A Systematic Mapping Study of Emotion Analysis in Arabic Language

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Abstract

In this study, we address the problem of emotion analysis in Arabic text by reviewing the current studies on the topic between the years 2013- 2023.
The standard systematic mapping study method has been employed collecting 62 studies on Arabic emotion text research, including 31 articles from SCOPUS, and 31 from Google Scholar.
The results of the review indicates that the largest number of research was conducted and published in 2023. 31 journals published articles in the area of Arabic Emotion Detection, and the journal that published the most articles is Applied Science (MDPI).
The statistical approach using different supervised machine learning algorithms has been the most popular approach for Arabic Emotion Analysis for the past ten years, followed by the deep learning algorithms. There are only two studies that have used lexical-based techniques and the hybrid approach. The data sets collected from social media platforms (Twitter and Facebook) are the most widely used in the Arabic text emotion analysis, especially Twitter. Lastly, the number of type of emotions used in previous studies to detect Arabic emotion amounted to 26 emotions, where the most common emotion types recognized were: sadness, anger, fear, joy, surprise, disgust, and love.

I. INTRODUCTION

In recent years, an enormous amount of online text documents have been created on the internet. The number of Internet users is increasing rapidly, especially on social media communication platforms (Twitter, Facebook, Instagram, etc.). Every second, thousands of posts, news, photos, comments, expressions, feelings, opinions, etc. are being uploaded via the internet, and all of them are rich with emotion and expressions, but in an unstructured form.
This huge amount of digital communication content needs a form of categorization to make online text documents easier to search and analyze.
In our study, we focus on text classification for the Arabic Language. Social media text communication is a useful source of information for many researchers for analysis and mining using Natural Language Processing, especially in the branch of text-based emotion detection (TBED).
The objective of this systematic mapping study (SM) is to assess the current studies in emotion analysis from text, published in the past ten years (2013- 2023) for the Arabic Language. The study aims to determine which approaches have been used as a basis for emotion analysis and evaluate the current trends in this research area. SM is conducted by identifying, selecting, synthesizing, summarizing, and assessing 62 relevant studies related to this research topic.
This paper is organized as follows:

- Section 1 presents the introduction and background.
- Section 2 presents the methodology used for this systematic mapping study.
- Section 3 answers 5 major research questions

- Section 4 presents the results and discussion.
- Section 5 presents conclusions and future work.

II. BACKGROUND

A. Natural language processing

Natural language processing (NLP) is a field of artificial intelligence (AI), in which computers can understand, analyze, and process the meaning of natural language in a useful way. This field is an intersection of the fields of computer science, artificial intelligence, and computational linguistics. NLP is a human-computer interaction that allows machines to understand how humans speak. Some NLP applications include sentiment analysis, text mining, machine translation, automated question answering, emotion analysis, automatic text summarization, etc.

Emotion detection, analysis, or recognition is the process of identifying human emotions using computer technology. Since in real life, even people have difficulty recognizing the emotions of others, performing this task is challenging.

B. Emotion Detection and Recognition (EDR):

Emotion Detection and Recognition aims to identify emotions from various forms of input such as written text, speech, video/audio, etc. With the current advances in technology, emotion recognition software has become more reliable and successful.

Six basic emotion categories are widely used to describe human behavior through the text, namely, anger, disgust, fear, happiness, sadness, and surprise. Other researchers have added two more emotion categories, trust and anticipation. Also, in other studies, 11 emotions of anger, aversion, courage, dejection, desire, despair, fear, hate, hope, love, and sadness were identified.

C. Emotion Models:

1. Discrete Emotion models (DEMs): The discrete model of emotions involves placing emotions into distinct classes or categories. Prominent among them include:

• The Paul Ekman model: distinguishes emotions based on six (6) basic categories. These fundamental emotions are happiness, sadness, anger, disgust, surprise, and fear [1].

• The Robert Plutchik model: Eight fundamental emotions were named, that is, acceptance/trust and anticipation in addition to the six primary emotions by Ekman [1].

• Orthony, Clore, and Collins (OCC): They discretized emotions into 22, adding 16 emotions to the emotions Ekman posited as basic, with additional classes of relief, envy, reproach, self-reproach, appreciation, shame, pity, disappointment, admiration, hope, fears-confirmed, grief, gratification, gloating, like, and dislike [1].

Any of the DEMs mentioned can be used to represent emotions when designing EDR systems, depending on the researcher's preference. However, the OCC model generally provides a broader emotion representation scope due to its greater number of classes [1].

2) Dimensional Emotion Models (DiEMs): The dimensional model presupposes that emotions are not independent and that there exists a relation between them hence the need to place them in a spatial space. Thus, dimensional models position emotions on a dimensional space (uni-dimensional, ie, 1-D, and multidimensional, ie, 2-D and 3-D). Unidimensional models are rarely used but their fundamental idea permeates most multidimensional models. This article elucidates more on multidimensional models for representing emotions [1].

• Russell presents a circular two-dimensional model prominent in dimensional emotions representation called the circumplex of affect (establishes that emotions are not independent but related) [1].

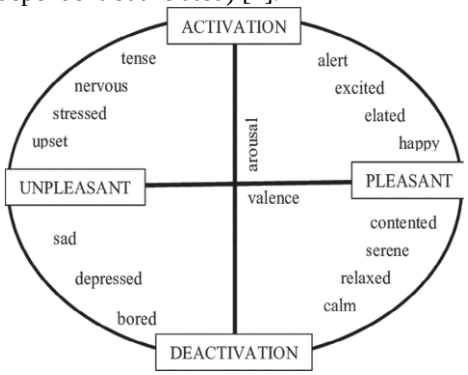


Figure 1. Emotions in DEMs [1]

• Plutchik presents a 2-dimensional wheel of emotions that shows Valence on the vertical axis and Arousal on the horizontal axis. The wheel shows emotions in concentric circles with the innermost emotions being derivatives of the eight fundamental emotions, then the eight fundamental emotions and finally combinations of the primary emotions on the outermost parts of the wheel [1].

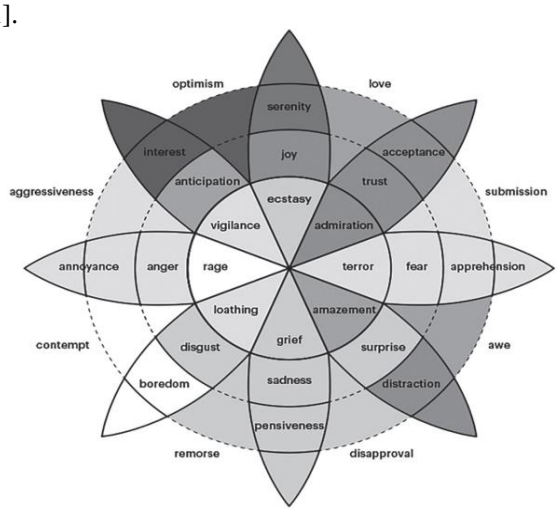


Figure 2. The Wheel of Emotions [1]

• Russell and Mehrabian [2] also present a 3-dimensional emotion model made up of Valence/Pleasure, Arousal, and Dominance as the third dimension. Arousal and Valence, as postulated in the 2-D, represent how pleasant/ unpleasant or active/inactive an emotion is respectively. The third dimension of Dominance describes the degree to which experiencers had control over their emotions [1].

Model	Year	Basic emotions	Approach	Structure
Ekman [59]	1992	Anger, disgust, fear, joy, sadness, surprise.	Categorical	-
Shaver *et al.* [66]	1987	Anger, fear, joy, love, sadness, surprise.	Categorical	Tree
Oatley et al. [67]	1987	Anger, anxiety, disgust, happiness, sadness.	Categorical	-
Plutchik [61]	1980	Acceptance, admiration, aggressiveness, amazement, anger, annoyance, anticipation, apprehension, awe, boredom, contempt, disapproval, disgust, distraction, ecstasy, fear, grief, interest, joy, loathing, love, optimism, pensiveness, rage, remorse, sadness, serenity, submission, surprise, terror, trust, vigilance.	Dimensional	Wheel
Russell [60]	1980	Afraid, alarmed, angry, annoyed, aroused, astonished, at ease, bored, calm, content, delighted, depressed, distressed, droopy, excited, frustrated, glad, gloomy, happy, miserable, pleased, relaxed, sad, satisfied, serene, sleepy, tense, tired.	Dimensional	Valence, arousal
Oatley et al. [68]	1988	Admiration, anger, appreciation, disappointment, disliking, fear, fears-confirmed, gloating, gratification, gratitude, happy-for, hope, liking, pity, pride, sorry-for, relief, remorse, reproach, resentment, self-reproach, shame.	Dimensional	Tree
Lövheim [69]	2012	Anger/rage, contempt/disgust, distress/anguish, enjoyment/joy, fear/terror, interest/excitement, shame/humiliation, surprise/startle.	Dimensional	Cube

Figure 3. The Emotions models (stored on the main emotion approach) [3]

D. Emotion Detection & Recognition (EDR) from text:

Text-based EDR research studies are very scarce compared to other studies in the field of emotion analysis such as speech, voice, and facial emotion.

To recognize emotion from text, text documents that are rich with feelings and expressions are needed for analysis such as social media text (Twitter and Facebook posts, customer reviews, and written news).

There is a certain difficulty in analyzing Tweets as a social media source. It is in the form of a slang language that has linguistic mistakes which cannot be easily understood by machines. Sentiment Analysis (SA), Natural Language Processing (NLP), Emotion Detection from text (ED) and Named Entity Recognition (NER) are utilized for analyzing and processing tweets [4].

F. Differences between Emotion analysis and Sentiment analysis:

The fields of "sentiment analysis" and "emotion analysis" from text are some of the promising fields in “Text Mining"[5]. Emotion analysis or detection from text is closely related to Sentiment Analysis, although they are quite different. Opinion and emotion mining share some common tasks, including the extraction of relevant textual features from documents used to express states, and the classification of the respective sentiment or emotion. Compared to polarity classification, emotion classification involves a few differences [6].

Sentiment analysis is limited to only dividing data points to see whether they reflect a negative or positive feeling. This is far from being the whole picture. Emotion analysis, on the other hand, is a more involved, deeper analysis of consumer emotions that tries to drill down into the psychology of different user behaviors.

F. Arabic language overview:

Arabic is one of the Semitic languages, spoken by nearly 380 million people around the world as their first official language [7], making it the fifth most widely spoken language in the world.

Arabic language is considered as one of the most ambiguous languages. The same meaning can be expressed in many different ways. It is a morphologically rich language [8]. The Arab people display powerful linguistic and educational continuity. Arabic is the formal tongue of countries from North Africa to the Arabian Gulf [7]. However, the Arabic language research that has been carried out is still very scarce. The Arabic language relative to other languages is poor in terms of language resources and studies conducted for sentiment and emotion analysis. Some languages like English, have been well-studied in emotion language analysis.

Most of the available studies for emotion recognition in Arabic are focused on spoken rather than written texts. However, Arabic emotion recognition remains under-addressed in comparison to other languages, primarily due to the scarcity of labeled data [9].

Furthermore, no structured methods exist for extracting and classifying emotions in Arabic tweets. If available, such mechanisms can be applied to improve customer service management, e-learning applications, product quality, detection techniques for psychologists to identify terrorist conduct, etc. [10].

The Arabic language consists of 28 different characters, and is written from right to left. There are formal and informal writing styles. We can divide the Arabic language into three formats:

- Standard Arabic Language (SA): used in formal (written and spoken transactions) like the news.
- Classical Arabic (CA): the Holy Quran language. This is an old Arabic people language used in poems and literature.
- Dialects of Arabic: depending on the region, each country has its own dialect language, like (Egyptian, Philistine, and Moroccan dialects) which use the same letters but differ in terminology use, meaning, and tunes. Most of Arabic text in social media are different dialects of Arabic.

One of the most important challenges in Arabic emotion detection is the variety of dialects. The Arabic language has complex morphology, because of this it needs advanced pre-processing and Lexicon-building techniques. And because of various dialects, the Arabic data that is available online may have words with different meanings [11].

Another challenge is the Arabic alphabet. The letters change their form depending on their position in the word. For example, the letter of the Seen (س) at the beginning looks like (سـ) in the middle looks like (ـسـ), and at the end like (ـس). Another difficulty comes from the word originality; 85% of the Arabic words are derived from the roots [7].

Another challenge is what is known as Compound Phrases which are widely used. Such phrases may vary from one dialect to another and may have a different meaning in various regions of the Arab world. This problem leads to the need for other models for different areas of the Arab world. Also, new phrases are evolving in the Arabic language day by day so it is hard for Arabic text classifiers to classify these phrases accurately [11].

G.Dataset:

With the growth of the Internet community, social media has become an important and useful source of data and information in the world. People use these various online social media platforms (Twitter-

Facebook- Instagram. etc.) to share their opinions and feelings. Social media is rich with texts, photos, sentences, feelings and emotions, so researchers can easily use these social platforms to develop data sets.

Written text is one good source for expressing your ideas, emotions and feelings. Languages not only are used for communication but also impart emotion associated with it. Feelings can be easily expressed in the form of text [12].

One of the main problems of text classification, in general, is the availability of general datasets which can be used as a benchmark. There is no general Arabic dataset which can be used by different researchers as a benchmark. Most Arabic text classification researchers build their own datasets [13]. Almost all of these collected datasets are from social media, especially Twitter. For the Arabic language, public datasets for emotion analysis are limited.

Most of the Arabic studies focus on sentiment analysis as positive and negative but few of them go deeper to analyze and classify the emotions behind tweets.

There are more than one Arabic dataset and lexicons used in previous studies. However, they are in other dialects or informal language. These data sets make the analysis more challenging, since they require pre-processing and cleaning. Most of the emotion analysis techniques are built on Modern Standard Arabic (formal language).

Example data sets are the Jordanian dataset called Twitter Data set for Arabic Sentiment Analysis Dataset [12], and a Saudi dataset called AraSenti Lexicon, which is annotated with the sentiment analysis, not with the emotion analysis [14], and the dataset that is written in Arabic- Syrian dialect with an emotional connotation in their content [5].

Some of them use the SemEval-2018 Task 1 emotion dataset that contains three languages data (Arabic- English-Spanish) [14], [15] and [16].

In the study [15], the researchers built the first dataset of Arabic tweets annotated for emotion analysis as a multi-label multi-target problem. This dataset is used in other studies such as [18].

In general, a few annotated datasets are available for EDR that are publicly available for research purposes. Table1 contains a collection of information about the most used emotion corpora/datasets available, and some of their features, emotion models they represent and downloadable links, which have been collected and used in the field of Arabic emotion detection research.

TABLE 1: THE DATASETS USED IN PREVIOUS STUDIES FOR ARABIC EMOTION ANALYSIS.

Dataset	Dataset size& Features	Downloadable Link	Emotion model	Language
SemEval 2018	10,983 English tweets 4,381 Arabic tweets 7,094 Spanish tweets	https://competitions.codalab.org/competitions/17751.	Anger, Joy, sad and fear	English/ Arabic/ Spanish
ArSEL Arabic Sentiment and Emotion Lexicon	32,196	https://github.com/Husseinjd/ArSEL		Arabic
IAEDS	1,365 posts Iraqi dialect Facebook Postings.	[19]	Ekman's basic emotions.	Iraqi dialect
DINA	3,000 tweets	www.slideshare.net/iwan_rg/p05-dina-a-multidialect-dataset-for-arabic-emotion-analysis	Happiness, sadness, anger, disgust, surprise, and fear.	a multi-dialect data set for Arabic emotion analysis
ExaAEC	consisting of approximately 20,000 tweets categorized	[20]	Plutchik emotion model plus "love" and "neutral"	Dialect
AETD	The total number of tweets is 10,065	[21]	Anger, fear, happiness, love, sadness, surprise, sympathy, or none.	Egyptian dialect
LAMA	9,064 tweets	[22]	Robert Plutchik's 8 basic emotion types	Modern Standard and Dialectal Arabic
AEELex	35,383 tweets.	[23]	Plutchik's eight basic emotion categories	Saudi dialect
AraEmoCorpus	5.5 million Arabic tweets	[24]	The corpus contains Arabic tweets tagged with emotion categories: anger, disgust, fear, joy, sadness, and surprise.	Arabic

ArECTD dataset	1,597,939 tweets using COVID19 hashtags		sadness, fear, sarcasm, sympathy, anger, surprise, love, joy, hope, and none	Egyptian dialect
(SEDAT) Sentiment and Emotion Detection			Anger, Joy, Fear, or Sadness	Arabic dialect tweets
Emotional-Tone	10,000 tweets		Sadness, Anger, Joy, Surprise, Love, Sympathy, Fear, None.	
Monitoring People's	5.5 million Tweets. Arabic emotion and COVID-19		anger, disgust, fear, joy, sadness, and surprise	Saudi dialect
Arabic news headlines	From paper 16 in excel file in its references 1698 news headlines	http://dx.doi.org/10.21227/7e79-nt12 Arabic News Headlines | IEEE DataPort (ieee-dataport.org)	anger, disgust, fear, happiness, sadness, surprise, and neutral	

H. Data processing:

This stage consists of the data cleaning and Removal of the stop words from the data sources. This is an important process to clean (filter) the data source from the noisy and unneeded content (uninformative data), to increase the data quality, by deleting: Twitter shortcuts - URL links - Negation emotion - , etc.

I. Feature selection

Feature extraction is a process of transforming data into features to be used in the machine learning model. Typically, machine learning algorithms programmed with numeric data. Hence, the text or word is then mapped into numerical vectors feature [25].

Each tweet selected from labelled data in this step is converted to a vector of features (numerical values) after pre-processing. We need to capture features that describe the emotion expressed by representing each word in the text as an attribute in the feature vector (numerical features). These sets of numerical features meet one-word emotion.

This process is called text vectorization (word embedding), which reduces the size of vector words converted from the features. This leads to improving the execution speed and reducing the training time.

There are plenty of text vectorization techniques to perform vectorization based on the project requirement such as:

- Bag-Of-Words (Count Vectorizer).
- TF-IDF: Term Frequence-Inverted Document Frequency (TF-IDF)
- Word to vectors or semantic word embedding (doc2vec): Skip-gram, and CBOW (Continuous Bag-of-Words).
- GloVe

Every method has their advantages. Bag-Of-Words is suitable for text classification, TF-IDF is for document classification and if you want semantic relation between words then word2vec can be useful [26].

K . Algorithm selection for emotion classification (classification model -Methodologies for emotion detection):

There are 3 detection approaches used to achieve textual emotion recognition, and the choice of approach has some important consequences in the modeling solution process.

1- Knowledge-based techniques, also named lexicon-based techniques, which can be mainly classified into two categories: dictionary-based and corpus-based approaches.

2- Statistical approach (use of different supervised and unsupervised machine learning algorithms).

Machine learning (SVM. Naive Bayes. Decision tree. Random forest, etc.)

Deep learning (CNN, LSTM, BI_LSTM, etc.) are examples of the statistical approach.

3- Hybrid approaches. Combination of the two previous approaches.

Once the feature extraction and text document transformation are completed, the following step, which is training the classifier, starts. It is the most important step of text classification, and it is accomplished by selecting an appropriate model.

This step is responsible for assigning an unlabeled document to the correct class of that document. For determining which class the document is assigned to, it is required to calculate the probability of assigning that document to each class [17].

Figure 4 shows the main process to detect emotion from text.

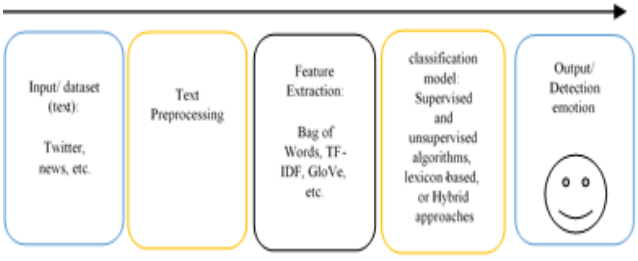
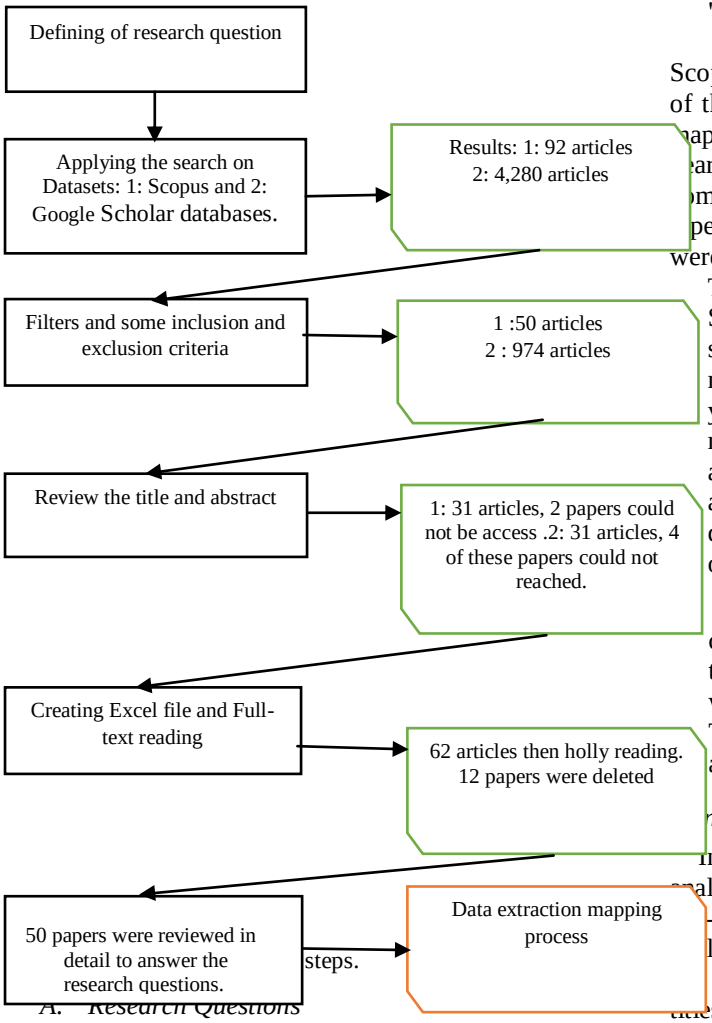


Figure 4: Main process of emotion detection from text.

III. METHOD

Systematic mapping study is a methodology that is frequently used in medical research but that has largely been neglected in Software Engineering. This study has been conducted as a systematic mapping and the steps of this method are listed below in the Figure 5.



steps.

A. Research Questions

The research questions (RQs) of this study are listed below:

RQ1. What is the yearly distribution of articles?

RQ2. What are the journals that focus on this study area (Arabic emotion detection) as well as the years the articles were published?

RQ3.What are the methods used for Arabic emotion detection in text?

RQ4. What are the datasets and types of Arabic language used for text-based emotion detection?

RQ5. What types of emotions are recognized by the studies?

B. Search process

Define Search strategy (Search question):

In this paper, a systematic mapping study is applied to the Scopus and Google Scholar databases. The keywords and their synonyms determine the search for the relevant papers as shown below:

The search term: ("Emotion" and ("analysis" or "detection" or "recognition" or "classification" or "mining") and (“Arabic”))

Result: The results from the search question on Scopus database are (92 document results). Then, some of the Scopus filters that are suitable for this systematic mapping are applied: The search year for the past ten years (2013 to 2023), the subject area, including computer science and engineering, the article document type from journals filters were applied, and the results were 31 articles, 2 papers could not be accessed.

The results from the search question on the Google Scholar database are 4,280 articles. Then some of the same filters that are suitable for this systematic mapping are applied: The search year for the past ten years (2013 to 2023), article document type filters results in 974 articles. To identify the emotion analysis articles, the title and abstract were reviewed, and the articles that were not also found on the Scopus database were selected. The results were 31 articles, 4 of these papers could not reached.

Then the Excel file for the chosen papers was created, containing in total 62 articles. After reading these papers, 12 papers were deleted because they were not directly related to Arabic emotion analysis. The remaining 50 papers were reviewed in detail to answer the research questions.

nclusion and exclusion criteria

In general, to identify articles that focused on emotion analysis, the title and abstracts were reviewed as well as -text reading. Some of the papers were included or luded based on the following criteria:

The following inclusion criteria were applied to tles and abstracts:

- Articles that were published in years (2013 to 2023).

Articles that are:

- Articles that are in the field of computer science and engineering.
- Journal articles.
- Articles that are written in English.
- Articles that are in the “final” application stage.
- Only Text-based emotion analysis was chosen.

• The following criteria state when a study was excluded:

- Articles not analyzed the Arabic Language.
- Articles not accessible in full-text, or not completed, or are in progress.
- Articles that are published as a technical report, bachelor’s thesis, or master’s/Ph.D. thesis.
- Articles that are published with missing information or in an incomplete way (gray literature).
- Articles that have unrelated titles and abstracts.

- Articles that are not text-based, such as facial emotion recognition, etc., or dealing just sentiment analysis.

D.Data analysis

The data was tabulated to show:

- The number of articles that were published per year (addressing RQ1).
- The journals focusing on the area of Arabic emotion detection and the years that these articles were published. (Addressing RQ2).
- The methods that are used for text-based analysis for detecting emotions (addressing RQ3).
- The datasets and the type of Arabic Languages that are used for text-based emotion analysis (addressing RQ4).
- Type of emotions recognized by the studies (addressing RQ5).

IV. RESULTS AND DISCUSION

This section summarizes the results of this study.

Figure 6 shows the results of the first search question that is applied to 62 articles. Figure 6 shows that the largest number of research was conducted and published in 2023. And some years, such as the year (2015), did not have any study or research in this domain.

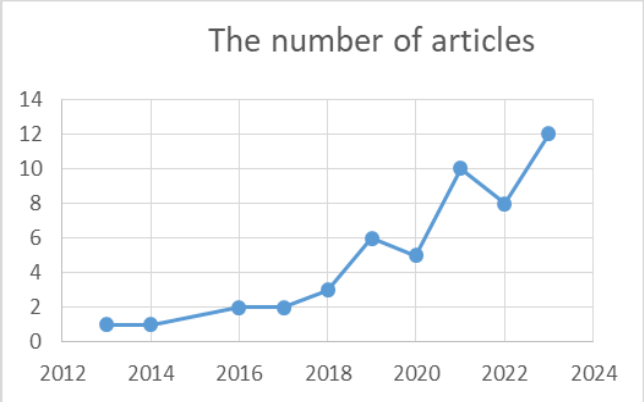


Figure 6. Articles that were published per year

To answer RQ2, The journals focusing on Arabic emotion detection and the years that these articles were published, are presented in Table 2.

TABLE 2: (THE JOURNALS NAME AND THE YEARS WERE PUBLISHED).

Name of the journal	The number of articles	Article ID	Year
Applied Science(MDPI)	5	[S1], [S3], [S5], [S7], [S18]	2023/2023/2023/ 2023/2021
SN Applied Sciences	2	[S2] , [S31]	2023/ 2017
Journal of Theoretical and Applied Information Technology	1	[S4]	2023
Computer(MDPI)	1	[S6]	2023
IEEE Access	3	[S9], [S27], [S44]	2023/ 2020/ 2021
Computer Systems Science and Engineering (Tech science press)	2	[S10], [S11]	2023/2023
Journal of King Saud University – Computer and Information Sciences	1	[S12]	2022
Journal of Universal Computer Science	1	[S13]	2022
Peer J Computer Science	2	[S14], [S]	2022/
(IJACSA) International Journal of Advanced Computer Science and Applications	3	[S15], [S24], [S52]	2022/ 2020/ 2016
International Journal of Computers and Applications	2	[S16], [S23]	2022/ 2020
Journal of Big Data	2	[S17], [S28]	2021/ 2019
Information (MDPI)	3	[S19], [S20], [S29]	2021/2021/2019
Intelligent Automation & Soft Computing (tech science press)	1	[S21]	2021
Indonesian Journal of Electrical Engineering and Computer Science	2	[S25], [S43]	2020/ 2022
Journal of Internet Technology	1	[S26]	2020
International Journal of Advanced Trends in Computer Science and Engineering	1	[S30]	2018
Electronics (MDPI)	1	[S32]	2021
Journal of Intelligent & Fuzzy Systems	1	[S36]	2023
Frontiers in artificial intelligence	1	[S40]	2022
2019 IEEE Jordan International Joint Conference on Electrical Engineering and Information Technology (JEEIT)	1	[S41]	2019
2018 12th IEEE International Conference on Semantic Computing	1	[S46]	2018
2021 12th International Conference on Information and Communication Systems (ICICS)	1	[S47]	2021
2019 Sixth International Conference on Social Networks Analysis, Management and Security (SNAMS)	1	[S48]	2019
Modern Applied Science	1	[S49]	2019
2021 Fifth International Conference On Intelligent Computing in Data Sciences (ICDS)	1	[S54]	2021
2023 International Conference on Multimedia Computing, Networking and Applications (MCNA)	1	[S55]	2023
Proceedings of the 12th International Workshop on Semantic Evaluation (SemEval-2018)	1	[S56]	2018
IJISCS (International Journal of Information	1	[S61]	2022

System and Computer Science)			
International Journal of New Technology and Research (IJNTR)	1	[S62]	2021
conference paper	4	[S33], [S44], [S50] , [S53]	2019/ 2017/ 2014/ 2016

As shown in Table 2, 31 journals published articles in the area of Arabic Emotion Detection, and the journal that published the most articles (5) is Applied Science (MDPI) where 4 of the articles were published in 2023. The journals IEEE Access, (IJACSA) International Journal of Advanced Computer Science and Applications, and Information (MDPI) published 3 articles.

To answer RQ3, the methods used for emotion analysis from Arabic texts, are presented in Table 3.

The three approaches/methods used for emotion detection from text are: Lexicon-based techniques, Statistical methods (machine learning algorithms), and Hybrid approaches.

Table 3. The methods used for emotion analysis in Arabic

The method	The number of articles	Article ID
Natural Language Processing (NLP)	2	[S1], [S24]
machine learning (ML) machine learning (Weka) supervised learning approach (MEKA)	18	[S3], [S10], [S13], [S21], [S25], [S31], [S51], [S52], [S54], [S55], [S56], [S61], [S62] [S23], [S26], [S30], [S50] [S48]
Deep Learning Deep Learning model .(BERT)	17	[S2], [S5], [S6] [S9], [S11], [S12], [S14], [S15], [S16], [S17], [S20], [S28], [S44], [S47], [S4], [S7], [S19]
Deep Neural Networks (DNNS)	1	[S29]
Lexicon	2	[S18], [S53]
Hybrid model	1	[S27]
Survey, Review	8	[S32], [S33], [S36], [S40], [S41], [S43], [S45], [S49]

As can be seen from Table 3, machine learning methods have been the most popular approach for the past ten years, followed by deep learning algorithms. There are only two studies that have used lexicon-based techniques and the hybrid approach.

To answer RQ4, Table 4 shows the data sets and the type of Arabic Languages used for emotion detection in the articles:

TABLE 4. THE DATA SETS AND TYPE OF ARABIC LANGUAGE

Article ID	The Dataset	Formal Arabic	The number of articles
[S1], [S3], [S9], [S10], [S14], [S20], [S23], [S25], [S30], [S46], [S47], [S48], [S50], [S51], [S52], [S55], [S62] [S11] [S26], [S53] [S54]	Twitter Facebook posts (DATASET1) Facebook and Twitter Combine more than one dataset the source of them from twitter.	 Iraqi dialect	21
[S12], [S15], [S17], [S19], [S28], [S29], [S44], [S56], [S61]	Tweets: SemEval-2018 Task1	Dialect	11 (9 +2 combine)
[S2]	Twitter : ArECTD	Egyptian dialect	1
[S4]	Arabic Emotions Twitter Dataset (AETD)	Egyptian dialect	1
[S31]	Twitter	Syrian dialect	1
[S18], [S21], [S24],	Twitter	Saudi dialect	3
[S5]	Arabic HARD dataset (includes hotel reviews associated with ratings)	Arabic formula	1
[S6]	Poems with their corresponding emotions from Al Diwan	Arabic formula	1
Combine more than one dataset: [S7], [S13], [S27]	EATD + ExaAEC data sets. SemEval-2018 Task1+ LAMA+DINA AETD +IAEDS+ SemEval-2018	Dialect	3
[S16]	Arabic news headlines	Arabic formula	1

As shown in Table 4, the data sets that were collected from social media platforms (Twitter and Facebook) are most widely used in the Arabic text emotion analysis, especially Twitter.

Nine studies were used the dataset: SemEval-2018 Task1- Twitter, and two studies were used SemEval-2018 dataset combine with other datasets.

Three studies were used the formal Arabic language collected from: hotel reviews [S5], poems [S6], and news headlines [S16].

Three studies were developed for the Saudi dialect [S18], [S21], and [S24]. Two of them used the

Egyptian dialect [S2], [S4], one article for the Syrian dialect [S31], and one article used the Iraqi dialect [S54].

Three studies were combine more than one dataset -different datasets [S7], [S13], [S27].

Figure 7 shows the data sets that were used previously.

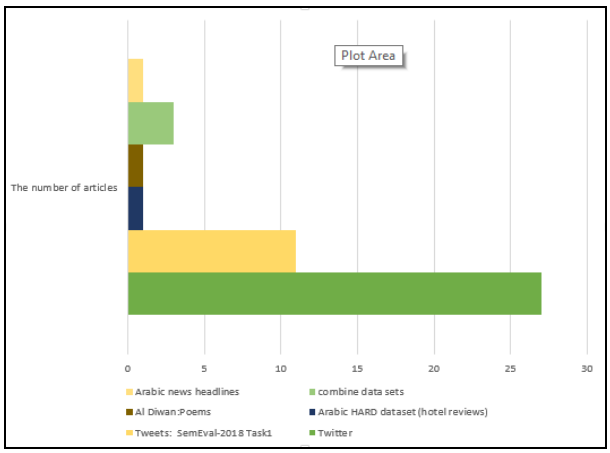


Figure 7. The data sets that were used previously.

To answer RQ5, the types of emotions recognized by the studies are presented in Figure 8 and Figure 9.

The number of types of emotions used in previous studies in emotion detection was 26 emotions. Figures 8 and 9 show the number of times each one of these emotion are used and the percentage of their frequency. Figure 8 shows the most common emotions used: sadness, anger, fear, joy, surprise, disgust, and love.

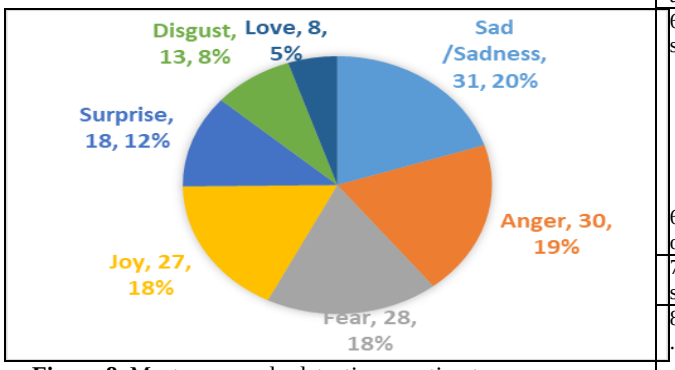


Figure 8. Most commonly detection emotion types

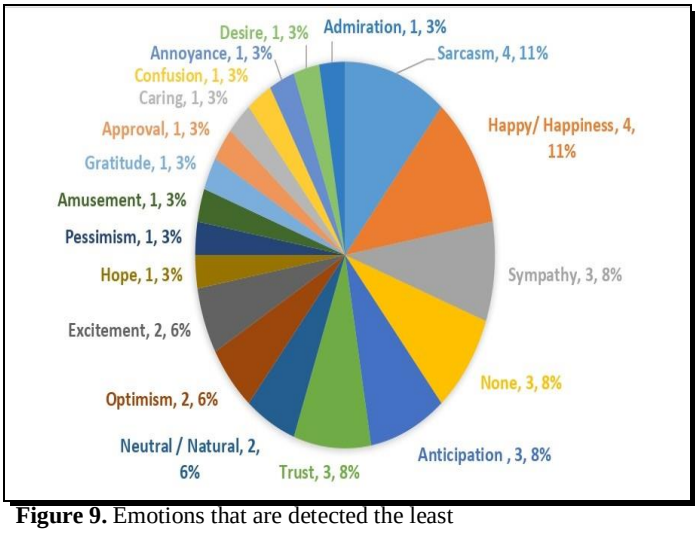


Figure 9. Emotions that are detected the least

As shown in Table 6, four basic emotions: anger, joy, sadness, and fear are the most analyzed emotions in the previous studies.

TABLE 6. EMOTIONS RECOGNIZED IN PREVIOUS STUDIES

The type of emotion	The number of the article	Article ID
Sarcasm	2	[S36], [S62]
3: sad. Love. Joy	1	[S6]
4 basic emotion: anger. Joy. Sadness. Fear	12	[S9], [S10], [S12], [S13], [S19] [S23],[S28], [S30],[S51], [S52], [S56], [S61]
5: surprise, happiness, sadness, and anger and sarcasm	1	[S52]
6: joy, sadness, anger, disgust, fear, and surprise 6: anger, disgust, fear, happiness, sadness, or surprise.	9	[S7], [S20], [S21], [S31], [S46], [S47], [S48], [S50] [S27]
7: anger, disgust, fear, happiness, sadness, surprise, and neutral	1	[S16]
8: anger .fear .joy .love .sadness .surprise .sympathy .none 8: anger .fear .happy .love .sadness .surprise .sympathy .none	2	[S4], [S27]
9: Anger ,Anticipation ,Disgust ,Fear ,Joy ,Sadness ,Surprise ,Trust ,Natural	1	[S24]
10: sympathy, hope, sarcasm, surprise, joy, love; anger, fear, sadness and non" 10: anger, joy, love, sadness, anticipation, surprise and trust, disgust and optimism, fear	2	[S2] [S29]
11: anger, anticipation, disgust, fear, joy, love, optimism, pessimism, sadness, surprise, and trust	1	[S44]
14: amusement . Sadness. Joy. Excitement. Gratitude. Approval. Caring. Love. Confusion. Anger .surprise .annoyance .desire. Admiration	1	[S3]

There has been limited research on Sarcasm emotion detection in Arabic language. Just two studies detected Sarcasm emotion in previously. This issue has been addressed mostly in English and other languages. Due to the non-detection of sarcasm, accuracy of NLP systems becomes ambiguous. Sarcasm detection is a very difficult issue and requires an intelligent system. This challenge should be properly assessed for improving the accuracy of Arabic text classifiers [11]. Detection of Sarcasm is somewhat difficult due to the gap between its literal and intended meaning and the different ways in which sarcasm may be expressed especially for the Arabic language which has a rich nature and very complex morphology [27].This problem has importance to improve the performance and the accuracy results of Arabic text emotion detection.

. CONCLUSION, LIMITATION AND FUTURE WORK

In this article, we tried to cover and summarize the available research, models, datasets, emotions, approaches, and some other aspects of Emotion Detection and Recognition (EDR) in Arabic for the last ten years (2013- 2023).

The standard systematic mapping has been employed collecting 50 studies on Arabic emotion text research, from the Scopus database, and Google Scholar database.

This study is interested in: the yearly distribution of articles during the last ten years, what emotions have been studied in Arabic articles, the journals that focus on this study area and the methods used for text-based analysis of emotions.

As a result, our findings are:

- In last ten years, 2023 has the largest number of research conducted and published for Arabic Emotion Detection studies, 31 journals published articles in the area of Arabic Emotion Detection, and the journal that published the most articles (5) is Applied Science (MDPI).

- The Statistical approach using different supervised machine learning algorithms has been the most popular approach for Arabic Emotion Detection, followed by deep learning algorithms. Only on study has used the lexical-based, and only one study has used the hybrid approach.

- The Arabic social media is playing a major role in the Arabic text emotion analysis. The data sets that were collected from social media platforms (Twitter and Facebook) are the most widely used, especially Twitter. Most of these data sets used a dialect Arabic language, which makes the analyses more complex.

- Lastly, the number of emotions used in previous studies to detect Arabic emotion was 26 emotions, and the four basic emotions: anger, joy, sadness, and fear, are the most analyzed emotions in the previous studies. Emotion detection for sarcasm in Arabic language has been limited.

Limitation of the study

- The limitations about this study is that only Google Scholar and Scopus databases were used in the search. Other databases can be added to expand the collected articles.
- There is also a limitation on the research questions, another research question about the findings of all the studies can be added.

Future work

Arabic research needs more resources and research in the area of text emotion analysis. For future work:

- This study can be compared with similar studies conducted in other languages like English.

- Standard datasets for Arabic needed for emotion analysis in future research, this lack in Arabic datasets makes it hard to employ the compare output results among languages, as the accuracy of text classification depends on the amount of results to make the compare studies.

- Due to different Arabic dialects, we need to find appropriate techniques and methods to solve the problem of Arabic emotion detection in all these dialects.
- Detection of Sarcasm in Arabic emotion research has been limited. As a future work we intend to investigate this issue.

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