DOWNLOAD PDF A CASE-BASED SYSTEM TO SUPPORT ELECTRONIC CIRCUIT DIAGNOSIS

Chapter 1 : Full text of "A case-based system to support electronic circuit diagnosis"

Thecase-basedsystemstores individualdiagnosticinstances rather thangeneral rules and algorithmicprocedures; its knowledge base grows as new faultsare detected anddiagnosedby the analyzers.

It is interesting to Abstract note that backward-chaining systems have precisely this advantage in fault-diagnosis; the goal-directed reasoning CBR seems well suited to fault diagnosis because diagnostic episodes naturally form cases and much of asks the user only for information that contributes to the expert competence seems to be based on reuse of old hypothesis being examined. However, in many diagnosis problems it is In this paper we consider the problem of using CBR in difficult to compile a complete case description in electronic fault diagnosis and discuss the re-engineering of advance, consequently the conventional one-shot case an existing model-based, goal-directed diagnosis system as a retrieval methodology will not work. In this paper we case-based system. Fault diagnosis seems a good candidate introduce a set of fault diagnosis problems that have this for CBR because it is clear that much of human expertise in characteristic and we describe a model-based goal-driven fault diagnosis is experience based. Further, fault diagnosis system that produces focused questions that request extra seems naturally case-based with each diagnostic episode information required for diagnosis. The central constituting a case. The problem that we have encountered contribution in this paper is a description of a CBR system that also has this characteristic of producing focused is centred on the cost of gathering a useful case description. We describe the information In our problem domain there can be up to a hundred theoretic mechanism that allows the CBR system to do symptoms that potentially impact on the diagnosis and this and we present an evaluation of the CBR system and a there is a cost associated with gathering most of these. For comparison of the two systems. This system uses goal-directed is clear that much of human expert competence is based on reasoning in the diagnosis and this has the advantage of the reuse of past solutions in solving new problems. This parsimony dividend of backward- methodology is that it tends to be one-shot, requiring that chaining systems has been recognised since the early days the target case description be available in advance and that of MYCIN and, in this paper, we will examine the problem can be solved with a small number of modifications to the CBR idea that can operate with the retrievals. This methodology can be problematic for some same, or even less, information. The problem in the situation that we describe is existing model-based system and explain how the goal- that all information is not available in advance and there is directed reasoning dictates the number of symptoms a cost associated with getting information. Consequently, it requested from the user. This is covered in the next section. What is needed is a CBR methodology that is systems and consider how they tackle or avoid our problem. Alternatively it can be incremental in the sense we me here; that is that the It has long been recognised that goal-directed reasoning, or target specification is composed during the CBR process. In circumstances where there is a cost associated designed to detect these. Fault diagnosis of these SMPS with determining the various symptoms associated with the involves locating the faulty module and finding the faulty fault or illness the goal-driven reasoning can focus the user component in that module. This advantage is not restricted to simple rule- Node-2 based systems; model-based systems can adopt a goal-driven Frame for Q1 reasoning strategy and enjoy the same advantage. LPS-1 Fault diagnosis in switching mode power 3 Emitter: The system is a b implemented in KEE a hybrid expert systems development environment. The original motivation for its development Figure 2. NODAL has a generic reasoning circuit. The block diagram of one of the power-supplies first input in the diagnosis is the results from the test used in testing the system is shown in Figure 1. This input is shown in Figure 3. However, because the internals of the unit are ontrol ontrol 1 N4 I6 Circuit switch 2 Rectifier 1 1 Filter not being examined, the amount of diagnostic information 1 2 12 2 2 O1 Clock 1 N5 4 1 N15 N17 that they carry is limited. The test results are processed by N8 Gen. The top-level represents the blocks in the block diagram as Module Component frames, the main information on the frames being Level Level interconnection information and also some information Diagnosis Diagnosis about the characteristics of the blocks. These blocks are interconnected by nodes and these nodes themselves are represented as frames. These node frames carry information Figure 3. For more complex power- processes. The detailed level of representation corresponds to In order to further isolate the fault it is necessary to detailed information available in schematics of the SMPS perform some internal measurements on the unit. An example of the detail of the Local Power Supply measurements are taken at the nodes mentioned already. The Measurements may involve estimating the goodness of a components are represented as frames that carry signal, or measuring voltages and resistances. This interconnection information and details of the characteristics information is stored in the frames during the diagnosis. A of the components. Again, the interconnecting nodes are typical circuit will have about 20 nodes at the module level also represented as frames. The frame for the Q1 transistor and approaching nodes altogether. Consequently there is shown in Figure 2 b. The advantage of the goal-driven diagnosis is assumption that the circuit under examination has worked at that it requests only measurements that contribute to its some stage reduces the number of fault categories to be current hypothesis. A typical rule from the faulty one for more example dialogues see Cunningham module level reasoning is as follows: Nevertheless it serves to illustrate how the goal- directed reasoning focuses the requesting of measurements IF from the operator. It should be able to direct the The rule is expressed in the TellAndAsk knowledge-base operator on what measurements are important just as the query language of KEE as follows: IS2 AND successful research in the area. Porter et al UNIT. Using the model of the circuit, the goal-directed reasoning uses these heuristics to determine first the faulty module, then the faulty component. An example of a dialogue with NODAL will illustrate This help desk application is designed to assist product how this works in practice. The fault being analysed arises support engineers in diagnosing customer problems with from removing the zener diode CR2 in the Local Power the VMS operating system. This simulates case retrieval process of surface feature-based retrieval that diode blowing open-circuit. At the point when the followed by model-based validation. The surface features are dialogue commences the system has already completed the inexpensive to obtain and include hardware and software shallow reasoning based on the function test rules and has system descriptions and data obtained from the core dump established a candidate set of faulty modules. It then associated with the system failure. The first phase in the proceeds to try and prove one of these to be faulty retrieval process returns all cases from the case-base that are underlined text is input by the user: The model-based validation uses validation information from these cases to Setup for Test Vector 1 direct further inquiry into the target case. Bad similar to any of those retrieved from the case-base. The operator is free to In CASEY, Koton integrates case-based and model-based leave blanks in this template as the retrieval mechanism can reasoning techniques to produce an expert system for operate with incomplete information. The system uses an managing the diagnosis of cardiac disease. Each case inductively built decision tree to identify a group of represents a single patient diagnosis and is composed of candidate cases with contextually similar features to the both descriptive features and solution features. The score reflects the symptoms and test results, whereas the solution features similarity of the candidate to the target. If the initial target describe the diagnosis and suggested therapy. First, CASEY will search for a case The determination of which additional features to specify is that is similar to the current patient diagnosis context. Second, it evaluates the significance of any differences between the target and base case. This evaluation is carried out using a set of evidence principles and will reject a Incremental CBR in NODALCBR match if these principles suggest that certain features of the Our objective in this work is to explain how the desirable, base case cannot be applied to the target. What we have context. CASEY adapts a retrieved case using a set of causal repair strategies to modify the nodes or links in the developed is a CBR system that can begin operation casual explanation of the base case. Thus, rather that expecting the operator operation in clinical audiology Porter et al. PROTOS to chose the next test to apply, the system will propose one implements a type of prototype based classification automatically. In addition the test chosen should maximise whereby surfaces features of the case are used to identify a the amount of new information gained, and hence ensure the set of candidate categories. The system uses prototypical most rapid route to the desired diagnosis.

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If the diagnosis Our first objective has been to replace the first two stages is incorrect the system attempts to adjust its links between of diagnosis in the old system see Figure 3 with one CBR case features and categories in order to produce a correct stage. Consequently the cases features are the information diagnosis. The focus of the work on PROTOS has been on used in the diagnosis at this point, that is the function test concept acquisition in a weak theory domain rather than on results and the module level signal information. The case the diagnosis itself. So, while PROTOS, does conduct a also contains a case name and the identity of the faulty dialogue with its operator, the motivation is different to module associated with these symptoms the solution. A what we have in mind. It is concerned with knowledge typical case structure is shown in Figure 4. It is in the acquisition while we want the dialogue to further the nature of the diagnosis task that the case features are sparse. There is often a small number of results to the function tests because once a unit fails one of the early tests it is not possible to proceed with subsequent tests. In this example these are cases with the the nodes of the decision tree. At this stage the unit We can view the decision tree as an information source under test has not been probed for this signal information producing one of d messages from the set D. Let Di so we want the system to ask some discriminating questions - this was the particular strength of the old represent the number of cases with diagnosis Di. The root classification of the cases in C. Then the expected information required for the sub-tree of Gi is I Di1 , We can The solution we have adopted is to use information obtain the expected information for the tree with F as root theoretic criteria similar to those used in ID3 Quinlan by computing the weighted average over all value branches to determine the most discriminating feature to be of F as follows: The information gained from using F, building a decision tree that will have leaf nodes or the discriminatory power of F, is: In ID3 this is done by selecting features based on most discriminating feature is selected using this criterion. The retrieved cases that cannot match on ID3 except that the semantics of the branching in the this feature are removed from the retrieved set. This process decision tree is slightly different because of the large is repeated until the set reduces to one diagnosis or the number of unknowns in the case features. A brief target case proves to be dissimilar to all the retrieved cases. This technique 5 has proved remarkably successful; indeed it results in less information that will confirm that the cases match. The questions being asked of the user that was the case with the importance of this validation depends on the coverage of the original NODAL system. It is not required when coverage is good. Two other smaller evaluations are shown system. Returning to the example introduced earlier, we can on Figure 7 a and b. From a situation where our initial aspiration was to produce a CBR Selecting function test failure cases: G Category 1 What is the value for N3? G What is the value for N10? G What is the value for N7?

Chapter 2 : DSpace@MIT: A case-based system to support electronic circuit diagnosis

Excerpt from A Case-Based System to Support Electronic Circuit Diagnosis Rapid changes in electronics product and process technology, such as smaller, surface mounted components, higher board densities.

The standard CBR methodology requires a detailed case description in order to perform case retrieval and this is often not practical in diagnosis. We describe two fault diagnosis tasks where many features may make up a case description but only a few features are required in an individual diagnosis. We evaluate an incremental CBR mechanism that can initiate case retrieval with a skeletal case description and will elicit extra discriminating information during the diagnostic process. Case-based reasoning, case retrieval, electronic fault diagnosis. In particular, good performance in both technical and medical diagnosis is often dependent on remembering similar cases encountered in the past. However, an analysis of the use of CBR in diagnosis illustrates that the structure of conventional CBR is very rigid when compared with the flexibility of reuse that humans exhibit in problem solving. A particular problem in using CBR for many diagnosis tasks is that a complete case description is needed in advance of case- retrieval. This is often not practical as the case can be characterised by a large set of symptoms or test results, not all of which are required in order to make a diagnosis. Moreover, many of these features will be expensive to determine so it is desirable that the number required to deliver a good diagnosis should be minimised. In this paper we describe an incremental case retrieval mechanism that can initiate case retrieval with a brief case description. This brief description is used to retrieve a matching subset of the case-base. This retrieved set is analysed to determine discriminating tests that the operator is asked to perform. This procedure offers an incremental case retrieval mechanism that retrieves good matches while requiring a minimal case description [6]. The mechanics of this procedure are described in detail in section 3. First we illustrate the motivation for this approach by describing two diagnosis tasks that require incremental case retrieval. These tasks involve troubleshooting a switching mode power supply and a microprocessor board. In section 4 we describe some experiments on troubleshooting these circuits that illustrate the effectiveness of incremental CBR. This approach has the important advantage that the goal-directed reasoning mechanism can drive the generation of queries for the user. In this way the user is only asked to provide information or perform tests that are of use to prove or disprove a particular hypothesis [1][2]. The user will only need to provide a subset of all the information that might possibly be relevant to a particular fault or diagnosis. This is important because acquiring some information may be expensive; whether it be taking measurements on a circuit, or performing tests on a patient. It will be evident from the examples presented later in this section that diagnostic tasks require information that is readily available; for instance the results of some function test results that will be performed automatically to determine if the circuit is faulty. In addition to this the diagnosis will also require information that is expensive to obtain; for example, diagnostic tests or detailed measurements in the circuit. All this causes problems for the conventional model of CBR because it requires a full description of the target problem to initiate case retrieval. Case retrieval can be initiated using just the free features with the user then being asked for selected expensive features to narrow down the set of retrieved cases. Before elaborating on how this I- 2 CBR mechanism works we will describe some diagnosis and classification problems that fit this structure. There are many features or tests that may be relevant to a particular diagnosis but only a subset of these are required to establish a diagnosis. A block diagram for a particular microprocessor board is shown in Figure 1. Block diagram for a Motorola based microprocessor board. We are not concerned with the detailed operation of this system, instead we can concentrate on troubleshooting issues. The fifteen chips of the circuit can be divided into four main modules: This is the kernel microprocessor module, containing the processor, the EPROM, some clock circuitry and some glue logic. This is the most complex module in the system. The memory; two 2Kbyte RAMs. The operating system called the monitor program is burnt into the EPROM and allows loading of programs into RAM, examining and changing individual memory locations and some other useful functions. Many of the possible faults will cause the system to fail this boot process. Diagnostic information is obtained either with a logic analyser or with an oscilloscope. With the logic analyser it is possible to examine step by step all the instructions of the diagnostic 3 program. With some faults the diagnostic program fails to start catastrophic error ; with other faults only a few instructions reveal problems fault located in some peripherals. It is possible to use the oscilloscope to read signals at various points in the circuit, particularly at the output pins of different chips in the circuit. Evidently the results from the diagnostic program can be considered free features. Information gathered using the oscilloscope is expensive and the amount required should be minimised. It is implemented in KEE a hybrid expert systems development environment. The original motivation for its development was to produce a generic diagnostic system for a class of electrical devices. NODAL has a generic reasoning mechanism and can be set up to work for a particular power supply by encoding the model of that power-supply in the system. The top-level represents the blocks in the block diagram as frames, the main information on the frames being interconnection information and also some information about the characteristics of the blocks. These blocks are interconnected by nodes and these nodes themselves are represented as frames. These node frames carry information used during the diagnosis. For more complex power-supplies these blocks were further divided into sub-modules. The detailed level of representation corresponds to detailed information available in schematics of the SMPS circuit. The components are represented as frames that carry interconnection information and details of the characteristics of the components. Again, the interconnecting nodes are also represented as frames. The frame for the Q1 transistor is shown in Figure 3 b. Local Power Node-9 Supply a b Figure 3. NODAL was designed for use in a repair shop so the assumption that the circuit under examination has worked at some stage reduces the number of fault categories to be considered. Fault diagnosis of these SMPS involves locating the faulty module and finding the faulty component in that module. Since NODAL is designed to operate in a repair shop the first input in the diagnosis is the results from the test equipment on which it was confirmed that the unit was faulty. This input is shown in Figure 4. These tests will number between twenty and forty depending on the complexity of the circuit. However, because the internals of the unit are not being examined, the amount of diagnostic information that they carry is limited. These measurements are taken at the nodes mentioned already. Measurements may involve estimating the goodness of a signal, or measuring voltages and resistances. This information is stored in the frames during the diagnosis. A typical circuit will have about 20 nodes at the module level and approaching nodes altogether. Consequently there is a large number of measurements that can be taken during the diagnosis. The advantage of the goal- driven diagnosis is that it requests only measurements that contribute to its current hypothesis. The goal directed reasoning in the model-based implementation has the advantage that it reduces the amount of expensive features required. It is to be expected that the knowledge engineering requirement in developing a CBR system should be less than that for an MBR system. However, this is hardly conclusive as the experience might have been very different if the systems were developed in the reverse order. This is also a characteristic of help-desk problems as reported by Kriegsmann and Barletta [3]. They describe a CBR system for providing help-desk functionality across a range of computer hardware, software, and networking problems. The problem being addressed in that system is similar to ours in that there is a cost associated with determining the case features. Their system offers the operator a template on which the target specification is to be entered. The operator is free to leave blanks in this template as the retrieval mechanism can operate with incomplete information. The system uses an inductively built decision tree to identify a group of candidate cases with contextually similar features to the target problem. For each candidate a score is computed using nearest-neighbour methods. The score reflects the similarity of the candidate to the target. If the initial target specification is too general or sparse to result in the retrieval of a single best case or even a small subset of candidates the system allows the operator to specify additional information to further focus the retrieval process. The determination of which additional features to specify is left to the operator. This two stage retrieval process is similar to I-CBR with the key difference being that, with I- CBR, the system specifies the additional features to be provided. I-CBR works as follows: Generate a candidate set of cases based on initial features available. The operator provides the system with the values of the free features for the target case. The candidate set is made up of cases that match on these features. Select the most discriminating expensive feature in the candidate set. Query the operator for the value of that feature in the target case. Narrow down the candidate set based on this information. Eliminate cases that cannot match this feature, cases for which the value of this feature is unknown are allowed to remain in the candidate set. Repeat from 1 until a unique diagnosis remains. The main objective is to provide added information about the target case that will allow the system to reduce the candidate set. The key issue here is the process in Step 1 where the system determines the test to perform next. One possibility is that this test selection process itself should be case-based. Alternatively the operator may be given the discretion to select the information to provide next [3]. In I-CBR the candidate set is analysed and the most discriminating feature is selected based on information theoretic criteria. This process is described in full in section 4. This could be done using a flat search of the case-base but since I-CBR is implemented on top of a frame system called KRELL a simple activation based mechanism is employed. This is more economical than flat search with retrieval time increasing less than linearly with the size of the case base. This has the effect of making accessible from the target case cases that have matching features. An example of this is shown in the diagram in Figure 5.

Chapter 3 : A Case-Based System to Support Electronic Circuit Diagnosis

*Case-Based System to Support Electronic Circuit Diagnosis [Thilo Semmelbauer, H. Q. Asada, Anantaram Balakrishnan] on calendrierdelascience.com *FREE* shipping on qualifying offers. This is a reproduction of a book published before*

Introduction In case-based reasoning CBR systems expertise is embodied in a library of past cases, rather than being encoded in classical rules. The knowledge and reasoning process used by an expert to solve the problem is not recorded, but is implicit in the solution. To solve a current problem: The retrieved cases are used to suggest a solution which is reused and tested for success. If necessary, the solution is then revised. Finally the current problem and the final solution are retained as part of a new case. Case-based reasoning is liked by many people because they feel happier with examples rather than conclusions separated from their context. A case library can also be a powerful corporate resource, allowing everyone in an organisation to tap into the corporate case library when handling a new problem. Mature tools and application-focused conferences exist. Case-based reasoning is often used as a generic term to describe techniques including but not limited to case-based reasoning as we describe it here e. All case-based reasoning methods have in common the following process: There are a variety of different methods for organising, retrieving, utilising and indexing the knowledge retained in past cases. Retrieving a case starts with a possibly partial problem description and ends when a best matching case has been found. Some systems retrieve cases based largely on superficial syntactic similarities among problem descriptors, while advanced systems use semantic similarities. Reusing the retrieved case solution in the context of the new case focuses on: Generally the solution of the retrieved case is transferred to the new case directly as its solution case. Revising the case solution generated by the reuse process is necessary when the solution proves incorrect. This provides an opportunity to learn from failure. Retaining the case is the process of incorporating whatever is useful from the new case into the case library. This involves deciding what information to retain and in what form to retain it; how to index the case for future retrieval; and integrating the new case into the case library. A good tool should support a variety of retrieval mechanisms and allow them to be mixed when necessary. In addition, the tool should be able to handle large case libraries with retrieval time increasing linearly at worst with the number of cases. The majority of installed systems are of this type and there are many medical CBR diagnostic systems. Assessment tasks are quite common in the finance and marketing domains. CBR systems have been developed to support in this problem retrieval process often at the level of document retrieval to find relevant similar problems. CBR is particularly good at querying structured, modular and non-homogeneous documents. Systems to support human designers in architectural and industrial design have been developed. These systems assist the user in only one part of the design process, that of retrieving past cases, and would need to be combined with other forms of reasoning to support the full design process. A list of applications can be found here. Techniques for Enterprise Systems". Further information and a detailed list of contents is available. Some of the characteristics of a domain that indicate that a CBR approach might be suitable include: Case-based reasoning is often used where experts find it hard to articulate their thought processes when solving problems. This is because knowledge acquisition for a classical KBS would be extremely difficult in such domains, and is likely to produce incomplete or inaccurate results. When using case-based reasoning, the need for knowledge acquisition can be limited to establishing how to characterise cases. Case-based reasoning allows the case-base to be developed incrementally, while maintenance of the case library is relatively easy and can be carried out by domain experts. A list of CBR development tools, both commercial and academic can be found here A comprehensive review of CBR software tools is also available. Another review paper in Word format is also available.

Chapter 4 : Diagnosys - Keeping your Electronics working longer

Excerpt. Rapid changes in electronics product and process technology, such as smaller, surface mounted components, higher board densities. And more complex circuitry, have made circuit diagnosis more challenging.

A single failure in any harness can affect the entire system. Nevertheless, to accommodate the growing demand for in-car electronics, the complexity of automotive wiring harnesses continues to grow, increasing the need to detect broken or shorted wires quickly and easily. Wire diagnostics are important throughout the entire life of the car. Starting with the installation phase, diagnosing and repairing wiring faults can cause extensive manufacturing delays. During the operational phase, diagnosing and repairing wiring faults can cause prolonged visits to the repair shop, adding significant costs to manufacturers in the form of warranty repairs. Active safety systems, including lane detection and parking assist front and rearview cameras â€”and infotainment systems, including navigation and rear seat entertainmentâ€"are some of the more highly sought automotive electronics systems. For these systems to be effective, video data transmitted via cable from all corners of the car must reliably get to the driver and passengers. Cable health is crucial for maintaining proper operation of these systems. This article offers a circuit idea that provides a robust, cost-effective technique for implementing wire diagnostics on the video and audio transmission lines in automotive applications. The circuit shown in Figure 1 can effectively detect short-to-battery STB , short-to-ground STG , open-circuit, and short-circuit faults. The circuit uses an ADA U1 fully integrated video reconstruction filter as part of the video transmission signal chain and an ADA U2 high-speed difference amplifier as the detection circuit. It has excellent video specifications, overvoltage protection STB and overcurrent protection STG on its outputs, and low power consumption. The ADA provides an attenuating gain of 0. It features input overvoltage protection of up to 18 V, a wide common-mode input voltage range, and excellent ESD robustness. In the example circuit shown in Figure 1, U1 represents the differential output buffer that transmits the video signal from a rearview camera or engine control unit ECU to the receiver. The input would typically be driven by a CMOS imager or video encoder. The primary function of U1 is to provide the active filtering function reconstruction and to drive the video signal through the cable to the display. The inputs of U2 are connected across the outputs of U1 to provide the fault detection features listed in Table 1 and described in the following paragraphs. If either output is shorted to ground, the differential voltage at the output of U2 will be greater than mV. If both outputs are shorted to ground, the differential voltage at the output of U2 will be approximately 0 V. If there is an open connection, the resulting differential voltage at the output of U2 will be approximately mV. If both outputs are shorted together, the differential voltage at the output of U2 will be approximately 0 V. The resulting differential voltage at the output of U2 will be approximately mV.

Chapter 5 : Diagnostic Technique Detects Open and Short Circuits in Wiring Harnesses | Analog Devices

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