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AN EXPERT SYSTEM TO DIAGNOSE CHICKEN DISEASES WITH CERTAINTY FACTOR BASED ON ANDROID

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ABSTRACT

Theresearch was conducted to create an expert system that is able to diagnosechicken diseases based on the experts / specialists knowledge. This study uses a calculation method called Certainty Factor (CF) to calculate the level of expertise. The expert system created on Android mobile device platform.The research data consist of symptoms data, chicken diseases data, and data rules. Chicken disease data is limited to diseases caused by bacteria (bacterial), totaling 19 types of diseases with 78 kinds of symptoms and 184 types of rules.Inference method that used is forward chaining by searching for rules based on user answers in the form of check mark (√).Users answers are processed according to the rules and calculated using certainty factor method. The test results showed that : (1) Functional testing using Black Box Equivalence Partitioning (EP) get results as expected as the test scenarios in each test class.(2) Diagnosis testing by comparing the results of manual calculations and systems calculations showed 99 percent was appropriate and well-run.(3) Questionnaire testing with 31 respondents were divided into three groups of respondents indicated; first respondents group consisting of specialists of chicken diseases gets 63.33 percent of an average value (categorized good), the second respondents group consisting of breeder and students of majoring in animal husbandrygets77.71 percent of an average value (categorized good), and the third respondents group consisting of students of majoring computer science gets82 percent of an average value (categorized very good).

Keywords**:** *Android, Certainty Factor, CF method, Chicken Disease, Expert System.*

1. INTRODUCTION

According to data from Directorate General of Livestock and Animal Health Ministry of Agriculture in 2015, the type of free-range chicken, chicken laying and broiler are the most populated livestock that managed by entrepreneurs or breeders in Indonesia. In the history of poultry in Indonesia, raising chickens in the dry season, rainy season, and transition season are very exhausting for breeders. Because of that seasons, the possibility of a disease will attack the chickens will be higher.

In Lampung, the presence of veterinarians still very low when compared to the high population of poultry. Head of Department of Animal Husbandry and Animal Health Lampung Province, Dessy Desmaniar Romas said in 2014 they only had 40 veterinarians. From that amout, 12 people already have the status as civil servant (PNS). While 28 other people are still listed as 'Tenaga Harian Lepas' (THL).

The process of diagnosing a disease on livestock should be done by an expert in that field. However, the limited number and difficulty interacting with experts such as veterinarians, make most of breeders handle their own health problems and diseases of livestock. Lack of knowledge about how to handle the disease on livestock, may result breeders make mistakes in diagnosis and give medicine to animals that are sick. Therefore, it takes an expert system that is able to diagnose the disease in poultry with the knowledge that comes directly from the experts.

Application of expert systems can represent an expert to solve the problems. With these applications, knowledge of expert can be stored indefinitely. In addition, the expert system can also increase productivity, save time in resolving the problem, simplification solutions for complex and repetitive cases. Implementation of expert system can be constructed in various forms, such as based on web or mobile.

In this era, the development of technology is developing very rapidly, such as the development of the Operation System (OS) Android on the phone. According to data from Waiwai Marketing, the number of Android users in Indonesia reached 94 percent while users of other OS such as iOS (iPhone OS) is only about 6 percent. This indicates that Android platform is the most widely used in Indonesian society. In addition, Android can be utilized in the process of implementation of an expert system application because of Android is an open platform for developers to create many applications.

2. LITERATURE REVIEW

Expert System

An expert system is a branch of Artificial Intelligence (AI) that was developed in the mid 1960. The expert system is derived from the term knowledge-based expert system, a system that uses human knowledge where knowledge is inserted into the computer and then used to solve the problems that usually requires the expertise or human expertise [1].

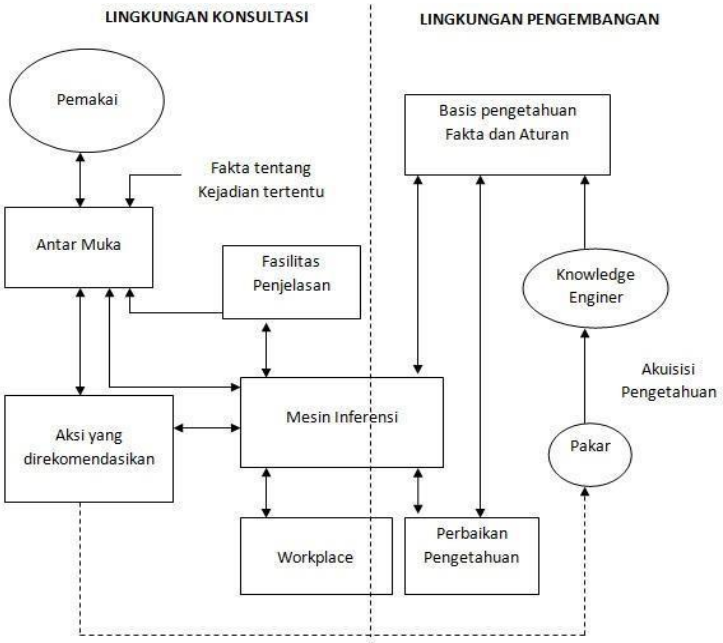

Figure 1 Expert System Architecture

Expert systems composed by two main parts, development environment and consultation environment. The development environment is used by manufacturers to build an expert system components and introducing knowledge into the knowledge base. The consultation environment is used by the user to consult so that users get the knowledge and advice of an expert system like a consultation with an expert [2]. The components of the expert system can be seen in Figure 1.

Diseases in Chicken

In general, the disease in poultry may be brought about by two causes [4], namely:

1. Causes of living (Living agent), such as: Microorganisms (microbes) such as bacteria, viruses, fungi, rickettsial, protozoan one-celled animals. Worms such as round worms, flat, and tapeworms and the species of insects such as ticks, flies, and others.
2. The cause is not alive (Nonliving agent), such as high or low temperature stress, chemical poisoning or vegetable, food deficiency and excess food element.

According Tabbu (2015) [3], in general there are 10 types of disease in chickens caused by bacteria, as shown in Table 1.

Table 1 Data Chicken Diseases Causing Bacteria

No	Name of Diseases	Type of Diseases	Name of Bacteria
1	*Infectious coryza* (snot)		*Haemophilus paragallinarum*
2	*Fowl cholera* (kolera unggas)		*Pasteurella multocida*
3	*Kolibasilosis*	Kematian embrio, infeksi *Yolk Sac*, dan *Omfalitis*	*Escherichia coli*
		Koliseptisemia	
4	*Salmonelosis*	*Pulorum*	*Salmonella*
		Fowl typhoid	
		Infeksi *paratifoid*	
		Arizonosis	
5	*Klostridial*	*Enteritis ulseratifa*	*Clostridium sp.*
		Enteritis nekrotikan	
		Dermatitis gangrenosa	
		Botulisme	
6	*Stafilokokosis*		*Staphylococcus aureus*
7	*Streptokokosis*		*Streptococcus sp.*
8	*Tuberculosis*		*Mycobacterium avium*
9	Infeksi *pseudomonas*		*Pseudomonas aeruginosa*
10	*Mikoplasmosis*	Infeksi*Mycoplasma gallisepticum* (CRD)	*Mycoplasma*
		Infeksi *Mycoplasma synoviae* (bentuk sinovitis)	
		Infeksi *Mycoplasma synoviae* (bentuk pernapasan)	

Certainty Factor

Certainty Factor (CF) theory proposed by Shortliffe and Buchanan in 1975 to accommodate the uncertainty of thought (inexact reasoning) from an expert. To accommodate this used to describe the level of confidence of experts on the matter at hand [1]. In expressing some degree of belief, certainty theory using a value called certainty factor to assume a degree of belief of an expert to the data. This concept was formulated in the basic formula in Equation (1) as follows.

$$CF_{combine}(CF_1,CF_2) = \begin{cases} CF_1 + CF_2(1 - CF_1) & \text{Both} > 0 \\ \dfrac{CF_1 + CF_2}{1 - \min(|CF_1|,|CF_2|)} & \text{One of} < 0 \\ CF_1 + CF_2(1 + CF_1) & \text{Both} > 0 \end{cases}$$

According Kusrini (2008) [4], there are two kinds of certainty factors, namely:

1. Certainty factor populated by experts with the rules.
2. Certainty factor provided by the user.

a. Getting the results of interviews with experts
That is by getting the results of interviews with experts concerned. Value of CF is obtained from interpretation of the "term" of experts to be value an MD / MB particular as shown in Table 2.

Table 2 Certain Term CF

Certain Term	MD/MB
Unknown	0.00 - 0.29
Maybe	0.30 - 0.49
Probably	0.50 - 0.69
Almost certainly	0.70 - 0.89
Definitely	0.90 - 1.00

b. Using the calculation method*'Net Belief'*
Certainty Factor indicates the size of belief to the fact of the rules.Certainty Factor notation shown in Equation (2), (3) and (4) as follows.

$$CF(H,E) = MB(H,E) - MD(H,E) \quad (2)$$

$$MB(H,E) = \begin{cases} 1 & P(H) = 1 \\ \dfrac{\max[P(H|E), P(H)] - P(H)}{\max[1,0] - P(H)} & \text{others} \end{cases} \quad (3)$$

$$MD(H,E) = \begin{cases} 1 & P(H) = 1 \\ \dfrac{\min[P(H|E), P(H)] - P(H)}{\min[1,0] - P(H)} & \text{others} \end{cases} \quad (4)$$

CF(H,E) = Certainty factorof the hypothesis H influenced by symptoms *(evidence)* E. The amount of CF ranges from 0 to 1
MB(H,E) = Measure of increased belief of the hypothesis H that are affected by the symptoms of E
MD(H,E) = Measure ofincreased disbelief of the hypothesis H that are affected by the symptoms of E
P(H) = The probability of the truth of the hypothesis H
P(H|E) = The probability that H is true because facts of E
H = Hypothesis (alleged)
E = Evidence (events or facts)

Android Operating System

Android is an operating system for *mobile devices* that was developed by Android Inc.This company purchased by Google in 2005. To develop Android formed a group called *Open Handset Alliance* (OHA), which is a combination of 34 companies hardware, software, and telecommunications, including Google, HTC, Intel, Motorola, Qualcomm, Tmobile, and Nvidia.Android is built using a modified Linux kernel 2.6.Android applications written in Java using *Java Core Libraries*.Android applications run on a VM called *Dalvik Virtual Machine*.Android provides an open *platform* for developers to create their own applications that can be used by a variety of propulsion devices [5]

3. METHODS

Time and Place of Research

This research was conducted at the Department of Computer Science Faculty of Mathematics and Natural Sciences and the Department of Animal Husbandry, Faculty of Agriculture, University of Lampung.The research was implemented during the second semester of the 2015/2016 Academic Year.

Support Tools

Support tools that used in this study are as follows:

A. Hardware
- ACER Aspire E1-431 laptopwith specifications*Processor Intel* (R) *Celeron* (R)CPU B820 @ 1.70 GHz, *Harddisk* 350 GB, RAM 2.00 GB.
- *Smartphone* Android (Lenovo A316i *Jelly Bean 4.2.2 version*).

B. Software
- Operating system Windows 7 32-bit.
- *Eclipse Luna* SDK, is used as framework of making an application.
- *Java Develoment Kid* (JDK),tools of Java programming language.
- *Android SDK (Software Development Kid*, tools of the development android programming.
- *Android Development Tool (ADT),* Plug-insare used to integrateinto the development environmenteclipseandroid.
- *SQLite Manager*, a software to create and access databases.
- *Microsoft Excel 2007*, is used to do calculation process with certainty factor method.
- *Photoshop CS4*, is used to design user interface system and to editpicture atributte.

Stage of Research

Stages of research are the steps that will be conducted by researchers in conducting research.The steps in this research include the identification of problems, problem formulation, data collection, system development, system testing and analysis of results.Stages of this research can be seen in Figure 2.

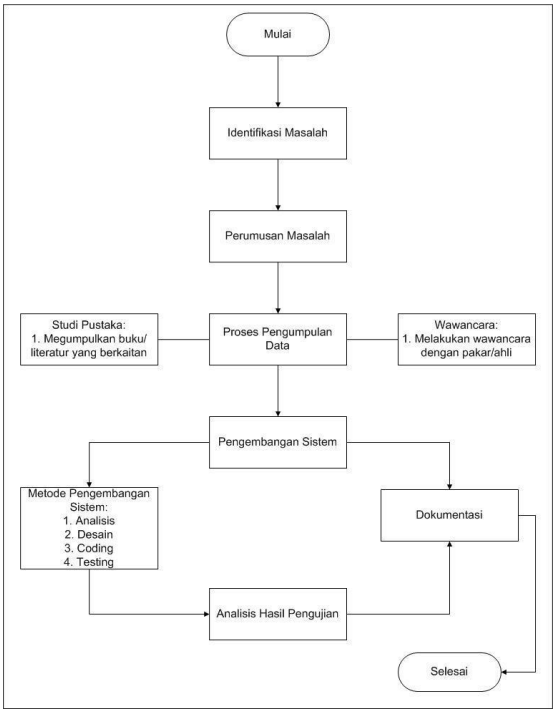

Figure 2 Stage of Research

Stage of Problem Formulation

This stage is the process of formulating and limiting the problem to be investigated.Formulation and restrictions of problem is needed in order to better guide the researchers in making the system so that the project is done not out of predetermined limits.

Stage of Data Collection

Stages of data collection is used by two methods: through literature and interviews.

a. Literature Review
   At this stage the data is collected through a variety of literature such as books, journals or documents relating to the research theme.
b. Interview
   In this method the process of interviewis done with experts / specialists.It aims to get the data that is not found in literature study method.Furthermore, the data that has been collected compiled into the rule base to be used in an expert system.

Stage of Systems Development

In this stage uses waterfallmethod consists of four stages as follows.

a. Software Requirements Analysis

In this process,do searchingsystem requirements.In building applications expert system based on android has been designed a use case model diagram to interpret the functions of the user interface. Design of use case diagram is shown in Figure 3.

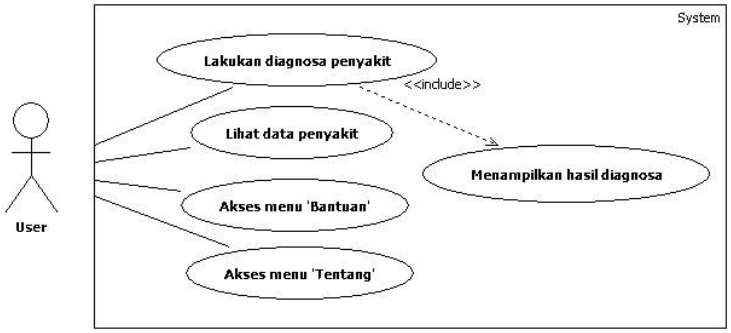

Figure 3 *Usecase Diagram*

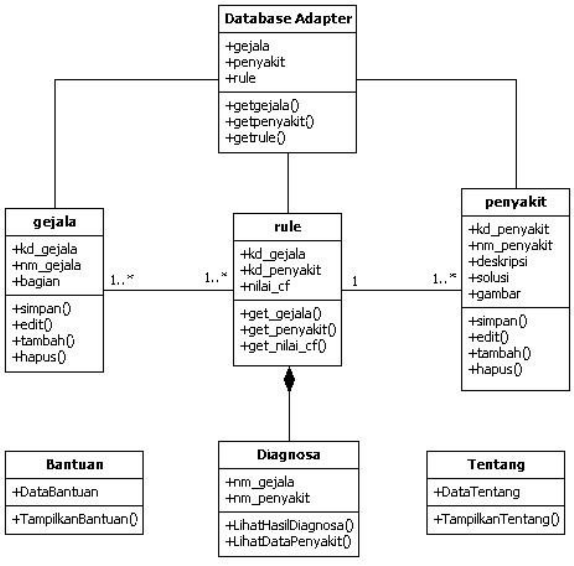

Figure 4 *Class Diagram*

In this process, system design where design is created to be able to implement the requirements mentioned in the previous stage.The design of system is made using UML (Unified Modeling Language).Design in this study used four models, namely flowcharts,class diagrams, sequence diagrams and activity diagrams.Model class diagram is shown in Figure 4.

b. Coding

The process of translating a design that has been designed into a language understood by the computer.In order to be understood by the machine, in this case is a computer, the design must be transformed into a programming language such as C, C ++, PHP, Java, or others.In this study, the system is built using android programming language which consists of the Java language and XML using the Eclipse framework.

c. Testing

After the coding process is completed, then is conducted the testing process using black box method.Black box testing is a test of the fundamental aspects of the system regardless of the internal logic structure of software.This process is done to make sure the system was created has worked in accordance with the specified conditions.

4. RESULT AND DISCUSSION

Analysis of Data Requirement

Data requirement on this expert system includes symptoms data and disease in chickens data caused by bacteria (bacterial). Information on symptoms and disease as well as treatment and prevention of chicken comes from the book"Penyakit Ayam dan Penanggulangannya" (Rangga Tabbu, 2015).In the literature there are 78 types of symptoms and 19 types of chicken diseases caused by bacteria.The name of the symptoms and diseases name on this expert system is coded as "G" for the symptoms data and "P" for the disease data.

Analysis Calculation of Precentage of Disease

Calculation of percentage of the expert system is built based on Certainty Factor (CF) using the formula in Equation (1).CF value in the equation obtained from an expert chicken diseases.
For example, a user selects some of the following symptoms:

1. Exudate becomes thick and malodorous (G3)
2. Eyelid redness (G5)
3. Eyes closed (G6)
4. Diarrhea (G10)

Table 3 The symptoms weight that selected by user

No	Possibility of Diseases	The Symptoms	Weight (CF Value)
1	Salmonelosis Pulorum shape (P5)	Diarrhea (G10)	0.95
2	Kolibasilosis Embryo shape (P3)	Diarrhea (G10)	0.9
3	Salmonelosis Infectious Paratifoid shape (P7)	Eyes closed (G6)	0.8
		Diarrhea (G10)	0.9
4	Infectious Coryza (P1)	Exudate becomes thick and malodorous (G3)	0.9
		Eyelid redness (G5)	0.7
		Eyes closed (G6)	0.7
		Diarrhea (G10)	0.6

1. Salmonelosis Pulorum shape (P5)

- Diarrhea (G10)
  Precentage = CF Value × 100%
  = 0.95×100% = 95%

2. Kolibasilosis Embryo shape(P3)

- Diarrhea (G10)
  Precentage = CF Value × 100%
  = 0.9×100% = 90%

3. Salmonelosis bentuk Infeksi Paratifoid (P7)

- Eyes closed (G6)
- Diarrhea (G10)

CF (P7,G6|G10) = CF(P7,G6) + (CF(P7,G10) × (1 – CF(P7,G6)))
= 0.8 + (0.9 × (1-0.8))
= 0.8 + (0.9 × 0.2) = 0.8 + 0.18 = 0.98
Precentage = CF Value × 100%
= 0.98×100% = 98%

4. Infectious Coryza (P1)

- Exudate becomes thick and malodorous (G3)
- Eyelid redness (G5)
- Eyes closed (G6)
- Diarrhea (G10)

CF (P1,G3|G5) = CF(P1,G3) + (CF (P1,G5) × (1 – CF(P1,G3)))
CF (A) = 0.9 + (0.7 × (1-0.9))
CF (A) = 0.9 + (0.7 × 0.1) = 0.9 + 0.07 = 0.97

CF (P1,A|G6) = CF(P1,A) + (CF(P1,G6) × (1 – CF(P1,A)))
CF (B) = 0.97 + (0.7 × (1-0.97))
CF (B) = 0.97 + (0.7 × 0.03) = 0.97 + 0.021 = 0.991

CF (P1,B|10) = CF(P1,B) + (CF(P1,G10) × (1 – CF(P1,B)))
CF (C) = 0.991 + (0.6 × (1-0.991))
CF (C) = 0.991 + (0.6 × 0.009) = 0.991 + 0.0054 = 0.9964

Precentage = CF Value × 100%
= 0.9964×100% = 99.64%

Based on above calculation example, get the conclusion that the *Infectious Coryza* diseases have the largest percentage is 99.64 per cent. According to *certain terms* in Table 2, it can be concluded that *Infectious Coryza* diseases have a level of belief "Definitely" and become the result of a diagnosis based on a choice of four symptoms.

Designing of Expert System For Diagnosing Chicken Diseases

There are some screenshots of expert system diagnosing chicken disease based on android which can be seen ini Figure 5.

Testing

This research uses two types of testing, namely internal testing and external testing.Internal testing conducted by researchers for functional test systems and test diagnosis of expert system based on the facts provided.

Functional Testing

Functional testing is used to find errors in the system that has been built.Functional testing in this study using Black Box Equivalence Partitioning (EP).This method is done by dividing the input domain (input) into classes so that the test casecan be obtained.The tests on this research is done by dividing class tests such as android version testing, screen resolution and density of the screen, user interface testing, and testing functions and the application menu.The process of functional testing is to get results as expected on the test scenarios in each test class.

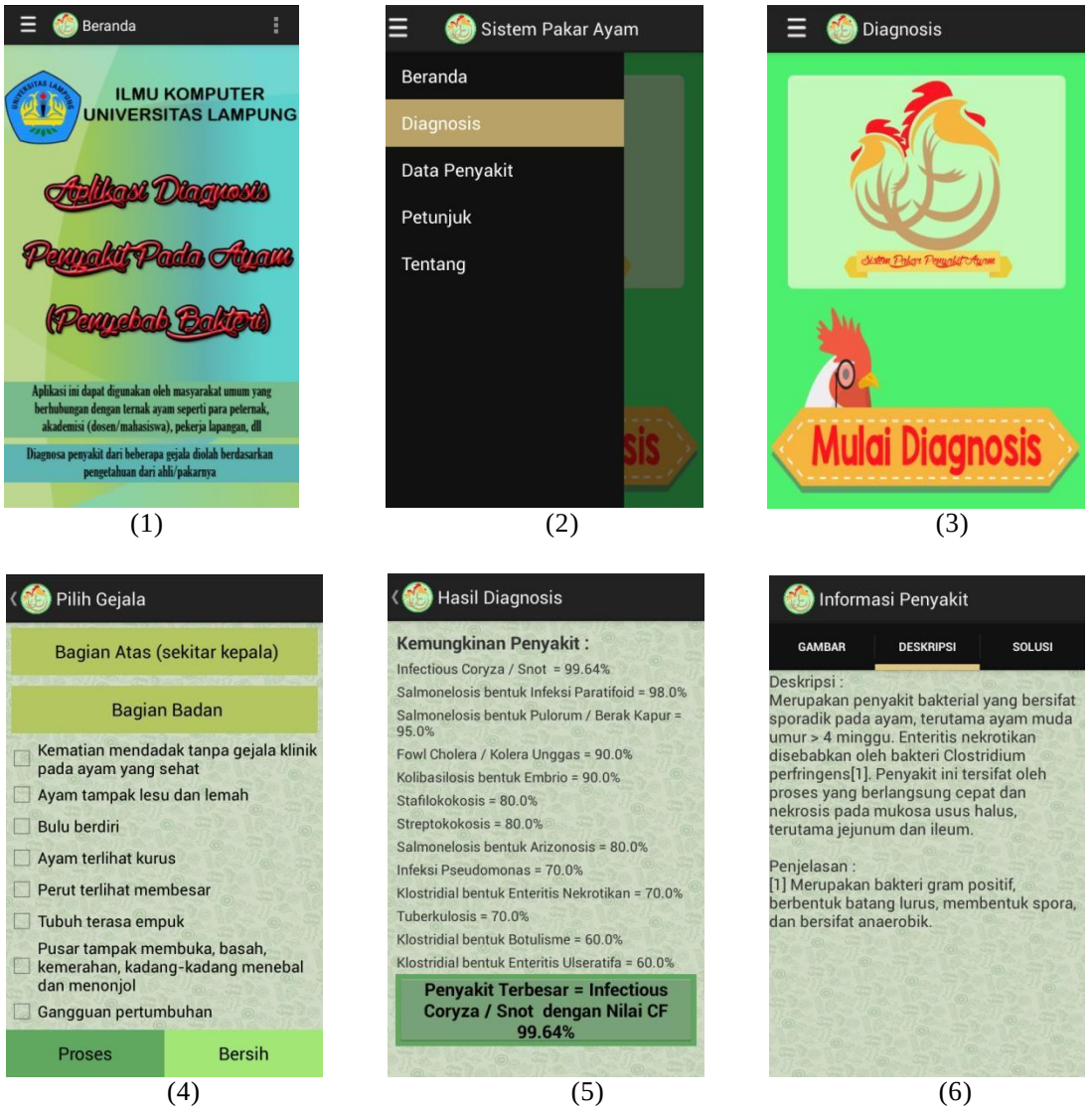

Figure 5 (1), (2), (3), (4), (5), (6)Screenshot of User Interface (UI) Expert System For Diagnosing Chicken Diseases

Diagnostic Testing

The test aims to see the diagnosis expert system capability in this application in diagnosing chicken disease cause by bacterial based on the facts that is given.The fact of this system in the form of selection of symptoms with a check mark. The tests conducted with 10 times of testing.The test results showed that the belief level of diseases diagnosing, either manually or on system get 99 per cent was appropriate and well-run.

External Testing

External testing is done by collecting questionnaires filled out by respondents were selected at random.Overall, the test was conducted by involving 31 respondents.In details 6 respondents of chicken disease experts consisting of veterinarians, professors, and civil servants.Five respondents are farmers/entrepreneurs of chickens livestock.Twenty respondents came from 10 students of Department of Animal Husbandry and 10 students from the Department of Computer Science.

From 31 respondents were divided into three groups of respondents;the first respondent group (chicken diseases expert), the second respondents group (breeders and students of Animal Husbandry), and the third respondent group (students of Computer Science).The purpose of grouping

these respondents is to compare assessment result of respondents between who understand about chicken diseases such as an experts (veterinary), who related directly to chicken diseases such as breeders and students of Animal Husbandry, and whodo not understand and related about chicken diseases such as Computer Science students.

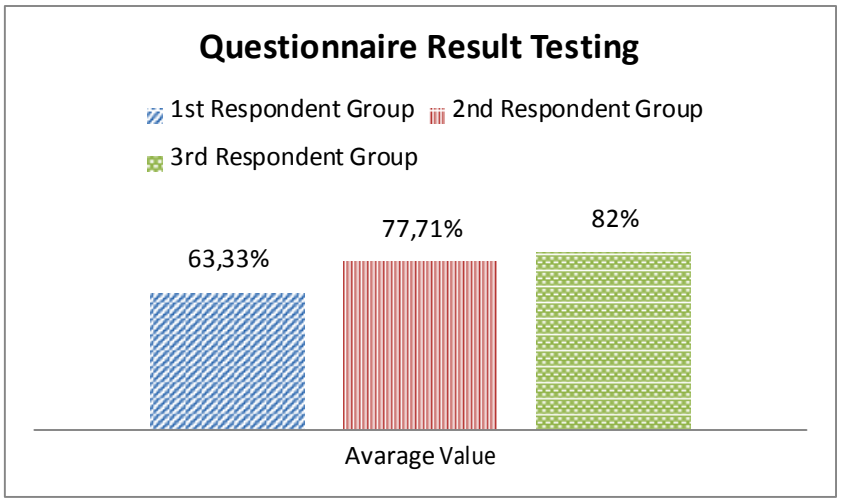

Figure 6 Average Value of Questionnaire Result Testing

Based on test results that have been calculated by the likert scale, is concluded that from 31 respondents, 6 peopleof the first respondent group gets 63.33 percent of average value.This shows that the assessment of the application by the respondents were aware of the chicken disease classified as 'Good'.

Fifteen people of the second respondent group gets 77.71 percent of average value.This shows that the assessment of the application by respondents relate directly to diseases of chicken are 'Good'.10 people of the third respondent group gets 82 percent of average value.This shows that the assessment of the application by respondents who do not understand and are not related to the disease chicken is 'Very Good'.

5. CONCLUSION

Based on research that has been done, it can be concluded:

1. Have successfully built the application'Pakar Ayam' based on Androidthat can help breeders, entrepreneurs or academics that associated with poultry in diagnosing disease problems chickens.
2. Expert systems are built can provide a percentage of the diagnosis of disease based on facts and knowledge that has been given.
3. Percentage of diagnostic results by using the calculation processCertainty Factor(CF) is very influenced on the value of CF that is given by experts.

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