**Cover letter**

**Dear Editor,**

Thank you very much for the insightful and valuable reviews, I greatly appreciate them and sincerely thank the reviewers for taking the time to read our work and write the review comments. After doing major professional editing, paper was modified and enhanced according to the reviews and they are greatly satisfied in the reviewed version. The article “Arabic Sentiment Analysis Using Recurrent Neural Networks: A Review” is a valuable contribution in the domain of RNN Natural Language Processing and is the first to be done for the Arabic language. Below are the responses to the review comments. Thanks for considering my paper for publication in the “Artificial Intelligence Review” journal.

Best Regards,

Authors

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| **Reviewer 1** | | |
| **Note to reviewer 1:**  Thank you very much! I'm in deep gratitude to your valuable comments that deeply helped enhancing the paper. I did major editing, then reflected upon the reviews. Therefore, there are conceptual, stylistic, and linguistic changes in the submitted document. I will be referring to the required changes in this document using the notation: **L** for line, **S** for section, and **P** for pages. | | |
| **No.** | **Reviewer Comment** | **Author Answer** |
| 1 | The manuscript is centered on an interesting topic. Organization of the paper is good and the proposed analysis is quite new. | Thank you |
| 2 | The manuscript, however, does not link well with recent literature on multilingual sentiment analysis appeared in relevant top-tier journals, e.g., check Dashtipour et al.'s survey on multilingual sentiment analysis (state of the art and independent comparison of techniques) and Oueslati et al.'s review of sentiment analysis research in Arabic language. | Thanks for the reference, it was an interesting read. However, those papers mentioned state of the art models in the field of multilingual sentiment analysis and Arabic sentiment analysis in general. Those papers do not cover any deep learning methods such as RNN. Instead, they cover machine learning methods which are out of our focus. |
| 3 | Also, do not use arxiv citations for papers that have already been officially published. | Thank you. The modification is done to include references that are published only. |
| 4 | Some bad English constructions, grammar mistakes, and misuse of articles: a professional language editing service is strongly recommended (e.g., the ones offered by IEEE, Elsevier, and Springer) to sufficiently improve the paper's presentation quality for meeting AIRE's high standards. | Thank you for your editing recommendation. An extensive language edit is done through Elsevier editing service. |

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| **Reviewer 2** | | |
| **Note to reviewer 2:**  Thank you very much! I'm in deep gratitude to your valuable comments that deeply helped enhancing the paper. I did major editing, then reflected upon the reviews. Therefore, there are conceptual, stylistic, and linguistic changes in the submitted document. I will be referring to the required changes in this document using the notation: **L** for line, **S** for section, and **P** for pages. | | |
| **No.** | **Reviewer Comment** | **Author Answer** |
| 1 | The title should be changed. You discuss more about Sentiment Analysis than Arabic Sentiment Analysis. | I see what you mean, the aim of the paper is discussing and reviewing Arabic RNN models in the field of SA. However, sentiment analysis concepts were a part of the paper proceeding the discussion on Arabic related works as background. |
| 2 | I suggest the authors should also explore other data intelligent models in this regard. | Thank you for your suggestion. While our main focus is about recurrent models, we may expand the research in future. |
| 3 | The introduction is not enough. Please work on it. | Thank you, the modifications are done as the following. The introduction flow is changed, and two subsections are added: Arabic sentiment analysis in P2, S 1.1, and contributions in P3, S 1.2. |

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| **Reviewer 3** | | |
| **Note to reviewer 3:**  Thank you very much! I'm in deep gratitude to your valuable comments that deeply helped enhancing the paper. I did major editing, then reflected upon the reviews. Therefore, there are conceptual, stylistic, and linguistic changes in the submitted document. I will be referring to the required changes in this document using the notation: **L** for line, **S** for section, and **P** for pages. | | |
| **No.** | **Reviewer Comment** | **Author Answer** |
| 1 | Overall, this paper is good but it has many typo, format and grammar mistakes. | Thank you. An extensive language edit is done through Elsevier editing service. |
| 2 | there is a misunderstanding of the classification of sentiment analysis techniques that was reflected on the writing in Section 3.2 and on the drawing in Figure 2. Sentiment analysis techniques divided into two main techniques, namely, "machine learning based techniques", and "lexicon-based techniques". Machine learning based techniques can be supervised or unsupervised, and it divided into "shallow learning" (e.g. SVM,  ME, and Naïve Bayes) and "deep learning (e.g. CNN, and RNN). Lexicon-based techniques can be divided into  "syntactic pattern-based" and "dictionary-based" | Thank you for your valuable comments. The changes are done in P7, S 3.2. |
| 3 | Figure 2 has been drawn wrongly based on unreliable reference (ref#11) and misunderstanding. Authors need to re-read carefully about classifying sentiment analysis techniques from reliable references. | 1. The reference is changed to (Madhoushi et al.: Sentiment analysis techniques in recent works 2015) 2. Figure 3 is fixed in P10. Thank you. |
| 4 | In addition, the authors need to justify why they choose RNN to review, rather than any other models. | The justification is done in P6, L10 after Table 3. Thank you |
| 5 | When the term with its abbreviation is written for the first time it is written in the following way: (e.g. Recurrent Neural Networks (RNN)), then when we mention it in the rest of the paper we use its abbreviation. | was taken into consideration. Thank you very much |
| 6 | Follow and check the sections' heading format of this journal, the first letter is the capital the rest letters are small. Also, follow and check the tables and figures format. | The modification is done, and the format is checked in the whole document. Thank you. |
| 7 | If it's possible to put the table on one page then do, don't divide the table across the pages (make it together). If it's big then repeats the heading row. | The modification is done, and each table is in one page now. Thank you very much. |
| 8 | Put the figure and its caption together on the same page. | The modification is done for all figures. Thank you. |
| 9 | Use the past tense when you state other works (e.g. "Gonzalez et al. [69] propose ELiRF-UPV system" --> "Gonzalez et al. [69] proposed ELiRF-UPV system"). Revise the whole paper. | The modification is done for all the document. Thank you. |
| 10 | When you refer to the same section you are in, write it in small letter( "in this section"), but when you refer to other section write the first letter capital (e.g. "in Section 2") | It has been reflected in the whole document. Thank you. |
| 11 | For the typo mistakes, I highlighted them on the paper with some other format and language mistakes. | Thank you very much for your time and efforts, all typo mistakes have been modified except the first paragraph of introduction. The first paragraph shows the importance of sentiment analysis field that’s why we kept it. |

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| **Reviewer 4** | | |
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| **No.** | **Reviewer Comment** | **Author Answer** |
| 1 | The paper is well-motivated. Recently, became using deep learning as a powerful machine learning tool for analyzing opinions because of its accuracy in predicting unstructured data. Moreover, few studies have been published focusing on Arabic sentiment analysis using the two main types of DNN structures (CNN and RNN). Unlike English, Arabic has several specifics that complicate processing and analyzing the language by traditional methods. This paper presented a systematic review of state-of-the-art methods and research on sentiment analysis using recurrent neural networks (RNN) for the Arabic language. We believe that the paper reviews an interesting research problem. | Thanks for your time and valuable comments, it is very much appreciated. |
| 2 | However, the paper lacks enough original work to warrant publication at this stage - the reviewers provide no justification as to why RNN models were chosen. | The justification is done in P6, L10 after Table 3. Thank you very much. |
| 3 | In addition to explain the concept of the recurrent neural network, its architecture and how it works, explain the two most important models of this network and finally discuss related work. | I assume that you mean by the two most important models:(LSTM and GRU), the two models are also described in S4.3 and S4.4 |
| 4 | Given that Sentiment Analysis depends greatly on the morphology of the language being analyzed, So the reviewers shall explain in the details the linguistic features that make Arabic one of the most challenging varieties for Sentiment Analysis researchers. Therefore, it requires clarification of the following: a - Arabic orthography (Write direction, Availability of upper or lower cases, diacritical marks, etc.). b - Clarify the morphological aspects of the Arabic language including derivation, entanglement, and stacking. c- present the challenges of language such as Morphological analysis, multiple dialects, Arabizi, Comparison, neutral texts, and Named entity recognition. In addition to providing the justifications that make the RNN suitable to face the challenges of this language and identifies limitations, weaknesses, or inadequacies of the selected model. | Thank you for your informative comment. The challenges have been mentioned in P2, S1.1. Thank you |
| 5 | Section 3.1 did not provide sufficient information on the three basic techniques used to create sentiment analysis systems, were only two techniques reviewed (supervised machine learning-based techniques, and unsupervised lexicon-based techniques). While there is another type namely (hybrid) has achieved results that outperform other approaches that use only deep learning for Arabic sentiment analysis (Altaher, 2017, Heikal et al., 2018). ALTAHER, A. 2017. Hybrid approach for sentiment analysis of Arabic tweets based on deep learning model and features weighting. International Journal of Advanced and Applied Sciences, 4, 43-49. HEIKAL, M., TORKI, M. & EL-MAKKY, N. 2018. Sentiment analysis of Arabic Tweets using deep learning. Procedia Computer Science, 142, 114-122. | Corrected the techniques in S3.2 P7. thank you for your valuable comment. |
| 6 | Table 7. shows related works and used Arabic datasets for sentiment analysis using RNN. We suggest broadening your search and try to highlight other Arabic datasets which can be used as references available free on the web like: -  ArSenL Project Datasets (A Large-Scale Arabic Sentiment Lexicon for Arabic Opinion Mining): <http://www.oma-project.com/#publications>  - Arabic Sentiment Analysis and Cross-lingual Sentiment Resources : <http://saifmohammad.com/WebPages/ArabicSA.html> | ArSenL and Semeval-2016 Task 7 dataset + Arabic Gold Standars Twitter Data + ArSAS have been added in the table 7, P16. Thank you very much. |
| - Twitter Data set for Arabic Sentiment Analysis Data Set: <https://archive.ics.uci.edu/ml/datasets/Twitter+Data+set+for+Arabic+Sentiment+Analysis> | The dataset is already in the table with name: ArTwitter. Thank you. |
| 7 | Section 6 presents the conclusions and the future scope of work has been defined by say: "The future direction is to develop Arabic word embedding models to capture features properly". This information should be re-presented and discussed explicitly.  As well as, the effectiveness of using different methods of feature selection should be discussed as it is common procedures in the development of machine learning models. | The changes are done in S8 P29 L5. Thank you. |
| 8 | Reviewers should combine Table 8 with Table 9 and add a column in which the level type is selected (aspect based, document level, etc.). | Thank you very much for your comment. When the column was added, the related works become longer and stacked as one paragraph as noticed. perhaps, it is suitable to split these levels in different sections for better readability. |
| As well as, you must the following columns must be added to the new table: - Year | Thank you very much for helping to enhance the table presentation. The year is in the reference concurrently with the author name (column name: papers) |
| - Language type (Modern Standard Arabic (MSA) or Dialectical Arabic) | The language type is already mentioned in P16 table 7 (column name: Arabic form). |
| - Application (Hotels, Movie reviews, Twitter, etc.) | The application is already mentioned in the same table (column: size) along with the size of dataset.  Moreover, to enhance the table 7, we added a new column (named: Classes) to identify the number of classes in the dataset. |
| 9 | Reviewers should create and add a new table for section 5, this table must contain the following: - Types of models that have been reviewed - Advantages - Drawbacks - Assessments | Done in P27, table 14. Thank you. |
| 10 | Reviewers should add a section at the end of the article to discusses the evaluation criteria in opinion mining like Accuracy, Precision, Recall, etc. | Added in S6, P27. Thank you |
| 11 | Reviewers should add the word "deep learning" to the keywords. | Done. Thank you very much |
| 12 | Details of reference (90) are not mentioned. | Done, in P9 line 10 thank you |

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| **Reviewer 5** | | |
| **Note to reviewer 5:**  Thank you very much! I'm in deep gratitude to your valuable comments that deeply helped enhancing the paper. I did major editing, then reflected upon the reviews. Therefore, there are conceptual, stylistic, and linguistic changes in the submitted document. I will be referring to the required changes in this document using the notation: **L** for line, **S** for section, and **P** for pages. | | |
| **No.** | **Reviewer Comment** | **Author Answer** |
| 1 | the paper seems not to summarize major contributions of significant studies and articles to the body of knowledge under review; to point out major methodological flaws or gaps in the related fields, inconsistencies in theory and findings, and areas or issues pertinent to future study. | Thank you very much for your comment. The contributions have been added in P3, S 1.2. |
| 2 | The authors did not point out major methodological flaws or gaps in research, inconsistencies in theory and findings. | The findings are mentioned in S7, P29. Thank you. |
| 3 | The paper lists experimental results without providing any synthesis, connection, or critique and thus it does not give anything useful to beyond a reasonably up-to-date bibliography.  The paper does not make an impact through enabling new applications, by providing new insights, or presenting clear methods, procedures, or reviews to help other researchers perform similar work. | Thank you. We changed the way we dealt with the papers and how they were reviewed and criticized.  The paper is enhanced by adding:  - Challenges of Arabic language in S1.1.  - why we coose RNN in P6, L10 after Table 3.  - Add RQ4 in Table 1  - Critique analysis for papers:   1. Al-Smadi et al. 2018: P17 S5.1 2. Ponti et al. 2017: P17 S5.1   - Overall outcome in P19 after Table 8  - Critique analysis for papers:   1. Abbes et al. 2017: P23 S5.2.4 2. Alwehaibi and Roy 2018: P23 S5.2.4 3. Elnagar et al. 2018: P24 S5.2.4 4. Alayba et al. 2018b: P25 S5.2.4   - Overall outcome in P26 after Table 13  - Table 14 has been added in P27  - Research gaps has been enhanced in P28 S7  - Conclusion and future scope has been enhanced in P29 S8  Thank you very much |

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| **Reviewer 6** | | |
| **Note to reviewer 6:**  Thank you very much! I'm in deep gratitude to your valuable comments that deeply helped enhancing the paper. I did major editing, then reflected upon the reviews. Therefore, there are conceptual, stylistic, and linguistic changes in the submitted document. I will be referring to the required changes in this document using the notation: **L** for line, **S** for section, and **P** for pages. | | |
| **No.** | **Reviewer Comment** | **Author Answer** |
| 1 | The abstract needs modification and better arrangement especially in the proposed method. No connection between paragraphs. | The abstract has been enhanced. Thank you |
| 2 | The introduction is appropriate but requires better organization. | Thank you for your comment. The modification is done in the introduction. The introduction flow is changed and two subsections are added:   1. Arabic sentiment analysis in P2 ,S 1.1, 2. Contributions in P3, S 1.2. |
| 3 | The author done fairly literature reviews and up-to-date especially on search strategy and research questions. However, the author is required to address the following:  ∎ Rewrite the contents of the tables in section 2. | Thank you very much, we assume you mean by (rewrite the contents): changing libraries representation. This representation is done with support of below papers:   1. Kitchenham, Procedures for Performing Systematic Reviews. 2. Heckman et al. A Systematic Literature Review of Actionable Alert Identification Techniques for Automated Static Code Analysis. |
| ∎ Recheck the paragraph in line 6 page 4. | Rechecked and enhanced in P5, S(ii). |
| ∎ Recheck the numbers of figures in all sections. | The figure numbers are rechecked and corrected. Thank you very much |
| ∎ Delete the table 11, or need to add more than one items to it. | The table has been deleted, thank you |
| 4 | - The research issues should be improved to make it clear. | I assume that research issue is meant to be research questions. We add RQ4 to present the research gaps from related studies |
| - The author needs to add paper contributions. | a contribution section has been added in S1.2, P3 |
| - Finally, the author needs to add a framework to show the flow of the research to achieve both the goal and objectives respectively. | Done. In page 4 Figure 1. |
| 5 | In general, I finds the paper to lack novelty and technical depth and breadth. In my opinion, the paper needs to be revised significantly. | the paper has been revised and modified extensively according and beyond the valuable comments. Thank you very much |

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| **Reviewer 7** | | |
| **Note to reviewer 7:**  Thank you very much! I'm in deep gratitude to your valuable comments that deeply helped enhancing the paper. I did major editing, then reflected upon the reviews. Therefore, there are conceptual, stylistic, and linguistic changes in the submitted document. I will be referring to the required changes in this document using the notation: **L** for line, **S** for section, and **P** for pages. | | |
| **No.** | **Reviewer Comment** | **Author Answer** |
| 1 | Arabic sentiment analysis and sentiment analysis using deep learning techniques are continuing fields of research that lies at the intersection of many application domains. \* The method behind the proposed systematic review is clear and well explained. \* The reviewed papers have been introduced and resumed clearly. | Thanks for your time and valuable comments, it is very much appreciated. |
| 2 | The abstract needs some rewording to clearly state the review objectives and findings. | The abstract has been enhanced with objective and findings. Thank you very much |
| 3 | The paper needs some editing throughout to correct some errors in grammar and presentation style, and to correct some minor typos. For example, in the first line of the introduction, "the power and influence of internet has continued to..." have not has. | Thank you for your editing recommendation. An extensive language edit is done through Elsevier editing service. |
| 4 | The established research questions are weak and need revision. | Thank you for your informative comment. We added RQ4 to present the findings. |
| 5 | \* The systematic review lacks critically appraising the research studies and synthesizing findings qualitatively and regarding the challenges posed by the Arabic language.  \* The central part of the review "Arabic SA using RNN" is presented in the 5th section. However, the section lacks in-depth analysis and discussion to figure out significant findings. For example, after Tables 8, 9, 10, and 13, the research analysis has not been expanded and linked to the properties and challenges of the Arabic language. Therefore, it is not relevant to the research community and not helpful to chose future direction. | Thank you. We changed the way we dealt with the papers and how they were reviewed and criticized.  The paper is enhanced by adding:  - Challenges of Arabic language in S1.1.  - why we coose RNN in P6, L10 after Table 3.  - Add RQ4 in Table 1  - Critique analysis for papers:   1. Al-Smadi et al. 2018: P17 S5.1 2. Ponti et al. 2017: P17 S5.1   - Overall outcome in P19 after Table 8  - Critique analysis for papers:   1. Abbes et al. 2017: P23 S5.2.4 2. Alwehaibi and Roy 2018: P23 S5.2.4 3. Elnagar et al. 2018: P24 S5.2.4 4. Alayba et al. 2018b: P25 S5.2.4   - Overall outcome in P26 after Table 13  - Table 14 has been added in P27  - Research gaps has been enhanced in P28 S7  - Conclusion and future scope has been enhanced in P29 S8  Thank you very much |
|  | you need to say here is your critical review on the papers, their limitations, and their strength. Your observation after doing this study, what did you find? Then you can write one or two future directions based on reason and justification |  |

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| **Editor comments to the Author** | |
| **Comment** | **Answer** |
| Based on the advice received, the Editor has decided that your manuscript could be reconsidered for publication should you be prepared to incorporate major revisions.  When preparing your revised manuscript, you are asked to carefully consider the reviewer comments which are attached, and submit a list of responses to the comments.  Your list of responses should be uploaded as a file in addition to your revised manuscript. | Thank you for your time and efforts, all reviews are taken into consideration, reflected and addressed by answering. |