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Prediction of Damage to Electronic Devices Based On Power Consumption Characters Using Artifician Neural Network

Wayan Widya Artana[1] , Gede Indrawan[2], and Kadek Yota Ernanda Aryanto[3]

[1,2,3] Computer Science Department Ganesha University of Education Bali, Indonesia
Email : [1]artha.pico@gmail.com , [2]gindrawan@undiksha.ac.id , [3]yota.ernanda@undiksha.ac.id

ABSTRACT

This study was conducted to determine the ability of artificial neural network in predicting the damage of electronic devices based on the character of electric power consumption. each electronic device has standard input and power consumption when the condition of the device is good. This test is performed using artificial neural network backpropagation with sigmod activation function. To conduct training on the system, we perform the recording of power consumption of electronic devices that are considered in good condition. Data is recorded as a volt ampere line in a given time unit. From the results of testing and implementation of artificial neural network is able to recognize the good pattern of device consumption by using 300 or more hidden network. Artificial neural network backpropagation successfully detects abnormal power consumption with a success rate of over eighty percent

Keywords—artificial neural network, electricity consumption, demage of electronic devices.

I. INTRODUCTION

Human life at this time can not be separated from using elektronik devices. Based on PLN Indonesia data in 2014, electricity usage increased by 5.90% from the previous year. From these statistics, it is known that the most use is the use of households. A total of 42.34% of the total electricity sold as many as 198,601,78 GWh that use is household. Uncontrolled use of electronic goods triggers the use or depletion of high electrical energy. In addition, electronic tools are currently not equipped with a system to break the current when there is damage. Often electric users also underestimate the use of electricity in household appliances. Often forget to turn off the television also forget to turn off the AC after leave the house.

Many of electronic devices in the market today are not equipped with damage early of detection system. The way detection of damage to home electronic devices is still a lot done in a conventional way by relying on the user's feelings. The use of air conditioner for example, damage can only be known if the user in the room no longer feel the cool temperature from the air conditioner. Though the use of electricity by ac remains high. Or even abnormal not same as the normal condition of factory output.

Electronic devices in consuming electricity are not stagnant or constant. In reality electricity consumption depends on the given work load and the stability of the current used. However, the consumption of electric power

will not go too far from the description of the device provided by the manufacturer.

In 1952, Arthur Samuel created a program, game of checkers on an IBM computer. Because from the very first creation of computers, people have been thinking about how to get the computer to learn from experience. Utilization of machine learning in various fields. The program by Arthur Samuel can learn the movement to win game checkers and save the movement into his memory. Machine learning in the digital age is used in various fields such as text analysis, image processing (image tagging, face detection), self-driving cars, Finance (Stock trading) and search and recommendation engine.

Machine learning can be trained in various ways depending on the interests and data used. Supervised learning is used to train algorithms with data y = f (x), unsupervised learning for data with input data that has nothing to do with the results of calculations or outputs. And between them is semi-supervised learning where the data used some have correlation with the output and some have no correlation. By

using machine learning computer capable to learn the pattern of electric power consumption of electronic devices.

In this experiment try to implement machine learning on smarthome which also can control the flow of electricity from long distance. The main focus of this research is to use machine learning to help detect premature deterioration in electronic devices by studying the habits of electric devices consuming electrical power under normal circumstances. Machine learning model used in this research is model of neural networks.

II. BASIC THEORY

A. IoT Internet Of Things

IoT (Internet of Things) is a term to name a device or something connected to the Internet, can communicate between devices, allowing remote monitoring and control using an internet connection. In this twenty-first century, people want to connect to every object that related with. People want to stay connected anywhere and anytime. The thing that can support this happens is IoT, where the concept of connectivity that occurs is between the device or hardware. In addition to home-based devices, IoT can be developed to help smart city development.[1]

In Figure 1 we will see the concept of IoT architecture applied to the smarthome system.

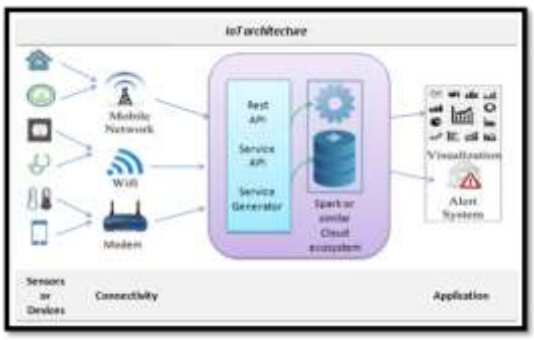

Figure 1. IoT Architecture

From Figure 1. We can understand that every device connected using available technology to provide data and communicate using the Internet sercive cloud API to provide system alerts to applications used by users. The main function of IoT development is to assist people in monitoring the electrical devices used, or monitoring things using electronic devices.

B. Artificial Neural Network

AI stands for Artificial Intelligence is a branch of computer science that is dedicated to creating intelligent software, sophisticated and capable of performing calculations like a human brain. This concerns the methods, tools, systems used to simulate human logic in solving problems. There are two methods for developing AI. The first is to use methods and systems to simulate people using experience and making decisions based on rules. These are usually used to build expert systems. And the second is to use models and systems that mimic the workings of the brain with its constituent components such as artificial neural networks.

Artificial neural network that is inspired by the biological structure of neurons connected by coefficients or weight forming neural structures. Biologically the form of one cell neuron is as in figure 2 below.

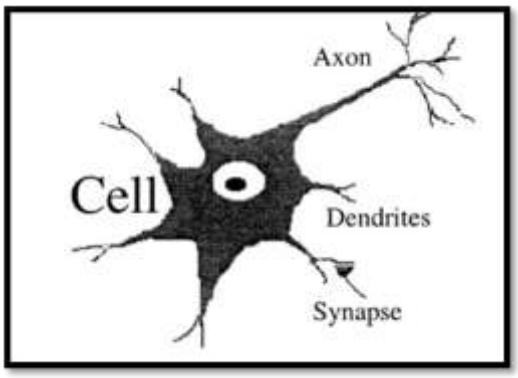

Figure 2. Neuron Cell

The following figure 3 and 4 are the implementation concepts of the artificial neural network.

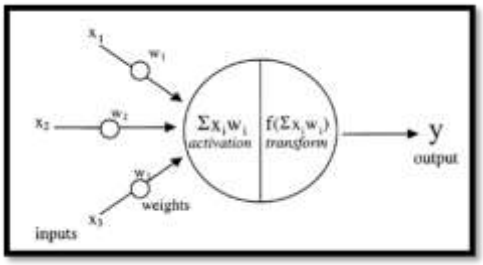

Figure 3. Artificial neural network model

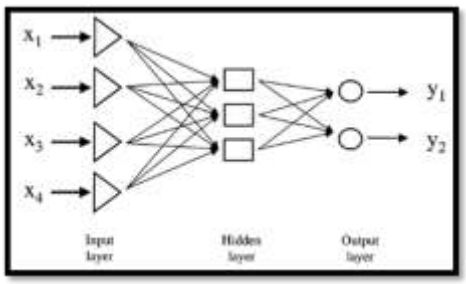

Figure 4. Feed Forward ANN

Artificial neurons are ANN components that are designed to simulate the way of neurons work biologically.

The incoming signal is considered an input calculated weighted and adjusted then passed the transfer function to get the output of the neuron. [2]

C. Artificial Neural Network Feedforward Backpropagation

Artificial neural network backpropagation is one model of neural networks that are often used for the case of learning supervised learning to solve a problem. This model is believed to be good for detecting and classifying patterns, characterization and other things. In this research using gradient descent method that do iterative weight update. The iteration formula is used as in the following formula 1.

$$w_k \longleftarrow w_k - \mu \frac{\partial E}{\partial w_k}$$

Formula 1. Iterative weight update

This function bellow is an activation function that uses sigmod to calculate inputs into outputs. Figure 5 is a sourcode image used in this function using the PHP programming language.

```
protected function activation($value) {
    //return tanh($value);
    return (1.0 / (1.0 + exp(- $value)));
}
```

Figure 5. PHP Sigmod Activation

In this function it is simple that the input is a value of the previous neuron or of the input weight. Calculated using the sigmod function to then forwarded to the next neuron. The electricity usage data for each device is set to get an output of 0 indicating the device is in normal condition. Sigmod function used in neural network has a range of values from -1 to 1. Where the further away from the 0 value then the device in the prediction is damaged.

III. RELATED WORK

Design and Application of Intelligent Electrical Outlet for Campus's Electricity Saving and Emission Reduction. The research was conducted in China in 2012 by Ma Yan, from Zhejiang Water Conservancy And Hydropower College, Hangzhou, China. In this study, Ma Yan created an outlet terminal to store electricity data and control the current through this system. With this system Ma Yan managed to save electricity usage up to 10-40%. The core of this device is to monitor the use of electricity, communicate with the admin and allow the admin to control the current at this outlet terminal. So if any unneeded currents can be disconnected by the admin through the control page [3].

Short-Term Load Forecasting Using an Artificial Neural Network. This study attempts to implement an artificial neural network to detect the short-term expenditure of a large electrical system. Electrical output system is divided or divided into two patterns. Distribution by working day and weekday holiday of the week. This forecasting is done using backpropagation algorithm. This algorithm is considered strong in predicting nonlinear equations. In each case backpropagation can calculate the weights well on the specified tolerance [4].

Time-series Extreme Event Forecasting with Neural Networks at Uber. The research was conducted by Nikolay Laptev, Jason Yosinski, Li Erran Li and Slawek Smyl in Sidney, Australia in 2017. This research was conducted to help the online transportation company that is Uber. The purpose of this study is to help predict the accurate number of riders for Uber's online taxi drivers. From their research they managed to create an application to forecast the needs of drivers during a special event even for Uber company. Based on their experience there are three criteria that need to be considered to use neural network in time-series forecasting that is time series and time series and correlation between time-series [5].

Combination of Fuzzy Logic And Artificial Neural Networks For Time-Series Rainfall Forecast In Puspo Area - East Java. This study was conducted to assist the authorities in the field of meteorology services in estimating rainfall. The main problem to be solved is the increasing predictive error rate. Seasonal and climate changes are the main causes of the difficulty of estimating the precipitation. In this study tried to combine Fuzzy logic to estimate the uncertain and multi-layer neural networks to deal with increasingly uncertain circumstances. From the results of tests conducted in this study showed that the combination of fuzzy with artificial neural network provides a little error value as listed in figure 6.

Aktual	FIS+JST	JST	FIS
0,6	4.179	3.194	5.164
2,9	4.162	0.847	7.478
11,5	-0.950	-3.012	1.112
11,909	-1.006	-3.188	1.176
10,8	-0.541	-1.391	0.308
6,4	2.029	0.882	3.175
0	2.518	4.215	0.822
19,7	-5.249	-7.922	-2.576
16,8	-3.782	-5.029	-2.535
11,625	1.359	-0.584	3.302
9,9	1.860	0.418	3.302
18,3	-4.549	-7.125	-1.973
10,727	-1.785	-2.904	-0.665
9,1	-0.847	-1.954	0.259
16,6	-1.358	1.718	-4.433
24,8	-4.600	-3.004	-6.197
6,5	1.863	-0.330	4.055
11,8	-3.280	-4.472	-2.088
11,636	-1.181	-2.351	-0.011
RMSE	2.882	3.553	3.358

Figure 6 . RMSE FIS+JST, JST dan FIS

IV. RESEARCH METHOD

A. *Getting Data Training*

The data used in this research is data training and data testing. Data training is data taken using the data usage of electricity by the device at the time is new. New electronic devices are believed to have excellent conditions. And the character of its power consumption can be learned and used as the guideline character of the most normal power usage. For example, Figure 7 is the following power consumption data for the simbadda active speaker device.

Figure 7. Simbadda active speaker power consumption

B. *Test and Training system*

The results of this study, successfully implemented neural networks using php programming language. Researchers use neural network functions in class form. In its implementation, php neural network class is tested to learn xor functions. Following are the results of testing and training using the xor function.

No	Input			Output
	1	2	3	
1	-1	-1	1	**-1**
2	-1	1	1	**1**
3	1	-1	1	**1**
4	1	1	1	**-1**

By using the php class that has been created the application is able to perform calculations to predict with error value less than 0.01 as in table 5 below.

No	Input			Output
	1	2	3	
1	-1	-1	1	**-0.98894**
2	-1	1	1	**0.9917**
3	1	-1	1	**0.99123**
4	1	1	1	**-0.98855**

V. RESULTS AND DISCUSSION

A. *Result*

The results show that the php class used to predict can work well when tested using XOR function. So it is believed to be able to do training with variations of the data used. For the training data, the use of 60 neurons as much as 60 hidden neurons and output only 1. Just to do training data or iteration as much as this takes a relatively long time. Figure 8 below is the result of training for neural networks predicting the results of training using data on power consumption.

Figure 8. Learning power consumption

From the data above, it is known that to be able to predict correctly with a margin error of 0.01 the system takes 180.2 seconds. However, the system is able to predict well the results of exercise to detect damage. From the results of literature review, implementation and testing conducted by researchers then some conclusions that became the final stage of this study. Researchers have successfully implemented an artificial neural network to predict damage to electronic devices using the character of power consumption in a device. To learn one character of power usage, it is necessary to use a neural network scheme with 60 input configurations, 900 hidden neurons and 1 output and takes 180 seconds.

B. *Discussion*

In this study, only one artificial intelligence method, artificial neural network, was used to predict the damage of electronic devices. Predicting using artificial intelligence will be better if it is possible to use more than one model of artificial intelligence so that it can predict better. In addition Figure 27 shows that training using algorithms such as those used by researchers takes a relatively long time.

Further research is expected to be able to modify the algorithm used so that it has better performance. In addition, researchers also suggested using more than one model of artificial intelligence to forecast the destruction of electronic devices.

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