Tensorflow Based Image Classification usingPyramidal Multiscale Convolutional Network with Polarized Self-Attention (PMCN-PSA)

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***Abstract* -** Using a PMCN-PSA, image classification tasks will be carried out in this research. Since Tensorflow is a Python library, Python will be our primary programming language in this case. The majority of the input data used in the research focuses on plant classification using leaf types. The best course of action for the training and testing data is to use PMCN-PSA because it consistently produces positive outcomes for automated plant identifications. TensorFlow's performance analysis for the precision of the model's prediction on TensorFlow and a comparison of the outcomes with Python show that the model can predict outcomes effectively and accurately when compared to both human cognition and computational neural networks in terms of image recognition. On the Intel® CoreTM i3-7100U CPU, TensorFlow with nonlinearity demonstrated remarkable accuracy at 95%.

***Keywords* -Convolutional Network, channel wise feature extraction, TensorFlow, Image classification, spatial wise feature extraction.**
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I. INTRODUCTION

The fastest-evolving technology right now for developers is image recognition. To better grasp what image identification is, let's use an example of recognition. To better grasp what image identification is, let's use an example. Google currently employs image captures to verify users [1–3]. Social media platforms these days often contain numerous images of users, either tagged or untagged. Therefore, in social media, this technology is essential for accurately identifying individuals based on their facts in 95% of cases and above [4–6]. The ability of modern technology to identify images surpasses that of humans. Here, machine learning has an advantage over other strategies. Artificial intelligence includes machine learning, which is capable of carrying outtasks without the need for human involvement [7–9].

The identification of plants, which is the process of classifying a specific plant into a taxonomy based on its characteristics, is the focus of this research [10]. Quantitative and qualitative features will be used to identify these qualities. While qualitative characteristics, including size, colour, and appearance, convey information in terms of their features, statistical features provide quantifiable data [11–13]. All of these things need to be classified because different plants closely resemble one another. Because image identification is the greatest challenge for machine vision, taxonomists seek more effective ways to meet the criteria for identification [15–17]. Therefore, tensorflow-based PMCN-PSA is employed in this work for identification; datasets should include hundreds of images in them.

Five parts make up the paper: the second part, which summarizes the relative work; the third part, which describes the technique; the fourth section, which summarizes the findings and discussion; and the final section, which summarizes the paper's main points.

II. RELATED WORK

Here we review some related paper in deep learning based on tensorflow are given below;

Abu et al. [18] introduced image categorization using TensorFlow and a deep neural network (DNN), also known as deep learning. Python is a good programming language due to the TensorFlow infrastructure that is included.The input data mainly focuses on the flower category, and 5 types of flowers are used in this paper. The significant validation loss is high.Yeboah et al. [19] developed the categorization of images using deep learning and the TensorFlow GPU. The datasets for the classification modules are CIFAR-10 and MNIST. The outcomes demonstrate the effectiveness and precision of TensorFlow GPU-based deep learning-based picture classification. Additionally, some important problems that have an impact on performance as a whole are discussed. It has high accuracy but less precision.

Binary format image categorization using a Quantum Convolutional Neural Network (QCNN) was presented by Chen et al. [20]. The image data is properly downscaled using MERA and BC-FF before being sent into the QCNN's quantum circuitry for quantum pooling, state preparation, and convolution. Three hybrid QCNN models and one QCNN were trained using a breast cancer dataset, and their performance was compared to that of a traditional CNN. It has a high computational time.

The classification model image was developed using the Tensorflow library and CNN architecture created by Kembuan et al. [21]. The dataset used for this analysis is called Indonesian Sign Language (BISINDO), and it contains 2658 images for each of the 26 letter categories. It achieves good accuracy but has a high validation loss.

Tripathi et al. [22] introduced Deep CNNs are widely used for a variety of jobs to analyze, detect, and classify images. Similar to human neural networks, these neural networks have neurons with learnable weights and biases that are taught to recognise and categorise various objects or features in the picture. With less complexity proposed and excellent classification accuracy produced for all tested data sets, this paper provides a practical implementation of image recognition using a small convolutional neural network. Time consumption is high.

I. PROPOSED METHODOLOGY

From a computer perspective, using CNN in particular is a very popular process for deep learning. Many expectations have been raised by ImageNet's exciting findings. Here, CNN attempts to recognise plants using their complete image or any of their sections, which is the most challenging assignment, whereas other organisations handle the process one step at a time, starting with a particular organism (such as flowers, leaves, or bark) before moving on to the entire image of the organism. There are some restrictions with CNN, such as its poor performance with very large image sets or its lack of explanation ability. Therefore, PMCN-PSA will take the place of CNN as it is more compact than CNN for image recognition.

This will determine how PMCN-PSA categorises architectural images. The proposed network has a network for classification, a network for pulling features spatially and channel-wise, and a network for channel-wise feature extraction. The channel-wise feature extraction contains one channel-only PSA block, four convolutional layers, and three channel-wise convolutional blocks. Both residual grouping and one-shot grouping are used when retaining early data.The spatial feature extraction network is framed by feature extraction frames for each channel. The spatial-wise feature extraction network has two convolutional layers, one spatial-only PSA block, and three spatially-aware pyramidal convolutional blocks, just like the channel-wise feature extraction. The spatial pyramidal convolutional algorithm employs a method known as one-shot groupings. In order to keep the network unpredictable and stable, Batch Normalization (BN) and Parametric Rectified Linear Unit (PReLU) are strategically positioned.

The classification network, which consists of a BN layer, a Mish layer, an average pooling layer, and a linear layer, is then tasked with producing the classification outcome. Features are derived from feature maps are determined by using the average pooling layer. By applying the BN layer, the network is stabilised and made simpler to converge. To give the output data a broader range of values, the Mish activation function is used. The linear layer is used to deliver the classification outcomes at the end. All of these steps rely on the TensorFlow function, an open-source programme with all of its libraries written in the Python programming language. After importing TensorFlow, each stage will proceed as planned.

Consider the input data be a $a_i \in M^{d \times h \times w}$, where, d is denoted as the amount of channels, a_i is the cube-based HSI data of i_{th} pixel, $h \times w$ is denoted as the spatial size of the data and the output of the network is $b_i' \in M^{1 \times r}$. The suggested network is trained using cross-entropy loss, which can be written as

$$l_i = -\left[b_i \log b_i' + (1-b_i)\log(1-b_i')\right] \qquad (1)$$

Where, b_i is denoted as the land cover label of the i_{th} pixel and l_i is the cross-entropy loss of the i_{th} pixel.

A. Feature extraction

As a result, a channel-aware convolutional block and a spatial-awareness pyramidal convolutional block (two types of PCBs) are implemented. Both spatial feature extraction networks and per-channel feature extraction use these nodes.

Assuming the incoming data are fr_i, the channel-wise convolutional blockhas three convolutional layers with multiscale feature extraction using $(7\times1\times1),(5\times1\times1), and (3\times1\times1)$ kernels. The characteristics are then brought together using the concatenation operator. For the network's stability and nonlinearity, BN and PReLU are used. Convolutional layerswith PReLU and BN are utilized to the feature maps to reduce their dimension and generate the output (fr_{out}). Three convolution layers with $(1\times7\times7),(1\times5\times5), and (1\times2\times2)$ kernels are included in the spatially-aware pyramidal convolutional blockto retrieve multiscale spatial attributes.Combinatorial operators as well as per-channel convolution blocks are used to build feature maps. The ultimate output is then produced using the convolutional layer, BN, and PReLU after that.

B. Classification

The spatial-only block and the channel-only block are the two types of PSA blocks that are introduced in the classification process.

The input of feature map is fr_i and the channel wise attention weight $a^{ch}(fr_i)\in M^{c\times1\times1}$ can be written as in equation (2),

$$a^{ch}(fr_i)=f_{sg}(k_z(\sigma_1(k_v(fr_i))\times f_{sm}(\sigma_2(k_q(fr_i))))) \quad (2)$$

Where, $\sigma_1 and_2$ are the tensor reshape operators, $w_{z,}w_q, and w_v$ are the (1×1) convolution layers, the Softmax operator is defined as $f_{sm}(.)$, $f_{sg}(.)$ is denoted as the sigmoid operator and $(\times)$ is the dot-product matrix operator.

The output fr_{out}^{ch} of the channel-only block can be written as in equation (3),

$$fr_{out}^{ch}=a^{ch}(fr_i)\otimes^{ch} fr_i \quad (3)$$

Where, $\otimes$ is denoted as the channel-wise multiplication operator.

The spatial-only block $a^{sp}(fr_i)\in M^{1\times h\times w}$

$$a^{sp}(fr_i)=f_{sg}\left[\sigma_3(f_{sm}(\sigma_1(f_{gp}(w_q(fr_i))))\times\sigma_2(w_v(fr_i)))\right. \quad (4)$$

Where, $\sigma_1,\sigma_2 and \sigma_3$ are the tensor reshape operators, $w_q and w_v$ are the (1×1) convolution layers and f_{gp} is denoted as the global pooling operator and $(\times)$ is the dot-product matrix operator.The output fr_{out}^{sp} of the spatial-only block can be written as in equation (5),

$$fr_{out}^{sp}=a^{sp}(fr_i)\otimes^{sp} fr_i \quad (5)$$

Where, $\otimes^{sp}$ is denoted as the spatial-wise multiplication operator.

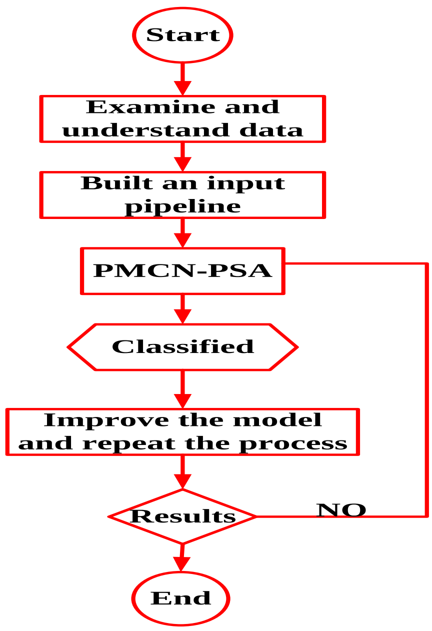

Figure 1: Flowchart of proposed method

TensorFlow will be used for the image classification flowchart application. This flowchart shows that the categorization process will begin by looking over and comprehending the data. The input route will be built, and the model will then be trained using PMCN-PSA. Images of leaves are the basis for PMCN-PSA testing, and it must be repeated if the output does not match your expected results. When output is put into the correct category, the procedure is finished.

I. RESULT AND DISCUSSION

There are 6000 images in each of the 10 groups of the CIFAR-10 dataset's 60000 total images. The information in this case will be split into two phases: training and testing.There are fifty thousand images in the training phase and ten thousand images in the assessment phase. Here, there is no overlap between the groups and they are all mutually exclusive.

A. Results of Image Classification

There are several image classification models in deep learning algorithms that are applied in real-world scenarios. Numerous methods have been developed, and more are constantly emerging. In contrast to PMCN-PSA, we will now discuss some of the fundamentals of other models.Regression and classification neural networks are trained using deep neural networks (DNN). Because of its poor accuracy, DNN does not work well with images.

Convolutional Neural Networks (CNN) has a strong track record of achievement in image classification, object recognition, and other tasks. In comparison to DNN, the outcomes are muchoptimized here. However, the significant validation loss in CNN results in over-fitting.Another strategy for applying newly acquired information is transfer learning. It implies that a model that has already been trained is used on a big dataset to produce accurate results in related research. However, compared to other places, this accuracy is excellent and takes less time.

Table 1: Results of comparing the suggested method to existing techniques

S.NO	ACC-R	TC	ER	VL
DNN	81%	5 hrs	Very high	7.6
CNN	91%	4 hrs	high	4.5
Transfer Learning	93%	13mins	Low	0.7
PMCN-PSA	96%	7mins	Very low	0.2

Results of the suggested method's comparison with existing approaches are shown in table 1. It may be shown such as Accuracy rate (ACC-R), Error rate (ER), Time consume (TC) and Validation Loss (VL). From Table 1, we can clearly see that the proposed method has higher accuracy than other existing methods.

II. CONCLUSION AND FUTURE WORK

In conclusion, the issue of image classification or identification using the TensorFlow Framework and PMCN-PSA has been explored in this research study. Using the CIFAR 10 dataset, we conducted classifications on plant leaves for this study. As a consequence, we examine the comparison of various models using the given dataset. While others are unable to provide results that are objective-based, the PMCN-PSA achieves all results with a precision of over 95%. Our primary goal is to classify images using PMCN-PSA because adding dense layers and lengthening epochs improves results. Epochs are employed to manage the overfitting issues. PMCN-PSA are much quicker than other types, and they classify data much more quickly. Because PMCN-PSA uses both GPUs and their own TPUs to operate. Even faster than the GPU is the TPU. As a consequence, we will outperform othersthrough this. Our PMCN-PSA will be further enhanced so that it can classify a large number of pictures, and we may even change our model. Since the TensorFlow framework is a popular tool for building data models, studies on this subject will continue with the help of numerous species images.

III. REFERENCES

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