STUDY AND ANALYSIS PERFORMANCE OF INTELLIGENT SAFETY MODULE

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Abstract: This paper is based on review on working culture and performance of Expert System and on the communication from sensors and an analysis and solution based decisions/issuing concept. The Artificial Neural Networks (ANN) shall be used for obtaining the solutions. The authors propose a hybrid fault analysis system using an expert system (ES), neural networks (NNs), and a conventional fault analysis package (CFAP). The system detects fault type and approximate fault points using information from operated relays, circuit breakers (CBs), and fault voltage/current waveforms. Faulted sections are estimated by ES and the fault voltage/current waveform is analyzed by NNs. Since power systems require high reliability, the system uses a verification procedure based on CFAP for the result of NN waveform recognition. Four different types of NNs are compared and an appropriate NN is selected for waveform recognition. With NNs, ES and CFAP used together, the system can obtain the convenient features of these methods.

Keywords: Expert System, Smart Grid; Artificial Neural Network(ANN.), Conventional fault analysis package (CFAP)

I. INTRODUCTION

A continuous and reliable supply of electricity is necessary for the functioning of today's modern and advanced society. Since the early to mid 1980s, most of the effort in power systems analysis has turned away from the methodology of formal mathematical modeling which came from the areas of operations research, control theory and numerical analysis to the less rigorous and less tedious techniques of artificial intelligence (AI). Power systems keep on increasing on the basis of geographical regions, assets additions, and introduction of new technologies in generation, transmission and distribution of electricity. AI techniques have become popular for solving different problems in power systems like control, planning, scheduling, forecast, etc. These techniques can deal with difficult tasks faced by applications in modern large power systems with even more interconnections installed to meet increasing load demand. The application of these techniques has been successful in many areas of power system engineering.

Need for AI in power systems: Power system analysis by conventional techniques becomes more difficult because of:
(i) Complex, versatile and large amount of information which is used in calculation, diagnosis and learning.
(ii) Increase in the computational time period and accuracy due to extensive and vast system data handling. The modern power system operates close to the limits due to the ever increasing energy consumption and the extension of currently existing electrical transmission networks and lines. This situation requires a less conservative power system operation and control operation which is possible only by continuously checking the system states in a much more detail manner than it was necessary. Sophisticated computer tools are now the primary tools in solving the difficult problems that arise in the areas of power system planning, operation, diagnosis and design.

A. Advantages:
- Speed of processing.
- They do not need any appropriate knowledge of the system model.
- They have the ability to handle situations of incomplete data and information, corrupt data.
- They are fault tolerant.
- ANNs are fast and robust. They possess learning ability and adapt to the data.
- They have the capability to generalize.

B. Disadvantages:
- Large dimensionality.
- Results are always generated even if the input data are unreasonable.
- They are not scalable i.e. once an ANN is trained to do certain task, it is difficult to extend for other tasks without retraining the neural network.

II. PROPOSED METHOD FOR INTELIGENT SAFETY MODULE

In proposed expert format it have dynamic ability to protection for control system against fluctuation in received signal power parameters like voltage , frequency, power etc. Initially, Expert system learns and train and validate from previous stored data bank. After this process it scans the bus or line to receive the signal to detect and produce the decision to protect the system as pet Indian standard of fulfillments.

Algorithm
Initialization
Generate the set of sample.
Read the data after generation or read the data from standard data bank .
Perform the ANN structure.
Loop: Input available.
After getting the signal parameter from Bus or line .
Take the decision as per convergence criteria.
If input satisfy , than obtain optimum condition* for relay like off condition .
Back to loop.
If input satisfied than relay in on condition* and modify the

design of ANN.
Back to loop.
Return null.
Condition * Voltage reject if Voltage <200 or > 240; reject if frequency < 49 Hz or > 51Hz

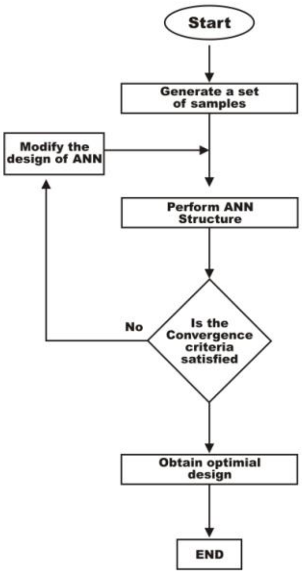

Fig. 2.1: Proposed flow chart of expert system

Liebenberg–Marquardt algorithm: In mathematics and computing, the Liebenberg–Marquardt algorithm (LMA or just LM), also known as the damped least-squares (DLS) method, is used to solve non-linear least squares problems. These minimization problems arise especially in least squares curve fitting. The LMA is used in many software applications for solving generic curve-fitting problems. However, as for many fitting algorithms, the LMA finds only a local minimum, which is not necessarily the global minimum. The LMA interpolates between the Gauss–Newton algorithm (GNA) and the method of gradient descent. The LMA is more robust than the GNA, which means that in many cases it finds a solution even if it starts very far off the final minimum. For well-behaved functions and reasonable starting parameters, the LMA tends to be a bit slower than the GNA. LMA can also be viewed as Gauss–Newton using a trust region approach.

III. EXPERT SYSTEM

An expert system is a computer program which captures the knowledge of a human expert on a given problem, and uses this knowledge to solve problems in a fashion similar to the expert. The system can assist the expert during problem-solving, or act in the place of the expert in those situations where the expertise is lacking.[3]Expert systems have been developed in such diverse areas as science, engineering, business, and medicine. In these areas, they have increased the quality, efficiency, and competitive leverage of the organizations employing the technology.

The program models the following characteristics of the human expert:

- Knowledge
- Reasoning
- Conclusions
- Explanations

The expert system models the knowledge of the human expert, both in terms of content and structure. Reasoning is modelled by using procedures and control structures which process the knowledge in a manner similar to the expert.

Table 1: Comparison between a human expert and an expert system

S.No.	Comparisons		
	Factors	Human System	Expert System
1	Time availability	Workday	Always
2	Geographic availability	Local	Anywhere
3	Perishable	Yes	No
4	Consistant result	No	Yes
5	Cost	High	Affordable
6	Productivity	Variable	Consistent

Fig. 3.1: Proposed flow chart of expert system

A. Expert system structure

The structure and operation of an expert system are modelled after the human expert. Experts use their knowledge about a given domain coupled with specific information about the current problem to arrive at a solution.

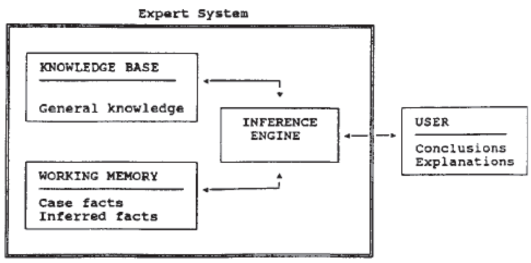

Fig.3.2: Expert system structure.

IV. ANALYSIS AND PERFORMANCE OF INTELIGENT SYSTEM

Proposed Smart grid can be considered as the next generation power grid, which provides bi-directional flow of electricity and information, with improving the power grid reliability, security, and efficiency of electrical system from generation to transmission and to distribution .A smart grid enables the

(i) Integration of renewable energy resources at distribution network.
(ii) Supervisory control and real-time status monitoring on the power network.
(iii) Self-monitoring.
(iv) Self-healing feature, adaptive response to fault.

A. Performance calculation: In statistics and signal processing, a minimum mean square error (MMSE) estimator is an estimation method which minimizes the mean square error (MSE), which is a common measure of estimator quality, of the fitted values of a dependent variable. In the Bayesian setting, the term MMSE more specifically refers to estimation with quadratic loss function. In such case, the MMSE estimator is given by the posterior mean of the parameter to be estimated. Since the posterior mean is cumbersome to calculate, the form of the MMSE estimator is usually constrained to be within a certain class of functions. In statistics, the mean square error or MSE of an estimator is one of many ways to quantify the difference between an estimator and the true value of the quantity being estimated. MSE is a risk function, corresponding to the expected value of the squared error loss or quadratic loss. MSE measures the average of the square of the error.[4][5]

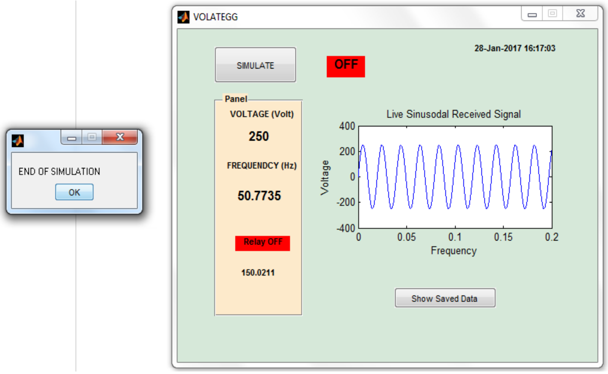

Fig. 3.1 : Panel diagram of expert system

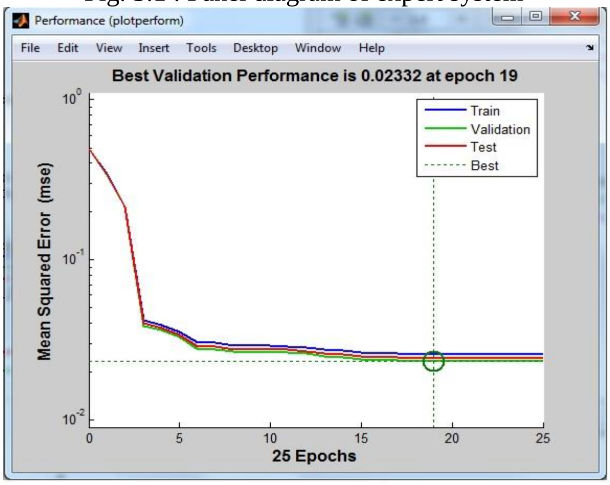

Fig.3.2 : Neural Network Training Performance for 20 epoch

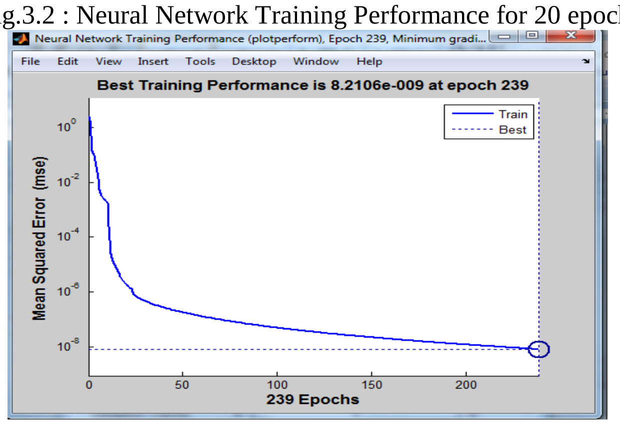

Fig.3.3: Neural Network Training Performance for 239 epoch.

Performance of neural network with different epochs uses at the time of neural network training as follows.

Table 2: Comparison Neural Network Training Performance

S.No.	Comparisons		
	Epoch	Performance	Best at Epoch
1	25	.02332	20
2	239	8.2106-e009	239

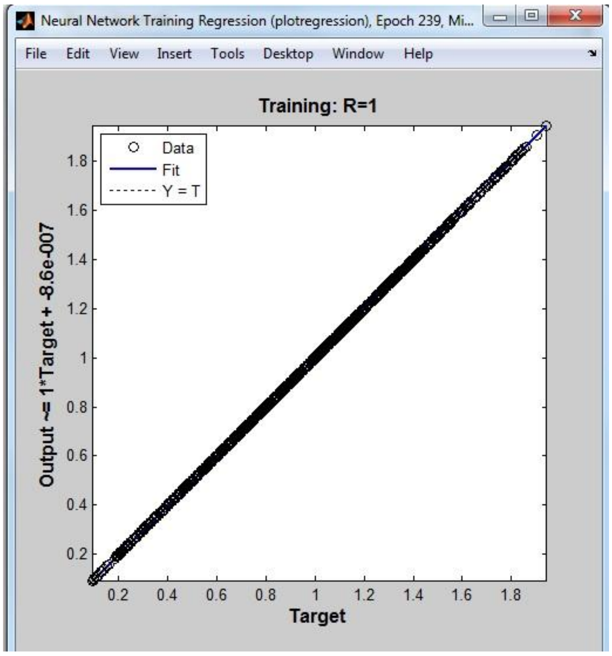

Fig.3.4.Neural Network Training Regration

Above plot shows the neural network Regrassion between output and target at epoch 239 for best performance under real time and satatic input data .

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