Application of Expert System with Web-Based Forward Chaining Method in Diagnosing Corn Plant Disease

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Abstract: Corn plants are crops in agriculture which are widely cultivated, especially in the Jerowaru area. The empowerment of corn plants is often constrained by disease. Diseases in maize plants are caused by fungi, bacteria, viruses, soil conditions, and weather conditions. Diseases that attack corn plants can result in decreased productivity of corn plants. On the other hand, the limited number of agricultural extension workers makes farmers unable to quickly consult, therefore it is necessary to create a system that can provide information, make decisions and provide solutions regarding web-based corn plant diseases can diagnose corn plant diseases based on symptoms experienced corn plant. This expert system is designed using the Forward Chaining method consisting of several stages, namely, the stages of assessment, knowledge acquisition, design, and testing. Based on the results of tests conducted, this method can provide solutions in dealing with problems related to corn diseases and pests.

Keywords: Forward chaining, Corn crop disease, Expert system.

1. Introduction

Expert systems, in general, are systems that attempt to adopt human knowledge to computers so that computers can solve problems as is usually done by experts. Expert systems can collect data storing the knowledge of an expert or several experts on a computer[1][2]. In the book, expert systems began to be developed in the mid 1960s by the Artificial Intelligence Corporation[3][4]. This Artificial Intelligence research period is dominated by a belief that reason combined with sophisticated computers will produce expert achievements or even supermen. An effort in this direction is the General Purpose Problem-Solver (GPS). GPS is a procedure developed by Allen Newell, John Cliff Shaw, and Herbert Alexander. Simon from Logic Theorist is an experiment to create an intelligent machine. In the early 1980s, ES (Expert System) technology which was initially limited by an academic atmosphere began to emerge as a commercial application, specifically XCON, XSEL (developed from R-1 on Digital Equipment Corp.) and CATS-1 (developed by General Electric). Expert systems for conducting health diagnoses have been developed since the mid 1970s. The expert system was created by Bruce Buchanan and Edward Shortliffe at Stanford University. The system is named MYCIN. MYCIN is an interactive program that carries out the diagnosis of meningitis and bacremia infections and provides recommendations for antimicrobial therapy. MYCIN is able to provide an explanation of his reasoning in detail. In trials, he was able to show abilities like a specialist. Although MYCIN has never been used routinely by doctors, MYCIN is a good reference in other artificial intelligence studies. Expert system software can help the work of an expert and can be used by farmers, ordinary people to fulfill information about pests and diseases and as additional information for farmers who are just starting to plant corn but still lack knowledge about corn plants[5][6]. So far, pests that often attack the author's research area include leaf caterpillars, stem caterpillars, lobworms, gray caterpillars, cob borer, mushrooms, seed flies, and mice. While diseases that often attack include stem rot, stem rot, stem fungus, leaf spot, mosaic virus, leaf...
rust, leaf air or midrib[5]. Symptoms that arise are usually directly carried out by the process of diagnosis by farmers. In fact, the cultivation process carried out by farmers is not fully in accordance with the problems that arise so that it affects the expected growth and yields that are not in accordance with the desired results. Corn crop disease is undesirable for corn farmers because it can cause suboptimal production and death for corn plants. To overcome this obstacle, farmers need knowledge about disease information, symptoms, and treatment for the disease. However, the availability of information about corn disease is still limited, this causes difficulties in its handling and how to treat it. Therefore, it takes the role of experts in the field of food crops, especially corn as a place of consultation. Corn plant experts are also expected to provide information about diseases, how to handle drugs, and solutions to overcome them. However, to contact a specialist in corn disease requires money, time and energy. Based on this, an expert system was developed about maize plant diseases, so that they could provide solutions to overcome maize plant diseases. In an expert system, a component that functions as the brain to solve thinking problems like an expert is called an inference machine. Forward chaining is one of the methods in the inference engine. There are 2 models of forward chaining and backward chaining inference engines.

2. Method
The method used in this research is to use forward chaining and backward chaining methods[7][8][9]. Forward chaining is a method that works based on facts to get a conclusion, while backward chaining is a method of reasoning that works starting from the purpose of the conclusion by examining facts that support the hypothesis[10][11]. This method of backward chaining and forward chaining has the characteristics of each field, where the backward chaining method is suitable for handling problems and diagnosing and classifying diseases, while forward chaining is used to deal with planning, monitoring, and control issues. But forward chaining can also be used in the area of problem diagnosis[12][13]. The use of forward chaining / backward chaining methods can be seen from the needs in building the system. If the purpose of the system is built to find conclusions from the facts given, then the system must use the forward chaining method. The following is an overview of web-based expert systems using the forward chaining and backward chaining methods.

Figure 1. Diagram of a web-based expert system with forward chaining and backward chaining methods in diagnosing corn disease.
3. Discussion.

3.1. Corn.
Corn is one of the most important food crops in the world, besides wheat and rice[14][15]. Corn is not only a source of carbohydrates, corn is also planted as animal feed (forage or cob), oil is taken (from seeds), flour is made (from seeds, known as cornstarch or cornstarch), and industrial raw materials (from seed flour and flour the cob).

3.2. Data needed
The data needed to build this expert system is the name of the disease, symptoms, causes, and solutions/controls. In the expert system application of corn plant disease diagnoses, there are 13 diseases and 33 symptoms.

| Code  | Disease name               | Caouse                                |
|-------|----------------------------|---------------------------------------|
| P001  | Hawar Leaves               | Helminthosporium mushroom turcicum    |
| P002  | Bulai disease              | Peronosclerospora maydis fungus       |
| P003  | Fusarium cob rot          | Fusarium graminearum Schwabe mushroom |
| P004  | Rotten Diplodia Cob       | The mushroom Diplodia maydis          |
| P005  | Gosong                     | Ustilago maydis mushroom              |
| P006  | Rust                       | Puccinia Sorghi and Puccinia Polysora |
| P007  | Mosaic virus               | Myzus persica                         |
| P008  | Nitrogen Deficiency (N)    | Nitrogen Deficiency (N)               |
| P009  | Phosphorus deficiency (P)  | Phosphorus deficiency (P)             |
| P010  | Potassium deficiency (K)   | Potassium deficiency (K)              |
| P011  | Lack of Sulfur (S)         | Lack of Sulfur (S)                    |
| P012  | Iron Deficiency (Fe)       | Iron Deficiency (Fe)                  |
| P013  | Zinc deficiency (Zn)       | Zinc deficiency (Zn)                  |
Table 2. Symptoms of Disease

| Code | Symptoms of the disease |
|------|-------------------------|
| G01  | Small patches           |
| G02  | Oval-shaped patches     |
| G03  | Round spots             |
| G04  | Elongated spots such as funnel or brown boat |
| G05  | There is orange powder at the bottom of the leaf |
| G06  | There is no orange powder at the bottom of the leaf |
| G07  | There is chlorosis in the leaves |
| G08  | There is powder like flour on the surface under the leaves |
| G09  | There is no powder like flour on the surface under the leaves |
| G10  | Chlorosis extends parallel to the leaf bone |
| G11  | Yellow leaves from the bottom to the top are shaped as a V |
| G12  | Burning brown leaves are inverted V-shaped |
| G13  | The base of the leaves is yellow and is striped on the leaf near the top |
| G14  | High Fe deficiency then all leaves turn yellow to whiten between the leaf bones |
| G15  | Pale green, yellow and even white leaves on the middle leaf that produce stripes |
| G16  | Edge of reddish purple leaves from the tip to the base |
| G17  | Symptoms appear on the lower leaves |
| G18  | Mosaic / green colored leaves interspersed with yellow stripes |
| G19  | Plants stunted growth   |
| G20  | Stem rot                |
| G21  | Broken stem base occurred |
| G22  | Rot occurs in the lower segment of the stem |
| G23  | Rotten covered upih pale leaves |
| G24  | If the stem is cut, the pith is soft and broken |
| G25  | COB smaller than normal |
| G26  | The tip of the cob is not seeded |
| G27  | The cob is often bent   |
| G28  | Seed formation is not perfect |
| G29  | Rare seeds              |
| G30  | Rotten COB              |
| G31  | Rotten pink or reddish to brown |
| G32  | The seeds are white to gray brown |
| G33  | The seeds swell to black and then burst out |

3.3. System

The resulting system is an expert system specifically designed for use in displaying information related to the diagnosis of corn plant diseases[5]. In operating this system, users must follow the provisions in the system. Here discussed how to run the system that has been created and the objects that support the formation of the system.
4. Research Results and Discussion
Display the main page of the expert corn disease diagnosis system website that functions to display the information created.

Figure 3. Login Page. This is the page that is used to enter the first time as an expert system user, and on this page, there is a command to enter a username and password.

Figure 4. Admin Menu Page. This is a page for inputting information that is accessed by an admin about information about diseases and pests of corn and at the same time a solution in handling. As on this page, there is a menu of choices including choice of symptom data, choice of added symptoms, choice of disease and choice of rule.

Figure 5. User Menu Page. This is a system page that is used for information transactions about information about diseases and pests of corn and at the same time a solution in handling it. As for this page, there are menu choices including consultation, symptom data, disease data and choices about.

Figure 6. Consultation Menu Page. This is a system page used for consultation as well as a solution for adding information about diseases and pests of corn. As for this page, there is a menu of choices, among others: a menu to start consultations on several indicators of maize plant diseases.
5. Conclusion

Based on the results of research conducted in Jerowaru Village and discussions conducted by the author, it can be concluded that diagnosing diseases in corn plants is only done by agricultural extension workers, limited labor is not able to reach remote areas, especially Jerowaru area as a whole and farmers cannot fast consultation, as a result of diseases that affect corn plants are not quickly diagnosed the cause, it will be replaced by an expert system for diagnosing diseases in web-based corn plants. This expert system to diagnose diseases in corn-based web can help farmers in diagnosing diseases in corn plants and can provide solutions and knowledge about the types of diseases in corn plants and their control.

6. References

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