

Laptop Troubleshooting Expert System Using CLIPS

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Abstract: Laptop computers have become essential tools for education, business, and daily activities. However, users frequently encounter hardware and software problems that require technical expertise to diagnose and resolve. This research presents a Laptop Troubleshooting Expert System developed using the CLIPS expert system shell. The system assists users in identifying common laptop problems through a rule-based knowledge base and an inference engine. The expert system covers several troubleshooting categories, including power and charging issues, display problems, performance degradation, overheating, Wi-Fi connectivity issues, keyboard and touchpad malfunctions, speaker failures, and microphone problems. The system interacts with users by asking diagnostic questions and providing recommendations based on predefined rules. Experimental testing demonstrated that the system successfully identifies common laptop faults and offers appropriate troubleshooting advice. The proposed expert system can serve as a useful decision-support tool for non-technical users and computer maintenance personnel.

Keywords: Expert System, Knowledge-Based System, CLIPS, Laptop Troubleshooting, Rule-Based System, Artificial Intelligence

1. Introduction

Expert systems are one of the most successful applications of Artificial Intelligence (AI). They are designed to simulate the decision-making abilities of human experts within a specific domain. Expert systems utilize a knowledge base containing expert knowledge and an inference engine that applies reasoning rules to solve problems [2], [4].

Laptop computers are widely used in educational institutions, businesses, and homes. Due to continuous usage, laptops often experience various hardware and software problems such as battery failures, display issues, overheating, slow performance, network connectivity problems, and audio device malfunctions. Diagnosing these problems usually requires technical expertise and experience.

The purpose of this research is to develop a Laptop Troubleshooting Expert System using CLIPS (C Language Implementation Production System) [3]. The system helps users diagnose common laptop problems by answering a series of questions. Based on the user's responses, the system identifies the most probable fault and provides troubleshooting recommendations.

The proposed system aims to reduce diagnostic time, assist non-technical users, and provide consistent troubleshooting decisions through a structured knowledge base [2], [6].

2. Materials and methods

2.1. Development Environment

The proposed expert system was developed using CLIPS, a rule-based programming language specifically designed for building expert systems [3]. CLIPS provides facilities for knowledge representation, rule processing, and inference mechanisms.

2.2. Knowledge Acquisition

Knowledge was collected from:

- Laptop maintenance guides
- Technical support documentation
- Computer hardware troubleshooting manuals
- Common laptop repair practices

The acquired knowledge was organized into categories representing common laptop problems.

2.3. Expert System Design

The system follows the traditional expert system architecture consisting of:

- User Interface
- Knowledge Base
- Inference Engine

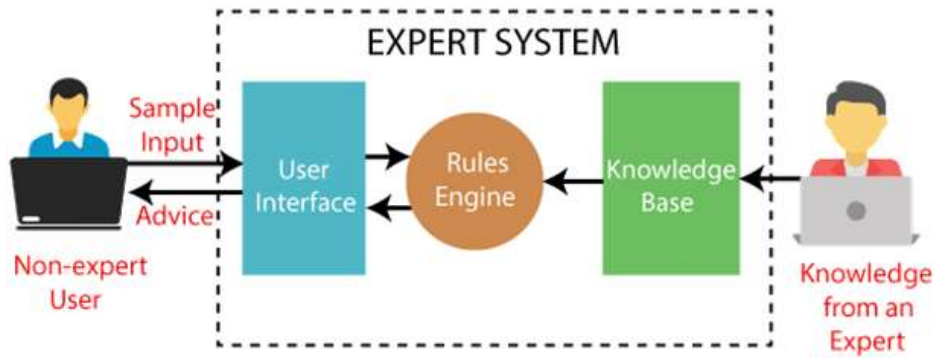


Figure 1: Expert System Implementation

The user first selects a troubleshooting category. The system then asks a series of diagnostic questions related to that category. Based on the user's answers, the inference engine activates the appropriate rules and generates a diagnosis and recommendation.

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Laptop Troubleshooting Expert System
=====

Choose the laptop problem category:
1 - Power / Charging Problem
2 - Display Problem
3 - Performance / Storage Problem
4 - Overheating Problem
5 - Wi-Fi / Network Problem
6 - Keyboard / Touchpad Problem
7 - Speaker / Sound Problem
8 - Microphone Problem

Enter your choice number: 1
Does the laptop power on? (yes/no) n
Is the charging light on? (yes/no) y
Is the battery removable? (yes/no) y

----- RESULT -----
Diagnosis: Battery problem
Recommendation: The battery may be damaged or fully drained. Try testing the laptop with AC power only.
=====

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Figure 2: Main Menu Of The Laptop Troubleshooting System

2.4 Problem Categories

The expert system supports the following troubleshooting categories:

1. Power and Charging Problems
2. Display Problems
3. Performance and Storage Problems
4. Overheating Problems
5. Wi-Fi and Network Problems
6. Keyboard and Touchpad Problems
7. Speaker and Sound Problems
8. Microphone Problems

3. Literature Review

Expert systems are among the most important applications of Artificial Intelligence. They use a knowledge base and an inference engine to simulate the decision-making process of human experts. Expert systems have been successfully applied in areas such as medical diagnosis, education, engineering, and technical support [2], [4].

Several studies have developed computer troubleshooting expert systems to help users diagnose hardware and software problems. These systems commonly use rule-based reasoning, where user symptoms are matched with predefined rules to determine the cause of a problem [2], [6].

Laptop troubleshooting systems focus on identifying issues related to power supply, display devices, storage, network connectivity, and peripheral components. Most of these systems utilize IF-THEN production rules and forward chaining inference techniques [2], [5].

The proposed Laptop Troubleshooting Expert System follows the same approach using CLIPS [3]. It provides diagnosis and recommendations for common laptop problems, including charging issues, display failures, overheating, Wi-Fi problems, keyboard faults, speaker issues, and microphone malfunctions.

4. Knowledge Representation

Knowledge representation is the process of organizing expert knowledge in a form that can be understood and processed by a computer system [2], [6]. In the proposed Laptop Troubleshooting Expert System, knowledge is represented using production rules in the CLIPS environment [3].

The system follows a rule-based knowledge representation approach, where knowledge is stored as facts and IF-THEN rules. User responses are stored as facts in the working memory, and the inference engine analyzes these facts to determine the most appropriate diagnosis [2], [5].

4.1 Knowledge Base

The knowledge base contains information about common laptop problems and their corresponding solutions. The knowledge is organized into the following categories:

- Power and Charging Problems
- Display Problems
- Performance and Storage Problems
- Overheating Problems
- Wi-Fi and Network Problems
- Keyboard and Touchpad Problems
- Speaker and Sound Problems
- Microphone Problems

Each category contains a set of diagnostic rules developed from laptop troubleshooting knowledge.

4.2 Facts

Facts represent information provided by the user during the consultation process. Examples include:

(power-on no)
(charging-light yes)
(sound-working no)
(headphone-sound yes)

These facts are stored in the working memory and used by the inference engine to activate appropriate rules.

4.3 Rules

Rules represent expert knowledge using the IF-THEN format. When the conditions of a rule are satisfied, the system generates a diagnosis and recommendation.

Example of a battery diagnosis rule:

```
(defrule battery-problem
(power-on no)
(charging-light yes)
=>
(assert (diagnosis "Battery problem"))
```

(assert (solution "Test the battery and replace it if necessary"))
)

4.4 Inference Mechanism

The proposed system uses a forward chaining inference mechanism [2], [6]. The process begins when the user selects a problem category and answers diagnostic questions. The user's responses are stored as facts in working memory. The inference engine then evaluates the available rules and fires the rule whose conditions match the provided facts. Finally, the system displays the diagnosis and troubleshooting recommendation [2], [3].

4.5 System Workflow

The workflow of the system can be summarized as follows:

1. Select a problem category.
2. Answer diagnostic questions.
3. Store responses as facts.
4. Match facts with rules.
5. Generate a diagnosis.
6. Display recommendation.

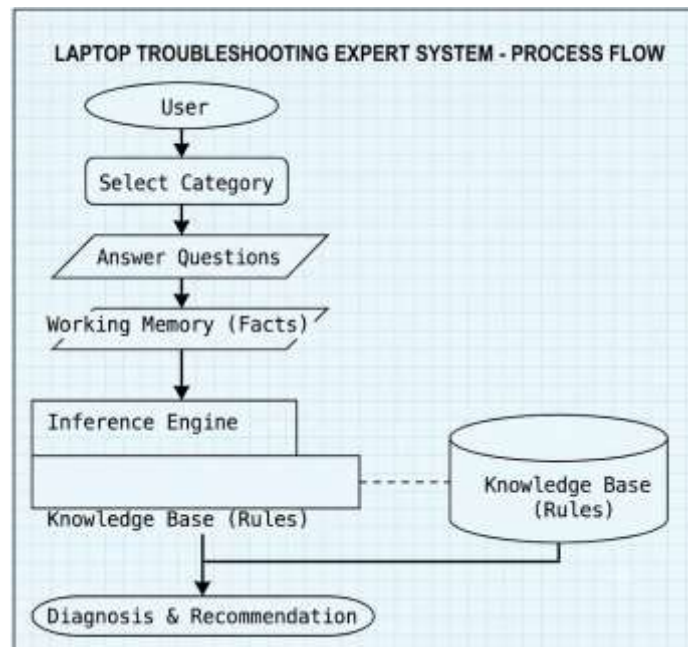


Figure 3: System Workflow

4.6 Implementation Screenshot

Figure 4: Clips Implementation Screenshot

1. Test Case 1: Power Problem

Figure 7: Power Problem Implementation

Figure 8: Display Problem Implementation

3. Test Case 3: Performance / Storage Problem

```
Enter your choice number: 3
Does the operating system boot successfully? (yes/no) n
Is the laptop very slow? (yes/no) y
Do you hear strange noise from the hard disk? (yes/no) y

----- RESULT -----
Diagnosis: Operating system problem
Recommendation: Try startup repair, safe mode, or reinstall the operating system. Backup important data first.
```

Figure 9: Performance Storage Problem Implementation

4. Test Case 4: Overheating Problem

```
Enter your choice number: 4
Does the laptop become very hot? (yes/no) y
Is the fan very noisy or not spinning? (yes/no) n
Does the laptop shut down suddenly? (yes/no) y

----- RESULT -----
Diagnosis: Overheating problem
Recommendation: Clean the fan and air vents, replace thermal paste, and avoid using the laptop on soft surfaces.
```

Figure 10: Overheating Problem Implementation

5. Test Case 5: Keyboard / Touchpad Problem

```
Enter your choice number: 6
Is the keyboard working? (yes/no) y
Are only some keys not working? (yes/no) y
Is the touchpad working? (yes/no) y

----- RESULT -----
Diagnosis: Partial keyboard key problem
Recommendation: Clean the keyboard carefully. If the problem continues, replace the keyboard.
```

Figure 11: Keyboard /Touchpad Problem Implementation

6. Test Case 6: Speaker / Sound Problem

```
Enter your choice number: 7
Is the laptop speaker sound working? (yes/no) 2
Please answer using: (yes no y n)
Is the laptop speaker sound working? (yes/no) n
Does sound work with headphones? (yes/no) y
Is the sound muted or volume very low? (yes/no) n

----- RESULT -----
Diagnosis: Internal speaker problem
Recommendation: The internal speakers may be damaged. Check audio settings and speaker hardware.
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Figure 12: Speaker /Sound Problem Implementation

7. Test Case 7: Microphone Problem

```
Enter your choice number: 8
Is the internal microphone working? (yes/no) n
Does an external microphone work? (yes/no) n
Are microphone permissions enabled? (yes/no) y

----- RESULT -----
Diagnosis: Microphone driver or sound card input problem
Recommendation: Update or reinstall the audio input driver and check microphone input settings.
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Figure 13: Microphone Problem Implementation

5. Conclusion

This research presented a Laptop Troubleshooting Expert System using CLIPS to diagnose common laptop problems and provide troubleshooting recommendations. The system uses a rule-based knowledge base and forward chaining inference to identify issues related to power, display, performance, overheating, network connectivity, keyboard, speaker, and microphone components.

Testing showed that the system can successfully diagnose common laptop faults and provide appropriate recommendations. The results demonstrate that Knowledge-Based Systems can be effectively used to assist users in troubleshooting laptop problems quickly and consistently.

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