# Real-time Face Mask Detection Using Machine Learning (Comparison of all the models)


## Group - 13

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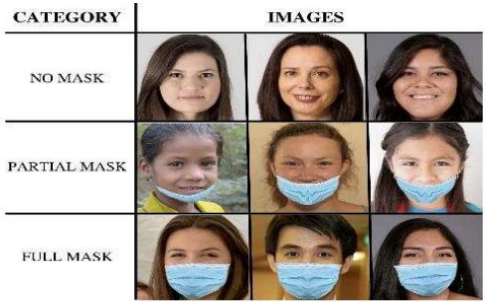
# ABSTRACT


- Our model comprises two aspects in this hour of need :
    1.For dimensionality reduction through feature extraction
    2.The initial element is produced with InceptionV3.
- The facemask classification procedure is developed with the Logistic Regression (LR) method.
- Deep learning (DL) is used to efficiently train an architecture using a dataset of photos of people's faces with and without and partial face masks to extract features.
- The retrieved traits are now passed into various classification algorithms namely: **Random Forest,Logistic Regression and K-Nearest Neighbors**
- Hence, we can project that employing Transfer Learning (TL) and Deep Learning together can detect a properly or improperly worn face mask with high accuracy.
- This system design stops transmitting this fatal virus by detecting individuals in urban areas who are not wearing facemasks effectively.

# INTRODUCTION

The machine learning algorithms with various pre-trained deep learning architectures have been trained on 66% of our dataset and analyzed by the remaining 34% i.e. our test dataset.

- For each of the algorithms, we obtained Area Under Curve (AUC), Recall, F1, Precision and Classification Accuracy (CA) varied with popular models for feature extraction by visualizing the obtained results in the form of a ROC Curve and Confusion Matrix.
- A principal challenge confronted was to be able to find and amalgamate the images to the category of partial masks.
- Another major problem was finding images of faces with masks having the right kind of orientation.
- We classified the given data into three categories as “no mask”, “partial mask”, “full mask”.



# Motivation & Contribution

- We imported our dataset which was separated into pictures with full mask, partial masks (mouth-jawline/just jaw) and typical appearances (or) normal faces without masks.
- The following element extraction models are then carried out on our dataset:
  -Beginning Inception V3, VGG-16 and VGG-19.
- An examination of three different profound highlights and three AI calculations were done.
- We utilized Random Forest,LR(Logistic Regression) and KNN(K-Nearest Neighbors) techniques employed in the image classification process.
- For each of the three various feature extraction models, LR has the most remarkable accuracy in our result observation.

In statistical analysis, for this image classification, we calculate some of the measures:

**Accuracy, recall and Loss.**

**Accuracy = (TP + TN) / (TP + TN + FP + FN)**

**Recall = TP/ (TP + FN)**

**Loss = TP / (TP + FP)**

# Literature Work

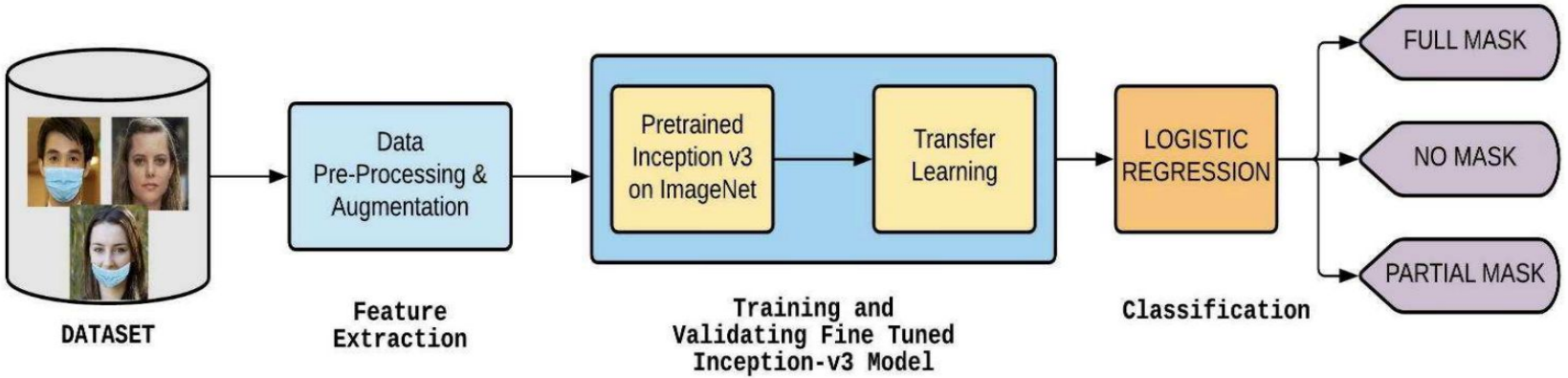
- Utilizing facemasks to assist with keeping up with social separating at overfilled places by using PC vision and Raspberry Pi can produce precise criticism through reports.
- The first dataset is the simulated Masked Face Dataset(SMFD), the second is Marked Faces (MF) and the third is Real world masked  Covered Face Dataset (RWMFD).
- In SMFD, the SVM learning calculation acquired 99.49 percent precision.
- LFW got 100% testing precision though RMFD scored 99.64 percent.
- One more critical commitment in this area is the productive finder, Retina Facial covering Locator which is a face the cover analyzer that identifies whether people are wearing their covers or not.
- This design is to be sure a single-stage finder that incorporates an original encompassing consideration module zeroed in on facial covering recognizable proof
- The Retina Facial covering accomplishes state-of-the-workmanship results on facemask datasets that are 2.3 percent, what's more, 1.5 % higher than the normal outcome separately, furthermore, veil recognition accuracy is 11.0 % and 5.9 % better than the standard outcome.

# Proposed Model

Our study uses a mix of both conventional machine learning and advanced deep learning techniques to detect the facemasks. There are two components to the model:

- The first element is built using deep convolutional, pre-trained neural network models based on
  **- VGG16 ,VGG19 and Inception V3** architectures
- The second component is constructed using a number of machine learning methods namely:
  **- RF,LR and KNN**
- This technique achieves the maximum accuracy of 96.3% using Inception V3 model and Logistic Regression classifier.
- Proposed architecture, utilizes a fine tuned feature extraction model, Inception V3 that had been pre-trained on the Normal Face without masks dataset.
- This image recognition algorithm has been demonstrated to achieve better than 78.1 percent accuracy on the ImageNet dataset and is the culmination of numerous ideas explored by researchers over the years.

# Block Diagram



# Result & Analysis

## Inception V3 feature model

MACHINE LEARNING ALGORITHMS UTILIZED IN INCEPTION V3

| Model | Performance Measures | | | | |
|---|---|---|---|---|---|
| | *AUC* | *Accuracy* | *F1* | *Precision* | *Recall* |
| LR | 99.4% | **96.3%** | 95.3% | 96.2% | 96.3% |
| KNN | 97.0% | 91.1% | 90.8% | 91.3% | 90.7% |
| RF | 96.7% | 91.3% | 91.0% | 90.6% | 90.7% |

- Through the observed outcomes in Table and ROC curves:
- The Logistic Regression technique provides us with the best accuracy of 96.3 % and AUC value of 99.4%.

# VGG16 feature model

MACHINE LEARNING ALGORITHMS UTILIZED IN INCEPTION V3

| Model | Performance Measures | | | | |
|---|---|---|---|---|---|
| | *AUC* | *Accuracy* | *F1* | *Precision* | *Recall* |
| LR | 99.1% | **94.1%** | 94.1% | 94.1% | 94.1% |
| SVM | 96.6% | 88.7% | 88.5% | 88.6% | 88.7% |
| KNN | 87.4% | 79.1% | 78.0% | 77.8% | 79.1% |

- Through the observed outcomes and ROC curve:
- The Logistic Regression technique provides us with the best accuracy of 94.1% percent and AUC of 99.1%.

# VGG19 feature model

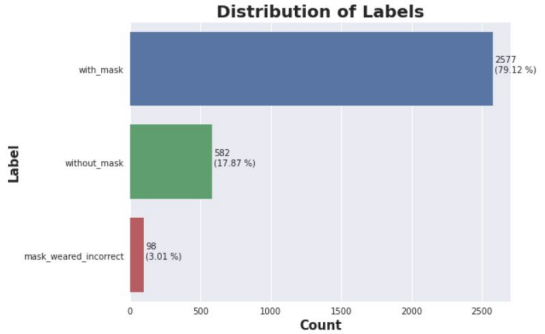
MACHINE LEARNING ALGORITHMS UTILIZED IN VGG19

| Model | Performance Measures | | | | |
|---|---|---|---|---|---|
| | *AUC* | *Accuracy* | *F1* | *Precision* | *Recall* |
| LR | 99.2% | **94.7%** | 94.6% | 94.6% | 94.7% |
| KNN | 89.9% | 84.0% | 82.9% | 83.7% | 84.0% |
| RF | 92.2% | 84.6% | 83.8% | 84.4% | 84.6% |

- Through the observed outcomes in and ROC curve,the Logistic Regression technique provides us with an accuracy of 94.7 % and AUC of 99.2%.
- Finally, based on our observations, we determined that the Logistic Regression method is best suited for our model for classification, and Inception V3 model as feature extraction model.
- The highest accuracy achieved was 96.1%.

# RESULTS

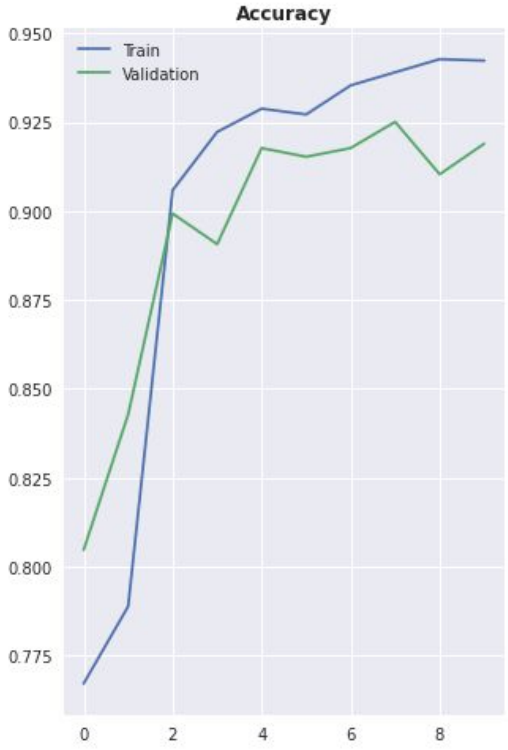
| | label | count |
|---|---|---|
| 0 | with_mask | 2577 |
| 1 | without_mask | 582 |
| 2 | mask_weared_incorrect | 98 |



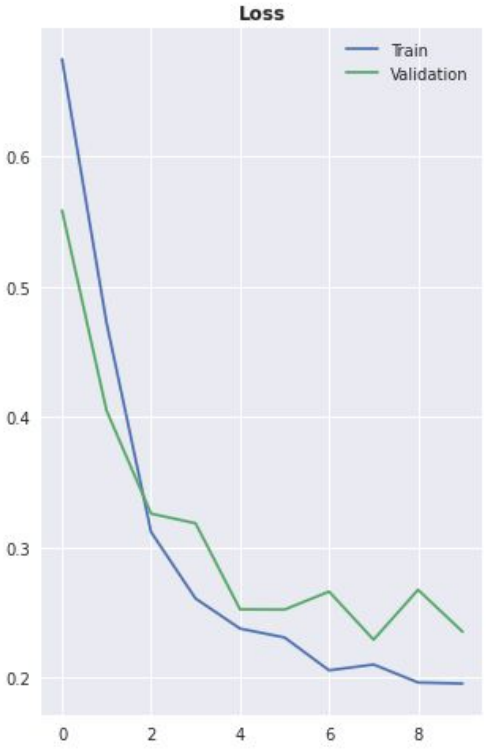

- For all the 3 different masks:
  a) Mask, b)No Mask and c)Mask weared incorrect - The Confusion matrix for logistic regression
- These are actual and predicted outcomes
- No mask is predicted exactly than with the others.
- Actual there are 3257 with mask and 2577 without mask and 582 with partial mask using logistic regression and VGG19.
- **Results :** It predicted 2577 with mask out of 3257, no masks with 582, and 98 incorrect masks

# Results / Outputs :

# Model Performance







# Conclusion and works

- We applied the proposed hybrid model using previously described deep learning architectures and compared the outcomes of images with various methods and models for feature extraction, after which we accomplished the following outcomes:
- The exactness is determined and compared. As you can see, it achieves ~99% accuracy on our test set that means it gives best results.
- We present a hybrid method that makes use of deep learning architectures linked with the transfer learning methodology.
- It obtained the highest accuracy of percent among the two deep learning techniques.In general there aren’t enough instance to train a deep architecture.
- In reality our technique provides a realistic solution to employ CNN’s which eliminates their need to generate hand-crafted features.

# Future Scope of the project

- This framework can soon achieve great heights by expanding the collection of images that can transform the network to be more powerful in the near future.
- Finally, this research opens up new avenues for future researchers.
- The suggest approach is not just restricted to mask detection and may be implemented into any high-resolution video surveillance system.
- Secondly, this framework may be extended to recognize facial landmarks while wearing a facemask for biometric purposes.
- Experts worry that as face recognition becomes a more important part of catching criminals, the widespread use of masks could stymie criminal investigations in the future.

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Thank
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