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E-Learning for Car Faulty Diagnosis

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ABSTRACT

Car fault identification is not easy for inexperienced mechanical engineer or driver because it is needed a lot of knowledge for finding the fault. Therefore, they extremely depend on expert mechanical engineer. In this study, to develop e-learning for car faulty diagnosis by using 19 rule-based of the knowledge-base is collected from mechanical engineer experts, specialized books, and from different car websites. The three knowledge bases of car start problem, break problem, and cooling system problem are created after compiling enough information for each problem using Visual Basic and Microsoft Access. The system is designed to meet user's needs in terms of ease of use and understandability and convenience that are the most necessary factors that attract users to use the system. Moreover, the system indicated that an expert system will be practical and can be useful in providing consistent car problem detection. It can be concluded that e-learning for car faulty diagnosis is helpful although it might not give a complete guide and help as a human expert namely mechanical engineer do, but at least the e-learning for car faulty diagnosis can give a temporary assistance to those who are in need of an instance help.

Keywords: *e-learning, car faulty diagnosis, rule-based*

1. INTRODUCTION

When there is a problem with their car, they normally call mechanical engineer for help and it would be sent to an auto repair shop in case of high level of problem severity. Although, most car owners should be exposed to knowledge about car components, how each component works, and how small problems could be solved. Some problems require technical knowledge to analyze and understand the problems in order to allow car owners to apply a preliminary action or repair it immediately by themselves in uncertain situation. Correct preliminary action may substantially reduce a level of problem severity [1]. In some cases, a car owner may diagnose a problem wrongly and it may cause more severe problems to their car. Also, in uncertain situation, car owners need to cope with the unexpected problems as fast as possible. Car fault identification is not easy for inexperienced mechanic or driver because it is needed a lot of knowledge for finding the fault. Therefore, they extremely depend on expert mechanic. Dependence of the expert can be minimized if its expertise can be documented into a computer system.

E-learning using an expert system (ES) as a tool that employs human knowledge captured in a computer to solve problem that ordinarily require human expertise. Expert system seeks and utilizes relevant information from their human users and from available knowledge bases in order to make recommendations. With the expert system, the user can interact with a computer to solve a certain problem. This can occur because the expert system can store heuristic knowledge. Then the system can make inferences and arrive at a specific conclusion to give advices and explains, if necessary, the logic behind the advice. ES provide powerful and flexible means for obtaining solutions to a variety of problems that often cannot be dealt with by other, more traditional and orthodox methods. The terms expert system and knowledge-based system (KBS) are often used synonymously [2,3].

The main objective of this study is to develop a car diagnostic system has rules which relate symptoms to problems that is helpful for those who are in need of guides to deal with their car's problems.

2. SCOPE OF WORK

2.1 To develop e-learning for car faulty diagnosis that is capable of assisting car's owner in dealing with their car problem them whenever time is limited and the human expert, also known as mechanical engineer, is not available at that time.

2.2 To develop the system as a tool for training inexperienced mechanical engineer and reduce the need for skilled mechanic. The repair of car requires a high level of expertise. With this system, inexperienced mechanic can be guided step-by-step to find out the car problem.

2.3 To reduce repair time of each car for mechanical engineer that allow mechanic to do more work in less time.

2.4 To help improving knowledge of drivers in diagnosing the problem of car that, in turn, reduce a level of problem severity and costs of car maintenance. Prior knowledge in relation to car

problems can be used to get drivers well-prepared to the problem that is unaware of happening. Car owners can use it to help keeping their car in a good condition providing safety to drivers.

2.5 To develop the system in the direction of simplicity and convenience for all people to be able to apply it immediately and correctly in the real environment.

2.6 To compile experience, information, and knowledge coming form as many experts as possible into the system.

2.7 To allow the mechanical engineer to work without stopping. As a human, expert mechanical engineer would be tired if he works continuously.

3. METHODOLOGY

To do the knowledge base life cycle that there are 4 steps as following:

3.1 Problem definition

In dealing with car's problem, mechanical engineers are those who can help to solve them. But sometimes they do not have enough time to see the mechanic and maybe the distance is quite far, and we are in hurry. Therefore we need instance help and solution. So it is believed that the use of expert system can be benefits in this situation by giving a temporary and instance guides to car's owner. Inexperienced mechanic wrongly diagnosing the problem of the car can cause the loss of customer and income of an auto repair shop. If mechanic's repair shop makes a wrong diagnosis, the customer will be reluctant to come back to the repair shop. Also inexperienced mechanical engineer needs to be trained by the expert. It takes long period of time for a new mechanical engineer to understand all the matters. Also, in the busy time, the skilled mechanical engineer may have no time to repair the car and train new mechanical engineer in every step at the same time. Moreover, to waste time of car owners who always send their car to check a trivial problem at an auto repair shop instead of repairing it by their own. Car owners would face with high costs of car maintenance and long waiting time of repair processes in case a car is sent to check at the shop all the time. No preliminary action taken place by the car owner while a car problem occurs can increase a chance of higher severity level. Many cars' owners never know how to check their cars in order to keep them in a good condition. Thus, a car owner would have to pay more for maintenance cost.

3.2 User requirement

Users who will use the system can be car owners, car drivers, inexperienced mechanical engineer, expert mechanical engineer and interested users, and students. Car owners may want to have the knowledge to know how to maintain their car in good condition. Drivers must have the knowledge to deal with the problem as fast as possible. Inexperienced mechanical engineer can use the system to gain more knowledge and improve their work performance. Experienced mechanical engineer can use the system to help them make better and faster decision making. Interested users who may not have their own car can use the system to study in their area of interest. Students could apply the system to be used as the supplement of their further studies. They may improve the system by adding more knowledge base.

3.3 Design knowledge base

The knowledge of the system is collected from mechanical engineer experts, specialized books, and from different car websites [4,5,6]. The three knowledge bases of car start problem, break problem, and cooling system problem are created after compiling enough information for each problem. The 19 rule-based system of car start problem is shown to be an example below:

Rule 1: IF the result of switching on the headlights is they light up AND nothing happen is the result of when you turn the key to try to start the car THEN car symptom is dead battery

Rule 2: IF car symptom is dead battery THEN recommended action is replace the battery

Rule 3: IF the headlights light up when switch on them AND the car cranks slowly when you turn a key to try to start the car AND the gas tank is empty THEN the car is out of gas.

Rule 4: IF the car is out of THEN refuel the gas.

Rule 5:IF the headlights light up when switch on them AND the car cranks slowly when you turn a key to try to start the car AND the gas tank is not empty AND the headlights dim when you to try the starter THEN the battery is weak.

Rule 6: IF the battery is weak THEN recharge the battery.

Rule 7: IF the headlights light up when switch on them AND the car cranks slowly when you turn a key to try to start the car

AND the gas tank is not empty AND the headlights does not dim when you to try the starter THEN the symptom cannot be identified.

Rule 8: IF the symptom cannot be identified THEN recheck from the first step.

Rule 9:IF the headlights light up when switch on them AND the car cranks slowly when you turn a key to try to start the car AND the gas tank is not empty AND the headlights sometimes dim and sometimes don't when you to try the starter THEN the battery is weak.

Rule 10: IF the headlights light up when switch on them AND the car cranks slowly when you turn a key to try to start the car AND you're not so sure if the gas tank is empty or not THEN the symptom cannot be identified.

Rule 11: IF the headlights light up when switch on them AND the car cranks normally when you turn a key to try to start the car AND the gas tank is empty THEN the car is out of gas.

Rule 12: IF the headlights light up when switch on them AND the car cranks normally when you turn a key to try to start the car AND the gas tank is not empty AND the smell of gasoline is present when trying the starter THEN the car is being flooded.

Rule 13:IF the car is being flooded THEN wait 10 minutes, then restart flooded car.

Rule 14:IF the headlights light up when switch on them AND the car cranks normally when you turn a key to try to start the car AND the gas tank is not empty AND the smell of gasoline is not present when trying the starter THEN the symptom cannot be identified.

Rule 15:IF the headlights light up when switch on them AND the car cranks normally when you turn a key to try to start the car AND the gas tank is not empty AND the smell of gasoline is sometimes present when trying the starter THEN the car is being flooded.

Rule 16:IF the headlights light up when switch on them AND the car cranks normally when you turn a key to try to start the car AND you're not so sure if the gas tank is empty or not THEN the symptom cannot be identified.

Rule 17:IF the headlights light up when switch on them AND the car cranks sometimes when you turn a key to try to start the car AND the gas tank is empty THEN the car is out of gas.

Rule 18:IF the headlights light up when switch on them AND the car cranks sometimes when you turn a key to try to start the car AND the gas tank is not empty THEN the symptom cannot be identified.

Rule 19:IF the headlights light up when switch on them AND the car cranks sometimes when you turn a key to try to start the car AND you're not so sure if the gas tank is empty or not THEN the symptom cannot be identified.

3.4 Implementation

E-learning for car faulty diagnosis is developed using Visual Basic and Microsoft Access. The system is designed to meet user's needs in terms of ease of use and understandability and convenience that are the most necessary factors that attract users to use the system. Communication between the user and the system is done through the user interface which implemented in English languages. The user interface is represented as a menu which displays the questions to the user and the user answers with Yes/No or multiple choices provided to select. The entire question asked in the system is created from rule-based system that the authors have collected the information and built knowledge-based system.

4. RESULTS AND DISCUSSION

E-learning for car faulty diagnosis starts with the window showing three alternative ways for a user to choose as shown in figure 1. Three buttons are "New Customer" button, "Login to the System" button, and "Exit Program" button. The user selects by clicking at "New Customer" button. For "Login to the System" button, the users can get access to the system without having to sign up a new customer to see how the system works and they can also gain the knowledge from the system. Users who do not want to use the system or they want to leave after they finishing using the system by clicking at "Exit Program" button.

Figure 1: Car Faulty Diagnosis expert system

After "New Customer" button is chosen, "Add New Customer" window will be shown up. The user needs to fill out the registered form to be stored in the database. The information required is Customer_ID, Name, Address, Telephone, E-mail, and Car make that they own as shown in figure 2. The system requires each user to fill out all the text box and then press "Add" button to save and collect the information into the database.

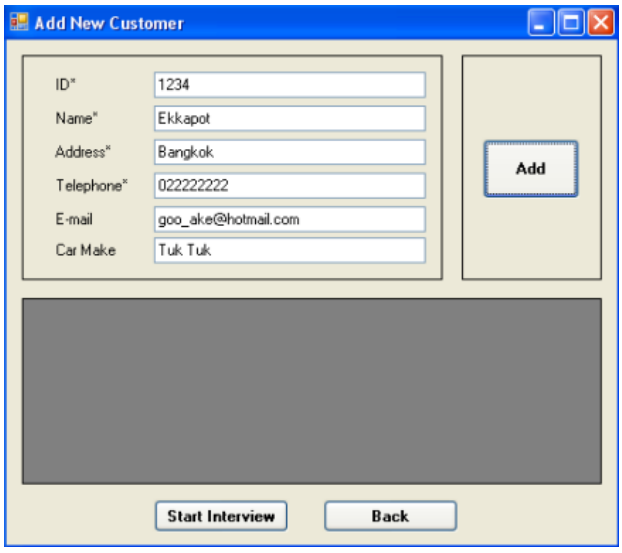

Figure 2: Add new customer window (1)

Data grid view will display all the information filled out by the user as shown in figure 3. It is arranged by order. Hence, the first customer registered would be on the top of the list and then second user would be under the first. Each customer has a unique ID used to get into the system. Then, the user clicks at "Start Interview" button.

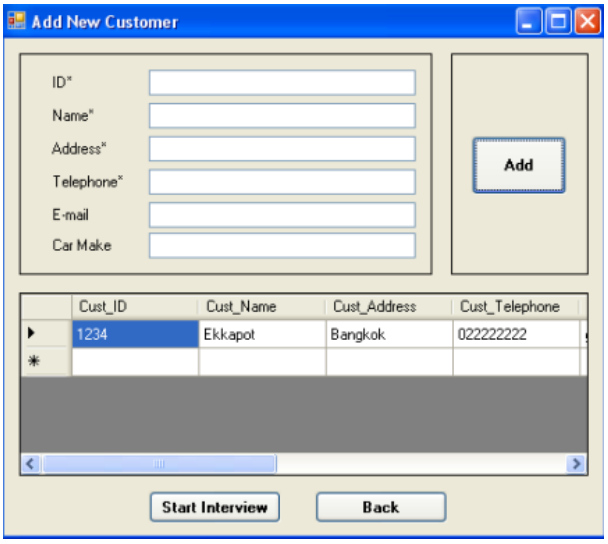

Figure 3: Add new customer window (2)

The user would be sent to "Login" window to enter their ID and name that must be the same as what the user filled out in the registered form to ensures that that user has already registered as shown in figure 4. Then, the user press "Login" button to confirm that ID and name is correct.

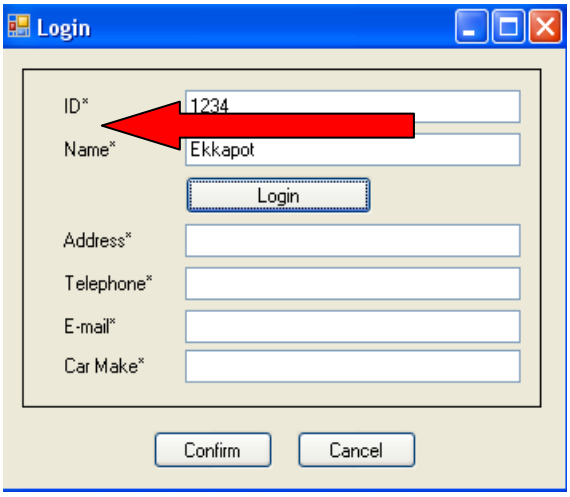

Figure 4: Login window (1)

IF the ID and name are correct, information of address, telephone, E-mail, and car make will be shown up as shown in figure 5. At this point, the login process is accomplished. Then, the user select "Confirm" button to start interviewing.

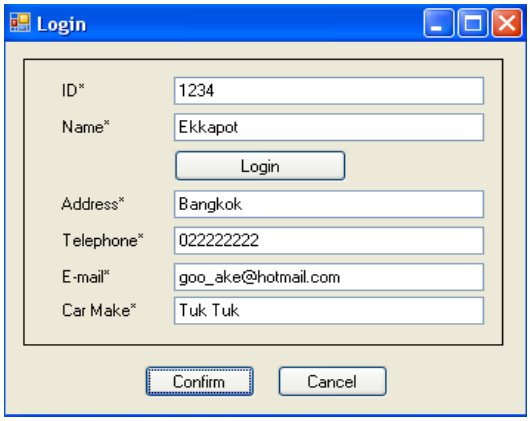

Figure 5: Login window (2)

For figure 6, the user has to choose the problem the user wants to be interviewed by clicking at a radio button. In this case, car start problem are selected and the user then press "Enter" button. The user can exit the system by selecting "Exit" button.

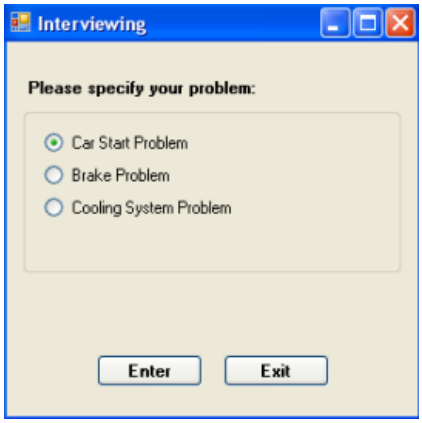

Figure 6: Interviewing window

The first question comes out for the user to make selection as shown in figure 7. The user may choose the answer based on what the user encounters with their car start problem. After the user select the answer, press "Enter" button to go to the next question.

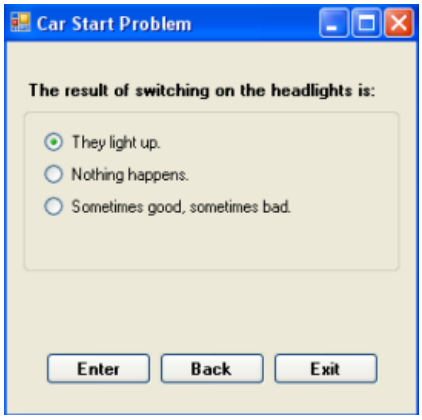

Figure 7: Car start problem (1)

The next question of car start problem will be shown up for the user to choose as shown in figure 8. This will narrow the problem down to find the car symptom and provide the recommended action.

Figure 8: Car start problem (2)

For figure 9, when finishing interviewing, the system will diagnose car symptom and provide the recommended action to the user. "First Page" button will bring the user back to the first page of the system or "Exit" button will bring the user out of the system. The user can choose whether to save or not depending on each user decision, because sometime the car symptom can not be determined, so there is no need to save it.

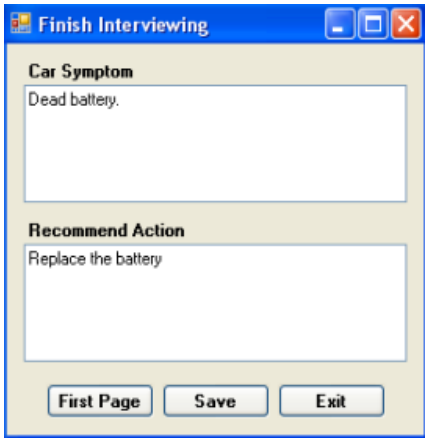

Figure 9: Car symptom and recommended action

For figure 10, the saved data is added in the database that contains the table of the customers who have used the system with their customer information, date_added, car_symptom, and recommended action. The user can check their data by going back to the first page of the system and select add customer. It will be displayed in the data grid view.

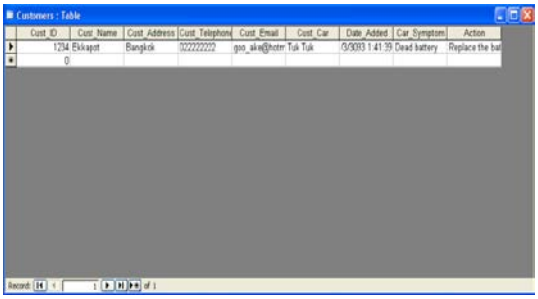

Figure 10: Table of customers

When the system is started, a main menu is displayed on the screen which asks the user to choose. In the figure 11, the system requires a user to specify their problem. In this case, car start problem is selected and then a user clicks "enter" to go forward to the next question.

The folder of car diagnosing system contains the database named CDS. The database is used for collecting the customer data. This database is connected to the system by applying a string connection which can not be changed.

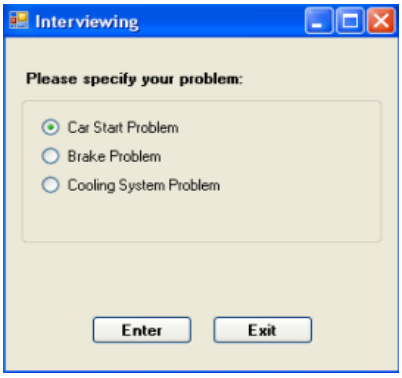

Figure 11: Interviewing question

The first question about car start problem is displayed as shown in figure 12. The user has to choose one answer and the next question will be shown after clicking at "Enter" button. The more questions the authors create and use in the system, the more specific symptom of the problem the user would get with recommended action provided.

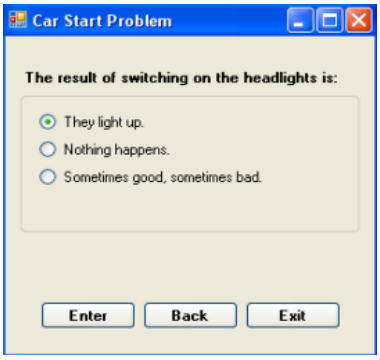

Figure 12: Car start problem

After the user passes all the questions, the system will diagnose the car symptom and recommended action to the user.

Figure 13: Car symptom and recommended action

5. CONCLUSION AND RECOMMENDATION

E-learning for car faulty diagnosis can help the human by replacing the human expert function whenever the expert can't be accessed or by assisting the human expert in situations where it has to cover many things. In this case e-learning for car faulty diagnosis may be useful to execute the routine works and let the human expert to do the rest especially the more difficult jobs. The system is developed in a limited time and resources. Thus, some parts of the system are not compatible and useful enough to be implemented in the real world yet. There must be so many other works to be taken in refining the errors and rules before it can really be used in the real situation. When this is done, the Expert System is ready to be used to assist all the car owners out there in situation where they are having problem with their cars and they can do it by themselves. Time and distance is no more a constraints to them [7,8].

Knowledge-based system for car problem diagnosis is presented in the paper. The knowledge-based system is implemented by using the Visual Basic and Microsoft Access. During the test phase of system it never gave wrong diagnosis according to the rules used. The system indicated that an expert system will be practical and can be useful in providing consistent car problem detection in just only three areas of problem which are car starting problem, brake problem, and cooling system problem.

The system has the characteristics of good e-learning for car faulty diagnosis, such as high performance, adequate response time, and understandability. It can help inexperienced mechanic or driver in providing decision support system, interactive training tool and expert advice [9]. Using this system, loss of customer and income due to lack of knowledge can be avoided. Having this system may allow mechanic to do

more work in less time, thus bringing in more revenue and mechanical engineer gain through improved productivity. Further work is needed to improve the system by adding sufficient domain knowledge that represents domain knowledge thoroughly to cover all the car problems.

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