Image Classification using Deep Learning Framework

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Abstract**:** *Among all the monitoring methods, models with data that is driven have more success rate when compared to any other methods. However these methods are functional to the procedure of material features such as rate of flow, pressure and temperatures. In this we use Keras, in this a group the neurons forms a pair consisting of a unit from visible layer and hidden layer. Forming so they may be formed in a symmetry which provides us to detect the fault. There must not be type of connection between the nodes of a particular group. CNNs are regularized versions of one of the many multilayer perceptrons. Multilayer perceptrons generally means entirely linked networks, that is, each and every neuron that is present in one of the any layer is linked to all neurons in the rest of all layer. The "fully-connectedness" of these modeling networks makes all of them liable for the over-fitting cause of data. Classic ways for the regular use includes accumulation of magnitude measurement of weights by the loss function. On the other hand, CNN took an unusual move towards or step towards the regular use: they take the benefit of the current hierarchical outline in the data set and gather more and more difficult outline using smaller outlines. Thus, on comparing among the connectedness and difficulty, CNN's are at the least limit.*

Keywords**:** *CNN, Keras, Magnitude measurement, Multilayer Perceptron.*

I. INTRODUCTION

Here we will be taking some datasets containing different pictures of one particular type, then we will check the accuracy of the detection of the image into the same object class or not and in order to do that we will use CNN (Convolutional Neural Network) with TensorFlow as our deep learning framework. Based on the picture resolution, it will check the height x weight x depth.

Eg., An photo is of 4 x 4 x 2 array of matrix of RGB and another photo of 2 x 2 x 1 array of matrix for gray-scale photo. [6] Generally, we use deep learning Convolutiona Neural Network models for training as well as testing; each and every photo that is sent as a input will have to pass throughout a sequence of layers among the filters and imply Softmax function to categorize an object with probable standards in-between 0 and 1. There must be a full flow of convolutional neural network to practice a photo and to categorize the objects based on standards. [6]

A **CNN** is a Deep Learning algorithm which can take input as an image, assign significance to several aspects of objects present in the photo and still be able to identify and differentiate one from another. The pre-processing that is necessary in a ConvNet is very much minor as when compared with several other categorization algorithms. [7]

The classification of a image that is uploaded on any website that contains images are characterized by the number of segments available. In this project, we try to discover the idea that the characteristics of a image might make it easier to categorize the shown image. Lately CNNs are being used vastly in Computer Vision space to identify things, places and people in images, board signs, people and lights in self-driving cars, types of crops, forests and traffic in mid-air imagery, various inconsistent images in medical field and all kinds of other useful things. [8]

II. LITERATURE SURVEY

A. Bogdan Georgescu, et al. [1]

Present trending methods for parsing of image of volumetric medical data are generally depended on machine learning techniques which utilize huge annotated photos databases. We propose an innovative methodology for image or pattern recognition and segmentation in the context of volumetric image-parsing, resolving a problem: medical based pose evaluation and limit description. For this work we propose Marginal Space Deep Learning (MSDL), an optimal framework utilizing the advantages of well-organized object parameterization in hierarchical marginal spaces and the computerized attribute model of Deep Learning (DL)

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architectures. In this context, the function of deep learning system is bounded by huge convolution of the parameterization. The accuracy obtained by this process is 97%. [1]

B. Monjoy Saha, et al. [2]

We present a well-organized deep learning framework to identify, segment, and classify cell membranes and nuclei from human epidermal growth factor receptor-2 (HER2) blurred breast cancer photos through minimum interference of patient. This is an ever-lasting problem of a pathologist due to the physical quantification of human epidermal growth factor receptor-2 is fault liable, expensive and more time taking process. Therefore, we introduce a deep neural network (Her2Net) to resolve this problem. A completely linked layer and a softmax layer are also applied for categorization and fault assessment. The method got 96.64% of precision, recall value of 96.79%, F-score value of 96.71%, negative predictive value of 93.08%, accuracy of 98.33%, and a false positive rate of 6.84%. These results shows the higher accuracy and larger application reliability of the deprived Her2Net in the context of HER2 scoring for the detection breast cancer. [2]

C. Yuting Lyu, et al. [3]

Along with the advancement in visual sensing and photo capturing systems, processed photos provide new alternatives to method monitoring. Comparing to the processed data set obtained with conventional sensors at confined areas, processed photo improves the data-driven method monitoring a much better by obtaining more important varieties in the whole space.

By means of this simply accessible industrial method photos, a fresh skeleton based on the deep belief network is provided for attribute separation and in-time error recognition. Not like the current deep belief network models giving the photos directly in the model, as in the introduced framework, the sub-networks are helped to obtain confined attributes from the sub-photos.

As a by-product, capable improvement had been implemented in method monitoring and the error analysis area with the higher order for secure process and constant product value. The accuracy provided is 89% by this method. [3]

D. Muthukrishnan Ramprasath, et al. [4]

Recent years, with the fast development in the digital contents recognition, automatic classification of the photos became the most difficult task in the area of computer vision. Automatic perceptive and analyzing of photos by system is complicated as compared to human visions. Several researches have been to overcome the problem in present classification system, but the output was lessened only to low level photos primitives.

This system uses the Digit of MNIST data set as a standard for categorization of grayscale photos. The grayscale photos in the data set which is used for training which demand more computational power for categorization of photos. By training the photos using CNN network we obtain the 98% accuracy result in the experimental part it shows that this proposed model achieves the high accuracy percentage in categorization of photos. [4]

E. Masakazu Sato, et al. [5]

The aim of the current study was to explore whether deep learning could be applied efficiently to the categorization of photos from colposcopy. For this work, a total of 158 clients who underwent conization were registered and medical records and data from the gynaecological oncology database were retrospectively verified. Deep learning was performed with the Keras neural network and TensorFlow libraries. The colposcopy is used to identify the abnormal cervical cells in medicine field for so long, but due to the advance and enhancement of technologies we can use colposcopy on almost each and every image. The accuracy is of 85% because this colposcopy is now yet to be used efficiently by enhancing the techniques and technologies used for checking. [5]

III. METHODOLOGY

Convolutional neural network is one out of many important features to find photo identification and categorization. Object detections, face identification etc., are some of the areas where these are mostly applied. [6]

Convolutional Neural Network photo categorization takes image as an input data, develop it and categorize it under some circumstances groups. A computer observes the provided photo as the array of pixels and that weighs on the resolution of photo. Precisely, we use deep learning Convolutional Neural Network models for training as well as testing; each photo that is provided as input will go all the way through a sequence of layers with the filters (Kernals) and Softmax function is applied to categorize an object with probable standards in-between 0 and 1. There must be a absolute flow of convolutional neural network to practice an image and to classify the objects based on standards. [6]

So generally Convolutional Neural Network is an algorithm based on machine learning for machines to understand the attributes of photo with future sight and to remember the characteristics to guess whether the name of the new photo given to the machine. Since it is not a paper, explaining the CNN, so we will add some links in the end if you guys are fascinated how CNN mechanism works and behaves.

Each and every neuron evaluates the data for only its concerned area. Even though completely linked feed forward neural networks are used to know the attributes and categorize the data, it is not realistic to imply this design to photos. A large amount of neurons might be important, even in low design, due to the huge input sizes related with the photos, where each and every pixel is an essential variable. [9]

Here we used several other algorithms apart from CNN for cross-validation, they are:

A. Naïve Bayes
B. K- Means Clustering
C. Support Vector Machine
D. Linear Regression

A. Naïve Bayes

This is a set of categorization algorithm dependent on the Bayes Theorem. This is not a lone algorithm; instead a family or cluster of algorithms where all of those will share a mutual motto, i.e. every pair of characteristics that is being categorized is not dependent on one another. This theorem determines the probability of an event happening provided the probability of one more event which has by now happened. Bayes theorem is defined in equation (mathematically) as:

$$P(A|B) = \frac{P(B|A)P(A)}{P(B)}$$

```
library(naivebayes)
library(dplyr)
library(ggplot2)
library(psych)
data <- read.csv(file.choose(), header = T)
str(data)
xtabs(~admit+rank, data = data)
data$rank <- as.factor(data$rank)
data$admit <- as.factor(data$admit)
pairs.panels(data[-1])
data %>%
         ggplot(aes(x=admit, y=gpa, fill = admit)) +
         geom_boxplot() +
         ggtitle("Box Plot")

data %>% ggplot(aes(x=gpa, fill = admit)) +
         geom_density(alpha=0.8, color= 'black') +
         ggtitle("Density Plot")
set.seed(1234)
ind <- sample(2, nrow(data), replace = T, prob = c(0.8, 0.2))
train <- data[ind == 1,]
test <- data[ind == 2,]
model <- naive_bayes(admit ~ ., data = train, usekernel = T)
model
train %>%
         filter(admit == "1") %>%
         summarise(mean(gre), sd(gre))
plot(model)
p <- predict(model, train, type = 'prob')
head(cbind(p, train))
p1 <- predict(model, train)
(tab1 <- table(p1, train$admit))
1 - sum(diag(tab1)) / sum(tab1)
p2 <- predict(model, test)
(tab2 <- table(p2, test$admit))
1 - sum(diag(tab2)) / sum(tab2)
```

B. K- Means Clustering

A cluster means to a collection of data points aggregated together because of certain similarities. It is one of the unsupervised learning which is used to classify. It is a well-liked choice for the analysis of cluster in the data-mining. Its main aim is to divide *n* data sets into *k*-clusters in which each and every data set belonging to the cluster with the mean nearest to it.

To update the mean value, we use:

$$m = (m * (n - 1) + x)/n$$

Where,

m denotes the mean value for a feature,

n denotes the number of items in a cluster,

x denotes the feature item for the added item.

```
mydata <- read.csv("E/Pro/utilities.csv")
str(mydata)
head(mydata)
pairs(mydata)
plot(mydata$Fuel_Cost~ mydata$Sales, data = mydata)
with(mydata,text(mydata$Fuel_Cost ~ mydata$Sales, labels=mydata$Company,pos=4))
z = mydata[,-c(1,1)]
means = apply(z,2,mean)
sds = apply(z,2,sd)
nor = scale(z,center=means,scale=sds)
distance = dist(nor)mydata.hclust = hclust(distance)
plot(mydata.hclust)
plot(mydata.hclust,labels=mydata$Company,main='Default from hclust')
plot(mydata.hclust,hang=-1)
mydata.hclust<-hclust(distance,method="average")
plot(mydata.hclust,hang=-1)member = cutree(mydata.hclust,3)
table(member)aggregate(nor,list(member),mean)
aggregate(mydata[,-c(1,1)],list(member),mean)wss <- (nrow(nor)-1)*sum(apply(nor,2,var))
for (i in 2:20) wss[i] <- sum(kmeans(nor, centers=i)$withinss)
plot(1:20, wss, type="b", xlab="Number of Clusters", ylab="Within groups sum of squares")
kc<-kmeans(nor,3)
```

C. Support Vector Machine

[21]This is an algorithm based on machine learning which is supervised, that analyses the data to classify the image on the basis of datasets. A (SVM) Support Vector Machine is a differentiate categorizer properly stated by an untying hyper-plane. In other words, the algorithm outputs an efficient hyper-plane which categorizes latest examples.

```
library("e1071")
d->read.csv("E/Pro/iris.csv")
head(iris,5)
attach(iris)
x <- subset(iris, select=-Species)
y <- Species
svm_model <- svm(Species ~ ., data=iris)
summary(svm_model)
svm_model1 <- svm(x,y)
summary(svm_model1)
pred <- predict(svm_model1,x)
system.time(pred <- predict(svm_model1,x))
table(pred,y)
svm_tune <- tune(svm, train.x=x, train.y=y,
              kernel="radial", ranges=list(cost=10^(-1:2), gamma=c(.5,1,2)))

print(svm_tune)
svm_model_after_tune <- svm(Species ~ ., data=iris, kernel="radial", cost=1, gamma=0.5)
summary(svm_model_after_tune)
pred <- predict(svm_model_after_tune,x)
system.time(predict(svm_model_after_tune,x))
table(pred,y)
```

D. Linear Regression

[22]In statistics and machine learning, linear regression is a linear manner to model the connection between a scalar response and to one or many functional and explanatory variable. In this the case of one explanatory variable is called simple linear regression.

The equation of regression line represented as:

$$h(x_i) = \beta_0 + \beta_1 x_i$$

Where,

$h(x_i)$ denotes the response value predicted for the i^{th} input,

β_0 and β_1 are the coefficients of regression which represents β_0 as y-intercept and β_1 as the regression slope line.

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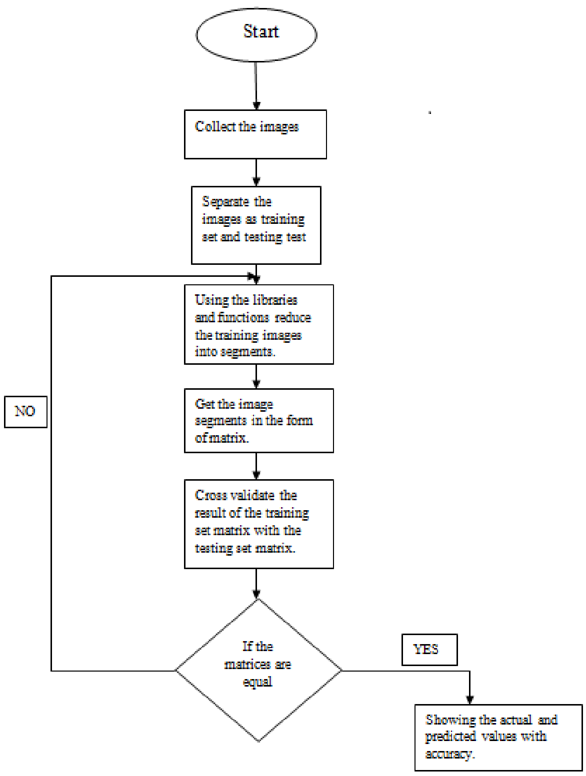
```
vehicle <- read.csv("E/Pro/vehicle.csv", header = TRUE)

vehicle$lh[vehicle$lh==0] <- mean(vehicle$lh)
vehicle$lc[vehicle$lc==0] <- mean(vehicle$lc)

set.seed(1234)
ind <- sample(2, nrow(vehicle),
              replace = TRUE,
              prob = c(0.7, 0.3))
training <- vehicle[ind==1,]
testing <- vehicle[ind==2,]

model <- lm(lc~lh, data=training)
model
summary(model)
plot(lc~lh, training)
abline(model, col = "blue")

par(mfrow=c(2,2))
plot(model)
vehicle[1620,]

pred <- predict(model, testing)
predict(model, data.frame(lh=10))
```

IV. BLOCK DIAGRAM



Step 1: We will collect the images in datasets.
Step 2: We will divide the images in datasets as training dataset and testing dataset.
Step 3: Then we will apply the methods and functions which will divide these images into segments to form a matrix.
Step 4: After checking the matrices of training and testing matrices, we will cross-validate it and also generates some graphs.
Step 5: Based on the results we will see the actual and predicted output.

V. RESULTS

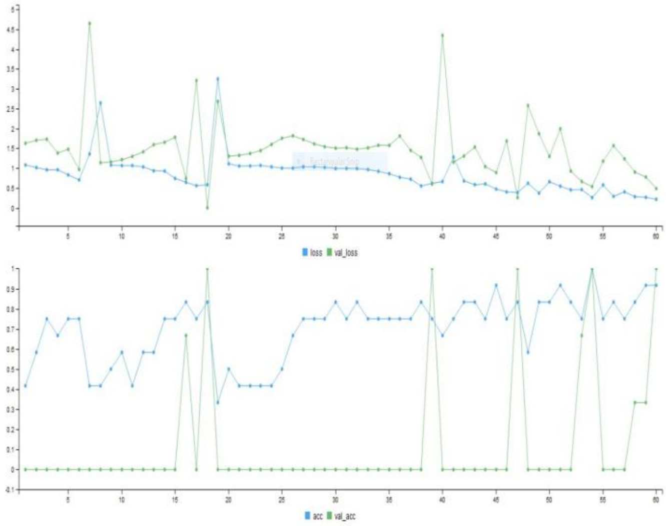


Fig 1: The above graph shows the plotting and metrics of the training dataset.

Fig 2: The above picture depicts the training dataset

Fig 3: The above picture depicts the testing dataset

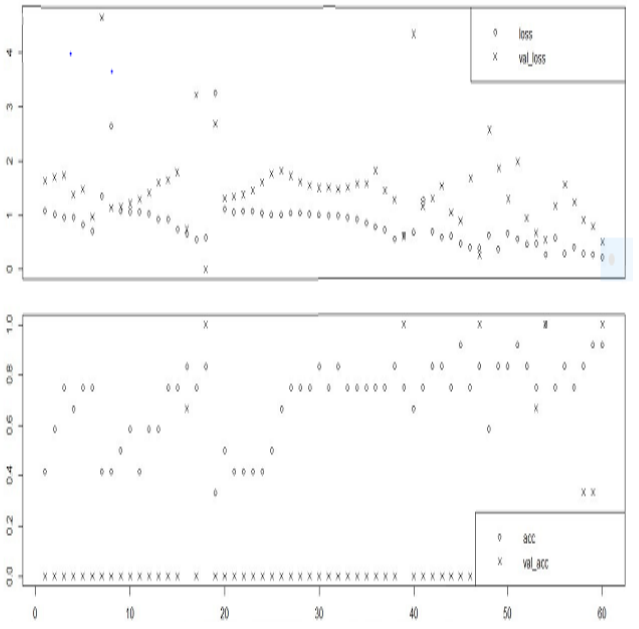


Fig 4: The above graph shows the plotting accuracy and loss

```
> pred <- model %>% predict_classes(train)
> table(Predicted = pred, Actual = trainy)
         Actual
Predicted 0 1 2
        0 5 0 0
        1 0 5 0
        2 0 0 5
```

Fig 5: The above picture shows the confusion matrix

```
      [,1] [,2] [,3]
 [1,]    1    0    0
 [2,]    1    0    0
 [3,]    1    0    0
 [4,]    1    0    0
 [5,]    1    0    0
 [6,]    0    1    0
 [7,]    0    1    0
 [8,]    0    1    0
 [9,]    0    1    0
[10,]    0    1    0
[11,]    0    0    1
[12,]    0    0    1
[13,]    0    0    1
[14,]    0    0    1
[15,]    0    0    1
```

Fig 6: The above picture is of initial values assignment of cars, airplanes and bikes.

```
> cbind(prob, Predicted_class = pred, Actual = trainy)
                                          Predicted_class Actual
 [1,] 7.246165e-01 0.0013771065 0.2740064859            0      0
 [2,] 6.592169e-01 0.0010134695 0.3397696018            0      0
 [3,] 7.591561e-01 0.0007591469 0.2400847524            0      0
 [4,] 7.880597e-01 0.0315755159 0.1803648621            0      0
 [5,] 7.123086e-01 0.0110597406 0.2766315639            0      0
 [6,] 8.435203e-05 0.9993694425 0.0005462192            1      1
 [7,] 7.146647e-05 0.9991797805 0.0007487240            1      1
 [8,] 1.307985e-03 0.9931225181 0.0055695153            1      1
 [9,] 1.288214e-04 0.9988337159 0.0010374120            1      1
[10,] 3.763228e-03 0.9866387844 0.0095979692            1      1
[11,] 1.400123e-01 0.0047142319 0.8552734852            2      2
[12,] 2.614087e-01 0.0024154473 0.7361757755            2      2
[13,] 4.703862e-01 0.0023789990 0.5272347927            2      2
[14,] 4.142499e-01 0.0016958156 0.5840543509            2      2
[15,] 2.358154e-01 0.0076813214 0.7565032840            2      2
>
```

Fig 7: The above picture shows the actual and predicted values

VI. PERFORMANCE METRICS

Methods	Accuracy	Precision	Recall	F1-Score
Convolutional Neural Network	98%	96%	95%	95.4%
Naïve Bayes	95%	94%	94%	94%
K-means Clustering	92%	92%	91%	91.4%
Support Vector Machines	91%	90%	91%	90.4%
Linear Regression	88%	88%	89%	88.4%

VII. FORMULAS

TP denotes True Positive
TN denotes True Negative
FP denotes False Positive
FN denotes False Negative

$$\text{Accuracy} = \frac{TP + TN}{TP + FP + FN + TN}$$

$$\text{Precision} = \frac{TP}{TP + FP}$$

$$\text{Recall} = \frac{TP}{TP + FN}$$

$$\text{F1Score} = 2 * \text{Precision} * \frac{\text{Recall}}{\text{Precision} + \text{Recall}}$$

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VIII. CONCLUSION

This data set uses both for training and testing purpose using Convolutional Neural Network. It generates the accuracy rate of 98%. Photos that are used for the training purpose are very tiny and Grayscale photos. The time taken for computing or processing these photos is too high when compared to any other JPEG photos. [10]

Also in this we used TensorFlow as back end method due to which we were able to categorize the data into correct set. However, the performance measures maximum classification accuracy and minimum computational time are not guaranteed as these algorithms are sensitive to the fitting.

We gathered and evaluated the CNN model to classify images of cars, airplanes and bicycles. We have tested that this model works really well with a small number of images. We measured how the accuracy weighs on the number of epochs in order to identify potential over-fitting problem. We determined that epochs are enough for a successful training of the model.

IX. FUTURE SCOPE

The outcomes in this project are based on the results that involve only sample datasets. It is necessary that much more datasets should be considered for the evaluation of different classification problems along with different methods as the information growth in the recent technology is extending. The field of technology is growing day by day and data are by nature dynamic. Therefore, further classification of the entire system needs to be implemented or executed right from the beginning since the results from the old process have become less optimistic. The scope of future work can deal with innovative learning, which contains the existing model and processes the upcoming and new models, methods more efficiently. More specifically, the models with innovative learning can be used in categorization process to improve the accuracy of the particular model.

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