Livestock Database Management: Preliminary Studies in Malaysia

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***Abstract*— This paper outlined the preliminary studies in Malaysia for livestock database management. Livestock area signifies the biggest food industry segment in Malaysia. Self-sufficiency in livestock product for beef, mutton and dairy product is claimed to be low by the Department of Veterinary Services (DVS) in year 2015, which is less than 30%. To improve the current Malaysia livestock industry, this paper proposes a better management system especially in handling database of the cattle at Malaysian Agricultural Research and Development Institute (MARDI). The objectives of this work are; to study and propose on livestock database management system architecture and to develop graphical user interface (GUI) for livestock management system. A system combining the RFID technology supported with GUI is developed using VisualBasic.NET for four sections that are breeding, feedlot-fattening, dairying and slaughtering. User may update the data on the GUI and view existing data collected from the tag, which is then automatically updated at the central database. The data gathered on temperature will be further analyzed for early detection of disease.**

***Index Terms*— database, GUI, livestock management**

I. Introduction

MANAGING livestock requires for high awareness on environmental conditions and property management. The interaction between animals and environmental factors such as temperature, humidity, solar radiation and wind can be critical. These are the factors that would determine the level of health and production of the animal. The urge to have an efficient livestock management system is due to the need to increase productivity, yield, traceability and disease control. Improper livestock management may be a factor to low self-sufficiency of livestock product as declared by DVS.

In this country, farming is done in a small scale, which are conducted by farmers as rural activities. The farmers need more exposure on management of livestock to improve on the quantity and quality of the livestock product in order to increase the cattle self-sufficiency in Malaysia for breed, meat and dairy products. Commonly data management is done manually where recording and reporting of data are handwritten. These may sometimes cause error in data record due to human mistake. To avoid such mistakes, a proper database should be developed to help the farmers or livestock managers.

Database management for livestock has been studied for health monitoring, identifying and recording the information of the cattle, breeding management practice and tracking the location of the cattle. In Malaysia, the system that incorporated RFID for livestock database management is already available at the level of controlling and tracing diseases, animals, and animals' productsas provisioned under the Animal Act 1953 and State Enactments. However, the focus for this proposed work is to develop a system with RFID supported with GUI for individual section of breeding, feedlot, milking/dairying and slaughtering since coverage of each section has not yet significant in the livestock industry.

Focusing on cattle, their productivity varies substantially due to breed, health status and feeding regime. Selective breeding for best progeny is a highly effective and sustainable approach for increasing animal productivity in long-term. Traceability of beef by origin is demanded progressively to ensure the quality and safety of beef in the food supply. On the other hand, food supply is also depending on health status of the livestock and the major threats are infectious diseases. Some diseases may spread quickly throughout a region. Another aspect is the feeding regime; where improvised nutrition in the feedlot section will improve the livestock production.

The concern on IT-based system with RFID technology is at a high demand since people are aiming for a system that can rapidly report and at real-time. This may help to improve on managing livestock with less human intervention and monitoring. The system supported with a program interface such as GUI will upgrade on the easy communication between the human and data collected onto the computer. This system will also increase efficiency in handling the data record, reducing errors and easy accessability.

II. Previous Work On Livestock Management

The early stage on improving the livestock management system in Malaysia is suggested by having a better database management system. The implementation of such system using GUI to manage the livestock has long existed. For

This paper was submitted for review on 26th September 2016. This research work is supported in part by the Universiti Teknologi Mara under the Lestari Grant, 600-IRMI/MyRA 5/3/LESTARI (0159/2016). Accepted on 21st November 2016.

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example, Smith et al. [1] analyzed their data using My SQL database for an integrated cattle health monitoring system supported by Zigbee as a wireless receiver and GPS in monitoring and recording details of temperature, heart rate, head motion and position of cattle. The system particularly concentrates on analyzing the health condition of each cattle. This proposed research is concentrating on developing the temperature sensor, which is integrated to the RFID system. The sensor is to detect the cattle temperature and analyze the health condition of the cattle.

For nationwide cattle monitoring system, Radenkovic and Wietrzyk [2] investigated and proposed a system using wireless mobile ad hoc sensor networks based on the Distributed Hash Table (DHT) substrate. The work focused on large scale monitoring with novel data storage and routing protocol. As in Malaysia, the farmers are still handling their livestock in a small scale, therefore this research aims for a lower cost and scale compared to the work done by [2] and the mean of communication of data is based on RFID as the sensor network.

A study was conducted by Joseph et al. [3] where RFID technology is used to prevent cattle rustling in the East Africa. The system provides identification and information of the cattle using a centralized database system and the livestock information can be retrieved via internet, Short Messaging (SMS) and GPRS. Cattle are tagged by bolus Low Frequency (LF) RFID tag with neck collar integrated GPS receiver and GPRS for geofencing. In this research, the plan is to use High Frequency (HF) and Ultra Hugh Frequency (UHF) rather than using LF; since LF has limitation in distance, data storage and data transfer.

Zaiqiong et al. [4] also used RFID for their study in cattle breeding management practice. The purpose of the study is to provide the breeding information. RFID tag is attached to the cattle's ear and a PDA is used to read information from the tag and data from the PDA is transferred to PC platform. This paper is used as a reference for further enhancement on more sections covered in this research. The sections will be extended to sections such as feedlot, dairying and slaughtering.

Another study using RFID is by Ketprom et al. [5] for cattle traceability at animal checkpoint by proposing an automatic data acquisition system called e-Note, verification service and estimation of arrival time at animal checkpoint. The information of the animal can be retrieved in the Animal Checkpoint Center (ACC) website by key in the information such as number of movement permit on the ACC website. This system is relatively similar to E-Permit 2, using low frequency (LF) RFID and only limited for premise registration and animal transfer permission.

A conceptual framework for animal traceability is proposed by Mukviboonchai et al. [6]. The GUI for animal traceability database was designed using the relational data model and focused on swine and poultry only. By 2011, Wenxing and Yongsheng [7] proposed a traceability system for beef farming using GSM and PDA. The system has a center database server to store the information of the beef. SQL Server 2005 and Microsoft .NET 2005 is used for the system development. Earlier works done provided more knowledge on developing the database for this proposed research. However, the focus is mainly on livestock cattle and using RFID technology for collecting data.

Previous researches showed great efforts are done to improvise on livestock management system. Basically the system including GUI and RFID has been developed, however coverage on every section details is not yet significant in the livestock industry. Based on the studies above, the proposed work is to focus on database of individual section; breeding, feedlot, dairying and slaughtering. The database management will be constructed using Visual Basic.NET and Microsoft Access database for the application of GUI.

III. Result

In this work the focus of livestock management is mainly for cattle. The aim of having a better livestock management system is to facilitate the local cattle farmers on how to improve on quality in breeding and production of beef and dairy, managing and controlling disease and protecting the integrity and safety in food supply chain.

For this section, the work done is distributed into two subsections that are the proposed system architecture overview and the development of GUI for the livestock management system.

A. Proposed System Architecture Overview

The focus of the research group covers feedlot-fattening section, milking/dairying section, breeding/field section and slaughtering house. The livestock process flow is illustrated in Figure 1. This project aims to model data center for animal profiling and animal heredity history for the livestock.

The development of system database is done based on Figure 2. This is the proposed architecture on gathering the data from the four sections that are fattening, dairying, breeding and slaughtering sites. All data are to be stored at the data center and can be utilized for further analysis and update by the system admin.

The livestock management system can be simplified into attributes as in Table 1 where the activities of cattle in every section are traced and tracked for database record, their products can be closely monitored and all the processes involved are noted. The system admin will be supplied with the knowledge on parameter setting, security setting and data configuration.

On the software part, the development work has covered four sections that are breeding section, feedlot-fattening section, dairying section and slaughtering section. The system contains two main components; central database and graphical user interface (GUI). Information related to the cattle in all sections will be stored in the central database as shown in Figure 3. The database is constructed using Microsoft Access 2007. Meanwhile, the GUI is designed in Visual Basic.NET (VB.NET) for human interaction with the computer as the work done in [8].

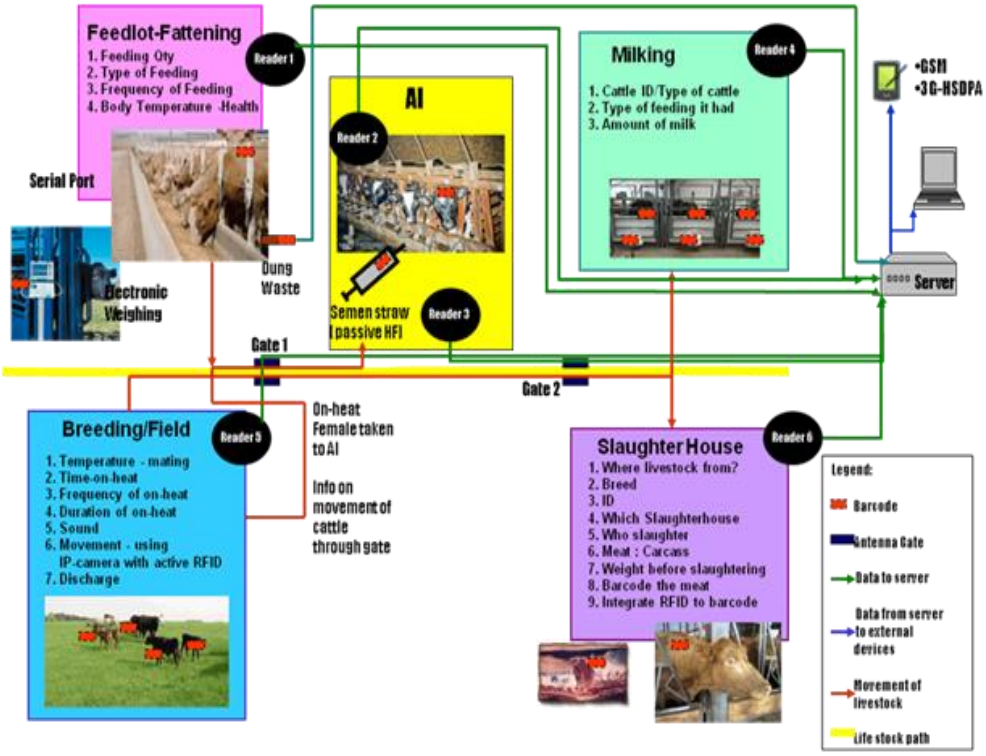

Fig. 1 Livestock Process Flow

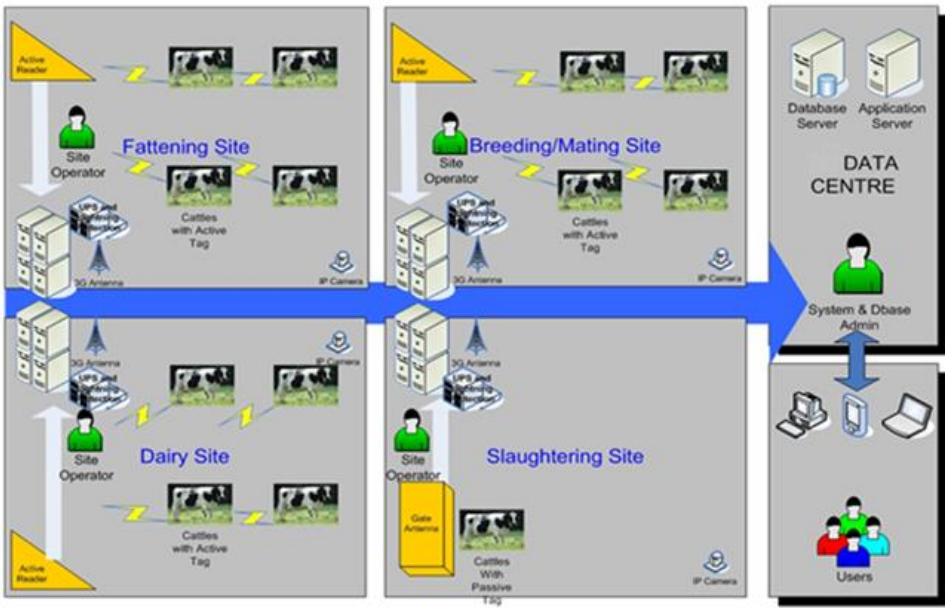

Fig. 2 Livestock management architecture

In all sections, cattle ID is a compulsory attribute in order to initialize on identifying the unique ID of the cattle. The details of cattle information such as breed, sex, age, date of birth, etc. are required at the breeding section. Other than that, the cattle is recorded on pregnancy status which is important to monitor on the cattle condition during pregnancy especially on embryonic development and to avoid embryonic mortality [9]. In this section, body temperature is also noted for further analysis on suitable time of mating and the health status of that particular cattle.

Type of feeding is an important attribute for feedlot and dairying section. Significantly both sections depend on nutrition supplied in the food intake which is highly correlated to the health status, growth and output of dairy product. Improvement of nutrition in feeding regime is an important strategy for improving the output of livestock production. In

TABLE I
ATTRIBUTES FOR LIVESTOCK MANAGEMENT

Dairy Modules	Breeding & Mating Modules	Fattening Modules	Slaughtering Modules	Admin Modules
Trace and track dairy activity	Trace and track activity	Trace and track fattening activity	Trace and track slaughtering activity	Parameter setting
Monitor cattle – quality and quantity	Monitor cattle – quality and productivity	Monitor cattle – feeding time, quality and frequency	Monitor cattle – slaughtering and quantity	Security setting
Monitor dairy process	Monitor process	Monitor fattening process	Monitor slaughtering time and frequency	Data configuration

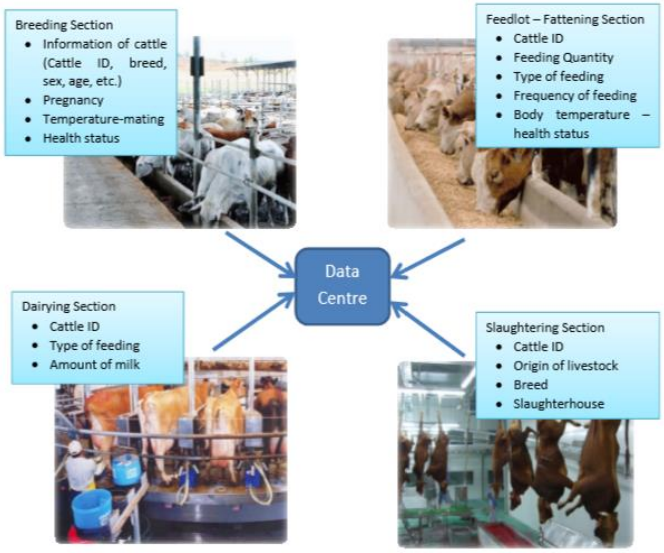

Fig. 3 Central database for four sections

the feedlot section, quantity and frequency of feeding are also recorded. Furthermore, body temperature is again noted here to determine on health condition of cattle since unhealthy cattle shows symptom of loss in appetite. Dairying section includes the attribute for data on amount of milk being collected in a session.

The slaughtering section also keeps record on origin of livestock, breed and slaughterhouse. Information on origin and breed are useful on providing the history and heredity details of the cattle, which is important during tracking and identification. Furthermore, aligned with the objective of Malaysia to become a global halal hub; the process of slaughtering should be handled in the best ethical and practical Islamic way to ensure that all filthy blood that is unhealthy for human consumption is flushed out from the animal. [10]

The system employs RFID readers to capture data of individual cattle using RFID tag, which is then transmitted directly to a central database. The system can provide important attribute on database of cattle history, retrieved and recorded the health status, breeding analysis, milking output and the best progeny of the cattle. The system also supports for easy access of details that can provide useful information of animal heredity to farmers or veterinary handling the livestock especially on identifying the history of the cattle and its immune system.

Based on Figure 3, the data on body temperature is collected in two sections that are feedlot-fattening and breeding sections. Body temperature can be further analyzed for monitoring on health condition of the livestock especially in the feedlot-fattening section since one of the symptoms of sick cattle is loss of appetite. While in the breeding section, the increase of temperature may indicate the readiness of cattle for breeding session. Additionally, this research work will be enhanced later on developing a body temperature monitoring system of livestock in Malaysia. This is to assist the local farmers on early detection and action that should be taken according to their livestock health condition.

B. Development of Graphical User Interface (GUI) for Livestock Management System

At present, the graphical user interface for the livestock management is established. It is to be used for the cattle data management. The main GUI window consists of details for all sections that are breeding, feedlot, dairying and slaughtering section as shown in Figure 4. This window will be connected to the central database, where details on serial port and its baud rate, RFID read tag time interval and ID can be found.

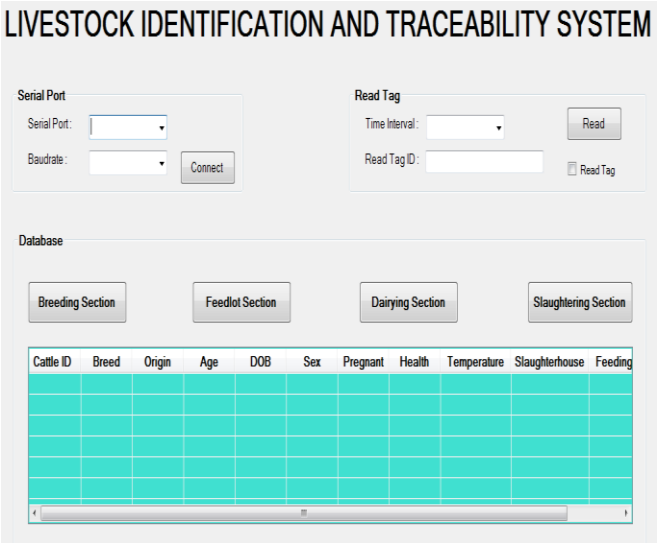

Fig. 4 Main GUI for livestock system

The data stored in the tag especially the unique ID is sent to the computer once the tag is detected by the RFID reader. This will update the database column in the GUI. User can also use the GUI for viewing the information of cattle or modify the details such as delete or edit the database. The central database is automatically updated with any changes happened in the GUI. The button for individual section is to connect with the particular details of each section in different window.

Figure 5 shows the GUI for breeding section that can be connected from the main GUI with all the attributes related to breeding of cattle. The details including type of breed, originality of the cattle and pregnancy status are updated in this section.

Fig. 5 Breeding section

Feedlot-fattening section can be reached via main GUI and the view of window is illustrated in Figure 6. The concern on this section is more on feeding regime and frequency of feeding. Body temperature data is also updated in this section to monitor the condition of cattle because unhealthy cattle may have less frequency of food intake.

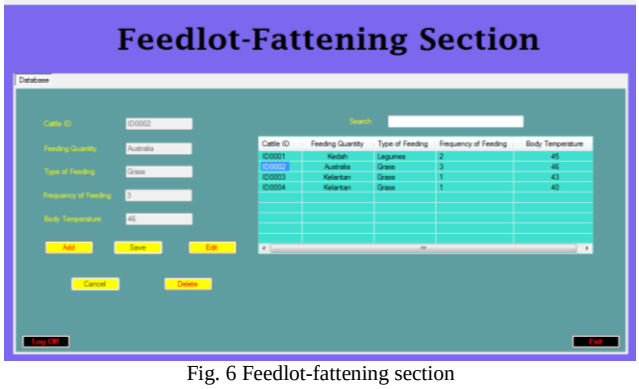

Fig. 6 Feedlot-fattening section

Figure 7 shows the details in the dairying section window. Data on amount of milk collected in each session is noted here. The attribute of type of feeding is also required in this section due to the quality and quantity of milk collection are very much related to the food intake of the cattle.

Fig. 7 Dairying section

The last section details that is connected from the main GUI is the slaughtering section, shown in Figure 8. The details of origin and breed of the cattle, and the location of slaughter house are kept here.

Figure 5 to 8 show the GUI for individual section. Each section is distinctive from another depending on attributes required in that particular section. Data can be recorded, updated or just viewed by the user in these windows.

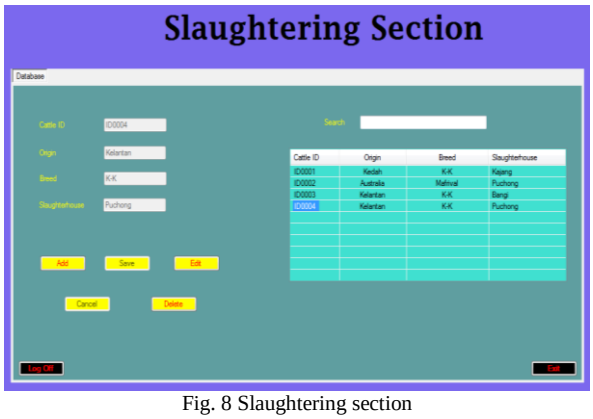

Fig. 8 Slaughtering section

Data recorded at this stage is to support the next level of work where a temperature sensor circuit is to be embedded to a commercial RFID handheld reader. The temperature measured will be updated in the current database. The system will be further enhanced for analysis of data on temperature to determine the health condition of the cattle in order to diagnose if the cattle is having fever or not.

IV. Conclusion

The development of RFID applications in precision agriculture makes possible to increase efficiencies, productivity and profitability while minimizing unintended impacts on wildlife and the environment, economy, and in many agricultural production systems. Moreover, the real time information from the fields will provide a solid base for farmers to adjust strategies at any time. Since installation of RFID is easier than existing wired solutions, sensors can be more densely deployed to provide local detailed data. The improvement of the livestock management system will be beneficial to the livestock industry.

The proposed system will identify and detect the livestock using RFID system. Data recorded into a database supported by GUI specifically according to section can provide useful information of animal heredity to farmers or veterinary handling the livestock especially on identifying the history of the cattle and its immune system.

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