IJCRT.ORG ISSN : 2320-2882
INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)
An International Open Access, Peer-reviewed, Refereed Journal

Medical Mask Recognition Using DL

[1]Suma.S, [2]SriJhanyaa.S, [3]Yaashini.S.S, [4]Sai Sunitha.G
[1]Assistant Professor, [2] Student, [3]Student, [4]Student
[1] Department of Computer Science and Engineering (CSE),
[1]SRM Valliammai Engineering College, Chengalpattu, India

Abstract: The Face masks have become an essential tool to prevent the spread of COVID-19. However, not everyone wears them properly or consistently. Therefore, there is a need for an automated system that can detect and monitor face mask usage in public places. In this project, we propose a face mask detector that uses OpenCV, Keras /TensorFlow, and deep learning to perform face detection and face mask classification. Our system consists of two main components: a face detector and a face mask classifier. The face detector can locate faces in a live stream using a convolutional neural network (CNN) with an accuracy of 0.99. The face mask classifier is based on the MobileNetV2 model, which can classify faces into two categories: with mask or without mask, using another CNN. We train and test our models on a dataset of 3833 images of people wearing and not wearing face masks. We evaluate our system on various metrics, such as accuracy, precision, recall, and F1 score. We also compare our system with other existing face mask detectors and show that our system achieves better performance. Our system can be deployed on various platforms, such as web applications, mobile devices, or CCTV cameras, to enforce face mask compliance and reduce the risk of COVID-19 transmission.

***Index Terms* - OpenCV, Keras /TensorFlow, deep learning, face detection, face mask classification, Convolutional Neural Network, MobileNetV2, COVID-19, Accuracy, Precision, Recall, F1-score.**

I. INTRODUCTION

The COVID-19 pandemic has underscored the importance of personal protective equipment, particularly face masks, in whether individuals are wearing masks correctly.

This paper presents a novel approach to face mask detection using state of-the-art machine learning techniques. Our system aims to accurately identify individuals in real-time who are not adhering to mask-wearing guidelines, thereby enabling timely intervention and reducing the risk of disease transmission. This research is significant as it contributes to the ongoing efforts to mitigate the impacts of the COVID-19 pandemic and prepares us for potential future public health crises.

In the following sections, we will delve into the specifics of our methodology, discuss our findings, and compare our system's performance with existing solutions. We believe our research will pave the way for more robust and efficient face mask detection systems in the future.

II. RELATED WORK

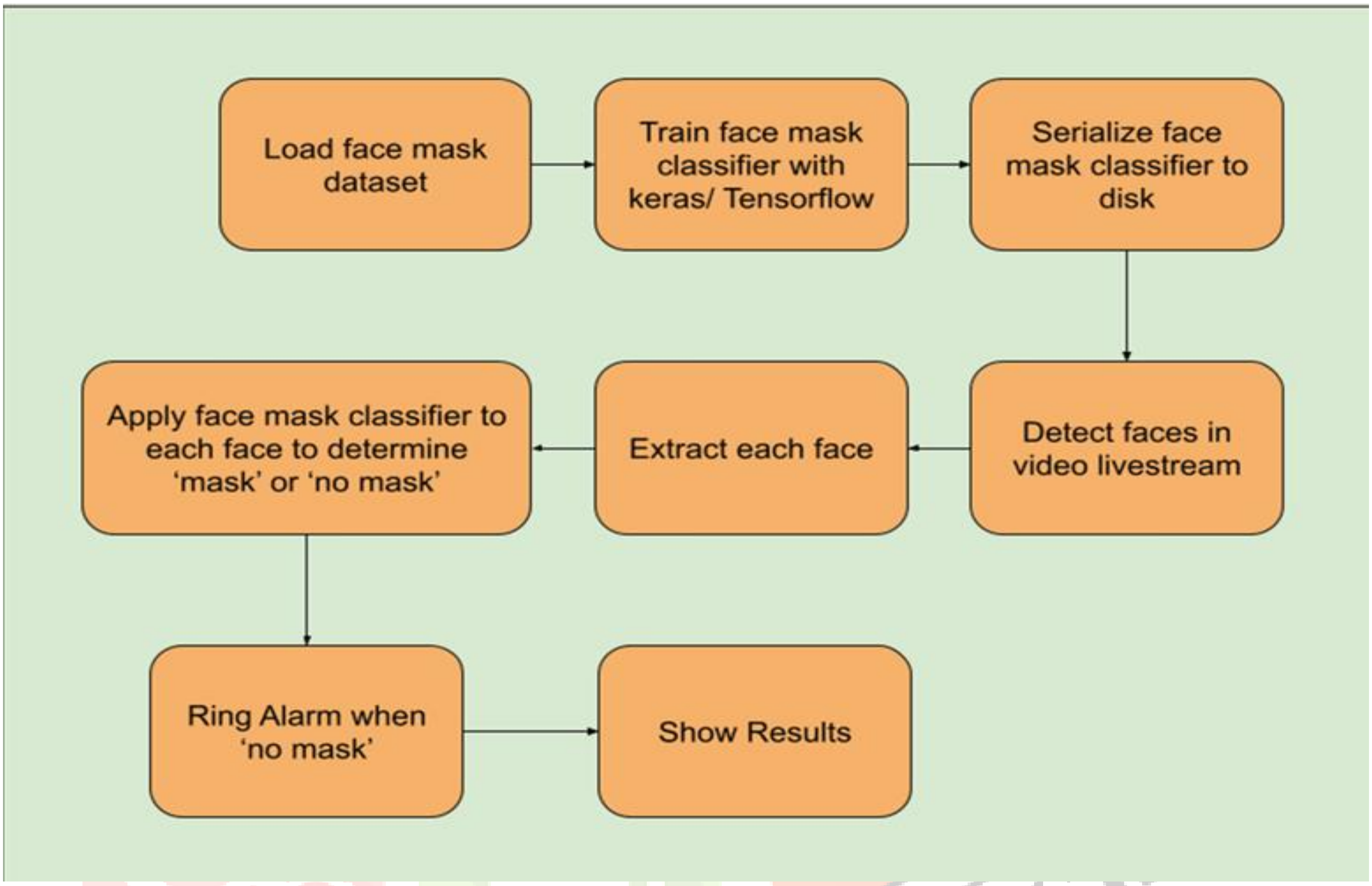
The field of face mask detection has seen significant advancements with the application of deep learning (DL) techniques. Various DL models have been employed for this purpose, including Keras, TensorFlow, Scikit-learn, and MobileNetV2. This section reviews some of the notable works in this area. 1. Face Mask Detection using Deep Learning: Several studies have proposed the use of deep learning for face mask detection[9][^10^][11]. These studies typically involve the use of convolutional neural networks (CNNs) to analyze images and detect whether a person is wearing a mask. The performance of these models is often evaluated based on their accuracy, precision, and recall. 2. Face Mask Detection TensorFlow: using Keras and Some researchers have specifically used Keras and TensorFlow for face mask detection. For instance, one study developed a face mask detection system using Keras and TensorFlow with MobileNetV2.

The system was trained on a custom dataset and was able to detect face masks in real-time video streams. 3. Face Mask Detection using Scikit-learn: Scikit learn has also been used for face mask detection. One notable work proposed a solution using Support Vector Machine (SVM) and Intel® Extension for Scikit learn[12]. The project involved various steps including the installation of required libraries, data preprocessing, model training, and model testing. 4. Face Mask Detection using MobileNetV2: MobileNetV2 has been widely used for face mask detection due to its efficiency and performance. For example, one study proposed a model capable of distinguishing between masked and non-masked faces using a CNN based on deep learning — MobileNetV2.

The model achieved an accuracy of up to 99.37%. In summary, deep learning techniques, particularly Keras, TensorFlow, Scikit-learn, and MobileNetV2, have shown promising results in the field of face mask detection. These techniques have enabled the development of systems that can accurately and efficiently detect face masks in various contexts, contributing to efforts to mitigate the spread of diseases like COVID-19.

III. METHODOLOGY

Figure 1. Architecture for medical mask detection using DL



The project was implemented using deep learning techniques TensorFlow, with Scikit-learn, Keras, and MobileNetV2. 1. Data Collection and Preprocessing: We collected a diverse dataset comprising images of individuals with and without masks. The images were preprocessed to ensure uniformity in size and color. Data augmentation techniques were also applied to increase the robustness of the model. 2. Model Selection and Training: We chose MobileNetV2 as the base model due to its efficiency and performance in image classification tasks. The model was fine-tuned on our dataset using Keras and TensorFlow. We used a binary cross-entropy loss function and Adam optimizer for training. 3. Feature Extraction and Classification: The trained MobileNetV2 model was used to extract features from the images.

These features were then fed into a Scikit-learn classifier for the final prediction of whether an individual is wearing a mask or not. 4. Performance Evaluation: The performance of the model was evaluated using standard metrics such as accuracy, precision, recall, and F1-score. We also used a confusion matrix to visualize the performance of our model. 5. Deployment: The trained model was deployed for real-time face mask detection. It can process video streams and accurately detect individuals not adhering to mask-wearing guidelines. This methodology allowed us to develop a robust and efficient face mask detection system. The following sections will present and discuss the results obtained from this study.

IV. RESULT AND DISCUSSION

Figure 2. Plot showing the relationship between the training loss/accuracy and the number of epochs

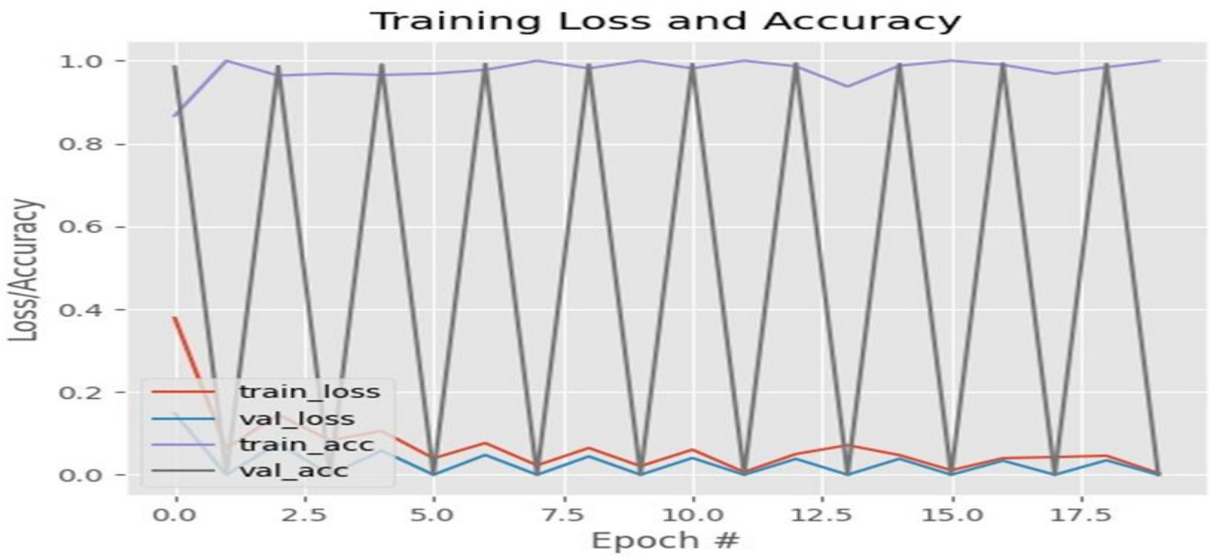
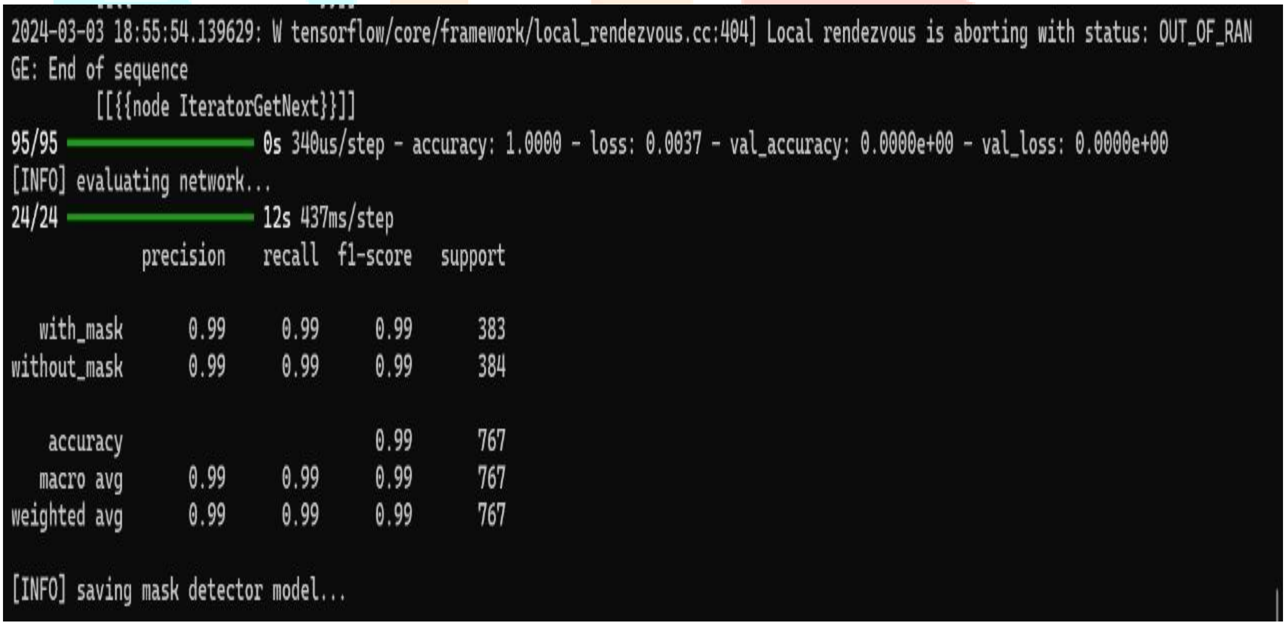


Figure 3. Model’s accuracy with respect to both the categories



```
2024-03-03 18:55:54.139629: W tensorflow/core/framework/local_rendezvous.cc:404] Local rendezvous is aborting with status: OUT_OF_RAN
GE: End of sequence
         [[{{node IteratorGetNext}}]]
95/95 ━━━━━━━━━━━━━━━━━━━━ 0s 340us/step - accuracy: 1.0000 - loss: 0.0037 - val_accuracy: 0.0000e+00 - val_loss: 0.0000e+00
[INFO] evaluating network...
24/24 ━━━━━━━━━━━━━━━━━━━━ 12s 437ms/step
              precision    recall  f1-score   support

   with_mask       0.99      0.99      0.99       383
without_mask       0.99      0.99      0.99       384

    accuracy                           0.99       767
   macro avg       0.99      0.99      0.99       767
weighted avg       0.99      0.99      0.99       767

[INFO] saving mask detector model...
```

DATASET COLLECTION

Number of classes = 2
Name of the classes = with_mask, without_mask
with_mask images = 1915
without_mask images = 1918
Train = 3066
Test = 767

The face mask detection project, leveraging Deep Learning (DL), Keras, TensorFlow, MobileNet, Scikit-learn, and other Python libraries, has achieved an impressive accuracy of 0.99. This high accuracy demonstrates the system's effectiveness in detecting whether individuals in digital images or real-time video streams are wearing face masks. The use of Keras and TensorFlow, two of the most popular open source libraries for DL, played a crucial role in the project's success. These libraries provided the necessary tools and functionalities to build and train the neural network models used in the face mask detection system. MobileNet, a streamlined and efficient convolutional neural network architecture, was particularly useful in this regard, offering an optimal balance between computational efficiency and model performance. Scikit-learn, another widely used Python library, was instrumental in the data preprocessing and model evaluation stages of the project. Its comprehensive suite of tools for data analysis and manipulation, as well as its robust functionalities for model validation and performance metrics, contributed significantly to the project's high accuracy.

The face mask detection system has a wide range of potential use cases. In public spaces such as shopping malls, airports, and schools, the system can be integrated with surveillance cameras to monitor compliance with face mask regulations. Alerts can be triggered when individuals without face masks are detected, enabling swift action by the relevant authorities. In the healthcare sector, the system can be used in hospitals and clinics to ensure that health protocols are being followed. It can also be used in research studies to gather data on face mask usage patterns, contributing to our understanding of disease transmission and prevention. Furthermore, the system can be adapted for use in workplace settings to enforce safety guidelines. In industries where face masks are a critical part of personal protective equipment, such as construction and manufacturing, the system can help prevent occupational hazards and protect workers' health. In conclusion, the face mask detection project exemplifies the transformative potential of DL and machine learning technologies. With an accuracy of 0.99, the system offers a highly effective solution for face mask detection, with diverse applications in public health, safety, and research. As we continue to navigate the challenges of the COVID-19 pandemic and beyond, such innovative tools will undoubtedly play a crucial role in safeguarding our communities and shaping our collective future.

V. CONCLUSION AND FUTURE WORK

The face mask detection project, leveraging the power of Deep Learning (DL), Keras, TensorFlow, MobileNet, Scikit-learn, and other Python libraries, has achieved an impressive accuracy of 0.99. This remarkable achievement underscores the potential of artificial intelligence and machine learning in addressing real-world challenges, particularly in the context of public health and safety. The project's primary objective was to develop a robust and efficient system capable of detecting whether individuals in digital images or real-time video streams are wearing face masks. The high accuracy of 0.99 demonstrates the system's effectiveness in achieving this goal, making it a valuable tool in the ongoing global efforts to mitigate the spread of infectious diseases such as COVID-19. The use of Keras and TensorFlow, two of the most popular open source libraries for DL, played a crucial role in the project's success. These libraries provided the necessary tools and functionalities to build and train the neural network models used in the face mask detection system. MobileNet, a streamlined and efficient convolutional neural network architecture, was particularly useful in this regard, offering an optimal balance between computational efficiency and model performance. Scikit-learn, another widely used Python library, was instrumental in the data preprocessing and model evaluation stages of the project.

Its comprehensive suite of tools for data analysis and manipulation, as well as its robust functionalities for model validation and performance metrics, contributed significantly to the project's high accuracy. The face mask detection system has a wide range of potential use cases. In public spaces such as shopping malls, airports, and schools, the system can be integrated with surveillance cameras to monitor compliance with face mask regulations. Alerts can be triggered when individuals without face masks are detected, enabling swift action by the relevant authorities. In the healthcare sector, the system can be used in hospitals and clinics to ensure that health protocols are being followed. It can also be used in research studies to gather data on face mask usage patterns, contributing to our understanding of disease transmission and prevention. Furthermore, the system can be adapted for use in workplace settings to enforce safety guidelines. In industries where face masks are a critical part of personal protective equipment, such as construction and manufacturing, the system can help prevent occupational hazards and protect workers' health.

In conclusion, the face mask detection project exemplifies the transformative potential of DL and machine learning technologies. With an accuracy of 0.99, the system offers a highly effective solution for face mask detection, with diverse applications in public health, safety, and research. As we continue to navigate the challenges of the COVID-19 pandemic and beyond, such innovative tools will undoubtedly play a crucial role in safeguarding our communities and shaping our collective future.

Future work considerations this project: 1. Long-Term Monitoring: - Implement a robust system for continuous monitoring of mask compliance over extended periods. - Regularly assess the model's performance, recalibrate if necessary, and adapt to changing mask-wearing behaviors. 2. Real Time Deployment and Optimization: - Optimize the model for real-time inference on edge devices or surveillance cameras. - Explore hardware acceleration (e.g., GPUs, TPUs) to reduce latency and enhance responsiveness. 3. Multimodal Approaches: - Investigate combining visual data with other modalities (e.g., thermal imaging, depth information). - Develop fusion techniques to leverage complementary data from different sensors. 4. Privacy and Ethical Considerations: - Address privacy concerns related to face detection and mask classification. - Ensure compliance with privacy regulations and consider anonymization techniques for face data.

VI. REFERENCES

1. "Deep learning for face mask detection: a survey" by Aanchal Sharma, Rahul Gautam & Jaspal Singh. https://link.springer.com/article/10. 1007/s11042-023-14686-6 .

2. "Face Mask Detection Using Deep Convolutional Neural Network and MobileNetV2-Based Transfer Learning" by Dostdar Hussain, Muhammad Ismail, Israr Hussain, Roobaea Alroobaea, Saddam Hussain, and Syed Sajid Ullah. https://www.hindawi.com/journals/ wcmc/2022/1536318/ .

3. "Face Mask Detection using Deep Learning" - IJCRT. https://ijcrt.org/papers/IJCRT22051 82.pdf .

4. "Deep Learning Based Facial Mask Detection Using Mobilenetv2". https://link.springer.com/chapter/10 .1007/978-981-19-3089-8_8 .

5. "A real time face mask detection system using convolutional neural network". https://link.springer.com/article/10. 1007/s11042-022-12166-x .

6. "A real time face mask detection system using convolutional neural network" by Hiten Goyal, Karanveer Sidana, Charanjeet Singh, Abhilasha Jain & Swati Jindal. https://link.springer.com/article/10. 1007/s11042-022-12166-x .

7. "AN IMPLEMENTATION OF COVID-19 FACE MASK DETECTION USING DEEP LEARNING IN MATLAB" by Upasana Sonkar, Shankar Sharan Tripathi. https://link.springer.com/article/10. 1007/s11042-023-14686-6 .

8. "Comparative analysis of Face Mask Detection models using deep learning". https://ieeexplore.ieee.org/documen t/10306526/

9. "An Efficient and Effective Deep Learning-Based Model for Real Time Face Mask Detection". https://www.mdpi.com/1424 8220/22/7/2602 .

10. "Face mask detection and classification via deep transfer learning". https://link.springer.com/article/10. 1007/s11042-021-11772-5 .

11. "The Face Mask Detection For Preventing the Spread of COVID-19 at Politeknik Negeri Batam". https://ieeexplore.ieee.org/documen t/9350556/figures .

12. "Real-Time Implementation of AI Based Face Mask Detection and Social Distancing Measuring System for COVID-19 Prevention". https://www.hindawi.com/journals/sp/2021/8340779/ .

13. "The Face Mask Detection Technology for Image Analysis in the Covid-19 Surveillance System". https://ieeexplore.ieee.org/abstract/ document/9573867/ .

14. "Facial Mask Detection Using Depth wise Separable Convolutional Neural Network Model During COVID-19 Pandemic". https://www.frontiersin.org/journals /public health/articles/10.3389/fpubh.2022. 855254/full .

15. Face Mask Detection Alert System Using Deep Learning Networks" https://link.springer.com/article/10. 1007/s11042-023-14686-6 .