sizes has involved manual measurements or size charts, which are often time-consuming, subjective, and prone to inaccuracies. A significant advancement in this area is the use of automatic dress size detection through computer vision, particularly employing YOLO (You Only Look Once) object detection technology. This innovative approach enables efficient and reliable size estimation based on visual analysis. Accurate dress size detection directly from images addresses key challenges for both retailers and consumers. For retailers, automated size detection enhances the shopping experience by reducing operational costs associated with returns, streamlining inventory management, and offering real-time insights into customer size preferences. For consumers, it provides a convenient solution that ensures well-fitting garments without the need for physical trials. YOLO stands out in this field due to its real-time object detection capabilities with high precision and speed. Its single-stage architecture processes images comprehensively, simultaneously predicting bounding boxes and class probabilities. This efficiency makes YOLO particularly suitable for rapid and accurate size estimation across various dress styles and categories. The primary goal of this project is to create a robust system for automatic dress size detection using YOLO. The project aims to achieve several objectives: high accuracy in predicting dress sizes across different categories (such as small, medium, and large) based on visual cues, real-time performance for seamless integration into retail platforms and online stores, a user-friendly interface for easy image upload and instant size recommendations, and scalability to handle a wide range of dress styles and sizes, accommodating evolving fashion trends and consumer preferences.

II. LITERATURE REVIEW

The exploration of automatic dress size detection using computer vision technologies, particularly YOLO (You Only Look Once), reflects a growing interest in improving accuracy and efficiency in the retail and fashion sectors.

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Historically, determining dress sizes relied heavily on manual measurements and size charts, methods that are often criticized for being time-consuming and prone to inaccuracies. Literature on this topic frequently highlights these traditional methods' limitations, including subjective interpretation and high error rates.Recent advancements in computer vision have introduced more reliable and efficient alternatives. Its architecture processes entire images in a single pass, predicting object locations and class probabilities simultaneously, which makes it particularly effective for rapid and precise size estimation. Research has shown that YOLO's real-time capabilities are well-suited for applications requiring swift and accurate detection of dress sizes across various styles. Studies indicate that integrating such automated systems can offer substantial benefits for retailers. Automated size detection not only streamlines the shopping process but also reduces return rates and improves inventory management by providing up-to-date insights into size trends. For consumers, these technologies enhance convenience by ensuring better fit predictions without the need for physical trials. Moreover, literature emphasizes the importance of developing scalable and user-friendly systems. Successful implementation depends on creating interfaces that are accessible to both retailers and consumers, ensuring that the technology can handle diverse fashion styles and sizes. Overall, the integration of YOLO into size detection represents a significant advancement toward more accurate and efficient solutions in the fashion industry.

III. PROPOSED METHOD

The proposed system aims to overcome the limitations of the current real-time Virtual Visualisation of Cloth Fitting by introducing several enhancements and innovations. Leveraging YOLO, a state-of-the-art object detection algorithm, the system enhances the precision of human body detection and landmark extraction, such as shoulder width, bust size, and waist circumference. Advanced segmentation based on dominant colours improves accuracy in cluttered backgrounds, while optimised algorithms ensure real-time processing even on devices with limited computational power. The system provides personalised dress size recommendations using extracted measurements and dynamically adjusts the clothing overlay to fit the user's movements. A comprehensive database of diverse clothing styles and textures, coupled with a user-friendly interface with interactive features, enhances the virtual fitting experience. Robust data protection measures ensure privacy and security, while seamless integration with existing e-commerce platforms and scalability support widespread adoption. Continuous usability testing and a user feedback mechanism drive ongoing improvements, aiming to provide an accurate, realistic, and satisfying virtual shopping experience that reduces return rates and boosts customer satisfaction.

IV. ALGORITHM

Convolutional Neural Network(CNN)

A Convolutional Neural Network (CNN) is a deep learning model tailored for analyzing structured grid data, like images. CNNs utilize convolutional layers to automatically and adaptively learn spatial hierarchies of features from the input images. Each convolutional layer applies filters to the image, generating feature maps that emphasize different elements of the image. These layers are followed by pooling layers that reduce the spatial dimensions, focusing only on the most important features. This architecture enables CNNs to efficiently identify patterns and objects in images. CNNs are commonly employed in tasks such as image classification, object detection, and image generation because of their ability to learn and generalize from visual data. They significantly surpass traditional methods by using deep layers to extract increasingly complex features from raw image data.

YOLOv7

YOLOv7, an advanced iteration in the YOLO (You Only Look Once) series of object detection models, represents a significant leap forward in real-time object detection. Building on the strengths of its predecessors, YOLOv7 enhances both accuracy and efficiency, making it a powerful tool for a variety of applications.YOLOv7 incorporates several key innovations that improve its performance. It introduces a new architecture designed to optimize both speed and accuracy, ensuring faster processing times while maintaining high detection precision. YOLOv7 employs a sophisticated backbone network and improved feature extraction techniques, allowing it to better capture and interpret complex features in images. One of the notable advancements in YOLOv7 is its enhanced anchor-free detection mechanism. Unlike previous YOLO models that relied heavily on anchor boxes, YOLOv7 utilizes a more refined

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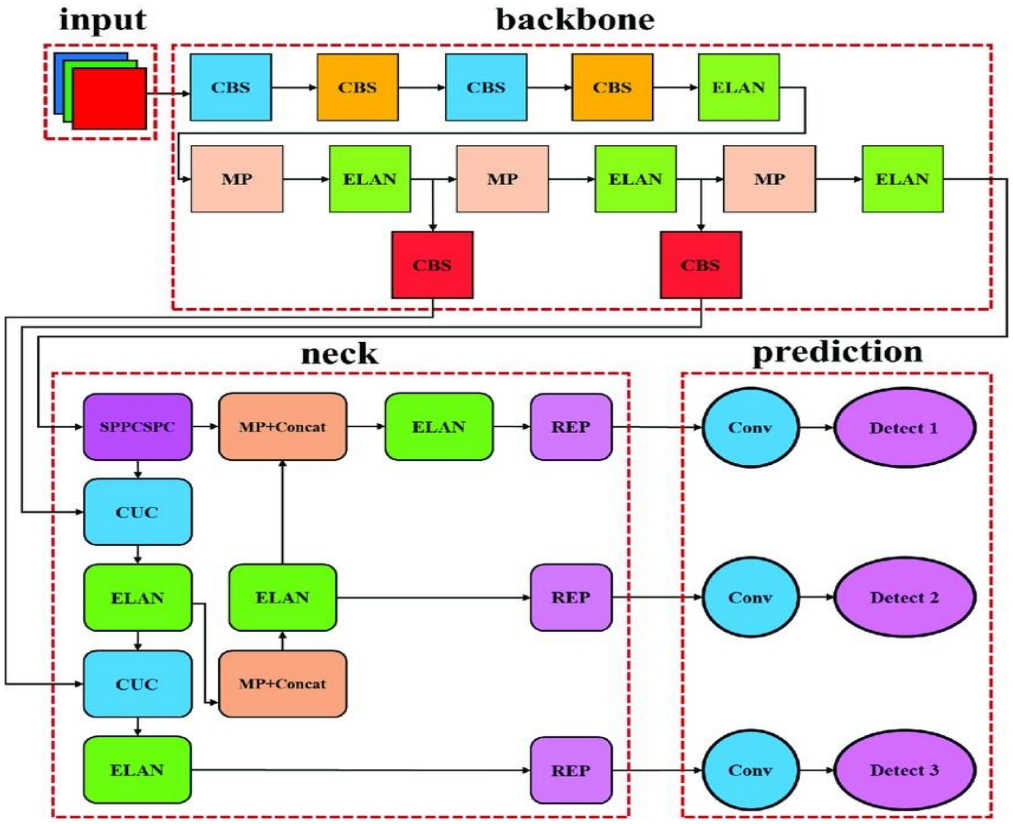
approach that reduces the dependence on predefined bounding boxes. This change improves the model's flexibility and accuracy, particularly in detecting objects of varying shapes and sizes. Another significant improvement is the integration of advanced data augmentation techniques during training. These techniques help the model generalize better to new and unseen data, thereby increasing its robustness and adaptability. YOLOv7's design ensures it operates efficiently in real-time scenarios, making it suitable for applications that require quick and reliable object detection, such as autonomous vehicles, surveillance systems, and interactive applications. Its ability to balance high performance with computational efficiency allows it to deliver state-of-the-art results without compromising on speed. Overall, YOLOv7 represents a notable advancement in the field of object detection, combining innovative techniques with practical performance improvements to meet the demands of modern computer vision tasks.



V. PACKAGES

Flask

Flask is a lightweight and flexible web framework for Python, designed to make web development straightforward and efficient. It provides the essential tools needed to build web applications, including routing, templating, and a development server. Flask operates on the WSGI standard, which allows for easy integration with various web servers. Its minimalist core is complemented by a rich ecosystem of extensions that add functionality such as database integration and user authentication. Flask's simplicity and extensibility make it ideal for both small projects and scalable applications.

Computer Vision

Computer vision integrates artificial intelligence and computer science to enable machines to analyze and interpret visual information, aiming to mimic human vision. It focuses on tasks like image classification, object detection, and facial recognition, crucial for applications such as autonomous vehicles, medical imaging, and robotics. Modern techniques often use deep learning, especially convolutional neural networks (CNNs), enhanced by methods like image

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normalization and transfer learning with large datasets. Rapid advancements in deep learning, hardware, and technologies like GANs are expanding capabilities in image synthesis. Challenges remain, including occlusions and limited data, prompting ongoing efforts to improve robustness and ethical application.

Pytorch

PyTorch is an open-source deep learning framework known for its flexibility, user-friendliness, and dynamic computational graph capabilities, which have made it popular among researchers and practitioners. It provides an effective platform for developing and training neural networks, serving a broad range of machine learning tasks. Unlike frameworks with static computation graphs, such as TensorFlow, PyTorch allows users to define and modify models dynamically during runtime. This dynamic nature enhances debugging and experimentation by enabling real-time monitoring of data flow and adjustments.Central to PyTorch is its tensor structure—a multi-dimensional array similar to NumPy arrays but with additional features like automatic differentiation, essential for backpropagation. PyTorch also supports GPU acceleration, which speeds up computations on compatible hardware, crucial for training large models with extensive datasets. The framework's `torch.autograd` module is key to its automatic differentiation and dynamic computation graphs, efficiently tracking tensor operations and computing gradients for backpropagation without manual intervention.PyTorch follows a modular design, offering pre-defined layers and loss functions through the `torch` module, and allows for custom module creation via subclassing `torch.nn.Module`. The training process involves loading data, creating the model, computing loss, and optimizing, with the `torch.utils.data` and `torch.optim` modules simplifying these tasks. PyTorch supports distributed training across multiple GPUs or machines and benefits from an active community that has developed various libraries and extensions, such as `torchvision` for computer vision and `torchaudio` for audio processing.

Keras

Developed in Python, it serves as a user-friendly API that operates on top of lower-level deep learning frameworks like TensorFlow, Theano, and Microsoft Cognitive Toolkit (CNTK). Keras is known for its simplicity and ease of use, allowing users to quickly design and experiment with neural network models. Its modular architecture enables the straightforward assembly of models by stacking layers, choosing optimizers, and defining loss functions. This makes Keras particularly appealing for rapid prototyping and iterative development. It supports various backend engines, with TensorFlow being the primary one, ensuring efficient computation and scalability. Keras also includes pre-trained models for a range of tasks, such as image and text classification, facilitating transfer learning and model fine-tuning. Overall, Keras combines simplicity with powerful capabilities, making it a favored tool for both researchers and developers in the deep learning community.

VI. EXPERIMENTAL RESULTS & PERFORMANCE EVALUATION

For our automatic dress size detection project, we have meticulously curated a diverse and comprehensive dataset to train our machine learning models. This dataset encompasses a broad range of dress types for both genders, including casual and formal wear, traditional garments, and seasonal attire. By including women's dresses such as sundresses, evening gowns, and men's wear like suits and trousers, we ensure that our model is exposed to a wide variety of styles and fits. We also prioritized model diversity in our dataset, featuring individuals of different body types, skin tones, and ages to represent a realistic spectrum of dress fitting scenarios. This approach not only improves the inclusivity of our model but also ensures balanced gender representation, enhancing its accuracy across all user demographics. In the preprocessing phase, we implemented several techniques to prepare the dataset for effective model training. Image enhancement steps, including contrast and brightness adjustments and noise reduction, were applied to improve clarity and visibility of the dresses. Cropping techniques focused on relevant parts of the images, maintaining aspect ratios to prevent distortion. All images were resized to a uniform resolution (e.g., 416x416 pixels) to standardize inputs and preserve quality. Data augmentation methods, such as rotation, flipping, scaling, and colour jittering, were used to increase dataset diversity and improve model generalization. The YOLOv7 model, used for object detection and size classification, processes images through a series of steps. It first extracts features using the CSPDarknet53 backbone, aggregates these features with PANet, and generates predictions through the detection head. Non-maximum

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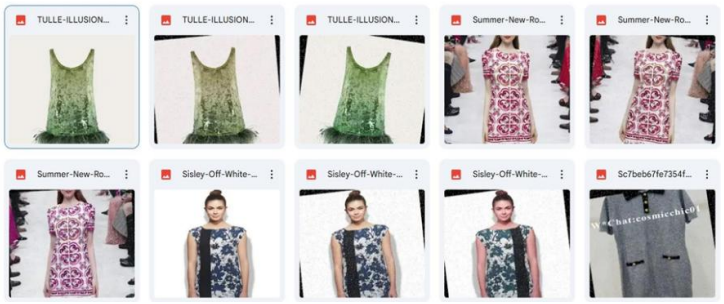
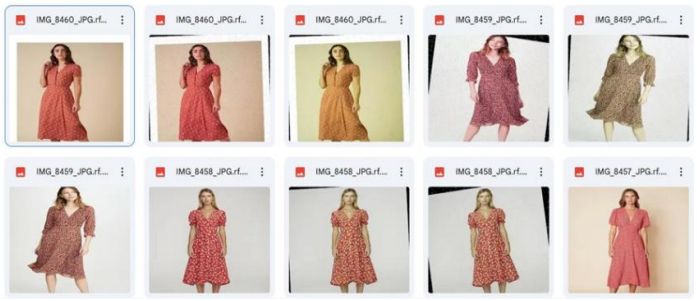
suppression is then applied to filter out redundant detections, providing accurate bounding boxes, class labels, and confidence scores. This structured approach ensures a robust and effective automatic dress size detection system.

Shift



Bodycon

A-Line



Preprocessed Augmented

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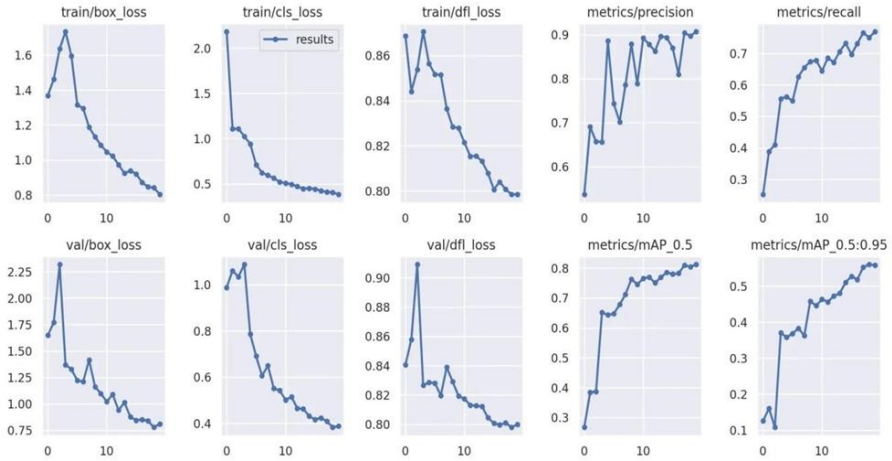
Preprocessed Image Enhanced

VII. ACCURACY GRAPH

An accuracy graph visually depicts a model's performance by plotting its accuracy against different conditions or parameters. Typically, the x-axis represents various experimental settings, such as training epochs or hyperparameter values, while the y-axis shows accuracy metrics. This graph is essential for demonstrating how accuracy changes with modifications in the model or training process. To ensure clarity, it is important to include clear labels, a legend, and precise axis titles. The accompanying analysis should interpret the graph, focusing on key trends and their implications for the model's overall performance and reliability. This interpretation helps in understanding how different settings impact the model's effectiveness and provides insights into areas for potential improvement.



VIII. LIMITATION

This project aims to tackle the issue of accurately determining dress sizes for online shoppers, which often leads to dissatisfaction and high return rates. By introducing an automated system that integrates human detection and landmark extraction techniques using YOLOv7, the project seeks to enhance the online shopping experience. YOLOv7's real-time object detection capabilities enable the system to detect human bodies in images and extract key measurements, such as shoulder width, bust size, and waist circumference. These measurements help in estimating the most appropriate dress size for users, aiming to reduce the problem of ill-fitting purchases. However, several limitations may affect the project's effectiveness. The accuracy of size recommendations heavily depends on the quality and consistency of the input images, which can vary significantly. Variations in body posture, clothing styles, and image resolution may impact the precision of landmark extraction. Additionally, the system's performance may be influenced by the diversity of body types and sizes not well represented in the training data. Usability testing and evaluation are essential to identify and address these limitations, ensuring the system's reliability and enhancing its ability to provide accurate and personalized dress size recommendations.

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IX. FUTURE SCOPE

The real-time Virtual Visualisation of Cloth Fitting system could undergo several enhancements to further improve its functionality and effectiveness. One potential enhancement is the integration of artificial intelligence and machine learning algorithms to provide more accurate and personalised dress size recommendations. Additionally, expanding the database of clothing styles, materials, and textures would enhance the realism of the virtual fitting experience. Incorporating augmented reality (AR) technology could allow users to virtually try on clothing items in real-world environments, further bridging the gap between online and in-store shopping experiences. Furthermore, exploring opportunities to collaborate with fashion designers and brands to offer exclusive virtual collections and collaborations would add value to the platform and attract a wider audience. Overall, these future enhancements have the potential to elevate the system to new heights, providing an even more immersive and satisfying virtual shopping experience for users while delivering tangible benefits for retailers.

X. CONCLUSION

In conclusion, the proposed real-time Virtual Visualisation of Cloth Fitting system offers a promising solution to the challenges faced by online shoppers in accurately determining dress sizes and visualising clothing fit. By leveraging advanced technologies such as YOLO for human detection, innovative segmentation methods, and personalised recommendations based on body measurements, the system aims to enhance the online shopping experience and reduce return rates for retailers. With a user-friendly interface, robust security measures, and continuous improvement through feedback mechanisms, the system strives to provide a seamless and satisfying virtual shopping experience for users. Through careful implementation and adherence to best practices in security, backup, and recovery, the system can deliver tangible benefits in terms of improved customer satisfaction, increased sales, and operational efficiency for retailers. Overall, the proposed system represents a significant step forward in revolutionizing the online shopping landscape and empowering users with personalized and convenient shopping experiences.

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