Sri Adichunchanagiri Shikshana Trust(R)

S J B Institute of Technology

Department of Electronics & Communication Engineering

A Mini project on

Learning Semantic Features for Classifying Very Large Image Datasets Using HOG and Machine Learning Techniques

REVIEW - 02

Presented By

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Contents

Abstract

- An approach to an ensemble model combining DCT, Wavelet and HOG is developed to represent an image in compressed domain.
- For classification purpose, different distance measure techniques and machine learning algorithm is used to obtain average classification rate.
- Proposed ensemble model is demonstrated on Caltech-101 & 256 datasets and Covid-19 chest x-ray radiography dataset.
- Covid 19 detection process involved with fused CNN and HOG feature vector.
- Real time object detection using multiple camara feeds.

Literature Survey

REFERENCES	YEAR	METHODOLOGY
Content Based Image Retrieval - Inspired by Computer Vision & Deep Learning Techniques, IEEE.[2]	2019	The CBIR method is emerging as an influential next-generation tool for accurate image retrieval from large digital image datasets.
Histogram of Oriented Gradients Feature Ex-traction Without Normalization, IEEE.[3]	2020	In the histogram of oriented gradients (HOG), the effects of normalizing are investigated. The normalizing function has been incorporated into the gradient creation stage.
An illumination, expression, and noise invariant gender classifier using two-directional 2DPCA on real Gabor space.[4]	2015	PCA is a computational technique for converting a huge amount of linked data into a smaller amount of congruent data
Coslets: A Novel Approach to Explore Object Taxonomy in Compressed DCT Domain for Large Image Datasets. Advances in Intelligent Systems and Computing, Springer.[6]	2015	In Novel transform technique known as coslets is derived by applying 1D wavelet in DCT Domain. Different distance measure techniques used for classification to obtain average identification rate.
Exploiting unlabelled data for hybrid object classification. In: NIPS Workshop on Inter-Class Transfer, Whistler.[10]	2005	The hybrid model allows us to combine the modelling power and flexibility of generative models with discriminative classifiers.

REFERENCES	YEAR	METHODOLOGY
Object recognition with features inspired by visual cortex. In: CVPR, San Diego [11]	2005	Their approach exhibits excellent recognition performance and outperforms several state-of-the-art systems on a variety of image datasets including many different object categories.
Automated Classification of Glaucoma Using DWT and HOG Features with Extreme Learning Machine.[5]	2021	An extreme learning machine (ELM) is used to make decisions based on the gradient histogram (HOG) and wavelet characteristics.
An Investigation of Gabor PCA and Different Similarity Measure Techniques for Image Classification. Advances in Intelligent Systems and Computing. Springer.[7]	2016	They propose diverse subspace techniques, which concentrate on consistency and orientations of an image, extracting color, shape, and texture data with orthogonal transformation into uncorrelated space.
A Novel Technique for Effective Image Gallery Search using Content Based Image Retrieval System.[1]	2019	The Edge Directivity Descriptor is used to take out the feature vectors of a particular image from the image database.

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Objectives

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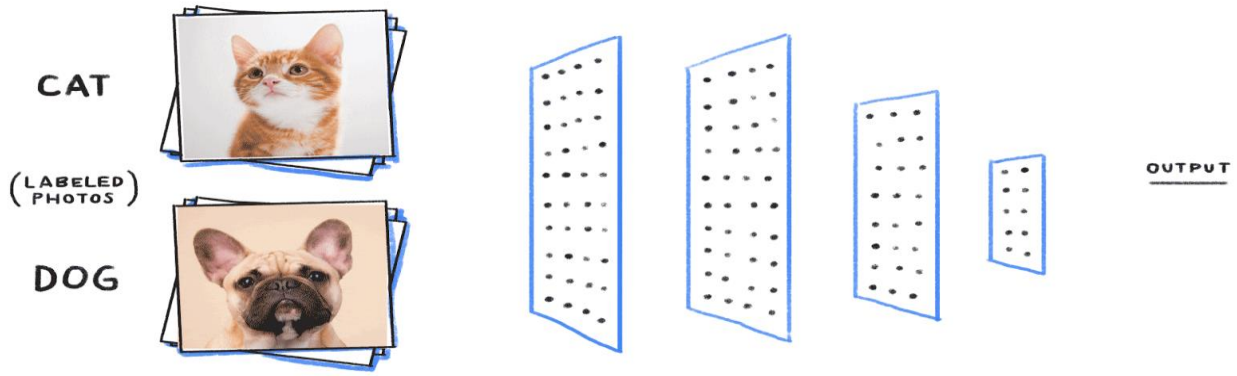
- To Bridge semantic gap between high level and low level features.
- Image representation and multi resolution analysis in compressed domain for image classification.
- Covid-19 prediction using Chest Xray image data.
- Real time object detection from multiple camara feed.



Block Diagram

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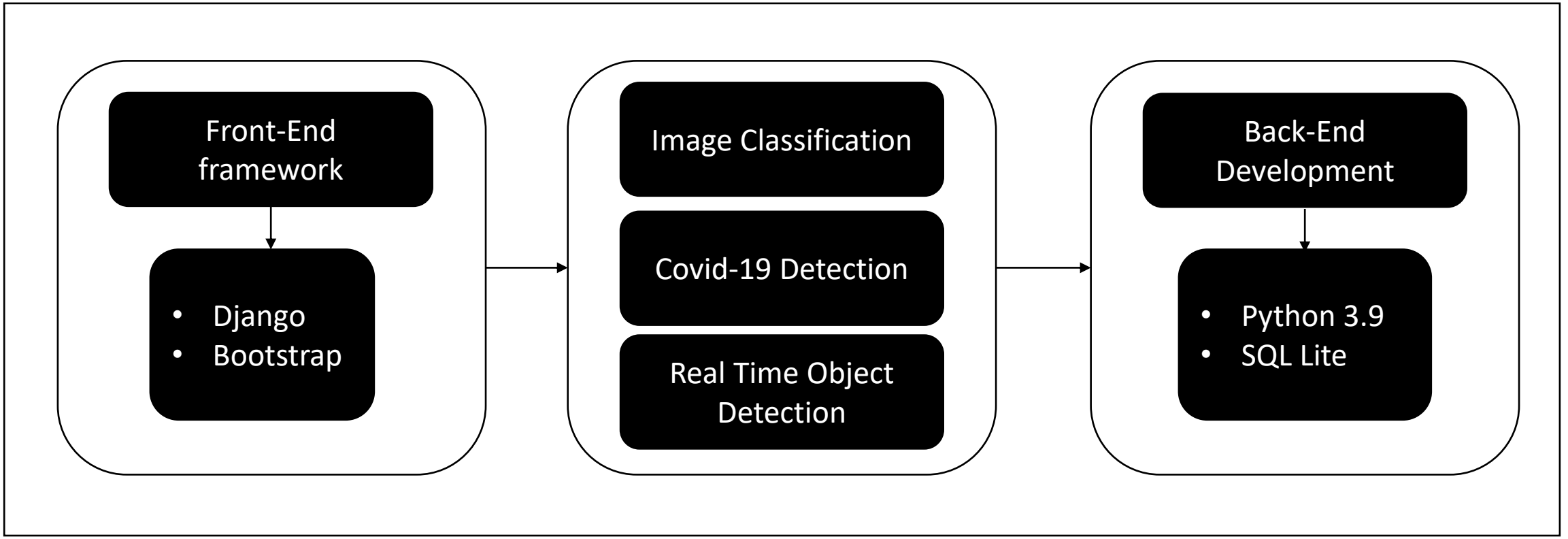
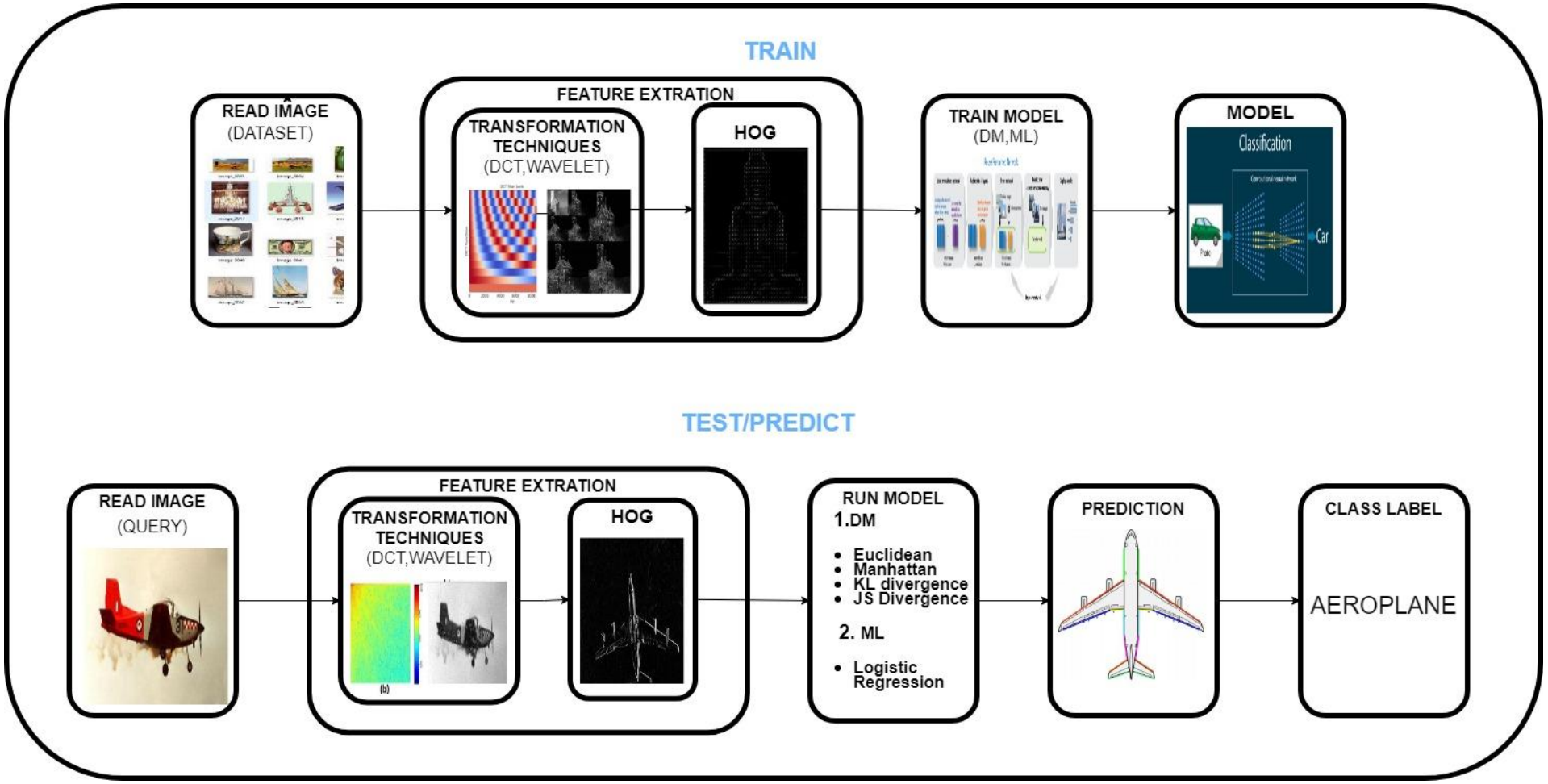
Web application



Proposed Work

- The below are the contents which we have worked with:



Methodology & Implementation

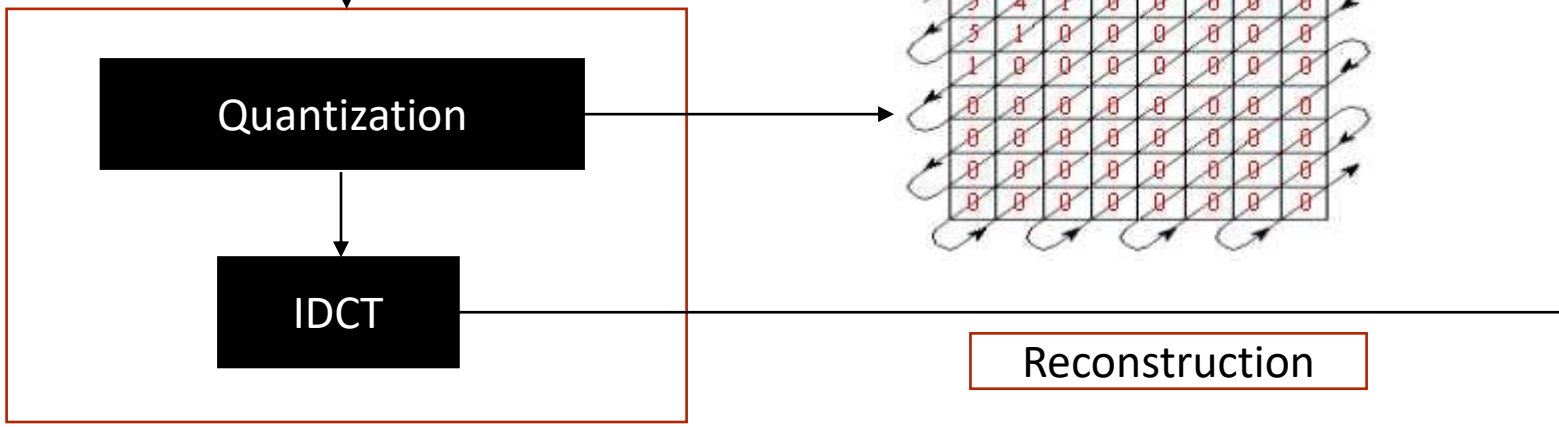
- Datasets
  - **Caltech 101** : Collection of 9,144 images from 101 distinct objects.
  - **Caltech 256** : Collection of 30,607 images from 256 distinct objects..
- To evaluate the performance of the proposed methodology, labeling the first 15 & 30 images in each category as training to generate feature vectors and the remaining as testing.
- Challenges are to overcome occlusion, corner artifacts, large variations, illumination, scale invariance.

Fig : Sample images of Caltech 101 and 256 datasets

DISCRETE COSINE TRANSFORM

- The DCT is a representation of image as a sum of sinusoidal of varying magnitudes and frequency.

$$C(u,v) = \frac{2}{\sqrt{mn}}\,\alpha(u)\alpha(v)\sum_{x=1}^{m}\sum_{y=1}^{n} f(x,y)\cos\left[\frac{(2x+1)u\pi}{2m}\right]\cos\left[\frac{(2y+1)v\pi}{2n}\right]$$



Original

Compressed

Implementation of Daubechies wavelet

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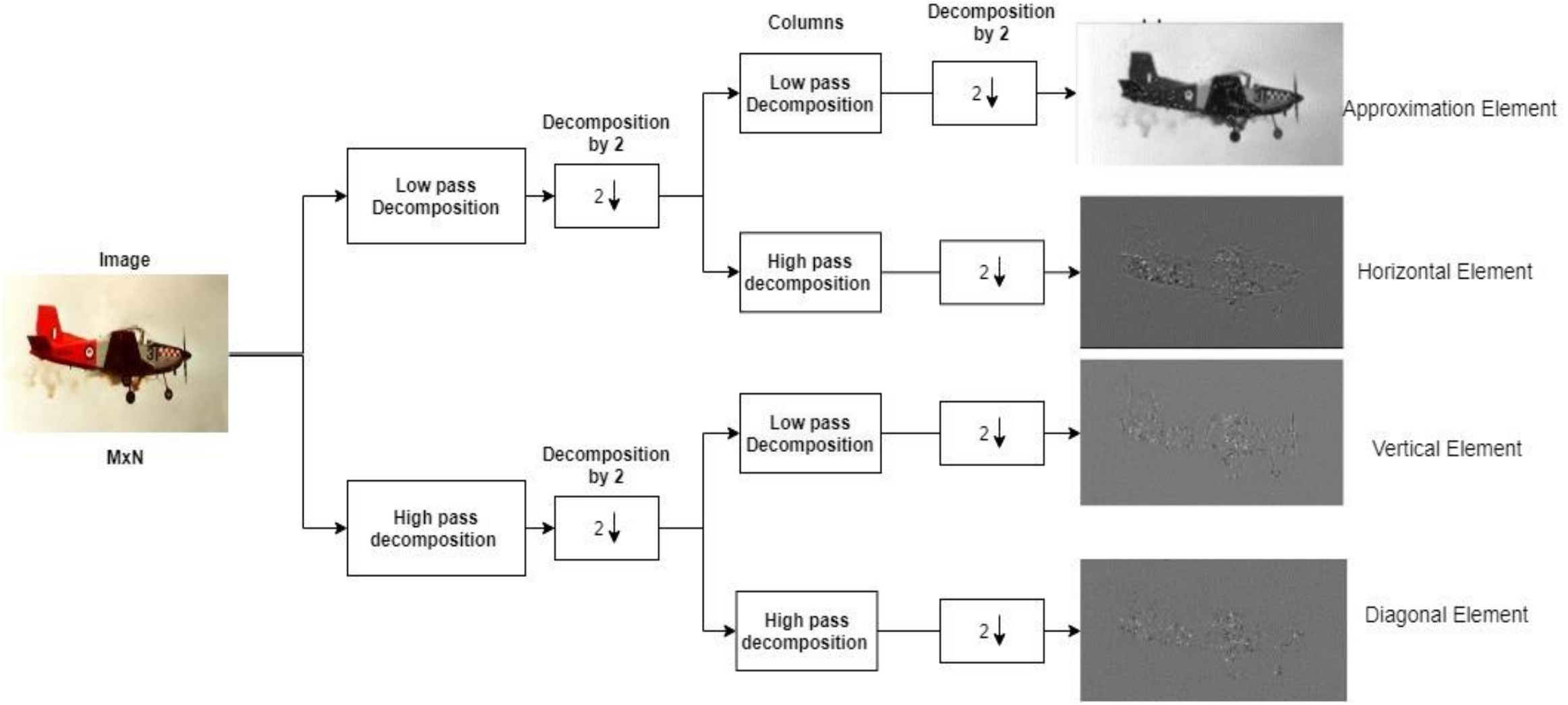

Histogram of Oriented Gradients

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$$G_x(i,j) = \frac{\partial I}{\partial x}(i,j)$$
$$G_y(i,j) = \frac{\partial I}{\partial y}(i,j)$$

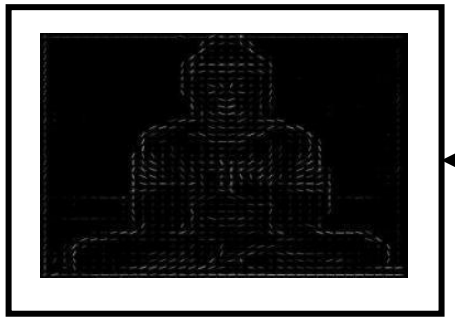
where G_x & G_y are the gradient magnitude

$$M(i,j) = \sqrt{G_x^2(i,j) + G_y^2(i,j)}$$
$$\theta(i,j) = arctan\left(\frac{G_y(i,j)}{G_x(i,j)}\right)$$

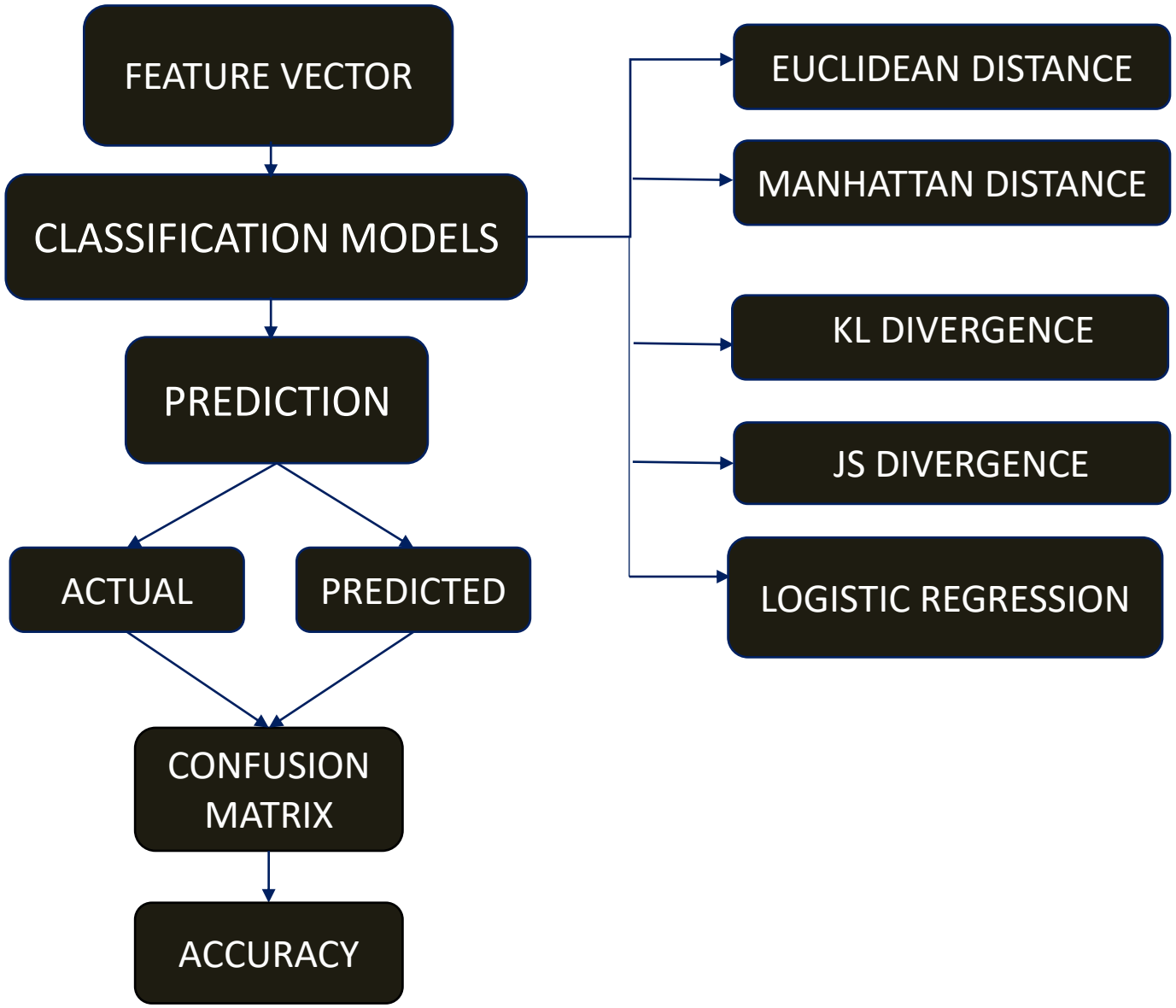
Block normalization

$$\boldsymbol{L1 - norm: v \rightarrow \frac{v}{||v||_2 + \epsilon}}$$

$$\boldsymbol{L2 - norm: v \rightarrow \frac{v}{\sqrt{||v||_2^2 + \epsilon^2}}}$$



Workflow of Classification Models



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Results & Discussions

The proposed ensemble methodology outperformed, produces very competitive results.

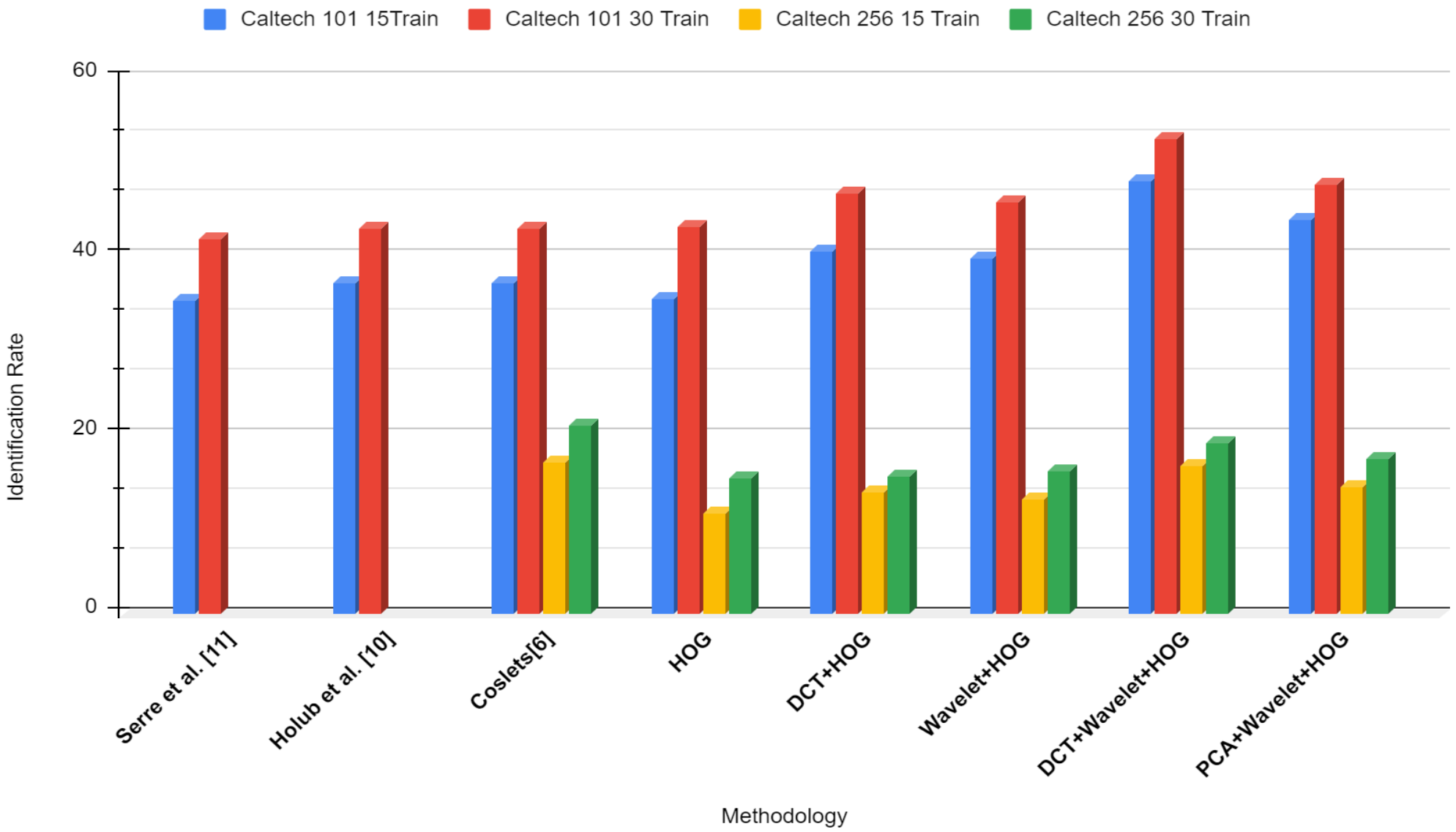
Distance metrics	Caltech 101 15 Train	Caltech 101 30 Train	Caltech 256 15 Train	Caltech 256 30 Train
	Classification Rate in %			
Euclidean Distance	35.2246	38.1712	12.3379	14.5542
Manhattan Distance	40.5264	44.2474	17.5962	20.5483
KL Method	23.8639	25.5652	-	-
JS Method	28.1980	28.1980	-	-

Table 1. Results of different distance metrics using HOG

Methodology	Caltech 101 15 Train	Caltech 101 30 Train	Caltech 256 15 Train	Caltech 256 30 Train
	Classification Rate in %			
Coslets[6]	37	43.1	16.9	21
Holub et al. [10]	37	43	-	-
Serre et al. [11]	35	42	-	-
HOG	35.1316	43.3317	11.1489	15.1768
DCT+HOG	40.5596	46.9413	13.6233	15.2541
Wavelet+HOG	39.6711	46.1189	12.8623	15.9632
DCT+Wavelet+HOG	48.3920	53.0854	16.6244	19.0058
PCA+Wavelet+HOG	44.0699	48.0862	14.0952	17.2614

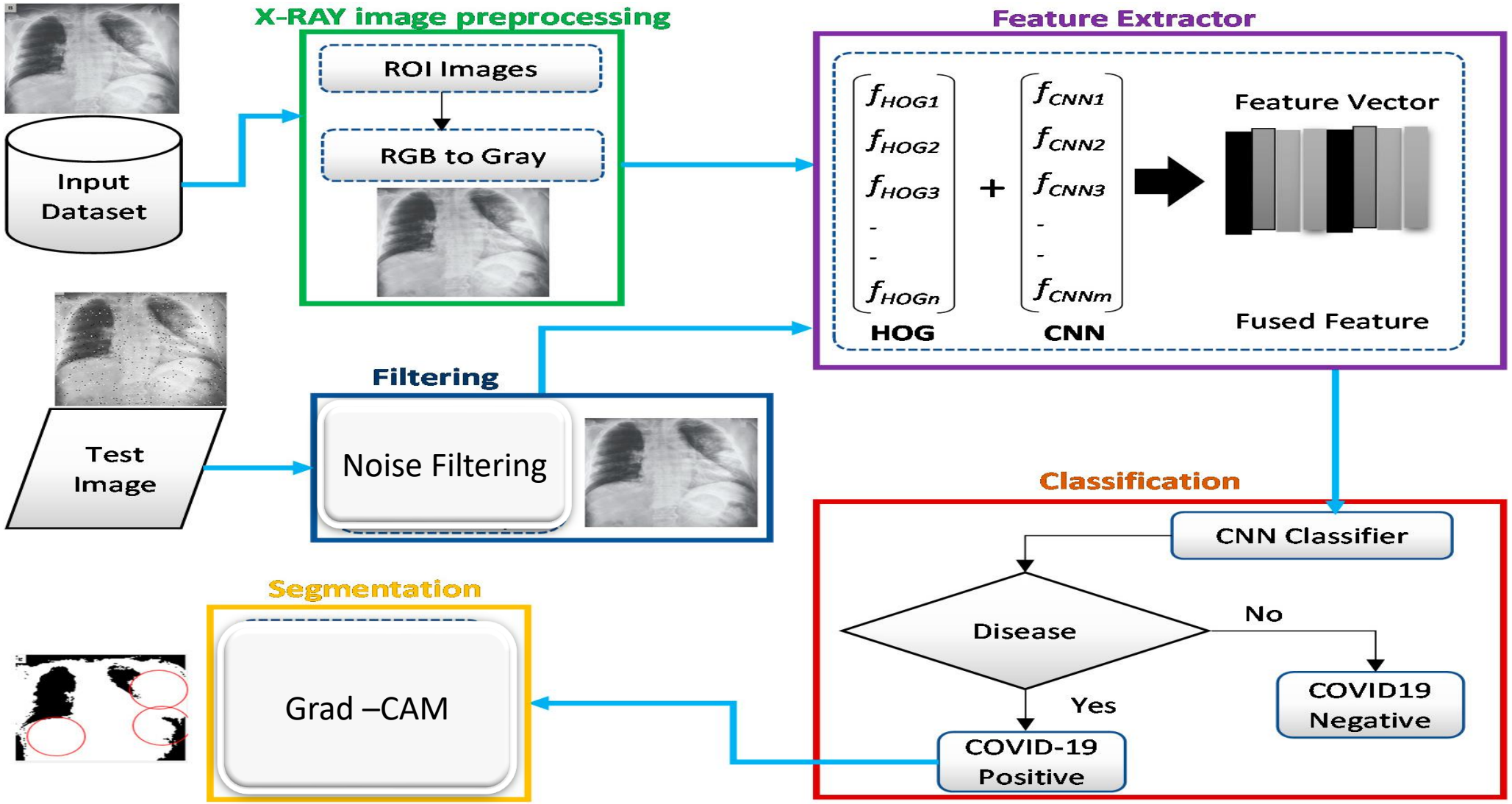
Table 2. Analysis of different transformation techniques with logistic regression

Graphical Representation and Analysis



APPLICATION 1 : COVID 19 PREDICTION

Flow Diagram



Features Extraction: By pre-trained convolutional neural network (CNN) model

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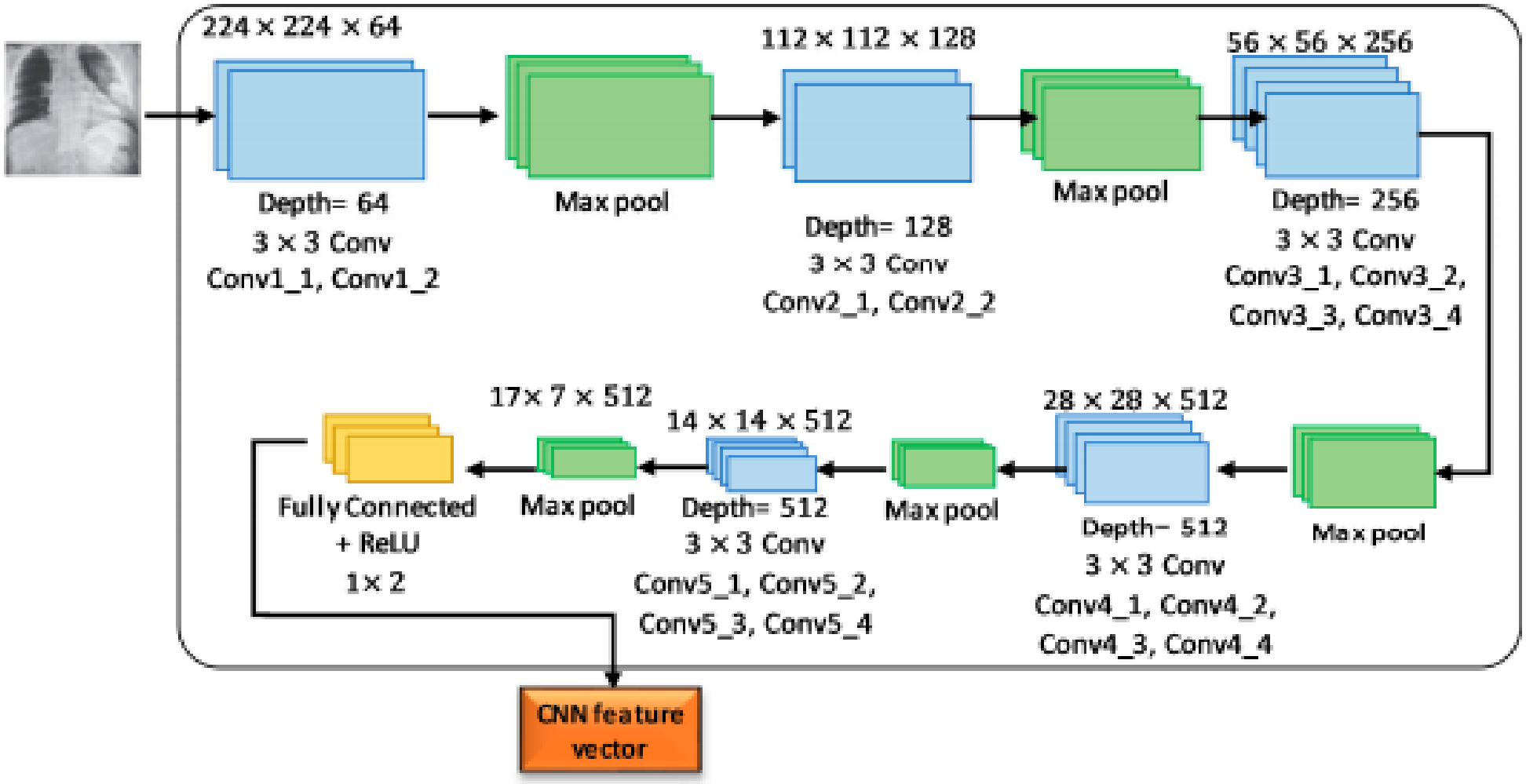

Dataset Used

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- In this work, standard radiography datasets from Kaggle were employed to validate the system's performance.
- The benchmark data set used in our experimental evaluation consisted of two main categories with 3615 COVID-19-positive and 20384 normal chest X-ray images.
- In general, similar to pneumonia, the density of the lungs is increased in the case of the COVID-19, which causes whiteness in the lungs on radiography. An experienced radiologist can confirm the disease by the appearance of a ground-glass pattern due to the increased whiteness.

Comparison of the COVID-19 and normal X-ray images.

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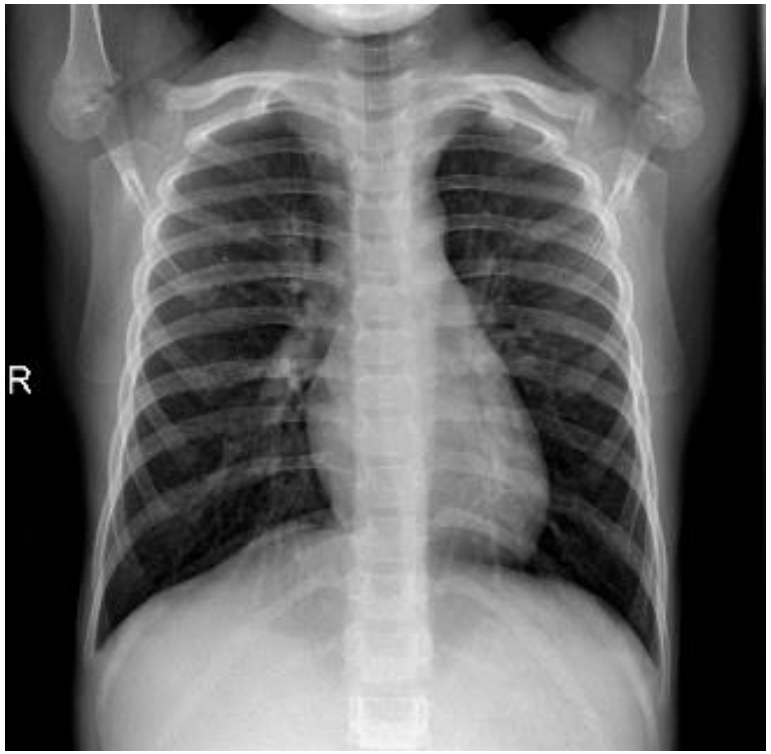
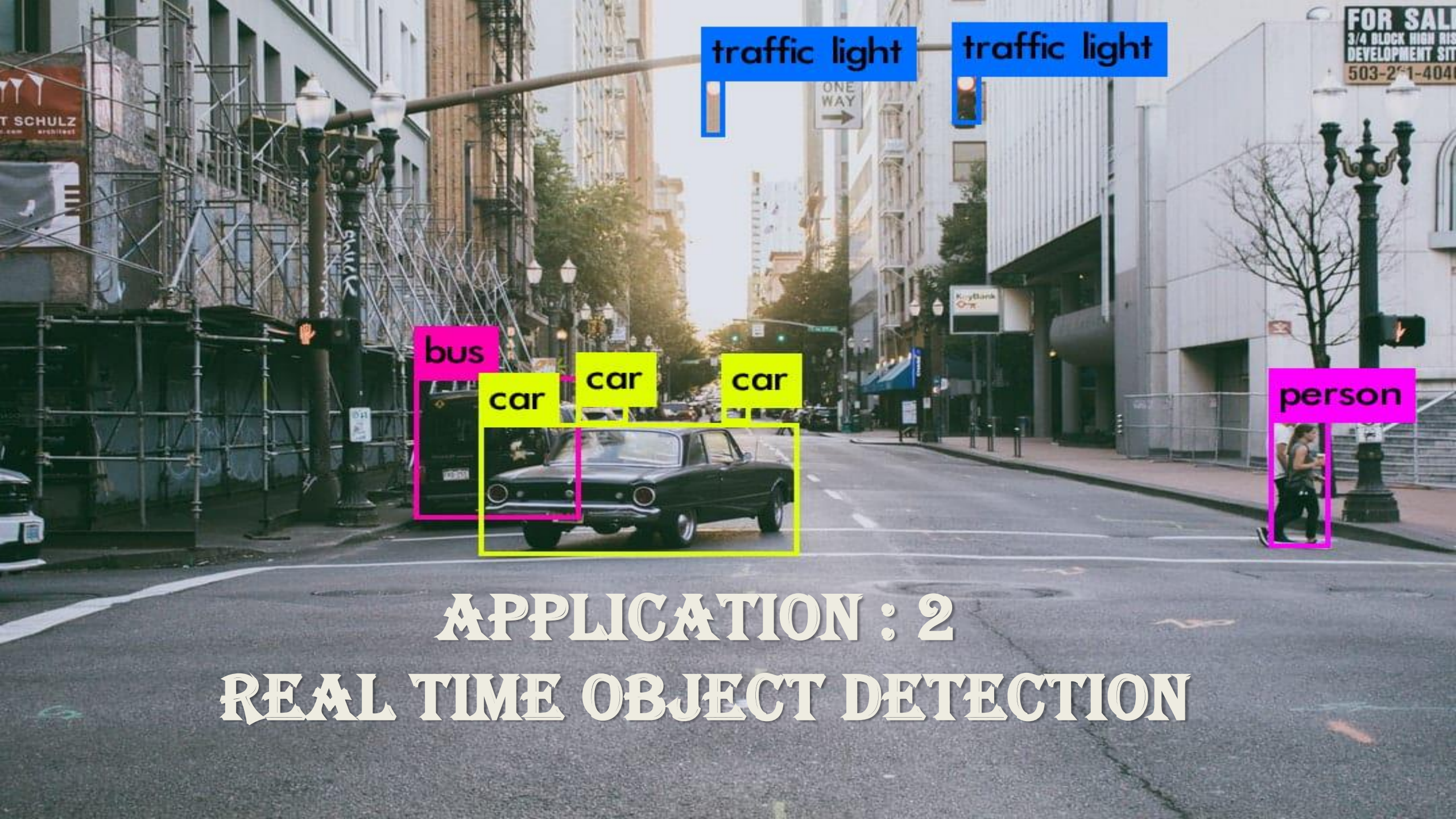


Fig 1: Normal Chest X-Ray sample

Fig 2: Covid +ve Chest X-Ray sample



APPLICATION : 2
REAL TIME OBJECT DETECTION

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Image classification

"Car"

Classification with localization

"Car"

One object

Detection

Multiple objects

Work Flow

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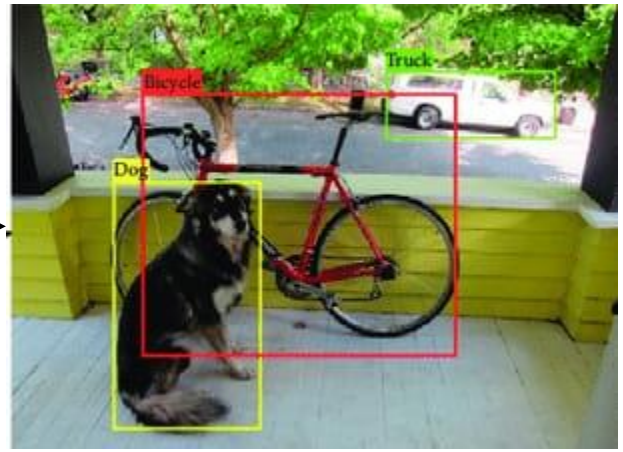
INPUT → Detection Algorithm → OUTPUT

Object Detector



Object Co-ordinates

- [x1 y1 x2 y2 dog]
- [x3 y3 x4 y4 bicycle]
- [x1 y1 x2 y2 van]

Conclusion

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- The proposed methodology preserves low frequency co-efficient, point singularities and edge orientations respectively from an image.
- Increased descriptors in HOG result in more information in the image data, hence our model is scale invariant but not rotationally.
- Different distance metrics, support vector machines, neural network topologies, and deep learning techniques can all be used to test our model's performance.
- Segmenting Infected regions from chest Xray data using GradCAM techniques.

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THANK YOU!