POWER THEFT DETECTION USING PROBABILISTIC NEURAL NETWORK CLASSIFIER

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Abstract - *The power theft has become a major problem in India. The power system consists of generation, transmission & distribution. The power theft is happening only in transmission & distribution side. In order to reduce the power theft, so many methods have been proposed. But the case of direct hooking to distribution line is more difficult to find out. This project presents this type of theft detection in power system. There are many technical losses present in transmission & distribution but at the same time loss due to power theft is more. Hence lot of loss for the utility. We propose the detection of power theft using probabilistic neural network classifier in power system*

Key Words*: *Electrical Power Theft, Non-Technical Losses, Power Theft, Location, Probabilistic Neural Network.

1. INTRODUCTION

Generation, distribution and transmission will constitute the power system. Major amount of power theft occurs in distribution system. There two type losses, one is Technical loss and another one is non-technical loss occur at the transmission and distribution side. Power theft is one such non-technical loss. In non-technical loss stealing of electricity is done by direct hooking to distribution line, in the meter injecting the foreign materials and drilling holes in electromechanical energy meter or resetting the meter, etc. Meter tampering can be minimized by place LDC circuits inside the meter, So it send the warm signals in to the substation, therefore these kind of power theft is not a major problem, But in the case of direct rigging to distribution line is major problem for detecting the power theft. In this project we propose detection of power theft in the distribution line. We are detecting these type problem by using probabilistic neural network control classifier.

2. PROBABILISTIC NEURAL NETWORKS

The feed-forward neural networks such as probabilistic neural networks finds wide application in pattern recognition and classification problems. Probabilistic neural network algorithm uses non-parametric function and parzen window to approximate each class of parent probability distribution function. By the use of probability distribution function of each class, the probability class can be computed for new data inputs .The new data inputs are allocated with highest posterior probability class by the use of Bayes rule. Thus the probability of mis-classification will be reduced by using this method. By using Bayesian network, probabilistic neural network can be derived. In 1966 D.F,.Specht introduced the statistical algorithm known as kernel fisher discriminant analysis.

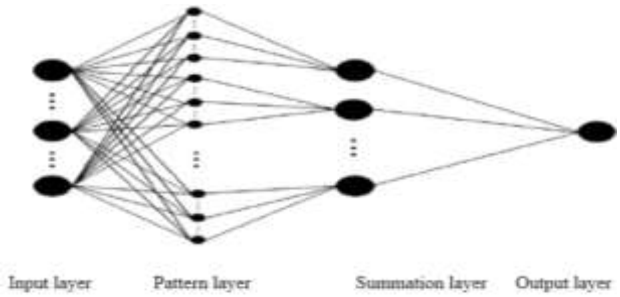

Figure 1. Architecture of Probabilistic neural network

In probabilistic neural networks the operation can be divided into multilayer feed-forward network consisting of four layers.

i. INPUT LAYER

In input layer, each neuron present will indicate predictor variable N-1 neurons are present in categorial variables, where N represents the category number. The median is subtracted and it is divided interquartile range as a result the range of values will be standardized.

ii. PATTERN LAYER

Pattern layer consists of training data set. Here for each case one neuron will be present together with the target values, value of the predictor variables for the case are stored. In this layer the neuron hidden will compute.

iii. SUMMATION LAYER

The each category of target variable of PNN network consist of one pattern neuron. With each hidden neuron, the real target category of each training cases will be stored zero hidden neurons, the weighted value will be carried out. And value will be fed to the pattern neuron.

iv. OUTPUT LAYER

Here the weighted votes for each target category present in pattern layer will be compared. The target category is predicted by the use of target vote.

3. DESIGN & IMPLEMENTATION

i. METHODOLOGY

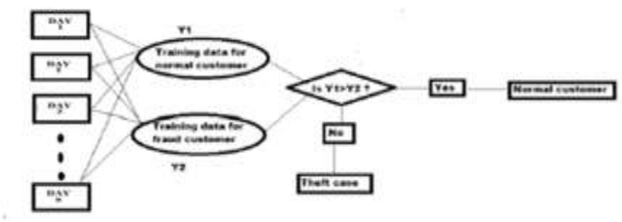

Figure 2. Over all block diagram of the concept

The project concept we can find out the power theft detection in the distribution line. first we make PNN training data for normal customer that is y1 and PNN training data for fraud customer, that is y2.then the condition y1>y2,if it is YES then there is no fraud occurred, otherwise theft case will occurred

3.1 ALGORITHM FOR THEFT LOCATION

In this Project (medium voltage) overhead power distribution system is taken into consideration. The system consists of source present at remote end and main line with load taps.

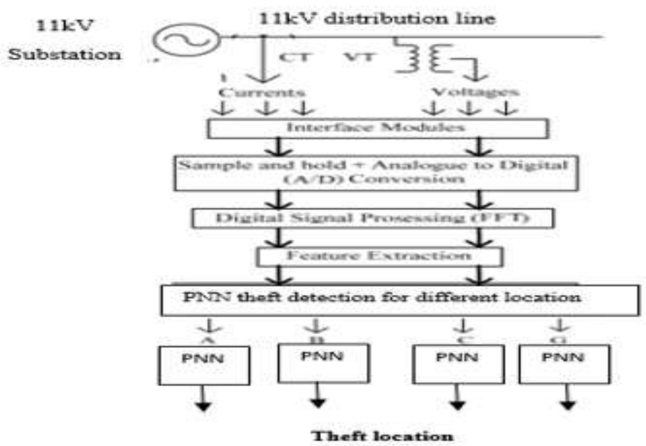

Figure 3. The block diagram for the theft location algorithm.

The theft location algorithm is shown fig.3, by using MATLAB/SIMULINK software the algorithm is simulated. By considering the effects of current transformer, voltage transformers and effects of analogue interface such as quantization and anti-aliasing filters, the theft location is developed. Therefore the location of theft determined will be closed real life situation.

For theft location methods using PNN, and a single PNN cannot be used for locating theft for different systems and different loading conditions. Because in order to train PNN large amount of data is needed and also accuracy of location of theft detected will be unsatisfactory. The PNN algorithm can be split into two section. The input pattern consists of six frequency parameters for each current waveforms and phase voltages for particular theft point. The theft classification and location can obtained by applying the frequency parameters to PNN. At first, a single PNN will be used to classify the overhead power distribution lines, regardless of exact to theft location. Secondarily, after classification of the theft, then the PNN should be used for locating theft. The PNN's is trained for the type of theft. Separate set of PNN are trained and designed for each theft for power theft detection.

4. DISCUSSION OF RESULTS & SUBSTITUTING FOR FUTURE WORK.

The design, development and performance of neural networks for the purpose of theft location are discussed in this section.

4.1. THEFT LOCATION DETECTION PROCESSES

Steps involved in fault location.

- Data Creation.
- Training of probabilistic Neural Network for the Desire Data.
- Design of main algorithm for theft Detection.

4.1.1. Data Creation

In this project first we create the data for the normal customer and fraud customer. For the detection of the power theft in the distribution line.

4.1.2. Training of probabilistic Neural Network

Feed forward back – propagation algorithm was once again used for the purpose of theft detection in transmission lines. The reason for doing so, as already mentioned is that these networks perform very efficiently when there is availability of sufficiently large training data set. For the training the neural network, several theft places have been simulated on the modeled transmission line.

4.1.3 Main algorithm for theft Detection

Now that the probabilistic neural network is trained for the next step is to analyze the performance of the network is called testing. The methods and means by which this neural network has been tested are discussed here in this section. It can be noted that both the average and the maximum error percentages in accurately determining the location of the theft in acceptable level and the network's performance is satisfactory.

4.2. MATLAB SIMULINK MODEL

a) Case 1: Theft at 0.2km Condition;

The below figure consists of a three phase transformer of rating 11kV/400V.and normal loads are connected for a particular distance. In each block we place three-phase VI measurement block. The block can output the voltages and currents. In below figure theft load is placed at 0.2km then we run the system.

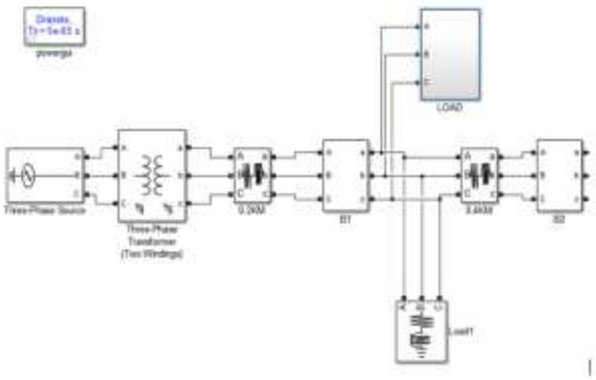

Figure 4. Simulink model

Output Theft at 0.2km Condition

After running the system the output shows the, theft location occurred at 0.2km as shown in below diagram.

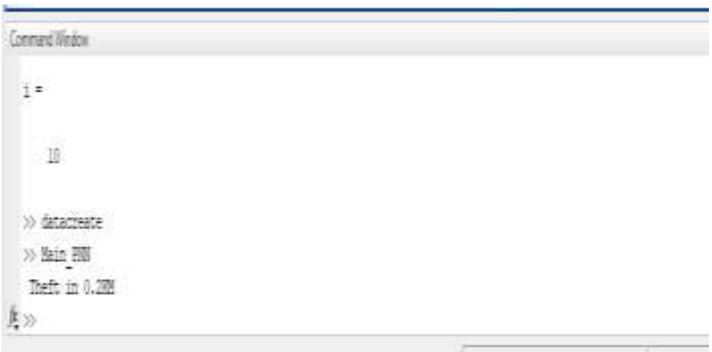

Figure 5. Output of simulink model

b) Case 2: No Theft Condition;

The below figure consists of a three phase transformer of rating 11kV/400V.and normal loads are connected for a particular distance. In each block we place three-phase VI measurement block. The block can output the voltages and currents. In below figure we doesn't place theft load to system, then we run the system.

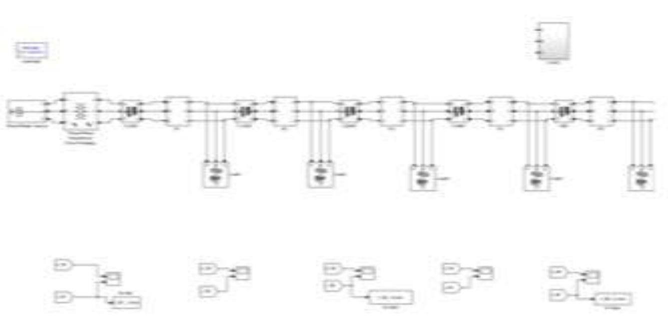

Figure 6. Simulink model

Output at No Theft Condition;

After running the system the output shows the, there is no theft occurred in distribution system as shown in below diagram

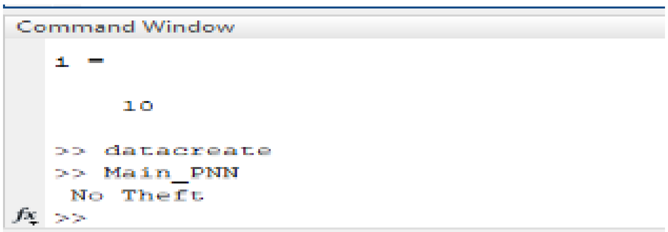

Figure 7. Output of simulink model

c) Case 3: Theft at 0.4km Condition;

The below figure consists of a three phase transformer of rating 11kV/400V.and normal loads are connected for a particular distance. In each block we place three-phase VI measurement block. The block can output the voltages and currents. In below figure theft load is placed at 0.4km then we run the system.

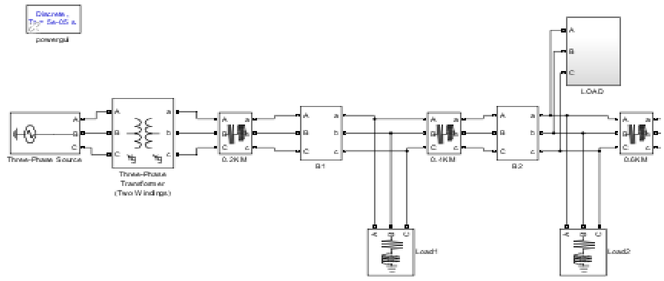

Figure 8. Simulink model

Output Theft at 0.4km Condition;

After running the system the output shows the, theft location occurred at 0.4km as shown in below diagram

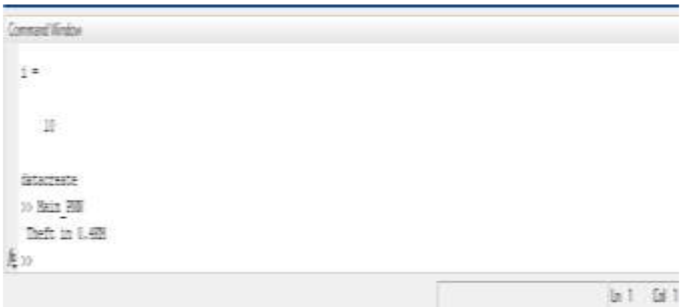

Figure 9. Output of Simulink model

d) Case 4: Theft at 0.6km Condition;

The below figure consists of a three phase transformer of rating 11kV/400V.and normal loads are connected for a particular distance. In each block we place three-phase VI measurement block. The block can output the voltages and currents. In below figure theft load is placed at 0.6km then we run the system.

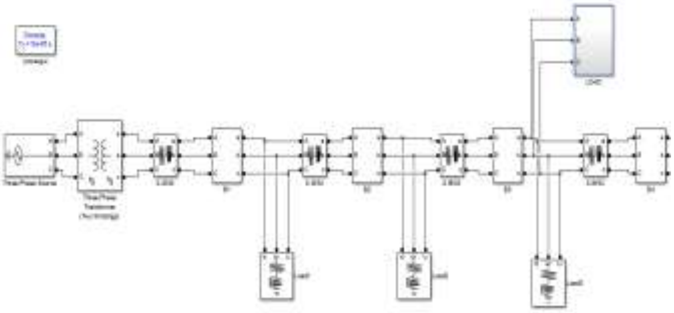

Figure 10. Simulink model

Output Theft at 0.6km Condition;

After running the system the output shows the, theft location occurred at 0.6km as shown in below diagram.

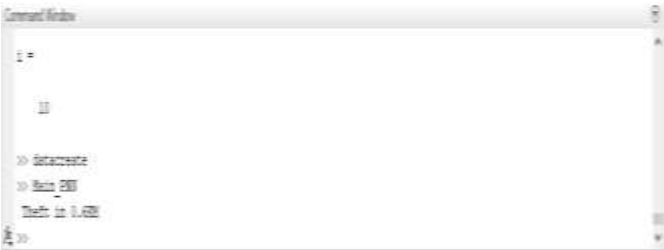

Figure 11. Output of simulink model

e) Case 5: Theft at 0.8km Condition;

The below figure consists of a three phase transformer of rating 11kV/400V.and normal loads are connected for a particular distance. In each block we place three-phase VI measurement block. The block can output the voltages and currents. In below figure theft load is placed at 0.8km then we run the system.

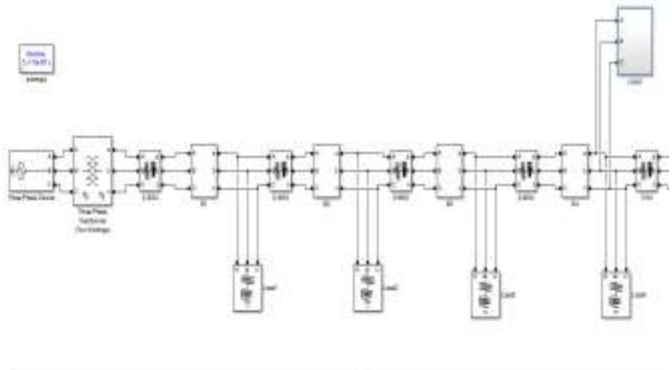

Figure 12. Simulink model

Output Theft at 0.8km Condition;

After running the system the output shows the, theft location occurred at 0.8km as shown in below diagram.

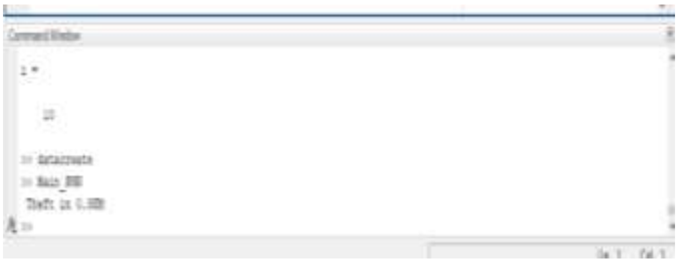

Figure 13. Output of simulink model

f) Case 6: Theft at 1km Condition;

The below figure consists of a three phase transformer of rating 11kV/400V.and normal loads are connected for a particular distance. In each block we place three-phase VI measurement block. The block can output the voltages and currents. In below figure theft load is placed at 1km then we run the system.

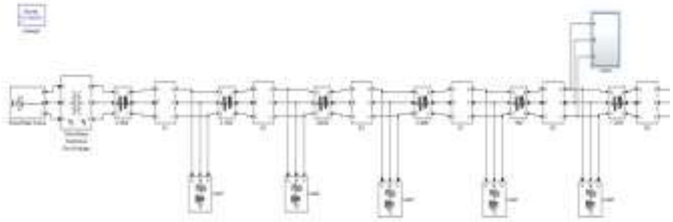

Figure 14. Simulink model

Output Theft at 1km Condition;

After running the system the output shows the, theft location occurred at 0.8km as shown in below diagram.

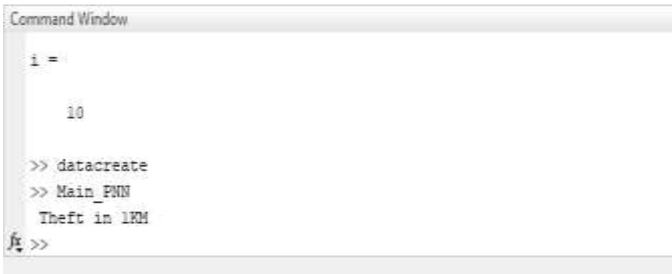

Figure 15. Output of simulink model

5. CONCLUSION

In this project neural networks are used alternately for detection of power theft, location of theft can be detected on the basis of transmission and distribution lines. The technique used will make use of phase currents and phase voltages as input for neural networks. Each neural network discussed in the project is belongs to back-propagation neural network architecture. The theft location method is used in the transmission right from the detection of theft on the line to theft location stage has been devised successfully but utilizing probabilistic neural network.

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