

Lung Cancer Detection Using Artificial Neural Network

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Abstract: *In this paper, we developed an Artificial Neural Network (ANN) for detect the absence or presence of lung cancer in human body. Symptoms were used to diagnose the lung cancer, these symptoms such as Yellow fingers, Anxiety, Chronic Disease, Fatigue, Allergy, Wheezing, Coughing, Shortness of Breath, Swallowing Difficulty and Chest pain. They were used and other information about the person as input variables for our ANN. Our ANN established, trained, and validated using data set, which its title is "survey lung cancer". Model evaluation showed that the ANN model is able to detect the absence or presence of lung cancer with 96.67 % accuracy.*

Keywords: Data Mining, Machine Learning, Classification, Predictive Analysis, Artificial Neural Networks, Lung Cancer, Cancer Diagnosis

1. INTRODUCTION

Cancer is a wide term. It labels the illness that outcome once cellular changes cause the uncontrolled growth and division of cells. Most of the body's cells have particular functions and fixed lifetimes. However, cell death is part of a natural phenomenon called apoptosis. A cell takes directions to die so that the body can substitute it with a newer one that functions better. Cancerous cells lack the mechanisms that train them to stop dividing and to die. Thus, they grow in the body, using oxygen and nutrients that would usually feed other cells. Cancerous cells can form tumors, damage the immune system and cause other deviations that prevent the body from functioning right. [1] Lung cancer is a malignant lung tumor considered by uncontrolled cell growth in lung tissues [2]. Lung cancer is the primary cause of cancer-related death. [1]

The primary goal of our research is to diagnose the presence of lung cancer cells based on attributes, which are set of human symptoms, and information. The study explores the possibility of using an Artificial Neural Network model to detect the presence of a lung cancer in someone's body. The purposes of this study are:

- To recognize some appropriate factors that cause lung cancer
- To model an Artificial Neural Network that can be used to detect the presence of lung cancer

Artificial neural networks (ANNs) are alike to our neural networks and offer a quite good technique, which solves the problem of classification and prediction [3]. An ANN is a mathematical model that is encouraged by the organization and functional feature of natural neural networks[4], Neural networks involve input and output layers, as well as (in most cases) hidden layers that transform the input into something so the output layer can use [5]. When a neural network used for cancer detections, the ANN Model go through two levels, training and validation. First, the network is trained on a dataset. Then the weights of the connections between neurons are fixed so the network is validated to determine the classifications of a new dataset [6]. ANN Architecture is shown in figure 1. In this paper, we used about 80% of the total sample data for network training, and 20% for network validation.

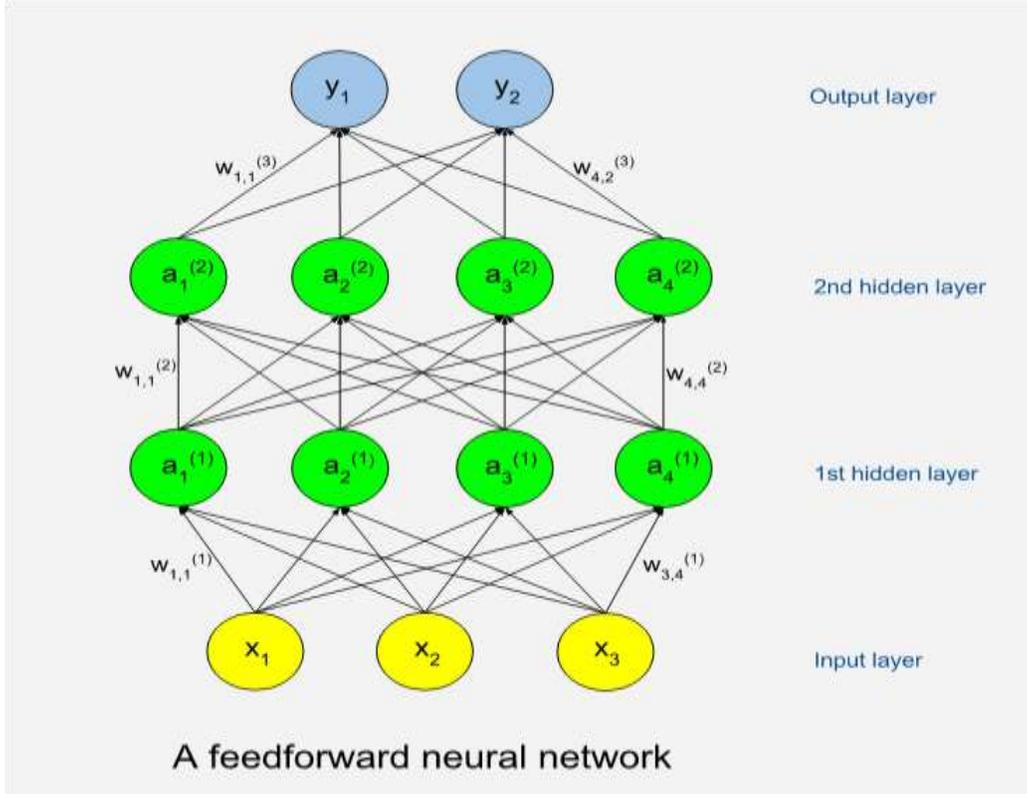


Figure 1: ANN Architecture

1. Literature Review

Nasser, Ibrahim M., et.al did researches in this field and build a lot of Neural network based models for the purpose of classification, prediction, and diagnosing.

They proposed an ANN to predict the category of movie’s rate [7], predict the price range of mobile phone [8], predict the category of animal [9], diagnose the category of tumor [10], and for diagnose Autism [11].

Abu Naser et.al. developed many classification models based on artificial neural network [12 – 26].

Moreover, Senthil and B. Ayshwarya [27] published a paper titled “Lung Cancer Prediction using Feed Forward Back Propagation Neural Networks with Optimal Features” and the accuracy of their neural network model was 91.5%.

2. Methodology

We downloaded a data set that contains persons information that have lung cancer and that have not. This dataset created by the user *sta427ceyin* on data world website [28].

We did some preprocessing on the data, and then we trained our ANN model and validated it.

3. Dataset Description

Table 1: Original Dataset attributes description

#	Attribute	Scope
1.	Gender	M(male), F(female)
2.	Age	Age of the patient
3.	Smoking	YES=2, NO=1.
4.	Yellow fingers	YES=2, NO=1.
5.	Anxiety	YES=2, NO=1.
6.	Peer pressure	YES=2, NO=1.
7.	Chronic Disease	YES=2, NO=1.

8.	Fatigue	YES=2, NO=1.
9.	Allergy	YES=2, NO=1.
10.	Wheezing	YES=2, NO=1.
11.	Alcohol	YES=2, NO=1.
12.	Coughing	YES=2, NO=1.
13.	Shortness of Breath	YES=2, NO=1.
14.	Swallowing Difficulty	YES=2, NO=1.
15.	Chest pain	YES=2, NO=1.
16.	Lung Cancer	YES, NO.

4. Dataset Preprocessing and Transformation

We did some preprocessing and transformation so the data is more suitable for predictive analysis. We used the first 14 attributes as inputs to our model and the lung cancer attribute as the predicted output based on the input attributes. We normalized the values of the attributes: gender, age, lung cancer. Gender scope becomes 0 (male) , 1 (female), lung cancer scope becomes 1 (yes) , 0 (No). However, age attribute normalized to become real because that is better for ANN. Age normalization formula was

$$new\ value = \frac{(old\ value - Min(a_1... a_n))}{(Max(a_1... a_n) - Min(a_1... a_n))}$$

5. The Neural Network

The resulted ANN Model is shown in figure (2).

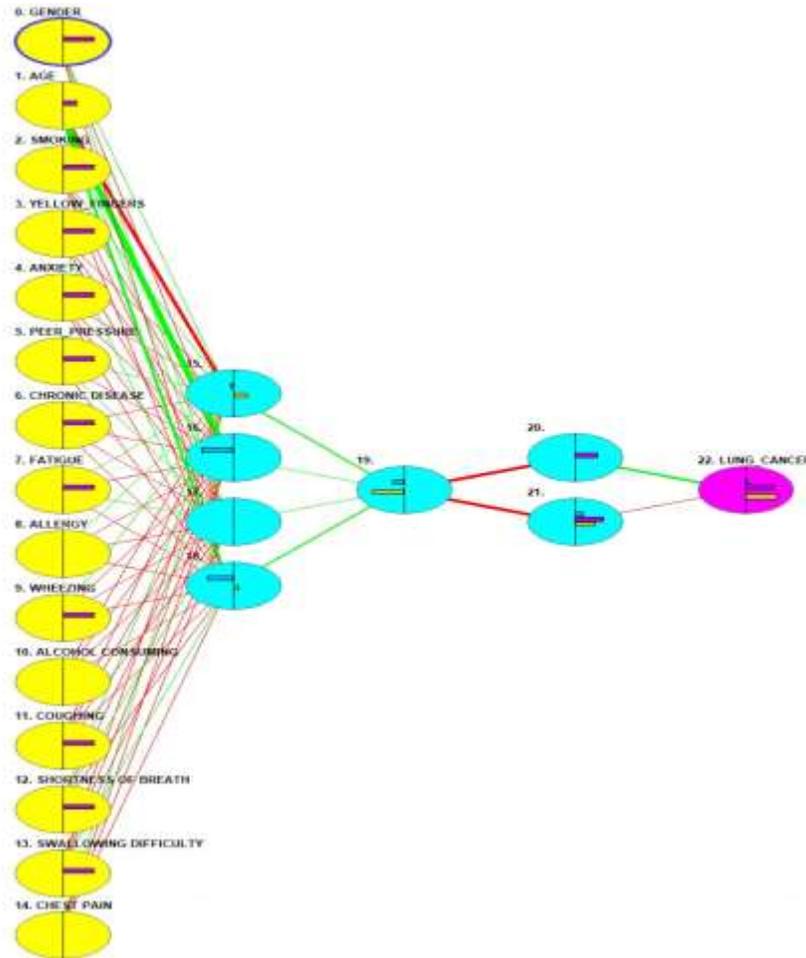


Figure 2: Our ANN Model

6. Results

Our ANN model was able to predict the presence of lung cancer with 96.67% accuracy, after 1418105 learning cycles with less than 1% training error rate as seen in figure (3). In addition, Our Model showed that the most attribute that has effect on the lung cancer presence is age. More details are shown in figure (4).

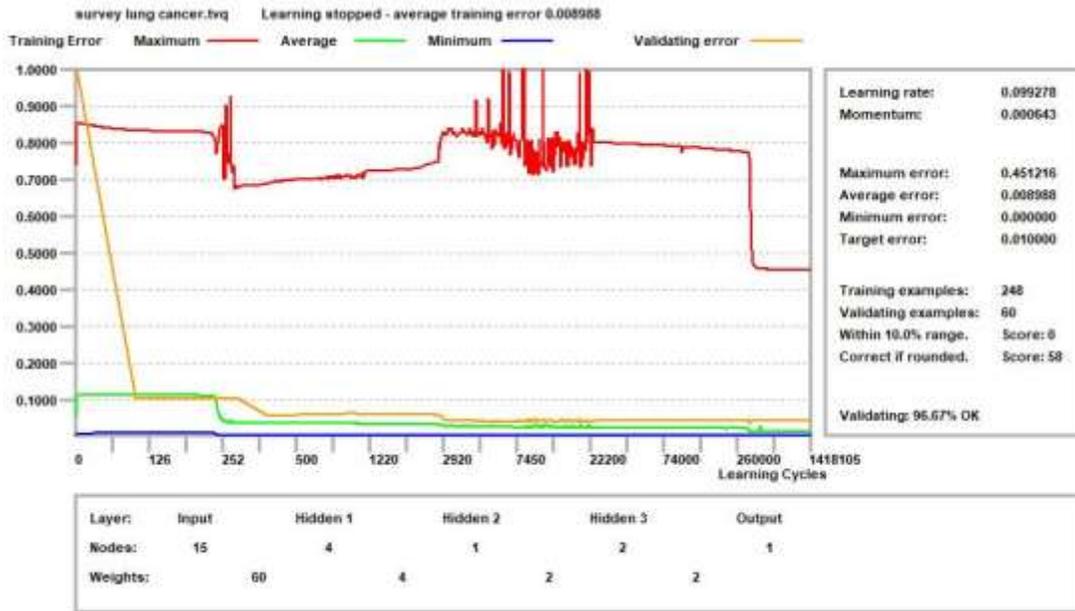


Figure 3: Validation and errors rates

survey lung cancer.tvq 1418105 cycles. Target error 0.0100 Average training error 0.008988

The first 15 of 15 Inputs in descending order.



Figure 4: Attributes Importance

7. Conclusion

An artificial Neural Network for diagnose the presence or absence of lung cancer in human body movie was developed. The model was validated; it was 96.67 accurate. This study showed that the neural network is able to diagnose lung cancer, so it can used as a diagnose tool by doctors.

REFERENCES

- [1] R. Nall, "Medical News Today," 12 11 2018. [Online]. Available: <https://www.medicalnewstoday.com/articles/323648.php>. [Accessed 14 3 2019].
- [2] cancer.gov, "National Cancer Institute," 7 2 2019. [Online]. Available: <https://www.cancer.gov/types/lung/patient/non-small-cell-lung-treatment-pdq>. [Accessed 14 3 2019].
- [3] Nasser, I. M., Al-Shawwa, M., & Abu-Naser, S. S. (2019). A Proposed Artificial Neural Network for Predicting Movies Rates Category. *International Journal of Academic Engineering Research (IJAER)*, 3(2).
- [4] Nasser, I. M., & Abu-Naser, S. S. (2019). Predicting Tumor Category Using Artificial Neural Networks. *International Journal of Academic Health and Medical Research (IJAHMR)*, 3(2).
- [5] L. Dormehl, "Digital Trends," 5 1 2019. [Online]. Available: <https://www.digitaltrends.com/cool-tech/what-is-an-artificial-neural-network/>. [Accessed 15 3 2019].
- [6] I. E. Livieris, K. Drakopoulou and P. Pintelas, "Predicting students' performance using artificial neural networks," in 8th PanHellenic Conference with International Participation Information and Communication Technologies in Education, Volos, Greece, 2012.
- [7] Nasser, I. M., & Abu-Naser, S. S. (2019). Artificial Neural Network for Predicting Animals Category. *International Journal of Academic and Applied Research (IJAAR)*, 3(2).
- [8] Nasser, I. M., Al-Shawwa, M., & Abu-Naser, S. S. (2019). Developing Artificial Neural Network for Predicting Mobile Phone Price Range. *International Journal of Academic Information Systems Research (IJASIR)*, 3(2).
- [9] Nasser, I. M., Al-Shawwa, M., & Abu-Naser, S. S. (2019). Artificial Neural Network for Diagnose Autism Spectrum Disorder. *International Journal of Academic Information Systems Research (IJASIR)*, 3(2).
- [10] Marouf, A., & Abu-Naser, S. S. (2018). Predicting Antibiotic Susceptibility Using Artificial Neural Network. *International Journal of Academic Pedagogical Research (IJAPR)*, 2(10), 1-5.
- [11] Al-Shawwa, M., & Abu-Naser, S. S. (2019). Predicting Birth Weight Using Artificial Neural Network. *International Journal of Academic Health and Medical Research (IJAHMR)*, 3(1), 9-14.
- [12] Afana, M., Ahmed, J., Harb, B., Abu-Nasser, B. S., & Abu-Naser, S. S. (2018). Artificial Neural Network for Forecasting Car Mileage per Gallon in the City. *International Journal of Advanced Science and Technology*, 124, 51-59.
- [13] Al-Mubayyed, O. M., Abu-Nasser, B. S., & Abu-Naser, S. S. (2019). Predicting Overall Car Performance Using Artificial Neural Network. *International Journal of Academic and Applied Research (IJAAR)*, 3(1), 1-5.
- [14] El_Jerjawi, N. S., & Abu-Naser, S. S. (2018). Diabetes Prediction Using Artificial Neural Network. *International Journal of Advanced Science and Technology*, 124, 1-10.
- [15] Kashf, D. W. A., Okasha, A. N., Sahyoun, N. A., El-Rabi, R. E., & Abu-Naser, S. S. (2018). Predicting DNA Lung Cancer using Artificial Neural Network. *International Journal of Academic Pedagogical Research (IJAPR)*, 2(10), 6-13.
- [16] Al-Shawwa, M., & Abu-Naser, S. S. (2019). Predicting Effect of Oxygen Consumption of Thylakoid Membranes (Chloroplasts) from Spinach after Inhibition Using Artificial Neural Network. *International Journal of Academic Engineering Research (IJAER)*, 3(2).
- [17] Alghoul, A., Al Ajrami, S., Al Jarousha, G., Harb, G., & Abu-Naser, S. S. (2018). Email Classification Using Artificial Neural Network. *International Journal of Academic Engineering Research (IJAER)*, 2(11), 8-14.
- [18] Heriz, H. H., Salah, H. M., Abdu, S. B. A., El Sbihi, M. M., & Abu-Naser, S. S. (2018). English Alphabet Prediction Using Artificial Neural Networks. *International Journal of Academic Pedagogical Research (IJAPR)*, 2(11), 8-14.
- [19] Salah, M., Altalla, K., Salah, A., & Abu-Naser, S. S. (2018). Predicting Medical Expenses Using Artificial Neural Network. *International Journal of Engineering and Information Systems (IJEAIS)*, 2(20), 11-17.
- [20] Jamala, M. N., & Abu-Naser, S. S. (2018). Predicting MPG for Automobile Using Artificial Neural Network Analysis. *International Journal of Academic Information Systems Research (IJASIR)*, 2(10), 5-21.
- [21] Alkronz, E. S., Moghayer, K. A., Meimeh M., Gazzaz, M., Abu-Nasser, B. S., & Abu-Naser, S. S. (2019). Prediction of Whether Mushroom is Edible or Poisonous Using Back-propagation Neural Network. *International Journal of Academic and Applied Research (IJAAR)*, 3(2).
- [22] Sadek, R. M., Mohammed, S. A., Abunbehan, A. R. K., Ghattas, A. K. H. A., Badawi, M. R., Mortaja, M. N., . . . Abu-Naser, S. S. (2019). Parkinson's Disease Prediction Using Artificial Neural Network. *International Journal of Academic Health and Medical Research (IJAHMR)*, 3(1), 1-8.
- [23] Al-Massri, R., Al-Astel, Y., Ziadia, H., Mousa, D. K., & Abu-Naser, S. S. (2018). Classification Prediction of SBRCTs Cancers Using Artificial Neural Network. *International Journal of Academic Engineering Research (IJAER)*, 2(11), 1-7.
- [24] Al-Shawwa, M., Al-Absi, A., Abu Hassanein, S., Abu Baraka, K., & Abu-Naser, S. S. (2018). Predicting Temperature and Humidity in the Surrounding Environment Using Artificial Neural Network. *International Journal of Academic Pedagogical Research (IJAPR)*, 2(9), 1-6.
- [25] Senthil, S., and Ayshwarya, B. (2018). Lung Cancer Prediction using Feed Forward Back Propagation Neural Networks with Optimal Features. *International Journal of Applied Engineering Research*, 318-325

- [26] @sta427ceyin, "Data World," 18 9 2017. [Online]. Available: <https://data.world/sta427ceyin/survey-lung-cancer/workspace/file?filename=survey+lung+cancer.csv>. [Accessed 15 3 2019].
- [27] Abu-Naser, S., Al-Masri, A., Sultan, Y. A., & Zaqout, I. (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.
- [28] Abu Naser, S., Zaqout, I., Ghosh, M. A., Atallah, R., & Alajrami, E. (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.
- [29] Elzamly, A., Abu Naser, S. S., Hussin, B., & Doheir, M. (2015). Predicting Software Analysis Process Risks Using Linear Stepwise Discriminant Analysis: Statistical Methods. *Int. J. Adv. Inf. Sci. Technol*, 38(38), 108-115.
- [30] Abu Naser, S. S. (2012). Predicting learners performance using artificial neural networks in linear programming intelligent tutoring system. *International Journal of Artificial Intelligence & Applications*, 3(2), 65.
- [31] Elzamly, A., Hussin, B., Abu Naser, S. S., Shibutani, T., & Doheir, M. (2017). Predicting Critical Cloud Computing Security Issues using Artificial Neural Network (ANNs) Algorithms in Banking Organizations. *International Journal of Information Technology and Electrical Engineering*, 6(2), 40-45.
- [32] Abu Naser, S. S., & Al-Bayed, M. H. (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.
- [33] Abu Ghali, M. J., Mukhaimer, M. N., Abu Yousef, M. K., & Abu Naser, S. S. (2017). Expert System for Problems of Teeth and Gums. *International Journal of Engineering and Information Systems (IJEAIS)*, 1(4), 198-206.
- [34] Abu Naser, S., & Akkila, A. N. (2008). A Proposed Expert System for Skin Diseases Diagnosis. *INSInet Publication. Journal of Applied Sciences Research*, 4(12), 1682-1693.
- [35] El Agha, M., Jarghon, A., & Abu Naser, S. S. (2017). Polymyalgia Rheumatic Expert System. *International Journal of Engineering and Information Systems (IJEAIS)*, 1(4), 125-137.
- [36] Abu Naser, S., Al-Dahdooh, R., Mushtaha, A., & El-Naffar, M. (2010). Knowledge management in ESMDA: expert system for medical diagnostic assistance. *AIML Journal*, 10(1), 31-40.
- [37] Almurshidi, S. H., & Abu-Naser, S. S. (2018). EXPERT SYSTEM FOR DIAGNOSING BREAST CANCER. Al-Azhar University, Gaza, Palestine.
- [38] Abu Naser, S. S., & Alawar, M. W. (2016). An expert system for feeding problems in infants and children. *International Journal of Medicine Research*, 1(2), 79-82.
- [39] Al Rekhawi, H. A., Ayyad, A. A., & Abu Naser, S. S. (2017). Rickets Expert System Diagnoses and Treatment. *International Journal of Engineering and Information Systems (IJEAIS)*, 1(4), 149-159.
- [40] Abu Naser, S. S., & AlDahdooh, R. M. (2016). Lower Back Pain Expert System Diagnosis and Treatment. *Journal of Multidisciplinary Engineering Science Studies (JMESS)*, 2(4), 441-446.
- [41] Nabahin, A., Abou Eloun, A., & Abu Naser, S. S. (2017). Expert System for Hair Loss Diagnosis and Treatment. *International Journal of Engineering and Information Systems (IJEAIS)*, 1(4), 160-169.
- [42] Abu Naser, S. S., & Alhabbash, M. I. (2016). Male Infertility Expert system Diagnoses and Treatment. *American Journal of Innovative Research and Applied Sciences*, 2(4).
- [43] Qwaider, S. R., & Abu Naser, S. S. (2017). Expert System for Diagnosing Ankle Diseases. *International Journal of Engineering and Information Systems (IJEAIS)*, 1(4), 89-101.
- [44] Abu Naser, S. S., & Al-Hanjori, M. M. (2016). An expert system for men genital problems diagnosis and treatment. *International Journal of Medicine Research*, 1(2), 83-86.
- [45] Naser, S. S. A., & Hasanein, H. A. A. (2016). Ear Diseases Diagnosis Expert System Using SL5 Object. *World Wide Journal of Multidisciplinary Research and Development*, 2(4), 41-47.
- [46] Nassr, M. S., & Abu Naser, S. S. (2018). Knowledge Based System for Diagnosing Pineapple Diseases. *International Journal of Academic Pedagogical Research (IJAPR)*, 2(7), 12-19.
- [47] Abu Naser, S. S., & El-Najjar, A. E. A. (2016). An expert system for nausea and vomiting problems in infants and children. *International Journal of Medicine Research*, 1(2), 114-117.
- [48] Elqassas, R., & Abu-Naser, S. S. (2018). Expert System for the Diagnosis of Mango Diseases. *International Journal of Academic Engineering Research (IJAER)* 2 (8), 10-18.
- [49] Naser, S. S. A., & Hilles, M. M. (2016). An expert system for shoulder problems using CLIPS. *World Wide Journal of Multidisciplinary Research and Development*, 2(5), 1-8.
- [50] Musleh, M. M., & Abu-Naser, S. S. (2018). Rule Based System for Diagnosing and Treating Potatoes Problems. *International Journal of Academic Engineering Research (IJAER)* 2 (8), 1-9.
- [51] Abu Naser, S. S., & Hamed, M. A. (2016). An Expert System for Mouth Problems in Infants and Children. *Journal of Multidisciplinary Engineering Science Studies (JMESS)*, 2(4), 468-476.

- [52] Almadhoun, H., & Abu-Naser, S. (2017). Banana Knowledge Based System Diagnosis and Treatment. *International Journal of Academic Pedagogical Research (IJAPR)*, 2(7), 1-11.
- [53] Abu Naser, S. S., & Mahdi, A. O. (2016). A proposed Expert System for Foot Diseases Diagnosis. *American Journal of Innovative Research and Applied Sciences*, 2(4), 155-168.
- [54] Dahouk, A. W., & Abu-Naser, S. S. (2018). A Proposed Knowledge Based System for Desktop PC Troubleshooting. *International Journal of Academic Pedagogical Research (IJAPR)* 2 (6), 1-8
- [55] Abu Naser, S. S., & Ola, A. Z. A. (2008). AN EXPERT SYSTEM FOR DIAGNOSING EYE DISEASES USING CLIPS. *Journal of Theoretical & Applied Information Technology*, 4(10).
- [56] Bakeer, H., & Abu-Naser, S. S. (2017). Photo Copier Maintenance Expert System V. 01 Using SL5 Object Language. *International Journal of Engineering and Information Systems (IJEAIS)* 1 (4), 116-124.
- [57] Abu Naser, S. S., & Shaath, M. Z. (2016). Expert system urination problems diagnosis. *World Wide Journal of Multidisciplinary Research and Development*, 2(5), 9-19.
- [58] Khella, R., & Abu-Naser, S. S. (2017). Rule Based System for Chest Pain in Infants and Children. *International Journal of Engineering and Information Systems* 1 (4), 138-148.
- [59] Abu-Naser, S. S., El-Hissi, H., Abu-Rass, M., & El-Khozondar, N. (2010). An expert system for endocrine diagnosis and treatments using JESS. *Journal of Artificial Intelligence; Scialert*, 3(4), 239-251.
- [60] Mrouf, A., Albatish, I., Mosa, M., & Abu Naser, S. S. (2017). Knowledge Based System for Long-term Abdominal Pain (Stomach Pain) Diagnosis and Treatment. *International Journal of Engineering and Information Systems (IJEAIS)* 1 (4), 71-88.
- [61] Abu Naser, S. S., Baraka, M. H., & Baraka, A. R. (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).
- [62] Abu-Nasser, B. S., & Abu-Naser, S. S. (2018). Cognitive System for Helping Farmers in Diagnosing Watermelon Diseases. *International Journal of Academic Information Systems Research (IJASIR)* 2 (7), 1-7.
- [63] Abu Naser, S. S., Alamawi, W. W., & Alfarra, M. F. (2016). Rule Based System for Diagnosing Wireless Connection Problems Using SL5 Object. *International Journal of Information Technology and Electrical Engineering* 5(6), 26-33.
- [64] Akkila, A. N., & Abu Naser, S. S. (2016). Proposed Expert System for Calculating Inheritance in Islam. *World Wide Journal of Multidisciplinary Research and Development* 2 (9), 38-48.
- [65] Abu Naser, S. S., & Zaqout, I. S. (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.
- [66] AbuEl-Reesh, J. Y., & Abu Naser, S. S. (2017). A Knowledge Based System for Diagnosing Shortness of Breath in Infants and Children. *International Journal of Engineering and Information Systems (IJEAIS)* 1 (4), 102-115.
- [67] Abu Naser, S. S., & Bastami, B. G. (2016). A proposed rule based system for breasts cancer diagnosis. *World Wide Journal of Multidisciplinary Research and Development* 2 (5), 27-33.
- [68] Abu-Nasser, B. S. (2017). Medical Expert Systems Survey. *International Journal of Engineering and Information Systems*, 1(7), 218-224.
- [69] Abu Dalffa, M., Abu-Nasser, B. S., & Abu-Naser. S. S. (2019). Tic-Tac-Toe Learning Using Artificial Neural Networks. *International Journal of Engineering and Information Systems (IJEAIS)*, 3(2), 9-19.
- [70] Abu Naser, S. S., & Almurshedi, S. H. (2016). A Knowledge Based System for Neck Pain Diagnosis. *World Wide Journal of Multidisciplinary Research and Development (WWJMRD)*, 2(4), 12-18.
- [71] Azaab, S., Abu Naser, S., & Sulisel, O. (2000). A proposed expert system for selecting exploratory factor analysis procedures. *Journal of the College of Education* 4 (2), 9-26.
- [72] Abu-Naser, S. S., Kashkash, K. A., & Fayyad, M. (2010). Developing an expert system for plant disease diagnosis. *Journal of Artificial Intelligence*, 3 (4), 269-276.
- [73] Barhoom, A. M., & Abu-Naser, S. S. (2018). Black Pepper Expert System. *International Journal of Academic Information Systems Research, (IJASIR)* 2 (8), 9-16.
- [74] AlZamily, J. Y., & Abu-Naser, S. S. (2018). A Cognitive System for Diagnosing Musa Acuminata Disorders. *International Journal of Academic Information Systems Research, (IJASIR)* 2 (8), 1-8.
- [75] Alajrami, M. A., & Abu-Naser, S. S. (2018). Onion Rule Based System for Disorders Diagnosis and Treatment. *International Journal of Academic Pedagogical Research (IJAPR)*, 2 (8), 1-9.
- [76] Metwally, N. F., AbuSharekh, E. K., & Abu-Naser, S. S. (2018). Diagnosis of Hepatitis Virus Using Artificial Neural Network. *International Journal of Academic Pedagogical Research (IJAPR)*, 2(11), 1-7.
- [77] Ashqar, B. AM, & Abu-Naser, S. S. (2019). Image-Based Tomato Leaves Diseases Detection Using Deep Learning. *International Journal of Academic Engineering Research (IJAER)* 2 (12), 10-16.
- [78] El-Khatib, M. J., Abu-Nasser, B. S., & Abu-Naser. S. S. (2019). Glass Classification Using Artificial Neural Network. *International Journal of Academic Pedagogical Research (IJAPR)*, 3(2).