AI-ML Based Sentiment Analysis: a Review

Arya Bharadwaj, Anjali Awasthi, Aviral Singh,
Abhisakshi Srivastava, Abhishek Mishra and Ayushi Tiwari

February 14, 2023

AI-ML Based Sentiment Analysis:
A Review

Arya Bharadwaj

Department of computer science & engineering

BBDITM

Lucknow, India

aryabhardwaj2504@gmail.com

Anjali Awasthi

Department of Computer science & engineering

BBDITM

Lucknow, India

anjaliawasthi2261@gmail.com

Aviral Singh

Department of computer science & engineering

BBDITM

Lucknow , India

aviralsingh6620@gmail.com

Abhisakshi Srivastava

Department of Computer science & engineering

BBDITM

Lucknow, India

abhisakshisrivastava@gmail.com

Abhishek Mishra

Department of Computer Science & engineering

BBDITM

Lucknow ,India

abmsra111@gmail.com

Ayushi Tiwari

Department of Computer Science & engineering

BBDITM

Lucknow , India

ayushit45@gmail.com

Abstract - The primary software of herbal language processing is to analyse the author's sentiment via context. This sentiment evaluation (SA) is said to determine the exactness of the underlying emotion in the context. it's been used in a variety of fields, inclusive of inventory market forecasting, social media statistics on product evaluations, psychology, judiciary, forecasting, disorder prediction, agriculture, and so on. Many researchers have laboured in these areas and have produced considerable outcomes. those effects are useful of their respective fields because they help to apprehend the general precis in a brief quantity of time. furthermore, Sentiment evaluation aids in comprehending actual remarks shared throughout numerous structures including Amazon, TripAdvisor, and others. The number one purpose of this significant survey changed into to examine a number of the maximum critical research. carried out thus far, in addition to offer an overview of Sentiment analysis fashions within the field of emotion AI-driven SA. moreover, this work discusses Sentiment analysis on various varieties of data along with snap shots and speech. visible Sentiment analysis seeks to recognize how snap shots have an effect on humans in phrases of evoked emotions. no matter the fact that this area is distinctly new, a wide range of strategies for numerous information assets and issues were advanced, resulting in a considerable frame of studies. To that end, this paper considers a dependent formalisation of the problem that is commonly used for textual content

evaluation and discusses its applicability inside the context of visual Sentiment evaluation. an outline of recent challenges is likewise blanketed inside the paper, the evaluation from the perspective of progress toward extra state-of-the-art structures and related practical applications, as well as a precis of the insights as a result of this observe.

1.   INTRODUCTION

Sentiment analysis is the technique of determining the human emotion conveyed inside a context. It lets in you to are expecting someone's emotion, attitude, or even personality, that is expressed via diverse factors. Sentiment evaluation identifies the human emotion highlighted in the context, allowing machines to accurately recognize those emotions. to start with, information and critiques had been shared in individual amongst circle of relatives members, neighbours, friends, family, and so forth. With the advancement of generation, maximum of these exchanges now take area online, in which SA plays an crucial role. technology has enabled people to be uncovered to hundreds of various points of view in a remember of mins. as an example, a person can percentage their thoughts on a social trouble or a product they very own. these opinions include films, accommodations, and restaurants. humans are becoming extra keen on online conversation; as a end result, each individual reviews and the need for sentiment prediction in commercial enterprise areas have improved in an effort to effortlessly understand the common human beings needs and likes and dislikes.

Historically, Sentiment analysis strategies had been evolved for the analysis of textual content , whereas limited efforts were hired to extract sentiments from visible contents (e.g., pictures and movies). Beside the large quantities of available statistics, usually the textual communications on social networks include short and colloquial messages. furthermore, humans tend to use additionally photographs and movies, further to the textual messages, to express their stories via the most not unusual social platforms. The statistics contained in such visual contents are not handiest related to semantic contents which includes items or movements about the acquired picture, but also cues approximately influence and sentiment conveyed by way of the depicted scene. Such information is consequently useful to recognize the emotional effect (i.e., the evoked sentiment) beyond the semantic. For those reasons pictures and videos have emerge as one of the maximum famous media by means of which human beings specific their emotions and percentage their experiences within the social networks, that have assumed a essential role in accumulating data about human beings evaluations and feelings. The pictures shared in social media structures replicate visible elements of users' day by day sports and pursuits. Such growing user generated snap shots constitute a current and powerful supply of information beneficial to examine users' pastimes. Extracting the emotions inherently underlying images perceived by way of the viewers ought to promote new tactics to numerous application fields which include brand belief, assessment of customer satisfaction, advertising, media analytic, etc. The diffusion of personal cellular gadgets continuously connected to net offerings and the growth of social media systems brought a new communication paradigm by means of which humans that share multimedia records. in this context, importing photos to a social media platform is the brand-new manner by using which human beings proportion their evaluations and experiences. This provides a strong motivation for research in this subject, and gives many challenging research issues. The proposed paper aims to introduce this emerging studies subject. It analyses the associated troubles, provides a short evaluation of modern-day research development, in addition to discusses the essential troubles and description the brand-new possibilities and demanding situations on this location. This paper extends our preliminary paintings , by using notably augmenting the wide variety and form of reviewed papers. Sentiment evaluation and opinion mining are among the fields which might be tremendously profited by using those revolutionary tactics, and that they involve an automatic process of perceiving and recognizing human feelings .

This paper intended to offer a huge range of analyses on diverse research on AI-driven SA and OM of emotion. in addition, this paper serves as a complete review of SA and OM primarily based on multiple methods and methodologies, including the implicit and express extraction of information. This assessment paper includes a taxonomy of analyses on sentiment and the professionals and cons of SA primarily based on preceding studies works. The numerous levels of SA, open issues, studies problems, in addition to future guidelines at the look at of sentiment and OM and their diverse applications are further highlighted in this assessment article.
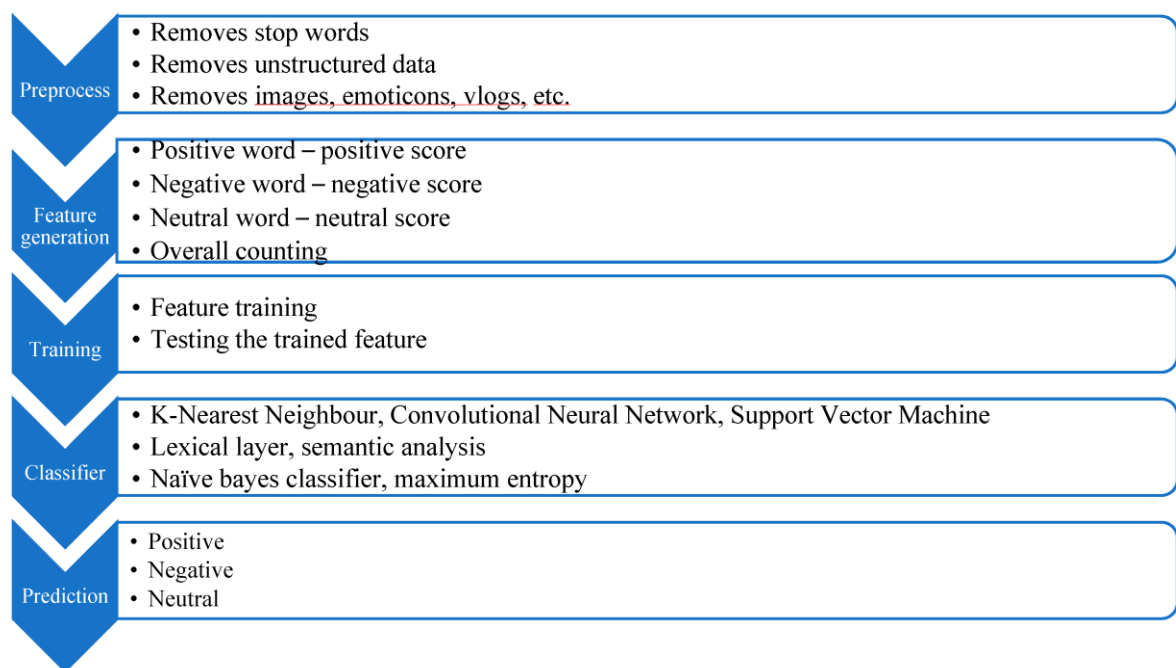
2. *Emotion AI-Driven Sentiment Analysis : The Process*

Sentiment analysis is looked after into the subsequent three dimensions: the report stage (DL), sentence stage (SL), and feature degree or attitude degree. on the DL, all the phrases related to emotions in the complete record are analyzed . The positive or poor outcomes of the sentences are analyzed without that specialize in each perspective. This evaluation offers a preferred evaluation of the record. on the DL, the examination supposes that the whole record has one precise subject . Afterwards, it's far anticipated whether the tone of the entire record is positive or bad. This kind of SA is used for programs along with social and intellectual examinations by way of casual institutions, consumer pleasure analyses, and analyses of sufferers in healing settings.

similarly, at the SL, the purpose is to find out the restriction of the sentence, and the result is given at the general sentence level. It determines whether the real sentence is fantastic or objective. also, it interprets whether the general inclination of the sentence is effective or terrible in energetic sentences that are viewed as small facts. it is far extensively used for tweets, fb posts, and short messages.

2.1 *Text-Analysis Process*

The principal objective of SA is to acquire the emotion from the context. The context might be records from an online evaluate or file; it is able to be whatever in a big quantity wherein humans may want to postpone the manner at the same time as coping with it. there are numerous steps to be followed to find the precise that means and the sentiment oriented to it. as a result, this phase explains the numerous methods of SA . The procedure of emotion AI-driven sentiment analysis is illustrated in discern under.

Preprocess	• Removes stop words • Removes unstructured data • Removes images, emoticons, vlogs, etc.
Feature generation	• Positive word – positive score • Negative word – negative score • Neutral word – neutral score • Overall counting
Training	• Feature training • Testing the trained feature
Classifier	• K-Nearest Neighbour, Convolutional Neural Network, Support Vector Machine • Lexical layer, semantic analysis • Naïve bayes classifier, maximum entropy
Prediction	• Positive • Negative • Neutral

Step 1: Data Collection

A dataset desires to be amassed. as an instance, tweets as a dataset may be accumulated by means of making use of the Twitter API; ROAuth is needed to approve the application . The dataset may be of more than 5000 tweets that change in size in step with the records needed. It should include all three kinds of facts, in which dependent information are in a prepared format inside the repository , semi-dependent records are formatted in the shape of dependent data, and unstructured records aren't organized and do now not contain any pre-described models .

Step 2 : Training Dataset and Subjective statistics

two sorts of datasets are applied for getting ready the classifier: subjective facts and impartial data. The subjective dataset includes the belief in the putting, whilst the impartial dataset does not consist of the sentiment or emotion

of the specific scenario . Emotional statistics incorporates the opinion of a selected condition and conveys the emotion in two methods: satisfied or unhappy. An ok degree of the terrible and advantageous views (tweets) for 2 consecutive days became accrued to put together the dataset by way of utilising the classifier.

Step 3: Facts Pre-Processing

Pre-processing is the initial section inside the supposition research, and it's far done earlier than semantically analyzing the vocabulary . for example, we will pass lower back to the instance of Twitter. Twitter is a platform in which individuals from specific parts of the sector offer their views as tweets in distinct languages. The data in these tweets might also comprise unstructured statistics that is boisterous, for instance, prevent phrases, non-English words, and emphasis marks . these types of unstructured facts are quite popular in tweets. inside the pre-processing step, the tweet is split primarily based on parts of the speech (POS) tags. information pre-processing includes evaluating URLs, sifting, expelling interrogative proclamations and prevent phrases, barring specific characters, barring retweets, expelling hashtags on the angle, barring emojis and snap shots, expelling dialects apart from English, and disposing of capitalized letters .

2.2 Visible Evaluation

 We specifically recognition at the statement that the sentiment expressed through a review image is probable prompted by 3 factors: photograph component (sentiment encoded in the photo itself); person aspect (sentiment expressed with the aid of a reviewer through an photograph); and object element (sentiment related to a photo because of an item). As we survey , previous works have relied usually on picture issue alone, associating the sentiment inherently with the photograph itself, efficiently assuming that a picture is both universally fantastic or terrible. We postulate that sentiments in online opinions are by means of nature relative. a piece of furniture can also look unfashionable in one eating place, however can also look run-down in any other (item thing). A reviewer may additionally and the atmosphere of a newly renovated region easy and elegant, even as another can also and the identical sterile and uninspired (consumer issue). e question of sentiment expressed through an photograph can also

be inseparable from the idiosyncratic alternatives of the reviewer, in addition to the atypical natures of the item or region being reviewed. recent procedures for image classification rely on deep studying, together with Convolutional Neural Networks (CNN). AlexNet [17] is one 9aaf3f374c58e8c9dcdd1ebf10256fa5 such model, which evokes our base version for visual Sentiment Convolutional Neural Networks, which we consult with as VS-CNN. Importantly, this base version might not be geared up to cope with the relative alternatives of reviewers (user element) or the bizarre traits of gadgets being reviewed (item issue). To take object aspect into account, we go beyond the base model and advocate an item-oriented version or iVS-CNN, which incorporates item-specific parameters, to react how some photograph functions

are interpreted inside the context of that item. Correspondingly, to react person elements, we build a consumer-oriented model or united states of America CNN, which incorporates user-unique parameters, to react how some photograph functions are interpreted via the lens of that user.

3.   RELATED WORK

3.1 Text-based

Figure below offers various techniques for sentiment evaluation and emotion detection which are extensively categorised right into a lexicon-based method, system studying-based totally approach, deep studying-based approach. The hybrid method is a mixture of statistical and machine gaining knowledge of techniques to overcome the drawbacks of each process. transfer gaining knowledge of is likewise a subset of system mastering which permits the usage of the pre-educated version in different comparable domain.
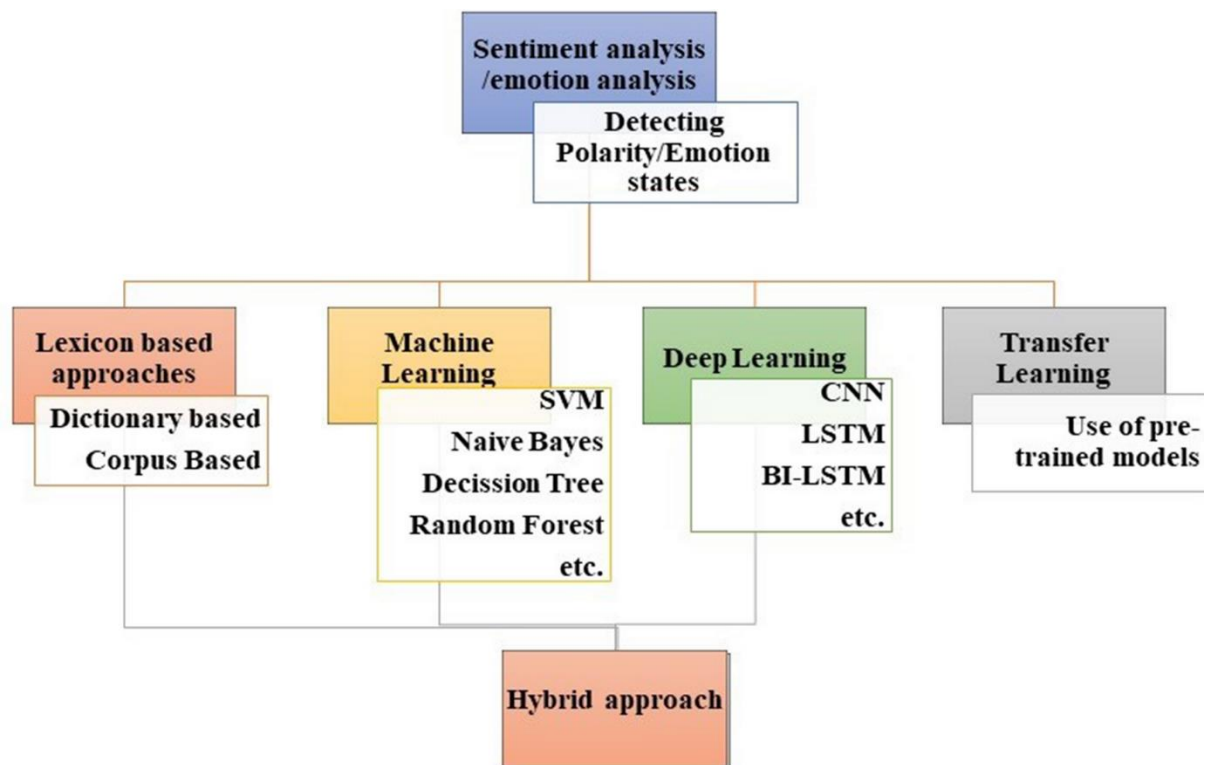
Gadget mastering-based totally method : This method for sentiment analysis known as the system learning approach. The entire dataset is divided into components for training and checking out functions: a schooling dataset and a checking out dataset. The training dataset is the records used to teach the version by way of providing the traits of different times of an object. The checking out dataset is then used to look how efficaciously the version from the education dataset has been skilled. commonly, the gadget getting to know algorithms used for sentiment evaluation fall beneath supervised classification. one of a kind sorts of algorithms required for sentiment type may also include Naïve Bayes, support vector gadget (SVM), selection bushes, etc. every having its execs and cons. Gamon (2004) applied a assist vector system over forty,884 patron feedbacks collected from surveys. The authors implemented various characteristic set mixtures and executed accuracy up to 85.47%. Ye et al. (2009) worked with SVM, N-gram version, and Naïve Bayes on sentiment and evaluate on seven popular destinations of Europe and the us, which become accumulated from yahoo.com. The authors achieved an accuracy of up to 87.17% with the n-gram model. indent Bučar et al. (2018) created the lexicon referred to as job 1.zero and labelled information corpora called SentiNews 1.0 for sentiment analysis in Slovene texts. task 1.zero consists of 25,524 headwords extended with sentiment scaling from – five to five primarily based at the AFINN model. For the construction of corpora, information had been scraped from numerous news web media. Then, after cleansing and pre-processing of information, the annotators had been asked to annotate 10,427 documents at the 1–5 scale wherein one manner bad and five method very tremendous. Then these documents were labelled with fantastic, poor, and impartial labels as consistent with the specific common scale rating. The authors observed that Naïve Bayes carried out better as compared to the support vector system (SVM). Naive Bayes finished an F1 rating above ninety% in binary type and an F1 score above 60% for the three-class class of sentiments. Tiwari et al. (2020) applied three system mastering algorithms known as SVM, Naive Bayes, and most entropy with the n-gram characteristic extraction method on the rotten tomato dataset. The training and checking out dataset constituted 1600 critiques in each. The authors discovered a decrease in accuracy with better values of n in n-grams such as n = 4, five, and 6. Soumya and Pramod (2020) labelled 3184 Malayalam tweets into high-quality and bad reviews using different function vectors like BOW, Unigram with Sentiwordnet, and so forth. The authors applied machine gaining knowledge of algorithms like random wooded area and Naïve Bayes and observed that the random wooded area with an accuracy of 95.6% plays higher with Unigram Sentiwordnet considering negation phrases.

Deep mastering-based totally method in recent years, deep getting to know algorithms are dominating other traditional approaches for sentiment evaluation. these algorithms come across the sentiments or reviews from textual content without doing feature engineering. There are more than one deep mastering algorithms, namely recurrent neural network and convolutional neural networks, that can be applied to sentiment analysis and gives effects which can be greater accurate than the ones provided by means of gadget studying fashions. This method makes human beings free from constructing the functions from text manually as deep learning fashions extract the ones functions or styles themselves. Jian et al. (2010) used a version primarily based upon neural networks generation for categorizing sentiments which consisted of soppy capabilities, function weight vectors, and prior knowledge base. The authors implemented the version to study the information of Cornell movie. The experimental effects of this paper discovered that the accuracy level of the I-model is awesome compared to HMM and SVM. Pasupa and Ayutthaya (2019) finished 5-fold go-validation on the youngster's story (Thai) dataset and compared 3 deep getting to know models referred to as CNN, LSTM, and Bi-LSTM. these fashions are implemented with or without capabilities: POS-tagging (pre-processing method to identify one-of-a-kind elements of speech); Thai2Vec (word embedding skilled from Thai Wikipedia); sentic (to understand the sentiment of the phrase). The authors determined the great overall performance within the CNN model with all of the three features noted in advance. As stated in advance, social media structures act as a significant source of records in the subject of sentiment evaluation. data amassed from this social web sites consist lot of noise due to its free writing style of customers. therefore, Arora and Kansal (2019) proposed a version named Conv-char-Emb that could handle the problem of noisy statistics and use small reminiscence area for embedding. For embedding, convolution neural network (CNN) has been used that makes use of less parameters in characteristic representation. Dashtipour et al. (2020) proposed a deep gaining knowledge of framework to perform sentiment evaluation in the Persian language. The researchers concluded that deep neural networks which include LSTM and CNN outperformed the prevailing device studying algorithms on the inn and product overview dataset.

transfer learning approach and Hybrid method switch learning is also part of system learning. A model educated on massive datasets to remedy one hassle can be carried out to different associated issues. Re-the usage of a pre-skilled model on related domains as a starting point can save time and bring extra green outcomes. Zhang et al. (2012) proposed a singular instance gaining knowledge of technique through without delay modelling the distribution among unique domains. Authors categorised the dataset: Amazon product critiques and Twitter dataset into effective and negative sentiments. Tao and Fang (2020) proposed extending recent class strategies in factor-based sentiment evaluation to multi-label classification. The authors also evolved transfer getting to know fashions known as XLNet and Bert and evaluated the proposed method on unique datasets Yelp, wine reviews rotten tomato dataset from other domain names. Deep gaining knowledge of and machine mastering techniques yield exact outcomes, however the hybrid approach can deliver higher outcomes because it overcomes the restrictions of each traditional model. Mladenovic et al. (2016) proposed a function reduction approach, a hybrid framework fabricated from sentiment lexicon and Serbian wordnet. The authors elevated both lexicons via addition some morphological sentiment phrases to keep away from lack of essential data at the same time as stemming. Al Armani et al. (2018) compared their hybrid version product of SVM and random woodland version, i.e., RFSVM, on amazon's product evaluations. The authors concluded RFSVM, with an accuracy stage of 83.4%, performs better than SVM with 82.4% accuracy and random forest with 81% accuracy in my opinion over the dataset of 1000 critiques. Alqaryouti et al. (2020) proposed the hybrid of the rule of thumb-based totally technique and area lexicons for component-stage sentiment detection to recognize human's evaluations concerning authorities clever applications. The authors concluded that the proposed method outperforms different lexicon-primarily based baseline models through 5%. Ray and Chakrabarti (2020) combined the rule-primarily based technique to extract elements with a 7-layer deep learning CNN model to tag every issue. The hybrid model accomplished 87% accuracy, whereas the individual fashions had seventy-five% accuracy with rule-based and 80% accuracy with the CNN model.

3.2 Image-Based

Visible Sentiment analysis. Sentiment analysis became pioneered for textual content . visible sentiment evaluation offers with classifying the polarity of a photograph. One way is to symbolize an image in terms of shade and SIFT capabilities, and then using type algorithms which include SVM or Naive Bayes . any other manner is to feed the photograph right into a deep learning framework which includes CNN . Our work builds on the framework of CNN , with numerous key distinctions. First is the distinction in the types of photos. preceding works teach on

social media images from Flickr, labelling their polarity based totally on tags. It also effectively assumes that the sentiment of an photo may be captured through the tags by myself. In evaluation, we recognition on evaluate pictures. 2nd is the difference in CNN structure. preceding works use CNN with globally shared parameters, whereas we investigate item and consumer elements respectively to peer their capacity results on visual sentiment analysis. by using focusing on images by myself, our paintings are also exceptional from the ones that concentrate on bridging modalities, including text (e.g., captions, tags) and images . by that specialize in evaluate photos ,which may be various, our work is neither limited to, nor in particular geared for recognizing human facial expressions .Visually-aware Recommender systems. Recommender machine estimates how an awful lot a consumer would love an object. it's miles typically formulated as rating prediction the use of matrix factorization it has been observed that photographs have a position in e-commerce . while an item picture is to be had, it could be used as additional function. A consumer's choice for an object is "transferred" to other objects with "similar" pixel . tough sentiment evaluation is potentially useful for recommendation, it's miles essentially a exceptional hassle. advice models the connection between a person and an item. e key information is derived from which gadgets the person has preferred previously, and an item is usually associated with handiest one representative image . In assessment, sentiment fashions the polarity of a photo itself. In our models, although some parameters can be object- or user-orientated, what is learned is the mapping among picture capabilities to the sentiment. but any other shape of visually-aware advice is to advise products just like a picture, essentially an image retrieval problem.

CNN has been successfully used in studying responsibilities consisting of handwriting popularity , document reputation , characteristic gaining knowledge of, sentence category , picture category .In essence, visible sentiment analysis is an photograph class project. because the software of CNN for a problem is related to its structure, we look at how user and item elements might be included into the architecture of CNN. within the following, we describe a base CNN architecture for visible sentiment evaluation, which we talk to as VS-CNN.
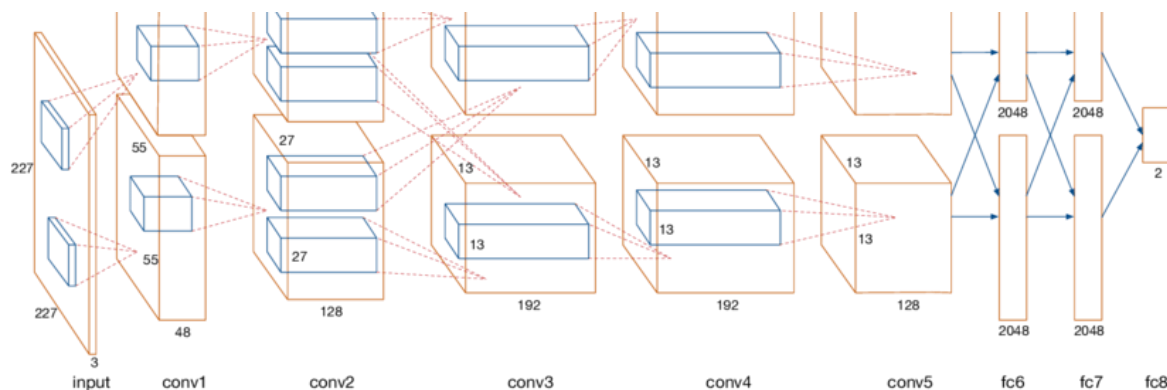
4. CONCLUSION AND FUTURE SCOPE

In this paper, an outline of emotion AI-pushed SA in numerous domains changed into provided. also, this survey reviewed the merits, demerits, and scope of the special methods that have been considered. A sizable advantage of SA is that it presents the precise emotion this is underlined in the context. conventional methodologies, which include device-mastering-based totally approaches, lexicon-primarily based analysis, and ontology-primarily based analysis, were considered for experimentation to evaluate performances. inside the taken into consideration pattern statistics, the thing-primarily based ontology method, SVM, and term frequency carried out high accuracy and provided better SA outcomes in every class. destiny studies guidelines in addition to limitations were also

highlighted for the advantage of future researchers. even though the outcomes confirmed better accuracy for the pattern information considered, those effects can also range while its miles applied to different applications. Deep studying techniques also can be considered for evaluating the performances as part of the future work which may additionally carry extensive modifications to the results.

We hypothesize that review photos contain sentiment alerts. certainly, the base version achieves higher accuracies than random. We similarly check out the roles of item-orientation and consumer-orientation. a few photograph capabilities can also code for superb sentiment for some items, and yet code for poor sentiment for others. Experiments display that the object-orientated CNN achieves even better accuracies, specially whilst item-orientation is included at better tiers of abstraction. Experiments for user-orientation yield comparable effects. As destiny paintings, we'd analyse how assessment text will be used with overview snap shots for multi-modal sentiment analysis.

5. REFERENCES

1. Khan, A.; Baharudin, B.; Khan, K. Efficient feature selection and domain relevance term weighting method for document classification. In Proceedings of the 2010 Second International Conference on the Computer Engineering and Applications (ICCEA), Bali Island, Indonesia, 19–21 March 2010; Volume 2, pp. 398–403.
2. Lu, Y.; Kong, X.; Quan, X.; Liu, W.; Xu, Y. Exploring the sentiment strength of user reviews. In *International Conference on Web-Age Information Management*; Springer: Berlin/Heidelberg, Germany, 2010; pp. 471–482.
3. Agarwal, A.; Xie, B.; Vovsha, I.; Rambow, O.; Passonneau, R. Sentiment analysis of twitter data. In Proceedings of the Workshop on Languages in social media; Association for Computational Linguistics: Stroudsburg, PA, USA, 2011; pp. 30–38.
4. Annett, M.; Kondrak, G. A comparison of sentiment analysis techniques: Polarizing movie blogs. In *Conference of the Canadian Society for Computational Studies of Intelligence*; Springer: Berlin/Heidelberg, Germany, 2008; pp. 25–35.
5. Liu, B. Sentiment analysis and opinion mining. *Synth. Lect. Hum. Lang. Technol.* **2012**, *5*, 1–167.
6. Li, X.; Peng, Q.; Sun, Z.; Chai, L.; Wang, Y. Predicting Social Emotions from Readers' Perspective. *IEEE Trans. Affect. Comput.* **2017**, *10*, 255–264.
7. Liu, B.; Hu, M.; Cheng, J. Opinion observer: Analyzing and comparing opinions on the web. In Proceedings of the 14th International Conference on World Wide Web, Cardiff, UK, 25 January 2020; ACM: New York, NY, USA, 2005; pp. 342–351.
8. Li, C.; Sun, A.; Weng, J.; He, Q. Tweet segmentation and its application to named entity recognition. *IEEE Trans. Knowl. Data Eng.* **2015**, *27*, 558–570.
9. Rout, J.K.; Choo, K.K.R.; Dash, A.K.; Bakshi, S.; Jena, S.K.; Williams, K.L. A model for sentiment and emotion analysis of unstructured social media text. *Electron. Commer. Res.* **2018**, *18*, 181–199.
10. Che, W.; Zhao, Y.; Guo, H.; Su, Z.; Liu, T. Sentence compression for aspect-based sentiment analysis. *IEEE/ACM Trans. Audio Speech Lang. Process. (TASLP)* **2015**, *23*, 2111–2124.
11. Bell, D.; Koulouri, T.; Lauria, S.; Macredie, R.D.; Sutton, J. Microblogging as a mechanism for human–robot interaction. *Knowl. Based Syst.* **2014**, *69*, 64–77.
12. Xia, R.; Xu, F.; Yu, J.; Qi, Y.; Cambria, E. Polarity shift detection, elimination, and ensemble: A three-stage model for document-level sentiment analysis. *Inf. Process. Manag.* **2015**, *52*, 36–45.
13. Singh, V.K.; Piryani, R.; Uddin, A.; Waila, P. Sentiment analysis of Movie reviews and Blog posts. In Proceedings of the 2013 3rd IEEE International Advance Computing Conference (IACC), Ghaziabad, India, 22–23 February 2013; pp. 893–898.
14. Mohammad, S.M.; Zhu, X.; Kiritchenko, S.; Martin, J. Sentiment, emotion, purpose, and style in electoral tweets. *Inf. Process. Manag.* **2015**, *51*, 480–499.
15. Aljanaki, A.; Wiering, F.; Veltkamp, R.C. Studying emotion induced by music through a crowdsourcing game. *Inf. Process. Manag.* **2016**, *52*, 115–128.
16. Denecke, K.; Deng, Y. Sentiment analysis in medical settings: new opportunities and challenges. *Artif. Intell. Med.* **2015**, *64*, 17–27.

17. Medhat, W.; Hassan, A.; Korashy, H. Sentiment analysis algorithms and applications: A survey. *Ain Shams Eng. J.* **2014**, *5*, 1093–1113.
18. Tubishat, M.; Idris, N.; Abushariah, M.A. Implicit aspect extraction in sentiment analysis: Review, taxonomy, oppportunities, and open challenges. *Inf. Process. Manag.* **2018**, *54*, 545–563.
19. Yue, L.; Chen, W.; Li, X.; Zuo, W.; Yin, M. A survey of sentiment analysis in social media. *Knowl. Inf. Syst.* **2019**, *60*, 617–663.