International Journal of Research in Engineering and Science (IJRES)
ISSN (Online): 2320-9364, ISSN (Print): 2320-9356
www.ijres.org Volume 09 Issue 10 ǁ 2021 ǁ PP. 78-88

Requirement Model of Livestock Management System for Veterinary Department

Hazaruddin Harun, Hamirul Aini Hambali, Nor Hazlyna Harun, and Ammar Azlan
Universiti Utara Malaysia, Malaysia,

Abstract *- Department of Veterinary Services (DVS) is a state department that responsible for managing livestock in their state. Managing livestock is very important in order to make sure the availability of the livestock. Unfortunately, the department is still using log book, cards, and receipts as a record keeping method. Livestock management system is a computerized system that automates the business process of the DVS to increase efficiency. A requirement model is important to ensure that the developed system satisfies the demand from the department. There are three steps in producing a requirement model which are requirement elicitation, requirement modelling, and requirement validation. For this research, requirement elicitation was performed using interview and document review techniques. Then, requirements were modelled using use case diagram, use case specification, sequence diagram, and class diagram. Lastly, requirement model was validated using a horizontal prototype. Representatives from DVS had reviewed and justified the correctness of the designed requirement model with some corrections.*

Keywords *- requirement model, livestock, veterinary, management system*

Date of Submission: 11-10-2021 Date of acceptance: 25-10-2021

I. INTRODUCTION

In Malaysia, the Department of Veterinary Services (DVS) is responsible for providing veterinary services that support the development and growth of all sectors of the animal industry, particularly the production of food. The services provided cover animal health, veterinary public health, development of the animal industry, development of genetic resources, veterinary research, human resource development (HRD) and the enforcement of laws and regulations.

Every state in Malaysia has a veterinary department that managed by that state. The operation of this department will control by the enactment called "Enakmen Pendaftaran Kerbau Lembu" and every state will have their own enactment which is sometime different to each other. In Kedah state, the main function of DVS department is to manage the livestock due to the high number of livestock in the state. By managing the livestock, the department could know the location for each livestock and also can monitor the disease of the livestock. However, more function has been added including the responsibility to make sure the production is enough to meet the consumption, creating a disease-free environment, enforcing quality and safety system for food, transforming breeders to commercial level, and improving the delivery of veterinary service.

Unfortunately, the department is still managing the livestock manually which is not efficient anymore due to the increasing number of livestock. The efficiency in managing livestock is important to the department because it is the main source of financial for the department through processing fee.

Therefore, a computerized livestock management system is proposed to accommodate the increasing number of livestock.

This research will gather requirements for the livestock management system, develop a prototype based on the requirements, and evaluate the developed prototype to ensure the livestock management system meet the user needs and preferences. The system will enable the department to manage the livestock efficiently hence increasing the financial of the department besides controlling theft and disease.

II. LITERATURE REVIEW

2.1 Requirement Model

Requirement model is a method of modelling the requirements. It can be categorized into two types which are structured analysis and object-oriented analysis. In structured analysis, data is separated from the processes that transform the data. On contrary, object-oriented analysis integrates data and processes that transform the data into an object. The later type is a more common practice among academic papers. In object-oriented analysis, requirements are modeled using Unified Modeling Language (UML). UML consists of many

techniques to model the requirement from different perspective. However, only four are considered as the core techniques on UML which are use case diagram, class diagram, sequence diagram, and state diagram.

There are plenty of literatures on requirement modeling but this research would focus on two articles due to their close similarity to this research. The first article is by Hyungi Kim, Seokkyun Jeong, and Hyun Yoe entitled "Design and Implementation of ICT-Based System for Information Management of Livestock Farm" and the second article is by James W. Baurley, Anzaludin S. Perbangsa, Anindito Subagyo, and Bens Pardamean entitled "A Web Application and Database for Agriculture Genetic Diversity and Association Studies".

Kim, Jeong, and Yoe (2014) proposed an ICT based system for information management of livestock farm. The objective of the system is to increase efficiency in operating livestock farm which can be achieved by managing information of livestock, environment, and fire. The management of these information could provide optimal breeding environment, forecast disease, prevent fire, monitor estrus, and schedule delivery time. Implementation of the system is expected to increase productivity and earning rate in livestock farm.

Baurley, Perbangsa, Subagyo, and Pardamean (2013) introduced a web application for large-scale agriculture genetic diversity and association studies that aims to simplify and automate many of the data management and analysis tasks common across studies. They presented a case study where their software was configured and populated with genome-wide data of over 750,000 genetic markers from the commercially available BovineHD array. Their software is scalable to multiple species and applicable to a wide range of genotyping and sequencing technologies and study designs.

2.2 Livestock Management System

Livestock management system is an innovation in managing livestock. Previously, farmers managed their livestock by writing records in a log book. This manual method is not efficient because it is tedious and time consuming especially having to go through all the records when needed to find a specific record. It is also prone to mistake because the records are managed by human. Furthermore, records saved in physical form especially books are not safe because they are exposed to damage by fire, water, or termites. This problem could be avoided by having a backup record but it raises another problem which is the burden of writing a record more than once which will also increase the rate of error.

On contrary, livestock management system provides an efficient record management. Through the technology of database, each record is needed to be entered once but could be used multiple times. It is also easier to create a backup of the database. All database providers include backup function in their services. Combine that with cloud technology, the records are safer because the records will be stored in the server of the cloud provider. Furthermore, searching for a specific record is easy and fast. Generating report based on the records is nothing but a click away. As a result of its advantages, livestock management system has been implemented in several countries like Serbia (Plavšić et al., 2009), United States of America (Foulkes et al., 2013), Indonesia (Ramadhan et al., 2014), and China (Gou, Lee, & Tiong, 2016).

In Serbia (Plavšić et al., 2009), a system known as Veterinary Information Management System (VIMS) was produced to notify and manage the animal diseases.This system enables the veterinary staffs to collect and analyze appropriate data in order to investigate, diagnose, and notify the authority or public about animal diseases. The ability of this system is very important in monitoring the livestock health and improving the quality of veterinary service.

Foulkes et al. (2013) has successfully developed a wireless livestock management system that is able to track and monitor cattle herds in United State of America. This system was used to assist farmers in monitoring the health and wellbeing of the herds. The monitoring process was done by identifying related information such as pulse rate, temperature, location information, grazing area, early signs of illness, and abnormalities of the livestock. By using this system, both farmers and veterinary department are able to monitor the disease of livestock and improve the vaccination process.

Livestock management system in Indonesia (Ramadhan et al., 2014), called Sistem e-Livestock Indonesia, was implemented in 2013 as a part of a whole e-Government system. It was researched since 2011 (Ramadhan & Sensuse, 2011) based on a conceptual design of information system for registration and planning national beef stock (Ramadhan, 2010). It was successfully implemented in the following third year as a web-based system. Ramadhan et al. (2012) defined e-Livestock in Indonesia as e-Government system that is mandatory for the identification, registration, documentation, and traceability of cows in Indonesia, starting from birth to death. There are five Geographical Information System (GIS)-based Decision Support System (DSS) modules that are integrated into the system to support decision and policy making regarding cows in Indonesia.

Gou et al. (2016) focused on the identification and traceability aspects of livestock management system to have a better control of contagious diseases in China. They adapted state-transition simulation model to evaluate the system in term of contagious livestock disease control. This model had been adapted by several other researchers to evaluate other diseases like classical swine fever (Saatkamp et al., 1996) and foot-and-mouth

disease (Miller, 1979). Furthermore, this model was also used to construct the North American Animal Disease Spread Model, which indicates the usefulness of this model as a decision support system for identification and traceability system of livestock. Their research yielded promising result in controlling contagious diseases.

III. METHODOLOGY

In this research, System Development Life Cycle (SDLC) was used. SDLC consists of four fundamental phases which are planning, analysis, design, and implementation. Each phase consists of a series of steps using certain techniques to produce certain deliverables. This paper focuses on delivering requirement model from analysis phase of SDLC. The steps involved in producing requirement model are requirement elicitation, requirement analysis, and requirement validation.

3.1 Requirement elicitation

Requirement elicitation is a process of determining the requirements using a variety of techniques to ensure that the business processes and the needs of the new system is well understood. It is important to identify the right key requirements before moving into design to avoid from chained problems later in the SDLC. There are five most commonly used requirement elicitation techniques which are interview, JAD session, questionnaire, document analysis, and observation. Given the limited period and staff of this project, this paper focused on Joint application design (JAD) and document analysis techniques.

3.2 Requirement analysis

Requirement analysis is the second step is producing requirement model. The information collected during requirement elicitation is analyzed and presented using appropriate techniques. This paper uses a list of functional and nonfunctional requirements to present business requirement, use case diagram to illustrate the basic processes that the system need to support, and class diagram to illustrate the characteristic of the system in term of classes and attributes of the classes.

3.3 Requirement validation

Requirement validation is a process to determine the correctness of a model. A requirement model is accurate when it performs and produces output as expected. To test for functions and output, a system should be developed based on the requirement model. Given the limited time and the small size of this project, a prototype is developed instead of a system.

IV. FINDING

An interview session was conducted in order to elicit requirements from the user for livestock management system.

In addition to the interview, this research also reviewed some documents like forms, log books, receipts, and enactment involved in managing livestock by the department. These documents were analyzed to identify the information needed and provided by the department. Below are the few examples of the documents.

Figure 4.1 shows the log book used to record the registration of livestock. It has column to record the information of the registration, the owner, and the livestock. It also has a column to record change of ownership and other event like death and slaughter.

Figure 4.1: Log Book to Record Livestock Registration

Figure 4.2 shows the certificate of livestock registration. It consists of a more detail information of the livestock

Figure 4.3 shows the loss of certificate, late notification, and change of location form. This form is used to produce a new copy of registration certificate in case of loss, produce a registration certificate for registration later than seven days, and modify the location of the livestock in case of transfer.

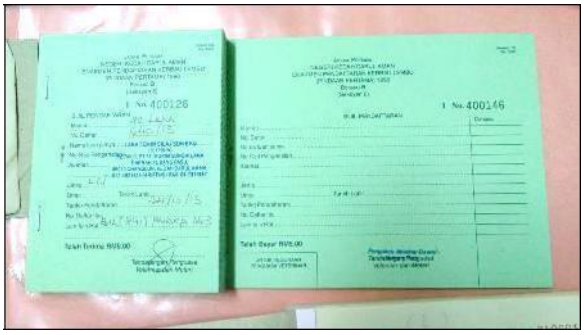

Figure 4.2: Livestock Registration Certificate

Figure 4.3: Loss Certificate, Late Notification, and Change Location From

Below are the outputs of the research.

4.1 Functional requirements

The main functions of the system is listed in Table 4.2

Table 4.1: Functional Requirements

No.	Req. ID	Requirement Description
	LMS-UC1	**Login System**
1.	LMS-FR01-01	Login into system
2.	LMS-FR01-02	Handle failed login
3.	LMS-FR01-03	Exit from system
	LMS-UC2	**Create livestock record**
4.	LMS-FR02-01	Create livestock record
5.	LMS-FR02-02	Cancel created livestock record
	LMS-UC3	**Create owner record**
6.	LMS-FR03-01	Create owner record
7.	LMS-FR03-02	Handle owner record already exist
8.	LMS-FR03-03	Exit from system
9.	LMS-FR03-04	Print monthly report
	LMS-UC4	**Create premise record**
10.	LMS-FR04-01	Create premise record
11.	LMS-FR04-02	Cancel create premise record
	LMS-UC5	**Record livestock slaughter**
12.	LMS-FR05-01	Record livestock slaughter
13.	LMS-FR05-02	Cancel record livestock slaughter

	LMS-UC6	**Record livestock sale**
14.	LMS-FR06-01	Record livestock sale
15.	LMS-FR06-02	Record not found
16.	LMS-FR06-03	Cancel record livestock sale
	LMS-UC7	**Record livestock transfer**
17.	LMS-FR07-01	Record livestock transfer
18.	LMS-FR07-02	Cancel record livestock transfer
	LMS-UC8	**Print livestock certificate**
19.	LMS-FR08-01	Print livestock certificate
	LMS-UC9	**Generate monthly report**
20.	LMS-FR09-01	Generate monthly report
21.	LMS-FR09-02	Print monthly report
22.	LMS-FR09-03	Exit from monthly report page

4.2 Use case diagram

Use case diagram is a UML diagramming technique that illustrates the main functions and users of a system based on user requirements. Figure 4.4 illustrates the use case diagram of Livestock Management System. The system will be used by veterinary officers. Hence, there is only one actor in the use case diagram named Veterinary Officer (VO). There are five main functions performed by VO which are maintaining Livestock Record, Livestock Slaughter, Livestock Sales, Livestock Transfer, and Generate Monthly Report. These use cases are associated directly to VO.

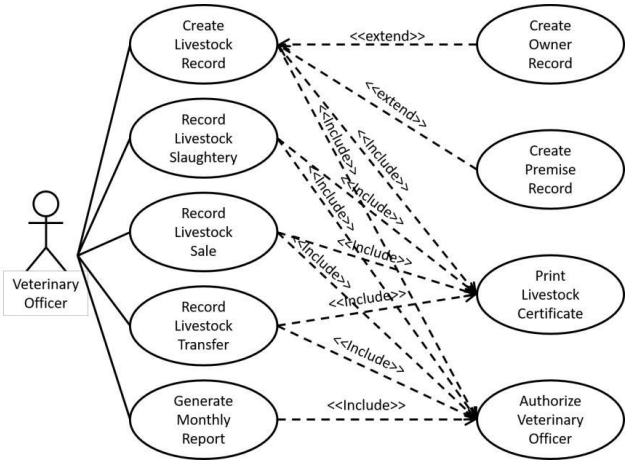

Figure 4.4: Use Case Diagram

Four use cases identified namely Create Owner Record, Create Premise Record, Print Livestock Certificate, and Authorize Veterinary Officer are supporting use cases to support the five main use cases. For a livestock to be registered, it must have an owner and a premise. Therefore, Create Owner Record and Create Premise Record should be performed prior to Create Livestock Record. Since Create Owner Record and Create Premise Record are required only for new owner and premise, they are considered as optional hence the extended association is used.

Another supporting use case is Print Livestock Certificate which enables VO to print a hardcopy of the livestock record. This use case is compulsory every time a transaction is performed on a livestock record. Livestock record is printed on a new certificate after Create Livestock Record use case and is printed on an existing certificate after Record Livestock Slaughtery, Record Livestock Sales, and Record Livestock Transfer use cases. Since it is compulsory, included association is used.

The last supporting use case is Authorize Veterinary Officer. This use case ensures that only authorized veterinary officer can perform any transaction. This use case is compulsory prior to other main use cases. Therefore, included association is used.

4.3 Use Case Specification

Use case specification, also known as use case description, contains all the information needed to build the following diagrams. The information included for use case specification in this research are use case ID, use case name, description, precondition, normal course, alternate course, exceptional course, and post condition. It is expressed in a less formal way for users to easily understand. This research uses table to present the use case specification. A few use case specifications for the use case are presented in the following sections.

4.3.1 UC1: Authorize Veterinary Officer

Table 4.2 presents the use case specification for UC1 which is Authorize Veterinary Officer. The normal course is where a veterinary officer is authorized without any problem. In addition to the normal course, an alternative course is provided to enable veterinary officer to exit the system without request for authorization. Furthermore, an exceptional course is also provided in case the authorization failed due to wrong username, wrong password, or unauthorized veterinary officer. The post condition of this use case is authorization of a veterinary officer where he or she is allowed to use the system.

Table 4.2: Use Case Specification for UC1: Authorize Veterinary Officer

Use Case ID	UC1
Use Case Name	Authorize Veterinary Officer
Description	This use case ensures that only authorized veterinary officer can use the system
Precondition	Veterinary officer is registered
Normal Course	Veterinary officer opens the system System displays login form Veterinary officer enters username and password then click login button [A1] System verifies username and password [E1] System proceed to next page.
Alternative Course	A1 – Exist system Veterinary officer clicks on close window button System terminates
Exceptional Course	E1 – Login failed System displays error message Veterinary officers relogin
Post condition	Veterinary officer is authorized to use the system

4.3.2 UC2: Create Owner Record

Table 4.5 presents the use case specification for UC2 which is Create Owner Record. The normal course is where an owner record is registered without any problem. In addition to the normal course, two alternative courses are provided to enable veterinary officer to either exit the system or print monthly report. Furthermore, an exceptional course is also provided in case the owner record already exists in the database. An owner record is compulsory to register premise and livestock.

Table 4.3: Use Case Specification for UC2: Create Owner Record

Use Case ID	UC2
Use Case Name	Create Owner Record
Description	This use case enables veterinary officer to register owner
Precondition	Veterinary officer is authorized Owner record is not found in database
Normal Course	System displays search owner form after authorizing veterinary officer Veterinary officer enters owner id [A1] [A2] System searches owner record in database based on owner id [E1] System displays owner registration form Veterinary officer enters owner details then clicks submit button System stores owner details in database System proceed to next page
Alternative Course	A1 – Exit system Veterinary officer clicks on exit link

	System goes to login page A2 – Print monthly report Veterinary officer clicks on print monthly report link System goes to print monthly report page
Exceptional Course	E1 – Owner record exits in database System displays owner record
Post condition	Premise and livestock can be registered to the owner

4.3.3 UC3: Create Premise Record

Table 4.6 presents the use case specification for UC3 which is Create Premise Record. The normal course is where a premise record is registered without any problem. In addition to the normal course, an alternative course is provided to enable veterinary officer to cancel the registration by closing the registration form. A premise record is compulsory to register livestock.

Table 4.6: Use Case Specification for UC3: Create Premise Record

Use Case ID	UC3
Use Case Name	Create Premise Record
Description	This use case enables veterinary officer to register premise
Precondition	Veterinary officer is authorized Owner record is found in database Premise record is not found in database
Normal Course	System displays premise registration form after authorizing veterinary officer and registering owner Veterinary officer enters premise details then click submit button [A1] System stores premise details in database System proceed to next page
Alternative Course	A1 – Close premise registration form Veterinary officer clicks on close window button System closes premise registration form and returns to search owner form
Exceptional Course	NA
Post conditions	Livestock can be registered to the premise

4.4 Sequence Diagrams

Sequence diagram is the most common kind of interaction diagram, which focuses on the message interchange between a number of lifelines. A sequence diagram describes an interaction by focusing on the sequence of messages that are exchanged, along with their corresponding occurrence specifications on the lifelines. A few sequence diagrams are presented in the following sections.

4.4.1 UC1: Authorize Veterinary Officer

The first sequence diagram as illustrated in Figure 4.5 is for UC1 which is Authorize Veterinary Officer. It consists of four lifelines for one actor which is Veterinary Officer and three objects which are Veterinary Officer Menu, Veterinary Officer Manager, and Veterinary Officer Database. It has an exception E1 on Veterinary Officer Manager's lifeline to handle error in login. It also has an alternative flow A1 where user can exit the system.

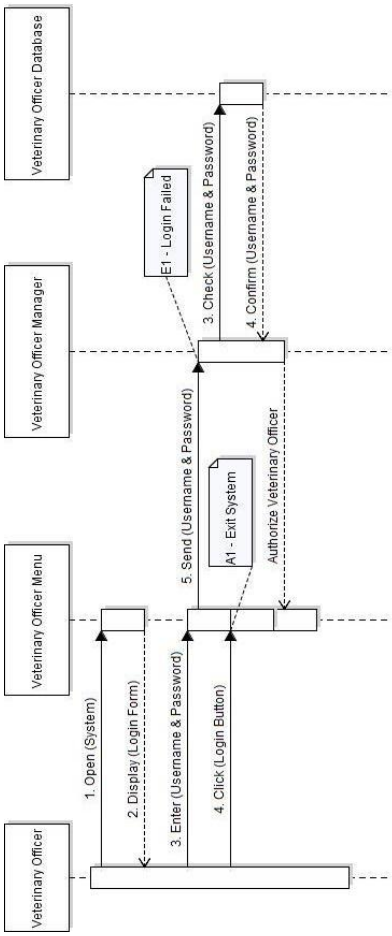

Figure 4.5: Sequence Diagram of UC1: Authorize Veterinary Officer

4.4.2 UC2: Create Owner Record

The second sequence diagram as illustrated in Figure 4.6 is for UC2 which is Create Owner Record. It consists of four lifelines for one actor which is Veterinary Officer and three objects which are Owner Menu, Owner Manager, and Owner Database. It has an exception E1 on Owner Database's lifeline to handle error when an owner record already exists in the database. It also has an alternative flow A1 where user can exit the system and A2 where user can print monthly report by parsing to the Generate Monthly Report page.

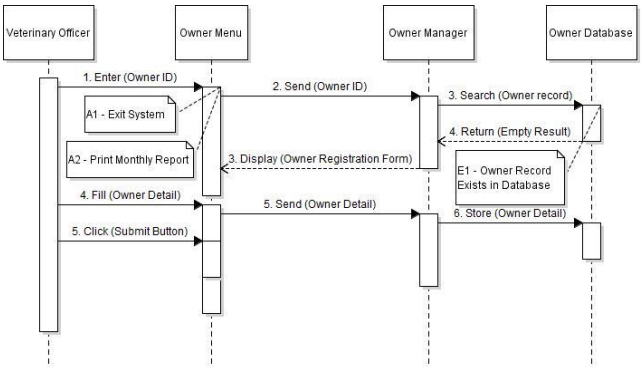

Figure 4.6: Sequence Diagram of UC2: Create Owner Record

4.4.3 UC3: Create Premise Record

The third sequence diagram as illustrated in Figure 4.7 is for UC3 which is Create Premise Record. It consists of four lifelines for one actor which is Veterinary Officer and three objects which are Premise Menu, Premise Manager, and Premise Database. It has an alternative flow A1 where user can cancel premise registration by closing the Premise Registration Form.

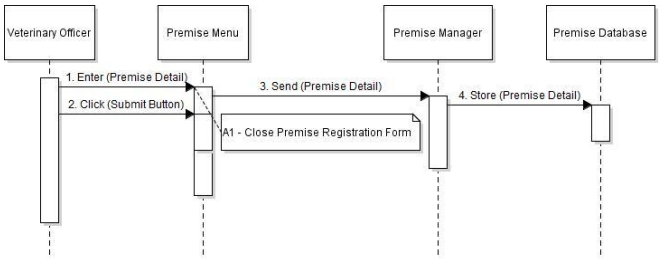

Figure 4.7: Sequence Diagram of UC3: Create Premise Record

4.5 Class diagram

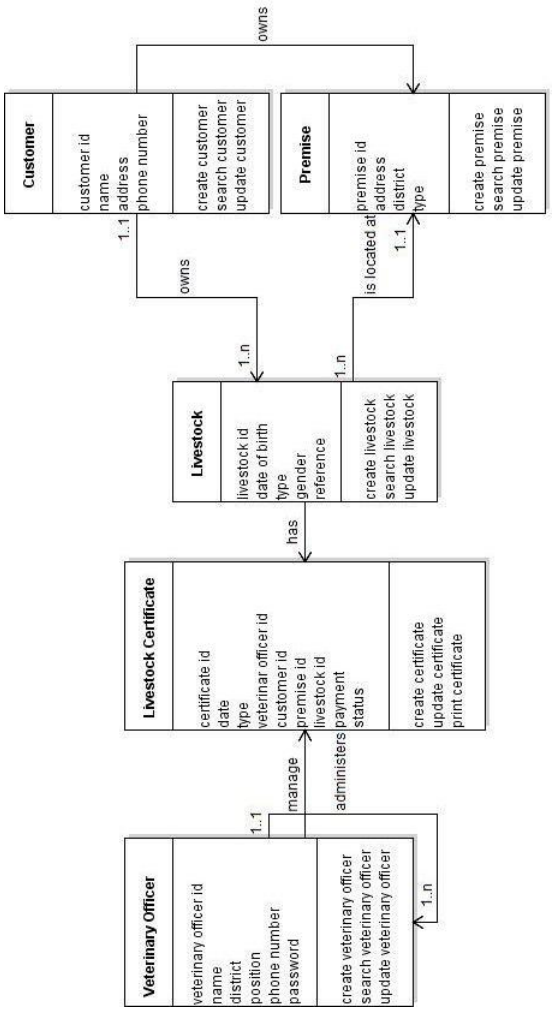

Figure 4.8: Class Diagram of Livestock Management System

A class diagram is generated based on the gathered requirements from the discussion and document review in requirement planning phase. Five classes have been identified which are veterinary officer, livestock certificate, livestock, customer, and premise. Each class becomes a table in the database. Each class has its own attributes which becomes the column of the table and behavior which becomes the functionality of the system. The class diagram for livestock management system is illustrated in Figure 4.8.

V. PROTOTYPE

Below is a few example of a screen that has been developed for the testing.

Figure 5.1: Veterinary Officer Authorization Page

Figure 5.1 shows the first page of the system. It contains veterinary officer authorization form which consists of two text box and a button. The first text box is for MyKad number while another text box is for password. A button labeled "MASUK" is clicked to check for veterinary officer authorization.

Figure 5.2: Owner Record Page

Figure 5.2 shows the owner record page which is the main page of the system. It is shown after veterinary officer is authorized and owner is identified.

Prototype evaluation was used to ensure that every requirement of the department is satisfied. Two representatives from Department of Veterinary Services (DVS) Kedah, had reviewed the prototype to ensure the requirements of the department is met.

VI. CONCLUSION

The main limitation for this research is obligation towards enactment. Since the enactment is only valid within the state, this requirement model is not really applicable for livestock management system in other states. However, it is still can be used as a reference for other state. Even in the state of Kedah, the requirements elicited for the requirement model is limited to what is allowed in the current enactment. Alteration and modification of current process need to be supported by a new enactment.

REFERENCES

[1]. Accreditation Commission for Programs in Hospitality Administration. (n.d.). *Handbook of accreditation*. Retrieved from http://www.acpha-cahm.org/forms/acpha/acphahandbook04.pdf

[2]. Billson, C. J. (1892). The Easter hare. *Folklore*, 3, 441-466. Retrieved from http://www.jstor.org

[3]. Bower, B. (2008, Feb. 9). Dawn of the city: Excavations prompt a revolution in thinking about the earliest cities. *Science News*, 173(6), 90-92. Retrieved from http://www.sciencenewsmagazine.org/

[4]. *Elementary school math instruction questionnaire results*. *Most significantly improved schools*. (n.d.). Retrieved fromhttp://www.sharingsuccess.org/code/highperf/2002-03/es_math/msi/index.htm

[5]. Fuchs, D., Fuchs, L. S., Al Otaiba, S., Thompson, A., Yen, L., McMaster, K. N., . . . Yang, N. J. (2001). K-PALS: Helping kinder-gartners with reading readiness: Teachers and researchers in partnerships. *Teaching Exceptional Children*, 33(4), 76-80. Retrieved from http://www.cec.sped.org/content/navigationmenu/publications2/teachingexceptionalchildren/

[6]. Goyen, A. (2007, February 22). Downtown Marquette dog sled races [Video file]. Retrieved from http://www.youtube.com/watch?v=gW3CNCGGgTY

[7]. Hartley, J. T., Harker J. O., & Walsh, D. A. (1980). Contemporary issues and new directions in adult development of learning and memory. In L. W. Poon (Ed.), *Aging in the 1980s: Psychological issues* (pp. 239-252). Washington, DC: American Psychological Association.

[8]. Herculano-Houzel, S., Collins, C. E., Wong, P., Kaas, J. H., & Lent, R. (2008). The basic nonuniformity of the cerebral cortex. *Proceedings of the National Academy of Sciences 705*, 12593-12598. doi: 1 0.1 073/pnas.08054171 05

[9]. Hipp, E. (2000). *Understanding the human volcano: What teens can do about violence* [Monograph]. Retrieved from http://www.eric.ed.gov/

[10]. Inness, S. A. (Ed.). (1998). *Delinquents and debutantes: Twentieth-century American girls' cultures*.New York, NY: New York University Press.

[11]. Katz, I., Gabayan, K., & Aghajan, H. (2007). A multi-touch surface using multiple cameras. In J. Blanc-Talon, W. Philips, D. Popescu, & P. Scheunders (Eds.), *Lecture Notes in Computer Science: Vol.* 4678. *Advanced Concepts for Intelligent Vision Systems* (pp. 97-108). Berlin, Germany: Springer-Verlag. doi:10.1007/978-3-540-74607-2_9