BeClear : Blur Detection in images using CNN

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***Abstract*—With the availability and usage of digital cameras in today's world, the number of digital images increases gradually which increases the demand for automatic image quality assessment. One of the major checks in image quality is detecting blurriness in the image. There are many methods to detect blurriness in the image where some of them are AlexNet, Unet, Mobile Net, VGG 16 and many more. These methods give more accuracy models on the dataset which may be feasible for applying in real-time applications. Few may also use KNN, Naive bayes, decision tree, but these do not give more accuracy in image classification as image classification need feature extraction. Hereby, we proposed a solution which uses convolutional neural networks which predict whether the image is blurry or not.**

Keywords— CNN, Blur detection, variance of Laplacian, convolution 2D component

I. INTRODUCTION

As the popularity of digital cameras is increasing, many have a huge collection of digital pictures. Even the photographers who take pictures in ceremonies like weddings, birthday parties and anniversary celebrations confess that almost 40% of the images taken by them, have a less quality of pictures.[1] One of the reasons for such poor quality of pictures is blurriness in the images. Therefore, Blur detection on these images helps the photographers or users to classify the images so that one can move all the blurred images into a separate folder so that their efforts in separating out the images becomes less.

Blur detection is more challenging as it is hard to distinguish the blur type, blur level and blur setting . It segments the blurred parts of an image accurately.[2] It is an important application in salient object detection, image restoration, defocus magnification, deblurring, blur segmentation and so on. According to the cause of Blurness,the blur is divided into 2 types i.e., out-focus and motion blur.[2][3] Blur detection is a baseline for many applications as mentioned above. Usually, Blur is purposefully added by the photographers or the cameraman to add effects to the image. This skill is very common by optical imaging systems. All these hand-crafted feature-based methods are convenient and effective.[1]

Blur detection is a rudimentary task in real time world. Multi-Layer Perceptron comes as a base structure to build this model. On top of that state of art architectures of Convolutional Neural Network such as Unet, AlexNet make the model more efficient.[1][4] Regarding the extraction of the features, differentiating between distorted and clear images is an efficient task in this model. In this model to differentiate the features we use a nonlinear activation function and, while classification of the image as blur or clear we use a linear activation function. Using both linear and non-linear activation function makes our model more efficient.

There are many methods in the field of machine learning where we can detect blur in a given image and classify the image as blur or clear image. Some of the methods are using variance of Laplacian using OpenCV library in python, using MLPCLassifier of sklearn library, implementation of Convolutional neural networks using TensorFlow and keras libraries in python. These methods give our desired output in a single floating value point which represents the class i.e., blur or clear.[5] These methods differ in giving the accurate results.Though,some methods can give good and appropriate results, other methods can give an inappropriate result while some may give accurate results based upon how we work in each method.

II. LITREATURE SURVEY

In [1], various problems of photographers were discussed. The photographers and their clients concluded that blur detection was a major problem in most of the case. They discussed about various methods of implementing blur detection in the field of machine learning in which CNN and Variance of Laplacian were considered superior to other methods. They made a comparison between CNN and variance of Laplacian and found that Variance of Laplacian was more efficient than the CNN methods in terms of accuracy and specificity.

In [3],they discussed the importance of Defocus Blur Detection. They presented an efficient way of obtaining local metric map for defocus blur detection based on CNN. They found that this method was better than the previous state-of-the-art methods. They discovered a novel iterative updating mechanism is proposed to refine the defocus blur detection result from coarse to the fine and they concluded it by exploiting the intrinsic peculiarity of hyperbolic tangent function.

In [2],a new method to implement the Blur Detection using VGG-16 network was discovered. It explains the working of VGG-16 and the layers used in it to classify the image as blur or clear. They found out the time ,their model takes to evaluate the image. A Step-by-step deconvolutional layers were introduced to get the same resolution with the input image. They concluded that their method has achieved fast evaluation speed and a good performance which can work on large datasets.

In [4],method for detection two kinds of partial blur, defocus blur and motion blur by deep CNN was proposed. They discussed the difficulties while applying partial blur detection. They have constructed synthetic dataset to resolve the mentioned issue. Their experiment proved that their model can perform better that the existing state-of-art architectures. The researchers have limited this paper only to detection of various types of blurs and have not focused on the estimation parts of blur.

In [5],this study has proposed a deep learning framework knows as Deepfocus for identifying blurry regions in digital slides. The researchers have discussed the accuracy, training and evaluation components i.e., the implementation of their proposed framework. They have discussed the advantages and the robustness of Deepfocus learning framework.

III. PROPOSED CNN MODEL FOR BLUR DETECTION

In the beginning, we have used variance of Laplacian using OpenCV where we get the threshold using that we get a blur rate to classify the image. Using this we have got a less accuracy ~62% then using the Sklearn library available, we have used MLP classifier to train our model with that trained model we have got an accuracy of ~78%. And upon analysing the things we came to know that there are some corner cases such as image of a plan wall, image of a picture taken in portrait mode. These were wrongly classified. Then we have decided to implement Convolutional Neural Networks using Keras and TensorFlow which we found as the simple and easiest technique. It gives the output as a single floating-point value which represents the class of the image i.e., blur or clear.

We have used Convutional neural networks on a pretrained model i.e., Unet for implementing blur detection on the images. The Unet Architecture is shown in figure 3.1.

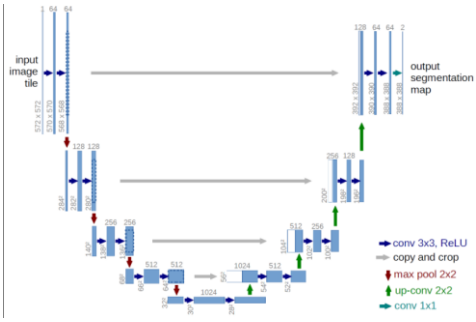

Fig 3.1

A CNN-trained model based on a dataset which contains training and evaluation directories in which there exists other two directories namely Naturally-blurred, artificially-blurred and undistorted image directories in training set and naturally-blurred and artificially-blurred directories under evaluation set of Certh image blur dataset.

Our dataset uses two types of blurs i.e., natural blur and artificial blur to classify the images. When there is any disturbance in the movement of the camera while clicking the picture, the image obtained is said to be naturally blurred. If the lens of the camera is not focused, then the image obtained is said to be artificially blurred. If the image is clear without any disturbance, then it is said to be undistorted.

As we are giving any kind of images without any specifications, we may get some specific use cases where the system may give an unpredicted answer. Some of those use cases include
1) An empty wall which should be interpreted as a clear image,
2) An image taken in Portrait mode from an iPhone which should be portraited as a clear image,
3) An image which contains 2 ppl standing diagonally in which a person standing away is clear whereas another person is blurred. This scene should give us a blur verdict,

These are some of the use-cases which are implemented in real life.

IV. IMPLEMENTATION

- Primarily we have collected the dataset from a valid open source, GitHub (data collection stage).
- Next, we have done the data cleaning as a second step in our project. We have checked whether the image is corrupted or not and then we have cross verified whether the images are placed correctly in their respective directories or not.
- We set the dataset folder path for training and validation folders, load all the image arrays and save the arrays as a pickle file for easy access of each folder further in the implementation part.

- Now, out dataset is ready to be sent into the model for training and validation purpose.
- We have used Sequential model – a 5 X5 CNN layer to train our model.
- We have added 4 convolution layers ,3 max-pooling layers, 4 dropout layers, 1 flatten layer and a dense layer as shown in the figure 3.1
- The activation functions used to train our model is ReLU and SoftMax. ReLU is used in Hidden Layers and SoftMax is used as the output layer.
- The optimizer for the model used was Adam as shown in figure 3.2
- The trainable parameters were 5,668,162.
- The architecture is as follows:
    - Input Layer as the convolutional 2D Layer, A combination of convolutional 2D and maxpooling layer with dropout layer added to it for the next 3 layers. (Conv-pool-dropout). After flattening the previous layer, we have the output dense layer without SoftMax for binary classification which gives a single floating-point value
    - Using the above architecture, we have trained the model. And then we have achieved a good accuracy.
- We compile the model using Adam Optimizer and use binary cross-entropy as the loss function.
- Now we, fit the model to 100 epochs with batch size of 128 and save the model to a h5 file.
- We calculate the train and validation accuracy by which we can know how accurate our model predicts the desired outputs.
- Then we have added a generic user interface where the user gives an image as an input to the model and our trained model predicts whether the input image is blurred or not.

V. RESULT DISCUSSION

We need to provide the input as an image of any format and it predicts whether the image is blurred or clear.

If the model gets implemented in web apps or mobile apps, then it can be directly installed and used. Our idea: one can use this model and segregate out the images based on its class i.e., blurred or clear . with this model one can move all the images that are blurred into a new directory.

The input in the interface can be as follows as in figure 5.1.

Fig 5.1

The output in the interface is as follows as in figure 5.2.

Fig 5.2

CONCLUSION

Blur detection have become a hot topic in the field of computer vision. There are many methods in the field of machine learning where this application can be implemented. There are also different types of blurs in Computer vision like motion blur, artificial blur, natural blur and many more. So, to handle such kind of blurs we need a model which can work on large dataset and can give a good amount of accuracy. Our paper proposes this kind of model using Unet architecture of state-of-art architecture of CNN which can solve the above problem. It provides the implementation of Unet architecture on Blur detection. The future work may include measuring the amount of blurriness in the blur image so that it could be helpful for the photographers to classify the images based on the amount of blur present in the image.

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