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Research Article

Design Website for Car's Faults Diagnosis using Artificial Intelligent Techniques

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Abstract

There are many people who do not have any experience in locating the car malfunction, and it is known that the malfunction can occur anywhere and at any time and the car may be in a place where it is difficult for the mechanic to arrive for the purpose of maintenance on the car. In this thesis, a system was developed for the purpose of diagnosing mechanical and electrical vehicle failures, which in turn helps inexperienced people diagnose car malfunctions in the event of a sudden malfunction in their cars. The proposed system in diagnosis consists of two parts, the first part in the collection of the largest number of faults and causes and create a table for these reasons where collected from sources in mechanical engineering, which numbered 320 malfunctions and then process this table using the algorithm Particle Swarm Optimization (PSO), where this algorithm extracted the most common faults, which numbered 231 types of faults i.e. 1386 rule or cause. The second part of the research is the applying of the Expert System to the data generated by the PSO process. The expert system works as follows, which is to display a set of questions to the user which through the user's answers the system can determine the location of the fault and also how to fix it.

Keywords: *E-Service, Expert System, Car's Faults Diagnosis, PSO*

1. Introduction

Today, the car technologies are of high importance to all the companies of car manufacturing since the specifications of cars are rapidly changing and stimulated through economic and environmental factors, such context is challenging to car drivers and mechanics to handle car malfunctions and faults (Nana, 2002). With the development of novel technologies such as hybrid engines, there are a lot of changes which must be learned. Actually, in common conditions, the identification of car faults remains one of the challenging tasks, particularly for in expert drivers and mechanics. Thus, the efficiency to find the faults is on the basis of individual's expertise. Yet, the dependence on experts might be diminished in the case when expertise was captured, documented, as well as retained in a few computer applications (Salama, 2002). The expert systems might be specified as "intelligent computer program that is using inference and knowledge processes for solving problems which were sufficiently complicated to need considerable human expertise for their solutions", one might take from such definition that the knowledge might be transferred from humans to computers and after that stored in computers in adequate forms which the users might call upon the computers for certain advice as required (Adsavakulchai, 2014). After that, the system might be making inferences as well as arriving at certain conclusion for giving explains and advices, when required, the reason behind the advice. In addition, ES is providing flexible and robust indicates to obtain solutions to a lot of issues which sometimes might not be handled via other, more orthodox and conventional approaches. Furthermore, the terms expert systems as well as knowledge based systems (KBS) were sometimes utilized synonymously (Markham, 2001).

2. Car Engine Fault Diagnosis

The majority of car drivers weren't extremely knowledgeable in the case when grasping the way that their cars are working. Also, in the case when something is wrong with the car, then experienced mechanic will be required for identifying the fault. Since expert or experienced mechanics weren't as prevalent as should be, the expert systems were introduced (Peijiang, 2013). The significant data and rules were obtained from mechanics and the knowledge bases were created. In addition, there were 2 forms regarding the system, one form is the usual session of questions-and-answers, in which a system is

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asking the mechanic questions which are related to what is wrong with cars and after that suggesting potential causes (Widodo, 2013), while the mechanic might be deciding the most likely suggestion, such choice might be fed to expert system, thus, it has additional rules as well as facts on which to be basing the future diagnoses. Whereas the other system was an expert system of the fault diagnosis that is related to the type fitted to various modern cars and connected to the system of engine management (Guvenir, 2000). In a case when the owner of the car is seeing certain symbol light on the dashboard to warn that there is potential fault with engine. After that, the car is driven to garage, in which the mechanic is inserting a connector from portable expert system to certain socket enabling the portable computer system for interrogating the system of engine management. Furthermore, the system has the ability of suggesting probable faults (Huang, 2001). Experienced mechanic has the ability of selecting the most possible fault and suggesting corrective treatment (Cho, 1997).

3. Literature Survey

a. Widodo Budiharto," Development Of Expert Car Failure Diagnosis System Using Bayes Method", Journal of Computer Science9 (10): 1383-1388, 2013, this study suggested expert system model for diagnosing car failures and malfunctions utilizing Bayesian method. In addition, the expert car failure diagnosis system can be defined as a computer system which applies certain knowledge that was owned via expert for resolving car problems, the system includes knowledge base as well as solution for diagnosing failures of cars from Toyota Avanza, which is popular car utilized today in Indonesia and using Bayesian method to know the belief of solution. The study developed techniques of knowledge representation related to symptoms as well as solutions from experts utilizing production rules. In addition, the experimental results were provided and the system has the ability of performing diagnosis on the car failures, providing solutions and providing the solution's probability value.

b. Fei Lin 1 , K. T. Chau 2 , C. C. Chan 3 , Chunhua Liu 4 , "Fault Diagnosis of Power Components in Electric Vehicles", Journal of Asian Electric Vehicles, Vol. 11, No. 2, Dec. 2013, The major components of electric vehicles (EVs) are electric motor, power electronics and battery. The failure in EV might lead to life threat or extreme system breakdown. The study is providing summary regarding the fault diagnoses in terms of electric motor, power electronic and battery in EV. The majorly utilized detection parameters for EV are voltage and current. Besides these, torque, power, temperature, noises and vibration were used based on various detecting methods. It is showing that the battery has fairly well-developed diagnostic system in the EV, such as battery management system. Even though that various literatures illustrated different fault diagnostic systems for the power electronics and electric motor individually, some researches were specifically done for EVs.

c. Olanloye, Dauda Odunayo, "An Expert System for the Diagnosis of Faults in Motorcycles", International Journal of Engineering and Applied Science Volume 5. Number 6, November 2014. The majority of individuals in African sub-region desired utilizing two wheeled vehicle to four wheeled vehicles for commercial purpose or personally since it was simply affordable, while the maintenance cost is extremely cheap. This is due to the bad state of economy in region. In addition, the thermodynamics' principle indicated that the functioning engine might be at times developing one fault or other and thus, there is a requirement for diagnosing the fault for the purpose of repairing or rectifying it. This study provided expert system to diagnose faults and profound potential solution utilizing AI principles. Various rules were specified utilizing forward chaining as well as being implemented with clip.

d. Aijaz ul Haq1 , N.A. Najar2 and Ovais Gulzar3, "Design of Expert System for Fault Diagnosis of an Automobile", Print ISSN: 2393-9907; Online ISSN: 2393-9915; Volume 2, Number 1; January-March, 2015 pp. 1-6, This paper presents a design and implementations related to Expert System for Fault Diagnoses of automobile utilizing mixture of various forms of the knowledge representation. The framework of knowledge representation is using declarative and procedural formalisms of the knowledge representation via applying the relational data-base. Thus, the frame base, case base and rule base formats were converted to tables. Also, the scheme is facilitating combinations regarding backward and forward chaining reasoning, utilizing the problem reduction approach to solve problems, and heuristic search method. All the system's editing facilities, which include, insertion, deletion and updating rule, case, and frame were existing.

4. Expert Systems (ESs)

Expert systems or (knowledge-based systems) are one of the major areas related to AI applications. ESs were of high importance, majorly due to the fact that they are restricting the field of interest to narrowly defined area which might be naturally specified via explicit verbal rules. ESs are providing advice which is derived from its knowledge base, utilizing a process of reasoning that is embedded in its inference engine, the system's thinking part. Backward chaining (deduction)

is used by ESs as inference base, since they are starting from 'possible' hypothesis (the selection will be essential to the efficiency and success of the system), after that looking for evidence for supporting such hypothesis. If, following the request of related information from users, such initial hypothesis cannot be supported, then the system is going to be default to 'next possible hypothesis', etc. (Huang, 2001). The process is considered to be analogous to the process of medical diagnosis (there is no surprise that some of earliest ES applications have been to medicine) in which a physician is starting with the most likely diagnosis as well as performing some tests for confirming it. In the case when such tests are inconclusive, then more testing is required. In the case when results are contradicting the initial diagnosis, then a physician must create another diagnosis, and the process will continue till the physician has the ability of confirming the diagnosis (Cho, 1997).

5. Particle Swarm Optimization

There are a few of the PSO algorithm parameters, which can impact its efficiency. For any problem of optimization, some of the values of those parameters and choices highly influence the PSO approach's efficiency, and other parameters have little effect or none (Nana, 2012). The main parameters of the PSO are size of the swarm or the number of the particles, velocity components, number of iterations, and coefficients of acceleration, which have been depicted bellow. Moreover, the PSO has been affected as well by the velocity clamping, inertia weight, and velocity constriction, Parameter of PSO are, (a) The size of the swarm: The size of the population or the swarm can be defined as the number of the swarm particles. The large swarm produces larger search space parts to be covered for each one of the iterations (P. Nabende, 2006). A high count of the particles can result in the reduction of the amount of the iterations which are required for obtaining a good result of the optimization. Contradicting to that, huge particle amounts result in increasing the computational time and the complexity in each one of the iterations. From several empirical researches, it was discovered that the majority of the implementations of the PSO utilize a range of $n \in$ for the size of the swarm (S. Adsavakulchai, 2011). (b) **Number of the Iterations:** The number of iterations for obtaining good results is problem dependent as well. An extremely low amount of the iterations can result in the premature stopping of the process of the searching, whereas the extremely large iterations result in the issue of the increase in the computational time as well as the unnecessary added computational complexity (Cho, 1997).

6. Proposed System

The proposed system was design using artificial intelligent and developed by using expert system and particle swarm intelligent (PSO). PSO used to design database and get the most car's faults occurs in the cars, expert system used this database to diagnosis the fault and how to solve the problem.

7. Database Designing

The proposed system depending on the database part of database was design to use the by expert system to diagnosis car's fault. At first step to design database, the information of car's faults was get from mechanic's engineering references then create database with 320 car's faults and more than 1920 rules. Then create Questionnaire to know what the most frequent malfunctions of cars, after that the information put in table then apply (PSO) on this table to find most frequent malfunctions of cars as in following steps:

Step1: Choose the number of particles. This step represents number of rules that used in dataset (1920 particles)

Step2: The initial population (i.e. the iteration number $t = 0$) can be represented $rules_i^0$ $where\ i =$ 1,2,3, … … . . , 1920

Then evaluate the objective function values Eq. (1)

$f(x) = -x^2 + 5x + 20 \quad with - 10 \leq x \leq$
$10 \ldots \ldots \ldots . . (1)$
$let\ c_1 = c_2 = 0$
$and\ the\ initial\ values\ of\ matrix\ v\ is\ zeros$
$v_i^0 = 0 \quad where\ i = 1,2,3, \ldots \ldots \ldots ., 1920$

Step3: Set the iteration number as $t = 0 + 1 = 1$ the go to step4.

Step4: Find the **personal best** for each particle by:

$$P_{best,i}^{t+1} = \begin{bmatrix} P_{best,i}^t & if\ f_i^{t+1} > P_{best,i}^t \\ x_i^{t+1} & if\ f_i^{t+1} \leq P_{best,i}^t \end{bmatrix}$$

Step5: Find the global best by:

$G_{best} = \min\{P_{best,i}^t\}\ where\ i = 1,2,3, \ldots \ldots, 1920$

Step6: Considering the random numbers in the range (0, 1) r_1^1 and r_2^1 find the velocities of the particles by

$v_i^{t+1} = v_i^t + c_1 r_1^t [P_{best,i}^t - x_i^t] + c_2 r_2^t [G_{best}^t - x_i^t]$
$where\ i = 1,2,3, \ldots \ldots \ldots . . 1920$

Step7: Find the new values of x_i^1 $where\ i =$ 1,2,3, … … , 1920

$x_i^{t+1} = x_i^t + v_i^{t+1}$

Step8: Stopping criterion:

If the terminal rule is satisfied, go to step 2,
Otherwise stop the iteration and output the results.

The result of this step is removed from dataset and add to database that used by proposed system.

Step9: repeat this step until get the most car's fault occurs.

The output database contains 231 car's faults, these databases was used to diagnosis the faults using expert system.

8. Proposed System Architecture

The proposed system depending on the database that result from PSO algorithm. Database contains seven columns, each column represents level of rules for expert system, each rule content question and set of choices the user must choose the answers to allow system to diagnosis the fault of the car. Fig.1.

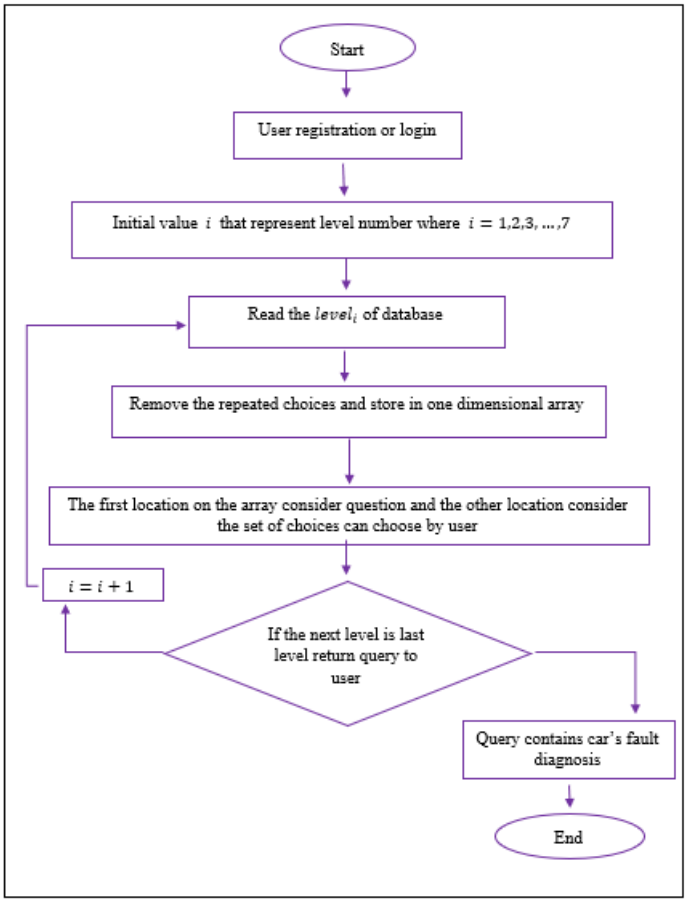

Fig.1: Proposed system structure

9. Steps of Proposed System

This section will illustrate the steps of proposed system, and how each step work and design.

Step1: the first step when user login to the diagnosis system the system send query to the database and load the first levels of rules, the put these rules in on dimensional array, then remove the repeated choices from array as in algorithm (1)

Algorithm 3.1: Load the first level from database
Input: first column from database
Output: array contains results without repeat
Begin: Step 1: Create connection with database Step 2: Send query to table Step 3: Store all values in one dimensional array (x) Step 4: Store first value from array (x) and put in array (y) Step 5: Read $value_i$ from array (x) and compare with array (y) if the values is found then remove it, otherwise The value will put in array (y). Step 6: Repeat step 5 until read all rows in table on database Step 7: In result array (y) the first value consider question And the rest values considers choices **End**

Step 2: the second step begin when user choose first answer from the list of answers, at this step the answer store in an array called (answer's array) which is one dimensional array that store the set of user's in order to diagnosis failure of car as in algorithm (2)

Algorithm 3.2: Expert system work
Input: the rest columns of database
Output: questions and answers
Begin: Step 1: Create connection with database Step 2: loop from the current column until the last column in Database. Step 3: combine the current query with the queries in array's Answers.

Step 4: Create query from all combined array's answers
Step 5: Store all values of the next column in one dimensional
array (x)
Step 6: Store first value from array (x) and put in array (y)
Step 7: Read $value_i$ from array (x) and compare with array (y) if the values is found then remove it, otherwise The value will put in array (y).
Step 8: Repeat step 5 until read all rows in table on database
Step 9: In result array (y) the first value consider question And the rest values considers choices.
Step 10: If the next column is the last column the return diagnosis
of failure, and stop the loop.
Step 11: If the next column is not the last column then continue
in loop.
End

10. Expert System Work

At this section will illustrate expert system. Take example as table to show how the expert system work and how can diagnosis car's fault, this table is part of **(problems table)**,

a. The first step is illustrate the first question and answers.
b. Second step if the user select (not working) as in table (1), the system will remove all questions and answers except the rows of not working.
c. Third step if user select (my car will not start), the system will remove all other choices in column level 2 as in table (2).
d. Fourth step if user choose (It tries to start and makes some noise while doing so) the system remove any other choices in column level 3 as in table (3).
e. The fifth step if user choose (Just a clicking sound), the s the system remove any other choices in column level 4 as in table (4).
f. The sixth step if user select (no) the system will give to the driver solution, table (5).
g. The solution in this case is as in table (6).

Table 1: System work if user select not working

feels like	Abnormal steering	When the engine is cold
feels like	Abnormal steering	Seemingly at random
feels like	Abnormal steering	The vehicle pulls slightly to the left or right
not working	What is not working properly	-
not working	Poor gas mileage	Are the tires on this vehicle low on air
not working	Poor gas mileage	Yes
not working	Poor gas mileage	No
not working	Poor gas mileage	No
not working	Poor gas mileage	No
not working	Poor gas mileage	I don t Know
not working	Poor gas mileage	I don t Know
not working	Poor gas mileage	I don t Know
not working	My car will not start	Which of the following symptoms most clos
not working	My car will not start	It makes a clicking sound or no noise what
not working	My car will not start	It makes a clicking sound or no noise what
not working	My car will not start	It makes a clicking sound or no noise what
not working	My car will not start	It makes a clicking sound or no noise what
not working	My car will not start	It tries to start and makes some noise while
not working	My car will not start	It tries to start and makes some noise while
not working	My car will not start	It tries to start and makes some noise while
not working	My car will not start	It tries to start and makes some noise while
not working	My car will not start	It starts and then dies right away
not working	Lack of hot or cold air	What climate control system is giving you p
not working	Lack of hot or cold air	The air conditioning system
not working	Lack of hot or cold air	The air conditioning system
not working	Lack of hot or cold air	The air conditioning system
not working	Lack of hot or cold air	The air conditioning system

Table 2: System work if user select my car will not start

feels like	Abnormal steering	When the engine is cold	-
feels like	Abnormal steering	Seemingly at random	-
feels like	Abnormal steering	The vehicle pulls slightly to the left or right	-
not working	What is not working properly	-	-
not working	Poor gas mileage	Are the tires on this vehicle low on air	-
not working	Poor gas mileage	Yes	-
not working	Poor gas mileage	No	Is there a lot of dirt on the air filter
not working	Poor gas mileage	No	Yes
not working	Poor gas mileage	No	No
not working	Poor gas mileage	I don t Know	Is there a lot of dirt on the air filter
not working	Poor gas mileage	I don t Know	Yes
not working	Poor gas mileage	I don t Know	No
not working	My car will not start	Which of the following symptoms most clos	-
not working	My car will not start	It makes a clicking sound or no noise whats	Are the dash lights out or extremely
not working	My car will not start	It makes a clicking sound or no noise whats	Yes
not working	My car will not start	It makes a clicking sound or no noise whats	Yes
not working	My car will not start	It makes a clicking sound or no noise whats	Yes
not working	My car will not start	It makes a clicking sound or no noise whats	No
not working	My car will not start	It tries to start and makes some noise while	What kind of noise does it make
not working	My car will not start	It tries to start and makes some noise while	Just a clicking sound
not working	My car will not start	It tries to start and makes some noise while	Just a clicking sound
not working	My car will not start	It tries to start and makes some noise while	Just a clicking sound
not working	My car will not start	It tries to start and makes some noise while	A spinning and whirring sound
not working	My car will not start	It starts and then dies right away	A grinding sound
not working	Lack of hot or cold air	What climate control system is giving you p	-
not working	Lack of hot or cold air	The air conditioning system	When does your AC performance de
not working	Lack of hot or cold air	The air conditioning system	Always
not working	Lack of hot or cold air	The air conditioning system	Always

Table 3: System work if user select it tries to start and makes some noise while doing so

feels like	Abnormal steering	When exiting a turn	-	-
feels like	Abnormal steering	When the engine is cold	-	-
feels like	Abnormal steering	Seemingly at random	-	-
feels like	Abnormal steering	The vehicle pulls slightly to the left or right	-	-
not working	What is not working properly	-	-	-
not working	Poor gas mileage	Are the tires on this vehicle low on air	-	-
not working	Poor gas mileage	Yes	-	-
not working	Poor gas mileage	No	Is there a lot of dirt on the air filter	-
not working	Poor gas mileage	No	Yes	-
not working	Poor gas mileage	No	No	-
not working	Poor gas mileage	I don t Know	Is there a lot of dirt on the air filter	-
not working	Poor gas mileage	I don t Know	Yes	-
not working	Poor gas mileage	I don t Know	No	-
not working	My car will not start	Which of the following symptoms most clos	-	-
not working	My car will not start	It makes a clicking sound or no noise whats	Are the dash lights out or extremely	-
not working	My car will not start	It makes a clicking sound or no noise whats	Yes	Take a look at the
not working	My car will not start	It makes a clicking sound or no noise whats	Yes	Yes
not working	My car will not start	It makes a clicking sound or no noise whats	Yes	No
not working	My car will not start	It makes a clicking sound or no noise whats	No	-
not working	My car will not start	It tries to start and makes some noise while	What kind of noise does it make	-
not working	My car will not start	It tries to start and makes some noise while	Just a clicking sound	Are the dash lights
not working	My car will not start	It tries to start and makes some noise while	Just a clicking sound	Yes
not working	My car will not start	It tries to start and makes some noise while	Just a clicking sound	No
not working	My car will not start	It tries to start and makes some noise while	A spinning and whirring sound	-
not working	My car will not start	It starts and then dies right away	A grinding sound	-
not working	Lack of hot or cold air	What climate control system is giving you p	-	-
not working	Lack of hot or cold air	The air conditioning system	When does your AC performance de	-
not working	Lack of hot or cold air	The air conditioning system	Always	How would you des
not working	Lack of hot or cold air	The air conditioning system	Always	Slowly over time

Table 4: System work if user select just clicking sound

feels like	Abnormal steering	When exiting a turn	-	-
feels like	Abnormal steering	When the engine is cold	-	-
feels like	Abnormal steering	Seemingly at random	-	-
feels like	Abnormal steering	The vehicle pulls slightly to the left or right	-	-
not working	What is not working properly	-	-	-
not working	Poor gas mileage	Are the tires on this vehicle low on air	-	-
not working	Poor gas mileage	Yes	-	-
not working	Poor gas mileage	No	Is there a lot of dirt on the air filter	-
not working	Poor gas mileage	No	Yes	-
not working	Poor gas mileage	No	No	-
not working	Poor gas mileage	I don t Know	Is there a lot of dirt on the air filter	-
not working	Poor gas mileage	I don t Know	Yes	-
not working	Poor gas mileage	I don t Know	No	-
not working	My car will not start	Which of the following symptoms most clos	-	-
not working	My car will not start	It makes a clicking sound or no noise whats	Are the dash lights out or extremely	-
not working	My car will not start	It makes a clicking sound or no noise whats	Yes	Take a look at the
not working	My car will not start	It makes a clicking sound or no noise whats	Yes	Yes
not working	My car will not start	It makes a clicking sound or no noise whats	Yes	No
not working	My car will not start	It makes a clicking sound or no noise whats	No	-
not working	My car will not start	It tries to start and makes some noise while	What kind of noise does it make	-
not working	My car will not start	It tries to start and makes some noise while	Just a clicking sound	Are the dash lights
not working	My car will not start	It tries to start and makes some noise while	Just a clicking sound	Yes
not working	My car will not start	It tries to start and makes some noise while	Just a clicking sound	No
not working	My car will not start	It tries to start and makes some noise while	A spinning and whirring sound	-
not working	My car will not start	It starts and then dies right away	A grinding sound	-
not working	Lack of hot or cold air	What climate control system is giving you p	-	-
not working	Lack of hot or cold air	The air conditioning system	When does your AC performance de	-
not working	Lack of hot or cold air	The air conditioning system	Always	How would you des
not working	Lack of hot or cold air	The air conditioning system	Always	Slowly over time

Table 5: System work if user select no

feels like	Abnormal steering	When exiting a turn	-	-
feels like	Abnormal steering	When the engine is cold	-	-
feels like	Abnormal steering	Seemingly at random	-	-
feels like	Abnormal steering	The vehicle pulls slightly to the left or right	-	-
not working	What is not working properly	-	-	-
not working	Poor gas mileage	Are the tires on this vehicle low on air	-	-
not working	Poor gas mileage	Yes	-	-
not working	Poor gas mileage	No	Is there a lot of dirt on the air filter	-
not working	Poor gas mileage	No	Yes	-
not working	Poor gas mileage	No	No	-
not working	Poor gas mileage	I don t Know	Is there a lot of dirt on the air filter	-
not working	Poor gas mileage	I don t Know	Yes	-
not working	Poor gas mileage	I don t Know	No	-
not working	My car will not start	Which of the following symptoms most clos	-	-
not working	My car will not start	It makes a clicking sound or no noise whats	Are the dash lights out or extremely	-
not working	My car will not start	It makes a clicking sound or no noise whats	Yes	Take a look at the
not working	My car will not start	It makes a clicking sound or no noise whats	Yes	Yes
not working	My car will not start	It makes a clicking sound or no noise whats	Yes	No
not working	My car will not start	It makes a clicking sound or no noise whats	No	-
not working	My car will not start	It tries to start and makes some noise while	What kind of noise does it make	-
not working	My car will not start	It tries to start and makes some noise while	Just a clicking sound	Are the dash lights
not working	My car will not start	It tries to start and makes some noise while	Just a clicking sound	Yes
not working	My car will not start	It tries to start and makes some noise while	Just a clicking sound	No
not working	My car will not start	It tries to start and makes some noise while	A spinning and whirring sound	-
not working	My car will not start	It starts and then dies right away	A grinding sound	-
not working	Lack of hot or cold air	What climate control system is giving you p	-	-
not working	Lack of hot or cold air	The air conditioning system	When does your AC performance de	-
not working	Lack of hot or cold air	The air conditioning system	Always	How would you des
not working	Lack of hot or cold air	The air conditioning system	Always	Slowly over time
not working	Lack of hot or cold air	The air conditioning system	Always	Sudden

Table 6: System give solution

feels like	Abnormal steering	Constantly, during normal driving	Does your steering feel loose and s	-	-
feels like	Abnormal steering	Constantly, during normal driving	Yes	-	Let some air out of each tire. Refer to this vehicle owner manual for the correct air pressure. Doing this should improve the steerir
feels like	Abnormal steering	Constantly, during normal driving	No	-	Check the power steering fluid level (please refer to the vehicle's owner's manual for instructions). If the level is low, add some fluic
feels like	Abnormal steering	Only at certain speeds	-	-	Have the front wheels balanced
feels like	Abnormal steering	When exiting a turn	-	-	Have an alignment job done on this vehicle
feels like	Abnormal steering	When the engine is cold	-	-	The control valve assembly will need to be replaced. However, note that most garages will only replace the entire steering rack and
feels like	Abnormal steering	Seemingly at random	-	-	If the steering stiffens up at random, you need to have the power steering pump replaced
feels like	Abnormal steering	The vehicle pulls slightly to the left or right	-	-	Make sure both front tires are at the correct pressure this should correct the slight pull of the vehicle. Refer to this vehicle owner
not working	What is not working properly	-	-	-	
not working	Poor gas mileage	Are the tires on this vehicle low on air	-	-	-
not working	Poor gas mileage	Yes	-	-	Add air to the tires. Make sure you do not exceed the pressure level as specified in the vehicle owner manual
not working	Poor gas mileage	No	Is there a lot of dirt on the air filter	-	-
not working	Poor gas mileage	No	Yes	-	Replace the air filter. If this does not solve the problem, please rerun this diagnostic for further analysis
not working	Poor gas mileage	No	No	-	A clogged PCV system or faulty oxygen system is likely causing poor gas mileage. Have a mechanic check these systems
not working	Poor gas mileage	I don t Know	Is there a lot of dirt on the air filter	-	-
not working	Poor gas mileage	I don t Know	Yes	-	Replace the air filter. If this does not solve the problem, please rerun this diagnostic for further analysis
not working	Poor gas mileage	I don t Know	No	-	A clogged PCV system or faulty oxygen system is likely causing poor gas mileage. Have a mechanic check these systems
not working	My car will not start	Which of the following symptoms most clos	-	-	-
not working	My car will not start	It makes a clicking sound or no noise whats	Are the dash lights out or extremely	-	-
not working	My car will not start	It makes a clicking sound or no noise whats	Yes	Take a look at the	-
not working	My car will not start	It makes a clicking sound or no noise whats	Yes	Yes	Have a mechanic clean the battery terminals. If this doesn't help the issue, have your battery tested. It may be dead
not working	My car will not start	It makes a clicking sound or no noise whats	Yes	No	Have the battery tested. Chances are it is dead and will need to be replaced. This could also signify an issue with the starter
not working	My car will not start	It makes a clicking sound or no noise whats	No	-	Replace the starter and solenoid
not working	My car will not start	It tries to start and makes some noise while	What kind of noise does it make	-	-
not working	My car will not start	It tries to start and makes some noise while	Just a clicking sound	Are the dash lights	-
not working	My car will not start	It tries to start and makes some noise while	Just a clicking sound	Yes	Replace the starter and solenoid
not working	My car will not start	It tries to start and makes some noise while	Just a clicking sound	No	Have a mechanic clean the battery terminals. If this does not help the issue, have your battery tested. It may be dead
not working	My car will not start	It tries to start and makes some noise while	A spinning and whirring sound	-	There is a problem with your starter. Have the starter wiring checked and replace the starter if necessary
not working	My car will not start	It starts and then dies right away	A grinding sound	-	It is likely you have a bad starter drive or a worn ring gear. Have it towed to a shop and replace the starter or ring gear as needed
not working	Lack of hot or cold air	What climate control system is giving you pr	-	-	-
not working	Lack of hot or cold air	The air conditioning system	When does your AC performance de	-	-
not working	Lack of hot or cold air	The air conditioning system	Always	How would you des	-
not working	Lack of hot or cold air	The air conditioning system	Always	Slowly over time	Have the condenser checked for dirt and debris and cleaned if necessary. This may fix the problem. If not, you will need to take this
not working	Lack of hot or cold air	The air conditioning system	Always	Sudden	There is a major refrigerant leak or AC electrical problem. You can open the hood and look for obvious leaks, but it is best to hav
not working	Lack of hot or cold air	The air conditioning system	Every once in a while	-	Actually, nothing is wrong. The compressor is automatically disengaging to keep the engine from overheating. This is normal behav
not working	Lack of hot or cold air	The heating system	Is your heater not blowing warm air	-	-
not working	Lack of hot or cold air	The heating system	Yes	Does this vehicle h	-
not working	Lack of hot or cold air	The heating system	Yes	Yes	Take this vehicle to a specialist for further analysis. It is likely you have a problem with the ambient air sensor or blend door, but we
not working	Lack of hot or cold air	The heating system	Yes	No	Take this vehicle to a shop specializing in heater repair and have the mechanic inspect both the heater control valve and the devic
not working	Lack of hot or cold air	The heating system	No	-	We are sorry, but based on the information provided we are unable to determine the exact cause of your issue. At this point we rec
not working	Lack of hot or cold air	No air is coming out of the vents	What best describes your issue	-	-
not working	Lack of hot or cold air	No air is coming out of the vents	My climate control vents barely crea	-	There is a problem with the blower or a physical blockage of the ducts. Check the fresh air intake port for debris which may be bloc
not working	Lack of hot or cold air	No air is coming out of the vents	My climate control vents do not off	-	The problem is likely a blown fuse or failed blower motor. Check the fuse and change it if need be. If this does not fix the problem,

Conclusion

This work presents a proposed intelligent electronic service based on the PSO and expert system. The characteristics of the proposed system can be described as follows:

a. The aim of this work is to achieve new method for electronic service for car's fault diagnosis by applying PSO and expert system.
b. The proposed system is capable not only diagnosis car's fault, the proposed system can apply in any other fields like human's Diseases just replace dataset.
c. The system has the characteristics of good expert systems, such as high performance, adequate response time, understandability, and understandability.
d. It also made possible the development of just-in-time services, or mobile services that literarily offer anytime and anywhere access to system.

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