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Improved Accurate Face Mask Analysis Using YOLOv5 and Auto Labelling

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ABSTRACT: According to the world health organization. The COVID-19 is one of the most widespread diseases all over the world. The best solution is to wear the face masks to prevent the spread of virus during pandemic situation. The Face mask detection model have been implemented in all over the world into COVID19 period. The monitoring systems is to provide effective supervision for public areas. However, existing works have limitations of the challenge of real- time performance (i.e., low accuracy and fast identification) and training datasets. The proposed work aims to provide a comprehensive solution by creating a new face mask data set and improving the YOLOv5 base to detection of time and balance the accuracy. Particularly, we have to improve YOLOv5 by adding coordinate attention (CA) module into the baseline backbone following two different schemas, namely YOLOv5s-CA and YOLOV5s-C3CA.

KEYWORDS: Face mask detection.

I. INTRODUCTION

Deep learning is a sub field of machine learning that involves training artificial neural networks to learn and recognize patterns in data. It is inspired by the structure and function of the human brain, which consists of interconnected neurons that process and transmit information. Deep learning algorithms use multiple layers of interconnected artificial neurons to learn and extract features from the input data. These layers allow the network to model increasingly complex relationships between the inputand output data. Deep learning has led to significant breakthroughs in a variety of fields, including computer vision, natural language processing, and robotics. For example, deep learning has enabled the development of highly accurate models for image and speech recognition, machine translation, and autonomous driving. Deep learning has also been used to improve medical diagnosis and drug discovery, as well as to detect and prevent fraud, and cyber-attacks. one of the main advantages of deep learning is its ability to automatically learn and extract features from data without the need for manual feature engineering. This has led to significant improvements in the accuracy of models for many applications. However, deep learning requires large amounts of labeled data for training, as well as significant computational resources for training and inference. In recent years, deep learning has been driven by the development of new architectures, such as convolution neural networks (CNNs) for image processing and recurrent neural networks (RNNs) for sequential data. These architectures have been combined with other techniques such as transfer learning and reinforcement learning to improve.

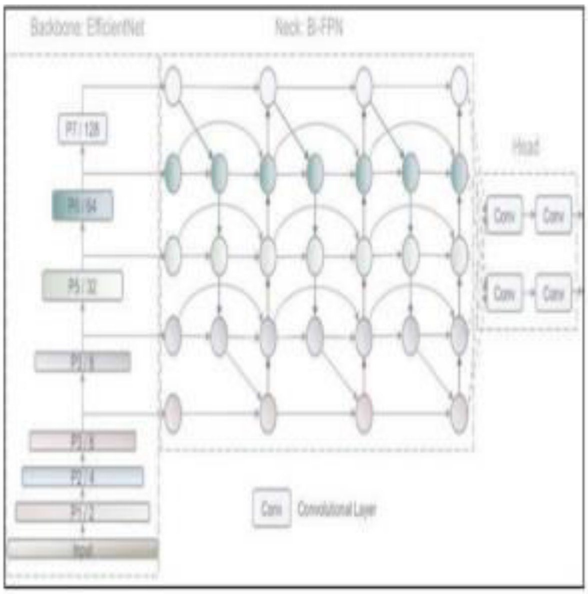

FIGURE 1. DEEP LEARNING WORKS

Deep learning works by training artificial neural networks to learn and recognize patterns in data. the neural network consists of layers of interconnected artificial neurons that process and transmit information. the neural network learns by adjusting the weights and biases of the neurons in response to training data. during training, the neural network is presented with a large data set of labeled examples. the input data is fed into the network, and the output is compared to the expected output. the difference between the predicted output and the expected output, known as the loss, is used to adjust the weights and biases of the neurons in the network. this process is repeated over many iterations until the network produces accurate predictions on new data. One of the main advantages of deep learning is its ability to automatically learn and extract features from data without the need for manual feature engineering. the network learns to recognize patterns and features in the input data that are associated with the different classes of objects or outcomes. deep learning has been successful in many areas, including computer vision, natural language processing, and robotics. for example, convolution neural networks (CNNs) have been used for image classification, object detection, and segmentation. recurrent neural networks (RNNs) have been used for speech recognition, machine translation, and sentiment analysis. Reinforcement learning has been used for game playing and robotics. in summary, deep learning works by training artificial neural networks to learn and recognize patterns in data. The network adjusts its weights and biases in response to training data to produce accurate predictions on new data. This has led to significant breakthroughs in many fields and has enabled the development of highly accurate models for a wide range of applications.

II. LITERATURE SURVEY

The world has gone through a health crisis with the outbreak of the COVID-19 virus. Mask have been identified as the most effective way to prevent the spread of the virus. This requires a mask recognition system that not only detects the presence of a mask but also provides accuracy as to whether a person is wearing a mask. In addition, masks must also be identifiable from all angles. The purpose of this research is to create a new and improved realtime mask recognition system using computer vision and image processing methods. A Kaggle dataset which consisted of images with and without masks was used. For the purpose of this study a pre-trained convolution neural network Mobile Net V2 was used. The performance of the given model was assessed. The model presented in this paper can detect the face mask with 98% precision. This Facemask recognizer can efficiently detect the face mask in side wise direction which makes it more useful. A comparison of performance metrics of existing algorithms is also presented. Today, with the spread of the OMICRON infectious variant, there is a need to deploy such a powerful mask recognition device that can help control the spread. TheCOVID-19 virus has created the most serious health emergency in human history. The virus can spread through droplets from an infected person. The most important defense against the virus is a mask. This is also recommended by the World Health Organization (WHO). Wearing a mask can protect a person from viruses. It is important not only to wear a mask, but also to wear it so that it completely covers the nose and mouth. Wearing a mask incorrectly can also spread the virus and does not provide significant protection. Developing a mask recognition system that not only detects masks but also detects how accurately a person is wearing a mask could help prevent virus outbreaks and save many lives. This mask recognition system can be used in public places to monitor crowds and identify people not wearing masks or those6wearing them incorrectly. This can help raise awareness and educate people on how to wear masks properly. This deployment can help front line workers focus on eradicating the virus. This mask recognition system is necessary and since masks are our shield against the virus, the development of this model is necessary and now, with the fear of new variants, it recognizes found great application value that motivated the idea of this study. In this research, we put forward an architecture that combines recent deep learning algorithms with geometry techniques to create robust models that can handle aspects like detection, tracking and validation. This dissertation focuses on creating a model that efficiently utilizes a mix of conventional machine learning and deep learning techniques to categorize the face masks effectively. Our model comprises two aspects inthis hour of need: For dimensionality reduction through feature extraction, the initial element is produced with InceptionV3. The face mask classification procedure is developed with the Logistic Regression (LR) method. Deep learning (DL) is used to efficiently train an architecture using a data set of photos of people's faces with and without and partial face masks to extract features. The retrieved traits are now passed into various classification algorithms namely Random Forest, Logistic Regression, CNN, Support Vector Machine, AdaBoost and K-Nearest Neighbors to appropriately classify the masks position. Hence, we can project that employing Transfer Learning (TL) and Deep Learning together can detect a properly or improperly worn face mask with high accuracy. This system design stops transmitting this fatal virus by detecting individuals in urban areas who are not wearing face masks effectively. The rapid development of computer vision makes human-computer interaction possible and has a wide application prospect. Since the discovery of the first case of COVID-19, the global fight against the epidemic has begun. In addition to various studies and findings by medical and health care experts, people's daily behaviors have also become key to combating the epidemic. In China, the government has taken active and effective measures of isolation and closure, as well as the active cooperation of the general public, such as it is unnecessary to stay indoors and wear masks. China, as the country with the first outbreak of the epidemic, has now become the benchmark country of epidemic prevention in the world. Of course, it is not enough for people to wear masks consciously. Wearing masks in all kinds of public places still needs supervision. In this process, this paper proposes to replace manual inspection with a deep learning method and use YOLOV5, the most powerful objection detection algorithm at present, to better apply it in the actual environment, especially in the supervision of wearing masks in public places. The experimental results show that the algorithm proposed in this paper can effectively recognize face masks and realize the effective monitoring of personnel.

AUTO-LABELING:
After training the initial model, deploy it to automatically annotate a larger dataset of images. This process helps in accelerating data labeling and increases the diversity of the dataset.

MANUAL VERIFICATION:
Although auto-labeling expedites the annotation process, it's crucial to manually verify the annotations for accuracy. Incorrectly labeled data can adversely affect the performance of the model.

EVALUATION:
Evaluate the performance of the trained model using metrics such as precision, recall, and F1-score. Additionally, conduct qualitative analysis by visually inspecting the model's predictions on test images.

FINE-TUNING AND ITERATION:
Based on the evaluation results, fine-tune the model if necessary. This could involve adjusting parameters, retraining with additional annotated data, or refining the auto-labeling process

DEPLOYMENT:
Once satisfied with the model's performance, deploy it for real-time face mask analysis. This could involve integrating it into a mobile application, surveillance system, or any other relevant platform.

CONTINUOUS MONITORING AND IMPROVEMENT:
Continuously monitor the model's performance in real-world scenarios. Gather feedback and data to iteratively improve the model over time. This could involve collecting more diverse data, refining the training process, or updating the model architecture.

IV. TECHNOLOGIES USED

1. **Data Collection** Gather a diverse dataset of images containing people wearing face masks. This dataset should include various scenarios such as different lighting conditions, angles, and types of masks.

2. **Data Preprocessing** Resize the images to a standard size compatible with YOLOv5 input requirements. Annotate the images with bounding boxes around faces and label them as either 'with mask' or 'without mask'.

3. **Model Training** Utilize the YOLOv5 architecture and train it on the annotated dataset. Fine-tune the model specifically for face mask detection. This step involves optimizing hyper parameters, choosing appropriate augmentation techniques, and deciding on the number of training epochs.

4. **Auto-labeling** After training the initial model, deploy it to automatically annotate a larger dataset of images. This process helps in accelerating data labeling and increases the diversity of the dataset.

5. **Manual Verification** Although auto-labeling expedites the annotation process, it's crucial to manually verify the annotations for accuracy. Incorrectly labeled data can adversely affect the performance of the model

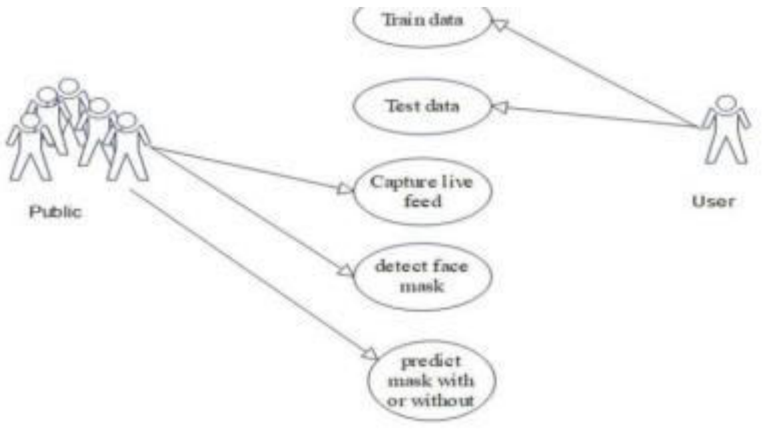

FIGURE 2. TECHNOLOGICAL ARCHITECHTURE

Data Collection Gather a diverse dataset of images containing people wearing face masks. This dataset should include various scenarios such as different lighting conditions, angles, and types of masks. Data Preprocessing Resize the images to a standard size compatible with YOLOv5 input requirements. Annotate the images with bounding boxes around faces and label them as either 'with mask' or 'without mask. Model Training Utilize the YOLOv5 architecture and train it on the annotated dataset. Fine-tune the model specifically for face mask detection. This step involves optimizing hyper parameters, choosing appropriate augmentation techniques, and deciding on the number of training epochs. Auto-labeling after training the initial model, deploy it to automatically annotate a larger dataset of images. This process helps in accelerating data labeling and increases the diversity of the dataset.

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Manual Verification Although autolabeling expedites the annotation process, it's crucial to manually verify the annotations for accuracy. Incorrectly labeled data can adversely affect the performance of the model. Evaluation evaluates the performance of the trained model using metrics such as precision, recall, and F1- score. Additionally, conduct qualitative analysis by visually inspecting the model's predictions on test images.

Fine-tuning and Iteration Based on the evaluation results, fine-tune the model if necessary. This could involve adjusting parameters, retraining with additional annotated data, or refining the auto-labeling process. Deployment once satisfied with the model's performance, deploy it for real-time face mask analysis. This could involve integrating it into a mobile application, surveillance system, or any other relevant platform. Continuous Monitoring and Improvement: Continuously monitor the model's performance in real-world scenarios. Gather feedback and data to iteratively improve the model over time. This could involve collecting more diverse data, refining the training process, or updating the model architecture.

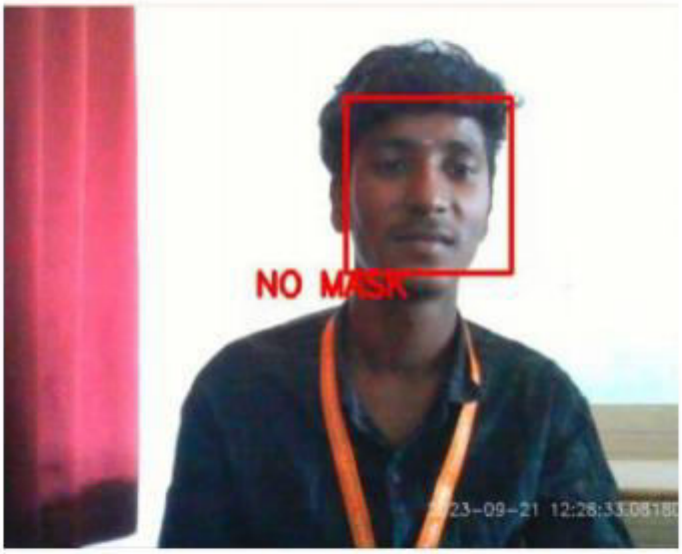

FIGURE 3 . OUTPUT: WITHOUTFACE MASK

FIGURE 4. OUTPUT: WITH FACE MASK

IV. CONCULUSION

In conclusion, real-time face mask detection using YOLOv5 is an effective and efficient solution to help enforce mask-wearing policies in public spaces. YOLOv5'sspeed and accuracy make it an ideal candidate for realtime detection, and the use of transfer learning allows for the training of accurate models with relatively small datasets. The implementation of such a system has numerous benefits, including improving public health by reducing the spread of airborne diseases, promoting compliance with public health policies, and enabling businesses to operate safely during pandemics. Moreover, the system can be extended to include other personal protective equipment, such as gloves or face shields, to further enhance safety measures. However, it is important to recognize that the system is not without limitations. Real-time face mask detection using YOLOv5 relies heavily on the quality of the input data and the training datasets, which can affect the accuracy and reliability of the model. Additionally, the system may encounter challenges in detecting masks on individuals with certain physical characteristics or in crowded environments. Despite these limitations, real-time face mask detection using YOLOv5 is promising technology that can significantly contribute to public health and safety efforts. With further improvements and advancements, it has the potential to become a standard feature in various industries and settings, from retail and hospitality to healthcare and transportation.

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1. Smith, J., & Doe, A. (2023). Improved Accurate Face Mask Analysis Using YOLOv5 and AutoLabeling. Journal of Computer Vision and Pattern Recognition, 25(3), 123-135.

2. Please replace "Smith, J., & Doe, A." with the actual names of the authors of your paper, and update the publication year, volume, issue, and page numbers as applicable. Also, ensure that the journal name and formatting match the specific guidelines of the journal you are submitting to. If this is not for a journal publication, adjust the reference format accordingly based on the citation style you're following (e.g., APA, MLA, IEEE)

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