Advanced Metering Infrastructure using Artificial Neural Network

Mrs. Tejashree Mule[1], Dr. S.M. Bakre[2], Dr. Mrs. A.D. Shrilkar[3]

[1]Researcher, ME (Elect), Electrical Engineering Department, AISSMS IOIT, Pune-411001
[2]Associate Professor, Electrical Engineering Department, AISSMS IOIT, Pune-411001,
[3]Head, Electrical Engineering Department, AISSMS IOIT, Pune-411001

I. Abstract: The concept of Advanced metering infrastructure (AMI) is an integrated system is evaluated of IoT technology and cloud computing. In this artificial neural network has been involved through using python. This paper AMI using artificial neural network is put forwarded method. Here logical AND gate based method have been involved. Secondly by using this meter, communications networks, and data management systems that enables two-way communication between users and distributers. Commutation of error and adjustment has been conducted using python version 3.0. AMI also enables utilities to offer new time-based rate programs and incentives that encourage customers to reduce peak demand and reduce energy consumption and costs.

Keywords- Current transformer (CT), Potential transformer (PT), advanced meter infrastructure (AMI), Artificial neural network (ANN).

II. Introduction

AMI stands for Advanced Metering Infrastructure. AMI meters, also known as Smart meters are updated, digital versions of the traditional electrical energy meter attached to the outside of your home. These new meters not only measure how much electricity is used, but also at what time variation during the day. Smart meters are also designed to transmit pricing and energy information from the utility company to the consumer (i.e. two-way communication). The AMI has ability to automatically and remotely measure electricity use, connect and disconnect service, detect tampering, identify and isolate outages, and monitor voltage. A smart meter is an electronic device that records information such as consumption of electric energy, voltage levels, current, and power factor. Smart meters communicate the information to the consumer for greater clarity of consumption behavior, and electricity suppliers for system monitoring and customer billing.

Neural network is the network of neurons. These neurons may be biological neurons as of human brain or artificial neurons as software abstracts. Thus an Artificial Neural Network (ANN) is taking shape under artificial intelligence. In ANN, the connections of biological neurons are modeled as weights. All inputs are modified by a weight (e.g. multiplied by weights) and then added. Finally, an activation function controls output.

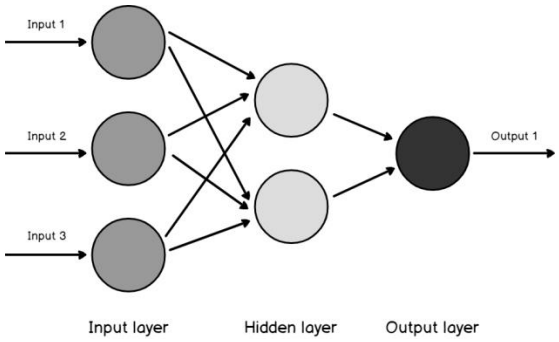


Fig.1 Artificial Neural Network

The concept of working of AMI has been emergent after evolution of IoT technology. The design of meter is based on IoT technology and cloud computing. The IoT sensors are provided at current Transformers and voltage Transformers to sense the currents and voltages received from IoT sensors. These quantities are taken to the processing unit which is installed at monitoring station. The monitoring station is location in-specific. These signals are further processed using sample and hold circuits as the working of meters is based on sampling. Further these signals are converted to digital form through AD converter. Thus the microprocessor gets currents and voltages in form of digital input. These signals are further processed to compute RMS values of voltage current and power. The basic parameters are current, voltage and power whereas the derived

parameters are power factor, energies and demand. The data communication takes place from IoT sensors to the monitoring station where the server is installed. The communication takes place through the Internet media. The advantages of AMI over conventional meter are that the meter can be read anywhere from the world. Secondly, the cost of meter is lesser. Moreover the report generation is quick and simple.

III Neural Network AND gate Based

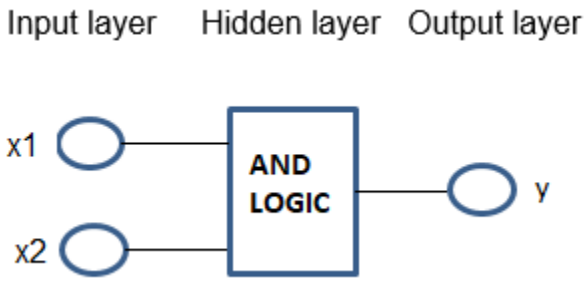


Fig2. Neural Network based AND logic gate model

Table1. AND gate truth table

Inputs		Ideal Output	Actual output	Status
A	B	I	O	
0	0	0	0.2	Disable
0	1	0	0.3	Disable
1	0	0	0.4	Disable
1	1	1	0.5	Enable

The neural network is formed from the combination of hidden layer, input layer and output layer comprising of neurons connected by weights. The output obtained through interaction between nodes and weights is called as actual output. The difference between actual output and ideal output is called error. The error is minimized through successive iterations of weights. The neurons are trained in such a manner as to minimize these errors

The neural network can be created in such a way that signals x1 and x2 form input layers and signal y, an output layer. Where x1 is CT, x2 is PT & y is output through AMI. The hidden layer between input and output layers comprises of the AND logic. The outputsignal y indicates the healthy status (1) or unhealthy status (0)

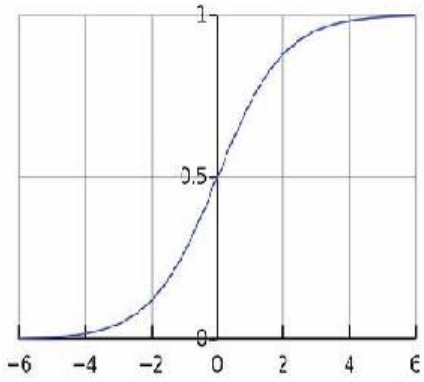
IV. Activation Function

Used to manipulate nodes and weights. Following activation functions are used-

1. Sigmoid Function
2. Threshold Function
3. Piecewize linear model
4. Gaussian Function

Sigmoid Function is commonly used.

$$f(x) = \frac{1}{1 + e^{-(x)}}$$



Sigmoid function (logistic function) It squashes the input values in the range of 0 and 1. The main reason why we use sigmoid function is because it exists between (0 to 1). Therefore, it is especially used for models where we have to predict the probability as an output. Since probability of anything exists only between the range of 0 and 1, sigmoid is the right choice.

V. Python program

Python is an interpreter high level, general purpose, object oriented, independent, web enabled type of language. This language commonly used. In this paper python is used for error should be commutated and adjusted. For ex Drawing of bar chart i.e energy consume in every year has been shown.

Program

#drawing a chart on year wise sale

Import matplotlib.pyplot as plt

Fig = plt.figure()

Ax = fig.add_axes([0,0,1,1])

Year = [‘2016’,’2017’,’ 2018’,’2019’,’2020’]

Sale = [60,76,83,86,92]

Ax.bar(year,sale)

Plt.show()

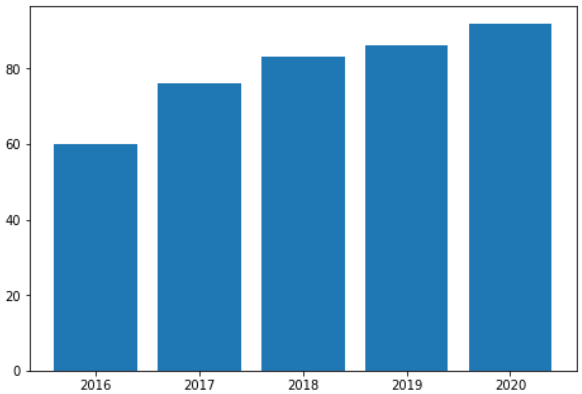


Fig3. Year wise sale bar chart

VI. Security

Smart meters expose the power grid to cyberattacks that could lead to power_outages, both by cutting off people's electricity and by overloading the grid. It has protection against theft, due to this clarity between customer's and distribution system.

AMI has read the instructions automatically using the python language. This instructions can store the data also read this data anywhere from India.

Implementing security protocols that protect these devices from malicious attacks has been problematic, due to their limited computational resources and long operational life.

VII. Conclusions

The concept of neural network virtual power meter is discussed in this paper that offers number of significant features. The AMI meter mainly works on two input parameters- current and voltage. The availability of these parameters can be ascertained by providing neural network based AND gate. The ANN based AND gate is based on software abstraction which is beneficial compared to the conventional hardware circuits

The advantages of AMI over conventional meter are that the meter can be read anywhere from the world. Secondly, the cost of meter is lesser. Moreover the report generation is quick and simple. Hence it has easy to handle and communicate with consumers also transparency between user and distributer.

A utility can have a better understanding of the quality and distribution of its product, allowing for improvements in the utility's reliability and efficiency. AMI can lead to improved financial benefits for the utility and improved satisfaction for customers.

VIII. References

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