An Expert System for Management of Poultry Diseases

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Abstract. Expert system could keep knowledge in its knowledge base as the system knowledge resources and manipulate that knowledge. So it could prepare the high level decision tool to the user that is called inference engine as the brain of the system. On the other hand, expert system could help people in many cases in order to get decision in solving a problem. This work aimed at developing an expert system for diagnosing poultry diseases which could also be used both by the farmer and the experts to train their students. The knowledge was elicited from the experts through interview and literature review. The knowledge was represented in the system using a rule based approach. The unified modeling language was used to describe the design of the system. Visual prolog 7.3 was used to develop the expert system. The system was tested using Design Criterion and Knowledge Base Expert System for Stratified Root.

Keywords: Poultry, Expert system, Inference engine, Knowledge base and Prolog.

1. Introduction

Poultry constitute by far the largest group of livestock and are estimated to number about 14,000 million, consisting mainly of chickens, ducks and turkeys. Throughout the developing world, many living in rural areas keep small flocks of scavenging poultry. These birds are usually chickens and have an important role to play in poverty alleviation and food security. The flocks are small but important - providing meat and eggs for family consumption, for sale to provide additional income, or for social obligations. Rural poultry also provide manure and are active in pest control. But for long time, poultry diseases have been one of the main problems to influent our poultry industry development; have become the bottleneck limiting the development of our poultry industry. To fit the basic strategy of “prevention is first, prevention is more important than cure”, we try to solve the logic reasoning of poultry disease diagnosis through the computer, and taking this chance, discuss the problems of realizing the poultry disease diagnosis. The designing is that we come to the basic rule through the comparison of data and come to the preliminary diagnosis. An Expert System is an intelligent computer program that uses knowledge and inference procedures to solve problems difficult enough to require significant human expertise to solve [1].

1.1. Justification of the Study

The subject of economic analysis of poultry production has received considerable attention in the literature [2, 3, 4, 5, 6, and 7]. [8] claimed that poultry production in Nigeria as well as in other warm climate countries has a high priority rating compared with other types of livestock because poultry has better energy and protein conversion ratio and that net return on investment are relatively high. Poultry was chosen because its importance should not be compromised. But the fact is that many farmers in this region do not know how to effectively treat poultry diseases. Another factor is insufficient poultry extension agents to give explanation to poultry farmers. The agent was limited by time, chance and any other limitation that could be solved by expert system. While we know that expert system have many advantages that could help people

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solve the human limitation. The aim of this study is to develop an expert system for diagnosing poultry pest and diseases.

There is a lot of related expert system in the literature on diagnoses problems. A web based expert system for management of pests and diseases of cassava [9] refers to Expert System also called knowledge based system or decision support system as a computer program that contains some of the subject specific knowledge of one or more human experts. An information technology enabled Poultry Expert System was presented in [10] while poultry disease diagnostic Computer Simulation Research was in [11]. PDDSS simplify the attribute and rules with the rough set theory anthology; it can make a conclusion of diagnosis and measure of cure quickly. Other diagnoses systems are presented in [12, 13, 14, 15, and 16]

1.2. Problem Formulation

The problem formulations are how to develop an expert system to assist the extension agent of agriculture and also farmer, especially in the case of diagnosed poultry diseases and its solution. The developed Expert System could be used to boost poultry production.

2. Architecture of Expert System

Expert System Knowledge represents a concept, non in form of numerical; information in expert system does not too complete and up-to-date, that’s why expert system should improve self-learning, expert system solution possibility to a problem differ, depend on expert thinking and program design, there is no guarantee that expert system load 100% needed expertise in system, expert system have to be trusted, easy to modified as according to science and technological growth. In developing an expert system the three components of an expert system that should be available are; User Interface, Inference Engine, and Knowledge Base.

2.1. Knowledge Elicitation

Knowledge elicitation is the process of collecting data from the consultation with domain experts which are the most important individuals in an expert system design process. In this work, knowledge is acquired by consulting experts in poultry farming. This involves constant interaction with the expert and extraction of relevant information including the signs, symptoms, diseases, pests, economic importance and control measures. The knowledge acquired from the domain expert and a summary of knowledge acquired on Poultry diseases are presented below:

<table>
<thead>
<tr>
<th>Disease</th>
<th>Causes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Abnormal Egg Shells</td>
<td>Improper Nutrition disease, Physical Condition of Hen.</td>
</tr>
<tr>
<td>Air Sac Disease</td>
<td>Egg transmitted Contact with Infected Birds.</td>
</tr>
<tr>
<td>Ammonia Burns</td>
<td>Ammonia Gases Crested in damp Litter</td>
</tr>
<tr>
<td>Anatipestifier Disease, New Duck Syndrome</td>
<td>Faecal Contamination of feed water or the Environment where survival of the infectious agent may be prolonged.</td>
</tr>
<tr>
<td>Chronic Respiratory Disease</td>
<td>It is caused by egg transmitted disease.</td>
</tr>
<tr>
<td>Lice</td>
<td>Ducks geese if housed with Chickens</td>
</tr>
<tr>
<td>Swollen Head Syndrome</td>
<td>Contact with infected birds or indirectly by Exposure to infectious material.</td>
</tr>
<tr>
<td>Infections Bursal Disease or “Gumboro”</td>
<td>Contact with Leaches of infected birds and contaminated equipments.</td>
</tr>
<tr>
<td>Leg Problems</td>
<td>Accident inadequate nutrition. Lack of Vitamins and Slippery Surface.</td>
</tr>
<tr>
<td>Newcastle Disease</td>
<td>Contaminated Equipment Shoes, Clothing Contact with infected birds.</td>
</tr>
<tr>
<td>Paratyphoid</td>
<td>Egg Shell penetration, Eating or Contact with droppings of infected Carriers.</td>
</tr>
</tbody>
</table>

The knowledge acquired is represented using a set of IF-THEN rules and stored in the knowledge base. Visual prolog was used to write the code in design phase, prolog is a high level, programming language that is specifically designed for applications in AI such as ES. It is based on predicate calculus [9]. Prolog
differs from traditional programming languages in that it tells the computer what to do (a technique called declarative programming) while programs in other language tell the computer how to do it (procedural programming). Prolog does this by making deductions and derivations from facts (assertions), rules (inference) and questions.

2.2. The System Rule Base
The knowledge elicited from the domain experts are used to produce the rule base for the system. The rule base structure help to determine the specific disease of the poultry using the If……Then statement. For example, If bird has Gray eye and enlarged feather follicles and there is paralysis of wings, legs and neck, Then the disease is Marek’s disease which is caused by Virus.

2.3. System Design Using Unified Modeling Language (UML)
The UML is an object oriented programming (OOP) tool for modeling objects and relationships between objects and classes in the design phase of a program. It is a powerful tool for representing the structure of programs. We make use of two UML type diagrams namely: the Use case and sequence diagrams.

The UML type used in this work is the UML 2.0. The use of case diagram in the description of the system’s behaviour is from the user’s viewpoint. This diagram is a valuable aid during analysis as it helps to understand the requirements. The use of case diagram is shown in figure 1. The actors are the user and the expert as they are the individuals that interact with the system. The resources are identified as the diagnoses medium and the knowledge base. The expert and the user can both call the knowledge base as a resource, while the user can call the diagnosis medium resource to be used within the program structure.

The sequence diagram describes how the objects in the system interact; the objects identified in this system are the specific user, specific user, specific diagnosis, specific control measure, particular portion of
the knowledge base, specific user interface and the diagnostic advisory subsystem. They interact in the sequence shown in figure 2 by passing messages across the timelines (presented by the dotted lines). These messages are the actions carried out by the objects in the system in a chronological order.

2.4. User Interface Design

The system is designed in such a way that it could accommodate various problems that can occur at present and those that may occur in the nearest future, concerning the diagnosis of poultry diseases using Expert Systems. Details of the diseases are in Figure 3. Diagnose consultation session is as presented in Figure 4.

![Fig 3:Disease detail form](image1) ![Fig 4: Diagnoses file](image2)

3. Testing

Testing is the last step in developing expert system design to diagnose pest and disease of poultry. Testing was held to really check the field, if the system developed matches with the expert criteria. There are several steps which should be followed to meet the criteria, from goal identification, testing itself and analysis of testing result.

3.1 Analysis of Testing Result: The analysis of testing was done using the formula [17].

\[
C \text{ Nilai} = \frac{\sum_{i=1}^{n} \text{Bobot } i \times \text{Nilai } i}{\sum_{i=1}^{n} \text{Bobot } i}
\]

With C Nilai category as follow:

<table>
<thead>
<tr>
<th>Skor Credit C Nilai</th>
</tr>
</thead>
<tbody>
<tr>
<td>1786 208</td>
</tr>
<tr>
<td>423 56</td>
</tr>
<tr>
<td>2209 264 8,367</td>
</tr>
</tbody>
</table>

Based on the testing analysis result above, we got C Nilai 8.37 that shows on the table. This indicate that problem solving analysis to diagnose pest and disease with expert system as alternative solution is correct and this expert system application has a good opportunity to success in usage.

4. Conclusion

In this study, Knowledge based System for poultry disease diagnosis has been designed and presented. The usefulness of an Expert System in diagnosing poultry disease is really required in the field of poultry and all other aspects of life. The study will actually assist poultry farmers and as well enhance foreign
exchange earnings for the country of adoption. Furthermore, adding feature system besides diagnoses of pest and disease could make expert system complete and more powerful.

Expert system design to diagnose pest and disease of poultry could be codified for elementary up to high school so it could be a local content to study computer and local application where applicable.

5. References


