Abstract

COVID-19 pandemic has rapidly affected our day-to-day life disrupting the world trade and movements. Wearing a protective face mask has become a new normal. In the near future, many public service providers will ask the customers to wear masks correctly to avail of their services. Therefore, face mask detection has become a crucial task to help global society. This paper presents a simplified approach to achieve this purpose using some basic Machine Learning packages like TensorFlow, Keras, OpenCV and Scikit-Learn. The proposed method detects the face from the image correctly and then identifies if it has a mask on it or not. As a surveillance task performer, it can also detect a face along with a mask in motion. The method attains accuracy up to 95.77% and 94.58% respectively on two different datasets. We explore optimized values of parameters using the Sequential Convolutional Neural Network model to detect the presence of masks correctly without causing over-fitting.

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INTRODUCTION

* 1. Project Definition and Objective

In recent times, the global community has witnessed a significant shift in societal norms, particularly in public health practices, with the widespread adoption of face masks as a preventive measure against the transmission of infectious diseases. Amidst this cultural shift, the integration of technology has emerged as a pivotal tool in enforcing adherence to mask-wearing protocols.

Face mask detection systems, leveraging advancements in computer vision and machine learning, have garnered substantial attention for their potential to automate the monitoring and enforcement of mask-wearing policies in various settings, ranging from retail environments to transportation hubs and healthcare facilities. These systems employ sophisticated algorithms to analyze live video feeds or images captured by surveillance cameras, identifying individuals within the frame and assessing whether they are wearing a face mask correctly, incorrectly, or not at all.

The deployment of face mask detection technology offers multifaceted benefits, including enhanced public safety, compliance enforcement, and operational efficiency. By providing real-time alerts to personnel or triggering automated responses, such as audible warnings or access control measures, these systems contribute to the creation of safer environments while minimizing the need for manual oversight.

However, the development and implementation of effective face mask detection systems are not without challenges. Issues such as varying lighting conditions, diverse facial expressions, and the presence of accessories (e.g., sunglasses or hats) can introduce complexities that require robust algorithmic solutions. Additionally, ethical considerations regarding privacy and consent underscore the importance of implementing these technologies responsibly and transparently.

Despite these challenges, the rapid advancements in artificial intelligence and computer vision hold promise for the continued evolution of face mask detection systems, empowering organizations and communities to navigate the complexities of public health management in an increasingly interconnected world. As we strive to adapt to the new normal, the integration of technology-driven solutions serves as a testament to our collective commitment to safeguarding public health and promoting safety and well-being for all.

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* 1. Motivation

1- Public Safety Enhancement: Contribute to public safety by ensuring adherence to face mask guidelines in crowded places, reducing the risk of virus transmission.

2- Health Compliance Monitoring: Assist businesses, institutions, and public spaces in enforcing health compliance measures by detecting individuals without face masks.

3- Workplace Safety: Enhance workplace safety by implementing face mask detection in office environments, manufacturing facilities, and other workspaces.

4- Public Awareness: Use the project to raise awareness about the importance of wearing face masks in public spaces for overall community health.

* 1. Project Overview **The Face Mask-Detection-Master** project leverages various machine-learning algorithms and pre-trained models to achieve robust facial mask detection. Incorporating state-of-the-art methodologies, the project employs a combination of convolutional neural networks (CNNs) and deep learning techniques. By utilizing pre-trained models, such as those from popular frameworks like TensorFlow or PyTorch, the system achieves high accuracy in detecting and localizing faces within live video feeds. The project's architecture showcases an integration of these models, optimizing performance and allowing seamless deployment for real-world applications. The outcomes highlight the effectiveness of leveraging machine learning for facial detection, demonstrating its potential for diverse applications, from security systems .
  2. Software Requirements

1- WINDOWS 7 OR ABOVE

2- PYTHON (VERSION 3.5 OR HIGHER)

* 1. Hardware Requirements

1- PROCESSOR (CPU): INTEL CORE I3-7TH GEN OR AMD RYZEN3 3RD GEN (OR EQUIVALENT)

2- MEMORY (RAM): 4GB RAM OR MORE

3- STORAGE (ROM): 128 GB OR MORE

4- WEBCAM : 480P RESOLUTION OR MORE

* + 1. Technologies ---- Python

FRAMEWORKS AND LIBRARIRES ---

1. TENSORFLOW
2. KERAS
3. IMUTILS
4. NUMPY

5-OPENCV-PYTHON

1. MATPLOTLIB
2. ARGPARSE
3. PILLOW
4. STREAMLIT
5. ONNX
6. TF2ONNX
7. LITRATURE SURVEY

2.1. Existing System

Face detection problem has been approached using Multi-Task Cascaded Convolutional Neural Network (MTCNN). Then facial features extraction is performed using the Google Face Net embedding model.

This system is capable to train the dataset of both persons wearing masks and without wearing masks

After training the model the system can predicting whether the person is wearing the mask or not wearing mask

2.2. Proposed System

Whether people are wearing their mask in a crowded environment or not, the program prefers to fix the problem based on mask. It can be used by a variety of organizations to keep the government's pandemic protocols up to date.This program may be used to identify people who are not adhering to protocols and to take strong action against them. Its use at various public sector access points can aid in the detection of those who are not wearing masks.When the mask is not identified, it outputs a red box, and when the mask is recognized, it outputs a green box.

2.3. Feasibility Study

1- Economic Feasibility:

Evaluating the economic feasibility of a face mask detection system is critical for determining its viability. The technology chosen should prioritize minimal costs while ensuring effective performance. The selection of resources, such as hardware and ML algorithms, should align with the application's requirements. Initial deployment costs and potential scalability for future extensions should be considered.

2- Technical Feasibility:

Assessing the technical feasibility of deploying a face mask detection system using ML involves a thorough examination of various technical aspects to ensure optimal performance, scalability, security, and cost-effectiveness.

1. SYSTEM ANALYSIS & DESIGN

Requirement Specification

3.1. Functional Requirements :

1. Face Detection: The system should be able to accurately detect human faces within a given image or video frame.
2. Mask Detection: Once a face is detected, the system should be able to determine whether the person is wearing a mask or not.
3. Real-time Processing: The system should process images or video frames in real-time to provide immediate feedback on mask detection.
4. Accuracy: The mask detection algorithm should achieve a high level of accuracy to minimize false positives and false negatives.
5. Alerting Mechanism: If a person is detected without a mask in a designated area, the system should trigger an alert mechanism to notify relevant authorities or individuals.
6. Compatibility: The system should be compatible with various input sources, such as live camera feeds, pre-recorded videos, or static images.
7. User Interface: A user-friendly interface should be provided for users to interact with the system, view results, and configure settings if necessary.

3.2. Non-functional Requirements:

1. Performance: The system should exhibit high performance, with fast processing times and minimal latency, to ensure real-time mask detection.
2. Scalability: The system should be scalable to handle varying loads, such as a large number of concurrent users or high-resolution video streams.
3. Reliability: The system should be reliable and robust, capable of functioning consistently under different lighting conditions, camera angles, and environmental factors.
4. Security: Measures should be implemented to ensure the security and privacy of captured images or video footage, as well as any personal data processed by the system.
5. Accuracy: The mask detection algorithm should be continually optimized to maintain a high level of accuracy, even in challenging scenarios or with diverse demographic groups.
6. Accessibility: The system should be accessible to users with different abilities, ensuring that the interface is easy to navigate and understand.
7. Resource Efficiency: The system should utilize resources efficiently, including computational resources and memory, to minimize hardware requirements and operational costs.
8. Compatibility: The system should be compatible with different hardware configurations, operating systems, and software dependencies commonly found in college environments.