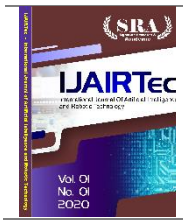

International Journal of Artificial Intelligence and Robotic Technology (IJAIRTec)

PISSN : 2775-5800 EISSN : 2775-5797
Volume : 1 Number : 2 pp. 45-58, August 2021
https://journal.sracademicpublishing.org/index.php/IJAIRTec

THE IMPLEMENTATION OF WEB-BASED FORWARD CHAINING AS AN EXPERT SYSTEM FOR DIAGNOSIS OF CATTLE DISEASE IN CENTRAL LAMPUNG (CASE STUDY: CATTLE FARM IN BANJAR SARI)

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Article Info
Article history:
Received July 19, 2021
Revised August 10, 2021
Accepted August 22, 2021

Keywords:
Cattle;
Central Lampung Regency;
Disease;
Forward Chaining;
Websiete.

Abstract
The potential of livestock in Central Lampung Regency has a great influence on most markets, because this is the largest livestock farming area in Lampung Province. Farmers in Indonesia often encounter various diseases in their livestock. In Central Lampung, many farmers know that their cattle are infected with certain diseases which cause farmers to experience losses in raising cattle because they are not suitable for trading. In this modern era, people must understand the problems they face. One of them is how to deal with the livestock industry when a cow is infected with a certain virus. Some breeders are confused about what disease will attack the cow so that it has the potential to get disease. An expert system is a digitalization model which transfers knowledge from an expert to a machine or program. In this case, the expert system is one way to solve the problem of cattle farming in Central Lampung. By using the Forward Chaining method and website-based implementation which is one way to solve expert system problems, this can make it easier for the community and cattle breeders to understand the disease and how to overcome it without spending too much money.

I. INTRODUCTION

High quality products such as beef cattle and dairy products in Indonesia have sufficient potential for livestock products. High quality livestock products are being developed and concentrated in production center development zones. With a large amount of production, the need for animal protein in Indonesia also increases along

with the increasing awareness of the importance of animal protein for the community. It is important for cattlemen to maintain the health of livestock in order to meet the nutritional needs and additional income of livestock owners. In rural areas, most of the various livestock kept by farmers are cattle. Lampung Province is a province which has quite a lot of cattle. It is spread in several districts/cities in Lampung Province. Based on the Central Statistics Agency in 2021, the cattle population by Regency/City in Lampung Province 2014-2018 can be seen in the following table:

Table 1. Cattle Population by District/City in Lampung Province 2014-2018

Region	Livestock (Cattle) Population				
	Jumlah				
	2014	2015	2016	2017	2018
West Lampung	5,087	5,810	6,261	6,957	6,650
Tanggamus	4,516	6,145	6,265	6,307	8,606
South Lampung	110,214	111,195	113,152	114,938	153,455
East Lampung	114,366	118,188	125,676	126,126	143,658
Central Lampung	205,986	260,054	260,569	264,790	344,508
North Lampung	25,764	28,017	28,437	29,034	30,455
Way Kanan	33,200	33,452	33,707	33,942	36,478
Tulang Bawang	18,959	18,902	19,084	18,584	21,038
Pesawaran	15,354	16,489	16,886	17,250	19,380
Pringsewu	10,691	10,807	10,906	11,629	14,783
Mesuji	10,650	8,886	8,537	8,577	8,291
West Tulang Bawang	15,878	17,393	17,917	18,724	19,632
Pesisir Barat	9,110	10,777	9,588	9,875	9,364
Bandar Lampung	2,103	1,785	1,504	1,202	1,067
Metro	5,949	6,098	7,223	7,413	9,615
Lampung Province	587,827	653,998	665,712	675,348	826,980

Source: https://lampung.bps.go.id in 2021

Based on the table above, it shows that Central Lampung Regency is the largest cattle-producing district in Lampung Province with a total cattle population of 344,508 from 2014 to 2018. This is evidence that Central Lampung Regency is a superior cattle producer.

Research has also been conducted by Satya (2018). This study implements the Naive Bayes deterministic factor method to diagnose an expert system for cattle disease. By using the naive Bayes-surety factor method, it can produce a good and accurate diagnosis, because the accuracy of the output produced by the system is 92%, and user satisfaction with the system created is 3,19411 [1]. The second study was conducted by Irawan, et al (2021). The purpose of this research is to build an expert system-based system which can provide an overview or decision. The method used is Forward Chaining and Backward Chaining in diagnosing cattle disease. The

discussion focused on applying Forward Chaining and Backward Chaining rules to the system. The results of the backward and forward method research provide information on how to prevent and treat cow disease so that farmers can know what steps to take [2].

Based on the two previous studies, it can be compared with research conducted by researchers using Forward Chaining and Certainty Factor methods, but in previous studies obtained an accuracy rate of 92% while the current research is 95%. Central Lampung Regency as the district with the largest cattle population in Lampung Province cannot be separated from various problems in raising cattle. This is because there are many types of diseases which can attack cows. In an effort to continue to increase cattle yields, various efforts have been made to prevent diseases which attack cattle. These efforts include giving medicine to cows to avoid disease but the low ability of livestock to meet nutritional needs. There are many reasons why meat and dairy production is reduced. One of them is because of disease. Anthracnose, rinderpest, brucellosis and diseases caused by parasites in the digestive tract are among the reasons why farmers reduce meat and milk production. An expert system is needed to diagnose livestock diseases which are easy to understand, and everyone in the Central Lampung region can access it via the internet. Livestock diseases can cause huge losses for farmers, especially the whole community. One of the most important parts of observing livestock health is observing the symptoms experienced by cattle so that solutions will be given in handling them.

II. LITERATURE REVIEW

2.1. Expert system

According to Yunizar in the journal Susanto, et al (2020), an expert system is a system which uses human knowledge and then implements it on computer devices to solve problems as an expert or doctor does. According to Yuwono in the journal Maharani and Irawan (2021), a good expert system solves specific problems by imitating the work of experts. By using this expert system, ordinary people can solve quite complex problems, which usually can only be solved by means of expert assistance [2]. Expert systems according to Turban in the journal Satya, et al (2018) are the authorities who believe that computer-based applications are used to solve problems. Experts are people with special skills which can solve problems which ordinary people cannot solve. Like a doctor, an expert can diagnose a patient's disease and provide treatment for the disease [1].

2.2. Cattle

Cattle are livestock which have great economic potential. Diseases in cattle can spread quickly and can lead to death. This disease can be caused by bacteria, viruses, fungi and parasites. To prevent infectious diseases in cattle, cattle owners must know their livestock diseases in advance so that cattle can be handled as soon as possible (in the journal Fahmy, 2018) [3]. Beef cattle are livestock which have good economic value and can be used as food. The success of raising livestock lies not only in increasing the number of livestock kept, but also in the success of its supervision and care (Nisak in the journal Kristi, 2019) [4]. Based on the above definition, it can be concluded that cows are ruminant animals which have a fairly high economic value,

such as beef cattle, cattle breeds and food. Cows can also be used as food ingredients such as milk, meat and skin. The cause of death of cattle is the spread of long-term infectious diseases that can interfere with the health of cows. The types of cattle found in Indonesia (in the journal Sibagarian, 2015) currently are native cattle from Indonesia and imported cattle. Among the various types of cattle, each has its own characteristics, both in appearance (body size, coat color) and genetics (growth rate). The types of cattle, among others, will be discussed below:

Table 2. Types of Cattle

Number	Types of Cattle	Diseases which usually attack
1.		Bali Ziekte, anthrax, scabies, Helmintiasis (worms), MCF (runny nose)
2.	Bali Cow	Anthrax, Helmintiasis (worms), MCF (runny nose), Epozootic Septicaemia (SE) / Snoring
3.	Simmental Cow	BEF (fever), Anthrax, Helmintiasis (worms), Epozootic Septicaemia (SE) / Snoring
4.	Limousine Cow	BEF (fever), Helminthiasis (worms), Anthrax, Epozootic Septicaemia (SE) / Snoring

The types of cattle diseases (in the journal Sibagarian, 2015) will be discussed below, among others:

Table 3. Types of Cattle Disease

Number	Disease Code	Disease Name	Cause	Symptoms	Prevention and Handling
1	P001	Epozootic septicaemia (SE) / Snoring	Pasuerella multocida, serotype	Difficulty breathing (snoring) and tremors, Continuous drooling, fever, swelling of the head to the lower neck, pneumonia (seen in the chest because the cow looks thin, the mucous membranes are red)	Quarantine and check newly arrived cattle, vaccinate adjuvant cattle, clean cages with disinfectant, give oxytetracyclin antibiotics, if cattle are slaughtered, the infected parts should be removed/burned (lungs)
2	P002	anthrax	Bacteria Bacillus Anthracis	Fever, weakness and easy to fall down, diarrhea, bleeding in the body, black color (on the nose, pores, and anal canal), shortness of breath, swelling of the lower abdomen.	Vaccination of avirulent spores in stages, cleaning and quarantine, do not feed the cows with the roots, do not have physical contact with the cows if it is not an emergency, give antibiotics, if the cow is dead do not touch the wound

					directly but the cow is buried/burnt.
3	P003	scabies	Sarcoptes mite, scabei	Cows often bite parts of their bodies, rub their bodies against the cage (such as scratching), hair loss and pus appears on the body, gray crust on the skin and feels stiff.	Try to keep the cage away from the house, the air flow and sanitation of the cage is good, animals that have been affected by scabies are separated and quarantined, giving coconut oil mixed with camphor then rubbing it on the affected cow skin.
4	P004	Helminthiasis	Liver worms, tapeworms, roundworms/ nematodes	No appetite, looks thin from day to day, diarrhea, weak movements, droopy eyes, gasping for breath, dry nose and mouth.	Try not to keep the cage moist, don't tend to cows often, don't keep the remaining feed in the cage for too long, give benzimidasol worm medicine, give traditional medicine with pineapple leaves or fruit
5	P005	MCF (Malignant Catharарr Fever)	Gamma Herpesvieinae Virus	Fluid appears in the nose and eyes, the cattle drooling, the muzzle is dry and sometimes oozes pus, difficulty breathing and tremors, the eyes look cloudy and tend to turn white, the skin of the cattle is peeling, the cow walks staggered and weak, the cow looks thin, paralyzed.	Control the cleanliness of the cage, separate and quarantine cows that have been affected, give antibiotics, consult a veterinarian.
6	P006	Bali Ziekte	Lantana Plant	Fever, pale skin, inflammation, mucus in the eyes and nose. Inflammation of the mucous membrane will develop into a shallow closed sore. Skin lesions in the form of eczema dry	Keep cows away from these plants, especially when they are hungry. Be aware that Lantana (Lantana camara) can thrive in dry land where herbivorous plants

				up, then peel like crackers and finally fall off, leaving scars	cannot grow in the dry season, whereupon the cows will eat them. Provide adequate drinking water and food and cattle showing symptoms of Baliziekte should be kept out of the sun. Give cows to drink coconut water very well. Apply oil to the resulting wound and protect it to prevent infection. If you can not handle it yourself, immediately contact the nearest veterinarian.
7	P007	BEF (Bovine Ephemeral Fever)	Bites of Cullicoides SP flies and Culex SP mosquitoes	The cow looks weak, has a high fever, looks very weak, is difficult to stand and move, is short of breath and is shaking. The presence of fluid in the nose and eyes, and decreased appetite.	A clean environment is needed, use of insecticides in the cage, then give fever-reducing drugs, give traditional medicines that are given brown sugar and salt and then drink them to the cows.
8	P008	Surra Disease (Mubeng Cow)	Haematophagus and Lyperosia fly bites	Cow movements become irregular and the mucous membranes turn yellow. Cows also have no appetite, hair loss, fever and tired quickly.	Give insecticide spray on the cage, clean the remains of feed, if the cow is injured do not let it get infected, quarantine the cow.
9	P009	Bloat	Wet and fibrous grass	The left side of the abdomen is enlarged, short of breath, less agile movement and often falls, even paralyzed.	Do not feed grass that is still wet, reduce the percentage of giving forage legumes, give dry hay in the morning before eating forage give anti-bloat medicine.

2.3. Forward Chaining

According to Giarratano and Riley in the journal Prasetyo and Wahyudi (2019), Forward Chaining is a method of finding or tracking solutions through problems in an expert system. In other words, the method considers the facts and then draws conclusions based on the facts. This method is the opposite of the backlink method, which is to conduct a search from the hypothesis to the facts which support the hypothesis. Forward linking is also called bottom-up reasoning, because this method considers evidence and facts at a lower level, and draws conclusions at the highest level based on facts [5]. Forward linking is an inference method of forward linking. This search is based on data. Therefore, the search first begins with premises or input information (if), then begins with conclusions or derivative information (then). Forward linking indicates the use of a set of conditional rules. In this method, the data is used to determine the rules to be executed, or to add data to the working memory to be processed in order to get results (Rifqi, 2019, journal) [6]. The reasoning method is influenced by three types of search. Depth-first search is a method of performing a direct search on the deepest root target of the root node. Breadth first search is a method of moving from the root node to the deepest target root by first testing each level of each root. The best first search is a method which combines the first two methods.

III. RESEARCH METHOD

3.1. Data Collection

The research method used in this research is experimental. In general, the research process begins with problem identification, data collection, knowledge base creation, implementation, and final testing. The data collection process is carried out by asking questions and answers to experts in the field of animal health (especially livestock diseases). A resourceful person only uses one person, because everyone has a different view of a particular disease and helps in modeling knowledge. In this case, two types of data are needed, disease data and symptom data. For livestock diseases, the data includes eleven diseases.

Literature research begins with collecting livestock inspection data from the information system of the Livestock and Plantation Service Office of Central Lampung Regency. The inspection data contains information about the owner of the cattle. Cattle data obtained from livestock medical records data so that it can be used forward chain to complete the composition structure in the diagnosis of livestock disease. Based on these data, it is continued by conducting literature research by looking for symptoms of each disease obtained from books whose experts are veterinarians. After getting the probability value from the expert, it is continued by seeking treatment for each existing disease in order to be able to use the forward link method to complete the compositional structure in the diagnosis of cattle disease. At the testing stage, the calculation using the forward link is to determine the probability value of the symptoms of each disease.

3.2. System design

In this study the development method used is Rapid Application Development (RAD). The RAD model was chosen because all stages are highly structured and software development can be completed quickly. The main reason for using the RAD development model is that it will work well when applied to small applications [6]. The development of the RAD system is divided into three stages:

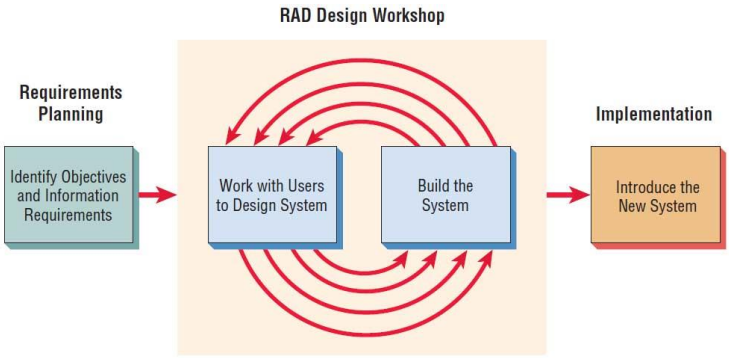

Figure 1. System Development Cycle RAD Model

Symptom data is data from disease symptoms which often appear in Central Lampung Regency. The table of symptoms and symptom codes can be seen in table 3 below:

Table 4. Symptom Table

Number	Symptom Code	Symptoms
1	G001	Fever
2	G002	Appetite down
3	G003	Nose leaking fluid
4	G004	Snoring tremor (convulsions)
5	G005	Diarrhea
6	G006	Difficulty breathing (snoring)
7	G007	Edema from the head to the lower neck
8	G008	Staggered walk
9	G009	Hard to breath
10	G010	There is a gray crust on the skin and feels stiff
11	G011	Pale
12	G012	Hair loss and pus appears on the body
13	G013	Pneumonia (visible on the chest because the cow looks thin)
14	G014	Black color (on the nose, pores, and anus)
15	G015	Weak movement
16	G016	Constantly drooling
17	G017	Weak and easy to fall/collapse
18	G018	Sluggish
19	G019	Cows often bite body parts
20	G020	Reddish mucous membranes
21	G021	Looking skinny day by day
22	G022	Dry mouth sometimes oozes pus
23	G023	Rubbing his body on the cage (like scratching)

24	G024	Bleeding in body parts
25	G025	Eyes look cloudy and tend to turn white
26	G026	droopy eyes
27	G027	Slimy eyes
28	G028	Yellowing of the mucous membranes
29	G029	Swelling of the lower abdomen
30	G030	Cow looks skinny
31	G031	Nose and mouth dry
32	G032	Nose is inflamed
33	G033	Fluid in the nose and eyes
34	G034	Breathless
35	G035	Cattle skin is like peeling off
36	G036	Inflammation of the mucous membranes and progresses to closed superficial sores
37	G037	Difficult to move and stand
38	G038	Cow movement becomes irregular menjadi
39	G039	paralyzed
40	G040	Impressed limp
41	G041	Skin damage in the form of eczema will dry up, then peel like crackers and eventually come off leaving a wound
42	G042	Hair loss
43	G043	Enlarged left abdomen
44	G044	Movement is less agile and often falls

Diagnostic data is a diagnosis filled in by a veterinarian at the Livestock and Plantation Service Office of Central Lampung Regency. The diagnosis also contains how to treat SE, Anthrax, Scabies, Helminthiasis, MCF, Bali Ziekte, BEF, Surra Disease, Bloat Disease. Relational data is data which is used to connect diseases and diagnoses so that the decision tree can run. Data comes from books, experts and extension modules. Personnel or officer data is data which stores people who will log into the system. Users who will enter the system need to enter data verification because the only veterinarians who can enter and manage disease data, diagnosis and interpersonal relationships are veterinarians.

Table 5. Table of Cattle Disease Rules

No	Cattle Disease Rules
P001	If the cow has difficulty breathing (snoring) and tremors and continuous drooling and fever and swelling of the head to the lower neck and inflammation of the lungs (visible on the chest because the cow looks thin and the mucous membranes turn red then se
P002	If the cow has a fever and is weak and falls easily down and has diarrhea and bleeding on the body parts and is black (on the nose, pores and anus) and shortness of breath and swelling of the lower abdomen then anthrax
P003	If cows often bite parts of the human body and rub their bodies in the cage (such as scratching), the hair falls out and pus develops on the body, the skin is gray in color, and feels stiff then scabies
P004	If the cow has no appetite and looks thinner every day and diarrhea and weak movements and droopy eyes and shortness of breath and dry nose and mouth

	then helminthiasis.
P005	If there is running water in the nose and eyes and the cow drools and the muzzle is dry sometimes oozing pus and it is difficult to breathe and shaking and the eyes look cloudy and tend to turn white and the cow's skin looks like it is peeling and the cow staggers and is weak and the cow looks thin, lame then mcf
P006	If the cow has a fever and is pale and the eyes are runny and the nose is inflamed and the inflammation of the mucous membranes will continue to become shallow closed wounds and skin damage in the form of eczema will dry up, then peel like crackers and eventually come off leaving a wound then bali ziekte
P007	If the cow looks weak and lethargic and has a high fever, seems to be limping and has difficulty moving and standing, shortness of breath and tremors and fluid in the nose and eyes and decreased appetite then bef
P008	If the movement of the cow becomes irregular and the mucous membranes turn yellow and there is no appetite and hair loss and fever and fatigue quickly then surra disease
P009	If the left side of the stomach is enlarged and short of breath and less agile movement and often falls and is paralyzed then bloat disease

IV. DISCUSSION

4.1. System design

In designing a disease detection system in cattle, a use case diagram model is used by involving two actors as shown in the following figure:

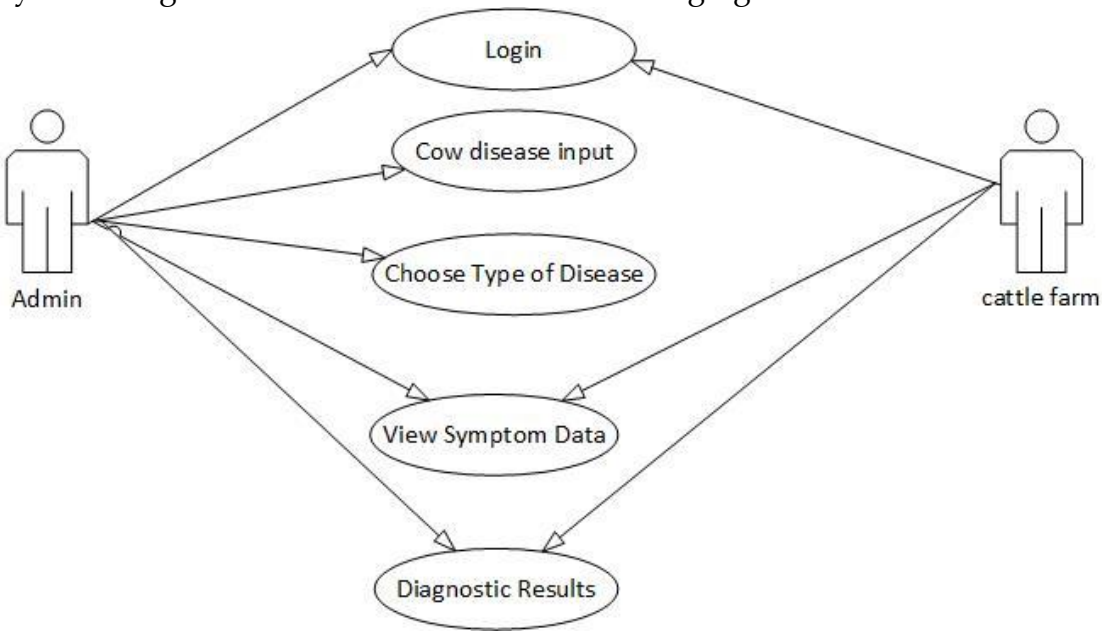

Figure 2. Use case Diagram Design

4.2. Implementation

The design of the home page is the page which first appears when the application is opened on a link.

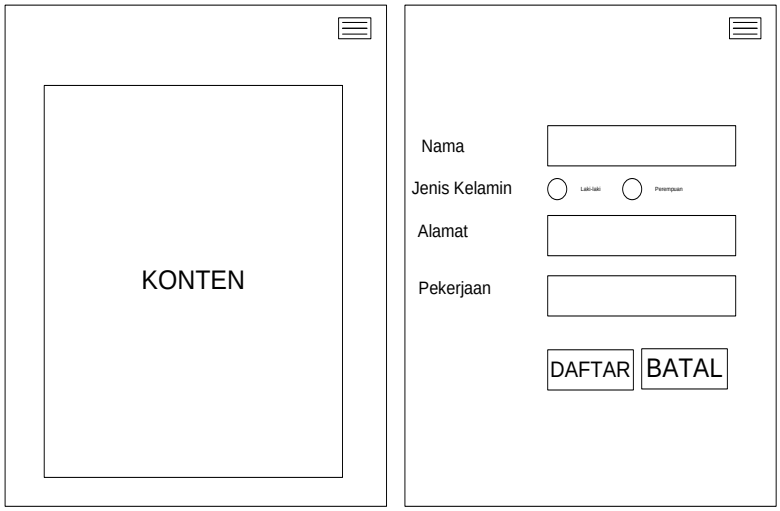

Figure 3. Homepage Design and Home Login

The consultation page design is a page for farmers to consult about their cattle disease.

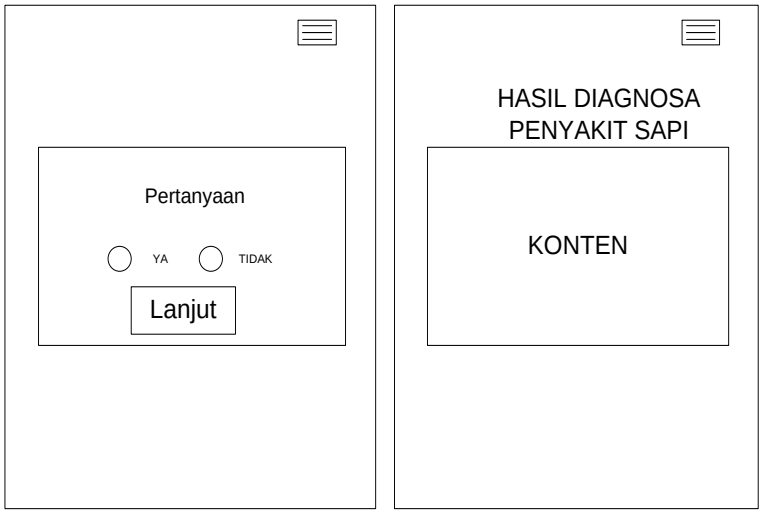

Figure 4. Design of Consultation Input Page and Consultation Result Output

The admin login page is a page which contains a login menu for admins.

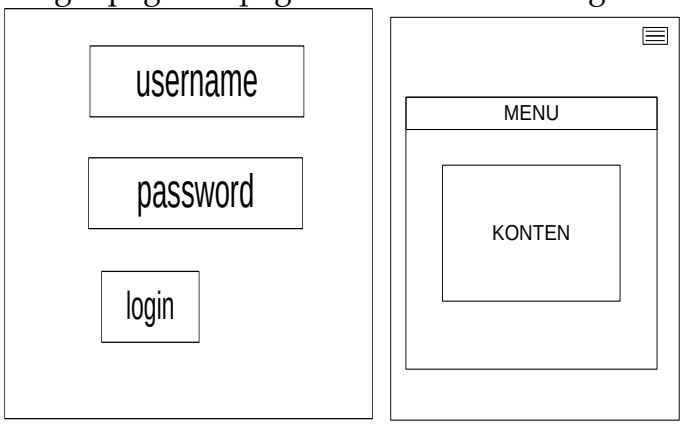

Figure 5. Admin Login Page Design and Admin Menu Display

When building a website-based cattle disease diagnosis expert system, the first step which must be completed is to create a database. Because we use a Web system, use PHPMySql for the database to create an accessible database. Open the address in the localhost/phpMyAdmin address bar. After the system design is completed, the system implementation will be carried out and system testing will continue to determine the operation of the system. The test result is that the administrator page will display information data. In order for the master data to be more static, it is necessary to process static data on the data to find information about the application of the expert system. Below is the admin login page to open the website:

Figure 6. Admin Login Page and Main View

The symptom input page on the admin is a page where the admin enters symptom data from several cattle diseases. Furthermore, the disease page is a disease data page consisting of the disease code, the name of the disease definition and how to handle it.

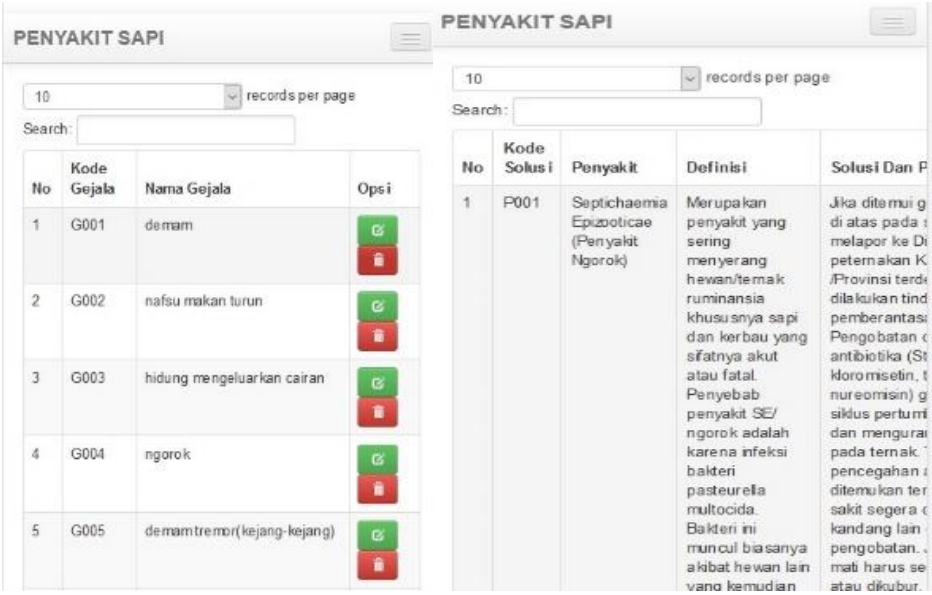

Figure 7. Symptom Page and Disease Input Page

The admin rule input page is a page which contains disease data with some of its symptoms. Furthermore, once selected, disease symptoms will display the output of the farmer's consultation with the expert system.

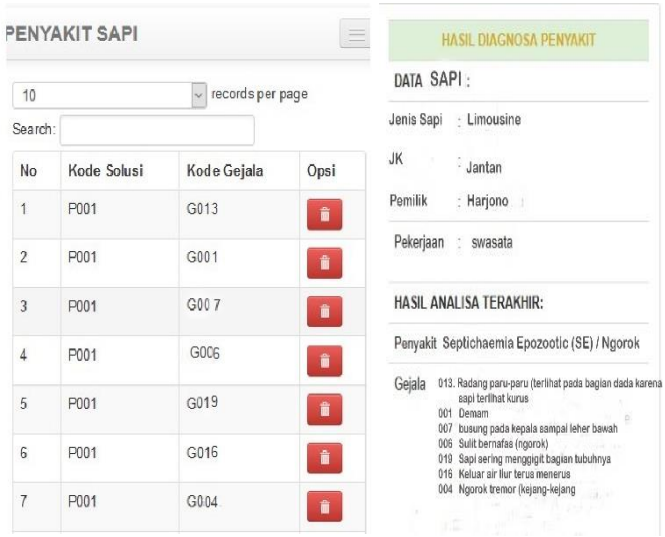

Figure 8. Admin Rule Input Page and Disease Diagnosis Results

4.3. System Test Results Analysis

The results of the system test analysis can be seen in the following table:

Tabel 6. Analysis of Application System Test results

Menu Test	Analysis result		Information
	Eror	Running	
Admin Main Menu	-	√	Success
Cultivator User Menu	-	√	Success
Consultation Menu	-	√	Success
Disease menu	-	√	Success
User Data Menu	-	√	Success

V. CONCLUSION

From the discussion of the problems above, it can be concluded that an expert system for diagnosing livestock diseases can help farmers overcome livestock diseases, their causes and how to handle them quickly and precisely. For the author, in the future I hope that there will be researchers who can develop this system, can add more complete symptoms and diseases to the development of the system and can add several other value variables which can improve the diagnosis of livestock diseases or by using other methods, for example a mobile-based system developed properly, so that the application can be accessed anywhere.

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