An expert system for diagnosing plant diseases using certainty factor and backward chaining based on android

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Abstract. Rice is a producer of basic human needs that have a very important role. Every use of new seeds can cause disease in new plants and often the results obtained are not optimal because they do not know more precisely the type of disease that attacks the rice plants. Most rice farmers still use manual methods to find out the existence of the disease in the rice plants, namely by seeing it directly in the rice fields so that often rice farmers are too late to know these symptoms due to the lack of more knowledge and understanding of rice plants. To overcome the problems that occur it takes a system that has the knowledge like an expert. In this study, an expert system with an Android-based design was designed to make it easier for farmers to access information and can be used as a tool to diagnosed diseases in rice plants so that they can be accessed wherever and whenever to overcome the problems faced by farmers. In this system applying the backward chaining method as the basis of the rules and the certainty factor method as weighting, so that by using the method that has been applied in testing various types of diseases and symptoms, the diagnosis of the type of blast disease is 68.83%.

1. Introduction

Current technological developments have shown a lot of progress and provide benefits in various aspects of life, the use of technology is very helpful in various agencies such as government and private institutions, education in fulfilling the need to complete work. One of the technological developments that can be done is an expert system. Expert systems designed by utilizing information technology can assist in presenting accurate information. In addition, this technology has touched almost all mobile technology circles can be easily obtained. This is what underlies the need for an application regarding the disease diagnosis system in addition to overcoming obstacles and limitations in the world of health above. So that it is expected that this application can improve the performance of health services, and can reduce the emergence of hazards caused by symptoms of the disease because it can be detected more quickly. The disease diagnosis mobile application that will be made using an expert system [1].

Rice is a staple food for the people of Indonesia, rice grains that have been separated from the stem are called grain and which have been removed from the outer shell is called rice [2]. In practice in the field every use of new seeds can cause pests or diseases in the new plant, the thing that often happens is the loss caused by the existence of diseases in plants that are late to be diagnosed and have reached a
severe stage and cause crop failure. Before widespread in general, the disease shows symptoms that are suffered in a mild stage and still few but farmers often ignore this because of ignorance and consider these symptoms are common things that often occur during the planting period until more severe symptoms arise making it difficult to control. Expert systems are systems that try to adopt human knowledge to computers so that computers can solve problems as they are usually done by experts. An expert system is an effort to apply the ability of experts to be used to consult using a system, making it easier for farmers to know which diseases or pests attack [3]. Currently, the existence of an Android platform is very popular among smartphone users. By using an expert-based system android, information from an expert will be easily obtained by users without having to visit an expert or expert in their field and Currently, the existence of an Android platform is very popular among smartphone users. By using an expert-based system android, information from an expert will be easily obtained by users without having to visit an expert or expert in their field [4].

Previous researchers used the method of certainty factor and backward chaining where previously there was no explanation of disease and accurate percentage rates [5].

2. Methodology

Expert system [6] is a computer program designed to simulate problem-solving from systems that try to adopt human knowledge to computers designed to solve problems like an expert. Expert systems usually consist of knowledge bases (information, heuristics, etc.), machine conclusions (basic knowledge analysis), and end-user interfaces (receiving inputs and producing output). Expert systems are computer programs that mimic the reasoning of an expert with expertise in a particular area of knowledge that combines a knowledge base with an inference engine that attempts to duplicate the functions of an expert in a particular field of expertise. The existence of expert systems makes it easy for the general public to make the right decision. One application of expert systems is in agriculture. Alternatives to overcome the limitations of the number of experts in agriculture can use the system to be designed [7].

Backward Chaining is a backward process of reasoning starting with a goal or goal and then tracing the path that will lead to that goal, looking for evidence that the condition is fulfilled. Matching facts or statements starts from the right side (then first). In other words, reasoning starts from the hypothesis first and to test the truth of the hypothesis facts must be found in the knowledge base [8-9].

The certainty factor method is used when dealing with a problem whose answer is uncertain. This uncertainty can be a probability. In dealing with a problem often found answers that do not have full certainty. Hasilyang is uncertainty caused by two factors, namely uncertain rules and uncertain user answers to questions raised by the system. This is very easy to see in a disease diagnosis system, where experts cannot define the relationship between symptoms and their causes for sure, and patients cannot feel a symptom with certainty. Eventually, there will be many possible diagnoses [10-12].

This method was introduced by Shortlife Buchanan. He uses this method when making diagnoses and therapies for meningitis and blood infections. Confidence factors show a measure of certainty about a factor rule [13-15].

\[
CF[h, e] = MB[h, e] - MD[h, e]
\]

where \(CF[h, e]\) = certainty factor, \(MB[h, e]\) = Measure of belief, measure of trust or level of confidence in the hypothesis (h), if given evidence (e) between 0 and 1, and \(MD[h, e]\) = Measure of disbelief, measure of distrust or level of confidence in the hypothesis (h), if given evidence (e) between 0 and 1.

\[
CF (h,e) = CF (expert) * CF (user)
\]

where in the second equation above completes and determines the CF value for each symptom then combines CF (user) and CF (expert). after the uncertainty value is obtained, it is multiplied by the expert weight value.
\[
\text{CF combine} = \text{CF1} + \text{CF2} \times (1 - \text{CF1})
\]  
(3)

In this step, combine the cf value of each rule of the formula by adding up the value of each combine.

\[
\text{confidence} = \text{CFold} \times 100\%
\]  
(4)

From the results of the calculations that have been done, then the percentage value of confidence is obtained. The following is an explanation of the block diagram that is used to determine the work order of expert systems to reach decisions and made to maintain the work process on the computer so that it is easy to understand. The following is a block diagram description in an expert system for diagnosing diseases with backward training methods and certainty factors based on android. The first user will see the interface of the disease definition, as well as the symptoms of several diseases of the rice plant. After that the user will return to input some symptoms and weight values, then after the symptom data and the weight of the inputted value the system will process and issue output or display output in the form of rice plant diagnosis, disease details, handling, and solutions obtained regarding rice plant disease. From Table 1 and Table 2, 3 are interrelated, because in Table 1 the description of the symptoms and in Table 2 is a description of the value of the weight of the root in the table and the type of symptoms, the type of disease and its weight.

If the system has obtained a solution to the disease, a list of the characteristics that have been asked, then in this system will display a conclusion that has been obtained. Following are symptom data, there are 39 symptoms and consist of 8 diseases can be seen in Table 1 and 2 below:

| Code | Symptoms                                      | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 |
|------|-----------------------------------------------|----|----|----|----|----|----|----|----|
| G01  | Panicles are small and not filled             | √  |    |    |    |    |    |    |    |
| G02  | The number of shoots decreases                |    | √  |    |    |    |    |    |    |
| G03  | Flowering is delayed                         |    |    | √  |    |    |    |    |    |
| G04  | Plant growth is less than perfect             |    |    |    | √  |    |    |    |    |
| G05  | Attack all part plant                         |    |    |    |    | √  |    |    |    |
| G06  | Leaf to be short and narrow                   |    |    |    |    |    | √  |    |    |
| G07  | Leaf colored green and yellowish              |    |    |    |    |    |    | √  |    |
| G08  | Plant start fall down when start charging     |    |    |    |    |    |    |    | √  |
| G09  | Puppies many but small                        |    |    |    |    |    |    |    |    |
| G10  | Attack leaf and point grow                    |    |    |    |    |    |    |    | √  |
| G11  | Is available lines between bone and leaf      |    |    |    |    |    |    |    |    |
| G12  | Line blister and contain fluid blackish       |    |    |    |    |    |    |    | √  |
| G13  | Leaf dry up and die                           |    |    |    |    |    |    |    |    |
| G14  | Attack panicle and seed young to be brownish  |    |    |    |    |    |    |    |    |
| G15  | Leaf drooping                                  |    |    |    |    |    |    |    |    |
| G16  | Root rot                                      |    |    |    |    |    |    |    |    |
| G17  | Attack midrib leaf on plants that make up puppies |    |    |    |    |    |    |    |    |
| G18  | Cause total and quality grain downhill        |    |    |    |    |    |    |    |    |
| G19  | Cooking hampered and granules rice to be empty |    |    |    |    |    |    |    |    |
| G20  | Seed rice rotten when germinate and then die  |    |    |    |    |    |    |    |    |
| G21  | Plant rice adult rotten and dry               |    |    |    |    |    |    |    |    |
The following table of weight values is from the first equation and has become an expert provision and can be seen as follows in Table 2.

| No. | Description                           | Weight Value |
|-----|---------------------------------------|--------------|
| 1   | definitely not                        | -1,0         |
| 2   | Almost Sure No                        | -0,8         |
| 3   | Most likely no                        | -0,6         |
| 4   | Mungkin Tidak                         | -0,4         |
| 5   | Do not know                           | -0,2 – 0,2   |
| 6   | Maybe                                 | 0,4          |
| 7   | Most likely                           | 0,6          |
| 8   | Almost certain                        | 0,8          |
| 9   | Certainly                             | 1,0          |

In the following table is the weight taken from the user to do a calculation so that the value of certainty is obtained. In table 3 can be seen from the equation of the first formula.

| Code | Symptoms | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 |
|------|----------|----|----|----|----|----|----|----|----|
| G01  |          | 0.7|     |    |    |    |    |    |    |
| G02  |          | 0.8|     |    |    |    |    |    |    |
| G03  |          | 0.6|     |    |    |    |    |    |    |
| G04  |          | 0.6|     |    |    |    |    |    |    |
| G05  |          |    |     |    |    |    |    | 0.7|    |
| G06  |          |    |     |    |    |    |    | 0.7|    |
| G07  |          |    |     |    |    |    |    | 0.8|    |
|   | G08 | 0.6 |
|---|-----|-----|
| G09 | 0.5 |
| G10 | 0.8 | 0.5 |
| G11 | 0.4 |
| G12 | 0.5 |
| G13 | 0.8 |
| G14 | 0.6 | 0.6 |
| G15 | 0.7 |
| G16 | 0.4 | 0.7 |
| G17 | 0.6 | 0.8 |
| G18 | 0.6 | 0.6 |
| G19 | 0.5 |
| G20 | 0.7 |
| G21 | 0.5 |
| G22 | 0.3 |
| G23 | 0.6 |
| G24 | 0.6 | 0.4 |
| G25 | 0.3 | 0.3 | 0.7 |
| G26 | 0.5 |
| G27 | 0.7 | 0.4 | 0.8 |
| G28 | 0.2 |

3. Results and Discussion

When the application starts, the system will display the main menu of the application, in the main menu there is a consultation menu, a list of symptoms of rice, a list of diseases of the rice, about the expert system, language settings, and out. On the system application button will ask the user to enter the name and click the login button, on the consultation page there are several symptoms and weights. The user must fill in the weight of the symptom and click the process button. Then the system will display the calculation and type of rice disease, along with explanations and prevention. On the rice symptom menu the system will display a list of symptoms, then in the rice disease list system the system will display several types of diseases in the paddy, the system also displays the user to display language
settings where in the system there are two languages namely Indonesian and English. after the user has finished consulting, the user will click the exit button. To find the level of percentage of trust from paddy disease, the calculation process is carried out by inputting the trust value with the value of distrust. after the results are obtained then multiply by the expert weight value. after the value added by the expert value will then be combined based on the certainty factor formula of the calculated value, the value of the percentage of the confidence of the rice plant against the disease will be obtained. in this backward chaining method where in diagnosing rice plant disease backward chaining is used as a reference to prove the results of the truth percentage level of trustworthiness.

![Image](image.png)

Figure 1. (1) menu interface, is used to displays the menu of the application (2) menu results, display the results of calculations and types of diseases and their explanations

4. Conclusion

Based on the results that have been designed to allow users to be able to find out the types of diseases and symptoms of rice plants so as to facilitate farmers in accessing information and can be used as a tool that can be accessed wherever and whenever to overcome the problems faced by farmers. which has been implemented, this system will apply the backward chaining method as the basis for rules and the certainty factor method as weighting, so that each symptom of the disease in rice plants can be seen in a system based on the selected symptoms, which will result in an 68.83%. blast disease.

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