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An Expert System for a Broadcasting Network

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ABSTRACT

This research will develop an Expert System that will aid a Broadcasting Network on their networking problems in radio broadcasting. It is a web-based system but it also has a stand-alone module in case of loss of internet connection. The researchers made use of rule extraction algorithm in order to find the minimal set of consistent rules that characterize the system. In order to give weight on what might have caused the problem, the researchers used the Quandary Weighting Algorithm with the aid of the Logic Scoring of Preference (LSP) foundations. The system has its autocomplete feature that expands strings that have been partially entered into complete strings. The system only used the data provided by the company.

Key words : Expert systems, networking problems, quandary weighting algorithm, rule extraction, Logic Scoring of Preference.

1. INTRODUCTION

An Expert System that will be designed by the researchers for a Broadcasting Network will be web-based. Therefore, PHP was chosen primarily as the main programming language for the system. PHP is fast on websites because it is embedded in HTML code, therefore, it shortens the time to process and load a webpage [1,2]. Its versatility to run on a variety of operating systems will also be important because we would want our system to run on different OS. PHP's s feature on being able to interact with HTML forms will be helpful since the main user interface of the expert system was about asking the user to fill out some forms [3,4]. PHP can display an HTML form and process the information that the user types in. PHP is also particularly strong in its ability to interact with databases [5,6]. The proposed expert system will be using MySQL for our database which is one of the major databases supported by PHP [7]. Its database configuration is like those in [9, 10].

2. EXPERT SYSTEM

An expert system is a computer program designed to simulate the problem-solving behavior of a human who is an expert in a narrow domain or discipline [11,12] . The expert system works like an interactive system that responds to questions, asks for clarification, makes recommendations, and guides the user in the decision process. These systems can used Spatial algorithms and Fuzzy Logic [13, 14,15]. Expert systems enable to deliver quantitative information, much of which has been developed through basic and applied research as well as heuristics to interpret qualitatively derived values, or for use in lieu of quantitative information [16,17,18]. Another feature is that these systems can address vague and incomplete data through the assignment of confidence values to inputs and conclusions.

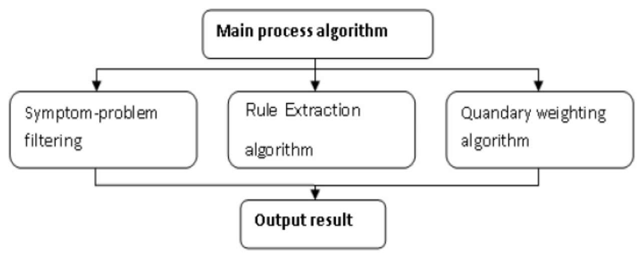

Figure 1: Three sections of the Main process algorithm

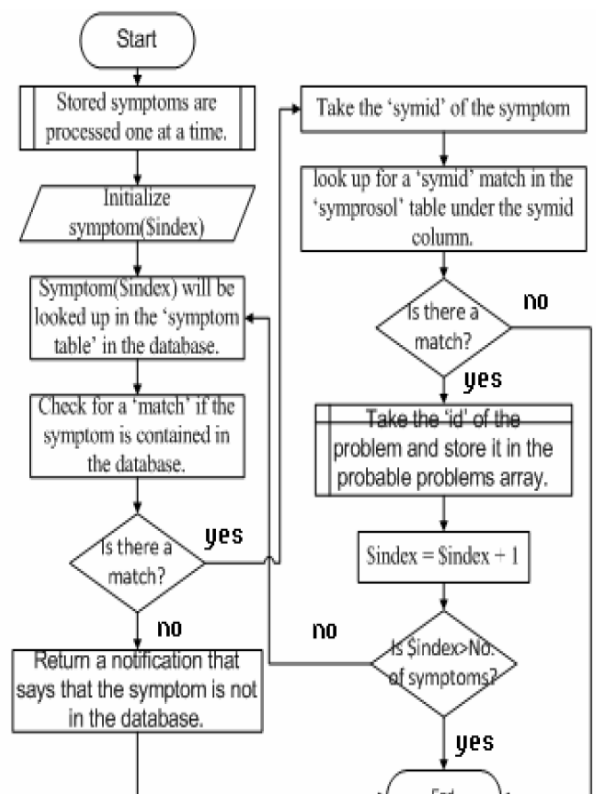

Figure 2: Flow chart of Symptom-problem filtering algorithm

3. MAIN PROCESS ALGORITHM

3.1. The Algorithm

The main process algorithm is the heart of the whole program of the expert system. As the user clicks the submit button, this algorithm does all the work. It processes all the symptoms and percentage of sureness stored in the session variables as inputted by the user. Neural Network can be used to interpret vagueness [19,20]. The program was designed in a way that the expert system makes use of the quandary weighting algorithm and the rule extraction algorithm to process the result. The main process algorithm is divided into 3 sections as shown in Fig. 1.

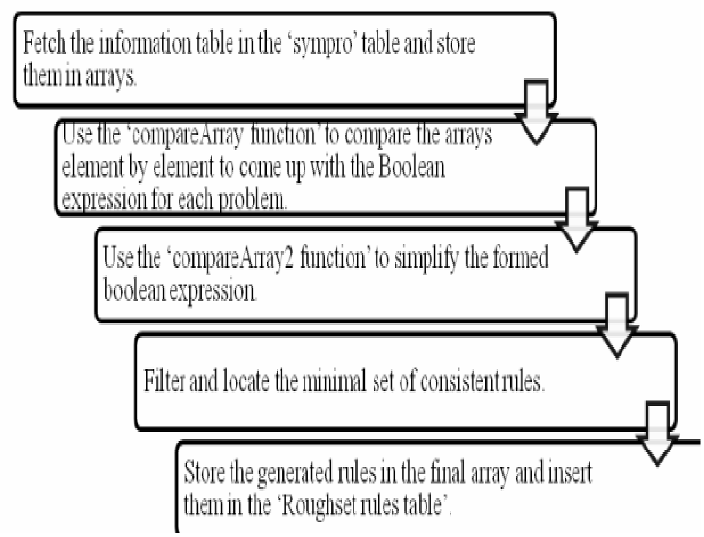

Figure 3: Pseudocode of the rule extraction algorithm

3.2. Symptom-problem filtering

With the inputted symptoms stored in session arrays, the system uses these symptoms to filter all the problems that correspond to the inputted symptoms. To do this, the system uses the SQL like clause. Fig. 2 illustrates the algorithm used to program the filtering process [21, 22].

Fig. 2 begins with the initialization where stored symptoms are processed one at a time. Each symptom then will be looked up in the „symptom table" in the database. The system will then store this in a session array and then do a SQL „like" query to see if the symptom is present in the symptom table. If a match is found, "symptom id" will be taken. Else, a note appears saying the entered symptom is not in the database. With the „symptom id" taken, the system will look up for a match in the "symprosol" table under the "symid" column to find the problems that have this symptom. If a match is found, the problem will be stored in the probable problems array for it will be a candidate problem. The data can be communicated via network or USB hub [23].

3.3. Rule Extraction Algorithm

I. This is the process of finding a minimal set of consistent rules that characterize the system. This process is very important since it constitutes the problem-symptom relationship of the system and this is the basis of the values for the quandary weighting algorithm using Logic Scoring of Preference [24, 25, 26]. The pseudo-code presented in Fig. 3 will briefly explain the process done in the algorithm.

Table 1 illustrates a sample decision matrix that was formed after fetching the information table and this will be the subject of simplification. Following is Fig. 4 that shows the output of the rule extraction algorithm as stored in the array.

Table 1: Sample Decision Matrix formed

Objects	2	3	4
1	s_2=0, s_3=0,s_4=1	s_1=1, s_3=0, s_4=1	s_1=1, s_3=0

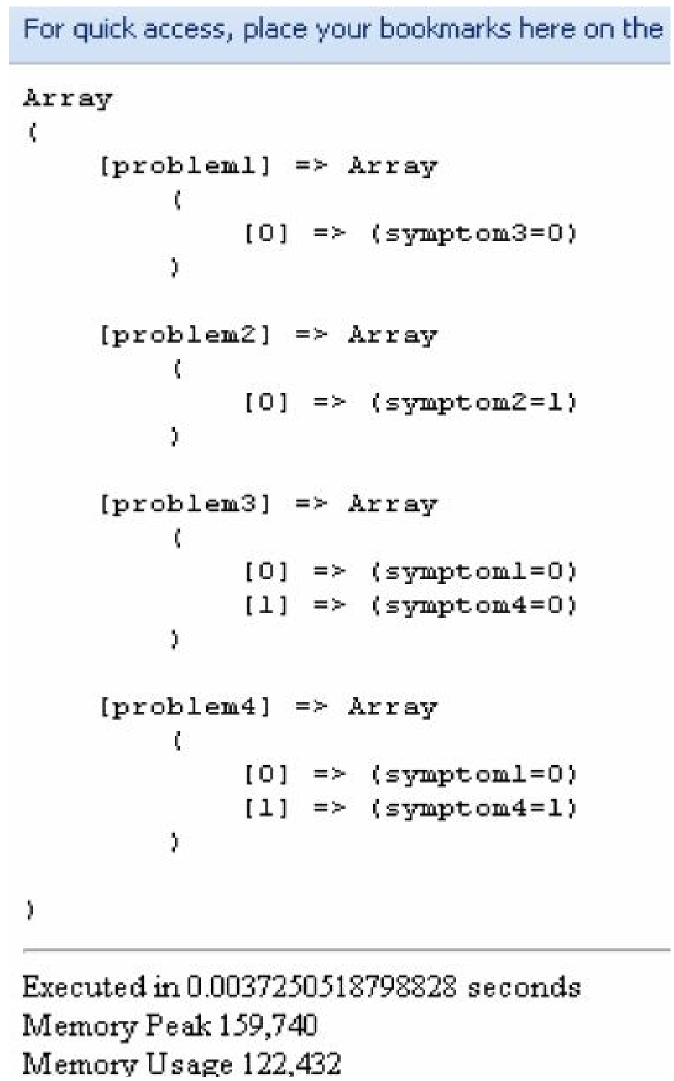

Figure 4: Extracted Rules of the Expert System

3.4. Quandary Weighting Algorithm

The basis of the quandary weighting algorithm is the theoretical foundations of the Logic Scoring of Preference model. For some basic information, logic scoring of preference model is basically used for evaluating complex hardware and software systems. For the designed expert system, this algorithm will aid to give weight to the ones an Expert System has recommended to what the probable cause.

This algorithm is useful for our system for it can be used in problem and symptoms relationships. For different input parameters, it may result in different probable cause of problems. For real applications, a human expert may give different suggestions to a problem. Through quandary weighting algorithm, the expert may give weight to what might have caused the problem with the aid of the LSP foundations. Table 2 shows the list of parameters of the andor function and among these, the expert system made use of Strong QD operation as suggested by the expert. But take note that it can be changed anytime depending on what the expert wants.

Table 2: Symbols and Parameters of the ANDOR functions [25]

Operation	Symbol	d	r2	r3	r4	r5
Disjunction	D	1.0000	+infinity	+infinity	+infinity	+infinity
Strong QD(+)	D++	0.9375	20.630	24.300	27.110	30.090
Strong QD	D+	0.8750	9.521	11.095	12.270	13.235
Strong QD(-)	D+-	0.8125	5.802	6.675	7.316	7.819
Medium QD	DA	0.7500	3.929	4.450	4.825	5.111
Weak QD(+)	D-+	0.6875	2.792	3.101	3.318	3.479
Weak QD	D-	0.6250	2.018	2.187	2.302	2.384
Square Mean	SQU	0.6232	2.000			
Weak QD(-)	D--	0.5625	1.449	1.519	1.565	1.596
Arithmetic Mean	A	0.5000	1.000	1.000	1.000	1.000
Weak QC(-)	C--	0.4375	0.619	0.573	0.546	0.526
Weak QC	C-	0.3750	0.261	0.192	0.153	0.129
Geometric Mean	GEO	0.3333	0.000			
Weak QC(+)	C-+	0.3125	-0.148	-0.208	-0.235	-0.251
Medium QC	CA	0.2500	-0.720	-0.732	-0.721	-0.707
Harmonic Mean	HAR	0.2274	-1.000			
Strong QC(-)	C+-	0.1875	-1.655	-1.550	-1.455	-1.380
Strong QC	C+	0.1250	-3.510	-3.114	-2.823	-2.606
Strong QC(+)	C++	0.0625	-9.060	-7.639	-6.689	-6.013
Conjunction	C	0.0000	-infinity	-infinity	-infinity	-infinity

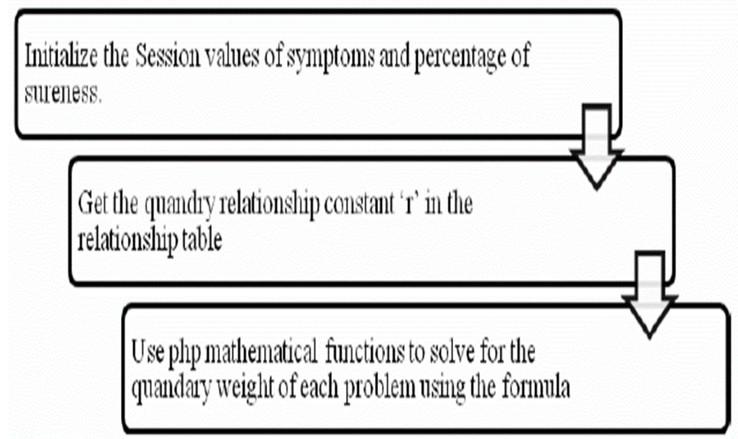

Figure 5: Pseudo code of the Quandary Weighting Algorithm

The pseudo-code presented in Figure 5 will briefly explain the process done in the algorithm.

First, the system will initialize the Session values of symptoms and percentage of sureness by retrieving them from the session array. Next to the quandary relationship constant "r" will be fetched in the relationship table. Note that the value of r depends on the number of symptoms inputted. For example, if the user inputted 2 symptoms, the system will use the value that is under the "rtwo" column as seen in Table 2. Lastly, the researchers programmed the system by using php mathematical functions to solve for the quandary weight of each problem using the formula.

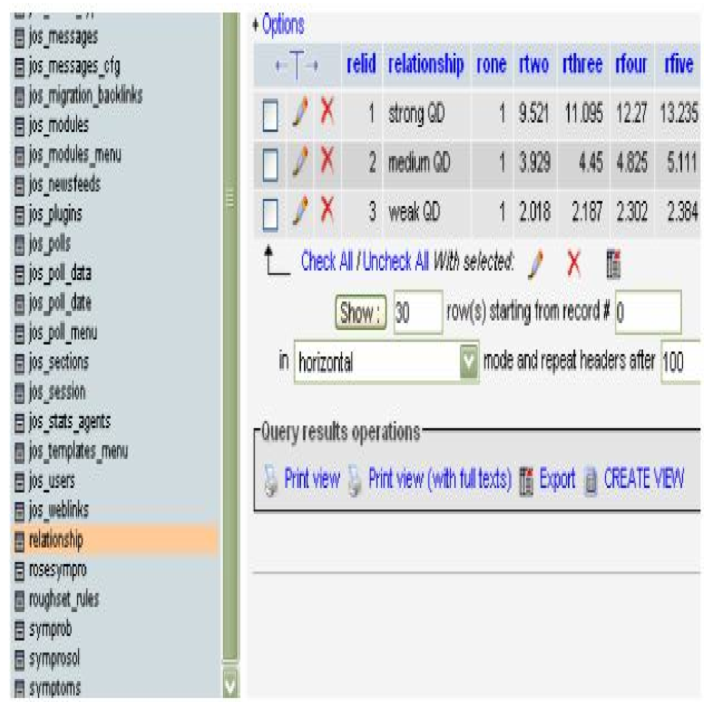

Figure 6: Relationship table

Sample Computation:
S1= 60% (weight= 0.3);S2= 70% (weight= 0.3);S3= 80% (weight= 0.4)
r for 3 using strong QD(+) is 24.3

To solve the quandary weight:
$= ((0.3)\ 60\%_{24.3} + (0.3)\ (70\%)_{24.3} + (0.4)\ (80\%)_{24.3})_{1/24.3} =$ **77.13%**

3.5 Output Result

Figure 7 shows the actual output display after the user clicked the submit button to process the data.

Figure 7: Output Result

The system was designed in such a way that upon submission, the expert system will show the probable problems and they are arranged according to their corresponding quandary weight. The problem with the highest quandary weight will be prioritized on the top suggesting that it is the most probable problem. The user can now then view for the solution by clicking the "View Solution" link. If the suggested solution did not solve the problem, the user can still go back and choose another solution until the user solves the problem.

4. ANALYSIS OF RESULTS

4.1. Preliminary Analysis

The Expert System was made specifically for a Broadcasting Network. Moreover, it caters to the concerns in the networking of the radio broadcasting system. The data of the system was obtained from actual data of the broadcasting network. For this reason database Management is Important [27, 28].

The data is a compilation of problems that the broadcasting network actually encountered during operations. The symptoms of each problem were also obtained from the network. Those set of data were stored in the database.

The researchers did two sets of tests. Each was designed to validate that the system aids in fixing networking problems, that the system makes the troubleshooting of these problems faster, and that the system utilizes all the data stored in the database. The principle in the sets of tests is similar. The researchers require a test subject from the system.

4.2. System Testing by Fixing Replicated and Actual Problems

This testing validates that the system aids in solving networking problems in the broadcasting system. Using 30 problems in the database as actual test problems.

Table 3: List of Replicated Network Problems

Problem	Fixed or Not Fixed	Comments
Program Application :"Low Virtual Memory" Alert Encountered (PC24)	Fixed	Increase virtual memory on settings
Network Connection Failure (PC5)	Fixed	Won't connect to internet or network. Test lan cable, lan card and admin settings of network flow.
LAN Card Malfunction (PC8)	Fixed	On and OFF LAN connection. Check lan cable using tester or replace lan card also to test.

In total, the researchers obtained 30 problems for the test, chosen from the pool of 45 problems in the database. 22 problems were replicated and 8 were actually encountered problems. To justify the objective of the researchers to attain a minimum efficiency of 90%, this testing proved 29 out of 30 problems are fixed using our system thus giving an efficiency of 96.67%. For unknown problems in the Possible Causes the Rough Set Theory can be used [29, 30].

4.3. System Efficiency through 5 Test Users

The second testing the researchers conducted was to prove that the system improves troubleshooting time and utilizes all the data in the database. All the 45 problems in the database were used in this testing. Among the 5 users, the 45 problems were duplicated and randomly given to each test user, having a total of 150 items for the 5 users, 30 each. In each item in the test, written are the symptoms of a problem. The tests were given to each user without the help of the system at first, and then they were asked to conclude what problem is occurring and what is the possible approach to solve it. They were given the same test and they tried to troubleshoot the problem with the aid of the expert system already. In each item, it was checked if the problem that was displayed by the system is the problem expected in the item. All the data are utilized correctly because they were queried and displayed the appropriate solutions.

Ex. In test item 1,

Enter symptoms S1 & S2 => PC1 is given.

The test users are shown the list of the symptoms so they can type into the system the symptom ID given in the item in words. The expected problem that is occurring is PC1, which is runtime error which is a common problem [31]. That same problem should be displayed by the system when the user typed in the query. After this testing, the test users were able to validate the objective. They were able to correctly attain the expected results in all the items.

5. CONCLUSION

A web-based expert system was developed in order to guide any user in troubleshooting networking problems under a Broadcasting Network. In case there's a loss of internet connection, a stand-alone module was also made. The main process algorithm, the heart of the whole program, processes all the symptoms and percentage of sureness stored in the session variables as inputted by the user. The program was design in a way that the expert system makes use of the quandary weighting algorithm and the rule extraction algorithm to process the result.

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