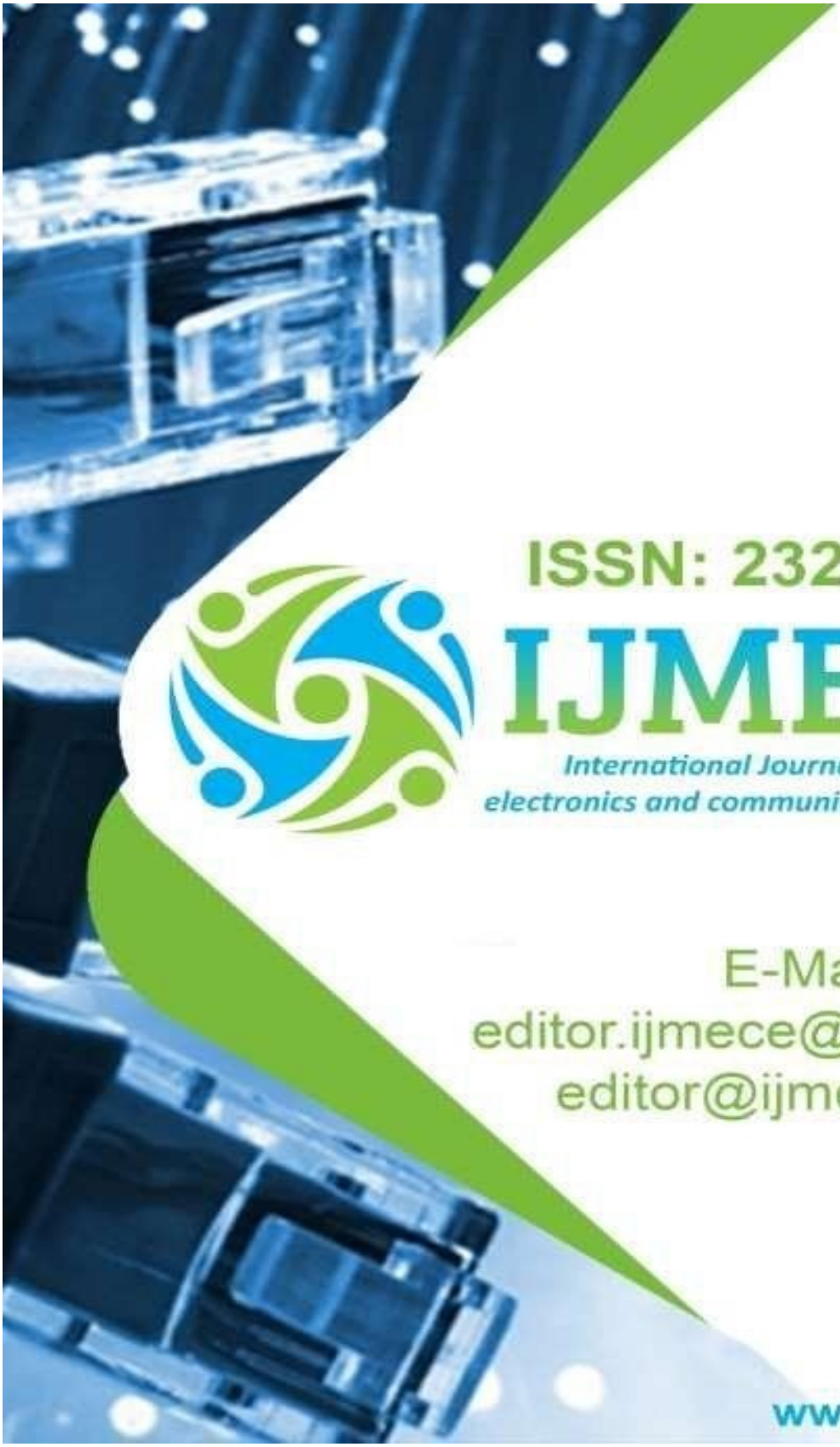


ISSN: 2321-2152

IJMECE

International Journal of modern electronics and communication engineering

E-Mail
editor.ijmece@gmail.com
editor@ijmece.com

www.ijmece.com

ISSN 2321-2152
www.ijmece.com
Vol 12, Issue 4, 2024

FACE MASK DETECTION USING DEEP LEARNING

HASAN SALEEM, MR. MD ASIF

UG Student, Department of Electronics and Computer Engineering, JBIET, India.

Assistant professor, Department of Electronics and Computer Engineering, JBIET, India.

ABSTRACT

In response to the global COVID-19 pandemic, wearing face masks in public spaces has become crucial for minimizing virus transmission. However, enforcing mask mandates in crowded places remains challenging and requires significant manual monitoring. This project proposes an automated face mask detection system using deep learning to address this need. The system leverages Convolutional Neural Networks (CNNs) to detect faces in images or video. This face mask detection system has significant applications in public health, providing an efficient, scalable solution to monitor mask compliance in real-time, reduce human intervention, and enhance public safety across diverse environments such as airports, hospitals, and public transport systems. frames and classify them based on mask usage—either "mask," "no mask," or "improper mask."

INTRODUCTION

Problem definition:With the rise of the COVID-19 pandemic, public health organizations worldwide have emphasized the importance of wearing face masks to prevent the spread of the virus. Masks are an effective barrier, significantly reducing transmission when worn properly in public spaces, especially in crowded or enclosed environments. However, ensuring compliance with mask mandates across large populations presents significant logistical challenges. Relying on manual enforcement is often labor-intensive, costly, and prone to human error.

To address this challenge, automated face mask detection systems powered by deep learning have emerged as a viable solution. Leveraging advanced machine learning techniques and computer vision, these systems can detect whether individuals in a video or image are wearing masks, not wearing them, or wearing them incorrectly. This project focuses on developing an efficient face mask detection system using a Convolutional Neural Network (CNN), a type of deep learning model well-suited for image classification tasks.

The system comprises several key modules: image data collection and preprocessing, face detection, mask classification, and real-time detection with alert capabilities. The model is trained on a diverse dataset of labeled face images, ensuring robust performance in different conditions and for various demographics.

This project's objectives include:

1. Building an accurate mask detection model that can classify images with and without masks, as well as improperly worn masks.
2. Developing a real-time system that integrates seamlessly with video feeds for continuous monitoring.
3. Providing a scalable solution for public safety that can be deployed in places like airports, schools, and hospitals to reduce the need for manual mask enforcement.

By leveraging deep learning and computer vision, this project demonstrates the potential of automated systems in enhancing public health measures, improving safety compliance, and reducing the spread of infectious diseases.

ISSN 2321-2152
www.ijmece.com
Vol 12, Issue 4, 2024

LITERATURE SURVEY

The rapid spread of COVID-19 has brought about an urgent need for reliable methods to enforce mask-wearing in public spaces to curb virus transmission. As a result, researchers and developers have turned to automated face mask detection systems as a scalable solution to monitor mask compliance in real-time, using advancements in deep learning and computer vision. This literature survey examines key research and technologies that contribute to face mask detection systems, covering methods of face detection, image classification using Convolutional Neural Networks (CNNs), and real-time implementation strategies optimized for efficiency and accuracy.

Historically, face detection has relied on classical methods such as Haar Cascades, but with the rise of deep learning, CNNs and models like YOLOv3 and SSD have significantly improved accuracy and robustness in complex environments. Moreover, transfer learning and data augmentation have emerged as valuable techniques, allowing models to generalize better across different lighting, facial orientations, and mask types, while pre-trained models such as MobileNet and ResNet have facilitated real-time deployment on edge devices. Despite these advancements, challenges persist in handling diverse real-world scenarios, ethical considerations, and ensuring privacy in public deployments. This survey highlights both the technical and ethical dimensions of face mask detection research, laying a foundation for developing efficient, effective, and responsible mask detection solutions.

Object detection has played a pivotal role in face mask detection, with models evolving from simpler approaches like Viola-Jones to complex deep learning frameworks like YOLO and Faster R-CNN. Redmon et al. (2016) introduced the YOLO (You Only Look Once) model, which demonstrated impressive speed and accuracy, making it suitable for real-time applications like mask detection. For mask recognition, researchers have modified YOLO to detect and classify masked and unmasked faces within single frames, achieving low latency but often requiring significant computational resources. Faster R-CNN, developed by Ren et al. (2015), has been used as an alternative due to its high detection accuracy, though it is generally slower, limiting its real-time capabilities.

ANALYSIS

I have created a face mask detection system using deep learning. We have added the functionality to detect a face without a mask or with it. It can detect the face mask by showing a green square or red square for a lack of mask in real time. This project's modular structure makes it simple to comprehend and more adaptable. More features can be added without affecting the program's overall functionality. The essential Python packages have been installed, and the code was written using the Visual Studio Code Integrated Development Environment (IDE).

Software Requirement Specification

User requirement

- It should contain camera for image detection.
- The system must be capable of installing new modules.

Software requirement

- 6GHz processor

ISSN 2321-2152
www.ijmece.com
Vol 12, Issue 4, 2024

- 512 MB or more RAM
- kernal version should be 3.0.16 or higher
- support of other basic applications like maps, calender, camera, web connection etc.

Hardware requirements

- Sound cards
- Microphones
- Computer/processor

- Internet connectivity
- Phone should have USB debugging mode for development and testing.

Algorithms and flowcharts

Model: Use a pre-trained deep learning model like YOLO (You Only Look Once) or Haar Cascade Classifier to detect faces in images or video streams.

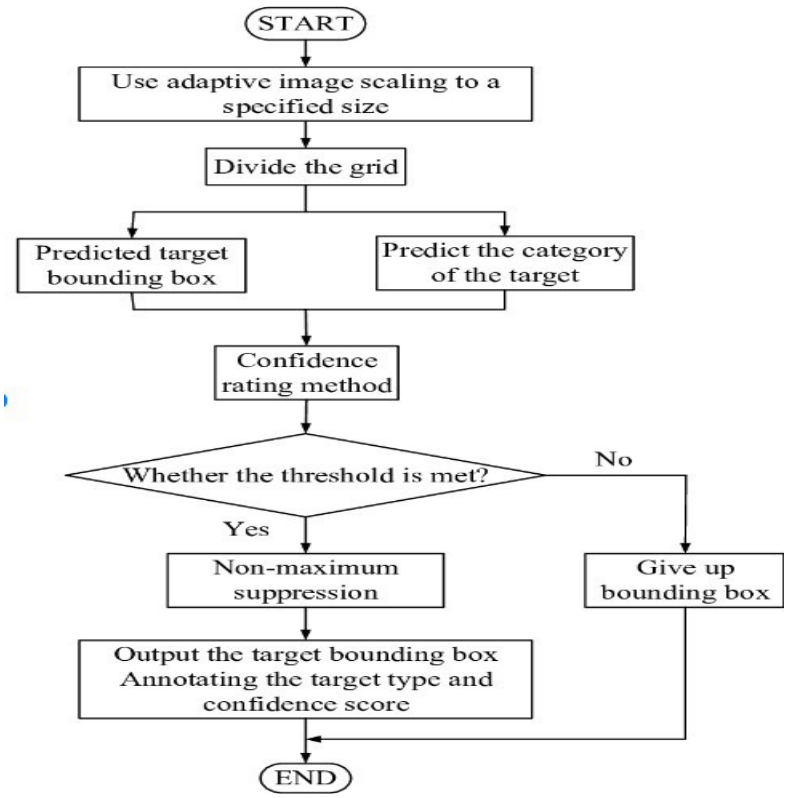


Figure 3.3

DESIGN

The design of the face mask detection system integrates multiple components and methodologies to accurately identify individuals wearing face masks in real-time, addressing the urgent need for compliance with public health measures. Structured around a modular architecture, the system includes several key components: an input module that captures video streams using OpenCV; a face detection module that employs pre-trained deep learning models like YOLO or Haar Cascade to identify faces; a mask classification module utilizing a Convolutional Neural Network (CNN),

such as MobileNetV2, to determine whether individuals are wearing masks correctly, improperly, or not at all; an alert system that triggers notifications for non-compliance; and a data logging and monitoring module that tracks compliance statistics for future analysis. The design incorporates advanced technologies, including OpenCV for image processing, deep learning frameworks like TensorFlow or PyTorch for model training, and edge computing devices for real-time performance. The operational flow consists of capturing and preprocessing video input, detecting faces, classifying mask usage, generating alerts for violations, logging data, and providing an intuitive user interface for monitoring compliance statistics. Key design considerations, such as scalability, robustness, privacy, and user experience, ensure the system is adaptable, effective, and ethically aligned. This comprehensive approach aims to deliver a reliable solution for monitoring mask usage across various environments, thereby contributing to public health safety and compliance. A doctor will be able to dictate his prescription to the patient while talking to his PC running windows

- Modular Architecture
- Input Module
- Face Detection
- Mask Classification
- Real-time Alerts

RESULTS

This chapter tells us about the implementation part of this app. This section deals with the brief introduction about the important functions used to create the face mask detection application. It consists of various source codes used in building this web page. Also lists out the outputs of each section which makes it clear about the different options available to complete the quiz successfully.

EXPLAINATION OF KEY FUNCTIONS

Able to to detect a face mask in real time:

This function is responsible for detection of face masks in real time. This can be used in public safety by officials looking to inforce the law.

METHOD OF IMPLEMENTATION

FORMS

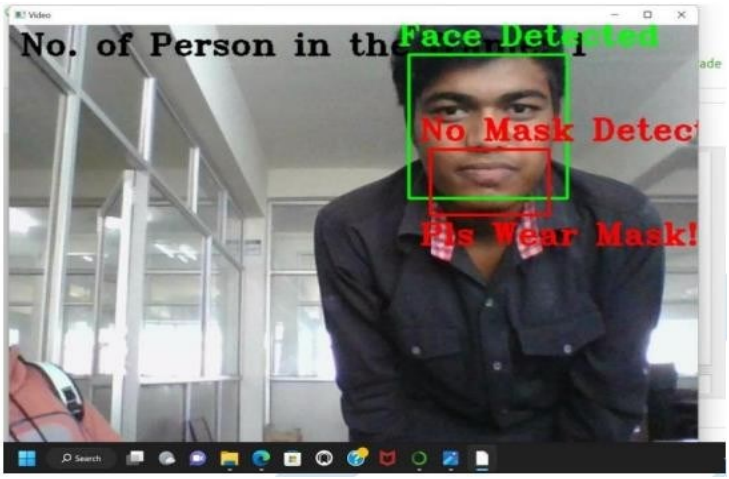
Source code:

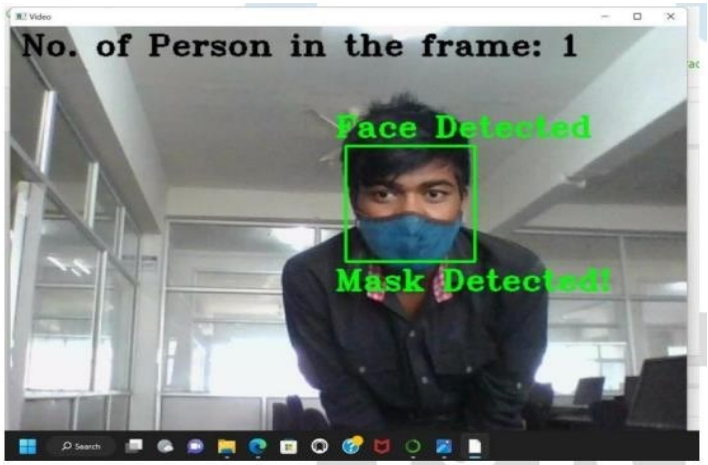
Main app:

```
<?xml version="1.0"?>
<opencv_storage>
<haarcascade_frontalface_default type_id="opencv-haar-classifier">
<size>24 24</size>
<!-- root node -->
```

<feature>
<rects>
<_>8 18 9 6 -1.</_>
<_>8 20 9 2 3.</_></rects>
<tilted>0</tilted></feature>
<threshold>5.7529998011887074e-003</threshold>
<left_val>-0.8746389746665955</left_val>
<right_val>1.1760339736938477</right_val></_></_>
<_>
<!-- tree 4 -->
<_>
<!-- root node -->
<feature>
<rects>
<_>3 5 4 19 -1.</_>
<_>5 5 2 19 2.</_></rects>
<tilted>0</tilted></feature>
<threshold>0.0150140002369881</threshold>
<left_val>-0.7794569730758667</left_val>
<right_val>1.2608419656753540</right_val></_></_>
<_>
<!-- tree 5 -->
<_>
<!-- root node -->
<feature>
<rects>
<_>6 5 12 16 -1.</_>
<_>6 13 12 8 2.</_></rects>
<tilted>0</tilted></feature>
<threshold>0.0993710011243820</threshold>
<left_val>0.5575129985809326</left_val>
<right_val>-1.8743000030517578</right_val></_></_>
<_>
<!-- tree 6 -->
<_>
<!-- root node -->
<feature>
<rects>
<_>5 8 12 6 -1.</_>

ISSN 2321-2152
www.ijmece.com
Vol 12, Issue 4, 2024





TESTING AND VALIDATION

Testing is the process of evaluating a system or its component(s) with the intent to find whether it satisfies the specified requirements or not. Testing is executing a system in order to identify any gaps, errors, or missing requirements in contrary to the actual requirements. According to ANSI/IEEE 1059 standard, Testing can be defined as - A process of analysing a software item to detect the differences between existing and required conditions (that is defects/errors/bugs) and to evaluate the features of the software item.

Who does Testing?

It depends on the process and the associated stakeholders of the project(s). In the IT industry, large companies have a team with responsibilities to evaluate the developed software in context of the given requirements. Moreover, developers also conduct testing which is called Unit Testing. In most cases, the following professionals are involved in testing a system within their respective capacities:

CONCLUSION

In conclusion, the face mask detection system serves as a vital tool in promoting public health and safety by ensuring compliance with mask-wearing regulations in various environments. Through the integration of advanced technologies such as deep learning and computer vision, the system effectively identifies individuals who are wearing masks, not wearing masks, or improperly wearing them in real time. Its modular design allows for scalability and flexibility, enabling future enhancements to adapt to evolving health guidelines. By providing timely alerts and comprehensive data logging, the system aids administrators in monitoring compliance, ultimately contributing to the reduction of transmission risks in public spaces. The successful implementation of this project highlights the significant role of technology in addressing contemporary health challenges, paving the way for more innovative solutions in the future.

Future Scope:

We intend to continue managing the project and improving it in response to user feedback. Here is our future to-do list:

- Add temperature detection and health status monitoring.
- Expand to detect other PPE, like face shields and goggles.
- Enhance accuracy in challenging conditions (lighting, angles).
- Integrate with access control systems for secure entry.
- Implement cloud-based analytics for centralized data insights.

The above-mentioned points are the enhancements that can be done to increase the applicability and usage of this project.

REFERENCES:

[1] 1.World Health Organization et al. Coronavirus disease 2019 (covid-19): situation report, 96. 2020. - Google Search. (n.d.). https://www.who.int/docs/default-source/coronaviruse/situation- reports/20200816-covid-19-sitrep-209.pdf?sfvrsn=5dde1ca2_2.

[2] 2.Social distancing, surveillance, and stronger health systems as keys to controlling COVID-19 Pandemic, PAHO Director says - PAHO/WHO | Pan American Health Organization. (n.d.). https://www.paho.org/en/news/2-6-2020-social-distancing-surveillanceand-stronger-health- systems-keys-controlling-covid-19.

[3] 3.Garcia Godoy L.R., et al. Facial protection for healthcare workers during pandemics: a scoping review, BMJ. Glob. Heal. 2020;5(5) doi: 10.1136/bmjgh-2020-002553. [PMC free article] [PubMed] [CrossRef] [Google Scholar] © 2023 IJRTI | Volume 8, Issue 2 | ISSN: 2456-3315 IJRTI2302047 International Journal for Research Trends and Innovation (www.ijrti.org) 287

[4] 4. Eikenberry S.E., et al. To mask or not to mask: Modeling the potential for face mask use by the general public to curtail the COVID-19 pandemic. Infect. Dis. Model. 2020;5:293–308. doi: 10.1016/j.idm.2020.04.001. [PMC free article] [PubMed] [CrossRef] [Google Scholar]

[5] 5. Wearing surgical masks in public could help slow COVID-19 pandemic's advance: Masks may limit the

spread diseases including influenza, rhinoviruses and coronaviruses -- ScienceDaily. (n.d.). https://www.sciencedaily.com/releases/2020/04/200403132345.htm .

[6] 6. Nanni L., Ghidoni S., Brahnam S. Handcrafted vs. non-handcrafted features for computer vision classification. Pattern Recogn. 2017;71:158–172. doi: 10.1016/j.patcog.2017.05.025. [CrossRef] [Google Scholar]

[7] 7. Y. Jia et al., Caffe: Convolutional architecture for fast feature embedding, in: MM 2014 - Proceedings of the 2014 ACM Conference on Multimedia, 2014, doi: 10.1145/2647868.2654889.

[8] 8. P. Sermanet, D. Eigen, X. Zhang, M. Mathieu, R. Fergus, and Y. Lecun, OverFeat: Integrated Recognition, Localization and Detection using Convolutional Networks, 2014.

[9] 9. Erhan D., Szegedy C., Toshev A., Anguelov D. Proceedings of the IEEE conference on computer vision and pattern recognition. 2014. Scalable Object Detection using Deep Neural Networks; pp. 2147–2154. [CrossRef] [Google Scholar]