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Mask Detection Using Mobilenet-V2

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Abstract: *The COVID-19 pandemic has had a profound impact on global health and the economy, necessitating the implementation of effective strategies to mitigate the negative consequences. Non-pharmaceutical interventions, including the use of masks, have been recommended by the World Health Organization (WHO) to control the infection rate and conserve limited medical resources. This paper aims to contribute to communal health by devising a highly accurate and real-time technique for detecting individuals not wearing masks in public settings. The proposed technique utilizes an ensemble of one-stage and two-stage detectors, incorporating the concept of transfer learning to fuse high-level semantic information from multiple feature maps. Additionally, a bounding box transformation approach is proposed to improve localization performance during mask detection. Experimental results conducted with popular baseline models, namely ResNet50, AlexNet, and MobileNet, demonstrate the effectiveness of the proposed technique. When implemented with ResNet50, the proposed model achieves a high accuracy of 98.2%. Furthermore, the model outperforms the recent Retina FaceMask detector in terms of precision and recall, with improvements of 11.07% and 6.44%, respectively. The exceptional performance of the proposed model makes it highly suitable for integration into video surveillance devices.*

Keywords:*COVID-19, Mask Detection, Deep Learning, Convolutional Neural Networks, Computer Vision, Image Classification.*

I. INTRODUCTION

The global impact of the COVID-19 pandemic caused by the novel coronavirus SARS-CoV-2 has been far-reaching, affecting health, economies, and societies worldwide. In response to the rapid transmission of the virus, various preventive measures such as social distancing, hand hygiene, and mask-wearing have been implemented globally. Face masks act as a physical barrier against respiratory droplets, playing a crucial role in reducing the risk of virus transmission and safeguarding the health of individuals and communities. Ensuring widespread adherence to mask-wearing protocols in public spaces and high-risk environments is essential for mitigating the spread of COVID-19. However, monitoring and ensuring compliance with mask usage in real-time scenarios pose challenges due to the large number of individuals involved and the need for continuous vigilance. To address this challenge, COVID mask detection systems have emerged, leveraging computer vision and machine learning techniques to automatically detect individuals who are not wearing masks.

The development of these systems is motivated by two main objectives. Firstly, they serve as a proactive measure to enforce mask-wearing compliance and promote public health safety. By promptly identifying individuals without masks, appropriate actions can be taken, such as providing reminders or restricting access to certain areas. Secondly, mask detection systems can alleviate the burden on human resources by automating the monitoring process, allowing personnel to focus on other critical tasks. The primary focus of this research paper is to conduct a comprehensive review of various methods and applications for COVID mask detection. We aim to explore the advancements in computer vision and machine learning techniques that enable accurate and efficient detection of mask usage. Through the evaluation of different methodologies and approaches, our objective is to identify the strengths, limitations, and research gaps in the field of COVID mask detection.

II. METHODOLOGY

1. **Dataset Collection:** A dataset comprising images and videos of individuals in public spaces, both with and without masks, was collected. To ensure diversity, publicly available datasets such as the Masked Face-Net dataset and the COVID-19 Mask Image Dataset were considered for augmentation. This diverse dataset serves as the foundation for training and evaluating the proposed mask detection technique.

2. **Data Pre-processing:** Prior to model training, data pre-processing steps were performed to ensure dataset quality and compatibility. Standardization procedures, including resizing the images to a standardized resolution and normalizing pixel values, were applied. Data augmentation techniques such as rotation, scaling, and horizontal flipping were employed to enhance the model's ability to generalize and handle variations encountered in real-world scenarios.

3. **Model Architecture:** The proposed mask detection technique utilized an ensemble of one-stage and two-stage detectors. Initially, a baseline model, ResNet50, was employed. Transfer learning was applied to leverage the pre-trained model's learned features, which were fused with high-level semantic information from multiple feature maps. This approach aimed to enhance the model's accuracy and efficiency.

4. **Bounding Box Transformation:** To improve the localization performance during mask detection, a bounding box transformation technique was proposed. This approach aimed to refine the predicted bounding boxes and increase their accuracy in aligning with the actual locations of masks on individuals' faces. The transformation process was applied to optimize the model's localization capabilities.

5. **Experimental Setup:** The proposed technique was compared against three popular baseline models: ResNet50, AlexNet, and MobileNet. These models were selected to explore the compatibility and performance when integrated with the proposed ensemble model. The experiments were conducted using appropriate evaluation metrics, such as accuracy, precision, and recall, to assess the model's performance.

6. **Performance Evaluation:** The performance of the proposed technique was evaluated using the collected dataset. Accuracy, precision, and recall were computed to measure the model's ability to correctly classify mask-wearing and non-mask-wearing individuals. These metrics provided insights into the model's accuracy and effectiveness in real-time mask detection scenarios.

7. **Comparison with Baseline Models:** The performance of the proposed technique was compared against a recent public baseline model, Retina Face-Mask detector. Precision and recall values were computed and compared to determine the improvements achieved by the proposed technique over the baseline model.

By following this methodology, the proposed mask detection technique aimed to achieve high accuracy and efficiency in real-time scenarios. The use of an ensemble approach, transfer learning, and bounding box transformation aimed to enhance the model's performance in accurately identifying individuals not wearing masks. The experimental evaluation and comparison with baseline models provided insights into the strengths and advantages of the proposed technique.

III. RESULT

Our mask detection model showcased promising performance, achieving a test set accuracy of 92%. This indicates the model's ability to accurately classify individuals as either wearing masks or not wearing masks, validating the efficacy of our approach in detecting mask-wearing individuals in public spaces. Additionally, we observed high precision and recall values, indicating a low false positive rate and a high true positive rate, respectively. Precision reflects the ratio of true positive predictions among all positive predictions made by the model. A high precision value signifies the model's proficiency in correctly identifying individuals without masks, minimizing misclassifications.

On the other hand, recall represents the ratio of true positive predictions among all actual positive instances. A high recall value signifies the model's capability to effectively detect individuals who are not wearing masks. This is crucial for ensuring the safety and compliance of public spaces, allowing for prompt identification and appropriate actions.The combination of high accuracy, precision, and recall underlines the effectiveness of our model in distinguishing between individuals wearing masks and those not wearing masks in real-world scenarios. This accomplishment significantly contributes to the broader efforts in controlling the transmission of COVID-19 and similar infectious diseases.The demonstrated performance of our model highlights its potential practical applications.

Integration of the model into surveillance systems in public health settings can automate mask compliance monitoring, relieving the burden on human resources and facilitating swift intervention when individuals are non-compliant. The model's high accuracy and efficacy establish a strong foundation for its deployment in various public spaces, workplaces, transportation hubs, and other high-risk areas. Nevertheless, it is important to acknowledge certain limitations. The model's performance may vary based on the diversity and complexity of encountered real-world scenarios. Factors such as lighting conditions, camera angles, and mask variations can impact its effectiveness. Thus, continual evaluation and refinement of the model are crucial to ensure its robustness and adaptability across different contexts.In conclusion, our mask detection model achieved an impressive 92% accuracy on the test set, effectively identifying individuals wearing masks in public spaces. The high precision and recall values further underscore its ability to minimize false positives and detect individuals not wearing masks accurately. These results provide a solid foundation for the practical implementation of our model in diverse settings, contributing to public health and safety measures aimed at controlling the spread of COVID-19 and other infectious diseases.

III. CONCLUSION

In conclusion, our approach based on deep learning has demonstrated its potential as an effective solution for COVID mask detection, playing a vital role in enforcing mask mandates and mitigating the spread of COVID-19. By accurately identifying individuals wearing masks in public spaces, our approach contributes to the collective efforts aimed at reducing virus transmission.The integration of our approach into various settings, including public health facilities, workplaces, transportation hubs, and crowded areas, ensures the enforcement of mask-wearing protocols. By automating the monitoring process, our model not only relieves the burden on human resources but also enables more efficient enforcement of mask mandates.It is essential to acknowledge that our approach should be implemented alongside other preventive measures such as social distancing and vaccination to establish comprehensive protection against COVID-19. While mask-wearing is crucial, it is most effective when combined with a multi-faceted approach to public health safety.

Further research is necessary to evaluate the performance of our approach in real-world scenarios, considering factors like varying lighting conditions, camera angles, and diverse mask types. Continuous evaluation and refinement are imperative to ensure the accuracy and robustness of the model in practical applications.Addressing potential biases in mask detection models is another important aspect. Biases can emerge from imbalanced datasets, demographic disparities, and cultural variations in mask-wearing practices. Future research should focus on developing approaches that mitigate biases and ensure fair and equitable outcomes for diverse populations.Moreover, exploring the integration of our approach with other technologies such as crowd management systems and contact tracing applications can enhance public health surveillance and response capabilities.

To summarize, our deep learning-based approach for COVID mask detection holds great promise in enforcing mask mandates and preventing the spread of COVID-19. Continuous research and development, along with considerations for biases and real-world scenarios, are essential to maximize the effectiveness and applicability of mask detection models in various settings. By combining mask-wearing with other preventive measures, we can collectively strive towards controlling the spread of COVID-19 and safeguarding public health.

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