An Efficient Methodology for Object Classification using Light Weight Deep Convolutional Neural Networks

Anjanadevi B, S Naga Kishore Bhavanam, E Srinivasa Reddy

Abstract: ***In current era, deep convolution neural networks (DCNNs) have good break-through in processing images while reducing computational cost and increasing accuracy. Proposed approach focuses on object detection using classification with DCNN model. This model uses feature map for pre-processing the images and convolution layers helps to minimize the processing using deep learning perceptron's. After that the proposed approach uses Light – Weight Deep Convolution Neural Network(LW_DCNN) Model which includes less number of convolution layers, Max Pooling layers with relevant parameters and Dense, flatten layers to train the data using Leaky ReLU function for improving accuracy. The proposed methodology LW_DCNN is highly efficient compared to traditional classification techniques and presenting simple and powerful model for object detection in Video Surveillance Systems. This model also tested on GPU systems and proved efficiency in less computational time. Obtained Results are clearly shows that model is more efficient in classifying the objects intern classifying the working condition of the overhead power polls insulators in real time video frame sequences.***

Index Terms: ***Deep Convolution Neural Networks(DCNN), Light – Weight DCNN Model (LW_DCNN), Leaky ReLU, AMPWC (Auto Monitoring of Product Working Condition).***

I. INTRODUCTION

In current era Artificial Intelligence (AI) is playing a key role. Deep learning(DL), object detection from screen, in that object classification is playing a key role [1]. DL is a part of machine learning which deals with algorithms inspired with structure and functionality of brain, this is also called artificial neural networks. Deep learning algorithms training features with more number of layers. This contains neurons which are connected to each other and pass information in between them. Obtained features are used to segmenting objects [2]. Each layer takes the information as input from the previous layers and process them in current layer and pass them to the next layer. These models perform well even with the large amount of data [3]. In this deep learning model feature extraction is done by the machine itself. Convolution neural networks [4] process the images by training the data with suitable features along with weights and bias parameters. CNN is used to reduce the number of internal parameters while computation. In literature, the MNIST Digit dataset is classified into 10 classes each with a set of 24 images where the image within a class looks similar [5]. The literature working on MNIST dataset and for classification using pre-defined models requires more computational time. Here, Proposed model uses the real time overhead power polls insulators data for classification of working condition of insulators good or not by using AMPWC (Auto monitoring of product working condition) System instead of manual check. The system uses a novel Light Weight DCNN (LW_DCNN) for AMPWC is described in detail in the following sections. The following sections describes overall process of object classification with results and discussions.

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II. PROPOSED METHODOLOGY

Basically, the proposed network is trained for object classification which is used for monitoring working condition of pin insulators which are equipped in overhead power lines. Periodical checking of insulator work condition (good or bad) is most important requirement in current scenarios. So that, working on this problem and giving efficient results is challenging thing. Here, we considered data of 720 images in which 320 are good working insulators and 360 insulators are not working (bad conditioned). In training stage, the network is trained using dataset of 60 percent and tested on 40 percent data. By using Deep Convolution neural network (DCNN) in less computational time we can process more data, because here, overhead power polls insulators data is generation is more in less time. By traditional image processing techniques takes more time to process this much of data. So that Custom DCNN model is gives better results in this area.The Proposed customized DCNN model (LW_DCNN) uses Convolution plus max_pooling plus Leaky ReLU function along with flatten and dense layers. It performs automatic feature extraction with weight assignments, here the weights are assigned in a random fashion. In first convolution layer, activation function is used with stride and padding on the input image then batch normalization is performed on the data which is passed through the first convolution layer. Then applying max pooling layer on convolved shape, so that closure features are extracted and conv+max pool is continued to classify the objects of suitable condition type (working or not). Detail Algorithm is shown in figure1. Core Layers of the model are Convolution, Max_polling, Dense Layers and Flatten Layers. The functionality of these layers are as follows:

A. Convolution layers

This layer applies a filters to the input. It convols the input using filters by sliding over the input in horizontal and vertical directions and computing dot product of assigned weights and obtained input after adding the bias to them.

B. Pooling layers - MaxPooling2D

Max Pooling operation for spatial data. It performs down sampling by reducing dimensionality of the input representation. It reduces the computational cost by reducing the number of parameters.

In this model, less number of layers are used and obtained good accuracy with less computational time. So this model is named as Light weight DCNN (LW_DCNN) object classification model.

C. Algorithm (Light-Weight DCNN Classification Model (LW_DCNN)

1. Input images considered in target size 251*250*3 holds raw pixel values of the image (width, height, channels) as (251,250,3).
2. Applied Convolution2D with kernal (3X3) and 64 filters are used to compute the Feature map with local regions in the input image, and Relu activation function is used with a dot product between their weights and local regions that are connected to input volume. produces output shape (118,118,32).
3. Maxpooling with pool size 2X2with padding =1 produces output shape (59,59,32)
4. Convolution2D with 32 filters with relu produces (57,57,32) and maxpooling with same padding produces (28,28,32).
5. Repeat step 4 and applying layers and produces output shape (13,13,32).

Finally flatten and dense layers used in the network for handling data into vectors formation and achieved accuracy of 0.8154. The below figure describes overall System process in step by step.

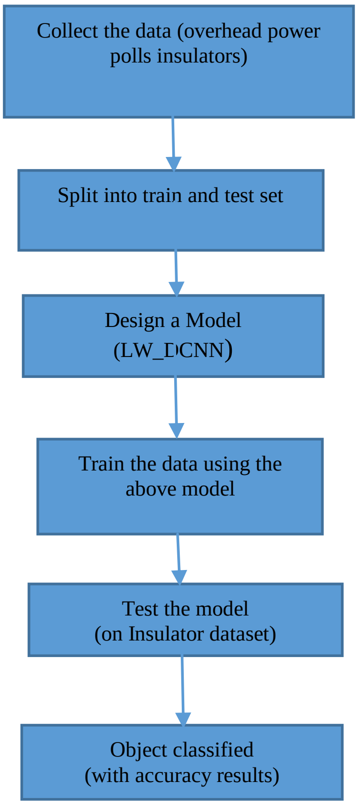

Fig 1: Flow diagram for Overall System

PROPOSED SYSTEM ARCHITECTURE

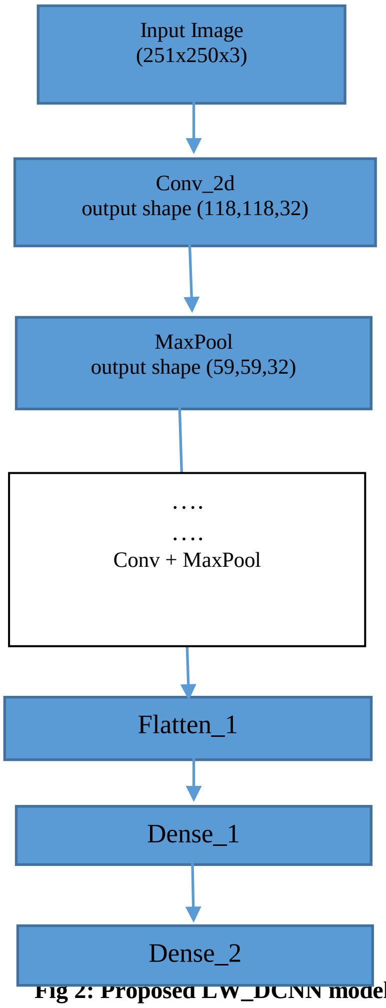

Fig 2: Proposed LW_DCNN model

III. EXPERIMENTAL RESULTS AND DISCUSSION

The input test sample images (Figure.3(a) & (b)) which are supplied for the model for finding an object and classified as working or not.(good condition or not) based trained data set of features.

Fig 3(a) Test_Image1 (working)Fig:3(b) Test Image2(not working)

The graph in figure 5 and figure 6 shows the accuracy results which are obtained after testing the network on Insulator dataset. The dataset contains images of insulators which belong to two classes based on working condition or not.. The below section provides sample data set of Images to obtain the features on pin insulators.

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Figure 4: Custom Dataset Of Pin Insulator Images

The graphs in below section provides the graphs which shows accuracy results of classification results of different categories. The figures 5 and 6 displays results of test images of epoch number.

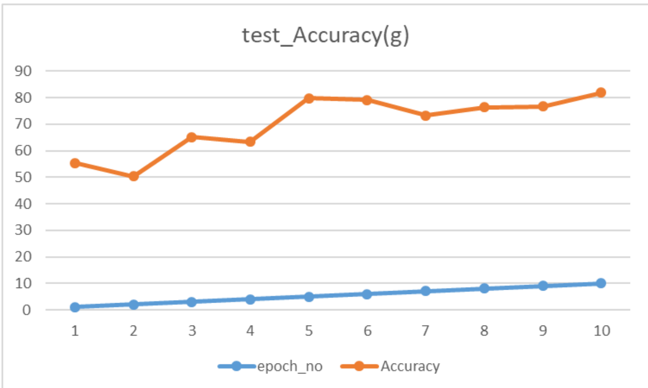

Figure 5: LW_DCNN Based Accuracy Graph (When Insulator Is Good Conditioned)

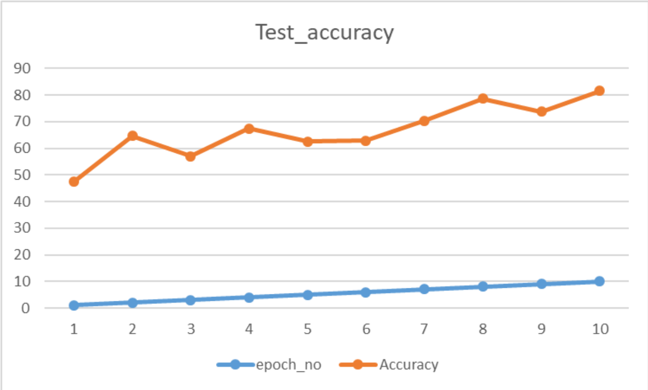

Figure 6: LW_DCNN based accuracy graph (when insulator is in not working conditioned)

IV. CONCLUSION

The proposed model LW_DCNN Object classification used for identifying the object. Here, proposed model used for classifying the object with working condition and obtained good accuracy. This architecture is very useful in real time monitoring of working condition of the insulators on overhead power polls. Which intern reduces lot of time for finding the working condition instead of manual check. Though, here less number of convolution+maxpool layers used for finding deeper insights in the images and also helps to minimize the Computation time. This method produces good accuracy in less computation time while compared to existing models. Further, extending to collect the data using drone thermal cameras in all the times in a day. Handling challenges in thermal camera images is open problem for current researchers.

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