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Web Page Categorization based on Images as Multimedia Visual Feature using Deep Convolution Neural Network

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ABSTRACT: Due to the explosive growth of the multimedia content on the world wide web (WWW), searching, retrieving, and recommending information becomes a challenging task. Visual information on the web pages is advantageous for web mining tasks, that can be used as features to categorize the web pages. In this paper, a novel framework has been proposed to categorize web pages based on multimedia features, specifically image using machine learning techniques. The Deep Convolution Neural Network VGG-19 has been utilized to determine the feature vectors of images. The transfer learning implemented to reduces the computational cost of the proposed framework. The proposed framework effectiveness demonstrated by comparing performance with two handcrafted image descriptor methods: Fisher Vector (FV) and Vector of Aggregated Local Descriptor (VALD). The proposed framework has achieved a classification accuracy of 86%.

Keywords: Categorization, Logistic regression, Machine learning, Support vector machine, Transfer Learning, VGG19.

Abbreviations: DCNN, deep convolution neural network; URL, uniform resources locator.

I. INTRODUCTION

Now-a-days, millions of data are uploaded to the web every day due to this size of the web increasing rapidly. Thus, an efficient web page categorization method is needed to deal with rapidly user generated data. The Web page categorization is a highly complex task since it contains textual information as well as images, videos, hyperlinks and multimedia [1].

The Web page categorization is a process of assigning a category to a web page [2]. It is used in many applications such as information retrieval, parental filtering, focused crawling, and recommendation system [1, 3]. Many distinct approaches have been developed for the web page categorization based on the mining textual information [4, 5]. Many Researchers have used HTML tags, each term belongs to tags and combination of both to classify web pages. Still, modern web pages contain more visual features. So, it neglects valuable discriminative information present on websites. The Web page categorization based on multimedia visual content is a challenging task due to intensive computation and extensive training datasets. Web page categorization based on a multimedia visual feature useful for cross-language information retrieval of web mining applications.

Over the past years, the development of deep learning models has been utilized for audio recognition, image processing, activity recognition, and object detection [6]. The deep learning model requires a large training dataset to build an effective model to classify web pages based on images. In addition, a transfer learning enables to address this problem [7].

In this paper, a novel web page categorization framework has been proposed. The proposed framework incorporates VGG-19 deep convolution neural network with the transfer learning method that has not been explored in the earlier web page categorization approaches. The main contribution in this paper is listed as follows:

– Gathering web pages of various categories and extract images from them.

– The various machine learning algorithms are exploited with features obtained by VGG19 to categorize the web pages.

– Experimental results shows that high accuracy is attained with the transfer learning method as compared to the image descriptor method [8, 9].

The remainder of the paper is organized as follows. In section II, the related work is discussed. Section III describes the proposed visual feature-based classification system. The creation of dataset and discussion of experimental result is presented in Section IV. Finally, section V concludes proposed work and suggests for future work.

II. RELATED WORK

As per the survey done for the web page categorization, categorization approaches categorized web pages based on textual content features or visual content features.

In textual analysis, the web pages are categorized based on plain text and HTML tags. The Web page categorization is different from the text classification since the web page contains structured data. Many researchers have focused on Html tags and every term

belongs to these tags used in classification, but the number of features is large. So, many optimization techniques are used in web page categorization such as Genetic algorithm (GA), Particle Swarm Optimization (PSO), Ant Colony Optimization (ACO), and Firefly Algorithm (FA).
Özel (2011) has proposed a web page classification technique based on GA, which uses HTML tag and term to improve classification accuracy. This technique has been achieved significant improvement as compared with well-known Naïve Bayes and K- nearest neighbor classifier [2].
Lee *et al*., (2015) have introduced a web page classification based on simplified swarm optimization, which learns the best weight of HTML tag to classify web pages. In this approach, Taguchi method used to for parameter setting [4].
Goncalves *et al*., [10] have developed automatic web page categorization system based on visual contents such as simple color, edge histogram, Gabor, and texture features. Bag of Word (BOW) model has been used the Scale Invariant Feature Transform (SIFT) local features from each image as words allowing to construct a dictionary for improvement the accuracy. Principal component Analysis (PCA) and chi-square technique has been used to select top discriminative features. A Machine learning algorithm such as support vector machine (SVM), Naive Bayes (NB), AdaBoost, and Decision Tree (DT) has been used to classify web pages based on their aesthetic value, recency value, and type of content.
A web pages are categorized based on the visual appearance of web pages [11]. This visual appearance is Look and Feel, aesthetically well-designed v/s badly designed, recent site v/s old sites. The low-level visual features used in the document are simple color and edge histograms, Gabor, and texture features. These were extracted using an off-the-shelf visual feature extraction method. J48 and Naïve Bays machine learning algorithms has been used to classify web pages.
In past literature, A Convolution Neural Network (CNN) applied to classify pornographic and non-pornographic web pages based on their visual content images and video [12]. It used DCNN (Deep Convolution Neural Network) network Alexnet and Google net architecture.
Hu *et al.,* [13] have proposed a text and image fusion algorithm to categorize pornographic web pages. A decision tree used to divide the web pages into continuous text pages, Discrete text pages, Images based pages. Continuous, Discrete, and Image classifiers were used to categorize pornographic web pages. Image classifier applied object contour-based image feature, and text classifier used naïve Bayes rule to categorize pornographic web pages.
Wang *et al.,* [14] have proposed a deep learning technique applied to classify adult images to categorized pornographic web pages. It focused on local context discriminative regions Such as naked bodies rather than global context such as the background.
Nian *et al*., [15] have proposed DCNN to detect pornography images on web pages. The Dataset obtained by the Internet to improved accuracy by data augmentations technique. It used the sliding window method for fast scanning of images.
Liparas *et al.,* [16] have developed a hybrid system which combined visual and textual features for web page categorization. N-gram model applied to extract textual features from the text. MPEG-7 visual descriptors extracted the low-level visual feature for a single image of the web page. A Random forest classifier reported higher accuracies than individual images and text classifiers.
Lopez Sanchez *et al.,* [17] have proposed a DCNN classifier to extract the feature vector of images. They applied Support Vector Machine, Logistic Regression, Perceptron, and K-Nearest Neighbor classifiers to classify web pages. The experimental result achieved good classification Accuracy.
Lopez Sanchez *et al.,* [18] have introduced a hybrid Framework to categorize web pages using their visual content images. Pre-trained VGG 16 model extracted case representation features. Dr. LIM algorithm used to resolve overtime learning. It also used a case-based reduction method Near miss -3 algorithm.
Lopez Sanchez *et al.,* [19] have proposed a DCNN using transfer learning and metric learning for feature extraction to categorize web pages with high categorization accuracy and resolve the overtime learning using Triplet loss and Dr. LIM algorithm. It achieved high accuracy over distance-based classifiers using metric learning.
In the above survey, researchers categorized web pages based on html textual features, but modern web pages contain little text information. So, the visual feature images-based framework is needed to categorized web pages.

III. PROPOSED FRAMEWORK

In this section, the proposed Novel framework is described in detail. First, the global structure and elements of the processing pipeline are presented, followed by a detailed description of each component of the chain. The proposed web page categorization framework is shown in Fig. 1 that work as follows:
– Collect the web page from WWW, extract all the images available on the web page and filter those that do not contain discriminative information.
– Applied VGG 19 model to compute feature vectors of each image.
– Finally, web pages are categorized.

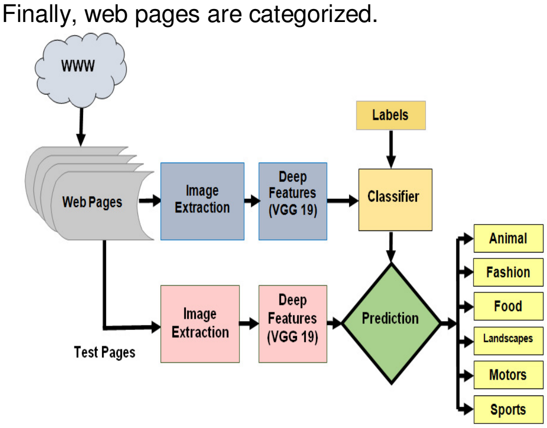

Fig. 1. Proposed web page categorization framework.

A. Extracting Images from web pages

Firstly, the web page is downloaded from WWW corresponding to given URL(uniform Resource Locator). All images present in web page is extracted. A web page parses is applied to parse web pages and all the web page elements are extracted. The parsed web page consist of the HTML tags. In order to extract all the images, the URL corresponding to “IMG tag.” are extracted. All the images of web page are downloaded corresponding to image URLs. Image URLs that contain web page discriminative information are stored only and image URLs such as advertisements, banners, navigation icons, etc. are discarded.

B. Deep Feature Extractor

The proposed image classification method requires a large number of training instances due to his high intra-class and low inter-class variability. To overcome this difficulty, transfer learning is applied [7].

In the proposed framework, the Pre-trained CNN model (VGG19 DCNN) is applied to extract feature vector. It is developed by the visual geometry group at the university of oxford [20]. The VGG19 model is trained on the image net data set which consists of 1.2 million training images with 1000 categories. It has been achieved 92.5% test accuracy. VGG19 DCNN model contains 16 convolution layer, five max-polling layers, two fully connected layers, and one SoftMax layer. The overall architecture of VGG19 shows in Fig. 2.

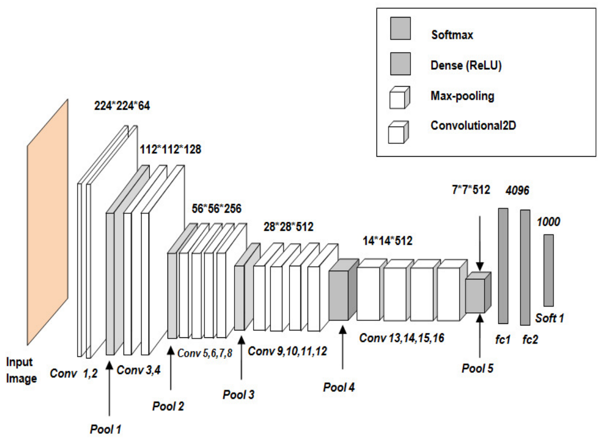

Fig. 2. Architecture of VGG19.

C. Classification Algorithms

The high-level features are derived from images by using a DCNN. The classifier uses these sufficient abstract features. The proposed work is evaluated using well known classifiers such as Support Vector Machine (SVM) [17], K-nearest neighbor (KNN) [19], Naïve Bays (NB) [2] and Logistic regression (LR) [19].

Support Vector Machine (SVM): SVM is a supervised machine learning algorithm. Its performance is based on Hyper parameter tuning and kernel functions which are important factors of SVM. For the optimal hyper plane, it can be characterized by a weight vector 'W' and bias 'b' such that

$$w^{t} x + b = 0 \qquad (1)$$

Where, W^t is a transpose of W and x is an input vector [21].

Let x is a unknown input point, the decision function can be defined as $f(x) = \sin(w^{t} x + b)$ to classify it.

K-Nearest Neighbor (KNN): KNN classification algorithm is independent of the structure of the data. Classification based on Euclidean distance among the feature vectors.

Naïve Bays (NB): Naïve Bays conventional classifier is based on the theorem of Bayes. It uses conditional probability. Naive Bays calculates the conditional probability of all classes in multi-class classification, and it is naïve, so it assumes every feature (attribute) that is independent of each other [22]. The posterior probability of a category Cj calculated as

$$P(Cj/Di) = \frac{P(Di/Cj).P(Cj)}{P(Di)} \qquad (2)$$

Where

Di is the set of values for input features

Cj is the priori probability of each category

Logistic Regression (LR): Logistic Regression performs multiclass classification using the one-vs-all method. Logistic Regression uses a sigmoid activation function

$$W(x) = \frac{1}{1+e^{-x}} \qquad (3)$$

IV. EXPERIMENT RESULT

In order to evaluate the performance of the proposed framework, experiments are performed and their results are presented in this section. The proposed framework performs individual image level and web page categorization. The performance of proposed framework is also compared with FV and VALD[8][9].

A. The Dataset

For experiments, 450 Web pages have been collected and distributed uniformly among six categories, namely: Food, Motor, Sports, Animals, Fashion, and Landscapes. These web pages contain a total 3890 images. Fig. 3-8 show sample images of Sports, Food, Animals, Motor, Landscapes and Fashion respectively. Both web pages and individual images are manually labeled by a human annotator.

The dataset is divided into a training set and test set in the ratio of 0.7 and 0.3, respectively. The classification accuracy evaluated on 1168 images of web pages.

Fig. 3. Sample of Sports images

Fig. 4. Sample of Food images

Fig. 5. Sample of Animals images.

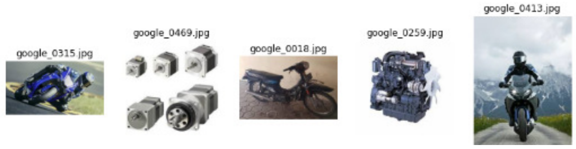

Fig. 6. Sample of Motor images.

Fig. 7. Sample of Landscapes images.

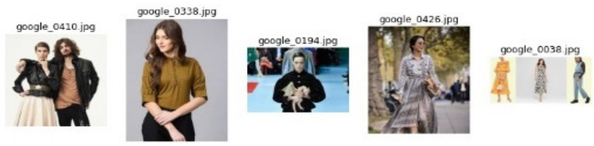

Fig. 8. Sample of Fashion images.

B. Evaluation Metric

The performance of proposed work is evaluated using well known metrics: precision, recall, *F*1-Score, and accuracy [4].

Precision and Recall: The measure of the ability of the framework to accurately identify the occurrence of a positive class instance is determined by recall. It is defined as the ratio between number of correctly related retrieve web pages and total number of related web pages.

$$\text{Recall} = \frac{\text{No.of correctly related retrieve web pages}}{\text{Total no.of correctly related web pages}} \quad (4)$$

Precision is defined as the ratio between number of correctly related retrieve web pages and total number of retrieve web pages.

$$\text{Precision} = \frac{\text{No.of correctly related retrieve web pages}}{\text{Total no.of retrived web pages}} \quad (5)$$

***F*1-Score:** *F*1 score is a harmonic mean of Precision and Recall [4]

$$\text{F1 –Score} = \frac{2*\text{Precision}*\text{Recall}}{\text{Precision}+\text{Recall}} \quad (6)$$

Accuracy: Accuracy is a measure of total correctly web pages out of all the web pages. It is defined as:

$$\text{Accuracy} = \frac{TP+TN}{TP+FP+TN+FN} \quad (7)$$

Where, True positive (TP), False positive (FP), True negative (TN) and False negative (FN) are correctly identified web pages, incorrectly identified web pages, correctly rejected web pages and incorrectly rejected web pages respectively.

Confusion Matrix: The information performed by a classifier about actual and predicted classifications is defined by a confusion matrix. A classifiers Performance evaluation is commonly performed the confusion matrix data [2].

C. Classification Result

After creating dataset, the deep dataset features of images has been extracted from the Pre-trained VGG-19 model. Table 1, Table 2 and 3 show the Precision, Recall, Accuracy, and F1-score of image level classification with FV [8], VALD [9] and VGG19 respectively using classifiers: KNN, SVM, NB and LR. Table 4, Table 5 and Table 6 show the Precision, Recall, Accuracy, and F1-score of web page level classification with FV [8], VALD [9] and VGG19 respectively using classifiers: KNN, SVM, NB and LR.

For implementation of proposed Framework, python TensorFlow, OpenCV, and Sklearn libraries are used. For experiment, the Hyper parameter is used in Pre-Trained VGG19 model as follows: Batch size = 128, Epoch = 50, Optimizer = Adam, Learning Rate = 0.01. The Hyper parameter of classifier is implemented using the Grid Search method.

Table 1: Image Level Classifier with FV.

Classifier	Precision	Recall	Accuracy	F1- Score
KNN	41.52%	42.48%	42.25%	42.00%
SVM	49.23%	48.75%	48.25%	49.00%
NB	46.00%	47.34%	47.00%	46.65%
LR	49.00%	49.50%	49.50%	49.25%

Table 2: Image Level Classifier with VALD.

Classifier	Precision	Recall	Accuracy	F1- Score
KNN	42.00%	42.20%	41.50%	41.10%
SVM	50.50%	51.00%	50.00%	50.80%
NB	47.00%	46.25%	47.25%	46.63%
LR	50.00%	51.25%	50.70%	50.63%

Table 3: Image Level Classifier with VGG19.

Classifier	Precision	Recall	Accuracy	F1- Score
KNN	71.00%	66.00%	67.60%	68.40%
SVM	85.16%	85.70%	85.30%	85.45%
NB	64.25%	63.05%	63.00%	63.60%
LR	85.00%	85.50%	85.50%	85.25%

Table 4: Web Page Level Classifier with FV.

Classifier	Precision	Recall	Accuracy	F1- Score
KNN	51.20%	52.45%	49.25%	51.85%
SVM	69.25%	68.75%	68.75%	69.00%
NB	65.00%	66.04%	66.00%	65.52%
LR	68.00%	68.50%	67.50%	68.25%

Table 5: Web Page Level Classifier with VALD.

Classifier	Precision	Recall	Accuracy	F1- Score
KNN	52.00%	52.95%	51.00%	50.48%
SVM	70.50%	71.00%	70.25%	70.75%
NB	66.00%	67.25%	66.00%	66.63%
LR	69.00%	69.75%	68.25%	69.38%

Table 6: Web Page Level Classifier with VGG19.

Classifier	Precision	Recall	Accuracy	F1- Score
KNN	72.00%	67.00%	67.60%	69.40%
SVM	85.00	85.70%	86.00%	85.45%
NB	66.25%	63.05%	63.00%	64.60%
LR	85.00%	83.50%	84.50%	84.25%

The experimental results show that the proposed framework is outperformed the other two handcrafted feature descriptor methods: FV and VALD. The performance of FV and VALD is poor since these cannot take advantages of transfer learning. The best accuracy achieved by SVM on image-level categorization and web page categorization is 85.30% and 86.00%, respectively. The Fig. 9 and 10 shows comparison of experimental Accuracy obtained by feature extracted methods: FV [8], VALD [9] and VGG19, at image level and web page level respectively.

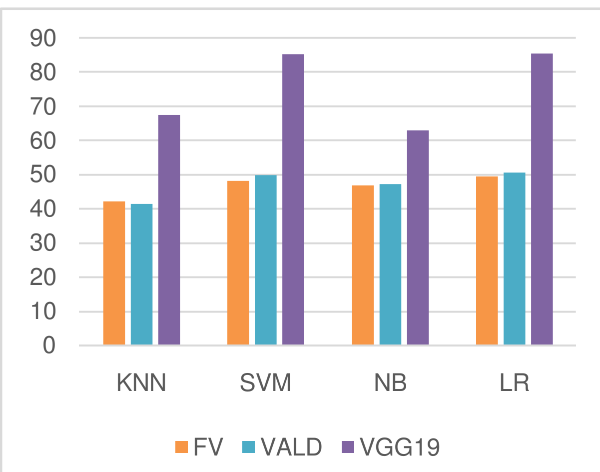

Fig. 9. Image Level Accuracy.

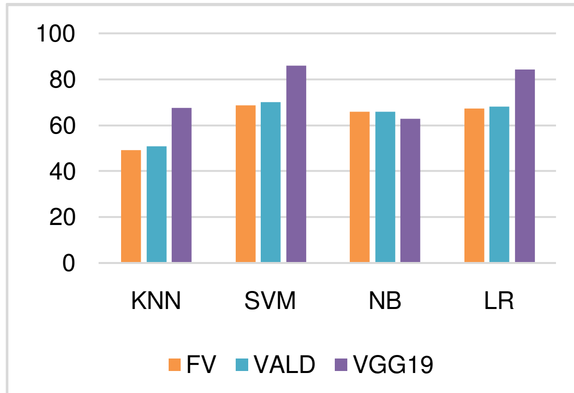

Fig. 10. Web Page Level Accuracy.

Table 7, 8, 9 and 10 shows the confusion matrix of classifies KNN, SVM, NB and LR respectively. The Confusion matrix of KNN classifier presented in Table 7 shows that it performs up to the mark for Landscapes class with 96% correct classification but becomes most confused for Sports class with only 35% correct classification.

Similarly, the confusion matrix of SVM presented in Table 8 shows that the highest performance of the Fashion class and Food class that is 87 % and 88 % respectively. The confusion matrix of NB presented in Table 9 shows poor performance of Motors class with 59% correct classification. The highest accuracy of Animals class achieved by Logistic Regression classifier with 86%.

Table 7: Confusion Matrix using KNN.

KNN	Animal	Fashion	Food	Landscapes	Motors	Sports
Animal	0.700	0.080	0.015	0.180	0.015	0.002
Fashion	0.117	0.730	0.000	0.084	0.031	0.038
Food	0.155	0.049	0.550	0.141	0.097	0.008
Landscapes	0.025	0.008	0.007	0.960	0.000	0.000
Motors	0.097	0.041	0.021	0.144	0.680	0.017
Sports	0.234	0.150	0.026	0.120	0.120	0.350

Table 8: Confusion Matrix using SVM.

SVM	Animal	Fashion	Food	Landscapes	Motors	Sports
Animal	0.830	0.030	0.037	0.044	0.015	0.044
Fashion	0.023	0.870	0.007	0.015	0.015	0.070
Food	0.024	0.016	0.880	0.000	0.049	0.031
Landscapes	0.033	0.000	0.025	0.920	0.008	0.014
Motors	0.041	0.021	0.048	0.048	0.820	0.022
Sports	0.033	0.078	0.026	0.026	0.017	0.820

Table 9: Confusion Matrix using NB.

NB	Animal	Fashion	Food	Landscapes	Motors	Sports
Animal	0.680	0.074	0.052	0.096	0.015	0.083
Fashion	0.053	0.690	0.053	0.015	0.069	0.012
Food	0.071	0.031	0.670	0.000	0.098	0.130
Landscapes	0.013	0.066	0.050	0.630	0.041	0.083
Motors	0.034	0.034	0.140	0.110	0.590	0.092
Sports	0.026	0.161	0.026	0.101	0.034	0.540

Table 10: Confusion Matrix using LR.

NB	Animal	Fashion	Food	Landscapes	Motors	Sports
Animal	0.860	0.022	0.022	0.044	0.007	0.045
Fashion	0.007	0.870	0.015	0.023	0.015	0.070
Food	0.033	0.016	0.850	0.016	0.045	0.040
Landscapes	0.051	0.000	0.025	0.920	0.000	0.004
Motors	0.034	0.007	0.055	0.048	0.790	0.066
Sports	0.033	0.069	0.026	0.026	0.026	0.820

V. CONCLUSION

In this paper, a novel framework has been proposed for web page categorization based on images of web pages. This framework plays a vital role in modern websites where visual content has a significant role. In addition, it is beneficial in cross-language information retrieval (CLIR). This framework is used the transfer learning technique to achieved high web page categorization accuracy by various classifiers such as KNN, SVM, NB, and LR based on features extracted with a pre-trained VGG 19 model. The experimental result shows that the proposed framework attains high accuracy for web page categorization as compared to well-known FV and VALD handcrafted feature descriptor methods.

VI. FUTURE SCOPE

The proposed framework is not appropriated with web pages that contain only textual information. To combine this approach with the current text-based web page categorization framework, a robust hybrid web page categorization model that can categorize web pages based on both textual content and images is required in the future.

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REFERENCES

[1]. Qi, X., & Davison, B. D. (2009). Web page classification: Features and algorithms. ACM computing surveys (CSUR), *41*(2), 1-31.

[2]. Özel, S. A. (2011). A web page classification system based on a genetic algorithm using tagged-terms as features. *Expert System with Applications, 38(*4), 3407-3415.

[3]. Dong, H., & Hussain, F. K. (2010). Focused crawling for automatic service discovery, annotation, and classification in industrial digital ecosystems. *IEEE Transactions on Industrial Electronics, 58*(6), 2106-2116.

[4]. Lee, J. H., Yeh, W. C., & Chuang, M. C. (2015). Web page classification based on a simplified swarm optimization. *Applied Mathematics & Computation, 270*, 13-24.

[5]. Ani,. A. A. (2007). An Ant Colony Optimization Based Approach for Feature Selection, *Optimization*, 19–21.

[6]. Ren, S., He, K., Girshick, R., Zhang, X., & Sun, J. (2016). Object detection networks on convolutional feature maps. *IEEE transactions on pattern analysis and machine intelligence, 39*(7), 1476-1481.

[7]. Aghamaleki, J. A., & Baharlou, S. M. (2018). Transfer learning approach for classification and noise reduction on noisy web data. *Expert Systems with Applications, 105*, 221-232.

[8]. Sánchez, J., Perronnin, F., Mensink, T., & Verbeek, J. (2013). Image classification with the fisher vector: Theory and practice. *International journal of computer vision, 105*(3), 222-245.

[9]. Delhumeau, J., Gosselin, P. H., Jégou, H., & Pérez, P. (2013). Revisiting the VLAD image representation. In *Proceedings of the 21st ACM international conference on Multimedia* , 653-656.

[10]. Goncalves, N., & Videira, A. (2014). Automatic Web Page Classification Using Visual Content for Subjective and Functional Variables. In *International Conference on Web Information Systems and Technologies*, 279-294.
[11]. de Boer, V., van Someren, M., & Lupascu, T. (2010). Web page classification using image analysis features. In *International Conference on Web Information Systems and Technologies,* 272-285.
[12]. Moustafa, M. (2015). Applying deep learning to classify pornographic images and videos. arXiv preprint arXiv:1511.08899.
[13]. Hu, W., Wu, O., Chen, Z., Fu, Z., & Maybank, S. (2007). Recognition of pornographic web pages by classifying texts and images. *IEEE transactions on pattern analysis and machine intelligence, 29*(6), 1019-1034.
[14]. Wang, X., Cheng, F., Wang, S., Sun, H., Liu, G., & Zhou, C. (2018). Adult image classification by a local-context aware network. In *2018 25th IEEE International Conference on Image Processing (ICIP),* 2989-2993.
[15]. Nian, F., Li, T., Wang, Y., Xu, M., & Wu, J. (2016). Pornographic image detection utilizing deep convolutional neural networks. *Neurocomputing, 210,* 283-293.
[16]. Liparas, D., HaCohen-Kerner, Y., Moumtzidou, A., Vrochidis, S., & Kompatsiaris, I. (2014). News articles classification using random forests and weighted multimodal features. In *Information Retrieval Facility Conference*, 63-75.
[17]. López-Sánchez, D., Arrieta, A. G., & Corchado, J. M. (2017). Deep neural networks and transfer learning applied to multimedia web mining. In *International Symposium on Distributed Computing and Artificial Intelligence*,124-131.
[18]. López-Sánchez, D., Corchado, J. M., & Arrieta, A. G. (2017). A CBR system for image-based webpage classification: case representation with convolutional neural networks. In *The 13th International Flairs Conference*, 483-488.
[19]. Lopez-Sanchez, D., Arrieta, A. G., & Corchado, J. M. (2019). Visual content-based web page categorization with deep transfer learning and metric learning. *Neurocomputing, 338,* 418-431.
[20]. Jain, R., Jain, N., Aggarwal, A., & Hemanth, D. J. (2019). Convolutional neural network based Alzheimer's disease classification from magnetic resonance brain images. *Cognitive Systems Research, 57*, 147-159.
[21]. Vishwakarma, G., & Thakur, G. S. (2019). Hybrid System for MPAA Ratings of Movie Clips Using Support Vector Machine. *In Soft Computing for Problem Solving,* 563-575.
[22]. Vishwakarma, G., Thakur G. S. (2019). Comparative performance analysis of combined SVM-PCA for Content-based video classification by utilizing inception V3. *International Journal of Emerging Technologies*, *10(*1), 01–03.

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