ENHANCING SAFETY: FACE MASK DETECTION USING COMPUTER VISION AND DEEP LEARNING

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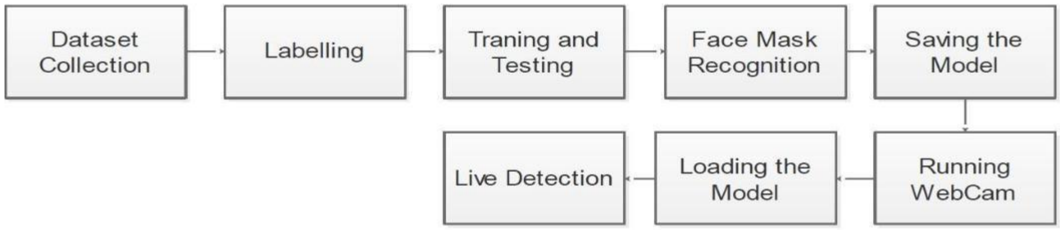
Abstract

Corona virus sickness has become a big public health issue in 2019. Because of its contact-transparent characteristics, it is rapidly spreading. The use of a face mask is among the most efficient methods for preventing the transmission of the Covid-19 virus. Wearing the face mask alone can cut the chance of catching the virus by over 70%. Consequently, World Health Organization (WHO) advised wearing masks in crowded places as precautionary measures. Because of the incorrect use of facial masks, illnesses have spread rapidly in some locations. To solve this challenge, we needed a reliable mask monitoring system. Numerous government entities are attempting to make wearing a face mask mandatory; this process can be facilitated by using face mask detection software based on AI and image processing techniques. For face detection, helmet detection, and mask detection, the approaches mentioned in the article utilize Machine learning, Deep learning, and many other approaches. It will be simple to distinguish between persons having masks and those who are not having masks using all of these ways. The effectiveness of mask detectors must be improved immediately. In this article, we will explain the techniques for face mask detection with a literature review and drawbacks for each technique.

1. Introduction

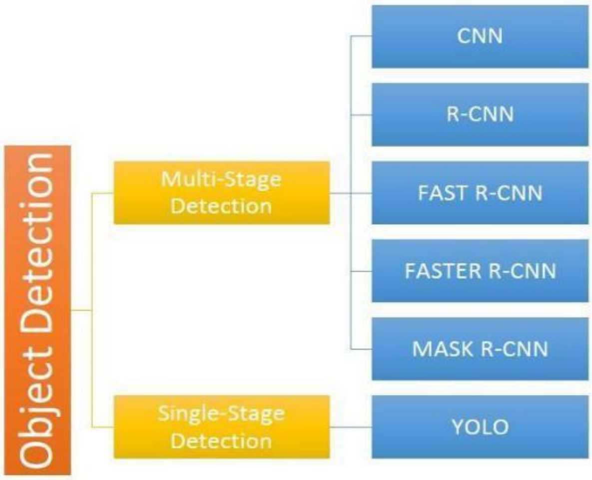
Because of the global pandemic of Covid-19, wearing a face mask in public is becoming increasingly popular. Since the people of Covid-19 refuse secure their health by wearing masks against air pollution. Others, on the other hand, are demure about their appearance and conceal their feelings from broader public by moving their own faces. Putting face masks helps to prevent Covid-19 transmission, according to someone. Covid-19 is most modern epidemic virus to poke human well-being in twentieth centenary. The quick spread of Covid-19 has prompted WHO to announce it an international pandemic in 2020. Covid-19 infected more than 5 million patients in 188 countries in less than six months. Close interaction is how the virus is spreading and in densely populated places. The corona virus outbreak has resulted in unprecedented levels of international scientific cooperation. Machine learning and deep learning powered by computer science will aid in fight for Covid-19 in number of different ways. Machine learning analyses massive amounts of data to estimate Covid-19 dispersion, behaves as a short notification system for prospective pandemics, and categorize sensitive populations. Many countries have regulations requiring people to keep face masks in crowd.

As a result, detecting face masks is a difficult process. Because of the expansion of the corona virus sickness, it has gotten a lot of attention lately since numerous countries have adopted policies such as" N o admission without a mask." Face mask detection is a critical issue in security and the prevention of Covid-19. In the medical industry, a mask minimizes the danger of infection from an infected individual, whether they show symptoms. Face mask detection is employed in a variety of settings, including airports, hospitals, offices, and educational institutions. Face recognition with not a mask is simpler but faces recognition with just a mask is more difficult since masked face feature extraction is more difficult than conventional face feature extraction. Many facial characteristics, such as the nose, lips, and chin, are missing from the covered face. The figure 1 shows the architecture model for Face Mask Detection. There are eight steps are used for the detection of face with mask.



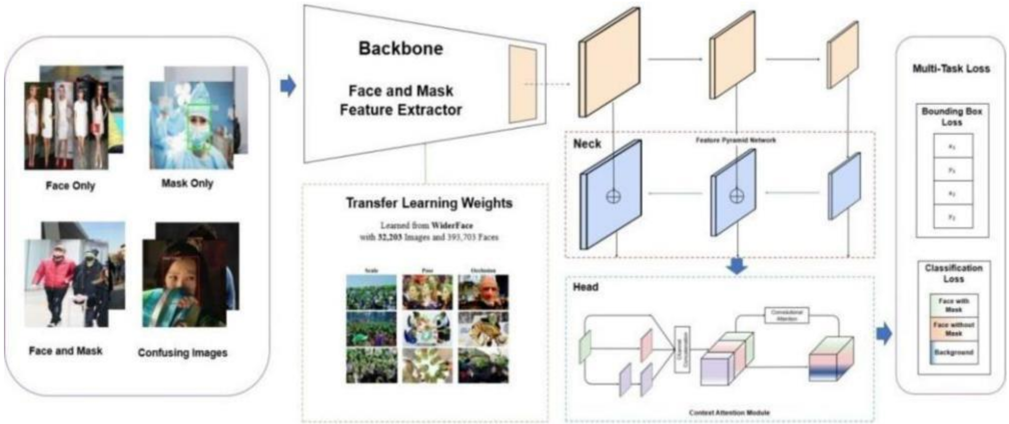
2. Techniques for Face Mask Detection

Convolutional Neural Networks (CNNs) are a type of deep neural network motivated by bio- logical phenomena. A CNN is composed of several components, including one with convolutional layer, pooling layer, as well as then fully connected layer, and it learns the spatial patterns of data autonomously and fluidly using the backpropagation method. The CNN kernels are common across entire image positions, making it incredibly parameter efficient. The CNN is a strong option for computer vision problems because of these properties. Because of major advancements in GPU com- punter capability, deep learning technologies have blossomed in recent years. Throughout computer vision, object recognition seems to be a critical task that has attracted a lot of attention. According to the recommended recommendations and tactics for improvement, shows us the current object detection methods:



2.1. Multi-Stage Detectors

The two-stage method uses a heuristic algorithm as CNN to generate a huge number of region recommendations for every image, next classifies and stagnates these eligible provinces. As first object detection technique, deep learning was applied. The figure shows the model architecture of retina face detection. There are many stages in this detection for the detection of masked face is shown in the figure.



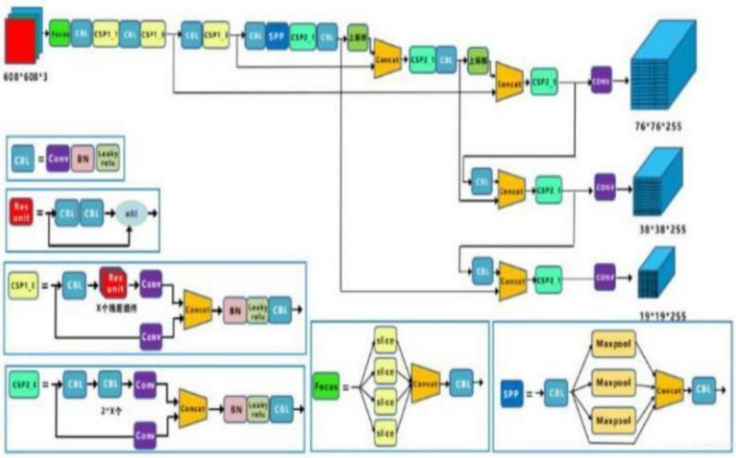
2.2. Single Stage Detection

Classification as well as regression are completed in single shot employing consistent and dense sampling having regard to locations, sizes, and aspect ratios in the one-stage technique:

FCOS is a one-stage detector that is both anchor-free as well as proposal- free. In tests, FCOS outperforms common anchor-depending one-stage detectors such as Retina Net, YOLO, and SSD, yet with far less design complication. FCOS entirely skips all anchor box calculation and hyper-parameters, solving object detection in a per-pixel predictions manner, identical to those other dense prediction problems like semantic segmentation. Between one detector, FCOS also reaches state-of-the-art effectiveness. We also demonstrate that FCOS can be employed as RPNs in the two-stage Faster R-CNN detector and surpasses its RPNs by a significant margin.

Optimized algorithm to improve efficiency of object detection as the accuracy of the one-stage detector often lags behind of the two -stage detector, the model was trained on VOC 2007 and 2012 train Val with total of 16.551 pictures, for enhancing part the data flipped left and right and random sampling is used. The results show that the one-stage detector gets high accuracy on SSD. By comparing the results, it can draw that first the improved algorithm for objects with similar categories has higher detection accuracy and reduce false detection, second improved algorithm has higher detection confidence for the same object detected.

To effectively apply YOLOV5 revealed that the network structure illustration, the most effective objection detection technique at the moment, in the real world, particularly in the guidance of donning masks in crowded locations, it was suggested to substitute manual inspection with only a deep learning approach and utilize YOLOV5 figure 10 exhibited the network structure illustration, the most influential objection detection technique at the moment. Depicts the system. When visitors enter the mall, they will capture images with the camera, which will then be transferred to interact for face mask identification. The mall gate would be opened and exhibited to pass if face detected within two seconds is indeed a face have a mask; else, it will be reverted to face mask identification until success is achieved. The experimental findings suggest that the suggested algorithm can efficiently recognize face masks and enable staff surveillance.



When contrasted to Faster R-CNN, YOLO has weaker recall and greater error in localization, fails to detect close items because every grid could only suggest two bounding boxes, and suffers to identify small objects.

3. Conclusion

In this paper, we have discussed some research papers about facial mask detection. As we know nowadays mask detection is a very challenging task. The applications of Facial Mask Detection are used especially for the prevention of spreading Corona Virus, tracking and identifying criminals and anti-spoofing etc. Each of these papers uses a different kind of algorithms, different techniques, different approaches but their goal is the same to detect a face, facial features like eyes, nose, eyebrows and to find out whether the face of a person is covered with a mask or not. After doing a deep study of all the algorithms we have concluded that each of these techniques have their own pros and cons but as compared to the other algorithms YOLO algorithm give better results with more accuracy and are more successful in real life.

4. Future Scope

The development and application of face mask detection systems using computer vision and deep learning represent a significant step toward ensuring public health and safety in various settings. As technology continues to evolve, there are several exciting avenues for future research and implementation:

1. Multi-Modal Detection: Future work can explore the integration of multiple sensors, such as thermal imaging and infrared cameras, to enhance face mask detection accuracy, especially in scenarios where traditional visual cues may be limited.
2. Real-Time Monitoring: The development of real-time face mask detection systems that can provide immediate feedback and alerts in public spaces, transportation hubs, and healthcare facilities can significantly contribute to infection control.
3. Mask Quality Assessment: Research can focus on assessing the quality of masks worn by individuals, identifying non-compliant or ineffective masks, and promoting the use of high-quality protective gear.
4. Privacy-Preserving Solutions: Investigate privacy-preserving techniques that enable face mask detection without storing or transmitting sensitive facial data, thus addressing privacy concerns.
5. Adaptive Models: Develop adaptive models that can handle variations in mask styles, materials, and designs, ensuring robust detection capabilities as mask technologies evolve.

6. Human-Computer Interaction: Explore how face mask detection technology can be integrated into human-computer interaction systems, including touchless interfaces and augmented reality applications.
7. Public Policy and Compliance: Collaborate with policymakers to establish guidelines and regulations for face mask usage in public spaces, with automated compliance monitoring using detection systems.
8. Crowd Management: Implement face mask detection in crowd management systems for events, gatherings, and public spaces to ensure adherence to safety protocols.
9. Education and Awareness: Develop educational tools and awareness campaigns that leverage face mask detection technology to inform and educate individuals about the importance of mask-wearing in pandemic situations.
10. Global Deployment: Extend the application of face mask detection systems to a global scale, adapting to different cultural norms and healthcare guidelines.
11. Mask Detection in Healthcare: Enhance mask detection in healthcare settings, including the ability to identify proper mask usage among healthcare professionals and patients.
12. Integration with Smart Devices: Explore integration with smart wearables, such as smart glasses or watches, to provide real-time feedback and reminders for mask usage.
13. Combating Deepfake Masks: Develop strategies to identify and combat deepfake masks that attempt to deceive detection systems.
14. Enhanced Accessibility: Ensure that face mask detection technology is accessible to individuals with disabilities, including those who rely on assistive technologies.
15. Long-Term Public Health Solutions: Investigate the role of face mask detection systems in long-term public health strategies and their potential applications beyond pandemics.

As technology evolves and the need for public health measures persists, face mask detection systems using computer vision and deep learning have the potential to make lasting contributions to safety and public well-being.

These future research directions and applications highlight the continued relevance and importance of face mask detection technology in a variety of contexts, from public health and safety to human-computer interaction and privacy protection.

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