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Knowledge-Based System for the Diagnosis of Flatulence

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Abstract: *Diagnosing flatulence involves a thorough assessment of an individual's symptoms, medical history, and, if necessary, the use of diagnostic tests. Healthcare providers gather information about the patient's medical background and conduct a physical examination to identify any signs of gastrointestinal issues. Dietary habits are evaluated, and potential triggers are identified through an elimination diet. Diagnostic tests such as breath tests, stool analysis, or imaging studies may be performed to further investigate the underlying causes of excessive flatulence. Accurate diagnosis is crucial for effective management and treatment of flatulence, enabling individuals to gain control over their symptoms and address any underlying conditions.*

Keywords: Artificial intelligence, expert system, CLIPS

INTRODUCTION

Flatulence, characterized by excessive gas in the digestive system, is a common and often bothersome issue experienced by individuals across various age groups. While occasional flatulence is considered normal, persistent or excessive flatulence can be indicative of underlying health conditions or dietary factors that require accurate diagnosis and appropriate management. The diagnosis of flatulence is a complex task for healthcare professionals, as it involves considering multiple factors and potential causes. The conventional diagnostic approaches heavily rely on subjective assessments and limited diagnostic tools, leading to potential misdiagnoses and suboptimal treatment outcomes.

To address these challenges, there is a growing need for an effective diagnostic system that can leverage existing medical knowledge and provide accurate, timely, and personalized assessments of flatulence causes. In recent years, knowledge-based systems have emerged as powerful tools in various domains, enabling the emulation of human expertise and decision-making capabilities. By harnessing a wealth of domain-specific knowledge and employing sophisticated reasoning mechanisms, knowledge-based systems have the potential to enhance the accuracy and efficiency of flatulence diagnosis.

The objective of this paper is to develop a knowledge-based system for the diagnosis of flatulence that incorporates a comprehensive knowledge base, rule-based reasoning, and a user-friendly interface. By leveraging existing medical literature, research papers, and expert opinions, a structured knowledge base will be established, encompassing various factors that contribute to flatulence, such as different types of flatulence, common causes, dietary factors, and gastrointestinal disorders. The rule-based reasoning system will utilize this knowledge to process patient input data and determine the most probable causes of flatulence in individual cases.

Additionally, the developed knowledge-based system will provide an intuitive user interface, allowing individuals to input their symptoms and relevant information easily, while receiving accurate and understandable diagnosis reports. The system's performance and accuracy will be validated by comparing its diagnostic outputs against expert opinions or established diagnostic criteria. Feedback from healthcare professionals and users will be gathered to refine and improve the system, ensuring its alignment with clinical practices and user needs.

By addressing the limitations of current diagnostic approaches, this knowledge-based system aims to significantly contribute to the field of flatulence diagnosis. It has the potential to empower both healthcare professionals and individuals in making informed decisions regarding treatment options and lifestyle adjustments. The outcomes of this research have practical implications for improving patient care, enhancing diagnostic capabilities in gastroenterology, and potentially serving as an alternative or complementary approach to traditional diagnostic methods.

In the following sections of this paper, we will discuss the development process of the knowledge-based system, including the knowledge gathering and organization, the design and implementation of the rule-based reasoning system, the user interface, and the validation methodology. We will also present the results of the system's performance evaluation and discuss the potential impact and future directions of this research.

OBJECTIVES

- Develop a knowledge-based system framework for the diagnosis of flatulence: The primary objective is to create a comprehensive framework that utilizes a knowledge-based approach to diagnose the causes of flatulence in individuals.

- Gather and organize relevant knowledge and information: Conduct a thorough review of existing medical literature, research papers, and expert opinions to gather relevant knowledge and information about the various causes and factors contributing to flatulence.
- Create a comprehensive knowledge base: Build a structured and comprehensive knowledge base that includes information on different types of flatulence, common causes, dietary factors, gastrointestinal disorders, and other relevant factors that can contribute to excessive gas production.
- Develop a rule-based reasoning system: Design a rule-based reasoning system that can process the input data from patients and apply the gathered knowledge to determine the most probable causes of flatulence in individual cases.
- Implement an intuitive user interface: Create a user-friendly interface for the knowledge-based system, allowing users to input their symptoms and relevant information easily, while receiving accurate and understandable diagnosis reports.
- Validate the system's performance and accuracy: Evaluate the knowledge-based system by comparing its diagnostic outputs against expert opinions or established diagnostic criteria to assess its accuracy, reliability, and effectiveness in diagnosing flatulence.
- Refine and improve the system: Analyze the system's performance, gather user feedback, and refine the knowledge base and reasoning algorithms to enhance the system's diagnostic capabilities and overall user experience.

Problem statement:

Flatulence, commonly known as excessive gas in the digestive system, is a prevalent and often embarrassing issue experienced by individuals of all ages. While occasional flatulence is considered normal, persistent or excessive flatulence can be indicative of underlying health conditions or dietary factors that require accurate diagnosis and appropriate management. However, diagnosing the exact cause of flatulence can be challenging for healthcare professionals due to the wide range of potential factors involved.

Currently, the diagnosis of flatulence heavily relies on subjective assessments and limited diagnostic tools, leading to potential misdiagnoses and suboptimal treatment outcomes. There is a need for an effective diagnostic system that can leverage existing medical knowledge and provide accurate, timely, and personalized assessments of flatulence causes.

Therefore, the problem statement for this paper is to develop a knowledge-based system that can effectively diagnose the causes of flatulence by incorporating a comprehensive knowledge base, rule-based reasoning, and a user-friendly interface. The system aims to improve the accuracy and efficiency of flatulence diagnosis, empowering both healthcare professionals and individuals to make informed decisions regarding treatment and lifestyle adjustments. By addressing this problem, the paper aims to contribute to the advancement of diagnostic capabilities in the field of gastroenterology and enhance patient care in relation to flatulence management.

Expert System

Expert systems are computer-based systems that emulate the problem-solving abilities of human experts in specific domains. They utilize knowledge, rules, and reasoning mechanisms to provide expert-level advice or solutions in a particular area. Here are some examples of expert systems:

MYCIN: Developed in the 1970s, MYCIN was one of the earliest and most influential expert systems. It was designed to assist physicians in diagnosing and recommending treatments for bacterial infections, particularly in the field of infectious diseases.

DENDRAL: DENDRAL was an expert system developed in the 1960s that focused on chemical analysis and organic chemistry. It could identify unknown chemical compounds based on mass spectrometry data, providing valuable insights for chemists and researchers.

PROSPECTOR: PROSPECTOR was an expert system developed in the 1980s for mineral exploration and mining. It utilized geological data and knowledge to assist geologists in identifying potential mineral deposits and making exploration decisions.

XCON: XCON (Expert Configurer) was developed by Digital Equipment Corporation (DEC) in the 1980s. It was used for the configuration of complex computer systems, providing expertise in selecting appropriate hardware and software components based on customer requirements.

INTERNIST: INTERNIST was an expert system developed to assist physicians in diagnosing complex medical cases. It utilized a large knowledge base and a sophisticated reasoning engine to analyze patient symptoms, medical history, and lab results to propose potential diagnoses.

CADIAG-II: CADIAG-II was an expert system designed for diagnosing cardiovascular diseases. It combined patient data, symptoms, and medical knowledge to provide accurate and timely diagnoses, aiding healthcare professionals in decision-making.

CASNET: CASNET (Computer-Aided Scheduling of Navy Training and Education in Real Time) was an expert system developed for scheduling and managing training activities in the United States Navy. It considered various constraints, resources, and priorities to optimize training schedules.

SMART: The System for the Mechanical Analysis and Retrieval of Texts (SMART) was an early expert system developed for information retrieval and document management. It employed natural language processing and knowledge-based techniques to facilitate effective document searching and retrieval.

These examples demonstrate the diverse range of domains and applications where expert systems have been employed to provide specialized knowledge and decision support.

An expert system has been established that diagnoses flatulence. The expert system helps doctors and facilitates the process of detecting the disease clearly and well. The system also diagnoses flatulence by showing a list of symptoms related to flatulence. The expert system was programmed using the CLIPS language. The expert system diagnoses diseases related to flatulence through a system consisting of some lists that make it easier for the user to use.

At first, a user interface will appear that contains four tasks. If the user clicks on the "Start" icon, the user will see an interface that contains a list of all the symptoms. The user will choose all the symptoms related to the disease he wants.

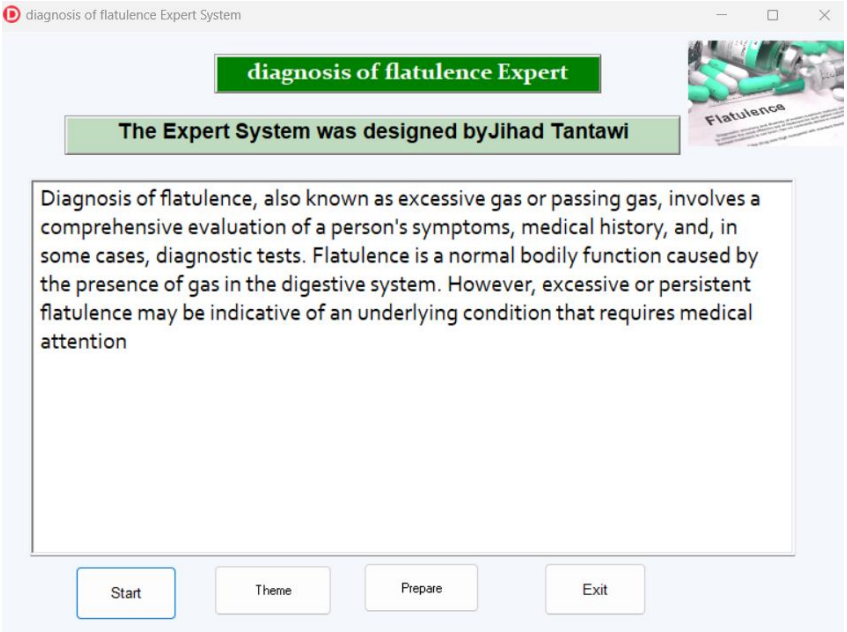

Figure 1 : user interface

Then appear list about destination diagnosis to show the symptoms for the user to choose the symptoms that will be treatment

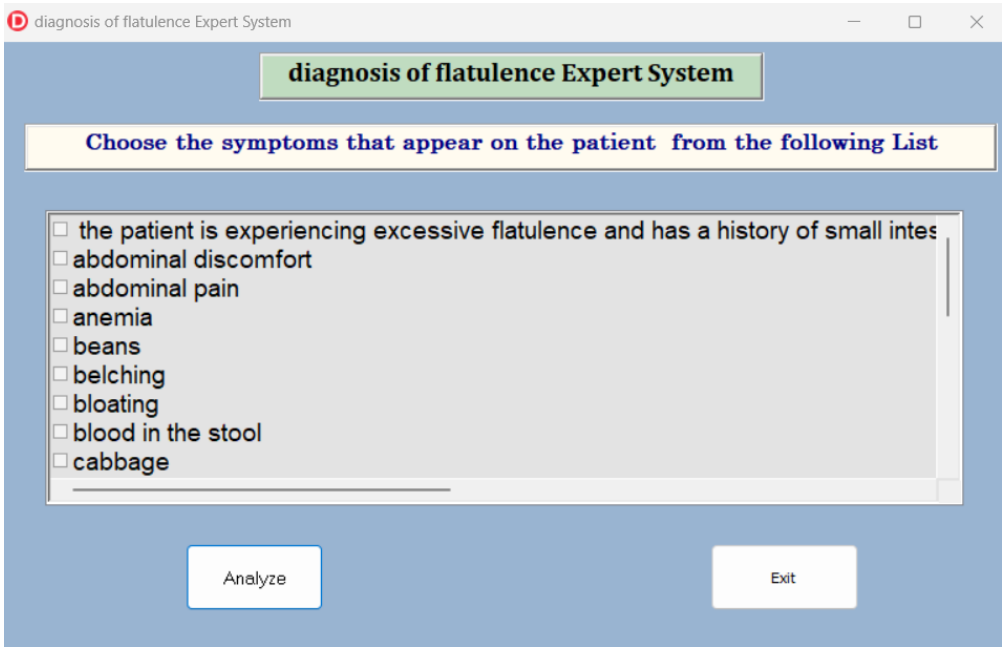

Figure 2: Symptom list

Then appear list about destination analyze to show the symptoms for the user to show the Favorable Conditions and Survival and spread.

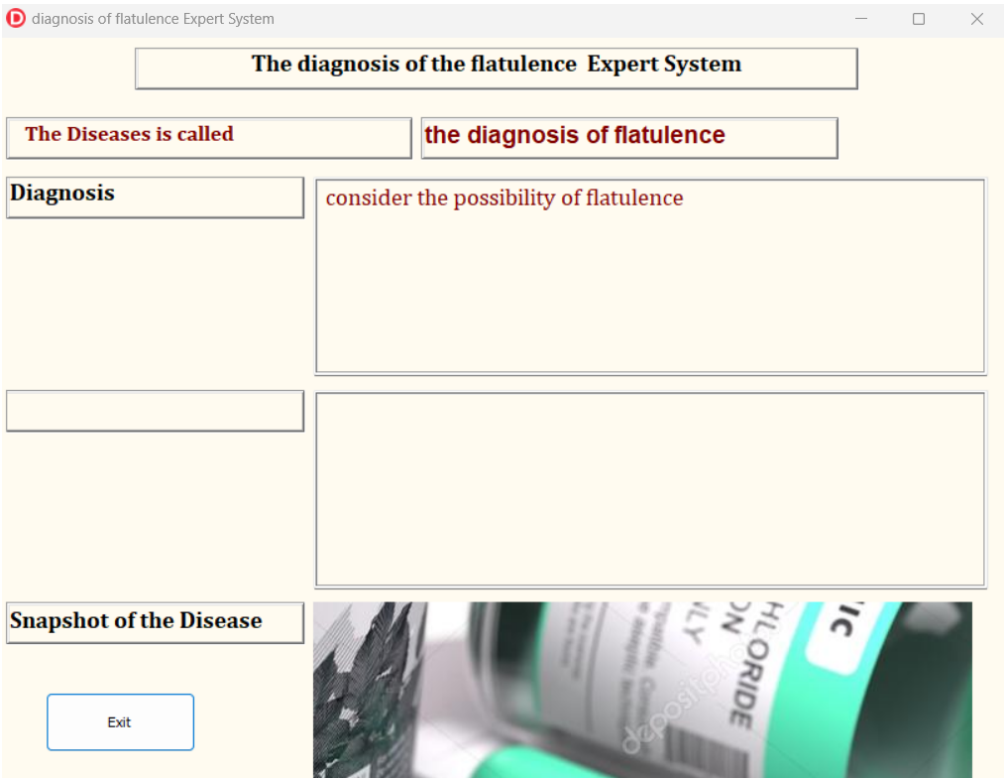

Figure 3 : Diagnosis of the disease

LITERATURE REVIEW:

Previous Studies

Previous studies on the diagnosis of flatulence have highlighted the importance of assessing symptoms, conducting dietary assessments, implementing elimination diets, and utilizing diagnostic tests such as breath tests and stool analysis. These studies emphasize the need to carefully evaluate symptoms associated with flatulence, identify dietary triggers, and use diagnostic tools to diagnose underlying conditions such as carbohydrate malabsorption or gut microbiota imbalances. While imaging studies are less commonly used, they may be considered in specific cases to evaluate the gastrointestinal tract. Further research in this area continues to contribute to our understanding of the diagnosis of flatulence.

Comments about previous studies

Although, there are many expert systems in Medicine field, there are no expert system for diagnosing flatulence diseases. That is why we are proposing expert system for diagnosing and treating flatulence problems.

KNOWLEDGE REPRESENTATION

There seven diseases to be diagnosed that are represented using CLIPS expert system language [1]:

Rules for the diagnosis of flatulence diseases:

1. IF a patient reports excessive gas production or passing gas more than usual THEN consider the possibility of flatulence.
2. IF the flatulence is accompanied by bloating, abdominal discomfort, or belching THEN consider the possibility of dyspepsia or gastroesophageal reflux disease (GERD).
3. IF the patient has a history of lactose intolerance or irritable bowel syndrome (IBS) THEN consider the possibility of flatulence related to these conditions.
4. IF the flatulence is associated with changes in bowel habits or diarrhea THEN consider the possibility of malabsorption syndromes such as celiac disease or pancreatic insufficiency.
5. IF the patient is taking medications that can cause flatulence such as fiber supplements or antibiotics THEN consider the possibility of medication-induced flatulence.
6. IF the patient has a history of gastric surgery or intestinal obstruction THEN consider the possibility of post-surgical or obstructive flatulence.
7. IF the flatulence is accompanied by other symptoms such as weight loss, anemia, or blood in the stool THEN consider the possibility of a more serious underlying condition such as inflammatory bowel disease or colorectal cancer.
8. If the patient has a history of digestive disorders, such as inflammatory bowel disease or irritable bowel syndrome, and is experiencing excessive flatulence, then the diagnosis of flatulence is likely.
9. If the patient has a diet high in gas-producing foods, such as beans, cabbage, onions, and carbonated beverages, and is experiencing excessive flatulence, then the diagnosis of flatulence is likely.
10. If the patient is experiencing excessive flatulence along with other gastrointestinal symptoms, such as abdominal pain, bloating, and diarrhea, then further evaluation may be needed to rule out underlying digestive disorders.
11. If the patient is experiencing excessive flatulence and has a history of lactose intolerance, then lactose intolerance may be the cause of the flatulence.
12. If the patient is experiencing excessive flatulence and has a history of small intestinal bacterial overgrowth (SIBO), then SIBO may be the cause of the flatulence.

Conclusion:

The diagnosis of flatulence involves a comprehensive evaluation of symptoms, medical history, and diagnostic tests. Symptoms such as bloating, belching, and abdominal pain are assessed to differentiate normal flatulence from excessive or pathological conditions. Dietary assessment and elimination diets help identify specific triggers. Diagnostic tests such as breath tests and stool analysis may be used to evaluate carbohydrate malabsorption and gut microbiota imbalances. Accurate diagnosis is crucial for effective treatment and improving the individual's well-being. Continued research contributes to our understanding of diagnostic approaches for flatulence.

Future Work

Integration of machine learning techniques: Incorporate machine learning algorithms, such as supervised learning or clustering, to enhance the diagnostic capabilities of the knowledge-based system. By analyzing patterns and correlations in large datasets of patient symptoms and outcomes, the system could learn and adapt its diagnostic rules, leading to improved accuracy and efficiency.

Expansion of the knowledge base: Continuously update and expand the knowledge base of the system to include emerging research, new diagnostic criteria, and additional factors that contribute to flatulence. This could involve incorporating information from ongoing medical studies, expert opinions, and patient feedback to ensure the system remains up to date with the latest knowledge in the field.

Incorporation of patient-specific data: Explore the integration of patient-specific data, such as medical history, diet logs, and lifestyle factors, to further personalize the diagnosis. By considering individual characteristics and circumstances, the system can provide more tailored recommendations and treatment plans for managing flatulence.

Integration with electronic health records (EHR) systems: Develop interfaces or interoperability with existing EHR systems to seamlessly integrate the knowledge-based system into clinical workflows. This integration would enable healthcare professionals to access and utilize the diagnostic capabilities of the system within their routine practice, improving efficiency and accuracy of flatulence diagnosis.

User interface enhancements: Gather user feedback and conduct usability studies to identify areas for improvement in the user interface of the knowledge-based system. Enhance the system's usability, intuitiveness, and accessibility to ensure a positive user experience for both healthcare professionals and individuals seeking diagnosis.

Validation studies and clinical trials: Conduct rigorous validation studies and clinical trials to assess the performance, accuracy, and clinical utility of the knowledge-based system. Compare its diagnostic outcomes with those of healthcare professionals and established diagnostic criteria to further validate its effectiveness and reliability.

Application in telemedicine and remote healthcare: Explore the integration of the knowledge-based system into telemedicine platforms or remote healthcare applications. This would enable individuals to access the diagnostic capabilities of the system from the comfort of their homes, facilitating remote consultations and improving access to expert-level diagnosis for individuals in remote or underserved areas.

Collaboration with healthcare professionals: Foster collaboration with healthcare professionals, including gastroenterologists and primary care physicians, to gather real-world insights and expertise in flatulence diagnosis. Engage in partnerships or collaborative studies to refine and validate the system, ensuring its alignment with clinical practices and needs.

By focusing on these future works, the knowledge-based system for the diagnosis of flatulence can be further enhanced, contributing to improved diagnostic accuracy, personalized treatment recommendations, and enhanced patient care in relation to flatulence management.

References:

1. Abunasser, B.S., Al-Hiealy, M.R.J., Zaqout, I.S., Abu-Naser, S.S. Literature review of breast cancer detection using machine learning algorithms, AIP Conference Proceedings, 2023, 2808
2. Al-Zamily, J.Y.I., Ariffin, S.B., Abu Naser, S.S.M. A survey of cryptographic algorithms with deep learning, AIP Conference Proceedings, 2023, 2808, 050002
3. Barhoom, A.M.A., Jubair, M.R., Abu-Naser, S.S. A survey of bone abnormalities detection using machine learning algorithms, AIP Conference Proceedings, 2023, 2808, 040009
4. Abunasser, B. S. Daud,S. M., Zaqout, I., Abu-Naser S. S. Abunaser - A Novel Data Augmentation Algorithm For Datasets With Numerical Features. Journal of Theoretical and Applied Information Technology, 2023, Vol. 101. No. 11.
5. Alrakhawi, H. A., Jamiat, N., Umar, I. N., Abu-Naser, S. S. Improvement of Students Achievement by Using Intelligent Tutoring Systems - A Bibliometric Analysis and Reviews. Journal of Theoretical and Applied Information Technology, 2023, Vol. 101. No. 11.
6. Abunasser, B.S., Al-Hiealy, M.R.J., Zaqout, I.S., Abu-Naser, S.S. Convolution Neural Network for Breast Cancer Detection and Classification Using Deep Learning. Asian Pacific journal of cancer prevention: APJCP, 2023, 24(2), pp. 531–544
7. Alrakhawi, H. A., Jamiat, N., Abu-Naser, S. S. Intelligent Tutoring Systems in Education: A Systematic Review of Usage, Tools, Effects and Evaluation. Journal of Theoretical and Applied Information Technology, 2023, Vol. 101. No. 4, pp. 1205-1226.
8. Zarandah, Q. M. M., Daud, S. M., Abu-Naser, S. S. A Systematic Literature Review Of Machine and Deep Learning-Based Detection And Classification Methods for Diseases Related To the Respiratory System, Journal of Theoretical and Applied Information Technology, 2023, Vol. 101. No. 4, pp. 1273-1296.
9. Alkayyali, Z. K. D., Idris, S. A. B, Abu-Naser, S. S. A Systematic Literature Review of Deep and Machine Learning Algorithms in Cardiovascular Diseases Diagnosis, Journal of Theoretical and Applied Information Technology, 2023, Vol. 101. No. 4, pp. 1353-1365.
10. Abunasser, B. S. Daud,S. M., Zaqout,I., Abu-Naser S. S. Convolution Neural Network For Breast Cancer Detection And Classification - Final Results. Journal of Theoretical and Applied Information Technology, 2023, Vol. 101. No. 1, pp. 315-329.
11. Taha, A. M. H., Ariffin, D. S. B. B., Abu-Naser, S. S. A Systematic Literature Review of Deep and Machine Learning Algorithms in Brain Tumor and Meta-Analysis, Journal of Theoretical and Applied Information Technology, 2023, Vol. 101. No. 1, pp. 21-36.
12. Abu Ghosh, M.M., Atallah, R.R., Abu Naser, S.S. Secure mobile cloud computing for sensitive data: Teacher services for Palestinian higher education institutions. International Journal of Grid and Distributed Computing, 2016, vol. 9, no. 2, pp. 17–22
13. Abunasser, B. S., AL-Hiealy, M. R. J., Zaqout, I. S. and Abu-Naser, S. S. “Breast Cancer Detection and Classification using Deep Learning Xception Algorithm” International Journal of Advanced Computer Science and Applications(IJACSA), 13(7),223-228, 2022.
14. Abunasser, B.S., AL-Hiealy, M.R. J., Barhoom, A. M. Almasri A. R. and Abu-Naser, S. S. “Prediction of Instructor Performance using Machine and Deep Learning Techniques” International Journal of Advanced Computer Science and Applications(IJACSA), 13(7), 78-83, 2022.
15. Alayoubi, M.M., Arekat, Z.M., Al Shobaki, M.J., Abu-Naser, S.S. The Impact of Work Stress on Job Performance Among Nursing Staff in Al-Awda Hospital. Foundations of Management, 2022, 14(1), pp. 87–108
16. Albatish, I.M., Abu-Naser, S.S. Modeling and controlling smart traffic light system using a rule based system. Proceedings - 2019 International Conference on Promising Electronic Technologies, ICPET 2019, 2019, pp. 55–60, 8925318
17. Almasri, A., Obaid, T., Abumandil, M.S.S., ...Mahmoud, A.Y., Abu-Naser, S.S. Mining Educational Data to Improve Teachers’ Performance. Lecture Notes in Networks and Systems, 2023, 550 LNNS, pp. 243–255
18. Almasri, A.R., Yahaya, N.A., Abu-Naser, S.S. Instructor Performance Modeling For Predicting Student Satisfaction Using Machine Learning - Preliminary Results. Journal of Theoretical and Applied Information Technology, 2022, 100(19), pp. 5481–5496
19. Arqawi, S., Atieh, K.A.F.T., Shobaki, M.J.A.L., Abu-Naser, S.S., Abu Abdulla, A.A.M. Integration of the dimensions of computerized health information systems and their role in improving administrative performance in Al-Shifa medical complex, Journal of Theoretical and Applied Information Technology, 2020, vol. 98, no. 6, pp. 1087–1119
20. Arqawi, S.M., Abu Rumman, M.A., Zitawi, E.A., ...Abunasser, B.S., Abu-Naser, S.S. Predicting Employee Attrition And Performance Using Deep Learning. Journal of Theoretical and Applied Information Technology, 2022, 100(21), pp. 6526–6536
21. Arqawi, S.M., Zitawi, E.A., Rabaya, A.H., Abunasser, B.S., Abu-Naser, S.S., “Predicting University Student Retention using Artificial Intelligence”, International Journal of Advanced Computer Science and Applications , 2022, vol. 13, no. 9, pp. 315–324
22. Barhoom, A.M.A., Al-Hiealy, M.R.J., Abu-Naser, S.S. Bone Abnormalities Detection and Classification Using Deep Learning-VGG16 Algorithm. Journal of Theoretical and Applied Information Technology, 2022, 100(20), pp. 6173–6184
23. Barhoom, A.M.A., Al-Hiealy, M.R.J., Abu-Naser, S.S. Deep Learning-Xception Algorithm for Upper Bone Abnormalities Classification. Journal of Theoretical and Applied Information Technology, 2022, 100(23), pp. 6986–6997
24. El-Habil, B.Y., Abu-Naser, S.S. Global Climate Prediction Using Deep Learning. Journal of Theoretical and Applied Information Technology, 2022, 100(24), pp. 4824–4838
25. Eneizan, B., Obaid, T., Abumandil, M.S.S., ...Arif, K., Abulehia, A.F.S. Acceptance of Mobile Banking in the Era of COVID-19. Lecture Notes in Networks and Systems, 2023, 550 LNNS, pp. 29–42
26. Alzamily, J. Y. I., Ariffin, S. B., Abu-Naser, S. S. Classification of Encrypted Images Using Deep Learning –Resnet50. Journal of Theoretical and Applied Information Technology, 2022, 100(21), pp. 6610–6620
27. Mady, S.A., Arqawi, S.M., Al Shobaki, M.J., Abu-Naser, S.S. Lean manufacturing dimensions and its relationship in promoting the improvement of production processes in industrial companies. International Journal on Emerging Technologies, 2020, vol. 11, no. 3, pp. 881–896
28. Obaid, T., Eneizan, B., Naser, S.S.A., ...Abualrejal, H.M.E., Gazem, N.A. Factors Contributing to an Effective E- Government Adoption in Palestine. Lecture Notes on Data Engineering and Communications Technologies, 2022, 127, pp. 663–676
29. Obaid, T., Eneizan, B., Abumandil, M.S.S., ...Abu-Naser, S.S., Ali, A.A.A. Factors Affecting Students’ Adoption of E-Learning Systems During COVID-19 Pandemic: A Structural Equation Modeling Approach. Lecture Notes in Networks and Systems, 2023, 550 LNNS, pp. 227–242
30. Saleh, A., Sukaik, R., Abu-Naser, S.S. Brain tumor classification using deep learning. Proceedings - 2020 International Conference on Assistive and Rehabilitation Technologies, iCareTech 2020, 2020, pp. 131–136, 9328072
31. Abueleiwa, M. H., et al. (2022). "Rule Based System for Diagnosing Bean Diseases and Treatment." International Journal of Engineering and Information Systems (IJEAIS) 6(5): 67-74.
32. Abu-Jamie, T. N., et al. (2021). "Diagnosing Cough Problem Expert System Using CLIPS." International Journal of Academic Information Systems Research (IJAISR) 5(5): 79-90.
33. Abu-Saqer, M. M., et al. (2019). "Developing an Expert System for Papaya Plant Disease Diagnosis." International Journal of Academic Engineering Research (IJAER) 3(4): 14-21.
34. Abu-Saqer, M. M., et al. (2019). "Knowledge Based System for Uveitis Disease Diagnosis." International Journal of Academic Information Systems Research (IJAISR) 3(5): 18-25.
35. 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.
36. Alfarra, A. H., et al. (2021). "An Expert System for Neck Pain Diagnosis." International Journal of Academic Information Systems Research (IJAISR) 5(7): 1-8.
37. Al-Ghoul, M. M., et al. (2022). "Knowledge Based System for Diagnosing Custard Apple Diseases and Treatment." International Journal of Academic Engineering Research (IJAER) 6(5): 41-45.
38. Alkahlout, M. A., et al. (2021). "Expert System Diagnosing Facial-Swelling Using CLIPS."
39. Alkahlout, M. A., et al. (2021). "Expert System for Throat Problems Using SL5 Object." International Journal of Academic Information Systems Research (IJAISR) 5(5): 68-78.
40. Alkahlout, M. A., et al. (2021). "Knowledge Based System for Diagnosing Throat Problem CLIPS and Delphi languages." International Journal of Academic Engineering Research (IJAER) 5(6): 7-12.
41. AlKayyali, Z. K., et al. (2022). "Prediction of Student Adaptability Level in e-Learning using Machine and Deep Learning Techniques." International Journal of Academic and Applied Research (IJAAR) 6(5): 84-96.
42. Almadhoun, H. R., et al. (2020). "An Expert System for Diagnosing Coronavirus (COVID-19) Using SL5." International Journal of Academic Engineering Research (IJAER) 4(4): 1-9.
43. Al-Masawabe, M. M., et al. (2021). "Expert System for Short-term Abdominal Pain (Stomach Pain) Diagnosis and Treatment." International Journal of Academic Information Systems Research (IJAISR) 5(5): 37-56.
44. Al-Qadi, M. H., et al. (2022). "Developing an Expert System to Diagnose Tomato Diseases." International Journal of Academic Engineering Research (IJAER) 6(5): 34-40.
45. AlQatrawi, M. J., et al. (2022). "Rule Based System for Diagnosing Lablab Problems." International Journal of Academic and Applied Research (IJAAR) 6(5): 249-256.
46. Al-Saloul, N. J., et al. (2022). "A Knowledge Based System for Cucumber Diseases Diagnosis." International Journal of Academic Information Systems Research (IJAISR) 6(5): 29-45.
47. Alsaqqa, A. H., et al. (2021). "Knowledge Based for Tooth Problems." International Journal of Academic Information Systems Research (IJAISR) 5(5).
48. Barhoom, A. M., et al. (2022). "Prediction of Heart Disease Using a Collection of Machine and Deep Learning Algorithms." International Journal of Engineering and Information Systems (IJEAIS) 6(4): 1-13.
49. Barhoom, A., et al. (2022). "Sarcasm Detection in Headline News using Machine and Deep Learning Algorithms." International Journal of Engineering and Information Systems (IJEAIS) 6(4): 66-73.
50. Dheir, I. M. and S. S. Abu-Naser (2022). "Classification of Anomalies in Gastrointestinal Tract Using Deep Learning." International Journal of Academic Engineering Research (IJAER) 6(3): 15-28.
51. Dheir, I., et al. (2019). "Knowledge Based System for Diagnosing Guava Problems." International Journal of Academic Information Systems Research (IJAISR) 3(3): 9-15.
52. El-Habibi, M. F., et al. (2022). "A Proposed Expert System for Obstetrics & Gynecology Diseases Diagnosis." International Journal of Academic Multidisciplinary Research (IJAMR) 6(5): 305-321.
53. Elhabil, B. Y., et al. (2021). "An Expert System for Ankle Problems." International Journal of Engineering and Information Systems (IJEAIS) 5(4).
54. Elhabil, B. Y., et al. (2021). "Expert System for Hib Problems."
55. El-Hamarnah, H. A., et al. (2022). "Proposed Expert System for Pear Fruit Diseases." International Journal of Academic and Applied Research (IJAAR) 6(5): 237-248.
56. Hamadaqa, M. H. M., et al. (2021). "Hair Loss Diagnosis Expert System and Treatment Using CLIPS." International Journal of Academic Engineering Research (IJAER) 5(5): 37-42.
57. Khalil, A. J., et al. (2019). "Apple Trees Knowledge Based System." International Journal of Academic Engineering Research (IJAER) 3(9): 1-7.
58. LAfi, O. I., et al. (2022). "A Proposed Expert System for Broccoli Diseases Diagnosis." International Journal of Engineering and Information Systems (IJEAIS) 6(5): 43-51.
59. Mansour, A. I. and S. S., et al. (2021). "Expert system for the diagnosis of high blood pressure diseases."
60. Mansour, A. I., et al. (2021). "An Expert System for Diagnosing Cough Using SL5 Object." International Journal of Academic Engineering Research (IJAER) 5(6): 13-27.
61. Masri, N., et al. (2019). "Survey of Rule-Based Systems." International Journal of Academic Information Systems Research (IJAISR) 3(7): 1-23.
62. Megdad, M. M., et al. (2022). "Fraudulent Financial Transactions Detection Using Machine Learning." International Journal of Academic Information Systems Research (IJAISR) 6(3): 30-39.
63. Megdad, M. M., et al. (2022). "Mint Expert System Diagnosis and Treatment." International Journal of Academic Information Systems Research (IJAISR) 6(5): 22-28.
64. Obaid, T., et al. (2022). Factors Contributing to an Effective E-Government Adoption in Palestine. International Conference of Reliable Information and Communication Technology, Springer, Cham.
65. Radwan, H. I., et al. (2022). "A Proposed Expert System for Passion Fruit Diseases." International Journal of Academic Engineering Research (IJAER) 6(5): 24-33.
66. Sababa, R. Z., et al. (2022). "A Proposed Expert System for Strawberry Diseases Diagnosis." International Journal of Engineering and Information Systems (IJEAIS) 6(5): 52-66.
67. Salman, F. M. and S. S. Abu-Naser (2022). "Classification of Real and Fake Human Faces Using Deep Learning." International Journal of Academic Engineering Research (IJAER) 6(3): 1-14.
68. Samhan, L. F., et al. (2021). "Expert System for Knee Problems Diagnosis." International Journal of Academic Information Systems Research (IJAISR) 5(4):59-66.
69. Samhan, L. F., et al. (2022). "Classification of Alzheimer's Disease Using Convolutional Neural Networks." International Journal of Academic Information Systems Research (IJAISR) 6(3): 18-23.
70. Taha, A. M., et al. (2022). "Gender Prediction from Retinal Fundus Using Deep Learning." International Journal of Academic Information Systems Research (IJAISR) 6(5): 57-63.