International Journal of Academic Information Systems Research (IJAISR)
ISSN: 2643-9026
Vol. 8 Issue 4 April - 2024, Pages: 18-25

Classification of Dates Using Deep Learning

Raed Z. Sababa and Samy S. Abu-Naser

Raed Z. Sababa

Department of information
Technology, Faculty of Engineering and Information technology,
Al-Azhar University, Gaza, Palestine

Samy S. Abu-Naser*

Department of Information Technology,
Faculty of Engineering & Information Technology,
Al-Azhar University - Gaza, Palestine

*Corresponding Author: Samy S. Abu-Naser, E-mail: abunaser@alazhar.edu.ps

Abstract: *Dates are the fruit of date palm trees, and it is one of the fruits famous for its high nutritional value. It is a summer fruit spread in the Arab world. In the past, the Arabs relied on it in their daily lives. Dates take an oval shape and vary in size from 20 to 60 mm in length and 8 to 30 mm in diameter. The ripe fruit consists of a hard core surrounded by a papery cover called the tartar that separates the core from the fleshy part that is eaten. Historians disagreed about the place of its origin, so some historians expressed their belief that it had originated around the Arabian Gulf, and some of them say that the oldest known information about palm trees was in Babylon 4 thousand years ago BC. It is known about the ancient Egyptians using dates in wine. Dates contain a high nutritional value and are considered a basic food for man since ancient times. The fruits of dates are considered the highest fruits in containing sugars. These components vary according to the nature of the fruit, whether it is wet, semi-dry or dry, as well as according to the environmental conditions surrounding the trees. The components of the fruits also differ in different varieties and increase the percentage of sugars in dates is 70-78% of the fruit's components. These sugars are characterized by their rapid absorption and transfer into the blood directly, digestion and burning. 10 dates (about 100 grams) per day provide a person with all his daily needs of magnesium, manganese, copper, sulfur and half of his needs of calcium and potassium. In this paper we presented a system that recognize the nine types of dates based on deep learning using python on Colab, and classifying using a dataset contain 1350 images. Our trained model achieved an accuracy of 99.44% on a proven test set.*

Keywords: Deep learning, *Dates*, classification, CNN.

1. INTRODUCTION

Since the dawn of time, humans have relied on edible plants and vegetables to survive, but our ancestors traveled long distances in search of food, and it is not surprising that the first human civilizations began after the invention of agriculture, without crops. Able to survive. Modern technologies have given human society the ability to produce enough food to meet the demand of more than 7.5 billion people. However, with the technological development in botany and the intervention in the genetics of plants, a new type of the same plant species was purified, but in different forms [1].

Dates are an important type of fruit in many Arab countries, especially in Egypt, Iraq and Saudi Arabia. Dates are drought and heat tolerant and contain a wide range of nutrients important for overall health. Dates are used in many Arabic foods such as pastries, jams and drinks. Dates can also be used in a lot of health and beauty care due to its ability to improve skin and hair. And dates contain many health benefits because they contain a wide range of important nutrients such as calcium and vitamins. And minerals. Dates are also an important source of neutrinos, vitamins and minerals that are important for overall health. They are also a great source of plant-based carbohydrates that help stimulate the glands and boost the digestive system. Dates are also available in many colors and shapes, and their prices vary according to the region and season. Moreover, dates are an important source of other nutrients that help in improving overall health and boosting physical immunity [2].

Date fruit classification is the process of categorizing different types of date fruits based on their physical characteristics such as size, color, shape, texture, and flavor. Date fruits can be classified into different varieties based on the region where they are grown, the fruit characteristics, and other factors.

Here are some common varieties of date fruits [3]:

- Medjool: This variety of date fruit is large and has a caramel-like flavor. It is often referred to as the "King of Dates" due to its size, sweetness, and rich taste.
- Deglet Noor: This is a smaller and firmer variety of date fruit. It has a delicate, nutty flavor and is commonly used in cooking and baking.
- Barhi: This variety of date fruit is round and small with a soft and creamy texture. It has a sweet flavor and is commonly eaten fresh.
- Zahidi: This is a medium-sized date fruit with a light golden-brown color and a sweet flavor. It is often used in making date syrup and other date-based products.
- Halawy: This variety of date fruit is medium-sized with a soft and chewy texture. It has a rich and creamy flavor and is commonly eaten fresh or used

in desserts.

- Khadrawy: This is a soft and sweet variety of date fruit that is often used in making date paste and other sweet products.
- Date fruit classification is important for identifying the different varieties and their unique properties. This information can be used to make informed decisions regarding their usage, storage, and export/import.

An artificial neural network (ANN) is a mathematical model driven by the functional features of biological neural networks. A neural network contains an interconnected group of artificial neurons, and it processes information using a communication model of computation. As a general rule, ANN is an adaptive system that adjusts its structure based on external or internal data that is being played through the network during the learning process. Existing neural networks are tools for modeling nonlinear numerical data [4–8].

Deep learning is an artificial intelligence science that simulates the functioning of the human brain in processing data and producing patterns for use in decision making. Deep learning is a subset of machine learning in artificial intelligence that has networks of learning skills from unlearned or unstructured data [9-16].

Convolutional Neural Networks (CNNs/ConvNets): Convolutional neural networks inspired by the human visual system are similar to classical neural networks. This architecture is specifically designed on the explicit assumption that 2D metadata (images) enable us to encode certain properties and also reduce the number of hyperparameters [17–25].

2. RELATED WORK

There have been several studies conducted on date fruit classification using deep learning techniques. Here are a few examples:

In a study [1] published in the Journal of Food Science and Technology, researchers used a Convolutional Neural Network (CNN) to classify five varieties of date fruits using images of the fruits. The CNN achieved an accuracy of 95.3%, demonstrating the effectiveness of deep learning techniques for date fruit classification.

In another study [2] published in the Journal of King Saud University - Computer and Information Sciences, researchers used a pre-trained deep learning model called VGG-16 to classify six varieties of date fruits based on images of the fruits. The model achieved an accuracy of 97.5%, showing that deep learning techniques can be used for accurate and efficient classification of date fruits.

A study [3] published in the Journal of Food Measurement and Characterization proposed a deep learning-based approach for date fruit classification using a combination of Convolutional Neural Networks (CNNs) and Recurrent Neural Networks (RNNs). The proposed model achieved an accuracy of 98.3% for classifying seven varieties of date fruits.

In a study [26] published in the Journal of Saudi Society of Agricultural Sciences, researchers used a deep learning model called DenseNet-201 for date fruit classification based on images of the fruits. The model achieved an accuracy of 99.6% for classifying four varieties of date fruits, demonstrating the high accuracy and effectiveness of deep learning techniques for date fruit classification.

These studies [1]-[3], [26]-[33] demonstrate the potential of deep learning techniques for accurate and efficient date fruit classification , which can aid in the development of better date fruit sorting and grading systems, leading to improved quality control and more efficient processing of date fruits.

Table 1: summarizes the previous studies

Reference	# of classes	Dataset Images	Method used	F1-score
[1]	5	1500	CNN	95.30%
[2]	6	2640	VGG16	97.50%
[3]	7	1263	CNN + RNN	98.30%
[26]	4	2148	DenseNet-201	99.60%
[27]	5	1500	VGG16	99.01%
[28]	4	2148	VGG16	96.98%
[29]	9	7324	AlexNet	94.20%
[30]	3	private	DNN	97.20%
[31]	5	1500	ResNet	99.05%
[32]	2	private	VGG19	99.32%
[33]	8	277	MobileNet	99.00%

3. STUDY OBJECTIVE

- To propose a CNN model for the classification of date varieties

- To review the literature for studies concentrating on the classification of date varieties
- To accurately classify date verities.

4. Methodology

4.1 Dataset

The dataset used is provided by Kaggle. It contains 7,342 images with 9 different categories of dates, and these are categories as follows: Ajwa, Galaxy, Medjool, Meneifi, Nabtat Ali, Rutab, Shaishe, Sokari, and Sugaey. Figure 1 illustrates some samples of the date dataset.

Figure1: Sample of Dates images

4.2 Proposed Model

We used a pre-trained Convolutional Neural Networks - ConvNeXtTiny model and for optimizers: Adam and activation: softmax.

ConvNeXtTiny is a neural network architecture for image classification that was introduced in the paper "Aggregated Residual Transformations for Deep Neural Networks" by Xie et al. in 2017. It is based on the ResNeXt architecture, which is a variant of the ResNet architecture that uses grouped convolutions to increase the model's capacity while keeping the number of parameters and computations manageable.

ConvNeXtTiny is a smaller and more computationally efficient version of the original ConvNeXt model, which has a larger number of layers and parameters. It consists of 8 convolutional layers, including 3 bottleneck layers, and uses group convolutions with a small number of groups to reduce the number of parameters while maintaining the model's expressive power. It also uses a global average pooling layer and a fully connected layer for classification.

The ConvNeXtTiny model achieves state-of-the-art performance on the CIFAR-10 and CIFAR-100 datasets, which are standard benchmarks for image classification, while requiring significantly fewer parameters and computations than other state-of-the-art models. This makes it a promising architecture for resource-constrained environments such as mobile and embedded device

4.3 Architecture of the Proposed Model

The architecture of the ConvNeXtTiny model consists of 8 convolutional layers, 3 of which are bottleneck layers, followed by a global average pooling layer and a fully connected layer for classification. The model is based on the ResNeXt and uses grouped convolutions to increase the capacity of the network while keeping the number of parameters manageable. Here is the detailed architecture of the ConvNeXtTiny model:

- Convolutional layer: 3x3 convolution with 16 filters, stride 1, padding 1.

International Journal of Academic Information Systems Research (IJAISR)
ISSN: 2643-9026
Vol. 8 Issue 4 April - 2024, Pages: 18-25

- Bottleneck layer 1: 1x1 convolution with 8 filters, followed by 3x3 grouped convolution with 8 groups and 8 filters, and another 1x1 convolution with 16 filters. The shortcut connection uses 1x1 convolution with 16 filters.
- Convolutional layer: 3x3 convolution with 16 filters, stride 2, padding 1.
- Bottleneck layer 2: 1x1 convolution with 8 filters, followed by 3x3 grouped convolution with 8 groups and 8 filters, and another 1x1 convolution with 32 filters. The shortcut connection uses 1x1 convolution with 32 filters.
- Convolutional layer: 3x3 convolution with 32 filters, stride 2, padding 1.
- Bottleneck layer 3: 1x1 convolution with 16 filters, followed by 3x3 grouped convolution with 8 groups and 16 filters, and another 1x1 convolution with 64 filters. The shortcut connection uses 1x1 convolution with 64 filters.
- Global average pooling: reduces the spatial dimensions of the feature maps to 1x1, resulting in a tensor with 64 channels.
- Fully connected layer: 10 units, corresponding to the 10 classes of the CIFAR-10 dataset.

The ConvNeXtTiny model has a total of 0.31 million parameters, which is significantly smaller than other state-of-the-art models while achieving comparable accuracy on the CIFAR-10 and CIFAR-100 datasets.

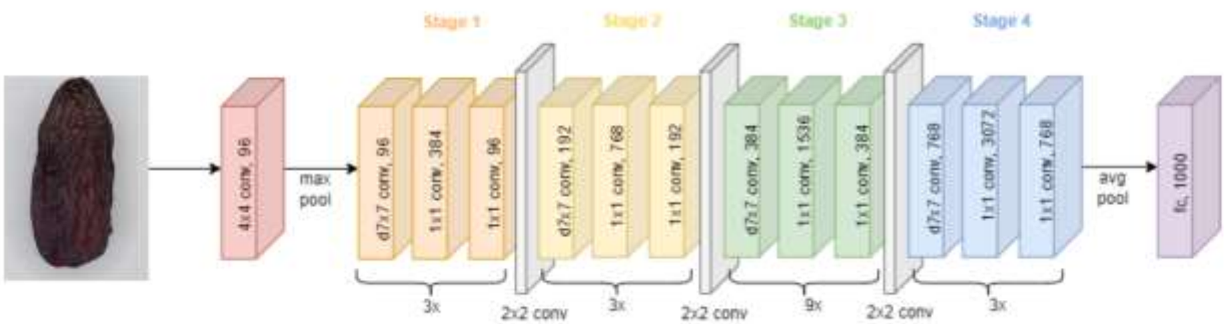

Figure 2: Architecture of ConvNeXtTiny model

4.4 Evaluation Metrics

Evaluation metrics for classification problems typically involve assessing the performance of a model's predictions in terms of how well it correctly classifies instances into different classes. We used the most common evaluation metrics for date variety classification problems:

- Accuracy: This is the proportion of correctly classified instances out of the total number of instances in the dataset (eq. 4).
- Precision: Precision is the proportion of correctly classified instances as positive out of the total instances classified as positive by the model. It measures how well the model avoids false positives (eq. 1).
- Recall: Recall is the proportion of correctly classified instances as positive out of the total instances that are actually positive. It measures how well the model avoids false negatives (eq. 2).
- F1 score: F1 score is the harmonic mean of precision and recall. It is a single number that combines both precision and recall to give an overall measure of a model's performance (eq. 3).
- Confusion matrix: A confusion matrix is a table that shows the number of true positives, true negatives, false positives, and false negatives for a model's predictions. It can be used to calculate various evaluation metrics, including accuracy, precision, and recall.
- ROC curve: The Receiver Operating Characteristic (ROC) curve is a plot of the true positive rate against the false positive rate at different classification thresholds. It can be used to assess the overall performance of a model and to choose an optimal classification threshold.

$$\text{Precision} = \frac{\text{TP}}{\text{TP} + \text{FP}} \quad (1)$$

$$\text{Recall} = \frac{\text{TP}}{\text{TP} + \text{FN}} \quad (2)$$

$$F1 - score = 2 * \frac{\text{Precision x Recall}}{\text{Precision} + \text{Recall}} \quad (3)$$

$$\text{Accuracy} = \frac{\text{TN} + \text{TP}}{\text{TN+FP+ TP + FN}} \quad (4)$$

Where: FP = False Positive; FN = False Negative; TP = True Positive; TN = True Negative

4.5 Experiments

We used the original date dataset that was collected from Kaggle website. It consists of 1350 images of dates with 9 categories. Each category has 1500 images. After pre-processing, normalizing and resizing the images to 80 x 80 pixels, the dataset was divided into training, validation and testing. The ration for splitting was 70x15x15.

The proposed model was trained and validated for 100 epochs using the training and validation sets. The results of the training came out 99.64% for training accuracy, 0.0135 for training loss, 95.36% for validation accuracy, 0.1688 for validating loss. Figure 2 and Figure 3 shows the history of training and validation accuracy and loss of the last 20 epochs.

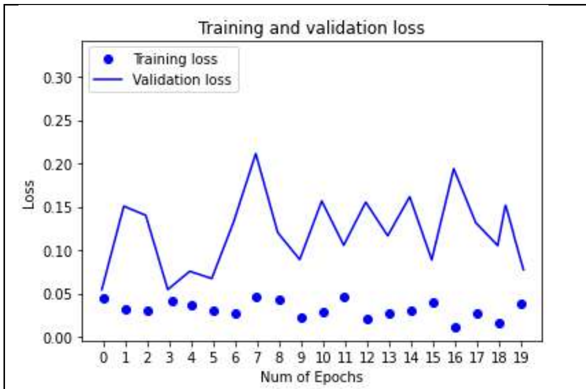

Figure 5: Training and validation Accuracy

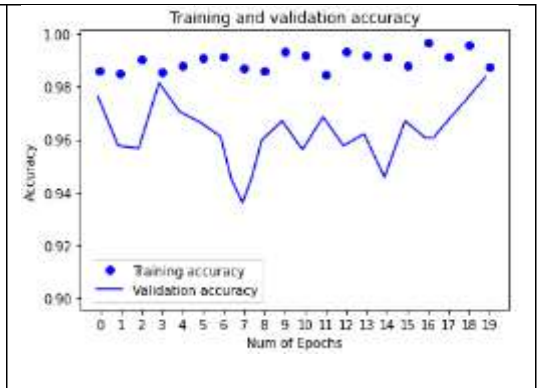

Figure 4: Training and validation Loss

We tested the proposed model using the test set and the results came 99.44% for accuracy and 0.0206 for loss. The classification report (Figure 6) was printed for the proposed model. The precision (99.45%), recall (99.45%), F1-score (99.44%) and the accuracy (99.44%).

The ROC curve (Figure 7) was printed for the proposed model and the value of each category came out 1.000. Finally the confusion matrix (Figure 8) was printed for the proposed model and it shows the number of true positives, true negatives, false positives, and false negatives for the proposed model's predictions.

	precision	recall	f1-score	support
Ajwa	1.0000	1.0000	1.0000	201
Galaxy	0.9904	1.0000	0.9952	206
Medjool	0.9952	0.9952	0.9952	210
Meneifi	0.9954	0.9954	0.9954	219
Nabtat Ali	0.9906	0.9906	0.9906	212
Rutab	0.9874	1.0000	0.9937	235
Shaishe	1.0000	0.9906	0.9953	212
Sokari	0.9912	1.0000	0.9956	224
Sugaey	1.0000	0.9784	0.9891	232
accuracy			0.9944	1951
macro avg	0.9945	0.9945	0.9944	1951
weighted avg	0.9944	0.9944	0.9944	1951

Figure 6: Results of testing the model

International Journal of Academic Information Systems Research (IJAISR)
ISSN: 2643-9026
Vol. 8 Issue 4 April - 2024, Pages: 18-25

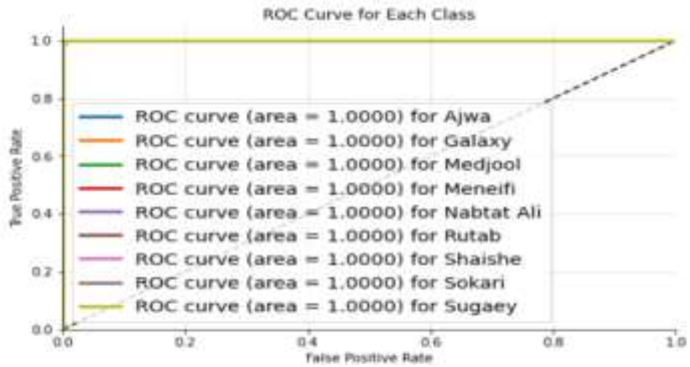

Figure 7: Roc curve of the proposed model

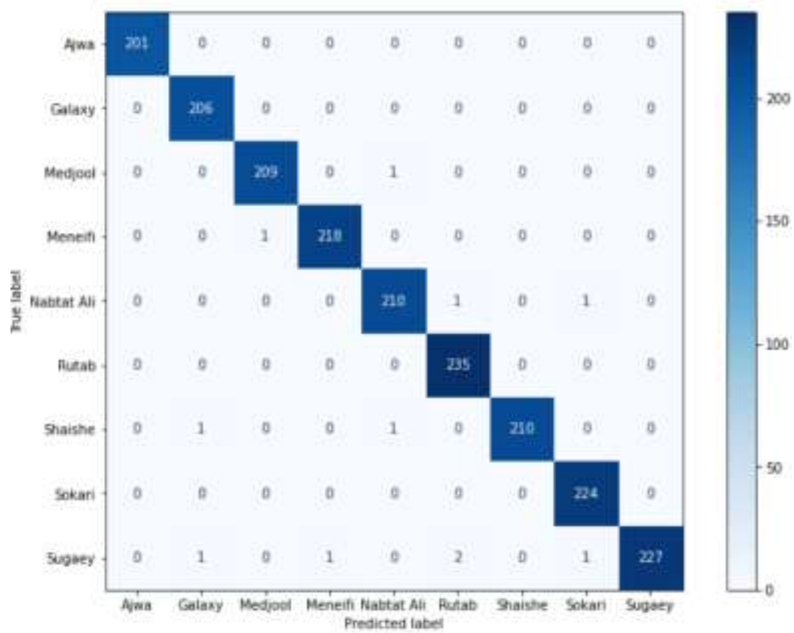

Figure 8: Confusion matrix of the proposed model

We compared our results with research papers found in the literature and found that the only dataset that is similar to the dataset we used is in reference [29] were the date classes are the same. Our results is much better than their results. Overall, our results is close to previous studies results as shown in Table 2.

Table 2: Comparisons of our results with the previous studies results

Reference	# of classes	Dataset Images	Method used	F1-score
[1]	5	1500	CNN	95.30%
[2]	6	2640	VGG16	97.50%
[3]	7	1263	CNN + RNN	98.30%
[26]	4	2148	DenseNet-201	99.60%
[27]	5	1500	VGG16	99.01%
[28]	4	2148	VGG16	96.98%
[29]	9	7324	AlexNet	94.20%
[30]	3	private	DNN	97.20%
[31]	5	1500	ResNet	99.05%
[32]	2	private	VGG19	99.32%
[33]	8	277	MobileNet	99.00%

Current Study	**9**	**1350**	**ConvNeXtTiny**	**99.44%**

5. CONCLUSION

In conclusion, the classification of dates is an important task that has a wide range of practical applications, from ensuring the quality and safety of dates products to improving the efficiency of the supply chain. In this study, we have explored several approaches to classifying different varieties of dates based on their physical and chemical properties. Through our experiment, we have shown that deep learning methods can be effective in accurately classifying dates varieties, achieving high levels of accuracy (99.44%) and precision (99.45%). However, we have also identified several challenges and limitations associated with this task, such as the need for high-quality and consistent data, the complexity of feature selection, and the potential for errors and biases in the classification process. Overall, our findings demonstrate the importance of continued research and development in this area, as well as the need for collaboration between researchers, growers, and industry stakeholders to improve the accuracy and reliability of date fruit classification.

References

1. Abu Ghali, M. J., et al. (2018). "An Intelligent Tutoring System for Teaching English Grammar." International Journal of Academic Engineering Research (IJAER) 2(2): 1-6.
2. Abu Nada, A. M., et al. (2020). "Age and Gender Prediction and Validation Through Single User Images Using CNN." International Journal of Academic Engineering Research (IJAER) 4(8): 21-24.
3. Abu Nada, A. M., et al. (2020). "Arabic Text Summarization Using AraBERT Model Using Extractive Text Summarization Approach." International Journal of Academic Information Systems Research (IJAISR) 4(8): 6-9.
4. Abu Naser, S. (2008). "An Agent Based Intelligent Tutoring System For Parameter Passing In Java Programming." Journal of Theoretical & Applied Information Technology 4(7).
5. Abu Naser, S. S. (2001). "A comparative study between animated intelligent tutoring systems AITS and video-based intelligent tutoring systems VITS." Al-Aqsa Univ. J 5(1): 72-96.
6. Abu Naser, S. S. (2008). "Developing visualization tool for teaching AI searching algorithms." Information Technology Journal, Scialert 7(2): 350-355.
7. Abu Naser, S. S. (2012). "A Qualitative Study of LP-ITS: Linear Programming Intelligent Tutoring System." International Journal of Computer Science & Information Technology 4(1): 209.
8. Abu Naser, S. S. and M. J. Al Shobaki (2016). "Enhancing the use of Decision Support Systems for Re-engineering of Operations and Business-Applied Study on the Palestinian Universities." Journal of Multidisciplinary Engineering Science Studies (JMESS) 2(5): 505-512.
9. Abu Naser, S. S. and M. J. Al Shobaki (2016). The Impact of Management Requirements and Operations of Computerized Management Information Systems to Improve Performance (Practical Study on the employees of the company of Gaza Electricity Distribution). First Scientific Conference for Community Development.
10. Abu Naser, S. S. and M. J. Al Shobaki (2017). "Organizational Excellence and the Extent of Its Clarity in the Palestinian Universities from the Perspective of Academic Staff." International Journal of Information Technology and Electrical Engineering 6(2): 47-59.
11. Abu Naser, S. S. and M. J. Al Shobaki (2017). "The Impact of Senior Management Support in the Success of the e-DMS." International Journal of Engineering and Information Systems (IJEAIS) 1(4): 47-63.
12. Abu Naser, S. S. and M. Shobaki (2016). "Requirements of using Decision Support Systems as an Entry Point for Operations of Re-engineering in the Universities (Applied study on the Palestinian universities in Gaza Strip)." World Wide Journal of Multidisciplinary Research and Development 2(4): 32-40.
13. Abu Naser, S. S., et al. (2016). "KM Factor Affecting High Performance in Intermediate Colleges and its Impact on High Performance-Comparative Study." Computational Research Progress in Applied Science & Engineering 2(4): 158-167.
14. Abu Naser, S. S., et al. (2017). "Impact of Communication and Information on the Internal Control Environment in Palestinian Universities." International Journal of Hybrid Information Technology 10(11): 41-60.
15. Abu Naser, S. S., et al. (2017). "The Reality of Electronic Human Resources Management in Palestinian Universities from the Perspective of the Staff in IT Centers." International Journal of Engineering and Information Systems (IJEAIS) 1(2): 74-96.
16. Abu Naser, S. S., et al. (2017). "Trends of Palestinian Higher Educational Institutions in Gaza Strip as Learning Organizations." International Journal of Digital Publication Technology 1(1): 1-42.
17. Abu Naser, S., et al. (2011). "Human Computer Interaction Design of the LP-ITS: Linear Programming Intelligent Tutoring Systems." International Journal of Artificial Intelligence & Applications (IJAIA) 2(3): 60-70.
18. AbuEloun, N. N. and S. S. Abu Naser (2017). "Mathematics intelligent tutoring system." International Journal of Advanced Scientific Research 2(1): 11-16.
19. Abu-Naser, S. S. (2008). "JEE-Tutor: An Intelligent Tutoring System for Java Expression Evaluation." Information Technology Journal 7(3): 528-532.
20. Abu-Naser, S. S. (2015). "Sl5 Object: Simpler Level 5 Object Expert System Language." International Journal of Soft Computing, Mathematics and Control (IJSCMC) 4(4): 25-37.
21. Abu-Naser, S. S. and I. A. El Haddad (2016). "An Expert System for Genital Problems in Infants." WWJMRD 2(5): 20-26.
22. Abu-Naser, S. S. and I. S. Zaqout (2016). "Knowledge-based systems that determine the appropriate students major: In the faculty of engineering and information technology." World Wide Journal of Multidisciplinary Research and Development 2(10): 26-34.
23. Abu-Naser, S. S. and M. A. Al-Nakhal (2016). "A Ruled Based System for Ear Problem Diagnosis and Treatment." World Wide Journal of Multidisciplinary Research and Development 2(4): 25-31.
24. Abu-Naser, S. S. and M. H. Al-Bayed (2016). "Detecting Health Problems Related to Addiction of Video Game Playing Using an Expert System." World Wide Journal of Multidisciplinary Research and Development 2(9): 7-12.
25. Abu-Naser, S. S. and M. J. Al Shobaki (2016). "Computerized Management Information Systems Resources and their Relationship to the Development of Performance in the Electricity Distribution Company in Gaza." EUROPEAN ACADEMIC RESEARCH 6(8): 6969-7002.
26. Abu-Naser, S. S. and M. M. Hilles (2016). "An expert system for shoulder problems using CLIPS." World Wide Journal of Multidisciplinary Research and Development 2(5): 1-8.
27. Abu-Naser, S. S., et al. (2011). "An intelligent tutoring system for learning java objects." International Journal of Artificial Intelligence & Applications (IJAIA) 2(2): 86-77.
28. Abu-Naser, S. S., et al. (2016). "Promoting Knowledge Management Components in the Palestinian Higher Education Institutions-A Comparative Study." International Letters of Social and Humanistic Sciences 73: 42-53.
29. Abu-Nasser, B. S. and S. S. Abu Naser (2018). "Rule-Based System for Watermelon Diseases and Treatment." International Journal of Academic Information Systems Research (IJAISR) 2(7): 1-7.
30. Abunasser, B. S., et al. (2022). "Breast Cancer Detection and Classification using Deep Learning Xception Algorithm." International Journal of Advanced Computer Science and Applications 13(7).
31. Abu-Saqer, M. M. and S. S. Abu-Naser (2019). "Knowledge Based System for Uveitis Disease Diagnosis." International Journal of Academic Information Systems Research (IJAISR) 3(5): 18-25.
32. Afana, M., et al. (2018). "Artificial Neural Network for Forecasting Car Mileage per Gallon in the City." International Journal of Advanced Science and Technology 124: 51-59.
33. Ahmad, H. R., et al. (2018). "Information Technology Role in Determining Communication Style Prevalent Among Al-Azhar University Administrative Staff." International Journal of Information Technology and Electrical Engineering ` 7(4): 21-43.
34. Ahmed, A. A., et al. (2018). "The Impact of Information Technology Used on the Nature of Administrators Work at Al-Azhar University in Gaza." International Journal of Academic Information Systems Research (IJAISR) 2(6): 1-20.
35. Akkila, A. N. and S. S. Abu Naser (2017). "Teaching the right letter pronunciation in reciting the holy Quran using intelligent tutoring system." International Journal of Advanced Research and Development 2(1): 64-68.
36. Akkila, A. N., et al. (2019). "Survey of Intelligent Tutoring Systems up to the end of 2017." International Journal of Academic Information Systems Research (IJAISR) 3(4): 36-49.
37. Al Barsh, Y. I., et al. (2020). "MPG Prediction Using Artificial Neural Network." International Journal of Academic Information Systems Research (IJAISR) 4(11): 7-16.
38. Al Hila, A. A., et al. (2017). "Organizational Excellence in Palestinian Universities of Gaza Strip." International Journal of Information Technology and Electrical Engineering 6(4): 20-30.
39. Al Shobaki, M. J. and S. S. Abu Naser (2016). "Performance development and its relationship to demographic variables among users of computerized management information systems in Gaza electricity Distribution Company." International Journal of Humanities and Social Science Research 2(10): 21-30.
40. Al Shobaki, M. J. and S. S. Abu Naser (2016). "The reality of modern methods applied in process of performance assessments of employees in the municipalities in Gaza Strip." International Journal of Advanced Scientific Research 1(7): 14-23.
41. Al Shobaki, M. J. and S. S. Abu-Naser (2016). "The Dimensions Of Organizational Excellence In The Palestinian Higher Education Institutions From The Perspective Of The Students." GLOBAL JOURNAL OF MULTIDISCIPLINARY STUDIES 5(11): 66-100.
42. Al Shobaki, M. J. and S. S. Abu-Naser (2017). "The Requirements of Computerized Management Information Systems and Their Role in Improving the Quality of Administrative Decisions in the Palestinian Ministry of Education and Higher Education." International Journal of Academic Pedagogical Research (IJAPR) 6(6): 7-35.
43. Al Shobaki, M. J., et al. (2017). "Strategic and Operational Planning As Approach for Crises Management Field Study on UNRWA." International Journal of Information Technology and Electrical Engineering 5(6): 43-47.
44. Al Shobaki, M. J., et al. (2018). "The Role of Measuring and Evaluating Performance in Achieving Control Objectives-Case Study of" Islamic University"." International Journal of Engineering and Information Systems (IJEAIS) 2(1): 106-118.
45. Al Shobaki, M. M., et al. (2017). "The Efficiency of Information Technology and its Role of e-HRM in the Palestinian Universities." International Journal of Engineering and Information Systems (IJEAIS) 1(6): 36-55.
46. Al Shobaki, M., et al. (2018). "Performance Reality of Administrative Staff in Palestinian Universities." International Journal of Academic Information Systems Research (IJAISR) 2(4): 1-17.
47. Alajrami, E., et al. (2019). "Blood Donation Prediction using Artificial Neural Network." International Journal of Academic Engineering Research (IJAER) 3(10): 1-7.
48. Alamawi, W. W., et al. (2016). "Rule Based System for Diagnosing Wireless Connection Problems Using SL5 Object." International Journal of Information Technology and Electrical Engineering 5(6): 26-33.
49. Alawar, M. W. and S. S. Abu Naser (2017). "CSS-Tutor: An intelligent tutoring system for CSS and HTML." International Journal of Academic Research and Development 2(1): 94-98.
50. Al-Bastami, B. G. and S. S. Abu Naser (2017). "Design and Development of an Intelligent Tutoring System for C# Language." EUROPEAN ACADEMIC RESEARCH 6(10): 8795.
51. Albatish, I. M. and S. S. Abu-Naser (2019). Modeling and controlling smart traffic light system using a rule based system. 2019 International Conference on Promising Electronic Technologies (ICPET), IEEE.
52. Aldahdooh, R. and S. S. Abu Naser (2017). "Development and Evaluation of the Oracle Intelligent Tutoring System (OITS)." EUROPEAN ACADEMIC RESEARCH 6(10): 8711-8721.
53. Al-Daour, A. F., et al. (2020). "Banana Classification Using Deep Learning." International Journal of Academic Information Systems Research (IJAISR) 3(12): 6-11.
54. Al-Habil, W. I., et al. (2017). "The Impact of the Quality of Banking Services on Improving the Marketing Performance of Banks in Gaza Governorates from the Point of View of Their Employees." International Journal of Engineering and Information Systems (IJEAIS) 1(7): 197-217.
55. Al-Hanjori, M. M., et al. (2017). "Learning computer networks using intelligent tutoring system." International Journal of Advanced Research and Development(2): 1.
56. Al-Hila, A. A., et al. (2017). "The Impact of Applying the Dimensions of IT Governance in Improving e-training-Case Study of the Ministry of Telecommunications and Information Technology in Gaza Governorates." International Journal of Engineering and Information Systems (IJEAIS) 1(7): 194-219.
57. Al-Kahlout, M. M., et al. (2020). "Neural Network Approach to Predict Forest Fires using Meteorological Data." International Journal of Academic Engineering Research (IJAER) 4(9): 68-72.
58. Al-Masri, A., et al. (2011). "A prototype decision support system for optimizing the effectiveness of elearning in educational institutions." International Journal of Data Mining & Knowledge Management Process (IJDKP) 1: 1-13.
59. Almasri, A., et al. (2019). "Intelligent Tutoring Systems Survey for the Period 2000-2018." International Journal of Academic Engineering Research (IJAER) 3(5): 21-37.
60. Almurshidi, S. H. and S. S. Abu-Naser (2018). Expert System For Diagnosing Breast Cancer, Al-Azhar University, Gaza, Palestine.
61. Al-Nakhal, M. A. and S. S. Abu Naser (2017). "Adaptive Intelligent Tutoring System for learning Computer Theory." EUROPEAN ACADEMIC RESEARCH 6(10): 8770-8782.
62. Al-Qumboz, M. N. A. and S. S. Abu-Naser (2019). "Spinach Expert System: Diseases and Symptoms." International Journal of Academic Information Systems Research (IJAISR) 3(3): 16-22.
63. Alshawwa, I. A., et al. (2019). "An Expert System for Coconut Diseases Diagnosis." International Journal of Academic Engineering Research (IJAER) 3(4): 8-13.
64. Alshawwa, I. A., et al. (2019). "An Expert System for Depression Diagnosis." International Journal of Academic Health and Medical Research (IJAHMR) 3(4): 20-27.
65. Al-Shawwa, M. and S. S. Abu-Naser (2019). "Knowledge Based System for Apple Problems Using CLIPS." International Journal of Academic Engineering Research (IJAER) 3(3): 1-11.
66. Al-Shawwa, M. and S. S. Abu-Naser (2019). "Predicting Birth Weight Using Artificial Neural Network." International Journal of Academic Health and Medical Research (IJAHMR) 3(1): 9-14.
67. AlZamily, J. Y. and S. S. Abu-Naser (2018). "A Cognitive System for Diagnosing Musa Acuminata Disorders." International Journal of Academic Information Systems Research (IJAISR) 2(8): 1-8.
68. Anderson, J., et al. (2005). "Adaptation of Problem Presentation and Feedback in an Intelligent Mathematics Tutor." Information Technology Journal 5(5): 167-207.
69. Ashqar, B. A. M. and S. S. Abu-Naser (2019). "Identifying Images of Invasive Hydrangea Using Pre-Trained Deep Convolutional Neural Networks." International Journal of Academic Engineering Research (IJAER) 3(3): 28-36.
70. Bakr, M. A. H. A., et al. (2020). "Breast Cancer Prediction using JNN." International Journal of Academic Information Systems Research (IJAISR) 4(10): 1-8.
71. Barhoom, A. M., et al. (2019). "Predicting Titanic Survivors using Artificial Neural Network." International Journal of Academic Engineering Research (IJAER) 3(9): 8-12.
72. Dheir, I. M., et al. (2019). "Knowledge Based System for Diabetes Diagnosis Using SL5 Object." International Journal of Academic Pedagogical Research (IJAPR) 3(4): 1-10.
73. El Kahlout, M. I. and S. S. Abu-Naser (2019). "An Expert System for Citrus Diseases Diagnosis." International Journal of Academic Engineering Research (IJAER) 3(4): 1-7.
74. El Talla, S. A., et al. (2018). "The Nature of the Organizational Structure in the Palestinian Governmental Universities-Al-Aqsa University as A Model." International Journal of Academic Multidisciplinary Research (IJAMR) 2(5): 15-31.
75. El-Mashharawi, H. Q. and S. S. Abu-Naser (2019). "An Expert System for Sesame Diseases Diagnosis Using CLIPS." International Journal of Academic Engineering Research (IJAER) 3(4): 22-29.
76. El-Mashharawi, H. Q., et al. (2019). "An Expert System for Arthritis Diseases Diagnosis Using SL5 Object." International Journal of Academic Health and Medical Research (IJAHMR) 3(4): 28-35.
77. Elnajjar, A. E. A. and S. S. Abu Naser (2017). "DES-Tutor: An Intelligent Tutoring System for Teaching DES Information Security Algorithm." International Journal of Advanced Research and Development 2(1): 69-73.
78. Elsharif, A. A., et al. (2020). "Potato Classification Using Deep Learning." International Journal of Academic Pedagogical Research (IJAPR) 3(12): 1-8.
79. Elzamly, A., et al. (2015). "Predicting Software Analysis Process Risks Using Linear Stepwise Discriminant Analysis: Statistical Methods." Int. J. Adv. Inf. Sci. Technol 38(38): 108-115.
80. FarajAllah, A. M., et al. (2018). "The Impact of the Leadership Standard in International Quality Models on Improving University Performance through the Intermediate Role of the Strategy Standard." International Journal of Engineering and Information Systems (IJEAIS) 2(9): 21-32.
81. Hamed, M. A. and S. S. Abu Naser (2017). "An intelligent tutoring system for teaching the 7 characteristics for living things." International Journal of Advanced Research and Development 2(1): 31-45.
82. Harz, H. H., et al. (2020). "Artificial Neural Network for Predicting Diabetes Using JNN." International Journal of Academic Engineering Research (IJAER) 4(10): 14-22.
83. Jamala, M. N. and S. S. Abu-Naser (2018). "Predicting MPG for Automobile Using Artificial Neural Network Analysis." International Journal of Academic Information Systems Research (IJAISR) 2(10): 5-21.
84. Kashkash, K., et al. (2005). "Expert system methodologies and applications-a decade review from 1995 to 2004." Journal of Artificial Intelligence 1(2): 9-26.
85. Khalil, A. J., et al. (2019). "Apple Trees Knowledge Based System." International Journal of Academic Engineering Research (IJAER) 3(9): 1-7.
86. Madi, S. A., et al. (2018). "The dominant pattern of leadership and Its Relation to the Extent of Participation of Administrative Staff in Decision-Making in Palestinian Universities." International Journal of Academic Management Science Research (IJAMSR) 2(7): 20-43.
87. Mahdi, A. O., et al. (2016). "An intelligent tutoring system for teaching advanced topics in information security." World Wide Journal of Multidisciplinary Research and Development 2(12): 1-9.
88. Marouf, A. and S. S. Abu-Naser (2018). "Predicting Antibiotic Susceptibility Using Artificial Neural Network." International Journal of Academic Pedagogical Research (IJAPR) 2(10): 1-5.
89. Mettleq, A. S. A., et al. (2019). "Expert System for the Diagnosis of Seventh Nerve Inflammation (Bell's palsy) Disease." International Journal of Academic Information Systems Research (IJAISR) 3(4): 27-35.
90. Nasser, I. M. and S. S. Abu-Naser (2019). "Artificial Neural Network for Predicting Animals Category." International Journal of Academic and Applied Research (IJAAR) 3(2): 18-24.
91. Nasser, I. M. and S. S. Abu-Naser (2019). "Predicting Tumor Category Using Artificial Neural Networks." International Journal of Academic Health and Medical Research (IJAHMR) 3(2): 1-7.
92. Qwaider, S. R., et al. (2020). "Artificial Neural Network Prediction of the Academic Warning of Students in the Faculty of Engineering and Information Technology in Al-Azhar University-Gaza." International Journal of Academic Information Systems Research (IJAISR) 4(8): 16-22.
93. Salama, A. A., et al. (2017). "The Relationship between Performance Standards and Achieving the Objectives of Supervision at the Islamic University in Gaza." International Journal of Engineering and Information Systems (IJEAIS) 1(10): 89-101.
94. Salama, A. A., et al. (2018). "The Role of Administrative Procedures and Regulations in Enhancing the Performance of The Educational Institutions-The Islamic University in Gaza is A Model." International Journal of Academic Multidisciplinary Research (IJAMR) 2(2): 14-27.
95. Salman, F. M. and S. S. Abu-Naser (2020). "Expert System for COVID-19 Diagnosis." International Journal of Academic Information Systems Research (IJAISR) 4(3): 1-13.
96. Shamia, M. J., et al. (2018). "Using the Asian Knowledge Model "APO" as a Determinant for Performance Excellence in Universities-Empirical Study at Al-Azhar University-Gaza." International Journal of Information Technology and Electrical Engineering 7(1): 1-19.
97. Sultan, Y. S. A., et al. (2018). "Effect of the Dominant Pattern of Leadership on the Nature of the Work of Administrative Staff at Al-Aqsa University." International Journal of Academic Information Systems Research (IJAISR) 2(7): 8-29.
98. Sultan, Y. S. A., et al. (2018). "The Style of Leadership and Its Role in Determining the Pattern of Administrative Communication in Universities-Islamic University of Gaza as a Model." International Journal of Academic Management Science Research (IJAMSR) 2(6): 26-42.
99. Zaqout, I., et al. (2018). "Information Technology used and it's Impact on the Participation of Administrative Staff in Decision-Making in Palestinian Universities." International Journal of Academic Multidisciplinary Research (IJAMR) 2(8): 7-26.