Application of Neural Network in User Authentication for Smart Home System

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Abstract— Security has been an important issue and concern in the smart home systems. Smart home networks consist of a wide range of wired or wireless devices, there is possibility that illegal access to some restricted data or devices may happen. Password-based authentication is widely used to identify authorize users, because this method is cheap, easy and quite accurate. In this paper, a neural network is trained to store the passwords instead of using verification table. This method is useful in solving security problems that happened in some authentication system. The conventional way to train the network using Backpropagation (BPN) requires a long training time. Hence, a faster training algorithm, Resilient Backpropagation (RPROP) is embedded to the MLPs Neural Network to accelerate the training process. For the Data Part, 200 sets of UserID and Passwords were created and encoded into binary as the input. The simulation had been carried out to evaluate the performance for different number of hidden neurons and combination of transfer functions. Mean Square Error (MSE), training time and number of epochs are used to determine the network performance. From the results obtained, using Tansig and Purelin in hidden and output layer and 250 hidden neurons gave the better performance. As a result, a password-based user authentication system for smart home by using neural network had been developed successfully.

***Keywords*—**Neural Network, User Authentication, Smart Home, Security

I. Introduction

RECENTLY there are a lot of criminals happening especially at residential areas. This shows that the security systems available in the market are not powerful enough. For an example, the security system can be easily hacked. Besides, the security system and the door lock are separated. Hence, the intruders can still break in without knowing the password for the security system. Therefore, a more powerful security system is required for the home safety.

Password-based user authentication is inexpensive and affordable. Currently most of the password-based user authentication systems are still using a table to keep the username and password of the authorized users. However, this password table has a potential threat that the passwords may be read or altered by an intruder.

The password-based user authentication using neural network which is introduced here is harder to be hacked. The neural network is used to train (generate and memorize) the identification parameters. One of the most well known types of neural network is the Multilayer Perceptrons Neural Network (MLPs). As a consequence of MLPs required hundred or even thousand of epochs to finish, even for a simple training since it is using Backpropagation technique, Resilient Backpropagation (Rprop) technique will be used to accelerate the training epochs in this paper. This was due to Backprogation Neural Network required a long time to train the nodes [1- 3].

By using the Neural Network system, it is safe enough for the user to combine the door lock with the security system because it is hard for the intruder to hack the system and get the UserID and password. Hence, the user does not need a key to open the door and no key lost or stolen will occur. Furthermore, this system can be applied as the authorization system before entering the smart home controlling system. Therefore, even the owner lost the hardware to remote access the smart home, the person who got it also difficult to access the smart home system because it is hard to crack the owner's User ID and password.

II. Literature Review

A. Resilient Backpropagation (RPROP)

MLP usually use sigmoid transfer functions in the hidden layers, these functions are often called squashing functions because they compress an infinite input range into a finite output range. Sigmoid functions are differentiated by the fact that their slopes must approach zero as the input gets large. Therefore, it causes a problem when a steepest descent is used to train a multilayer network with sigmoid functions, due to the gradient can have a very small magnitude and, hence, cause small changes in the weights and biases, even though the weights and biases are far from their optimal values.

In order to eliminate these harmful effects of the magnitudes of the partial derivatives, the Resilient backpropagation (Rprop) training algorithm is introduced. Only the sign of the derivative is used to determine the direction of the weight update; the magnitude of the derivative

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