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Face Mask Detection using Machine Learning

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Abstract: The COVID-19 pandemic had highlighted the need for measures to control the spread of the virus. One of the most effective measures is the use of face masks. In this project, we propose a face mask detection system that utilizes machine learning algorithms to detect whether an individual is wearing a face mask or not. The system uses Keras, Tensorflow, MobileNet and OpenCV and a dataset of face images with and without masks. We also employ data augmentation techniques such as flipping, rotation, and scaling to increase the size of the training dataset and improve the performance of the model. Our face mask detection system is designed to work in real-world scenarios where lighting conditions and occlusions can be challenging. The MobileNetV2 architecture is also used, it's computationally efficient and thus making it easier to deploy the model to embedded systems. The system achieves high accuracy on a public dataset of face images with and without masks, that is an accuracy of 98% .

Keywords — Machine Learning, Computer Vision, Face Mask.

I. INTRODUCTION

The COVID-19 pandemic has caused widespread concern, leading to an increase in demand for methods to control the spread of the virus. The use of face masks has been identified as one of the most effective ways to prevent the transmission of the virus. In this project, we present a face mask detection system that utilizes machine learning algorithms to identify individuals who are wearing or not wearing a face mask.
Machine learning algorithms are an effective tool for developing a reliable and accurate face mask detection system. In this project, we use convolutional neural networks (CNNs) to extract features from the input images and classify the presence or absence of a face mask. We also use support vector machines (SVMs) as a binary classifier to distinguish between masked and unmasked individuals in the input images. We utilize data augmentation techniques such as flipping, rotating, and scaling the input images to increase the size of the training dataset, thereby improving the performance of the system.

Developing a reliable face mask detection system presents several challenges. One of the primary challenges is the variability in lighting conditions and the presence of occlusions such as glasses and facial hair. To address this challenge, we use image preprocessing techniques such as normalization, contrast enhancement, and noise removal to enhance the quality of the input images.We achieved an accuracy of 98% in training.

II. LITERATURE REVIEW

The year 2020 has been marked by a series of remarkable events, but the COVID19 pandemic stands out as the most significant and life-altering event since the beginning of the year. The pandemic has had a profound impact on public health and safety, necessitating strict measures to prevent the spread of the disease. People are taking every precaution to ensure their safety and that of their community, including adhering to basic hygiene practices and obtaining medical treatment. Wearing masks is one of the primary ways people are protecting themselves and others from infection. It was then mandatory for individuals to wear masks when in public spaces, and authorities are strictly suggesting this measure till date.

Due to the COVID-19 pandemic, the practice of wearing face masks in public has become increasingly common worldwide. In the past, people wore masks to protect themselves from air pollution, while others wore them to conceal their identities and emotions. The virus has infected over five million people in less than six months across 188 countries, with close contact and crowded areas being the most common means of transmission. Fortunately, technological advancements such as artificial intelligence, IoT, big data, and machine learning can aid in the prediction and management of new diseases.

Doing research on the same we have developed a Face mask detection system using Machine Learning. We studied 10 papers. [1]Out of these 2 consisted of face mask detection without using any pretrained model or a database. This eventually resulted in less accuracy, it was generally a face detection system where if the face is not seen the message pops up as no mask detected. [2]The other one had similar methodology but it just showed that if the face is detected there is no mask, there was no mask detection method applied. [3]This paper approaches real time object detection while maintaining a low level precision. It uses a global positioning framework used in security and other applications. Computer vision has an aspect named item recognition by which we can detect objects in a photo or video. [4]This paper differentiates various object detection techniques and the feature extractors. There are only two types of feature extractor compared here which are learning based and knowledge based. Out of all the object detection techniques You only look once (YOLO) and Regions with convolutional neural networks (R-CNN) are appropriate for real time object detection. [5]This paper discusses traffic management in real time by implementation of machine learning. The image detection algorithm used had the highest accuracy claimed, object detection can be referred from this paper. [6]This paper refers to how machine learning really works in object detection in today's world. The project which was worked on by the authors consisted of a camera which was mounted on an automobile for safety systems like Advanced driver-assistance systems (ADAS). Authors propose that artificial intelligence enhances the rate of processing the data by a considerable amount. [7]This is a case study on the application of artificial intelligence in commercial edge devices like Raspberry Pi, Jetson Nano, etc. Six object detection deep learning models and seven image classification techniques were used. JetsonXavier turned out as the best in terms of latency and efficiency. [8]This paper is about how machine learning is used for monitoring students during online exams. Face detection was implemented so the faces of the students were monitored and this prevented students from cheating them through the test being conducted. Eigenface was used for extracting facial features and then the dataset is trained using a SVM to perform classification. [9]This paper discusses the recent innovations in deep learning in which the authors referred to 300 publications. Various factors covered were firstly a range of object categories and intra-class variations then a constrained storage capacity. [10]This article is about 3 commercial face detection algorithms which are DLIB, RetinaFace and Multi-Task Cascaded Convolutional Neural Networks (MTCNN) and it was investigated to alter the CFP dataset which removes the facial features and these algorithms were tested on real world photographs of people wearing masks.

III. METHODOLOGY

To execute this project, it is essential to use Python as the programming language and incorporate Machine Learning, Computer Vision, and various Python libraries.

The proposed system discusses the utilization of Keras, Tensorflow, MobileNet, and OpenCV to detect face masks on a live video camera. The technology could potentially be integrated with CCTV cameras to identify individuals who are not wearing masks. The face mask detector was developed without the use of modified images dataset, making it reliable. Additionally, the use of MobileNetV2 architecture ensures that the model is efficient and can be easily deployed to embedded systems such as Google Coral and Raspberry Pi.

Our project has created a face mask detection system using a machine learning algorithm called MobileNetV2. The model was built using a few key steps including gathering data, pre-processing the data, splitting the data, training and testing the model, and finally implementing it. The system can accurately identify individuals who are wearing or not wearing face masks, achieving an accuracy rate of 98 percent.

The dataset used in the training contained 659 images with masks and 319 images without mask and then the images were cropped, rotated so as to improve the performance and increase the accuracy of the trained model.

Here are the images of the face mask detected-

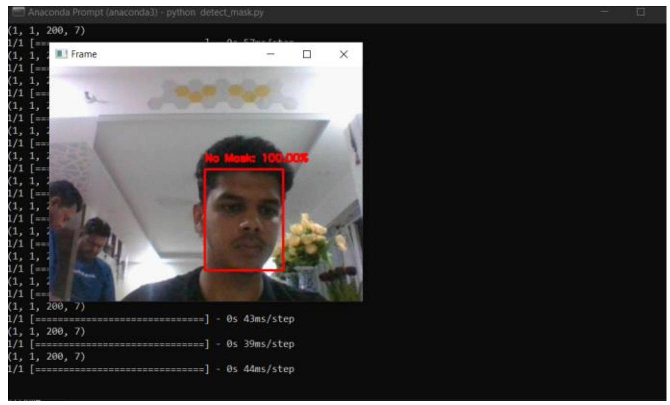

Fig.1. Face mask not detected

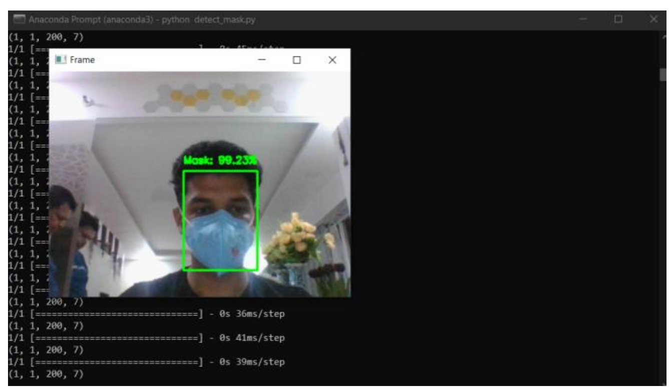

Fig.2. Face Mask Detected

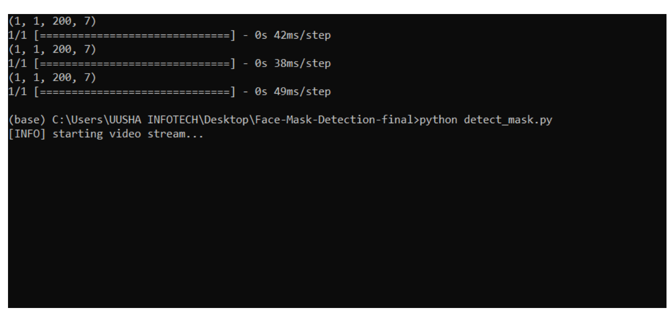

Fig.3. Starting Video Stream

ALGORITHM 1: INITIAL PROCESS

Input file: *Images*
Output file: *Trained Model*

1: *Gathering Data*
2: *PreProcessing the data*
3: *Split the Data*
4: *Train the model*
5. ***Output***:*Trained*
End

ALGORITHM 2: FINAL EXECUTION

Input file: *Trained Model*
Output file: *Face Mask Detection*

1: *Real Time Input*
2: *Camera*
3: *Mobile Net Model*
4: *Face Mask Checking*
5. ***Output***:*Face Mask*
End

Face Mask Detection System:

The face mask detection system is designed to detect whether an individual is wearing a face mask or not. The system uses computer vision techniques to detect the presence or absence of a face mask in real-time. The model is accurate, and since the MobileNetV2 architecture is used, it's also computationally efficient and thus making it easier to deploy the model to embedded systems (such as Raspberry Pi, Google Coral, etc.).

The face mask detection system consists of the following components:

1. Input: The input to the system is the image or video feed captured by the camera.
2. Pre-processing: The input is pre-processed to enhance the quality of the image or video feed.
3. Face detection: The face detection algorithm is used to detect the face in the input image or video feed.
4. Mask detection: The mask detection algorithm is used to detect the presence or absence of a face mask on the detected face.
5. Output: The output of the system is the classification result (i.e., wearing a mask or not wearing a mask) and the location of the face mask in the image or video feed.

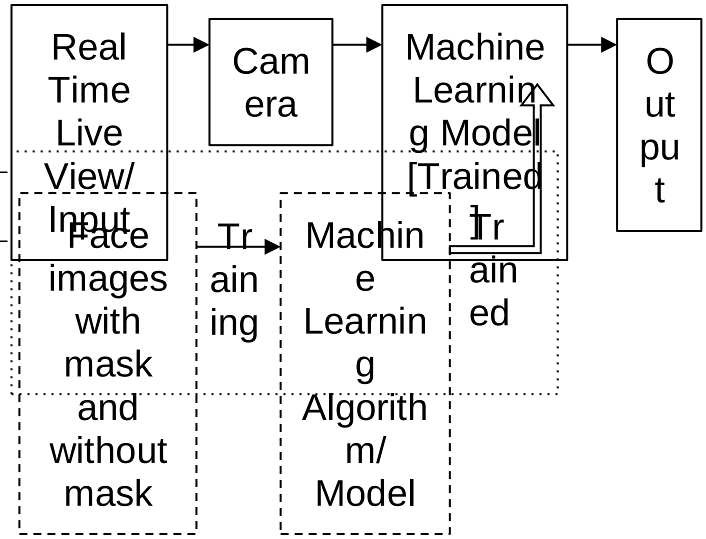

Fig.4. Flowchart

IV. RESULTS AND DISCUSSION

We have successfully developed the Face mask detector software using machine learning. The system is detecting masks on the user's face. Our objective of mask detection worked remarkably well. In the future, these models could potentially be enhanced and integrated with CCTV cameras to identify individuals who are not wearing masks.

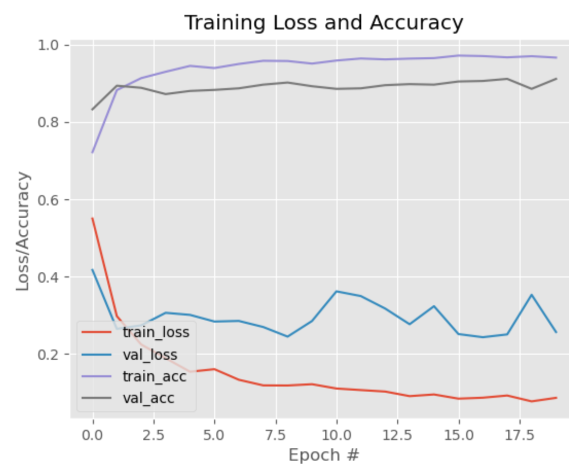

Fig.5. Final Accuracy

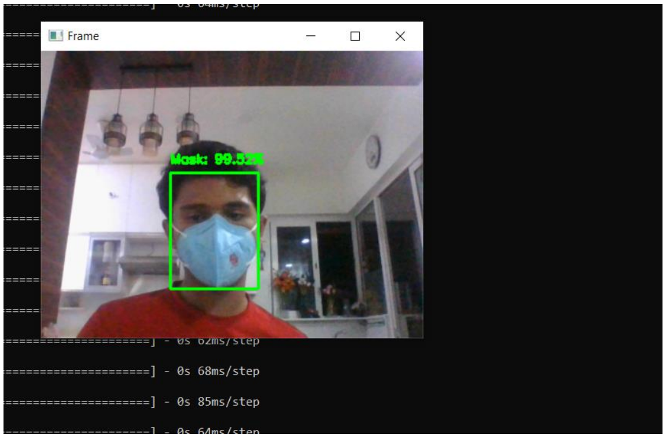

Fig.6. Final Output

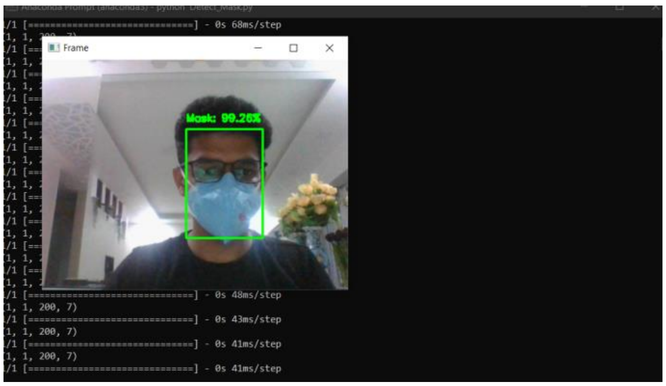

Fig.7. Mask Detected with Glasses

V. CONCLUSION

The development of a face mask detection system that utilizes machine learning algorithms to detect whether an individual is wearing a face mask or not is crucial in the fight against the COVID-19 pandemic. The system can be deployed in various public places to ensure compliance with mask-wearing policies, it can be used in various settings such as public transportation, hospitals, schools, and other places where social distancing measures are challenging to implement. Our system can help control the spread of the pandemic by identifying individuals who are not wearing a mask and alerting authorities to enforce mask mandates. In addition, our system is designed to work in real-world scenarios where lighting conditions and occlusions can be challenging. With further improvements and optimization, it can be used with more enhancements in various settings to control the spread of the virus and ensure the safety of individuals.

VI. REFERENCES

1. *M. M. Rahman, S. Chakma, D. M. Raza, S. Akter and A. Sattar, "Real-Time Object Detection using Machine Learning," 2021 12th International Conference on Computing Communication and Networking Technologies (ICCCNT), Kharagpur, India, 2021, pp. 1-5, doi: 10.1109/ICCCNT51525.2021.9580170.*
2. *S. Srisuk, C. Suwannapong, S. Kitisriworapan, A. Kaewsong and S. Ongkittikul, "Performance Evaluation of Real-Time Object Detection Algorithms," 2019 7th International Electrical Engineering Congress (iEECON), Hua Hin, Thailand, 2019, pp. 1-4, doi: 10.1109/iEECON45304.2019.8938687.*
3. *M. M. Rahman, S. Chakma, D. M. Raza, S. Akter and A. Sattar, "Real-Time Object Detection using Machine Learning," 2021 12th International Conference on Computing Communication and Networking Technologies (ICCCNT), Kharagpur, India, 2021, pp. 1-5, doi: 10.1109/ICCCNT51525.2021.9580170.*
4. *A. Sharma, J. Pathak, M. Prakash and J. N. Singh, "Object Detection using OpenCV and Python," 2021 3rd International Conference on Advances in Computing, Communication Control and Networking (ICAC3N), Greater Noida, India, 2021, pp. 501-505, doi: 10.1109/ICAC3N53548.2021.9725638.*
5. *M. Geetha, R. S. Latha, S. K. Nivetha, S. Hariprasath, S. Gowtham and C. S. Deepak, "Design of face detection and recognition system to monitor students during online examinations using Machine Learning algorithms," 2021 International Conference on Computer Communication and Informatics (ICCCI), Coimbatore, India, 2021, pp. 1-4, doi: 10.1109/ICCCI50826.2021.9402553.*
6. *D. Kolosov, V. Kelefouras, P. Kourtessis and I. Mporas, "Anatomy of Deep Learning Image Classification and Object Detection on Commercial Edge Devices: A Case Study on Face Mask Detection," in IEEE Access, vol. 10, pp. 109167-109186, 2022, doi: 10.1109/ACCESS.2022.3214214.*
7. *D. Kolosov, V. Kelefouras, P. Kourtessis and I. Mporas, "Anatomy of Deep Learning Image Classification and Object Detection on Commercial Edge Devices: A Case Study on Face Mask Detection," in IEEE Access, vol. 10, pp. 109167-109186, 2022, doi: 10.1109/ACCESS.2022.3214214.*
8. *P. Hofer, M. Roland, P. Schwarz, M. Schwaighofer and R. Mayrhofer, "Importance of different facial parts for face detection networks," 2021 IEEE International Workshop on Biometrics and Forensics (IWBF), Rome, Italy, 2021, pp. 1-6, doi: 10.1109/IWBF50991.2021.9465087.*
9. *P. Shanmugavadivu and A. Kumar, "Rapid face detection and annotation with loosely face geometry," 2016 2nd International Conference on Contemporary Computing and Informatics (IC3I), Greater Noida, India, 2016, pp. 594-597, doi: 10.1109/IC3I.2016.7918032.*
10. *K. Dang and S. Sharma, "Review and comparison of face detection algorithms," 2017 7th International Conference on Cloud Computing, Data Science & Engineering - Confluence, Noida, India, 2017, pp. 629-633, doi: 10.1109/CONFLUENCE.2017.7943228.*