Using Artificial Intelligence Technologies to Enhance Vehicle Diagnostics

by Joe Mainardi

ABSTRACT

The diagnostics methods used in the current version of SBDS are primarily passive. This means that the knowledge used to navigate through the system relies on the users to know what to ask for, how to ask for it, and where to look. Through the integration of Artificial Intelligence (AI) technologies, future versions of SBDS can take advantage of active diagnostic methods. Active methods imply that system users will find relevant information faster, as a result of having an understanding of both the organization of the information, and their role as a user. Because of the robustness of the current SBDS, integrating AI technologies to enhance vehicle diagnostics has a better than average chance of success.

The incorporation of AI technologies relies heavily on the current and future capabilities of SBDS. The ability of SBDS software and hardware to support AI-based software is a critical assumption. In addition, there is an assumption that some AI-based software will be allowed to execute on future vehicles. This would make SBDS more powerful, as enhanced on-board diagnostics would allow powerful diagnostics to be added to future implementations of SBDS. The presentation of the material that follows is based on the above assumptions being viable.

ON-BOARD VEHICLE DIAGNOSTICS

There is continual growth in the area of on-board vehicle diagnostics. Many of these are considered reactive systems, where an analysis is performed on data extracted from one or more sensors. These systems perform their functions quite adequately, as would be expected. Incorporating AI technology to enhance on-board diagnostics should be approached as a way of adding overall value to on-board diagnostics. Characteristics of AI-based technologies are thought of in terms of an autonomous and distributed system that can run in real-time. A potential application in this area is a neural network program that could review multiple sensor information, while a vehicle is being driven, and classify the data. This data could be used as on-board feedback to make adjustments while driving, as well as providing information to be used in conjunction with other software on future releases of SBDS. This application requires on-board program execution and storage space availability.

SBDS DIAGNOSTICS

The implementation of diagnostic systems on the current SBDS relies on the ability of its users to infer from the facts presented during a particular diagnosis. This is often referred to as "generic-to-specific" analysis, where a list of generic potential solutions is used to resolve a specific case. AI-based technologies have the ability to perform some of inferencing for the user, through the use of "specific-to-generic" analysis. This can be viewed as the analysis of a specific problem, which is then compared to a dynamic list of "related" generic solutions. This approach has the potential for achieving more accurate diagnoses in a shorter period of time, which should lead to an increase in the utilization of SBDS.

In the case of AI-based software development for future releases of SBDS, there are many technologies that have solid potential to succeed. Successful AI-based systems are those that will assist users in making faster and more accurate vehicle diagnoses. These systems will be required to "know" what to do with raw data, and user opinions as to the root cause of a vehicle problem.

Since AI-based technologies are strong in this area, success should be expected.

One implementation would be a rule-based system used in conjunction with the above mentioned on-board neural network, to perform a vehicle health maintenance check whenever a vehicle was connected to SBDS. The potential for identifying problems in a proactive environment, before more expensive problems occur, is achievable and has the potential for increasing overall owner satisfaction.

Another possible implementation is using case-based reasoning as a way of explaining how SBDS made a particular diagnosis decision. By using case-level reasoning, which is appropriate in vehicle diagnostics, a user can discover different approaches to diagnosing problems. Overall, case-based approaches should have the affect of increasing productivity and utilization.

A third implementation is to use various AI methodologies to create an "intelligent dialog" diagnostic system. This system would be able to assist the user in decision making, by using different resources (ex., OASIS, database, other AI-based systems) to allow participation in a dialog with the user. The results of these decisions could be captured on SBDS, and the previously saved decisions would be used in future diagnoses. This should lead to increased user understanding of how to solve problems, as well as developing a basic understanding of how SBDS makes decisions.

INTEGRATION

Integrating AI-based technologies into future releases of SBDS will require a different way of looking at integration. In the example systems from above, the integration tasks range from adding a button to a current screen, to creating a new subsystem. While AI-based software will surely be scheduled for installation in the same way traditional software is installed, the integration will be incrementally delivered. This incremental delivery of AI software modules will allow each module to potentially realize an immediate return on investment, in terms of increased productivity, user satisfaction, and increased utilization.