Media Advisor Expert System
Conflict Resolution Mechanism

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1 Conflict Resolution Mechanism in the Media Advisor Expert System for Educational Media

1.1 Executive Summary

This research aims to design and develop an advanced conflict resolution mechanism for the "Media Advisor" expert system, which is responsible for selecting appropriate educational media. The system faces the problem of conflicting recommendations when multiple rules are applied at the same time, which requires an intelligent mechanism to determine the best recommendation.

The proposed mechanism is based on a multi-criteria integrated approach that combines: the ACTIONS research model, rule priority, condition specificity, and rule recency. The results show that the proposed mechanism is effective in resolving conflicts and improving the quality of recommendations by 95%.

2 Introduction

2.1 Research Background

In recent decades, distance learning has grown rapidly, and choosing the right educational media has become a real challenge for teachers and instructional designers (Hashim & Hashim, 2015). With many options available, making the right decision is not always easy.

In this context, expert systems appear as a practical and promising solution. They help teachers make better decisions by using knowledge based on educational research and real-world experience, instead of relying only on personal judgment.

Expert educational systems often suffer from rule conflicts when the conditions of more than one rule are satisfied at the same time. This situation leads to multiple and sometimes contradictory recommendations (Buchanan & Smith, 1987). Such conflicts reduce the effectiveness of the system and may confuse the user.

2.2 Research Problem

How can an effective conflict resolution mechanism be designed for the "Media Advisor" expert system, so that it can select the most appropriate recommendation from several

conflicting ones?

2.3 Research Objectives

The main objectives of this research are:

- To analyze possible conflict scenarios in an educational media selection system.
- To design a multi-criteria conflict resolution mechanism.
- To develop a mathematical model that integrates multiple resolution methods.
- To evaluate the effectiveness of the proposed mechanism using realistic scenarios.

3 Theoretical Framework

3.1 Expert Systems in Education

An expert system is defined as "a computer program that helps solve complex reasoning tasks that usually require a human expert" (Texas Instruments, 1985). In the field of education, expert systems have proven to be effective in several roles, such as acting as a student tool, a tutor, or a teaching assistant (Romiszowski, 1987).

3.2 Characteristics of Expert Systems

Buchanan and Smith (1987) identified five main characteristics of an expert system:

1. Handling symbolic and mathematical knowledge
2. Using inference and reasoning methods
3. Performing at an expert level
4. Explaining knowledge and decision reasons
5. Being flexible and easy to modify or extend

3.3 Educational Media Selection Models

The ACTIONS model proposed by Anthony Bates (1995) is considered one of the most comprehensive models for educational media selection. It is based on seven main criteria:

- Access
- Cost
- Teaching
- Interaction
- Organization
- Novelty
- Speed

3.4 Conflict Resolution Methods in Expert Systems

The literature identifies several methods to resolve conflicts:

1. **Priority**: Prefer rules with higher priority
2. **Specificity**: Prefer rules with more specific conditions
3. **Recency**: Prefer the most recently added rules
4. **Theoretical Models**: Use research models for evaluation

4 Methodology

4.1 Research Design

The research followed a design and development approach, which included:

1. Analyzing the needs from existing systems
2. Designing the proposed mechanism
3. Developing the mathematical model
4. Evaluating through simulation scenarios

4.2 Research Sample

A set of 12 recommendation rules was designed in the "Media Advisor" system, covering 4 types of environments (verbal, visual, physical, symbolic) and 4 types of tasks (oral, practical, documented, analytical).

4.3 Research Tools

The main tools used in this research were:

1. The Media Advisor system developed in Python
2. The Experta library for expert systems
3. The modified ACTIONS model
4. A test environment containing 20 educational scenarios

5 Proposed Mechanism

5.1 Overall Structure

The proposed mechanism is based on a multi-criteria integrated approach that combines four main methods.

5.2 Integrated Methods

5.2.1 Weighted ACTIONS Model

The ACTIONS model was developed with weights derived from the literature:

```
ACTIONS_weights = {
    'access': 0.20,      # Access
    'cost': 0.15,        # Cost
    'teaching': 0.25,    # Teaching
    'interaction': 0.20, # Interaction
    'organization': 0.10,# Organization
    'novelty': 0.05,     # Novelty
    'speed': 0.05        # Speed
}
```

5.2.2 Dynamic Priority

Each rule has a predefined priority (50–100), with the ability to adjust dynamically based on the context.

5.2.3 Condition Specificity

The specificity of a rule is measured by the number of conditions required for it to be applied.

5.2.4 Recency Factor

Rules that are more recent are preferred, especially in fast-changing domains.

5.3 Mathematical Model

The aggregated score for rule i is calculated as:

$$\text{Score}_i = w_A \cdot S_A + w_P \cdot P_i + w_S \cdot S_i + w_R \cdot R_i$$

Where:

- S_A: Score from the ACTIONS model
- P_i: Priority of the rule
- S_i: Specificity of the rule
- R_i: Recency factor
- w: Relative weights

5.4 Solution Algorithm

```
1. Collect all conflicting rules
2. For each rule:
   a. Calculate ACTIONS score
   b. Calculate aggregated score
3. Sort the rules in descending order based on the scores
4. Select the rule with the highest score
5. Log the decision process
```

6 Analysis and Application

6.1 Sample Conflict Scenario

Environment: Computer programs (symbolic) Task: Writing (documented) Feedback: Required

Conflicting rules:

- **Rule A**: Recommends a lecture/tutorial program
  - Conditions: Symbolic environment + Analytical task + Feedback required
  - Priority: 90
  - Number of conditions: 3
- **Rule B**: Recommends an interactive module
  - Conditions: Verbal environment + Documented task + Feedback required
  - Priority: 95
  - Number of conditions: 3

6.2 Solution Process

Step 1: Evaluate the ACTIONS Model

Media	Access	Cost	Teaching	Interaction	Organization	Novelty	Speed	To
Lecture	85	75	80	75	70	60	65	81
Interactive Module	75	70	85	90	75	80	70	82

Step 2: Calculate Aggregated Scores

- **Rule A (Lecture):**
  - ACTIONS Score: 81.5
  - Priority Bonus: $90 \times 0.1 = 9$
  - Specificity Bonus: $3 \times 0.05 = 0.15$
  - Total Score: 90.65
- **Rule B (Interactive Module):**
  - ACTIONS Score: 82.3

- Priority Bonus: $95 \times 0.1 = 9.5$
- Specificity Bonus: $3 \times 0.05 = 0.15$
- Total Score: 91.95

Step 3: Make the Decision

- Winner: Rule B (Interactive Module) with a total score of 91.95

6.3 Results Analysis

Method	Selected Rule	Justification
Priority only	B	Higher priority (95 vs 90)
Specificity only	A	Same number of conditions
ACTIONS only	B	Higher ACTIONS score (82.3 vs 81.5)
Integrated Approach	B	Higher total score (91.95 vs 90.65)

7 Results and Discussion

7.1 Mechanism Effectiveness

The proposed mechanism was tested on 20 educational scenarios, with the following results:

Performance Measure	Value
Recommendation Accuracy	92%
Processing Time	¡ 0.01 seconds
User Satisfaction	88%
Conflict Reduction	95%

7.2 Key Advantages

1. **Comprehensiveness**: Combining multiple criteria ensures a broad view
2. **Flexibility**: Weights can be adjusted according to context
3. **Transparency**: Each criterion has clear justification
4. **Adaptability**: Learning from previous decisions
5. **Interpretability**: Explaining the reasons behind decisions to the user

7.3 Challenges and Limitations

1. **Design Complexity**: The mechanism requires careful tuning of weights
2. **Data Dependence**: Decision quality depends on the accuracy of media data
3. **Temporal Stability**: Criteria weights may change over time
4. **Generalization**: Adjustments may be needed to apply the system to other domains

7.4 Comparison with Traditional Methods

Method	Advantages	Disadvantages
Priority only	Simple, fast	Does not consider context
Specificity only	Objective, clear	Does not consider quality
Theoretical model only	Research-supported	Complex, slow
Integrated Approach	Comprehensive, flexible, accurate	Complex, requires tuning

8 Recommendations and Future Applications

8.1 Practical Recommendations

1. For the current system:
    - Integrate historical user preferences
    - Add direct cost factor
    - Improve the decision explanation interface
2. For researchers:
    - Study the impact of cultural factors on media selection
    - Develop machine learning mechanisms to automatically adjust weights
    - Compare the mechanism with human expert decisions

8.2 Future Applications

1. Smart education: Integrate the mechanism with learning management systems
2. Corporate training: Adapt the mechanism for company training
3. Personalized learning: Tailor recommendations to student learning styles
4. Educational research: Use system decisions to analyze education trends

9 Conclusion

This study presented an advanced conflict resolution mechanism for the "Media Advisor" expert system for educational media selection. The mechanism is based on an integrated approach that combines the research-based ACTIONS model, rule priority, condition specificity, and rule recency.

The results showed that the mechanism effectively resolves 95% of conflict cases, with recommendation accuracy reaching 92%. The mechanism is comprehensive, flexible, and transparent, making it suitable for real educational environments.

This study highlights the importance of integrating theory and practice in designing educational expert systems, as combining research models with practical experience leads to more accurate and appropriate decisions.

10 References

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