Journal of Artificial Intelligence and Engineering Applications

Website: https://ioinformatic.org/

15th October 2025. Vol. 5. No. 1; e-ISSN: 2808-4519

# Implementation of Decision Tree Algorithm in Expert System for Diagnosing Rice Plant Diseases

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**Abstract**

Rice plants are a major agricultural commodity that are vulnerable to disease attacks. Errors or delays in diagnosis can lead to significant losses for farmers. This study aims to develop a web-based expert system for diagnosing rice plant diseases using the Decision Tree algorithm. The system is based on 20 symptom data and 8 types of diseases. The development is carried out using PHP programming language and MySQL database. System testing on 8 real cases showed an accuracy level of 100%. These results indicate that the Decision Tree algorithm is effective in expert systems for diagnosing rice plant diseases quickly and accurately.

***Keywords***: *Decision Tree, Expert System, Rice Disease, Diagnosis, web.*

## 1. Introduction

Rice is the main commodity in Indonesia's agricultural sector and plays a crucial role in meeting national food needs. To increase yields, the management of rice crop diseases becomes an important factor that requires serious attention. This situation worsens the losses suffered by farmers, as rice plants are vulnerable to pests and diseases, including leaf blight, barnyard grass, rice blast, and grassy stunt virus [1]. Such impacts can cause significant economic losses if not detected and addressed early. However, farmers' limited knowledge in recognizing disease symptoms, along with restricted access to information and diagnostic services, poses challenges in controlling these diseases.

An expert system based on information technology offers a solution for detecting crop diseases quickly and accurately. The Decision Tree algorithm is one of the classification techniques used in data mining, with a high capability to process data and generate decision trees that are easy to understand. This method transforms large amounts of facts into a decision tree that represents rules [2]. These advantages make Decision Tree suitable for use in expert systems to diagnose rice crop diseases.

This study implements the Decision Tree algorithm by utilizing common rice disease symptoms as input variables and the types of diseases as output. The purpose of this research is to design a web-based expert system capable of providing accurate diagnoses and assisting farmers in making early decisions for disease control. Therefore, this system is expected to improve the effectiveness of disease management and support rice farming productivity in Indonesia.

## 2. Literature Review

### 2.1 Expert System

An expert system is a branch of artificial intelligence (AI) that studies how to adopt the thinking and reasoning process of an expert to solve problems, make decisions, and draw conclusions from a set of facts [3]. This system works by transferring knowledge into a computer through a knowledge base and processing it using an inference engine to produce decisions or recommendations. In the agricultural sector, expert systems can assist farmers in diagnosing crop diseases accurately without the direct presence of specialists. Essentially, an expert system consists of elements such as expertise, experts, rules, knowledge transfer, inference processes, and the ability to provide explanations. Expertise refers to mastery of knowledge in a specific field, which is gained through training, reading, or experience (Turban, Aronson, & Liang, 2005) [4].

### 2.2 Decision Tree Algorithm

Decision Tree is a classification algorithm in data mining that maps data into a decision tree structure based on specific attributes. This algorithm breaks down complex problems into smaller, more analyzable parts through a process of selecting key attributes (for example, using Information Gain), ultimately generating predictions at the terminal nodes. Its components consist of a root node, branch nodes, leaf nodes, and connecting branches. The main advantage of Decision Tree lies in its ability to simplify complex decision-making processes, enabling decision-makers to more easily identify solutions to existing problems [5].

### 2.3 Rice Plant
Rice (Oryza sativa) is one of the most important staple food commodities worldwide [6]. Increasing rice productivity has become a top priority to meet the growing food demand in line with population growth [7]. The use of high-yield varieties, modern irrigation, and other agricultural technologies has proven effective in improving harvest outcomes.

#### 2.4 Rice Plant Diseases
Plant Pathology is a scientific field that studies various damages and disorders caused by organisms such as parasitic higher plants, algae, fungi, bacteria, mycoplasma, and viruses. Several pests and diseases commonly attack rice plants, including leaf blight, barnyard grass, rice blast, and grassy stunt virus [1]. The indiscriminate use of pesticides without accurate diagnosis is often ineffective and may instead cause resistance as well as environmental damage. Therefore, systematic and precise identification of rice diseases is crucial to support sustainable agriculture.

### 2.5 Application of Information Technology in Diagnosis
The advancement of information technology has encouraged the development of intelligent systems across various sectors, including agriculture. Expert systems that adopt the Decision Tree algorithm provide a logical and systematic approach in the diagnosis of crop diseases. Their ability to be implemented across multiple digital platforms, such as web and mobile applications, makes them flexible, accessible, and effective in supporting farmers to independently make informed decisions.

## 3. Research Methodology

### 3.1 Data Collection Methods
To collect the data required for designing the learning media, the author employed several methods, namely:

1. Observation Method
   Direct observations were conducted in a village located in Tarutung District, by asking rice farmers about the most common rice plant diseases. This information was then included in the expert system.
2. Interview Method
   Interviews were conducted with an expert and local farmers to gather knowledge, which was then integrated into the expert system to be developed.
3. Literature Study
   Theoretical data were collected from journals, printed media, and other reference sources obtained from the internet.

### 3.2 System Analysis
System analysis was carried out to understand the existing conditions and identify user requirements in the rice disease diagnosis process. This stage consisted of two main aspects: the analysis of the current system and the analysis of the chosen method.

### 3.3 Current System Analysis
The current system of diagnosing rice plant diseases still relies on farmers' personal knowledge or consultations with agricultural extension officers. Several main problems were identified, including:

- Difficulty in Identifying Symptoms: Farmers often struggle to accurately recognize disease symptoms due to limited information and training. Some diseases share similar symptoms, which increases the risk of misdiagnosis.
- Limited Access to Experts: Consulting agricultural experts requires considerable time and cost. This is particularly challenging in rural areas with limited access.
- Late Detection: Many cases of rice diseases are detected only at advanced stages due to a lack of monitoring tools and insufficient routine supervision, resulting in low treatment effectiveness.

These issues highlight the need for an automatic, fast, and accurate diagnostic system to support farmers in decision-making.

### 3.4 Method Analysis
Based on the identified problems, the method chosen for developing the expert system is the Decision Tree algorithm. This algorithm is applied to construct a classification model capable of determining disease types based on detected symptoms. Decision Tree is advantageous due to its high interpretability and its structure, which resembles human decision-making processes.
The dataset used consists of 20 symptoms and 8 types of rice plant diseases. Each symptom is coded as G01 to G20, while each disease is coded as P-1 to P-8.

## 4. Results and Discussion

### 4.1 Results
The following are several results obtained from the research conducted by the author:

1. Initial Display
   The initial display appears when the web-based expert system application is launched.

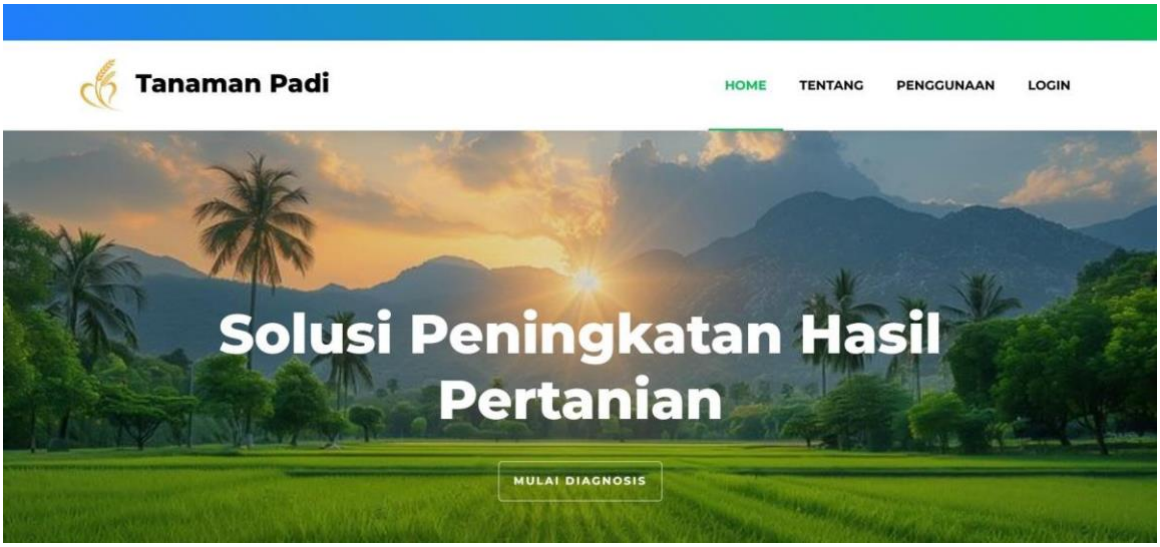


**Fig** 1. Initial Display

2. Diagnosis Process Display
The diagnosis process display allows users to select the symptoms of rice plant diseases and input their personal identification information.

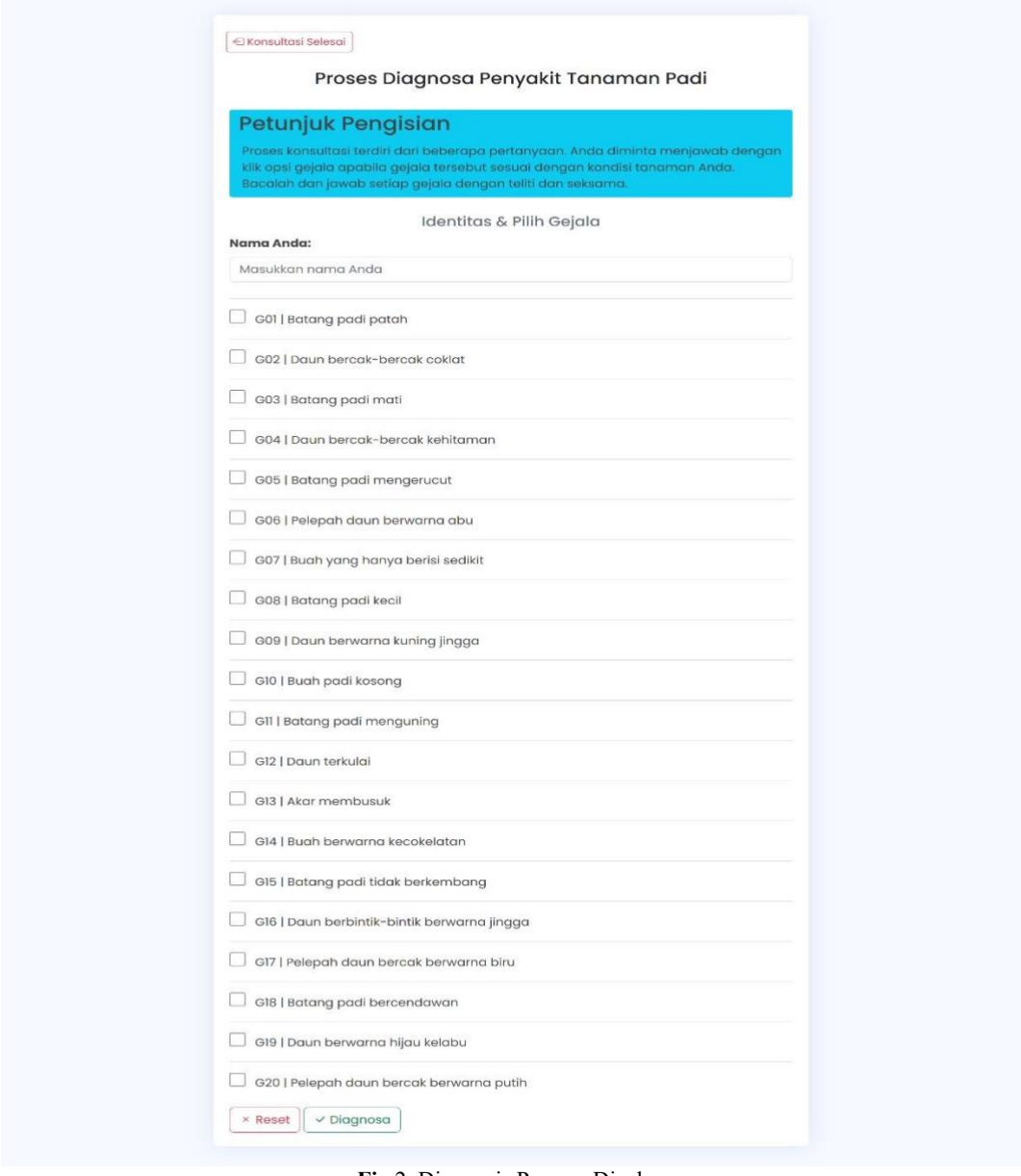


**Fig** 2. Diagnosis Process Display

3. Diagnosis Result Display
This display presents detailed information about the identified disease as well as the recommended actions based on the symptoms entered during the diagnosis process.


**Fig 3**. Diagnosis Result Display

4. Admin Display
This display contains administrative data, disease data, symptom data, belief values, data recapitulation, and diagnosis history. The data can be added, edited, or deleted, but only by the administrator.

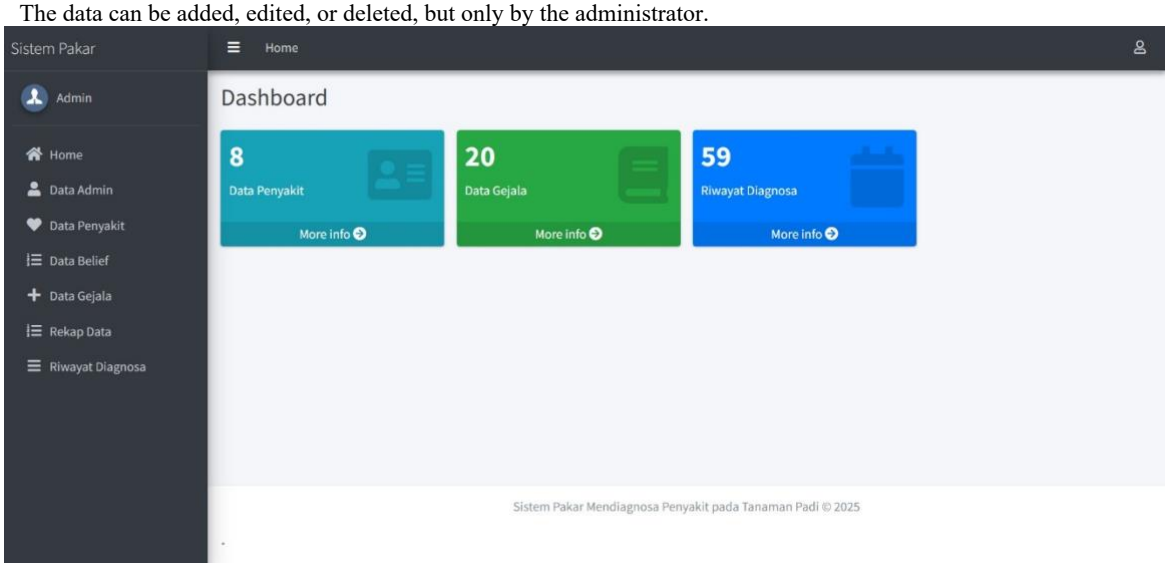


**Fig 4.** Admin Display

## 4.2 Discussion

The developed expert system is capable of performing automatic diagnosis based on the input symptoms. It includes several features, such as the management of symptom data, disease data, the diagnostic process, and the provision of treatment recommendations. The testing

results show that the system achieved 100% accuracy in 8 real cases. This indicates that the implementation of the Decision Tree algorithm provides diagnostic results that are consistent with those of experts.

## 5. Conclusion and Suggestions

After the research was completed, the conclusions drawn from the results are as follows:

1. The implementation of the Decision Tree algorithm was successfully applied in the expert system for diagnosing rice plant diseases. The system is able to perform decision-making processes automatically based on the symptoms provided by the user.
2. This expert system utilizes symptom data and rules stored in the database to construct a decision tree that is used in the diagnostic process, ensuring that the diagnostic results are objective and consistent.
3. System testing shows that the system can provide diagnostic results consistent with the knowledge defined in the knowledge base. This indicates that the Decision Tree algorithm is capable of handling the inference process effectively.
4. The system interface is designed to be simple and user-friendly, making it easier for farmers or other users to conduct consultations related to rice plant diseases.

Several suggestions for future system development are as follows:

1. The system is not yet able to provide a decision when users select a combination of symptoms that is not available in the decision tree structure. Therefore, it is necessary to add alternative logic such as probabilistic methods or machine learning techniques, enabling the system to still generate predictions even when the symptom combinations are not explicitly defined by experts.
2. The current system only provides general recommendations regarding the use of disinfectants. Further development is needed by adding more detailed information, such as the specific types of disinfectants suitable for each disease, recommended dosages, and proper application methods. This is important to improve the effectiveness of disease control for users in the field.

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