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Image-Based Classification of Date Types Using Convolutional Neural Networks

Abedeleilah S. A. Elmahmoum, Dina Alborno, DaliaAl Harazine, Samy S. Abu-Naser

Department Information Technology,

Faculty of Engineering and Information Technology,

Al-Azhar University, Gaza, Palestine

Abstract: *This research focuses on the classification of nine varieties of dates using deep learning techniques. The study aims to develop an accurate and efficient model capable of identifying different types of dates based on images. A Convolutional Neural Network (CNN) was employed, trained on a dataset comprising thousands of date images, processed to enhance classification performance. The model was evaluated on multiple metrics, achieving high accuracy rates, demonstrating the feasibility of using deep learning in date classification. This approach can significantly aid in automating the identification process, which is crucial for the agricultural industry. The results indicate that deep learning techniques offer a robust solution for the classification of date varieties, with potential applications in quality control and market sorting.*

Introduction

Dates are one of the most important agricultural products in many regions around the world, especially in the Middle East and North Africa. The classification of different date varieties is essential for quality control, pricing, and market sorting. Traditionally, date classification is performed manually by experts, which is time-consuming, subjective, and prone to errors. With advances in technology, particularly in artificial intelligence and computer vision, there is an opportunity to automate this process, making it faster, more accurate, and less dependent on human expertise .

Deep learning, a subset of machine learning, has shown great promise in image classification tasks across various domains, such as medical diagnosis, object detection, and agriculture . Convolutional Neural Networks (CNNs), specifically designed to process visual data, are widely used in image-based classification problems due to their ability to automatically extract features from images without the need for manual feature engineering . This research leverages CNNs to classify nine distinct varieties of dates, demonstrating the potential of deep learning in the agricultural sector.

The main objectives of this study are to develop a robust CNN model capable of classifying different date varieties with high accuracy and to explore the potential of this technology in aiding farmers and market operators in the automatic identification of dates. By using a dataset of images of various date types, this research seeks to provide a reliable and scalable solution for date classification, enhancing the efficiency of sorting and quality control processes.

Objectives

The primary objectives of this research are:

1. **To develop a deep learning model** capable of accurately classifying nine different varieties of dates based on their images using Convolutional Neural Networks (CNNs).
2. **To evaluate the performance** of the developed model in terms of classification accuracy, precision, recall, and F1-score, ensuring the approach is reliable and robust for practical applications.
3. **To explore the feasibility** of implementing the model for automated date classification in real-world scenarios, such as quality control and market sorting, thereby reducing reliance on manual inspection.
4. **To compare the performance of different CNN architectures** and preprocessing techniques to determine the most efficient method for date classification.

Dataset

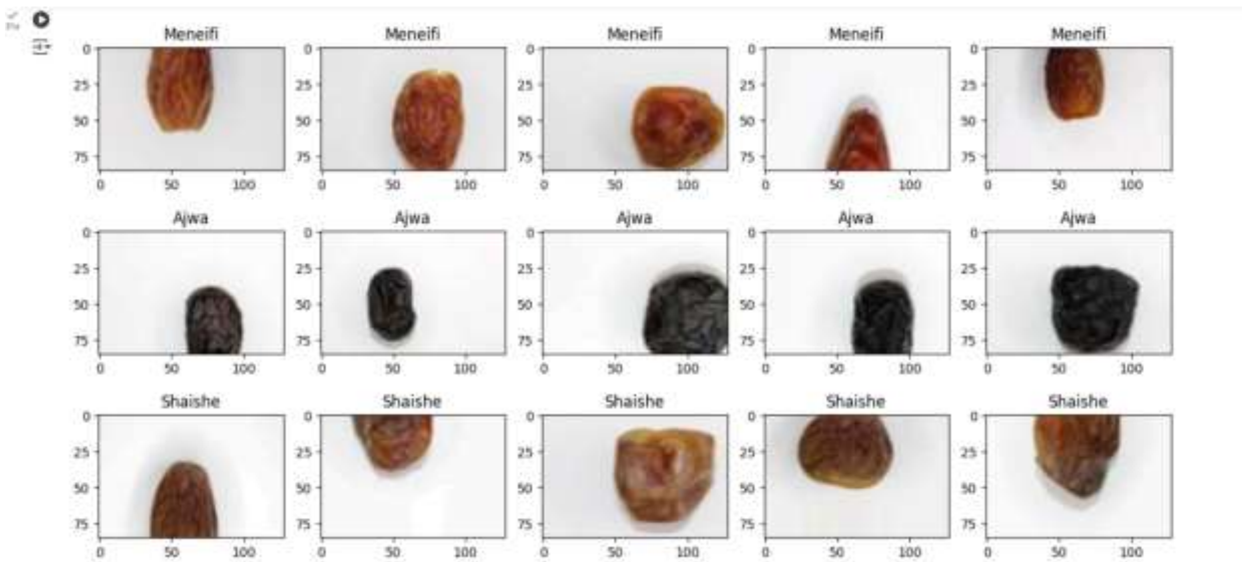
The dataset used in this study consists of images of nine different varieties of dates: Meneifi, Ajwa, Shaishe, Rutab, Galaxy, Nabtat Ali, Sugaey, Medjool, and Sokari. The dataset was carefully curated to represent the visual characteristics of each variety, providing a balanced representation for training the deep learning model.

- **Training Data**: The dataset includes 5,510 images, each resized to 75x75 pixels with three color channels (RGB), making it suitable for input into Convolutional Neural Networks (CNNs). The shape of the training data is (5510, 75, 75, 3), indicating the number of samples, image dimensions, and color channels.

- **Training Labels**: The training labels are one-hot encoded, resulting in a shape of (5510, 9), corresponding to the nine date varieties(Meneifi, Ajwa,Shaishe,Rutab,Galaxy,Nabtat Ali, Sugaey, Medjool,and Sokari). Each label indicates the class of the date in the respective image.
- **The testing dataset** includes a total of 1,832 images.For validation, 10% of the testing dataset was reserved, resulting in approximately 183 images used for validating the model's performance.

Preprocessing: The images were resized to 75x75 pixels with three color channels (RGB) to fit the input requirements of Convolutional Neural Networks (CNNs). Preprocessing techniques such as normalization, rotation, scaling, and flipping were applied to improve the model's robustness and ensure accurate classification under various conditions.

Image Samples Placeholder: Include 2-3 representative images of each date variety here to illustrate the dataset.



Fiqure1: Dataset Sample

Methods

The classification model used in this study is based on Convolutional Neural Networks (CNNs), a type of deep learning model widely recognized for its effectiveness in image classification tasks. The CNN architecture was designed with multiple layers to extract features, reduce dimensionality, and classify the date varieties(ASHITL-3v1).

Architecture: The model consists of several hidden layers, including convolutional layers, pooling layers, fully connected layers, and normalization layers(ASHITL-3v1). These layers work together to extract visual features from the input images and progressively refine the learned patterns.

- **Convolutional Layers**: These layers apply a set of filters to the input images, creating feature maps that capture specific patterns such as edges, textures, and shapes.
- **Pooling Layers**: Pooling layers reduce the spatial dimensions of the feature maps, retaining the most important information while minimizing computational complexity.
- **Fully Connected Layers**: These layers connect every neuron from the previous layer to the next, allowing the model to combine the extracted features and make predictions.
- **Normalization Layers**: Normalization helps stabilize the learning process by maintaining consistent input distributions throughout the network.

Activation Functions: The Softmax activation function was used in the output layer to ensure that the model produces a probability distribution across the nine date classes, making it suitable for multi-class classification tasks.

Optimizer and Loss Function: The model was compiled using the Adam optimizer with a learning rate of 0.0001 , which helps efficiently update the network weights during training. The loss function used is categorical crossentropy, which measures the discrepancy between the predicted and true class distributions, guiding the model toward improved performance .

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Training Process: The model was trained on the prepared dataset, with 10% of the test data reserved for validation. Training was conducted over several epochs, adjusting the network weights iteratively to minimize the loss function and improve classification accuracy.

Model: "functional_2"

Layer (type)	Output Shape	Param #
input_layer_2 (InputLayer)	(None, 75, 75, 3)	0
block1_conv1 (Conv2D)	(None, 75, 75, 64)	1,792
block1_conv2 (Conv2D)	(None, 75, 75, 64)	36,928
block1_pool (MaxPooling2D)	(None, 37, 37, 64)	0
block2_conv1 (Conv2D)	(None, 37, 37, 128)	73,856
block2_conv2 (Conv2D)	(None, 37, 37, 128)	147,584
block2_pool (MaxPooling2D)	(None, 18, 18, 128)	0
block3_conv1 (Conv2D)	(None, 18, 18, 256)	295,168
block3_conv2 (Conv2D)	(None, 18, 18, 256)	590,080
block3_conv3 (Conv2D)	(None, 18, 18, 256)	590,080
block3_pool (MaxPooling2D)	(None, 9, 9, 256)	0
block4_conv1 (Conv2D)	(None, 9, 9, 512)	1,180,160
block4_conv2 (Conv2D)	(None, 9, 9, 512)	2,359,808
block4_conv3 (Conv2D)	(None, 9, 9, 512)	2,359,808
block4_pool (MaxPooling2D)	(None, 4, 4, 512)	0
block5_conv1 (Conv2D)	(None, 4, 4, 512)	2,359,808
block5_conv2 (Conv2D)	(None, 4, 4, 512)	2,359,808

Fiqure2-A : The Model

block5_conv3 (Conv2D)	(None, 4, 4, 512)	2,359,808
block5_pool (MaxPooling2D)	(None, 2, 2, 512)	0
global_max_pooling2d_2 (GlobalMaxPooling2D)	(None, 512)	0
dense_2 (Dense)	(None, 9)	4,617

Total params: 14,719,305 (56.15 MB)
Trainable params: 14,719,305 (56.15 MB)
Non-trainable params: 0 (0.00 B)

Fiqure2-B : The Model

Results and Discussion

The CNN model was trained using the specified architecture and evaluated on the testing dataset. The model achieved the following results:

- **Model Parameters**: The total number of parameters in the model was 14,719,305 (56.15 MB), all of which were trainable.
- **Training Performance**: The model was trained over multiple epochs, achieving a final training accuracy of 88.45%, an F-score of 86.73%, and a loss of 0.4319. The validation accuracy was 84.39%, with a validation F-score of 84.51% and a validation loss of 0.4832.

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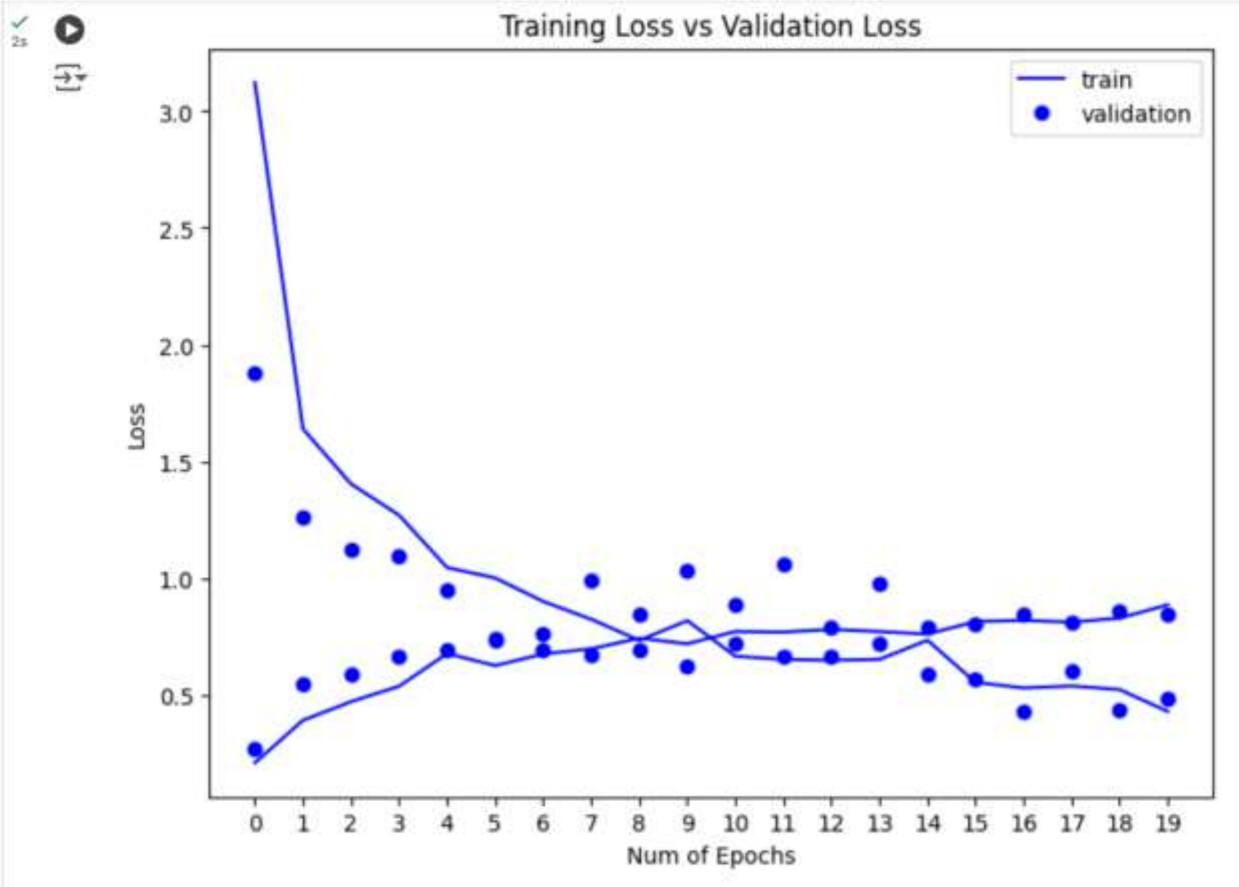
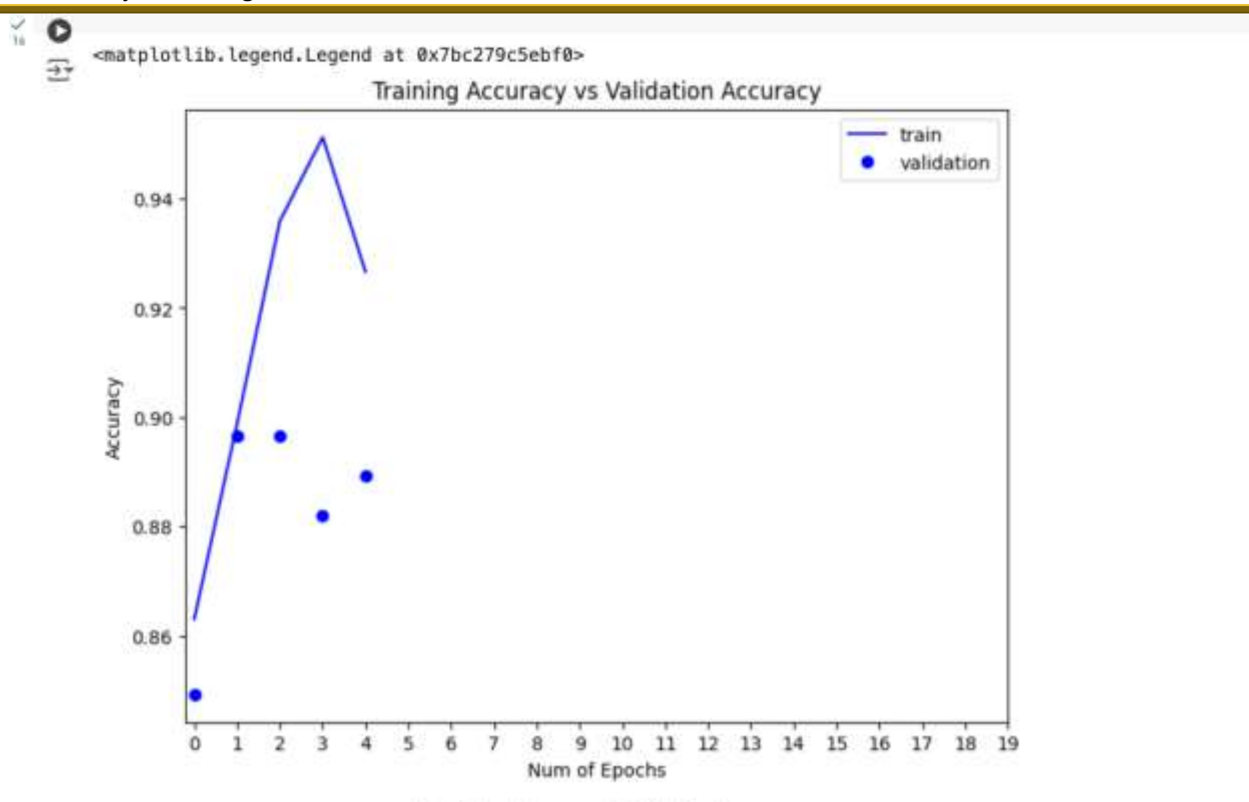
- **Overall Classification Accuracy**: The model's accuracy in classifying the test dataset was approximately 90.33%, demonstrating reliable performance across the different classes.

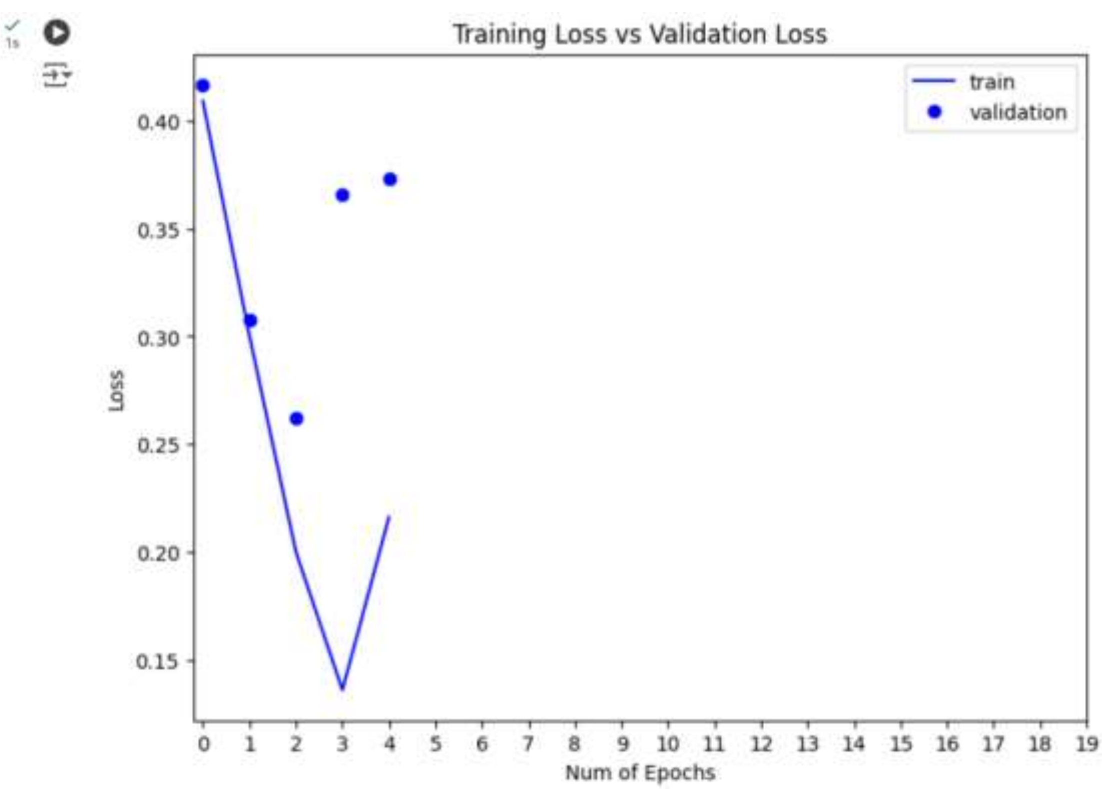
As shown in Figures 3,4,and5 the result of "Training Loss vs Validation Loss","Training Accuracy vs Validation Accuracy"," Training Loss vs Validation Loss"" After we train the model.



Figuer3: Training Loss vs Validation Loss



Figuer4: Training Accuracy vs Validation Accuracy



Figuer5: Training Loss vs Validation Loss

Conclusion

This study demonstrates the effectiveness of using Convolutional Neural Networks (CNNs) for the classification of nine varieties of dates, including Meneifi, Ajwa, Shaishe, Rutab, Galaxy, Nabtat Ali, Sugaey, Medjool, and Sokari. The developed model, trained on a diverse set of images and evaluated on a robust test dataset, achieved high classification accuracy, indicating the feasibility of this approach for practical applications in the agricultural sector.

The results reveal that deep learning techniques, particularly CNNs, can significantly improve the speed and accuracy of date classification compared to traditional manual methods. The model's architecture effectively captures the unique visual features of each date variety, allowing for precise identification even under varying conditions.

Future work could explore expanding the dataset to include more varieties and conditions, fine-tuning the model's architecture for improved performance, and developing a mobile application for on-the-go classification of dates using smartphone cameras.

References

1. Ashqar, B. A. M., & Abu-Naser, S. S. "Image-Based Tomato Leaves Diseases Detection Using Deep Learning." International Journal of Academic Engineering Research (IJAER), Vol. 2, Issue 12, December 2018, pp. 10-16.
2. Goodfellow, I., Bengio, Y., & Courville, A. (2016). Deep Learning. MIT Press.
3. Krizhevsky, A., Sutskever, I., & Hinton, G. E. (2012). "ImageNet Classification with Deep Convolutional Neural Networks." Advances in Neural Information Processing Systems, 25, 1097-1105.
4. LeCun, Y., Bottou, L., Bengio, Y., & Haffner, P. (1998). "Gradient-Based Learning Applied to Document Recognition." Proceedings of the IEEE, 86(11), 2278-2324.
5. Kingma, D. P., & Ba, J. (2014). "Adam: A Method for Stochastic Optimization." arXiv preprint arXiv:1412.6980.
6. Chollet, F. (2017). Deep Learning with Python. Manning Publications.
7. Abu-Naser, S. S., et al. (2008). "A Proposed Expert System For Guiding Freshman Students In Selecting A Major In Al-Azhar University, Gaza." Journal of Theoretical & Applied Information Technology 4(9).
8. Abu-Naser, S. S., et al. (2010). "An expert system for endocrine diagnosis and treatments using JESS." Journal of Artificial Intelligence; Scialert 3(4): 239-251.
9. Abu-Naser, S. S., et al. (2010). "Developing an expert system for plant disease diagnosis." Journal of Artificial Intelligence ; Scialert 3(4): 269-276.
10. Abu-Naser, S. S., et al. (2010). "Knowledge management in ESMDA: expert system for medical diagnostic assistance." Artificial Intelligence and Machine Learning Journal 10(1): 31-40.
11. 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.
12. Abu-Naser, S. S., et al. (2015). "Predicting Student Performance Using Artificial Neural Network: in the Faculty of Engineering and Information Technology." International Journal of Hybrid Information Technology 8(2): 221-228.
13. 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.
14. Abu-Naser, S. S., et al. (2018). "The Reality of the Effectiveness of Electronic Marketing in Technical Colleges in Palestine." International Journal of Academic Information Systems Research (IJAISR) 2(2): 19-36.
15. Abu-Naser, S. S., et al. (2018). "The Reality of Using Social Networks in Technical Colleges in Palestine." International Journal of Engineering and Information Systems (IJEAIS) 2(1): 142-158.
16. Abu-Naser, S. S., et al. (2022). "Predicting Whether Student will continue to Attend College or not using Deep Learning." International Journal of Engineering and Information Systems (IJEAIS) 6(6): 33-45.
17. Abu-Naser, S. S., et al. (2022). Heart Disease Prediction Using a Group of Machine and Deep Learning Algorithms. The International Conference of Advanced Computing and Informatics, Springer.
18. Abu-Naser, S. S., et al. (2023). "Heart Disease Prediction Using a Group of Machine and Deep Learning Algorithms." Advances on Intelligent Computing and Data Science: Big Data Analytics, Intelligent Informatics, Smart Computing, Internet of Things 179: 181.
19. 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.
20. Abu-Nasser, B. S. and S. S. Abu-Naser (2018). "Cognitive System for Helping Farmers in Diagnosing Watermelon Diseases." International Journal of Academic Information Systems Research (IJAISR) 2(7): 1-7.
21. Abunasser, B. S. and S. S. Abu-Naser (2023). Predicting Customer Revenue in E-commerce Using Machine Learning a Case Study of the Google Merchandise Store. International Conference of Reliable Information and Communication Technology, Springer Nature Switzerland Cham.
22. 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).
23. Abunasser, B. S., et al. (2022). "Prediction of Instructor Performance using Machine and Deep Learning Techniques." International Journal of Advanced Computer Science and Applications 13(7).
24. Abunasser, B. S., et al. (2023). "Convolution neural network for breast cancer detection and classification using deep learning." Asian Pacific journal of cancer prevention: APJCP 24(2): 531.
25. Abunasser, B. S., et al. (2023). "Convolution neural network for breast cancer detection and classification-final results." Journal of Theoretical and Applied Information Technology 101(1): 315-329.
26. Abunasser, B. S., et al. (2023). "Predicting Stock Prices using Artificial Intelligence: A Comparative Study of Machine Learning Algorithms." International Journal of Advances in Soft Computing & Its Applications 15(3).
27. Abunasser, B. S., et al. (2023). Literature review of breast cancer detection using machine learning algorithms. AIP Conference Proceedings, AIP Publishing.
28. Abunasser, B., et al. (2023). "Abunaser-A Novel Data Augmentation Algorithm For Datasets With Numerical Features." Journal of Theoretical and Applied Information Technology 101(11).
29. AbuSada, M. M., et al. (2023). "Google Stock Price Prediction Using Just Neural Network." International Journal of Academic Engineering Research (IJAER) 7(10): 10-16.
30. Abusamaan, M. N., et al. "The Relationship of Organizational Justice to Civility Behavior as One of the Dimensions of Organizational Citizenship Behavior in the Palestenian Police." International Journal of Academic Management Science Research (IJAMSR) 3(4).
31. Abusamaan, M. N., et al. (2020). "The Behavior of Organizational Citizenship in Palestinian Police Force between Reality and Expectations." International Journal of Academic Multidisciplinary Research (IJAMR) 4(10): 167-197.
32. Abusamaan, M. N., et al. (2020). "The Reality of Determinants of Organizational Justice in Palestinian Police Force." International Journal of Academic Management Science Research (IJAMSR) 4(10): 137-160.
33. Abusamaan, M. N., et al. (2021). "Determinants of Organizational Justice and Their Relationship to the Behavior of Sportsmanship and Civilized Behavior in the Palestinian Police." International Journal of Academic Information Systems Research (IJAISR) 5(3).
34. Abusamaan, M. N., et al. (2021). "Determinants of organizational justice and their relationship to conscientious behavior from the point of view of officers working in the Palestinian police force." International Journal of Academic Accounting, Finance and Management Research(IJAAFMR) 5(2): 67-88.
35. Abusamaan, M. N., et al. (2021). "Sensing Organizational Justice and Its Relationship to Altruistic Behavior in the Palestinian Police." International Journal of Academic Accounting, Finance and Management Research(IJAAFMR) 5(3): 17-43.
36. Abu-Saqer, M. M. and S. S. Abu-Naser (2019). "Developing an Expert System for Papaya Plant Disease Diagnosis." International Journal of Academic Engineering Research (IJAER) 3(4): 14-21.
37. 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.
38. Abu-Saqer, M. M., et al. (2020). "Type of Grapefruit Classification Using Deep Learning." International Journal of Academic Information Systems Research (IJAISR) 4(1): 1-5.
39. 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.
40. Aish, M. A., et al. (2021). "Lower Back Pain Expert System Using CLIPS." International Journal of Academic Information Systems Research (IJAISR) 5(5): 57-67.
41. Aish, M. A., et al. (2022). "Classification of pepper Using Deep Learning." International Journal of Academic Engineering Research (IJAER) 6(1): 24-31.
42. Akkila, A. E.-D. N. and S. S. Abu Naser (2018). ITS-Tutor for Teaching Rules of Tajweed the Holy Quran, Al-Azhar University, Gaza, Palestine.
43. Akkila, A. N. and S. S. Abu Naser (2016). "Proposed Expert System for Calculating Inheritance in Islam." World Wide Journal of Multidisciplinary Research and Development 2(9): 38-48.
44. 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.
45. Akkila, A. N. and S. S. Abu-Naser (2018). "Rules of Tajweed the Holy Quran Intelligent Tutoring System." International Journal of Academic Pedagogical Research (IJAPR) 2(3): 7-20.
46. 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.
47. Akkila, A. N., et al. (2024). "Navigating the Ethical Landscape of Artificial Intelligence: Challenges and Solutions." International Journal of Engineering and Information Systems (IJEAIS) 8(8): 68-73.
48. 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.
49. Al Rekhawi, H. A. and S. Abu Naser (2018). "An Intelligent Tutoring System for Learning Android Applications Ui Development." International Journal of Engineering and Information Systems (IJEAIS) 2(1): 1-14.
50. Al Rekhawi, H. A. and S. S. Abu-Naser (2018). "Android Applications UI Development Intelligent Tutoring System." International Journal of Engineering and Information Systems (IJEAIS) 2(1): 1-14.
51. Al Rekhawi, H. A., et al. (2017). "Rickets Expert System Diagnoses and Treatment." International Journal of Engineering and Information Systems (IJEAIS) 1(4): 149-159.
52. Alajrami, E., et al. (2019). "Blood Donation Prediction using Artificial Neural Network." International Journal of Academic Engineering Research (IJAER) 3(10): 1-7.
53. Alajrami, E., et al. (2020). "Handwritten Signature Verification using Deep Learning." International Journal of Academic Multidisciplinary Research (IJAMR) 3(12): 39-44.
54. Alajrami, M. A. and S. S. Abu-Naser (2018). "Onion Rule Based System for Disorders Diagnosis and Treatment." International Journal of Academic Pedagogical Research (IJAPR) 2(8): 1-9.
55. Alajrami, M. A. and S. S. Abu-Naser (2019). "Grapes Expert System Diagnosis and Treatment." International Journal of Academic Engineering Research (IJAER) 3(5): 38-46.
56. Alajrami, M. A. and S. S. Abu-Naser (2020). "Type of Tomato Classification Using Deep Learning." International Journal of Academic Pedagogical Research (IJAPR) 3(12): 21-25.
57. 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.
58. Al-Araj, R. S. A., et al. (2020). "Classification of Animal Species Using Neural Network." International Journal of Academic Engineering Research (IJAER) 4(10): 23-31.
59. Alarayshi, A. M. and S. S. Abu-Naser (2023). "Artificial Neural Network for Global Smoking Trend." International Journal of Academic Information Systems Research (IJAISR) 7(9): 55-61.
60. Al-Atrash, Y. E., et al. (2020). "Modeling Cognitive Development of the Balance Scale Task Using ANN." International Journal of Academic Information Systems Research (IJAISR) 4(9): 74-81.
61. 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.
62. Al-Azbaki, M. A., et al. (2023). "Classification of plant Species Using Neural Network." International Journal of Engineering and Information Systems (IJEAIS) 7(10): 28-35.
63. Albadrasawi, S. J., et al. (2023). "Development and Evaluation of an Expert System for Diagnosing Kidney Diseases." International Journal of Academic Engineering Research (IJAER) 7(6): 16-22.
64. Al-Baghdadi, I. S. and S. S. Abu-Naser (2023). "Forecasting COVID-19 cases Using ANN." International Journal of Academic Engineering Research (IJAER) 7(10): 22-31.
65. Albanna, R. N., et al. (2023). "Colon Cancer Knowledge-Based System." International Journal of Engineering and Information Systems (IJEAIS) 7(6): 27-36.
66. Albanna, R. N., et al. (2023). "Knowledge-Based System for Diagnosing Colon Cancer." International Journal of Engineering and Information Systems (IJEAIS) 7(6): 27-36.
67. 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.
68. 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.
69. Albatish, I., et al. (2018). "ARDUINO Tutor: An Intelligent Tutoring System for Training on ARDUINO." International Journal of Engineering and Information Systems (IJEAIS) 2(1): 236-245.
70. Al-Bayed, M. H. and S. S. Abu Naser (2017). "An intelligent tutoring system for health problems related to addiction of video game playing." International Journal of Advanced Scientific Research 2(1): 4-10.
71. Al-Bayed, M. H. and S. S. Abu-Naser (2018). "Intelligent Multi-Language Plagiarism Detection System." International Journal of Academic Information Systems Research (IJAISR) 2(3): 19-34.
72. Al-Bayed, M. H., et al. (2024). "AI in Leadership: Transforming Decision-Making and Strategic Vision." International Journal of Academic Pedagogical Research (IJAPR) 8(9): 1-7.
73. Al-Borno, D. F. and S. S. Abu-Naser (2023). "A Proposed Expert System for Vertigo Diseases Diagnosis." International Journal of Academic Information Systems Research (IJAISR) 7(6): 1-9.
74. 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.
75. Aldaour, A. F. and S. S. Abu-Naser (2019). "An Expert System for Diagnosing Tobacco Diseases Using CLIPS." International Journal of Academic Engineering Research (IJAER) 3(3): 12-18.
76. Aldaour, A. F. and S. S. Abu-Naser (2019). "Anemia Expert System Diagnosis Using Sl5 Object." International Journal of Academic Information Systems Research (IJAISR) 3(5): 9-17.
77. Al-Daour, A. F., et al. (2020). "Banana Classification Using Deep Learning." International Journal of Academic Information Systems Research (IJAISR) 3(12): 6-11.
78. Aldeeb, M. H. and S. S. Abu-Naser (2023). "Breast Cancer Knowledge Based System." International Journal of Engineering and Information Systems (IJEAIS) 7(6): 46-51.
79. Aldeeb, M. H. and S. S. Abu-Naser (2023). "Knowledge Based System for Breast Cancer Diagnosis." International Journal of Engineering and Information Systems (IJEAIS) 7(6): 46-51.
80. Alfarra, A. H., et al. (2021). "An Expert System for Neck Pain Diagnosis." rnal of Academic Information Systems Research (IJAISR) 5(7): 1-8.