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Design and Implementation of Android-based Livestock Disease Forecasting System using Thermal Image

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Abstract

In recent, domestic livestock farms are receiving enormous damages through various livestock diseases that are highly contagious such as foot-and-mouth disease and avian influenza (AI). Additionally, they are experiencing difficulties also financially as a result of decrease in income from production cost increase. This paper will propose a livestock disease forecasting system for diagnosing in advance livestock disease status in real-time through image information of livestock by using thermal image camera. The proposed system can extract livestock temperature information through images collected from thermal image camera to diagnose in advance livestock disease status through Android-based smart phone. Based on this, it is expected to contribute to the enhancement of the productivity of livestock farms and their competitiveness by minimizing damages from livestock disease by preventing disease damages in advance.

Keywords: *Livestock Disease, Forecasting System, Thermal Image, Android*

1. Introduction

In recent, annual domestic meat consumption per head has increased by more than twofold from 19.9kg in 1990 to 43.5kg in 2011, thereby occupying significant percentages. However, domestic livestock industry is experiencing many difficulties as a result of increase in die rate from various livestock diseases and increase in production cost such as feed & energy costs [1].

Since 2000, highly contagious diseases have been occurring such as foot-and-mouth disease and avian influenza. Accordingly, serious damages occurred in front back industry with about 3.4 million heads of livestock slaughter disposal and about 4 trillion won in damages [2, 4].

Table 1. Status of foot-and-mouth Slaughter Disposal

Kind	Number of target farms buried	Number of target livestock buried	Livestock breeding		Number of slaughter disposal
			2010.12.	2011.3.	
Cow	3,726	150,813	2,915,000	2,868,000	5.1%
Hog	1,987	3,315,118	9,880,632	7,000,000	33.6%
Total	5,937	3,465,846	12,795,632	9,868,000	27.1%

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As shown in Table 1, number of foot-and-mouth slaughter disposal is shown compared to that in December 2010. The percentage of cow slaughter disposal from foot-and-mouth disease is about 5% with 150,000 heads among 2.9 million heads and the percentage of pig slaughter disposal is 33.6% with 3.3 million head among 10 million heads, thereby showing that damages of livestock farms are inevitable. To solve such issue, there is a need for technology that can diagnose in advance livestock disease and increase production amount to enhance the competitiveness of domestic livestock industry [1, 3].

Although there are various methods of predicting livestock disease such as the method through livestock activity amount and the method of utilizing body insertion type sensor, it is difficult to check directly through visual inspection with a concern for causing issue in livestock safety [5, 6].

Accordingly, a disease forecasting system using thermal image came is proposed in this paper. Thermal image camera is high reliable as it is being used in various areas such as healthcare, architecture design, etc. and it can solve safety issue through its non-contact type. In the proposed system, server that extracts and manages livestock temperature information from images collected by using thermal image camera comparatively analyzes the information with livestock disease determination standard value to diagnose in advance disease occurrence status, which is notified to Android-based smart phone user that has been spread widely to reduce livestock disease damage to contribute to the productivity enhancement of livestock farms [5, 6].

The composition of this paper is as follows. Chapter 2 explains the composition diagram and flow chart of Android-based livestock disease forecasting system using thermal image, and Chapter 3 analyzes the implementation of system. Lastly, the conclusion will present a future study direction and expected effect of this system through conclusion.

2. Related Research

2.1. The Netherlands: Foster / Porker Automatically Selected Ship Systems (Nedap).

A multinational Dutch company Nedap specializing in the automation facilities of stall & animal area has developed a foster/poker automated sorting & shipment system. This is a system that has been developed to forecast the weight of each porker and the information of market pig and disease is predicted based on the data coming from this system [7].

Figure 1 is the self-developed RFID tag through which individual pig is distinguished.

Figure 1. Nedap RFID Tag

It automatically stores and records the weight & activity of each pig or pig herds whenever foster/porker contact the system, and the program provided through the stored data is as shown in Figure 2. It provides weight gain, visit frequency, weight distribution, visit frequency per time slot, weight and individual pig information based on which

veterinarians identify the condition of each pig or pig herds in real-time to predict disease through appropriate veterinarian treatment & consulting.

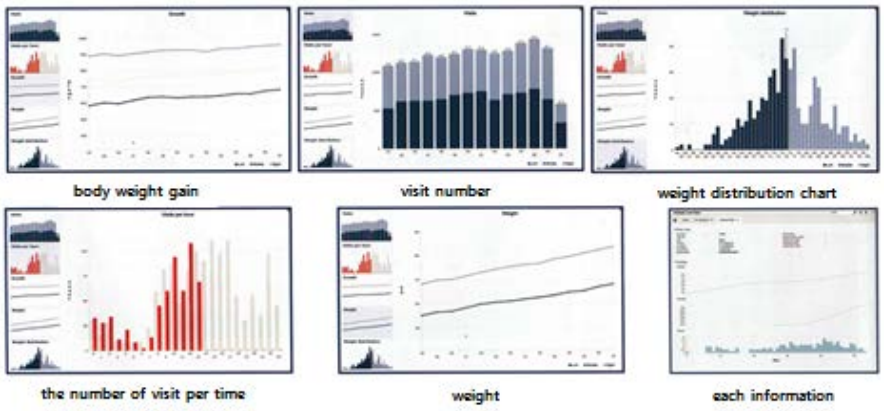

Figure 2. Automatic Sorting System Operating Software Factory

2.2. The Sweden: Active Sensing Systems (Delaval)

A Swedish company De Laval, a manufacturer of equipment specializing in diary industry, provides various solutions and services such as entity management system and milking system [8].

De Laval activity detection system monitors the activity of each entity and breeding status. Through the analysis of entity activity, it identifies low activity that shows rut surge and health condition and detects such activity in advance to allow swift measure such as artificial insemination on time. As for livestock activity, activity data of each entity is collected and transmitted each hour through wireless connection of antenna and necklace attached with activity detector.

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Figure 3. DeLaval Activity Sensor

De Laval herd test management program attached with activity detection system drastically reduces breeding cost through reduced non-pregnant condition days and insemination frequency with up to 95% of rut detection performance. The performance of activity detector can be estimated as it detects even slight rut signal of "silent rut".

These data can be checked through De Laval's program called ALPRO through which breeding calendar, smart breeding filter, breeding printout & rut alarm can be checked. Based on activity level, it automatically predicts breeding and detects disease and infection according to activity reduction and activity amount for early warning.

2.3. Livestock Disease Diagnosis Purpose Ear Insertion Type Module & Monitoring System (ETRI)

This system that has been developed by the top research institution of our country ETRI is a monitoring system to prevent the spread of disease through early identification of disease occurrence such as foot-and-mouth disease based on the temperature measured through reader or temperature transmitted periodically upon inserting RFID sensor chip that can measure livestock temperature into the ear of livestock [9].

In the case of existing body insertion type RFID sensor tag, it had the disadvantage of difficulty in the recycling of RFID sensor, as well as short recognition distance of RFID chip. It also threatened the safety of consumer through its loss and damage inside the body, along with the possibility of bodily abnormality occurrence when it is inserted inside the body. In the case of attachment type RFID sensor tag, there was a difficulty in accurately sensing inside body temperature as it is exposed externally. As shown in Figure 4, this ear insertion type module has alleviate the issues of existing temperature sensing by inserting it into livestock ear by inserting a rice grain size temperature sensor into polyurethane material module.

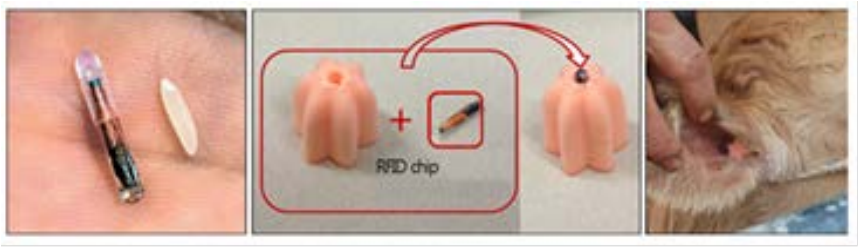

Figure 4. Ear Implantable Module

3. Design of Proposed System

The composition diagram of the Android-based livestock disease forecasting system using thermal image proposed in this paper is as shown in Figure 5.

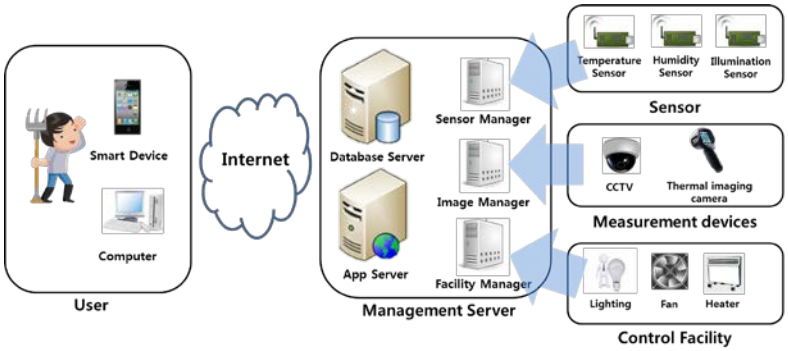

Figure 5. Diagram of the Android-based Livestock Disease Forecasting System using Thermal Image

In outside environment, there are various environment sensors that collect environment information, CCTV that collects image information, thermal image camera and facilities for controlling livestock environment. The environment sensors are installed inside stall to collect environment information such as temperature, humidity and illumination sensor, and sensing information collected is transmitted to management server through sink node to measure environment change. Thermal image camera and CCTV that collect images are installed inside stall to collect images in real-time, and collected images are transmitted to management server through DVR to extract livestock temperature

information from images. Environment facilities control consists of components that influence stall environment such as ventilator, fan heater and lighting and it received control signal from management server to manage the status of stall facilities.

The management server consists of Sensor Manager for managing information collected form environment sensor, Image Manager for managing image information collected from CCTV and thermal image camera, Facility Manager for controlling and managing stall facilities, Database Server for storing and managing stall environment information and livestock temperature information and App Server that allows user to see environment information through Android-based smart phone. Sensor Manager conducts format processing into format that can be stored in Database for the stall environment information collected from environment sensor and stores the information in Database by converting it into unit according to measurement component. Image Manager extracts livestock temperature information from images collected from CCTV and thermal image camera to store it in the format that can be stored in Database through format processing. Facility Manager plays the role of operating or managing stall facilities upon receiving control signal and storing such status of stall facilities in stall data. Database Server plays the role of storing data collected from environment sensor, image information collected from thermal image camera and CCTV stall facilities control data and status in each table. App Server plays the role of allowing user that uses Android-based smart phone to see and manage the environment information and image information stored in Database and transmitting the control signal sent by user to management server.

User plays the role of comparatively analyzing every environment data collected & facilities control service and livestock temperature information to notify livestock disease suspicion status through Android-based smart phone or user PC in the case of falling short/exceeding standard value.

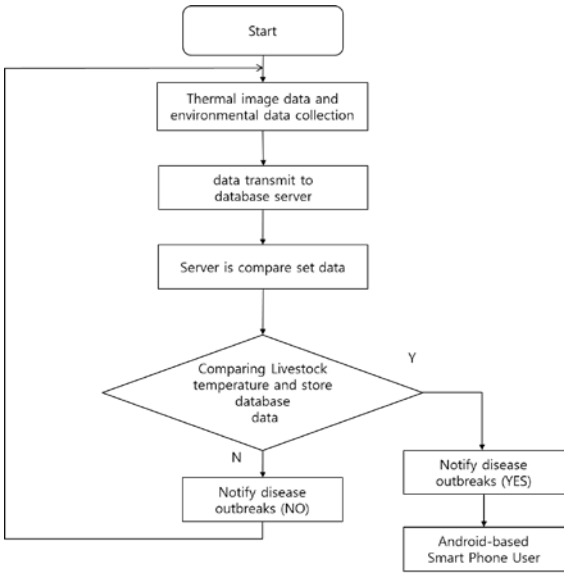

Figure 6. Service Flow Chart of Livestock Disease Forecasting System using Android-based Thermal Image

Figure 6 is the service flow chart of livestock disease forecasting system using Android-based thermal image. Using thermal image camera and various environment sensors, livestock temperature data and environment information data are collected and collected data are transmitted to Sensor Manager and Image Manager. The transmitted data information is converted into unit according to measurement component through storable format processing to be stored in Database, and the stored data information is transmitted in real-time to management server. Received data information and livestock

temperature standard value stored in Database are compared and when the result falls short/exceeds, it notifies disease status to Android-based smart phone user, and maintains real-time monitoring when the result is within the scope of standard value.

4. Implementation of Proposed System

To test the application proposed in this paper, the application was tested by installing it in New Nexus 7, and Eclipse 4.2 (Juno) was used for the development environment of Android-based smart phone application and Android SDK 4.1.2 (Jelly Bean) version was used for OS.

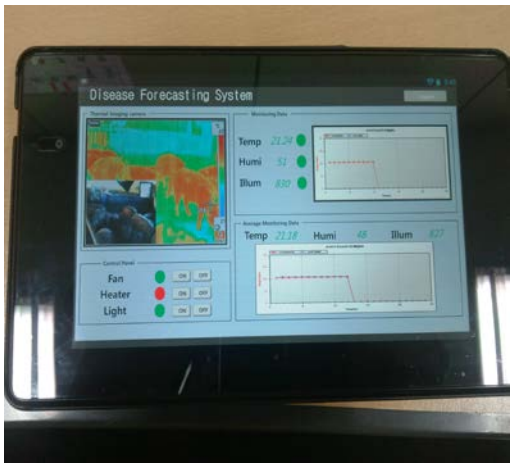

Figure 7. GUI Screen of Livestock Disease Forecasting System Application using Android-based Thermal Image

Figure 7 is the GUI screen of livestock disease forecasting system application using Android-based thermal image. In the application, image information collected through thermal image camera and CCTV is shown in real-time through thermal image camera. Monitoring Data shows the data value of real-time environment information of inside the stall in graphs per time. Average Monitoring Data comparatively analyzes image information processed into format that can be stored in database and the stored standard value for display. Control Panel can control fan heather, ventilator and lighting as basic environment control to accurate identify disease occurrence status.

Figure 8. Notification Screen of Disease Forecasting System

Figure 8 is the notification screen of disease forecasting system. Upon measuring temperature for each part of livestock, it notifies current situation to user through alarm

function when temperature increases to higher than the standard value set in Database Server as disease infection is expected in the livestock condition.

5. Conclusion

Livestock diseases that occurred domestically in recent were highly contagious and significant damages were experienced as there were difficulties in early response and prevention of their spread.

The system proposed in this paper used non-contact type safe thermal image to accurately measure the temperature of livestock to notify it to user through Android-based smart phone that can be used in real-time to predict disease.

Based on this, livestock farms can increase the accuracy of disease forecasting than existing system for early response and prevent the concern for disease spread to minimize damages from disease and contribute to the enhancement of productivity and competitiveness.

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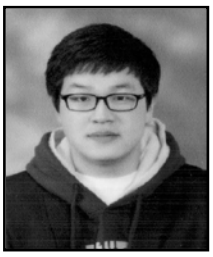

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