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IMAGE SENTIMENT ANALYSIS: A CRITICAL REVIEW

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Abstract: Recent years have seen a substantial increase in the usage of social media and the relevance of visual content, leading to a rise in the field of picture sentiment analysis—the automatic detection of emotions or feelings portrayed in photographs.
The development of machine learning algorithms has been essential to the accurate and effective analysis of picture sentiment. The purpose of this study of the literature is to present an overview of the state of the science in automated image sentiment analysis. The study also notes upcoming research directions and obstacles in the field.

Keywords: Deep learning, Algorithms for Machine Learning, analysis of sentiment.

1. INTRODUCTION

In today's digital age, where images are ubiquitous and play a significant part in communication, comprehending the sentiment expressed by visuals has become increasingly critical. Facial image sentiment analysis is an increasingly vital area .Image sentiment analysis, also known as the act of automatically evaluating and deciphering the attitudes, feelings, and sentiments conveyed in photographs is known as visual sentiment evaluation. It entails deriving significant information from visual content in order to comprehend the underlying emotions that people are expressing or that are portrayed in the images themselves. Because picture sentiment analysis has so many applications in so many different fields, it has attracted a lot of attention. with the proliferation of social media platforms, where users regularly share and engage with visual content, the ability to accurately analyze sentiments in images has become essential for businesses, marketers, researchers, and social media analysts.[1-2]

The significance of facial image sentiment analysis extended and practical application in several fields like In the healthcare sector, enabling timely interventions and personalized treatment plans, real-time emotion monitoring can offer valuable insights into patients' mental health, integrating emotion recognition into digital assistants and other AI systems can facilitate more natural and effective interactions, improving user satisfaction, Furthermore, sentiment analysis on social media can offer businesses valuable feedback, informing marketing strategies and customer service enhancements and Using sentiment analysis of images the purpose of instructional assessments is to provide insightful guidance on the method of teaching and learning. When assessing the effectiveness of teachers' instruction and the impact of students' learning through the use of student photographs in the classroom during class, sentiment data is crucial [26].

Image sentiment analysis has advanced significantly thanks to machine methods for learning, especially those that use deep learning technologies. These algorithms are capable of automatically learning and extracting complex structures and characteristics from photos, which allows them to identify the emotions and sensations that people are expressing or that are depicted in visual information. Large-scale annotated datasets can be utilized for training models that use

machine learning to identify visual signals that represent various sentiments, enabling precise and effective sentiment analysis. the potential of image sentiment analysis to yield insightful and useful data is what makes it so important. For businesses, understanding customer sentiment towards their products or services can help enhance brand perception, improve customer satisfaction, and refine marketing strategies. Social media analysts can monitor public sentiment, identify emerging trends, and gauge the impact of events or campaigns by analyzing sentiments expressed in pictures posted on social networking sites.

Furthermore, sentiment evaluation of images finds applications in market research, where sentiment analysis of product-related images can inform decision-making and identify customer preferences. It can also be used in user experience design to create emotionally engaging interfaces, in content moderation to filter inappropriate or harmful images, and in healthcare for patient monitoring and mental health assessment [3-11].

1.1 Significance of image sentiment analysis:

Nowadays, with social media and visual content sharing, images have become a dominant form of communication. People express their emotions, experiences, and opinions through images, making them a valuable source of sentiment and affective information. Image sentiment analysis, also known as visual the analysis of sentiment is the automatic identification and interpretation of the attitudes, emotions, and feelings expressed in images.

Understanding the sentiment expressed in images has grown significantly in prominence as a result of its possible applications in many different fields. Businesses can gain important insights into consumer happiness, brand perception, and product feedback by using image sentiment analysis.via analyzing sentiments expressed in images shared on social media or e-commerce platforms, businesses can monitor public sentiment towards their products or services, identify customer needs and preferences, and make data-driven decisions.

Image sentiment analysis also has implications in social media analysis, where it helps in understanding public opinion, sentiment trends, and user engagement. By analyzing sentiment in images shared on social media platforms, researchers and analysts can gain insights into the sentiment surrounding specific events, topics, or social issues. This information can be used for market research, opinion mining, crisis management, and public sentiment analysis [12].

1.2 Overview of the role of machine learning in image sentiment analysis:

Methods of learning from machines, especially Deep learning systems possess emerged as powerful tools in image sentiment analysis. They enable automated sentiment recognition by leveraging large-scale datasets and learning complex patterns from image features. models for deep learning, including convolution neural networks (CNNs), have revolutionized image analysis tasks, including sentiment analysis. The purpose of CNNs is to synthesize hierarchical representations from unprocessed visual input, capturing increasingly complex features at different levels. By training on labeled image datasets, deep learning models can learn to recognize visual patterns associated with different sentiments.

Machine learning models excel in image sentiment analysis by leveraging the power of large amounts of labeled data. They can generalize from this data to accurately predict sentiments in unseen images, even capturing subtle visual cues that might be missed by traditional rule-based or heuristic approaches.

Machine learning in image sentiment analysis involves various steps, including pre-processing of image data, feature extraction, training of models using labeled datasets, and evaluation using appropriate metrics. Deep learning advancements in addition to the accessibility of massive amounts annotated datasets have led to modern facilities performance for machine learning models in image sentiment analysis tasks.

Making use of machine learning, image sentiment analysis is able to carry out at scale, enabling the real-time analysis of vast amounts of pictures. Additionally, to improve sentiment analysis efficacy and accuracy, machine learning algorithms enable the integration of several modalities, such as written information in conjunction with visual features.

Image sentiment analysis heavily relies on machine learning methods, especially those that use deep learning models. by enabling automated sentiment recognition from images. They leverage large-scale datasets, learn complex patterns from image features, and provide scalability and accuracy in sentiment analysis tasks. Machine learning has revolutionized image sentiment analysis, allowing for a deeper understanding of sentiments expressed in visual content and opening avenues for practical applications in various domains [13].

2. Literature Review

The process of analysing the sentiments in photographs enables a system to recognize and obtain internal expressions [14]. Finding the sentiment's polarity—that is, whether it is positive, neutral, or negative—of a particular image is the primary objective of a visual emotion analysis. Sentiment analysis is a valuable tool for businesses that can be used in a multitude of ways, including finding out what customers think about products and services, building customer relationships and loyalty, improving customer service, and using emotional marketing. Numerous techniques and algorithms have been published in this area. Numerous corporate domains, including the management of data, marketing, sales, interaction with users, educational institutions, health care, economics, public monitoring, and modern PR, can benefit from the adoption of the suggested methodology [12].

The amount of data on the World Wide Web is growing dramatically each and every second of every day. The majority of these written materials, audio recordings, and video files are uploaded by online users, who are sharing an increasing amount of material via blogs, social media, and online forums. Numerous topics are being discussed, including travel, tourism, business, education, and health. Healthcare organizations, health insurance companies, academic institutions, and the government can all provide physiological data [15].

Under the Literature Survey, various research papers are studied and this study has provided the brief knowledge of the research subject to the researcher. While studying literature, it is found that there are many traditional approaches to find customer feeling, user expressing their view and opinions For the most part, earlier research used sentiment assessment to analyse feedback of pictures or other goods in order to gain greater comprehension of their audience and make the appropriate improvements.

In the first work Jana Machajdik et al. is headed "Image classification using features inspired by psychology and art theory." Based on psychology, lower-level graphic components were used. Over 70% success rates were achieved in the classification of a range of emotions. able to generate a sentiment histogram that shows how emotions are distributed among several categories. Better and additional features are needed to achieve better results [16].

In the second contribution, titled "Facial expression recognition based on fusion feature of pca and lbp with svm," Y. Luo et al. proposed a model which uses PCA and LBP for feature extraction and used SVM for classification PCA, LBP, SVM algorithm used Performed better than traditional approach but this system has Low accuracy [17].

In the work, titled Influence Factor Based Opinion Mining of Twitter Data Using Supervised Learning by MalharAnjaria, Ram Mahana Reddy Guddeti 2014. In this paper, we introduce the novel approach of exploiting the user influence factor in order to predict the outcome of an election result. We also propose a hybrid approach of extracting opinion using direct and indirect features of Twitter data based on Support Vector Machines (SVM), Naive Bayes, Maximum Entropy and Artificial Neural Networks based supervised classifiers.

In the work, titled "Image sentiment analysis using deep convolutional neural networks with domain specific fine tuning" Jindal, S. and Singh, S.A CNN with domain-specific tuning was used. Sentiment prediction on social media data yielded an accuracy of 53.5%. Domain-specific tuning helps in better sentiment prediction. The over fitting needs to be reduced and some challenges must be overcome to obtain enhanced performance [18].

In the study "Inferring Sentiment from Web Images with Joint Inference on Visual and Social Cues" by Yilin Wang et al., a major advancement in image-based sentiment evaluation was made by concentrate on understanding sentiments from the online world images by merging visual features with information from social networks.

In the work titled "An Approach to Analyzing User Emotions in Social Media Posts" was a study carried out by Yang Yang et al. The study aimed to develop a technique that simultaneously processes images and comments to determine user emotions. The proposed method increased accuracy by 37.4% when tested using a Flickr dataset.

The authors of this study present an entirely new deeper visual-semantic integrating model that gathers training data from unannotated text as well as pictures marked with item names. In a 1000-class ImageNet object identification task, the model outperforms the standard of current knowledge while outperforming it in more semantically specific failures.
Moreover, the semantic information helps predict tens of thousands of labels in images unseen during training. The model also improves zero-shot predictions by using semantic information and can achieve hit rates up to 18% for different categories.

The work "Visual Sentiment Prediction by Merging CNN Features and Hand-Craft" CNN was utilized in conjunction with Bag-of-Visual-Words (BOVW) characteristics, according to Fengjiao, W., and Aono, M. Researchers were able to estimate sentiment with 72.2% accuracy on the Twitter image collection. When CNN features are combined with hand-crafted features, sentiment prediction performs better. Limitations: A sizable training dataset is required in order to assess the model's efficiency [19].

In this paper "Utilizing VGG19-based Transfer Learning Approach for Sentiment Analysis from Images," the research conducted a new type of transfer learning method based on VGG19 in image sentiment analysis and has been used more frequently to make diverse judgments rather than text sentiment analysis over time. more end-to-end techniques utilizing transfer learning techniques for image sentiment evaluation should become common in the upcoming years.

The goal of this work is to enhance the performance of image categorization by utilizing additional deep features with the well-known VGG19 (also deep convolutional neural network. It is easy to recognize seven different kinds of emotions using the CK+, the FER2013, and JAFFE

databases and VGG-19 building construction, which is based on CNN, as well as to solve classification problems within a larger range. Findings: The findings indicate that a precision of 99% may be attained with the suggested approach. It can identify emotional patterns and a mental state that impact a person in this way [20].

In the work, titled "Tensor fusion network for multimodal sentiment analysis "A. Zadeh et al. use a type of network called the Tensor Fusion Network, which can combine information from several data sources into a single tensor to enable sentiment analysis in both independent and combined forms.employs a different strategy [24], combining them into pairs first, then merging them into one [21].

Authors Q. Truong and H. W. Lauw presented the "Visual Aspect Attention Network," a technique that leverages images as interest mechanisms to help readers recognize important lines within papers. Convolution Neural Networks (CNNs) are utilized in the method to analyze photographs, and the output is then employed as weights in a phrase encoder to improve sentence detection. This approach demonstrates the ground-breaking use of visible information to improve text evaluation and offers a fresh perspective on how images might contribute to more precise and context-aware sentiment assessment [22].

In the work, titled "A multimodal approach to image sentiment analysis," A.Gaspar and L. A. Alexandrethe authors propose a multimodal method that performs individual analysis of both the image and the text, and then performs a weighted average over the individual predictions to perform a final classification. However, while producing the individual predictions, the authors also introduce Image Content Analysis, a second method to classify the images, which is based on detecting the most predominant object on the image and classifying the image based on the probability of that object appearing in a given class in the training set [23].

In this article author Vasco Lopes et al.: "Multimodal Sentiment Analysis Approaches" in this study explored the use of multimodal sentiment analysis approaches that integrate both textual and image content for evaluation. Despite recent advancements, the research highlighted the ongoing challenges in effectively combining these modalities, particularly due to issues like subjectivity, inter-class homogeneity, and differences in data fusion. The authors proposed a method that employs AutoML to perform a random search for the best model, aiming to optimize the fusion of textual and visual data for sentiment classification. The study underscores the complexities of multimodal sentiment analysis and the need for innovative solutions to overcome these challenges [24].

In this article author Archana Sharma, V. M. Deep Learning based Student Emotion Recognition from Facial Expressions in Classrooms. In that journalsystem for recognizing students' emotions in the classroom is based on deep convolutional neural networks (CNN) technique. in the classroom, a video camera records the students collectively, and the captured video frames are sent to the processing unit for key frame extraction and facial feature detection. The CNN model, trained on comparable databases, accurately predicts emotions and determines the most probable emotion. the emotion predictions can be used to conduct an assessment, analyzing emotions such as happy, sad, surprise, disgust, angry, fear, and neutral emotions. This analysis can then be used to enhance teaching tools, improve lecture content, and create a more positive classroom environment [27].

After going through rigorous literature survey and study researcher notice and observed some research gaps that are as follows:

1. **Improved feature extraction techniques.**
2. Several studies mention limitations in model accuracy. There is a research gap in finding methods to further enhance the accuracy of image sentiment analysis models, especially for practical applications in areas like business, healthcare, and marketing.
3. One of the reviewed works highlights the issue of **over fitting** in image sentiment analysis models. Future research could focus on developing regularization techniques or model architectures that mitigate **over fitting** and improve generalization.
4. Many applications, such as digital marketing and customer service, require real-time sentiment analysis. Research could focus on developing models and techniques that can perform sentiment analysis on images in real-time or with low latency.
5. **S**entiment analysis models are increasingly used in decision-making **processes;** there is a growing need to address ethical concerns and potential biases in these models. Future research could explore methods for making sentiment analysis fairer and more transparent.

Addressing these research gaps could contribute to the advancement of image sentiment analysis and its applications across various domains. Researchers can choose to focus on one or more of these gaps based on their interests and expertise.

Conclusion:

Sentiment analysis of facial images is increasingly important for understanding emotions conveyed in visual content across various fields such as healthcare, education, business, and social media. The field's growing significance is driven by advancements in machine learning, particularly deep learning techniques, which have improved the accuracy and scalability of sentiment analysis models.

In this literature review, we explored the exciting field of image sentiment analysis using machine learning techniques. The reviewed literature revealed background, Overview and role of machine learning in image sentiment analysis

Despite these advancements, research gaps persist, including the need for better feature extraction techniques to capture more nuanced emotional cues. Improving model accuracy for practical applications remains a critical challenge, along with addressing over fitting and generalization issues. There is also a growing necessity for real-time sentiment analysis, requiring further research into models capable of low-latency processing.

Additionally, ethical implications and potential implications in emotion analysis models are an important area of concern. Future research should focus on making these models more accurate, transparent, and consistent with ethical standards. Addressing these gaps will not only develop the field of emotion analysis, but also expand its practical applications to various fields and lead to the efficient and effective use of this technology.

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