# ANN for Predicting Temperature and Humidity in the Surrounding Environment

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*Abstract: In this research, an Artificial Neural Network (ANN) model was developed and tested to predict temperature in the surrounding environment. A number of factors were identified that may affect temperature or humidity. Factors such as the nature of the surrounding place, proximity or distance from water surfaces, the influence of vegetation, and the level of rise or fall below sea level, among others, as input variables for the ANN model. A model based on multi-layer concept topology was developed and trained using data from several regions in the surrounding environment.*
*The evaluation of testing the dataset shows that the ANN model is capable of correctly predicting the temperature with 100% accuracy.*

**Keywords**: Artificial Neural Networks, Temperature, ANN, Predictive Model.

## 1. INTRODUCTION

The main objective of a temperature prediction system is to identify and measure temperature or humidity in the surrounding environment. The quality of temperature measurement affects any environment at the research, measurement and forecasting level. Moreover, it has a general impact on the environment and the country in general, be it economy, labor, agricultural crops and water.
The temperature is measured according to certain criteria, and it is very likely that it will take a long time to verify the accuracy of the grades or the inaccuracy. Once the measurement is complete, these values are officially displayed [1].

This study seeks to explore the possibility of using the artificial neural network model to predict the temperature at the lowest possible time and high accuracy in the results.
Of course one would expect the degree of warming to be associated with several influential factors as mentioned earlier. On the other hand it is clear that it will be very difficult to find a mathematical model that may be an appropriate model for this relationship between performance/factors. However, one realistic method of temperature prediction may be to study data on the background of the environment and the nature of the influencing factors[2].

The practical approach to this type of problem is to apply a regression analysis in which data is better integrated into some functions. The result is an equation in which both input $x_j$ is multiplied by $w_j$; the sum of all these products is constant,, and then an output of $y = \Sigma \ w_j \ x_j \ +$, is given, where j = 0.n.
The problem here is that it is difficult to choose a suitable function to capture all data collection as well as automatically adjust the output in the case of more information, because prediction is controlled by a number of factors, and this control will not be any clear and known regression model.
The artificial neural network, which simulates the human brain in solving a problem, is a more common approach that can address this type of problem. Thus, attempting to develop an adaptive system such as artificial neural network to predict the temperature based on the results of these factors[3].

The objectives of this study are:

- To identify some appropriate factors that affect the environment,
- To convert these factors into appropriate models for adaptive system coding, and
- Designing an artificial neural network that can be used to predict temperature based on some predefined data for a given environment.

## 2. LITERATURE REVIEW

Taymour Ahmad Hamdallah used a high-speed sensor for fiber optics and sensitivity to the fire-fighting system that could operate at a distance from telemetry. Fiber optic sensors are not affected by the electromagnetic field. It has a feature such as

compactness, engineering flexibility, simplicity of manufacturing, and ease of use in harsh environments. It also has a small, easy manufacturing, good accuracy, high sensitivity and quick response by measuring the small change in wavelength of signal reflected by saturation due to temperature change.

ANN consists of a number of very simple and highly interrelated processes called neurons. These people are trained so that a specific entry leads to a specific target. ANN is trained to perform complex functions in various application areas including pattern recognition, modeling, discrimination, classification, speech, and vision and control systems. Using ANN capability, ANN's current work is used in sensor temperature design using FBG[22].

Mustafa raj used an automatic linear input model with external inputs (ARX) and a non-linear, auto-linear, self-contained, external model (NNARX) to predict the thermal behavior of the open office in a modern building. The external and internal climate data recorded over three months were used to construct valid models to verify the dry temperature and relative humidity of different time scales (30 minutes to 3 hours). In order to compare the accuracy of different future predictions, the various performance measures, such as relevance, were calculated as the average of the bound error, ie the absolute error and the coefficient of selection between the expected model output and the actual measurements. For the NNARX model, the optimal network structure after training is then determined by pruning the entire network using the optimal brain surgeon strategy. The results show that both models provide reasonably good expectations but the nonlinear NNARX model outperforms the linear ARX model. These two models can be used to improve indoor air quality by focusing on building intelligence in the control unit of HVAC stations, in particular adaptive control systems [25].

## 3. THE ARTIFICIAL NEURAL NETWORKS

An Artificial Neural Network (ANN) is an application of Artificial Intelligence [4-35]. ANN is an arithmetical model that is motivated by the organization and/or functional feature of biological neural networks. A neural network contains an interrelated set of artificial neurons, and it processes information using a connectionist form to computation. As a general rule an ANN is an adaptive system that adjusts its structure based on external or internal information that runs through the network during the learning process. Recent neural networks are non-linear numerical data modeling tools. They are usually used to model intricate relationships among inputs and outputs or to uncover patterns in data. ANN has been applied in numerous applications with considerable attainment [7-8]. For example, ANN has been effectively applied in the area of prediction, handwritten character recognition, evaluating prices of lodging [9-10].

Neurons are often grouped into layers. Layers are groups of neurons that perform similar functions. There are three types of layers. The input layer is the layer of neurons that receive input from the user program. The layer of neurons that send data to the user program is the output layer. Between the input layer and output layer are hidden layers. Hidden layer neurons are only connected only to other neurons and never directly interact with the user program. The input and output layers are not just there as interface points. Every neuron in a neural network has the opportunity to affect processing. Processing can occur at any layer in the neural network. Not every neural network has this many layers. The hidden layer is optional. The input and output layers are required, but it is possible to have on layer act as both an input and output layer [10].

ANN learning can be either supervised or unsupervised. Supervised training is accomplished by giving the neural network a set of sample data along with the anticipated outputs from each of these samples. Supervised training is the most common form of neural network training. As supervised training proceeds the neural network is taken through several iterations, or epochs, until the actual output of the neural network matches the anticipated output, with a reasonably small error. Each epoch is one pass through the training samples. Unsupervised training is similar to supervised training except that no anticipated outputs are provided. Unsupervised training usually occurs when the neural network is to classify the inputs into several groups. The training progresses through many epochs, just as in supervised training. As training progresses the classification groups are "discovered" by the neural network [9].

Training is the process by which these connection weights are assigned. Most training algorithms begin by assigning random numbers to the weight matrix. Then the validity of the neural network is examined. Next the weights are adjusted based on how valid the neural network performed. This process is repeated until the validation error is within an acceptable limit [8].

Validation of the system is done once a neural network has been trained and it must be evaluated to see if it is ready for actual use. This final step is important so that it can be determined if additional training is required. To correctly validate a neural network validation data must be set aside that is completely separate from the training data [10].
About 60% of the total sample data was used for network training in this paper. About 30% of the total sample data served as test and the remaining 10% used for validation of the system.

## 4. METHODOLOGY

By looking deeply through literature and soliciting the experience of human experts on Humidity, a number of factors have been identified that have an impact on the degree of neutrality in a given environment. These factors were carefully studied and synchronized in an appropriate number to encode the computer in the ANN environment. These factors were classified as input variables. Configuration variables reflect some possible levels of temperature measurement by values and factors.

## 4.1 The Input Variable

The input variables specified are those that can be obtained simply from the temperature sensor. Input variables are:

Table 1: Attributes of the Data set

| No. | Attributes |
|-----|-----------|
| 1. | Input 1 |
| 2. | Input 2 |
| 3. | Input 3 |
| 4. | Input 4 |
| 5. | Input 5 |
| 6. | Input 6 |
| 7. | Input 7 |
| 8. | Input 8 |
| 9. | Input 9 |
| 10. | Input 10 |
| 11. | Input 11 |
| 12. | Input 12 |

## 4.2 The Output Variable

The output variable represents the performance of the temperature sensor. The output variable depends on the input.

Table 2: Output variables

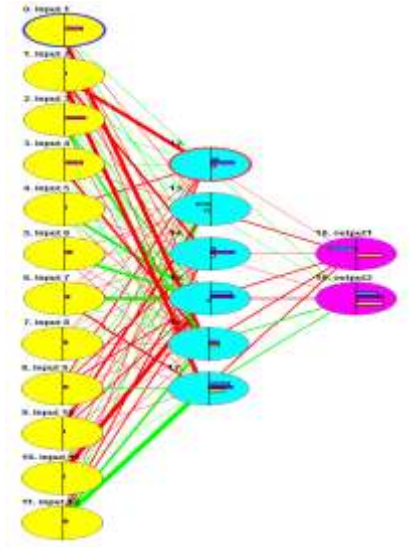| S/N | Output Variable | | Represent |
|-----|-----------------|----------|-----------|
| | Output 1 | Output 2 | |
| 1 | 1 | 1 | One |
| 2 | 0 | 1 | Two |
| 3 | 1 | 0 | Three |

## 4.3 Design of the Neural Networks
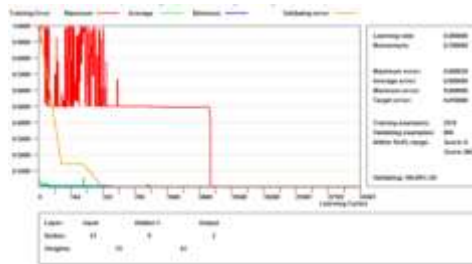
**Figure 1**: Shows the Design of the Neural Networks



**Figure 2:** Shows the Training, error, and validation of the data set.

## 4.4 The Back-propagation Training Algorithm

- Initialize each wi to some small random value
- Until the termination condition is met, Do
- For each training example <(x1,…xn),t> Do
- Input the instance (x1,…,xn) to the network and compute the network outputs $o_k$
- For each output unit k: δk=ok(1-ok)(tk-ok)
- For each hidden unit h: δh=oh(1-oh) Σk wh,k δk
- For each network weight wj Do wi,j=wi,j+Δwi,j,where Δwi,j= η δj xi,j and ηis the learning rate.

## 5. EVALUATION OF THE NEURAL NETWORK

As mentioned previously, the purpose of this experiment was to predict the temperature. Where we used sensor data, which provides the possibility to implement and test the neural network and its learning algorithm. Our neural network is a sensor expression designed to detect the presence of one of two sets of materials. Alternatively, sensor readings may be a "false alarm".
After training and validation, the network was tested using the test data set and the following results were obtained. This involves inputting variable input data into the grid without output variable results. The output from the grid is then compared with the actual variable data.
The neural network was able to accurately forecast 100% of the excellent data (representing 12 inputs and based on the inputs.) We have two outputs represented in values and each value is as follows:(11)100% , (01) 100%, (10) 100%).

## 6. CONCLUSION

The artificial neural network model was presented to predict the temperature value based on specific inputs.
The sensor data model was used for training. Form factors were obtained from input data. The model was tested and the total score was 100%. Thus, the potential of the artificial neural network to predict the temperature was reviewed.

## References

1. 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.
2. 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.
3. Ahmed, A., et al. (2019). "Knowledge-Based Systems Survey." International Journal of Academic Engineering Research (IJAER) 3(7): 1-22.
4. Alajrami, E., et al. (2019). "Blood Donation Prediction using Artificial Neural Network." Blood 3(10): 1-7.
5. Alghoul, A., et al. (2018). "Email Classification Using Artificial Neural Network." International Journal of Academic Engineering Research (IJAER) 2(11): 8-14.
6. Alkronz, E. S., et al. (2019). "Prediction of Whether Mushroom is Edible or Poisonous Using Back-propagation Neural Network." International Journal of Academic and Applied Research (IJAAR) 3(2): 1-8.
7. Al-Massri, R., et al. (2018). "Classification Prediction of SBRCTs Cancers Using Artificial Neural Network." International Journal of Academic Engineering Research (IJAER) 2(11).
8. Al-Mubayyed, O. M., et al. (2019). "Predicting Overall Car Performance Using Artificial Neural Network." International Journal of Academic and Applied Research (IJAAR) 3(1): 1-5.
9. 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.
10. Al-Shawwa, M. and S. S. Abu-Naser (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): 15-20.
11. Al-Shawwa, M., et al. (2018). "Predicting Temperature and Humidity in the Surrounding Environment Using Artificial Neural Network." International Journal of Academic Pedagogical Research (IJAPR) 2(9): 1-6.
12. Anderson, J., et al. (2005). "Adaptation of Problem Presentation and Feedback in an Intelligent Mathematics Tutor." Information Technology Journal 5(5): 167-207.
13. 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.
14. Ashqar, B. A. M. and S. S. Abu-Naser (2019). "Image-Based Tomato Leaves Diseases Detection Using Deep Learning." International Journal of Academic Engineering Research (IJAER) 2(12): 10-16.
15. Ashqar, B. A., et al. (2019). "Plant Seedlings Classification Using Deep Learning." International Journal of Academic Information Systems Research (IJAISR) 3(1): 7-14.
16. 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.
17. Elzamly, A., et al. (2016). "A New Conceptual Framework Modelling for Cloud Computing Risk Management in Banking Organizations." International Journal of Grid and Distributed Computing 9(9): 137-154.
18. Elzamly, A., et al. (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.
19. Elzamly, A., et al. (2019). "Critical Cloud Computing Risks for Banking Organizations: Issues and Challenges." Religación. Revista de Ciencias Sociales y Humanidades 4(18): 673-682.
20. Heriz, H. H., et al. (2018). "English Alphabet Prediction Using Artificial Neural Networks." International Journal of Academic Pedagogical Research (IJAPR) 2(11): 8-14.
21. 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.
22. Kashf, D. W. A., et al. (2018). "Predicting DNA Lung Cancer using Artificial Neural Network." International Journal of Academic Pedagogical Research (IJAPR) 2(10): 6-13.
23. Khalil, A. J., et al. (2019). "Energy Efficiency Predicting using Artificial Neural Network." International Journal of Academic Pedagogical Research (IJAPR) 3(9): 1-8.
24. Li, L., et al. (2011). "Hybrid Quantum-inspired genetic algorithm for extracting association rule in data mining." Information Technology Journal 12(4): 1437-1441.
25. Abu Naser, S. S., et al. (2016). "Design and Development of Mobile University Student Guide." Journal of Multidisciplinary Engineering Science Studies (JMESS) 2(1): 193-197.
26. Abu Naser, S. S., et al. (2016). "Design and Development of Mobile Blood Donor Tracker." Journal of
27. 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.
28. Masri, N., et al. (2019). "Survey of Rule-Based Systems." International Journal of Academic Information Systems Research (IJAISR) 3(7): 1-23.
29. 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.
30. Nasser, I. M. and S. S. Abu-Naser (2019). "Lung Cancer Detection Using Artificial Neural Network." International Journal of Engineering and Information Systems (IJEAIS) 3(3): 17-23.
31. Nasser, I. M. and S. S. Abu-Naser (2019). "Predicting Books' Overall Rating Using Artificial Neural Network." International Journal of Academic Engineering Research (IJAER) 3(8): 11-17.
32. 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.
33. Nasser, I. M., et al. (2019). "A Proposed Artificial Neural Network for Predicting Movies Rates Category." International Journal of Academic Engineering Research (IJAER) 3(2): 21-25.
34. Nasser, I. M., et al. (2019). "Artificial Neural Network for Diagnose Autism Spectrum Disorder." International Journal of Academic Information Systems Research (IJAISR) 3(2): 27-32.
35. Nasser, I. M., et al. (2019). "Developing Artificial Neural Network for Predicting Mobile Phone Price Range." International Journal of Academic Information Systems Research (IJAISR) 3(2): 1-6.
36. Ng, S., et al. (2010). "Ad hoc networks based on rough set distance learning method." Information Technology Journal 10(9): 239-251.
37. Owaied, H. H., et al. (2009). "Using rules to support case-based reasoning for harmonizing melodies." Journal of Applied Sciences 11(14): pp: 31-41.
38. Sadek, R. M., et al. (2019). "Parkinson's Disease Prediction Using Artificial Neural Network." International Journal of Academic Health and Medical Research (IJAHMR) 3(1): 1-8.
39. Salah, M., et al. (2018). "Predicting Medical Expenses Using Artificial Neural Network." International Journal of Engineering and Information Systems (IJEAIS) 2(20): 11-17.
40. Sulisel, O., et al. (2005). "Growth and Maturity of Intelligent Tutoring Systems." Information Technology Journal 7(7): 9-37.
41. Zaqout, I., 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.
42. Abu-Nasser, Bassem. "Medical Expert Systems Survey." *International Journal of Engineering and Information Systems (IJEAIS)* 1, no. 7 (2017): 218-224.
43. Abu-Nasser, Bassem S., and Samy S. Abu-Naser. "Cognitive System for Helping Farmers in Diagnosing Watermelon Diseases." *International Journal of Academic Information Systems Research (IJAISR)* 2, no. 7 (2018): 1-7.
44. Abu-Nasser, Bassem S., and Samy S. Abu Naser. "Rule-Based System for Watermelon Diseases and Treatment." International Journal of Academic Information Systems Research (IJAISR) 2, no. 7 (2018): 1-7.
45. Baker, J., et al. "& Heller, R.(1996)." Information Visualization. Information Technology Journal 7(2).
46. Baker, J., et al. (1996). "Information Visualization." Information Technology Journal 7(2): pp: 403-404.
47. Baraka, M. H., 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).
48. Barhoom, A. M., et al. (2019). "Predicting Titanic Survivors using Artificial Neural Network." International Journal of Academic Engineering Research (IJAER) 3(9): 8-12.
49. Chand, P. S., et al. (2008). "MADAMS: Mining and Acquisition of Data by ANT-MINER Samples." Journal of Theoretical & Applied Information Technology 4(10).
50. Chen, R.-S., et al. (2008). "Evaluating structural equation models with unobservable variables and measurement error." Information Technology Journal 10(2): 1055-1060.
51. Dalffa, M. A., et al. (2019). "Tic-Tac-Toe Learning Using Artificial Neural Networks." International Journal of Engineering and Information Systems (IJEAIS) 3(2): 9-19.
52. El_Jerjawi, N. S. and S. S. Abu-Naser (2018). "Diabetes Prediction Using Artificial Neural Network." International Journal of Advanced Science and Technology 121: 55-64.
53. El-Khatib, M. J., et al. (2019). "Glass Classification Using Artificial Neural Network." International Journal of Academic Pedagogical Research (IJAPR) 3(2): 25-31.
54. Elzamly, A., et al. (2015). "Classification of Software Risks with Discriminant Analysis Techniques in Software planning Development Process." International Journal of Advanced Science and Technology 81: 35-48.
55. Naser, S. S. A. "TOP 10 NEURAL NETWORK PAPERS: RECOMMENDED READING–ARTIFICIAL INTELLIGENCE RESEARCH."