The diagnose of oil palm disease using Naive Bayes Method based on Expert System Technology

Marlince Nababan*, Yonata Laia, Delima Sitanggang, Oloan Sihombing, Evta Indra, Saut Siregar, Windania Purba, Roy Mancur
Faculty of Technology and Computer Science, Universitas Prima Indonesia, Indonesia

E-mail: *marlince@unprimdn.ac.id

Abstract. Expert system is dealt with system that used computer-based human intelligence to overcome particular problem which is commonly conducted by an expert. Frequent problem faced by the farmers of oil palm is the difficulty in defining the type of plant disease. As a result, the delay treatment of plant disease brings out the declining of farm products. An application system is needed to deal with the obstacles and diagnosing the type of oil palm plant disease. The researcher designed an intelligence-based application with input-output plan which is able to diagnose the type of oil palm plant disease by applying naive bayes method. Based on the research result by conducting bayes method with recognized symptom, diagnose of oil palm plant disease could be accomplished. The data of symptoms found are leaves turned yellow 0.4, dead leaves 0.4, black and brown color among the veins of leaves 0.5, young and old fruit with whole space 0.4, and decay of bunches is 0.3. The roots are tender in the amount of 0.5, and damage on sheath is 0.3. Through the chosen symptoms as mentioned above, the value of bayes is 80% with the type of disease is rotten bunch.

1. Introduction
Palm oil contributes almost half of vegetable oil in entire world, which most of them are from mesocarp of oil palm of Africa, ElaeisguineensisJacq. Unfortunately, oil palm plantation in Southeast Asia, especially Malaysia and Indonesia are threatened by Basal Stem Root (BSR). BSR causes the extinct of 50% of oil palm product [1-2]. Technology that can adopt the process and way of thinking of human which is called artificial intelligence. In the prior research, expert system was applied as developing device in agriculture which was aimed to increase the growth of farm efficiently, including with decision making. When the expert system was applied, the result of research showed that the value of accuracy level is 84.15%. In other words, expert system could be used to as an effective training device in agriculture sector. Further, the research also shown that there was an increase of work performance when expert system was applied [3]. The most common obstacle invades oil palm is plant disease and epidemic pest or infection. Infected oil palm plant is usually indicated by various symptoms such as spot or colorful scratch on the leaves, stem, and seed of the plant.

Nowadays, in agriculture sector, diagnosing the type of plant disease is based on the expertise of human intelligence that tended to use conventional method, in the sense that the device is usually tested in laboratory. Therefore, the need for new approach to classify the type of plant disease is the main priority. This research is purposed to focus on innovative method based on technical processing of image. It is done to classify the shortage of nutrition which usually invades the leaves of oil palm by
analyzing the surface. The feature vector will be achieved as the input for fuzzy classifier. Overall, fuzzy method that proposed is beneficial for oil palm industry in gratifying industrial demand [4-7]. This research offers a description of how to apply WSN in the field and how the learning model machine is designed to predict the plant pest or disease by conducting Algorithm of Naive Bayes [8-12]. Earlier research was purposed to identify and classifying parts of plant disease pattern that consists of color and oil palm texture. Therefore, comparative study that related to segmentation of oil palm leaf figure taken from oil palm to be evaluated and validated by using Global Otsu Method by displaying that threshold of Global Otsu is the best segmentation based on tested image [13].

Prior research of expert system was mostly used in agriculture sector, especially oil palm. Some methods have been applied are fuzzy and Global Otsu Method. Fuzzy was used to classify the type of plant disease [14]. While Global Otsu Method was conducted to analyze the discriminator, in the sense that distinguishing between two or more groups that arose naturally. Discriminator will maximize the variables to divide the object of both foreground and background. The application of Global Otsu Method differentiate or classifying the pattern of oil palm plat disease [15]. In the earlier research, naive bayes was used to forecast the plant disease. Furthermore, naive bayes method was applied in the research to diagnose the plant disease of oil palm, coffee, onion, and assisting doctor in diagnosing any particular plant diseases [16-20]. Naive bayes classifier works very well comparing with another classifier model. It is indicated by Xhemali, Hinde and Stone in their prominent journal entitled “Naive bayes vs. Decision Trees vs. Neural Networks in the Classification of Training Web Pages” that elaborated that “Naive Bayes Classifier possesses much better level of accuracy than another classifier model [21].

2. Methodology
Data obtained was all about plants diseases that are commonly suffered by oil palm, symptoms, and ways of treating them. Disease symptom with probability level (P) is indicated drying leaves (0.4), leaves turned yellow (0.4), dead leaves (0.5) black and brown color among the veins of leaves (0.5), root turned tender (0.4), leaves are wilted (0.3), damage on the frond (0.3), torn leaves and totally torn (0.7), dead plant (0.5), hand of flower or closed spear of flower (0.4), tip of leaves turned into other color (0.6), decay on the stem around 2 meters above the ground turned into grey (0.5), decay of bunch (0.7), young or old leaves look holey (0.6), delayed formation of flower (0.3), tip of plant decay and turned brown (0.3), tip turned bended and curved (0.5), spot and fleck on the leaves (0.4), leaves fallen (0.3), tiny yarn (mycelium) turned into shiny white (0.5), pericarp faded and decay (0.4), fruit color turned and turned into brownish (0.3), damage in the plant in the age of 3 to 10 years (0.4), and decay on the main stem (0.4).

Expert system [22] is a computerized system that accumulates human decision making capacity which works for all things as human expert. Expert system arises from the very earlier of working process in overcoming the problems, especially when specific domain of intelligence is required. The knowledge of expert must be obtained from specialists or another relevant expert, such as texts, journal, and sources of data. Moreover, expert system receives facts from users and replies it back with expertise. The users will interact with the system through face to face users, then building by using menus, natural language or any other interactions. All the rules collected from the domain of expert are decoded in the form of intelligence basis. Then, inferential machine will conclude all the things from the intelligence basis and facts given by users. The expert system may or may not possess learning components. Series of expert advisory systems [23-24] can be developed in agriculture, and has been conducted in India.

Naive bayes is a statistical classification that can be used to predict the membership probability of particular class. Naive bayes is grounded from Bayes theorem that has classification ability as decision tree and neural network have. Naive bayes empirically proven has an accurate and high speed when it is applied in the database with huge number of data [8], with the formula (1), where X: data with unknown class, H: hypothesis data X comprises a specific class, P(H|X), P(H): probability of
hypothesis H (prior probability), P(X|H): probability of X based on the condition of hypothesis H, P(X): probability of X.

\[ P(C \mid X) = \frac{P(X \mid C)P(C)}{P(X)} \]  \hspace{1cm} (1)

3. Result and Analysis
The figures below elaborate the process within the application of expert system which has been designed by the researcher. Login button functions as security device when the data is needed to be edited or completed by the administrator. In other words, all the process should be through this phase. Further, if the login phase is correct, the main page can be entered which provides some menu such as Home, Types of plant disease, Symptoms, Training, and Password. Another important button is Logout menu which has been filled with some links connected to particular pages.

If diagnosing is going to be done, first, Symptoms button must be clicked then the display would be as figure number 2 below. Then, we have to click the symptom which is to be diagnosed. Below is the example of yellow leaves, dead leaves, brown and black among the bones, young or old fruit looks with all spaces, decay in bunches, the roots are tender, and damage on sheath is 0.3. Through the chosen symptoms as mentioned above, the value of bayes is 80% with the type of disease is rotten bunch.

![Diagram of Block system with bayes method.](image-url)
4. Conclusion

Based on the research result by conducting bayes method with recognized symptom, diagnose of oil palm plant disease could be accomplished. The data of symptoms found are like yellow leaves are 0.4, dead leaves are 0.4, brown and black among the bones are 0.5, young and old fruit with whole space are 0.4, and decay in bunches is 0.3. The roots are tender in the amount of 0.5, and damage on sheath is 0.3. Through the chosen symptoms as mentioned above, the value of bayes is 80% with the type of disease is rotten bunch.

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