Keras 및 Tensorflow를 이용한 Faster Deep-learning CNN 기반 QoE 평가 소프트웨어 개발

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Faster Deep-learning CNN based QoE Assessment Software Development with Keras and Tensorflow

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요 약

현대의 고해상도 스트리밍 서비스는 사용자들로부터 높은 품질의 경험(QoE)을 필요로 한다. 높은 계산의 오버헤드를 위해 4K 스트리밍에서 비디오 품질에 대한 평가는 처리하기가 쉽지 않다. 본 논문에서는 기준 영상 없이 영상 화질을 정확하게 예측하는 심층 학습 기반의 CNN(Convolutional Neural Network)을 논의한다. CNN은 이미지 패치를 입력으로 삼아 기존 방식에서 채용한 수공예 기능을 사용하지 않고 공간 영역에서 작업하고 제안된 모델은 MOS(Mean Opinion Score) 범주의 모든 이미지를 분류하는 데 활용된다. 이 접근 방식은 KoniQ-10k 데이터 세트에서 적절한 성과를 달성하고 적절한 이미지를 적절한 범주로 분류하는 데 탁월한 일반화 능력을 보여준다.

Abstract

Modern high resolution streaming services requires high Quality of Experience (QoE) from users. No Reference video quality assesment in 4K streaming is difficult to process for high computation overhead. In this work we describe a deep-learning based Convolutional Neural Network (CNN) to accurately predict image quality without a reference image. Taking image patches as input, the CNN works in the spatial domain without using hand-crafted features that are employed by most previous methods. proposed model is utilized to classify all images in a MOS (Mean Opinion Score) category. This approach achieves state of the art performance on the KonIQ-10k dataset and shows excellent generalization ability in classifying proper images into proper category.

Key words

Deep learning, Convolutional Neural Network, Computer Networks, Video Steaming, 4K UHD, QoE

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Ⅰ. Introduction

Quality of Service (QoS) simply gives users a fairly technical sense of service quality. QoS is primarily focused on describing the objective, technical criteria that the network infrastructure or application needs to achieve in order to guarantee quality service. In other hand, QoE (Quality of Experience)is a measure of the satisfaction of people with the service they are using based on subjective judgment. Thus, QoE can be synthesized from pure QoS and other non-technical factors such as the characteristics of the human visual and auditory system, etc.

In general, most of the module has to understand Image Quality Assessment (IQA), as video sampled in random time to ensure proper quality is essentially images. In principle, it is the calculated of the distortion compared with an ideal imaging model or perfect reference image. This type of system is usually know as the Full Reference (FR) IQA model [1]. In the technical sense, all the QoE model build based on this principles have to be ensured to provide the base or main reference image to compare. But the main drawback of such models are often the model has no reference image due to the configuration of the network of systems. This is also known as the NR (No Reference) IDA.

Recently, deep neural networks have research and deemed optimal for recognitions and achieved great success on various computer vision tasks. Specifically, CNN (Convolutional Neural Network) has shown superior performance on many standard object recognition benchmarks [2]. In this Research, the main QoE assessment model was developed with the NF-IQA that is developed with CNN with classify the given images in it's distinctive MOS (Mean Opinion Score). The main idea of this CNN is to classify images that is being sampled in various time domain in a steaming in edge side then classify the MOS to asses the maximum MOS to ensure best QoE. The train CNN has outperformed the state of the art CNN models and later the CNN will deployed into the QoE assessment tool shown excellent result, that paves the way to deeplearning based CNN in the QoE assessment tools.

Ⅱ. Related Works

To the best of our knowledge, deep learning CNN has not been applied to general-purpose QoE assesment Models. The primary reason is that the original CNN is not designed for capturing image quality features. In the object recognition domain good features generally encode local invariant parts, however, for the NR-IQA task, good features should be able to capture the asthetics of the images as a whole. because of this problem, the CNN based QoE model has not yet been properly researched.

Kang et al. [4] described a CNN for no-reference image quality assessment. But the CNN take input as the grayscale rather than the RGB and had linear optimization process. This type of process is computationally enriched and often had problems in QoE model implementation. This research was inspired by our previous research about MEC [1] with content-awareness component which is placed at MEC to retrieve DASH information for clients. On the basic of research on fuzzy logic to obtain DASH segments with high quality, we deploy segment selection for DASH streaming to MEC. As a result, it reduces network latency as well as the computation resource of clients with high streaming quality. However, the assessment module needs to be in a state of art NF IQA based model that can classify the hi resolution images and later it will adjust the service based on the quality. The CNN based

research in this field is novel.

III. Dataset

A variety of IQA databases have been released nowadays for focusing mainly on the development. but most of the datasets are not focused on the quantity. As the main focus of the research was to develop the neural network or CNN for the VQA, the KonIQ-10k Dataset was the perfect choice for this research [5]. The proposed Neural Network model that used for the assessment tool is proposed in the following way. As the whole CNN has to process the images and map the features according to the output MOS category. The whole images were converted into distinctive image classes according to the MOS scores. The main convolutional layers were added in various filter size based, but the main modification in this model were the batch normalization layer distribution in each models to ensure proper unbiased learning. Later the model were pooled

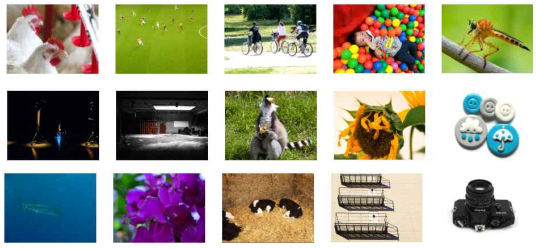

그림 1 KonIQ-10K Dataset Images Examples

and the densely connected layers mapped and merged the whole model to classify.

IV. Proposed Method

The QoE assessment model CNN was deployed in the python based program module in the machine. Experimental model was implemented in Python using Tensorflow and Keras libraries. The CNN neural net has 8 convolution layers with 32 filter with 5x5 kernel size and maxpooling after 2 convolution layers. then the dense fully connected

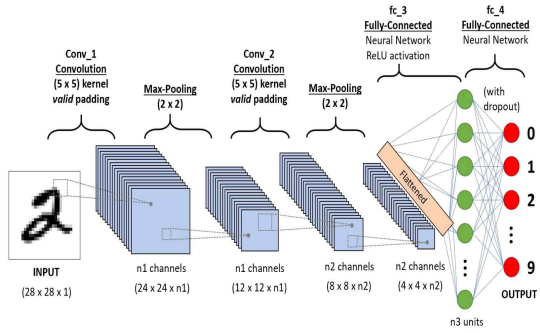

그림 2 Common CNN Architecture for Classifying Images Based on Label.

layers handle the classification of the convoluted features to classify the proper MOS category .The model was trained 100 epoch with different initialization. The batch size is 128 for both training and testing. Categorical crossentropy is used as the loss function in this model. Adadelta optimizer [6] is used to optimize the learning process. Among the 10300 images, 9500 are used

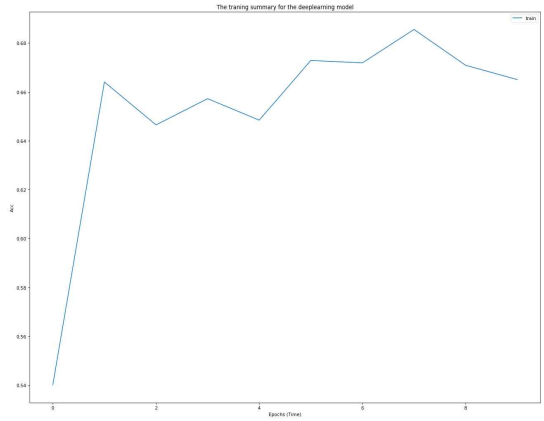

그림 3 CNN Training Accuracy Improvement over iterations.

for training and 700 is used in validation. We have used a computer with CPU intel i7-9700U CPU @ 4,30GHz and @ 32GB RAM. Nvidia Geforce GTX 1050 ti dedicated graphics is used for faster

computation, i.e CUDA support for accelerated training is adopted. The resulted assessment model successfully labeled the images based on it's learning and the whole model achieved a 78% accuracy over whole augmented learning. The previous all methods described models with more accuracy, although all other methods had pre-computed layers or some modern technique is included. This experiment process has the raw RGB hi-def image as input and the whole model were trained to classify only by assessing the pixel values. The proposed model is thus the novel representation of the QoE assessment tools and had the state of the art accuracy.

Ⅴ. Conclusion

4K or ultra-high-definition (UHD) will be the standard for video streaming in the next decade. In this research, we carry a study on deeplearning CNN QoE assessment tool which is a crucial adaptive algorithm. More specifically, we employ deep learning CNN algorithm in the form of quality of experience (QoE). In fact, QoE is an important factor to evaluate the efficiency of streaming transmission models. In this research article, we mainly focus on QoE performance analysis of streaming models to improve and ensure high quality (4K and UHD) streaming service in NFV. The developed CNN was state of the art QoE assessment tool with state of the art accuracy.

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