

Text-based Arabic Emotion Detection Challenges and Effective Approaches: A Review of the State-of-the-Art

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Abstract:- Language computational processing is not a straightforward task, most of the Natural Language Processing (NLP) tasks focused on computing underlying sentiments, while emotions are vital components of any language and known to be difficult to detect. Several studies have been carried out in English, but research in Arabic emotion detection is still in its infancy. With the rise of web 2.0 and social media platforms, the amount of textual data with embedded emotions has significantly increased. Although detecting emotions from a text is not trivial, researchers are interested to utilise established artificial intelligence techniques to build high-performance models for this task. This study has been undertaken to provide a Systematic Literature Review (SLR), which is defined as the process of identifying, assessing, and interpreting available resources related to a certain topic to answer the SLR research questions. The aim of this study is to answer questions about text-based Arabic emotion detection challenges and effective methods. Results show that the prevailing challenge in Arabic emotion detection is the limited availability of Arabic emotions annotated training dataset and the morphological complexity and dialect diversity in Arabic. Also, it has been found that most recent studies utilise deep learning approaches.

I. INTRODUCTION

Emotions play a major role in many facets of people's lives, influencing their physical health, jobs, learning, economic and social behaviours, and decision making. Recently with the rise of Web 2.0, social media platforms and micro-blogging systems such as Twitter, the amount of textual data with embedded emotions has tremendously increased. Thus, emotion recognition has captured the interest of many researchers to build different models to automatically detect users' emotions from these data. Learning people's emotions is critical to different applications such as better product and advertisement recommendations for customers (Mohammad et al., 2013), and tracking emotions towards a specific service to take proper responses to keep them satisfied (Li et al., 2016).

Emotion detection task from a given text is usually a categorical classification task with three distinct approaches: Rule-construction, Machine Learning, and hybrid approach (Acheampong et al., 2020), given an input text a classifier will predict the emotion corresponding to this text. Typical emotion categories representations are available: the Ekman representation including anger, happiness, surprise, disgust, sadness and fear (Ekman, 1992) and the Plutchik model that adds two more labels to the Ekman's six emotions which are trust and anticipation (Plutchik, 1994). Classifying text into these emotional categories or intensities is considered a difficult task.

Emotional processing in the field of affective computing can also utilise these data to analyse and predict peoples' emotions based on their captured diaries using machine and deep learning techniques for automated text mining and emotion detection.

Although Arabic language is considered an official language to more than 22 countries, but probably due to the complexity of this language morphology and variety of dialects, there has not been much work on analysing Arabic language text-based emotion detection systems. Thus, this SLR aims to identify and investigate Arabic text-based approaches currently used for emotion analysis.

II. METHODS

To achieve the objective of this SLR, a couple of research questions have been investigated in this review. Since the main aim of this study is to analyse the recent studies for an effective text-based Arabic emotion detection, the following set of research questions are formulated as follows:

- RQ1: What are the challenges in Arabic text-based emotion detection?
- RQ2: What are the current effective approaches for an Arabic text-based emotion detection?

This research will comply with PRISMA (Preferred Reporting Items for Systematic Reviews and MetaAnalysis) to develop a framework used to organize and document each step of the research process as illustrated in Figure 1.

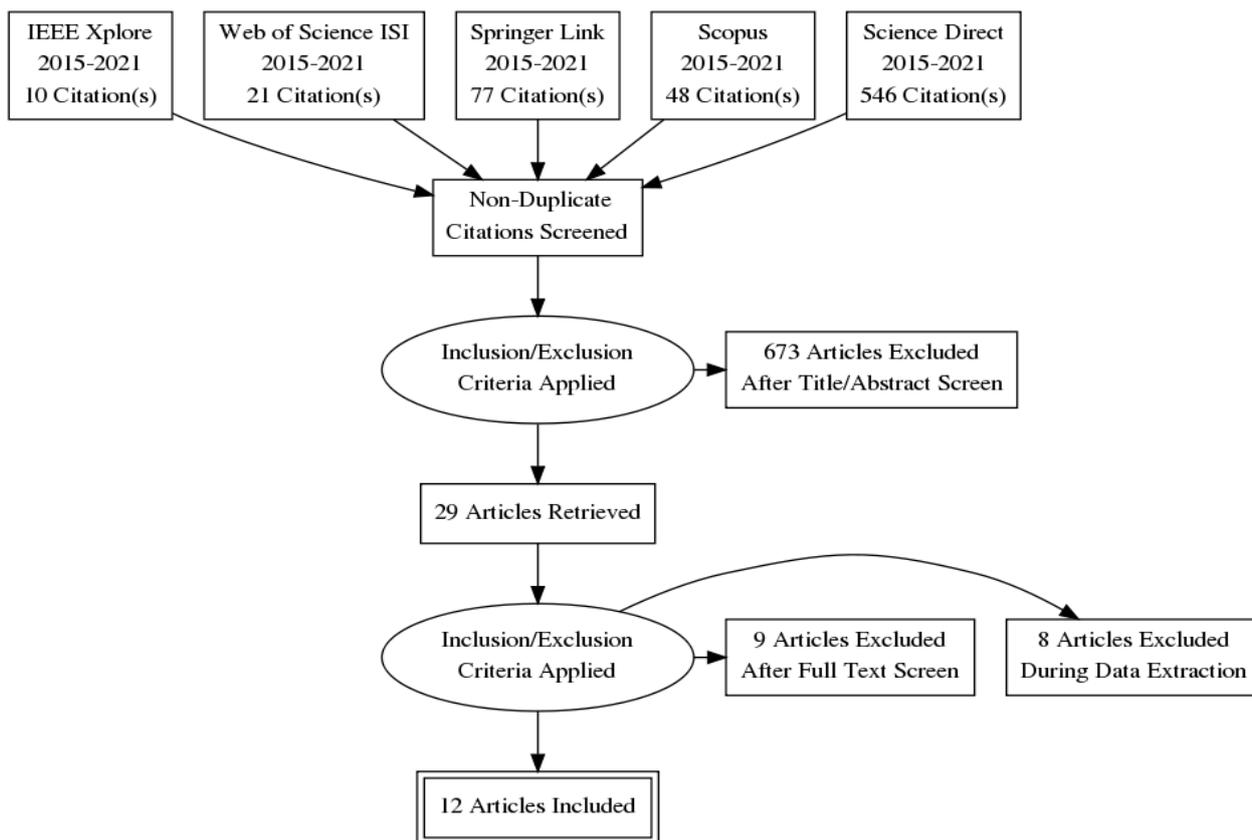


Figure 1. PRISMA Research Framework

Studies included in this research are collected from the following libraries: 1) Science direct (www.sciencedirect.com), 2) IEE Xplore Digital Library (ieeexplore.ieee.org), 3) Springer Link (link.springer.com), 4) Scopus (scopus.com), 5) Web of science ISI (mjl.clarivate.com). Using ["Arabic"] AND ["Emotion" OR "Affect"] AND ["detection"] as the basic search query among these libraries, some libraries required some modification in the format, thus these supported formatting styles had to be met, as a result, a set of articles is found for further processing in next steps.

Processing of the collected articles started with filtering unwanted papers based on some criteria: records

not written in English, papers published before 2015, and papers not focusing on Arabic texts-based approaches. Any paper falls into one or more of these criteria is excluded in this review.

Articles don't fall into any of the exclusion criteria will be further examined according to their full-text availability by scanning the paper abstract. Also, there are some papers which have multiple publications in different libraries, these papers are selected once. If the objective of the study aligns with the purpose of this review work, and their work results have answers to our predefined research questions it will be included. Table 1 illustrates the details of search results among different libraries.

Table 1. Digital Libraries search process

Source	Retrieved	Candidate	Selected
IEEE Xplore	10	6	6
Web of Science ISI	21	8	2
Springer Link	77	1	1
Scopus	48	12	3
Science Direct	546	2	-
Total	702	29	12

III. RESULT

As shown in Table 1, there have been 12 papers selected to be studied for the purpose of this review. In Table 2, a list of these publications with their references is provided.

Table 2. List of Selected Published Articles

Source	Year	Title	Reference
IEEE Xplore	2020	Emotion Analysis in Arabic Language Applying Transfer Learning	(Omara et al., 2020)
IEEE Xplore	2018	SEDAT: Sentiment and Emotion Detection in Arabic Text using CNN-LSTM Deep Learning	(Malak Abdullah et al., 2018)
IEEE Xplore	2018	Saudi Mood: A Real-Time Informative Tool for Visualizing Emotions in Saudi Arabia Using Twitter	(Almanie et al., 2018)
IEEE Xplore	2017	Detection and Visualization of Arabic Emotions on Social Emotion Map	(Alhamid et al., 2017)
IEEE Xplore	2016	Are Emoticons Good Enough to Train Emotion Classifiers of Arabic Tweets?	(Hussien et al., 2016)
IEEE Xplore	2015	Lexicon based and Multi-Criteria Decision Making (MCDM) Approach for Detecting Emotions from Arabic Microblog Text	(Al-Aziz et al., 2015)
Web of Science ISI	2018	A Context Integrated Model for Multi-label Emotion Detection	(Samy et al., 2018)
Web of Science ISI	2017	Emotional Tone Detection in Arabic Tweets	(Al-Khatib & El-Beltagy, 2017)
Scopus	2020	Emotions extraction from Arabic tweets	(Manal Abdullah et al., 2020)
Scopus	2020	A two-level deep learning approach for emotion recognition in Arabic news headlines	(Galal Elsayed et al., 2020)
Scopus	2020	Affect detection from Arabic tweets using ensemble and deep learning techniques	(AlZoubi et al., 2020)
Springer Link	2019	Emotion analysis of Arabic tweets using deep learning approach	(Baali & Ghneim, 2019)

To answer research questions of this review, each article listed in Table 2 will be studied to extract information related to each question:

- *What are the challenges in Arabic text-based emotion detection?*

Table 3. Challenges in Arabic text-based emotion detection

No	Challenge	Number of Articles	Reference
1	Limited support provided by most of the available commercial and open source tools.	2	(Alhamid et al., 2017), (Almanie et al., 2018)
2	Arabic contents need more pre-processing steps to remove unwanted contents.	3	(Alhamid et al., 2017), (Omara et al., 2020), (Manal Abdullah et al., 2020)
3	Limited availability of Arabic emotions annotated training dataset.	5	(Hussien et al., 2016), (Samy et al., 2018), (Al-Khatib & El-Beltagy, 2018), (Manal Abdullah et al., 2020), (Baali & Ghneim, 2019)
4	Limited existence of large dialect Arabic emotion lexicons	3	(Al-Aziz et al., 2015), (Malak Abdullah et al., 2018), (Omara et al., 2020)
5	Different dialects and morphological complexities	2	(Samy et al., 2018), (Galal Elsayed et al., 2020)
6	Context-aware emotion prediction systems	1	(Samy et al., 2018)

Table 3 shows the challenges stated in the selected articles. Although not every record stated the difficulties for conducting their research process, but it is clearly observed that most concerns lies in Arabic language specific issues. This covers the issue of limited availability of Arabic emotions annotated training dataset, different dialects and morphological complexities in Arabic text data, and the limited existence of large dialect Arabic emotion lexicons. After further observation, it seems that most of the challenges that researches face in the field of Arabic language processing as stated in table 3 are related to each another.

- What are the current effective approaches for an Arabic text-based emotion detection?

Table 4. Methods used in Arabic text-based emotion detection

No	Method	Reference
1	Classifiers	(Alhamid et al., 2017), (Almanie et al., 2018), (Manal Abdullah et al., 2020)
2	Automatically annotated training dataset.	(Hussien et al., 2016)
3	Lexicon based	(Al-Aziz et al., 2015)
4	CNN+LSTM	(Malak Abdullah et al., 2018)
5	Transfer source domain CNN layer	(Omara et al., 2020)
6	Transfer deep learning + GRU	(Samy et al., 2018)
7	Logistic regression	(Samy et al., 2018)
8	CNN	(Galal Elsayed et al., 2020), (Baali & Ghneim, 2019)
9	BiGRU_CNN, CNN, and XGB + ensemble approach	(AlZoubi et al., 2020)
10	Naïve Bayes + WEKA	(Al-Khatib & El-Beltagy, 2018)

Table 4 illustrates the most popular methods used for textual Arabic emotion detection approaches. The methods used in the studies analysed in this review are the usage of classifiers, convolutional neural networks, transfer learning, and probabilistic approaches. The best results obtained using deep learning approaches. However, this might be a general finding due to difference in dataset used and difference in model architectures.

IV. CONCLUSION

This systematic literature review examines the current implementations of textual Arabic emotion detection research approaches. The review started with surveying multiple online libraries yielded with 702 obtained records among these online databases, following a set of exclusion criteria the number of remained articles reached a total of 29 articles, these remaining articles were filtered based on title and abstract to finally have only 12 articles to be included, each of these studies was thoroughly analysed to answer the research questions defined in this study.

Findings in this literature review successfully answered this review questions, where the main challenges in Arabic text-based approach for emotion detection are Arabic language traits, and Lack of data and tools. While currently most popular used methods in Arabic text-based emotion detection are classifiers, convolutional neural networks, transfer learning, and probabilistic approaches. These methods proved to be the most effective Arabic text-based approaches for emotion detection.

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