Islamic Azad University Science and Research Branch Faculty of Management and Economics

International Journal of Finance, Accounting, and Economics Studies
Journal homepage: https://ijfaes.srbiau.ac.ir

International Journal of Finance, Accounting and Economics Studies

Facial Expression Recognition in Business Intelligence: A Deep Learning Approach

Kamelya Dehghani Kohneh Shahri[1], Mohammad Ali Afshar Kazemi[2*], Alireza Pourebrahimi[3]

[1] *Ph.D. Student, Department of Information Technology Management, Science and Research Branch, Islamic Azad University, Tehran, Iran.*
[2*] *Full Professor, Department of Industrial Management, Central Tehran Branch, Islamic Azad University, Tehran, Iran.*
[3] *Assistant Professor, Department of Industrial Management, Karaj Branch, Islamic Azad University, Alborz, Iran.*

Abstract
The Research purpose is to analyze data to predict customer behavior using facial expression detection in intelligent businesses based on deep learning. Currently among researchers, presenting methods that increase accuracy and efficiency in predicting customer behavior in intelligent businesses is important and has tremendous effects on e-commerce profitability, marketing, sales, economy, stock prediction, etc.

The methodology of this research is descriptive analytical and practical in terms of research objectives. The research was conducted using image processing and machine vision techniques to predict customer behavior and detect facial expressions to improve the performance of intelligent businesses in organizations and social networks. The information gathering tool was a library as well as using TensorFlow library in the Google Colab environment and Python programming to examine research topics and subjects using qualitative and quantitative content analysis.

By comparing the outputs obtained from image processing, out of the eight facial expression categories which consist of happiness, sadness, surprise, fear, disgust, anger, contempt, and neutrality- happiness expressions were detected with the accuracy of (73.6%) which means the model can predict this category the best. on the other hand, worst case scenario, disgust and hatred expressions were detected with the accuracy of (9.2%) that implies the poor performance of model for this kind of expressions.

* Corresponding Author: Dr.mafshar@gmail.com.

1. Introduction

Information and knowledge analysis in the third millennium has become the main wealth of organizations and commercial enterprises and production centers are looking for benefit analysis of this wealth in their serious decisions in dynamic environments as much as possible to take the competitive advantage (Babu & Kanaga, 2022). Nowadays, using the Internet and social networks has increased significantly. As a main media, social media is leading in the emerging technologies to introduce favorites, emotions, desires, and behaviors of all societies (Wang et al, 2020). The last years of the 20th century witnessed the emergence of a new kind of social scientist, i.e. non-verbal behavior specialists in the direction of emotion analysis (Appel et al, 2016). The sentiment analysis based on deep learning in the AI field, at the moment, is considered a global important research topic and many researchers in large businesses and internet companies are working in the field mentioned (Chen et al, 2022). This technology is so integrated into our lives that we use it to work, purchase, communicate, and even entertain. Many researchers believe that communication, display, and computing technologies will continue to progress, but the way of communicate with them and utilizing information flow will become the progress node and their use (Soon & Salamzadeh, 2021). Entering computers into people's social life has developed social duality and disunity among the people. Currently, from the researchers' point of view, providing methods that increase accuracy and efficiency in the field of sentiment analysis in social networks and business intelligence in online stores, has been considered very important (Tao et al, 2019; Atmaja & Sasou, 2022). and will have great effects on E-commerce, marketing, sales, politics, economy, psychology, and

health care, stock sales forecast (Arora & Arora, 2019; Kumar et al, 2019). Many deep learning architectures are used in order to increase accuracy with different machine learning algorithms including motion detection, detecting gestures, movement, and body language by the use of image processing algorithms, pattern detection, sound processing, text processing, machine vision, and different types of artificial neural networks (Wang et al, 2020; Poria et al, 2016).

Their research entitled "the evolution of human-computer interaction(HCI): the role of human beings in paradigm 4.0", suggested that Industry 4.0 is a novel pattern in the production world and it changed human-machine interaction profoundly. Industry 4.0 has been the key technology related to the Deming cycle standard to emphasize the importance of human-machine interaction. In this paper, a new perspective based on human centrality has been presented and the importance of human factors has been studied through the "sand cone model". Their research suggested the result that in order to solve complicated problems and help organizations to adapt to changes rapidly, scientists should involve database analysis to convert the data into strategic business offers (Nardo et al, 2020). According to research on previous studies and by processing existing data and providing new results in recognizing facial expressions in seven important facial expressions in the economic promotion of business intelligence, this paper provided conditions in which other researchers can collect results, advantages, and disadvantages of different algorithms enhance knowledge by a methodological approach of the present paper and with the help of the subject literature and seek help in promoting innovative ideas. Therefore, from a theoretical point of view and as one of the efficient tools in the decision-making process, employing the predicting

behavior of customers in their satisfaction towards purchasing goods for any large organization in business intelligence should be a prospective method. If aware of the behaviors, it can be possible to use them efficiently and effectively in making smart decisions leading to raise success rate. The current research aims to test and evaluate machine learning algorithms for facial expression recognition in business intelligence. The study focuses on comparing the accuracy and effectiveness of these algorithms in predicting customer behavior and satisfaction with manufactured products. Moreover, it seeks to provide a conceptual model that can analyze the emotions in applications such as social media and smart stores, more efficiently and faster. It is hoped that this research will take an effective step in the development and increasing knowledge by identifying gaps and presenting strategic proposals in this field.

2. Literature Review
➢ Business Intelligence

Business intelligence is a set of abilities, technologies, tools, and solutions which help managers have a better understanding of business situations (Guster & Brown, 2012). The tools of business intelligence provide people with viewpoints of the past, present, and future conditions which, by implementing its solutions, the existing gap between middle managers and top managers from the information communication point of view will be eliminated and the managers will be provided with information required in any level and moment with high quality (Ouda, 2018). Also, experts and analysts can improve their activities, use equipment, and achieve better results. The market considers business intelligence as a precise instrument for competitive superiority and knows it as a monitoring and analyzer of the market and customers(Ouda, 2018). From the technology's point of view, business intelligence is an intelligent

system that through accurate data processing, is considered a hardware and software interference point. But, simply put, the business intelligence is nothing more than the process of prompting the organization's profitability in the competitive market by intelligently using available data in the decision-making process (Ayuso & Santolino, 2012).

Azizi Borujeni and Kahidi Basiry [2016] showed in some research that business intelligence is the most important factor in developing the competitive market (Ouda, 2018). Business intelligence is only attempting to shorten the query paths within information and can't offer any solutions by itself and with no need for information. It was the business intelligence that could in addition to converting the existing systems' weaknesses, take a long step toward meeting the organizations' information needs by converting seemingly worthless data to fruitful knowledge. Business intelligence, in most cases, includes multidimensional analysis and providing reports that managers need (Habul & Pilav-Velic, 2010). As an accurate and up-to-date system approach such as business intelligence can have several effects on the organization's efficiency and performance, many factors can also influence the business intelligence efficiency some of which can be referred to as follows:

Customers: Business intelligence helps a business know its customers better explore their demands and priorities and match its features with the customers' priorities. The business intelligence analyzes, codifies, and uses the data obtained from the customers (Ayuso & Santolino, 2012).

Rivals: A successful business not only should keep the customers satisfied with itself but should try to compete with rivals. Business intelligence can help effectively companies establish those strategies that rivals use to capture customers (Ayuso & Santolino, 2012).

Technical infrastructure: Several research works have been done about the technical infrastructure of an organization to establish the business intelligence and its proper efficacy and it can be said that because of the great importance of this factor, the organizations' most efforts to provide the suitable conditions of the business intelligence, have been made in line with improving the technical infrastructure status (Presthus, 2012).

Communication with suppliers: The purpose of the communication with the suppliers is also, to provide a proper framework for continuous evaluation, their performance development, and selecting the most appropriate suppliers. Promotion of relationships with the suppliers causes the improvement of the delivery time, quality of products and services, and reduction in costs (Presthus, 2012).

➤ **Facial Expression Recognition**

Facial expression recognition is a key component of deep learning-based intelligent businesses that aim to predict and understand customer behavior. By analyzing facial expressions, businesses can gain insights into customers' emotions, preferences, and intentions, which can inform marketing strategies, product development, and customer service (Ali et al, 2022). Deep learning algorithms are particularly well-suited for facial expression recognition, as they can analyze large volumes of data and learn to recognize patterns in facial expressions. These algorithms can be trained on datasets of labeled facial expressions, such as the Facial Action Coding System (FACS), which maps facial movements to specific emotions (Li et al, 2021). Once trained, facial expression recognition algorithms can be integrated into a variety of business applications. For example, they can be used to analyze customer interactions with chatbots or virtual assistants, providing real-time feedback on customers' emotional states and allowing the system to adjust its responses accordingly. They can also be used to analyze customer feedback on social media, providing insights into how customers feel about products or services. Overall, facial expression recognition is an important tool for businesses that want to understand and predict customer behavior (Ali et al, 2022). By leveraging deep learning algorithms to analyze facial expressions, businesses can gain valuable insights into customers' emotions and preferences, allowing them to tailor their products and services to meet customer needs.

The impact of facial expressions on the sales of online products may vary and depend on the type of product and industry. For example, in the clothing industry, the effect of facial expressions on sales is very low, but in the beauty and cosmetics industry, it is very high. Similarly, in the automotive industry, the impact of facial expressions on product sales is relatively low, but in the technology and electronics industry, it is very high (Li et al, 2021). Overall, analyzing facial expressions and customer emotions can help businesses improve customer satisfaction and increase sales. By using image processing algorithms and sentiment analysis, customer feedback and emotions can be easily collected and analyzed on various social networks and websites. This information can help businesses make strategic decisions and improve their products and services (Atmaja & Sasou, 2022). To increase online product sales by determining facial expressions in customers, the following methods can be used:

1. Analyzing facial expressions in advertising: By using image processing algorithms and facial expression analysis, the impact of advertising on customers can be examined, and this information can be used to improve advertising and increase sales.

2. Analyzing facial expressions in online stores: By using smart cameras and image processing algorithms, the facial expressions of customers in online stores can be analyzed, and this information can be used to improve user interface and increase sales (Presthus, 2012).

3. Analyzing facial expressions in after-sale services: By using image processing algorithms and facial expression analysis, the facial expressions of customers in after-sale services can be analyzed, and this information can be used to improve after-sale services and increase customer satisfaction.

4. Analyzing facial expressions in customer feedback: By using image processing algorithms and facial expression analysis, customer feedback can be analyzed, and this information can be used to improve products and services and increase customer satisfaction (Atmaja & Sasou, 2022).

➢ **Sentiment Analysis**

Due to the process of recognition and detection and understanding the relationship between people, groups, and internet organizations, collection of accurate information towards development and satisfaction with businesses, sentiment analysis and predicting customer behavior in business intelligence and social networks are important (Li et al, 2021). Analyzing behavioral emotions and classifying all types of texts, pictures, sounds, and micro videos based on whether the content is positive, negative, or neutral is called sentiment analysis (Babu & Kanaga, 2022). The main purpose of the sentiment analysis is to process users' and customers' behaviors and interests in a way that helps develop the businesses (Tanna et al, 2020; Yue et al, 2019). The important technique in predicting customer behavior in business intelligence and sentiment analysis is machine learning-based sentiment analysis including teaching a machine learning model (Akhtar et al, 2017; Uddin et al, 2019; Cheng & Tsai, 2019). The two-dimensional psychological model of the Watson and Telgen is provided in Figure (1).
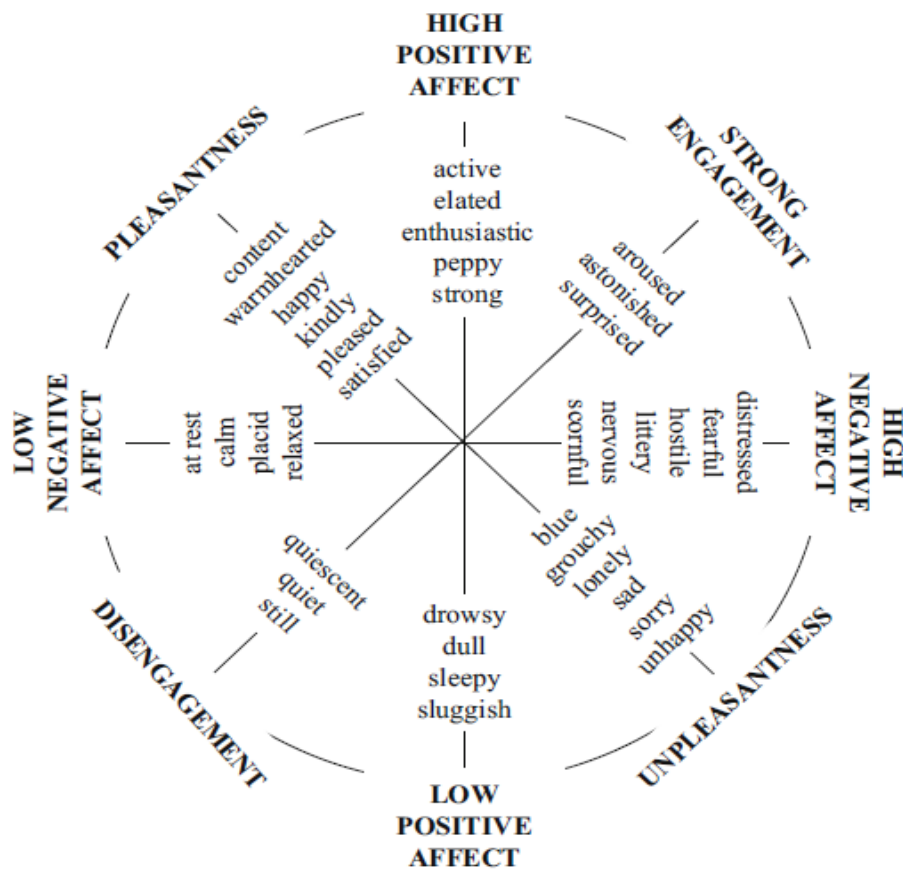
Figure 1. The psychological model of the sentiment analysis (Yue et al, 2019)

Recent developments in the field of emerging technologies have made it possible for users to interact with business intelligence and predict customer behavior in social networks. Nowadays, one of the ways of interaction is to understand the real feelings of people at the moment, the outcome of which, based on the people's reaction and attitudes appears in analyzing feelings like facial features, type of speech, or the people's jobs such as video, photograph, voice and text (Kundale & Kulkarni, 2019).

In order to better understand the data, the related information is categorized as binary and bipolar according to classified feelings and by using machine learning and deep learning different methods (Tanna et al,

2020; Tajuddin et al, 2020). One of the benefits of using AI in sentiment analysis which, due to developing computer systems in doing responsibilities like those of human intelligence, is very important can be to increase process efficiency and speed improvement or service stability in the social networks and also use the method of customer decision making to discover the new ways of marketing and advertisement and to discover opportunities for new services with the help of the AI-based sentiment analysis algorithms (Babu & Kanaga, 2022).

➢ **Deep Learning**
This kind of learning is one of the important elements in the data science that includes statistics and forecast modeling (Peng et al, 2022). For the data scientists who are responsible for collecting, analyzing, and interpreting large amounts of data, deep learning has many uses and

makes the process of analyzing and interpreting data faster and easier (Nalinde & Shinde, 2019). In a way, it can be said that deep learning, actually, is machine learning so that at the level of complex tasks, representation, or abstraction, it performs the learning process for an artificial intelligence system and by this way, the machine gets a better understanding of realities of existence and can identify different patterns (Alm et al, 2005). This type of learning, indeed, is like learning through neural networks that have several hidden layers and the further you go into this process, the more complex and complete models you get (Wang et al, 2021; Yadav & Vishwakarma, 2020; Kumar et al, 2019; Wan, 2008).

➢ **Image Processing**

How can customer behavior be predicted by determining facial expressions? To predict customer behavior by determining facial expressions, image processing, and deep learning algorithms can be used (Abid & Alam, 2020). These algorithms are capable of analyzing and identifying facial expressions of customers and predicting their behavior. For example, by analyzing the facial expressions of customers in online stores, it can be predicted whether a customer is looking to buy a specific product or not. Similarly, by analyzing the facial expressions of customers in after-sales services, it can be predicted whether a customer is satisfied with the service or not (Sparks & McCann, 2015). Using this information, businesses can improve their services and increase customer satisfaction (Abid & Alam, 2020). Some of the image processing and deep learning algorithms used to detect facial expressions in customers include:

1. Convolutional Neural Networks (CNNs): These algorithms are used to detect and identify facial expressions of customers. They are capable of analyzing and identifying specific patterns in images.

2. Recurrent Neural Networks (RNNs): These algorithms are used to analyze temporal sequences in images. They can provide a more accurate analysis of the facial expressions of customers.

3. Floating-point Attention Networks (FANs): These algorithms are used to detect and identify various points on the faces of customers. By analyzing different points on the face, a more accurate analysis of facial expressions can be provided.

4. Attention Networks (ANs): These algorithms are used to focus on specific points in images. By using these algorithms, a more accurate analysis of the facial expressions of customers can be provided (Li et al, 2021).

➢ **Artificial Neural Networks**

Artificial neural networks (ANNs) are a set of mathematical algorithms designed to simulate the human brain function (Chen et al, 2018; Luo, 2017). These networks are composed of several layers of neurons and can recognize the patterns and discover the hidden relationships in big data by using learning algorithms (Abid & Alam, 2020; Ligthart et al, 2021).

Theoretically, artificial neural networks as information processing models that are inspired by the method of Information processing of neurobiological devices of the brain, try to imitate and repeat the main functions of the brain (Bu, 2020; Poria et al, 2016). The artificial neural network follows the similar changes with the capability of inferring meaning from complex or incomplete data in pattern extraction or identifying the trends that are complicated for human beings (Ali et al, 2022). Operationally, the neural networks can be employed in new computing methods for machine learning, presenting knowledge and eventually applying the resulting knowledge to predict the output responses from complicated systems. The key element of this notion is to create new structures for the information processing system (Sivanandam & Deepa, 2007). All

the algorithms of the mentioned ANN are used in the sentiment analysis, but some of them are more commonly used (Luo, 2017). For example, the algorithms perception, backpropagation, Radial Basis Function Network, Convolutional neural network, and Recurrent Neural Network are used for the sentiment analysis (Poria et al, 2016; Hammou et al, 2020).

During past years, many efforts have been made to improve the efficiency of the sentiment analysis in the field of the AI that in this section, we will have an overview on the solutions provided (Manikandan et al, 2018). At the end, a summarized table of these research works is presented. Regarding the development of the algorithms employed in the artificial neural networks which create an optimal connection between the field of deep learning and machine learning, many efforts have been made (Chen et al, 2018; Syarif et al, 2019). In this section, the techniques, algorithms, and solutions and also a brief summary of the research done on the subject and the results in the field of sentiment analysis and the social networks will be reviewed and finally, an abstraction of the studies done and the theoretical framework and research background are provided in the table (1). In research high time has been allocated to feature extraction by making some changes in body status through the extraction of skeleton or joint features at the level of the human body and by reconfiguring the deep convolutional neural network through training images on datasets in the neural network that will be very complicated in voluminous data and high convolution layers (Zhao et al, 2019; Yang et al, 2016). Compared to the classical traditional methods, the strategies of combining and integrating the features of the convolutional neural network have improved the detection rate between 5 and 6 percent (Zhao et al, 2019; Zhao et al, 2015).

Oxyangol Bu in 2020: the main task of this article is to recognize body language and human movement and behavior analysis. Research in the field of human motion detection by the use of the frames and sequences obtained from videos has achieved certain results and has progressed by using image data of human movement status to analyze and extract information and finally improve human quality (Bu, 2020; Zhao et al, 2015).

Janixio Bu in 2022: this paper, focusing on behavioral sentiment analysis and objectifying mental thoughts, analyzes Effective video content analysis and optimizing users', consumers', and customers' feelings in different fields of business and the social networks which ultimately leads to problem diagnosis (Bu, 2020; Li et al, 2021).

The research with the help of recognizing feelings based on the bulk data of available videos and images has been compiled in the form of a set of voice information, movie sequence, consecutive frames, and calculating the optical flow. In the following, content analysis of photos, images, and texts have been used and finally, the model and framework for converting data into sentiment analysis has been presented (Wang et al, 2021).

In the present research by providing a set of data with multi-dimensional information to deepen the work in the field of sentiment analysis, the video data and text information related to the video are collected and based on the frame sequence, the sound sequences, and frame extracted from the video calculate optical flow sequence (Bu, 2022; Zhao et al, 2015).

Table 1. A summary of results of the comparison of thematic literature documents of the sentiment analysis with different algorithms

Authors	Experimental Results						Artificial Intelligence methods						
	High Cost	Low Accuracy	Making Noise	Delay in Implementation	Algorithm complexity	Video content analysis	Text Mining	Natural Language Processing	Computer Vision	Movement Detection	Gesture Recognition	Movement Detection	Neural Network
Babu and Kanaga (2022)		✓					✓		✓				✓
Xue et al (2022)					✓								
Peng et al (2022)				✓			✓						
Atmaja and Sasou (2022)		✓					✓					✓	
Ashraf et al (2022)				✓	✓						✓		✓
Liu (2021)		✓									✓		✓
Mohanty et al (2020)	✓	✓						✓			✓		
X Bu (2020)		✓		✓							✓		✓
Sharma et al (2020)		✓							✓				✓
Mohammad (2020)		✓					✓						
Hu et al (2020)		✓											✓
Xia et al (2020)				✓									✓
Yue et al (2019)		✓					✓						
Kumar et al (2019)								✓					
Elmahmudi and Ugail (2019)			✓								✓	✓	
Kusuma et al (2019)				✓	✓								✓
Jiang et al (2018)		✓			✓								✓
Li et al (2018)		✓										✓	✓
Manikandan et al (2018)							✓				✓	✓	
Jiang et al (2018)		✓									✓		✓
Kanokoda et al (2018)		✓				✓					✓	✓	✓
Arunnehrua et al (2018)		✓										✓	✓
Shao et al (2017)			✓										✓
Kim et al (2017)					✓				✓				✓
Zhang and		✓											✓

Table 1. A summary of results of the comparison of thematic literature documents of the sentiment analysis with different algorithms

Authors	Experimental Results						Artificial Intelligence methods						
	High Cost	Low Accuracy	Making Noise	Delay in Implementation	Algorithm complexity	Video content analysis	Text Mining	Natural Language Processing	Computer Vision	Movement Detection	Gesture Recognition	Movement Detection	Neural Network
Cao (2017)													
Zemblys (2016)											✓		✓
Jiao et al (2014)		✓									✓	✓	
Amendola et al (2014)				✓							✓	✓	✓
AL-Rahayfeh and faezipour (2013)		✓									✓		
Yee Yong et al (2011)		✓									✓		
Kuo Yang et al (2006)				✓									✓

## ➢ Problem Definition

The research uses machine learning techniques to detect facial expression in order to help businesses, taking feedback of customers into an account. In other words, with leveraging the potential of machine learning and artificial intelligence, businesses can get benefits from attitude of customers toward a specific product or service. In this article, a comprehensive and integrated classification for facial expressions with the available dataset and a proposed conceptual model for various dimensions of predicting customer behavior using facial expression detection in intelligent businesses were implemented.

This research attempted to provide a conceptual model and machine learning techniques and algorithms, by comparing previous studies and research with examining the role of empowerment in the

relationship between predicting customer behavior and the deep learning algorithms that have proceeded more precisely and deeply toward behavioral and sentiment analysis. The subject literature and the algorithms introduced in the research background were evaluated. In Table 1 the comparison of results from more than 30 papers studied regarding sentiment analysis and the introduced algorithms indicated that among all the subject literature reviewed in the table below, the integration technique presented in this research in a conceptual model was neglected. Some weaknesses were seen in the papers reviewed and with the help of the algorithm and conceptual model provided in this paper, the gaps in the previous research can be covered. It is worth mentioning that after a lot of research and revealing the weaknesses in this field, in this research a scientific pattern is presented having a knowledge framework and providing a conceptual model as a support for increasing knowledge to understand deeply the details of sentiment analysis in the field of AI and deep learning and machine learning in the business intelligence. The Facial Expression Recognition is among the most powerful and important tools for observing the Business Intelligence digital marketing and sales issues and nowadays, considering their popularity, they have become more prominent, therefore, to create brand awareness and increase sales, we need the sentiment analysis technology in these fields. Considering these explanations, the necessity for designing and providing the conceptual model of this research with a new algorithm to promote profitability in the smart businesses is evident.

3. Methodology
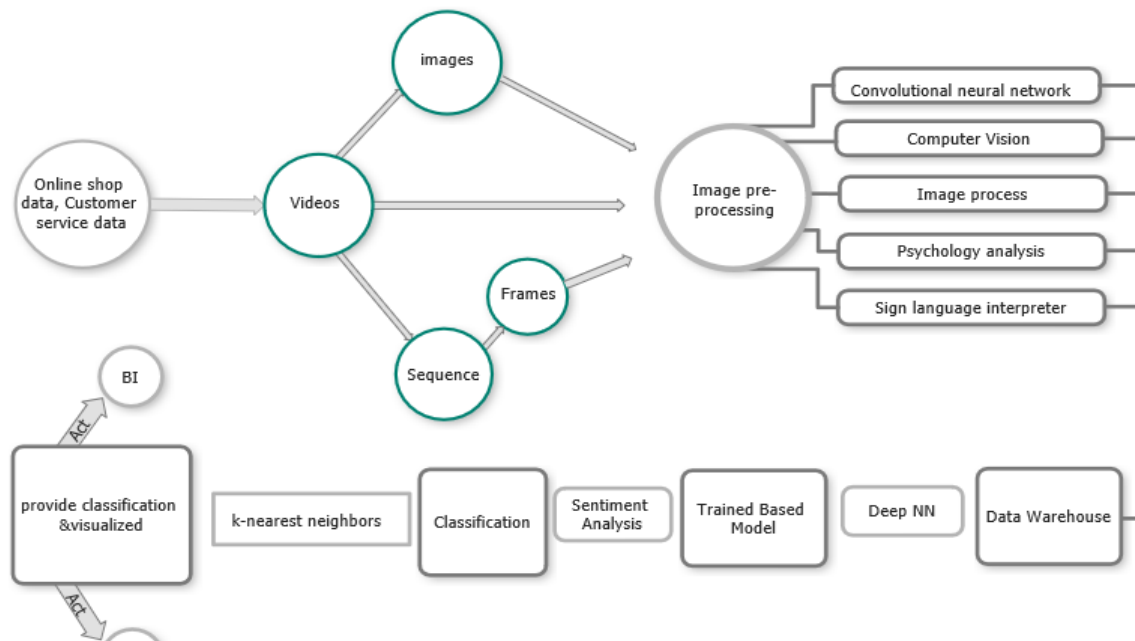
Figure 2. The conceptual model of the research

The present research with a scientific approach is of an analytical descriptive type and is an applied research in terms of research purpose. The methodology used in this article involves using image processing and machine vision algorithms to predict customer behavior and detect facial expressions in order to improve the efficiency of business intelligence. In this study, we used the AffectNet dataset, a public dataset on Kaggle, to train and evaluate our facial expression recognition model. AffectNet consists of over one million images of facial expressions collected from the internet, labeled with eight different emotions: happiness, sadness, surprise, fear, disgust, anger, contempt, and neutrality. This dataset is chosen due to its extensive size and diversity, which is crucial for training a robust deep learning model. The images in AffectNet are annotated with both facial landmark points and emotion labels,

providing rich information for both training and validation processes. By leveraging this dataset, we aimed to ensure our model's accuracy and flexibility in recognizing various facial expressions in real-world scenarios. The dataset's availability on Kaggle also ensures that our methodology can be easily evaluated and verified by other researchers.

The Google Colab environment and Python programming were used to analyze research topics and themes using qualitative and quantitative content analysis. Standard training data from the TensorFlow library in the Google Colab environment was used to train the available data. Ultimately, the research findings extracted seven important facial expressions as the most important indicators of predicting customer behavior in the economic success of smart businesses. By means of image processing and machine learning techniques, we found that happiness facial expression can be distinguished by the model with the accuracy of (73.6%) which can be interpret

by businesses as a sign of satisfaction from customers. However, the model has poor accuracy (9.2%) in case of disgust or hatred facial expression.

The research method in this article has been conducted using **CNN and Deep CNN algorithms** as important methods in the neural network, which have been trained with complex layers and long stages, and have reduced the error rate in detecting low-face conditions. Convolutional neural network (CNN) is an important method in artificial neural networks used for detecting patterns and different features in data. This network is trained using complex layers and long stages, and due to its high detection and interpretability capabilities, it is used in many applications such as face detection, object recognition, motion detection, etc. In this network, the input is in the form of an image that is divided into smaller pieces using a window. Then these pieces are processed using convolution filters, which are smaller matrices. In this process, convolution filters move over the image and transform each part of the image with a corresponding convolution filter using a dot product. In the next stage, pooling layers are used to reduce the dimensions of the image and preserve important features. In this layer, the image is divided into smaller pieces, and the maximum value of each piece is taken. Then these values are used as input for the next layers. Finally, using fully connected layers, the extracted features from the image are transformed into an output vector. This output vector is given to the model as a label and the model reduces the detection error rate using training techniques such as backpropagation. Due to the high capabilities of convolutional neural networks, this method is used as one of the most important algorithms in pattern and image recognition in many applications. In this study, the **Dropout Technique** was used as a method for training neural networks, in which some of the network units are deactivated with a certain probability in each training cycle. This method is used to prevent overfitting and improve network performance. By deactivating some of the network units, the network is forced to learn new and independent features from the previous units, resulting in better and more accurate performance. The research method in this article has been conducted using **CNN and Deep CNN algorithms** as important methods in the neural network. In this study, the **Dropout Technique** was used as a method for training neural networks, in which some of the network units are deactivated with a certain probability in each training cycle. Also in the customer behavior detection and sentiment analysis, the **Supervised Learning method** is employed to deliver meaningful inferences. In this way, the model is trained with labeled training data so that it can predict whether the new data has positive or negative feelings (Lyu et al, 2020; Dainty et al, 2002).).

4. Findings

The application, limitations, and social consequences of this research are issues that, if not properly addressed, can disrupt the efficiency and effectiveness of activities in e-commerce and intelligent businesses. Based on the artificial intelligence algorithms and techniques, and considering the articles reviewed in this research, the clear advantage of this study can be stated as follows: With the algorithms used in the conceptual model of the research and the addition of the algorithms mentioned in this study, customer behavior recognition and sentiment analysis have been successfully ranked by a combination of artificial neural network and machine learning methods in the research data. By comparing the results obtained from image processing, it can be said that among the seven facial expressions (surprise, sad, natural, happy,

fear, disgust, angry). Top performance of model is toward the happiness expression with the (73.6%) of accuracy. In the opposite, as shown in table (2), we can see the bad results of the model in recognition of disgust facial expression. Another important aspect of this research is the ranking of facial expressions based on the detection accuracy from the processed dataset and algorithm combination within the conceptual model. The first rank is assigned to the detection of happiness with (73.6%) accuracy, the second to neutral, the third to sadness, the fourth to fear, the fifth to anger, the sixth to surprise, and the seventh to disgust. In continuation of the research, efforts are made to increase accuracy, reduce errors, and decrease sentiment analysis time on social networks. This process is explicitly shown in Table (2).

Table 2. Results of Applying Algorithms on the Initial Dataset	
Information related to extracting facial expression results	
Parameter Name Facial Expressions	Percentage of Predicting Behavior Accuracy
Happy	73.6%
Natural	67.4%
Sad	43.0%
Fear	34.4%
Angry	27.0%
Surprise	24.2%
Disgust	9.2%

5. Results and discussion

Nowadays, the organizations' settings are full of several changes, opportunities, and challenges that the business intelligence is expected to have the ability and sufficiency to confront them. Among the most important environmental sensors the organizations use is information technology. One of the branches of information technology that is today paid attention to more than ever is the business intelligence. Economic issues; survival of the organizations and companies in the competitive economic turmoil today is

focused on two limitations of cost reduction and revenue increase (Sparks & McCann, 2015). Despite the exchange of information and the large volume of data that is commented on and shared by the daily news and events around the world and by millions of users on the social networks, analysts can use this information in business, politics, economics, psychology, marketing, and sales, predicting buying and selling of stocks, etc., and tracking sentiments in any field with the help of artificial intelligence algorithms in sentiment analysis. Considering that the main problem of predicting customer behavior is that it is only expressed with positive, negative, or neutral results, and in the previous research details of emotions in the business intelligence have not been deeply analyzed, so in this paper, we were looking for a solution that made the reaction of the users' emotions and the intensity and details of the emotions in a deeper way and a minimum time which itself causes profitability in production and trade industry of smart business as well as medical and financial systems of global societies.

Among these, the organizations in addition to employing the information technology which is also one of the virtualization elements of the organizations, need another element that realizes integrity among all the organization's elements. This element will undoubtedly be nothing other than artificial intelligence, important concepts, and algorithms such as image processing and computer vision. Using several technological tools for the purpose of improving decisions and increasing satisfaction and profitability in business intelligence, needs professional algorithms. Various studies show that the business intelligence's success in every organization depends upon determining and assessing the type of successful behavior. In the case of awareness of this behavior, the business

intelligence can be utilized effectively and efficiently in making wise decisions leading to promote success (Guster & Brown,2012; Dainty & Price, 2002). In addition to increasing the precision in the architecture of the presented algorithms, this paper also tries to improve their efficiency. So, by providing the new conceptual model, and Standard training data from the TensorFlow library in the Google Colab environment were used to train the available data. Ultimately, the research findings extracted seven important facial expressions as the most important indicators of predicting customer behavior in the economic success of smart businesses. By comparing the output of image processing with Python programming, it can be said that among the seven facial expressions. The model can detect happiness facial expression with most accurate performance (73.6%). In contrast, the recognition of disgust facial expression has the least accuracy (9.2%) by the model.

The research method in this article has been conducted using **CNN and Deep CNN algorithms** as important methods in the neural network. In this study, the **Dropout technique** was used as a method for training neural networks, in which some of the network units are deactivated with a certain probability in each training cycle. Also in the customer behavior detection and sentiment analysis, the **Supervised Learning method** is applied to ensure the accuaracy.

The main advantage of this research is that in addition to ranking facial expressions based on the priority and the combination of algorithms in the conceptual model, in conclusion, the model demonstrated the most accuracy in detecting the happiness facial expression (73.6% accuracy) which exhibits its efficiency for helping businesses to find customer satisfaction with their products or services. In contrast, the model cannot help businesses to find disgust or hatred of their customers because of its poor performance in detecting the disgust facial expression (9.2% accuracy). In continuation of the research, efforts have been made to increase accuracy and reduce errors in predicting customer behavior and analyzing emotions in social networks. The use of customer behavior recognition in intelligent businesses will be considered an efficient tool in decision-making processes for any large organization from a theoretical perspective and as a future-oriented approach. By being aware of behaviors and predicting them through sentiment analysis, artificial intelligence, and intelligent businesses can be effectively utilized to make smart decisions that will lead to enhanced success rates. Based on the scientific foundations and previous research, results, and findings from data analysis provide conditions for future recommendations, serving as a scientific and research backbone for future studies. With the help of this research, it is possible to create more effective facial expressions for users, leading to faster and more successful marketing and sales in the competitive market of intelligent businesses.

Suggestions for future research:

- It is recommended to look at the business intelligence not only as a technological tool but as an organizational architecture.
- Using picture recognition technology, to identify or better track hands or other body organs, even when we are not physically connected to a screen
- Using voice control to write text or visually impaired
- Using emotion tracking technology (inventing machines that anticipate something before they are asked)
- Data Availability Statement: Data used for carrying out the experiments in this

research is generated out of an experimental prototype and publicly available via this link:

https://colab.research.google.com/drive/1dW6R9rilEKPslQ1xRJ8fUfYc4LtpFDO

6. References

Abid, F., Li, C., & Alam, M. (2020). Multi-source social media data sentiment analysis using bidirectional recurrent convolutional neural networks. Computer Communications, 157, 102-115.

Akhtar, M. S., Gupta, D., Ekbal, A., & Bhattacharyya, P. (2017). Feature selection and ensemble construction: A two-step method for aspect based sentiment analysis. Knowledge-Based Systems, 125, 116-135.

Al Asad, N., Pranto, M. A. M., Afreen, S., & Islam, M. M. (2019, November). Depression detection by analyzing social media posts of user. In 2019 IEEE international conference on signal processing, information, communication & systems (SPICSCON) (pp. 13-17). IEEE.

Ali, A., Samara, W., Alhaddad, D., Ware, A., & Saraereh, O. A. (2022). Human activity and motion pattern recognition within indoor environment using convolutional neural networks clustering and naive bayes classification algorithms. Sensors, 22(3), 1016.

Alm, C. O., Roth, D., & Sproat, R. (2005, October). Emotions from text: machine learning for text-based emotion prediction. In Proceedings of human language technology conference and conference on empirical methods in natural language processing (pp. 579-586).

Appel, O., Chiclana, F., Carter, J., & Fujita, H. (2016). A hybrid approach to the sentiment analysis problem at the sentence level. Knowledge-Based Systems, 108, 110-124.

Arora, P., & Arora, P. (2019, March). Mining twitter data for depression detection. In 2019 International Conference on Signal Processing and Communication (ICSC) (pp. 186-189). IEEE.

Atmaja, B. T., & Sasou, A. (2022). Sentiment Analysis and Emotion Recognition from Speech Using Universal Speech Representations. Sensors, 22(17), 6369.

Ayuso, M., & Santolino, M. (2012). Forecasting the maximum compensation offer in the automobile BI claims negotiation process. Group Decision and Negotiation, 21, 663-676.

Babu, N. V., & Kanaga, E. G. M. (2022). Sentiment analysis in social media data for depression detection using artificial intelligence: a review. SN Computer Science, 3, 1-20.

Balahur, A., & Turchi, M. (2014). Comparative experiments using supervised learning and machine translation for multilingual sentiment analysis. Computer Speech & Language, 28(1), 56-75.

Bu, X. (2020). Human motion gesture recognition algorithm in video based on convolutional neural features of training images. IEEE Access, 8, 160025-160039.

Chen, A., Zhang, J., Liao, W., Luo, C., Shen, C., & Feng, B. (2022). Multiplicity and dynamics of social representations of the COVID-19 pandemic on Chinese social media from 2019 to 2020. Information Processing & Management, 59(4), 102990.

Chen, B., Huang, Q., Chen, Y., Cheng, L., & Chen, R. (2018, June). Deep neural networks for multi-class sentiment classification. In 2018 IEEE 20th International Conference on High

Performance Computing and Communications; IEEE 16th International Conference on Smart City; IEEE 4th International Conference on Data Science and Systems (HPCC/SmartCity/DSS) (pp. 854-859). IEEE.

Chen, Y., Zhou, B., Zhang, W., Gong, W., & Sun, G. (2018, June). Sentiment analysis based on deep learning and its application in screening for perinatal depression. In 2018 IEEE Third International Conference on Data Science in Cyberspace (DSC) (pp. 451-456). IEEE.

Cheng, L. C., & Tsai, S. L. (2019, August). Deep learning for automated sentiment analysis of social media. In Proceedings of the 2019 IEEE/ACM international conference on advances in social networks analysis and mining (pp. 1001-1004).

Dainty, A. R., Bryman, A., & Price, A. D. (2002). Empowerment within the UK construction sector. Leadership & Organization Development Journal, 23(6), 333-342.

Friedman, C., Rindflesch, T. C., & Corn, M. (2013). Natural language processing: state of the art and prospects for significant progress, a workshop sponsored by the National Library of Medicine. Journal of biomedical informatics, 46(5), 765-773.

Guster, D. E. N. N. I. S., & Brown, C. G. (2012). The application of business intelligence to higher education: Technical and managerial perspectives. Journal of Information Technology Management, 23(2), 42-62.

Habul, A., & Pilav-Velic, A. (2010, June). Business intelligence and customer relationship management. In Proceedings of the ITI 2010, 32nd International Conference on Information Technology Interfaces (pp. 169-174). IEEE.

Hammou, B. A., Lahcen, A. A., & Mouline, S. (2020). Towards a real-time processing framework based on improved distributed recurrent neural network variants with fastText for social big data analytics. Information Processing & Management, 57(1), 102122.

Hartmann, J., Huppertz, J., Schamp, C., & Heitmann, M. (2019). Comparing automated text classification methods. International Journal of Research in Marketing, 36(1), 20-38.

Hussain, J., Satti, F. A., Afzal, M., Khan, W. A., Bilal, H. S. M., Ansaar, M. Z., ... & Lee, S. (2020). Exploring the dominant features of social media for depression detection. Journal of Information Science, 46(6), 739-759.

Islam, M. R., Kabir, M. A., Ahmed, A., Kamal, A. R. M., Wang, H., & Ulhaq, A. (2018). Depression detection from social network data using machine learning techniques. Health information science and systems, 6, 1-12.

Jalloul, M. H. (2018). Improving customer satisfaction using Sentiment analysis (Master's thesis).

Katchapakirin, K., Wongpatikaseree, K., Yomaboot, P., & Kaewpitakkun, Y. (2018, July). Facebook social media for depression detection in the Thai community. In 2018 15th international joint conference on computer science and software engineering (jcsse) (pp. 1-6). IEEE.

Köseoglu, M. A., Chan, E. S., Okumus, F., & Altin, M. (2019). How do hotels operationalize their competitive intelligence efforts into their management processes? Proposing a holistic model. International Journal of Hospitality Management, 83, 283-292.

Kumar, A., Sharma, A., & Arora, A. (2019). Anxious depression prediction

in real-time social data. arXiv preprint arXiv:1903.10222.

Kumar, S., Yadava, M., & Roy, P. P. (2019). Fusion of EEG response and sentiment analysis of products review to predict customer satisfaction. Information Fusion, 52, 41-52.

Kundale, J. U., & Kulkarni, N. J. (2019, September). Language independent multi-class sentiment analysis. In 2019 5th International Conference On Computing, Communication, Control And Automation (ICCUBEA) (pp. 1-7). IEEE.

Ligthart, A., Catal, C., & Tekinerdogan, B. (2021). Systematic reviews in sentiment analysis: a tertiary study. Artificial Intelligence Review, 1-57.

Li, Y., Lu, Y., Chen, B., Zhang, Z., Li, J., Lu, G., & Zhang, D. (2021). Learning informative and discriminative features for facial expression recognition in the wild. IEEE Transactions on Circuits and Systems for Video Technology, 32(5), 3178-3189.

Luo, Y. (2017). Recurrent neural networks for classifying relations in clinical notes. Journal of biomedical informatics, 72, 85-95.

Lyu, Y., Chow, J. C. C., & Hwang, J. J. (2020). Exploring public attitudes of child abuse in mainland China: A sentiment analysis of China's social media Weibo. Children and Youth Services Review, 116, 105250.

Manikandan, K., Patidar, A., Walia, P., & Roy, A. B. (2018). Hand gesture detection and conversion to speech and text. arXiv preprint arXiv:1811.11997.

Mohammad, S. M. (2016). Sentiment analysis: Detecting valence, emotions, and other affectual states from text. In Emotion measurement (pp. 201-237). Woodhead Publishing.

Mohanty, J. P., Swain, A. K., & Mahapatra, K. (2020, December).

Predicting Sentiments to an accuracy matching the gesture recognized for the specially-abled. In 2020 IEEE International Symposium on Smart Electronic Systems (iSES)(Formerly iNiS) (pp. 61-66). IEEE.

Moreno, A., & Redondo, T. (2016). Text analytics: the convergence of big data and artificial intelligence. IJIMAI, 3(6), 57-64.

Nalinde, P. B., & Shinde, A. (2019). Machine learning framework for detection of psychological disorders at OSN. Int J Innov Technol Explor Eng (IJITEE), 8(11).

Nardo, M., Forino, D., & Murino, T. (2020). The evolution of man–machine interaction: The role of human in Industry 4.0 paradigm. Production & manufacturing research, 8(1), 20-34.

Ouda, G. K. (2018). Application of Business Intelligence in Insurance Industry (Iraq). The International Journal of Engineering and Science (IJES), 7(8), 84-92.

Peng, S., Cao, L., Zhou, Y., Ouyang, Z., Yang, A., Li, X., ... & Yu, S. (2022). A survey on deep learning for textual emotion analysis in social networks. Digital Communications and Networks, 8(5), 745-762.

Presthus, W. (2012). Never giving up: Challenges and solutions when teaching Business Intelligence. In The 35th Information Systems Research Conference in Scandinavia (IRIS), 17th-20th August, Sigtuna, Sweden.

Poria, S., Cambria, E., & Gelbukh, A. (2016). Aspect extraction for opinion mining with a deep convolutional neural network. Knowledge-Based Systems, 108, 42-49.

Poria, S., Cambria, E., Howard, N., Huang, G. B., & Hussain, A. (2016). Fusing audio, visual and textual clues for sentiment analysis from multimodal content. Neurocomputing, 174, 50-59.

Ruz, G. A., Henríquez, P. A., & Mascareño, A. (2020). Sentiment analysis of Twitter data during critical events through Bayesian networks classifiers. Future Generation Computer Systems, 106, 92-104.

Schouten, K., & Frasincar, F. (2015). Survey on aspect-level sentiment analysis. IEEE transactions on knowledge and data engineering, 28(3), 813-830.

Sethi, M., Pandey, S., Trar, P., & Soni, P. (2020, July). Sentiment identification in COVID-19 specific tweets. In 2020 International Conference on Electronics and Sustainable Communication Systems (ICESC) (pp. 509-516). IEEE.

Shen, G., Jia, J., Nie, L., Feng, F., Zhang, C., Hu, T., ... & Zhu, W. (2017, August). Depression detection via harvesting social media: A multimodal dictionary learning solution. In IJCAI (pp. 3838-3844).

Sivanandam, S. N., & Deepa, S. N. (2007). Principles of soft computing (with CD). John Wiley & Sons.

Soon, C. C., & Salamzadeh, Y. (2021). The impact of digital leadership competencies on virtual team effectiveness in mnc companies in penang, Malaysia. Journal of Entrepreneurship, Business and Economics, 8(2), 219-253.

Sparks, B. H., & McCann, J. T. (2015). Factors influencing business intelligence system use in decision making and organisational performance. International Journal of Sustainable Strategic Management, 5(1), 31-54.

Syarif, I., Ningtias, N., & Badriyah, T. (2019, October). Study on mental disorder detection via social media mining. In 2019 4th International conference on computing, communications and security (ICCCS) (pp. 1-6). IEEE.

Tadesse, M. M., Lin, H., Xu, B., & Yang, L. (2019). Detection of depression-related posts in reddit social media forum. Ieee Access, 7, 44883-44893.

Tajuddin, M., Kabeer, M., & Misbahuddin, M. (2020, January). Analysis of social media for psychological stress detection using ontologies. In 2020 Fourth International Conference on Inventive Systems and Control (ICISC) (pp. 181-185). IEEE.

Tanna, D., Dudhane, M., Sardar, A., Deshpande, K., & Deshmukh, N. (2020, May). Sentiment analysis on social media for emotion classification. In 2020 4th International Conference on Intelligent Computing and Control Systems (ICICCS) (pp. 911-915). IEEE.

Tariq, S., Akhtar, N., Afzal, H., Khalid, S., Mufti, M. R., Hussain, S., ... & Ahmad, G. (2019). A novel co-training-based approach for the classification of mental illnesses using social media posts. Ieee Access, 7, 166165-166172.

Tao, X., Dharmalingam, R., Zhang, J., Zhou, X., Li, L., & Gururajan, R. (2019, October). Twitter analysis for depression on social networks based on sentiment and stress. In 2019 6th International Conference on Behavioral, Economic and Socio-Cultural Computing (BESC) (pp. 1-4). IEEE.

Trotzek, M., Koitka, S., & Friedrich, C. M. (2018). Utilizing neural networks and linguistic metadata for early detection of depression indications in text sequences. IEEE Transactions on Knowledge and Data Engineering, 32(3), 588-601.

Tumasjan, A., Sprenger, T., Sandner, P., & Welpe, I. (2010, May). Predicting elections with twitter: What 140 characters reveal about political sentiment. In Proceedings of the international AAAI conference on web

and social media (Vol. 4, No. 1, pp. 178-185).

Uddin, A. H., Bapery, D., & Arif, A. S. M. (2019, July). Depression analysis from social media data in Bangla language using long short term memory (LSTM) recurrent neural network technique. In 2019 International Conference on Computer, Communication, Chemical, Materials and Electronic Engineering (IC4ME2) (pp. 1-4). IEEE.

Wang, X., Kou, L., Sugumaran, V., Luo, X., & Zhang, H. (2020). Emotion correlation mining through deep learning models on natural language text. IEEE transactions on cybernetics, 51(9), 4400-4413.

Wan, X. (2008, October). Using bilingual knowledge and ensemble techniques for unsupervised Chinese sentiment analysis. In Proceedings of the 2008 Conference on Empirical Methods in Natural Language Processing (pp. 553-561).

Williams, L., Bannister, C., Arribas-Ayllon, M., Preece, A., & Spasić, I. (2015). The role of idioms in sentiment analysis. Expert Systems with Applications, 42(21), 7375-7385.

Yadav, A., & Vishwakarma, D. K. (2020). Sentiment analysis using deep learning architectures: a review. Artificial Intelligence Review, 53(6), 4335-4385.

Yang, L., Liu, B., Lin, H., & Lin, Y. (2016). Combining local and global information for product feature extraction in opinion documents. Information Processing Letters, 116(10), 623-627.

Yang, L., Na, J. C., & Yu, J. (2022). Cross-modal multitask transformer for end-to-end multimodal aspect-based sentiment analysis. Information Processing & Management, 59(5), 103038.

Yang, X., McEwen, R., Ong, L. R., & Zihayat, M. (2020). A big data analytics framework for detecting user-level depression from social networks. International Journal of Information Management, 54, 102141.

Yazdavar, A. H., Mahdavinejad, M. S., Bajaj, G., Romine, W., Sheth, A., Monadjemi, A. H., ... & Hitzler, P. (2020). Multimodal mental health analysis in social media. Plos one, 15(4), e0226248.

Yue, L., Chen, W., Li, X., Zuo, W., & Yin, M. (2019). A survey of sentiment analysis in social media. Knowledge and Information Systems, 60, 617-663.

Zhao, J., Mao, X., & Chen, L. (2019). Speech emotion recognition using deep 1D & 2D CNN LSTM networks. Biomedical signal processing and control, 47, 312-323.

Zhao, K., Cong, G., Yuan, Q., & Zhu, K. Q. (2015, April). SAR: A sentiment-aspect-region model for user preference analysis in geo-tagged reviews. In 2015 IEEE 31st international conference on data engineering (pp. 675-686). IEEE.