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APPLICATION OF NEURAL NETWORK TECHNIQUE TO TELECOMMUNICATION FAULT DOCKET SYSTEM

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ABSTRACT

This paper concerns the application of neural network technique to automatic telecommunication fault docket system. Neural networks have a unique set of characteristics. They are not programmed; instead they are trained by being repeatedly shown large numbers of examples for the problem under consideration. As a result of this, they can provide good results in relatively short timescales but for only certain types of problem, and then a great deal of care is taken over the collection of the data, pre-processing of the data and the design of the network. In this research the feed-forward neural network strategy was adopted with mapping innovation called Kohonen self organizing mapping. It was implemented using Microsoft visual basic 6.0 as front end and Microsoft access 2000 as the back end. The results shows that, by observing great care in data collection, processing and network design, faults are diagnosed and solutions automatically proffered within a short time. This approach results in significant cost saving by improving the availability and efficiency of telecommunication systems.

Keywords: *service records, customer service database, intelligent fault docket system, neural process & data mining.*

INTRODUCTION

Some form of on-line and automated system is needed to keep track of fault reporting and repair work on telecommunication systems. If data can be captured and validated at the reporting time, fault analysis can be generated without difficulty. This automated system captures faults timely and route these faults to the appropriate maintenance unit for quick restoration. Telecommunication organizations generally have a customer service department (or fault desk) where faults are centrally reported and in addition provide a good quality of service and maintenance support for their customers. A help-desk service centre (or fault desk) is usually established to address frequently encountered problems by the customers. Service engineers are instructed by the help-desk centre to respond to customers' request and carry out on-site repair if necessary. At the end of each service, a report is generated to explain the nature of fault and remedies taken to rectify the problem. These service reports are then stored as service records in a customer service database. Presently, telephone subscribers report faults on dedicated telephone numbers or by physically going to the centre. The operator takes information from the customer and generates the docket. These dockets are moved from one position to another for restoration. All these processes are time consuming; therefore require some mechanism for automation.

Ezebuiro [1] established that using computer system for fault docket system improves the availability/efficiency of network equipment. He further suggested that this system can be improved by using neural network. Since the fault reporting system involves recording, decision making and routing of fault to the appropriate maintenance desk for quick clearance both data mining and neural processes are required in creating the algorithm for its automated functionality. The fed-forward neural network and the rule strategy adopted with a mapping innovation called kolonen self organizing mapping, and implemented using Microsoft visual basic 6.0 as front end and Microsoft Access 2000 as the back end.

LITERATURE REVIEW

The term' neural network can be described as an 'artificial intelligent network'. True neural networks are biological systems (e.g. the brains) that detect patterns, make predictions and learn. The artificial ones are computer programs implementing sophisticated pattern detection and machine learning algorithms on a computer to build predictive models from large historical databases. Artificial neural networks derive their name from their historical development which started off with the premise that machines could be made to 'think' if scientists found ways to mimic the structure and functioning of the human brain on the computer. Thus historically neural networks grew out of the community of artificial intelligence rather than from the discipline of statistics. To understand how neural networks can detect patterns in a database an analogy is often made that they 'learn' to detect these patterns and make better predictions in a similar way to the way that human beings do.

METHODOLOGY

The feed –forward neural network and the rule strategy methods were adopted with a mapping innovation called Kohonen self organizing mapping. It is implemented using Microsoft visual basic.6.0 as front end and micro access 2000 as the back end.

The neural network and the rule framework consist of two processes, the knowledge extraction and the fault diagnosis process. The knowledge extraction process extracts knowledge from the service records to form a knowledge base, which contain the neural network model. Fault condition in the customer database are first pre-processed, the result of the pre-processing is then used to form weight vectors to initialize the neural network model. The neural network was used to classify an instance of a new fault description into one of the known classes of fault and then used the suggested solution of the known fault for the current problem. Information on the fault is then extracted from the customer database to form cluster of similar fault and then classify a new problem instance into one of the clusters. The classification into specific fault condition is determined based on the closest match of the fault condition with the input pattern within the clusters. Knowledge extracted from the checkpoint solution of the fault condition is used to generate a rule to guide the reuse of checkpoint solution effectively. The rules provide step-by-step guidance in diagnosing a fault condition. The fault diagnosis process, accept the user's problem description as input, maps the description with the most closed fault condition of fault reported before from the knowledge base and retrieves the corresponding solution for the service engineer. The fault diagnosis process uses cycle, retrieve, reuse, revise and retain to diagnose reported problems. The revise information is retained as knowledge for enhancing its performance in future diagnosis.

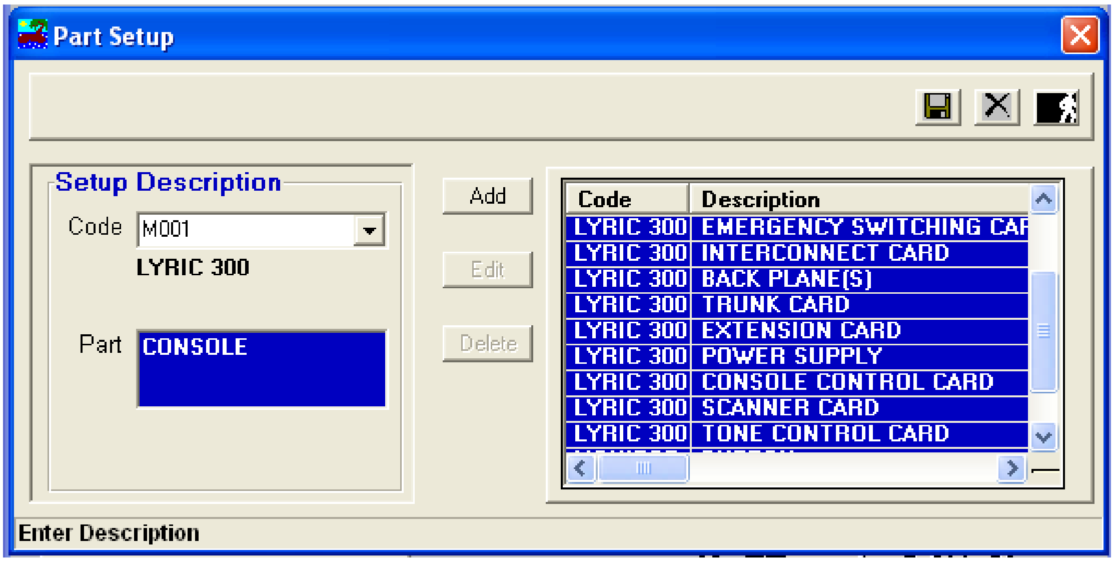


Figure 1: shows the interface to setup parts or accessories for equipment

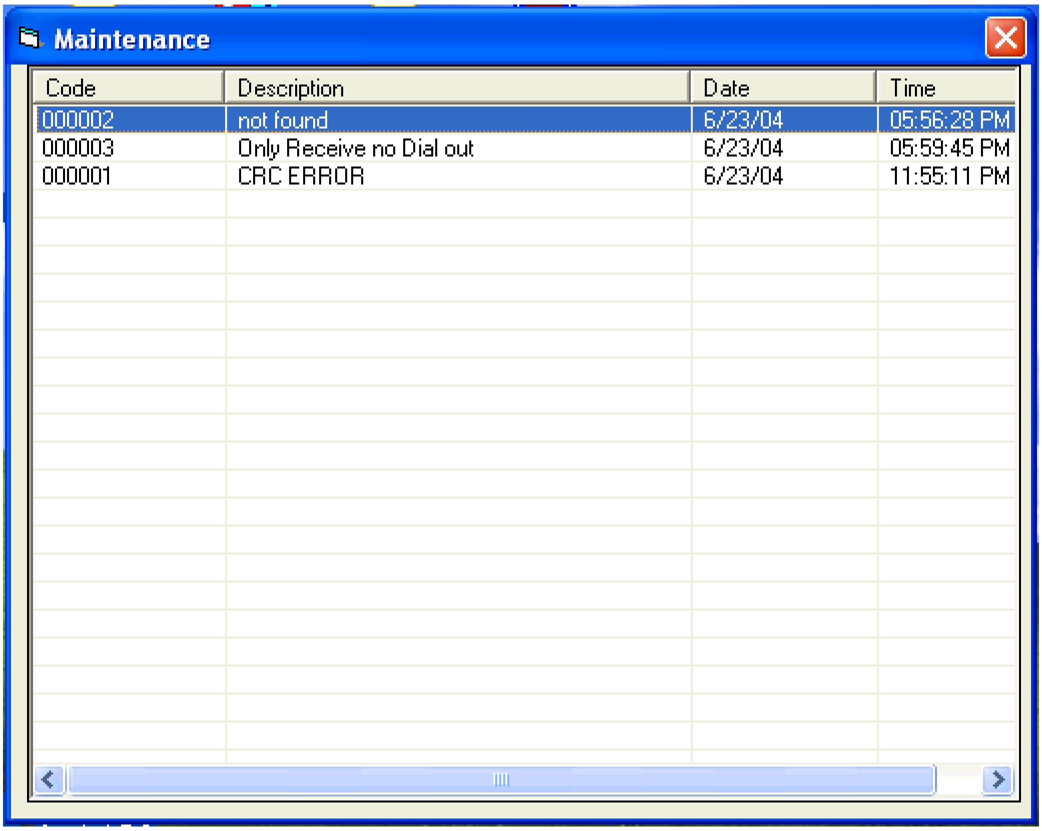
STIMULATION

The database was created with Microsoft Access, and the data for neural network. The data for neural network are stored as unstructured text in the machine fault and checkpoint table. There are over 250 service records in the customer service database with over 500 checkpoints. In addition, structured data on 250 employees, over 3000 subscribers and also features of antennae, switch, exchanges, cable etc are also stored.

Service records are defined and stored in the customer service database created with Microsoft Access to keep track of all reported problems and remedial actions. Each service records consist of customer account information and service details: fault condition and checkpoint information. Fault condition contains the service engineer's description of equipment faults.

When faults or complains are reported at the fault desk. Rectification of such fault is allocated to service engineer so that, the service engineer is able to view faults allocated to him immediately he login to the system. The process is done at the fault desk. The system has privilege section which is part of the security measures. By checking any of the privileges, limit access of the user to the privilege he is assigned.

Whenever complain is allocated to a service engineer, the system informs him immediately he logged on to the system. If the system engineer click 'OK' the descriptions of reported complains is displayed. This window shows the docket number, description, date and time of complain. When the service engineer double-click on complain the step-by-step rules to rectify the problem are displayed.



Maintenance

Code	Description	Date	Time
000002	not found	6/23/04	05:56:28 PM
000003	Only Receive no Dial out	6/23/04	05:59:45 PM
000001	CRC ERROR	6/23/04	11:55:11 PM

Figure 2: Complains that has been allocated to a service engineer

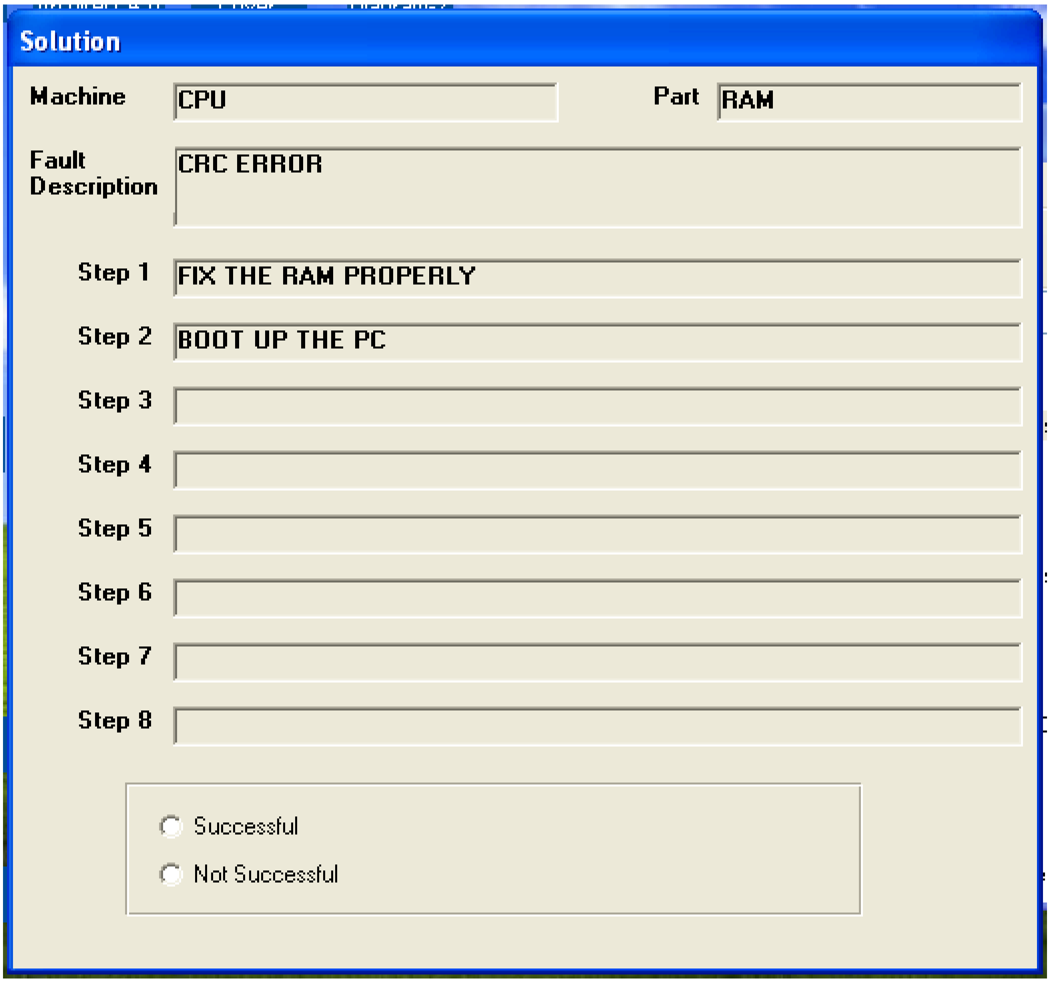


Figure 3: Step-by-step rules to rectify the fault (CRC ERROR).

Figure 3 shows the rules to rectify a fault. It will be observed that apart from the fault description that is displayed, the machine involved and the affected part is also displayed. In this case, this is the first time the complain is reported, it is important to inform the system whether the process displayed rectified the problem or not. Where the problem is solved by this process, the system updates the neural network. The update means that the neural network is trained for the solution to this particular problem. The neural network confidently display the solution to the same complain the next time it is reported.
Where the process displayed did not solve the problem the user is informed to contact the expert. When a user with expert privilege logon on to the system, a message is displayed for him to know that there are complains waiting for his attention.
The systems generate reports which can help to analyze the efficiency or durability of a particular equipment compare to others. Also, when a fault is booked and is pending beyond six hours it is automatically allocated to another services engineer who has fewer jobs or has no job pending.

IMPLEMENTATION
The system was tested on GPT Lyric 300 and SX-200 Generic 247, in an environment that has the combination of Nortel switch DMS500, Harris Farinol antennae. Also, there were

outside plant frame, and intern projector frame, which were used to monitor subscribers' lines.

RESULTS

The data used for the implementation were categorized into primary and secondary data. Data derived from previous (historical) record before the implementations are primary data. Secondary data were derived from the implementation of the intelligent fault docket system. The system availability figure was derived by subtracting number of faults rectified from the number of fault reported. The value of the subtraction is then subtracted from the total number of subscribers. These data recorded within a period of one week thus giving the figure for the availability of the system within the period of one week. Table 1 shows the average values obtained for the availability of the telecommunication system for primary data and table 2 for secondary data. Data were collected for 12 weeks in each case.

Table 1: Primary data

PRIMARY DATA	
EXCHANGE	**AVAILABILITY (%)**
Sx-200	92.26
LYRIC 300	96.96
PTO Standard	97.95

Table 2: Secondary data

SECONDARY DATA	
EXCHANGE	**AVAILABILITY (%)**
Sx-200	98.33
LYRIC 300	99.35
PTO Standard	99.99

The results of secondary and primary data obtained are now compared to give the true influence of the intelligent telecommunication fault docket system. These comparisons are represented graphically as shown in figures 4, 5 and 6.

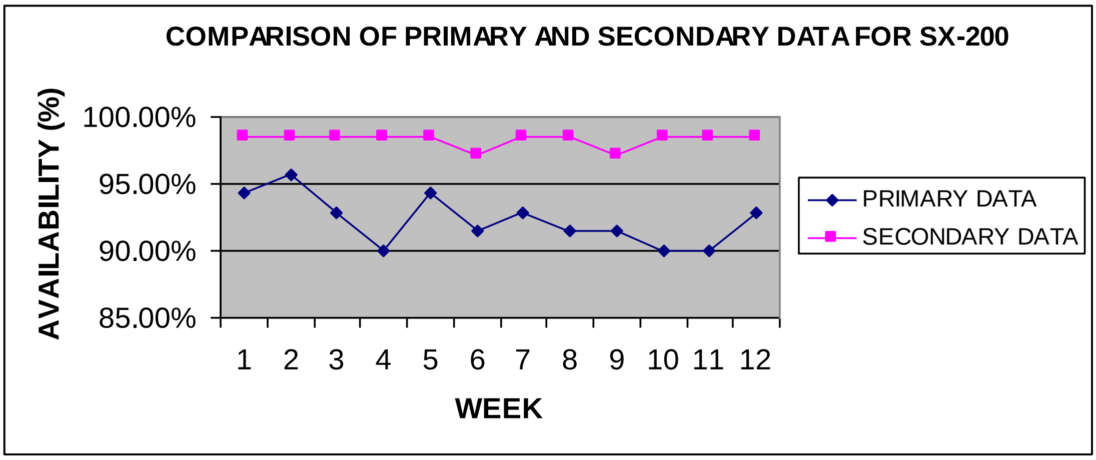


Figure 4: Primary shows the availability of SX-200 before the introduction of the intelligent fault docket system and secondary shows the availability of the exchange after the introduction of the program

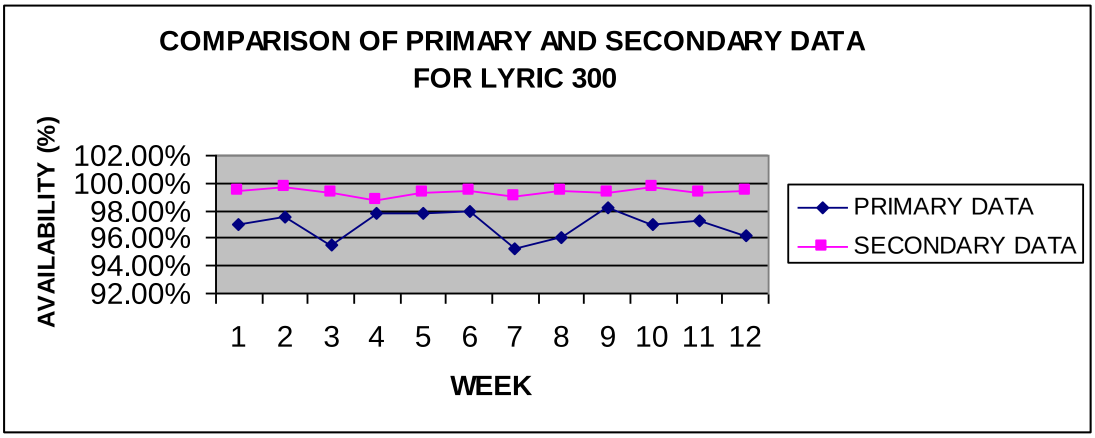


Figure 5: Primary shows the availability of LYRIC 300 before the introduction of the intelligent fault docket system and secondary shows the availability of the exchange after the introduction of the system.

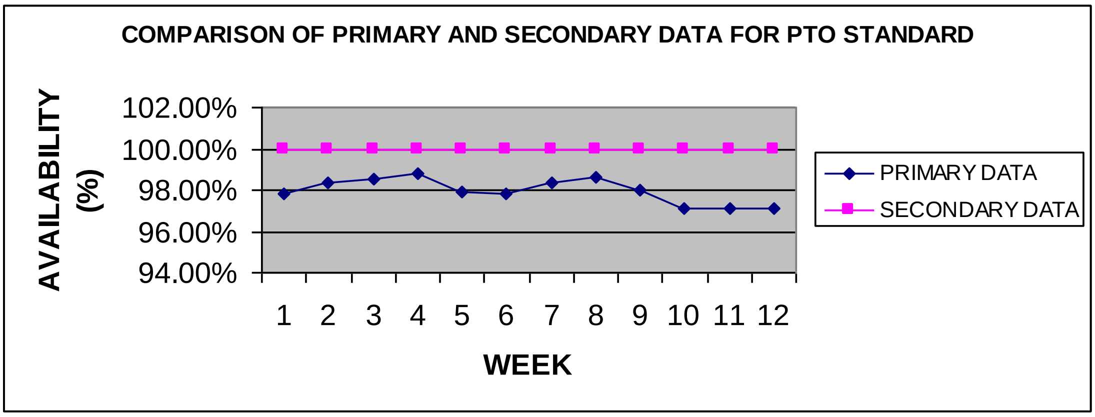


Figure 6: Primary shows the availability of PTO standard equipment before the introduction of the intelligent fault docket system and secondary shows the availability of the exchange after the introduction of the system

ANALYSIS OF RESULTS AND DISCUSSION

The entire algorithm was written such that it is network-based. This makes it possible for every user to login at different location. Whenever faults are reported and assigned to service engineer, each service engineer can login at their various desks. For the PTO standard there is existing software which runs on telnet. This software serves as the exchange. This software is also used to identify most subscribers' problems. Problems related to subscribers individual lines are already computerized and the results obtained for the efficiency is compared with the computerized activities. The other two exchanges has inbuilt software that run at the background of the activities of the equipment. The project takes care of all preambles and comes out with the step-by-step solution to the reported problem. From these two observations, the activities of the equipments in both locations are computerized.

If for any reason a system engineer has not attended to a fault in six hours any other system engineer that is free is automatically assigned the job. This feature makes sure no system engineer is idle when there are works to be done. From the results obtained for primary data compared to secondary data we observed that the introduction of the project affect the availability of telecommunication equipments positively. The data range would have been steady but for lack of replacement parts. The availability of SX-200 rose from an average of 92.26% to an average 98.33%, while the availability of Lyric 300 rose from average of 96.96% to an average of 99.35% also the availability of telecommunication equipment in PTO rose from 97.95% to 99.99%

CONCLUSIONS

In this project, we have incorporated neural network and rule base to mine data stored in a service database for telecommunication fault docket system. Neural network extract knowledge from service database and subsequently recalled the most appropriate service records based on fault description during the retrieval phase. Rule is then used to reuse the checkpoint solutions from the retrieved service records and guide the service engineer through a step-by-step approach to help solve the problem in the most effective manner. The machine problem and its solution were revised with user feedback. The revised information was then retained by updating the relevant databases. The performance of the project was carried out and compared with the existing computerized method. Evaluation shows that this method produced more efficient results. It is shown that system availability was fluctuating between 97% and 98.8% before the introduction of the intelligent fault docket system, with the introduction it rose to a steady value of nearly 99.99% after the application of the neural network technique. The project is easy to use, fast and accurate retrieval of solution to problem is highly efficient. This in on doubt enhances quality of service.

REFERENCES

Ezebuiro, I.I. (1988),"Management Techniques for improvement of Telecommunications service efficiency", Pp 92 - 130. A PhD dissertation, The Union Institute and University Cincinnat, OHIO, USA.

Fong A. C. M. and Hui S. C. (2001), "An intelligent online machine fault diagnosis system", IEE Computer and Computer Engineering Journal Pp 217 - 223.

High performance wireless research and Education Network. http:/hpwre.ucsd.edu/HPWREN Measurement and analysis.

Communication network, by J. E .Ettinger 1985.

Samplei, Seiichi, Applications of Digital Wireless Technologies to Global Wireless communications.

Principles of communication engineering by ANOKH SINGH, A.K.CHHABRA.