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Livestock management and automation system using radio waves

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ABSTRACT

The present invention provides a muitiband radio frequency identification-based embedded system (100) for livestock management and automation system, in which an animal carries a passive radio frequency identification (RFID) tag. The system comprises an automation means (102) that is adopted to control and monitor equipments in a house of the tagged animal; an animal detection means (101) to identify and monitor animals when entering the RFID coverage range; a server (103) to save data of the animals received from the animal detection means (101) and automation system (102); and an internet connection (104) to send the data to a user (105).

CLAIMS (OCR text may contain errors)

1. A multiband radio frequency identification-based embedded system (100) for livestock management and automation system, in which an animal carries a passive radio frequency identification (RFID) tag, wherein the system comprising:

an automation means (102) that is adopted to control and monitor equipments in a house of the tagged animal; and

an animal detection means (101) to identify and monitor animals when entering the RFID coverage range;

a server (103) to save data of the animals received from the animal detection means (101) and automation system (102); and

an internet connection (104) to send the data to a user (105). 2. A system according to claim 1 , wherein information of the tagged animal and status of equipments in the tagged animal's house is saved in a database

(201) that can be retrieved and monitored by the user in graphical user interface

(202) via internet connection (104). 3. A system according to claim 1 , wherein the automation means (102) includes a water container (802), a food container (803), a lighting means (801) and a fire detection means (804).

4. A system according to claim 3, wherein the automated water container (802) is disposed with water level sensors (901), a solenoid valve (804), and a microcontroller (902).

5. A system according to claim 3, wherein the automated food container (803) system is disposed with infrared sensors (1301), a solenoid valve (1304), and a micro-controller (1302).

6. A system according to claim 3, wherein the automated lighting means (801) system is disposed with photocells (1101), lamps (1104), and a controller (1102).

7. A system according to claim 3, wherein the fire detection means (804) is disposed with a smoke detector, thermistors, microcontroller (1603) and an alarm(1604).

DESCRIPTION (OCR text may contain errors)

LIVESTOCK MANAGEMENT AND AUTOMATION SYSTEM USING RADIO

WAVES

The present invention relates to livestock management and more particularly, an automated system For livestock data collection via multiband radio-frequency identification (RFID) and the distribution of information gathered in relation to equipments of an animal house.

BACKGROUND OF THE INVENTION

Electronic identification devices and systems have provided a good method for providing localized identification of livestock. Typically, electronic identification systems use a passive electronic identification device that is induced to transmit its identification signal by an externally radiating source.

The passive electronic identification devices may be a transponder carried with the individual animal on a collar as disclosed in U.S. patent number 4,475,481. The individual animal's health, ovulation, tracking, identification and temperature could be determined. Furthermore, automatic feeding could be implemented without overfeeding individual animals.

Saatkamp et al. (1995) proposed a framework for an animal identification and recording system to control contagious diseases in pigs. The great role of electronic identification and monitoring systems in improving the collection of information is evident.

Trevarthen A. and Michael K., (2007) provide an insight into an actual application of RFID technology used to enhance farm management as an example of the automating door, drafting, milking, and feeding process. Shanahan et al. (2008) designed a framework for the traceability of bovines. The electronic database was designed to record all animals' information such as birth, movement, and death. Its data was gathered automatically by RFID technology.

Furthermore, the EPC global network has been adopted for tracing bovines. Voulodimos et al. (2009) proposed an integrated animal management system based on low-frequency RFID technology. The platform stores and manages various categories of animals' information like nutrition health history, behaviour, and production. Abdul Samad et al. (2010) developed an integrated system for small-hold dairy farmers to enable employing RFID technology.

The majority of these works proposed some general frameworks to identify and collect each individual animal's information automatically. According to the regulations there is no definition of a comprehensive framework for recording and storing animal information. In comparing recent works greater frameworks have been presented by Trevarthen A. and Michael K. (2007), Shanahan et al. (2008), and Voulodimos et al. (2009).

All of these frameworks used a low frequency (LF) RFID system for animal identification.

The common frequency of the RFID system used in livestock tagging is the low frequency (LF) band (125 kHz-134 kHz). The short read range, about 20 cm; slow read speed; sensitivity to electrical noise; and difficult implementation because of the need for large antenna components, are some of the weak points of the LF-RFID systems. Moreover, it cannot handle a dense tag environment.

In view of the above, it is advantageous to provide a multi-band RFID system having three different set of frequencies for use in livestock tagging.

SUMMARY OF THE INVENTION

It is an object of the present invention to provide a system for livestock management.

Accordingly, the system for livestock management comprises:

an automatic animal detection means with a passive multiband radio frequency identification (RFID) setup consisting of RFID readers, RFID antennas, RFID tags and router; and an automation means disposed in an animal's house, the automation means comprising a photocell, a smoke detector, a water level sensor, infrared, a PIC microcontroller, a server and a wireless Internet connection. The automatic animal detection means is normally active if the multi-band RFID antennas sense any animal tags in its coverage range. The animal information, that is stored in the tag is captured by the antenna and sent to the RFID reader. The RFID reader sends the data to the server for the purpose of saving it in the database. The captured data will then be sent through the wireless Internet connection to users.

The photocell controls the light of the animal house by turning on the lamps automatically when the animal houses get dark. A smoke detector is incorporated with the thermistor to detect fire in the farm area. In this case, if the smoke detector detects smoke and the temperature is high the system detects fire and the fire alarm will sound. The water level sensor is used to detect the existence of water in a particular level. If the sensor does not sense water, the solenoid water valve will be opened. The infrared sensor detects the existence of food in the food container. The main container of food will be opened if the food container is empty.

All information is captured and stored in a database, for example MySQL database by the graphical user interface and application programming interface (API). The current status of the animal house equipment will be sent to the

database by serial port. The real-time information of the animal is captured and saved to the related table of the database by API. The RFID API is run under the online graphical user interface. The information will be sent to the users by Internet connection. Advantageously, the system of the present invention works with UHF RFID system and supports multiple RFID system. In addition, the graphical user interface of the system and the online monitoring of animals that is carried out by application programming interface are accessible by a client or user via internet connection. BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a block diagram of the multiband RFID-based embedded system for livestock management and automation system;

FIG. 2 shows a functional block diagram of connectivity of the server to other systems;

FIG. 3 illustrates the block diagram of the auto animal detection system;

FIG. 4 shows the work flow of the application programming interface (API); FIG. 5 shows the main page of API; FIG. 6 shows the write to tag page of API; FIG. 7 shows the trace animal page of API; FIG. 8 illustrates the block diagram of the automation system;

FIG. 9 illustrates the functional block diagram for automated water container system;

FIG.10 shows the workflow of the automated water container system;

FIG.11 illustrates the functional block diagram of automated lighting system;

FIG.12 illustrates the workflow of the automated lighting system; FIG. 11 illustrates the functional block diagram of automated lighting system;

FIG. 12 illustrates the workflow of the automated lighting system;

FIG. 13 illustrates the functional block diagram of the automated food container system; FIG. 14 illustrates the work flow of the automated food container system; FIG. 15 shows the block diagram of the fire detection system; FIG .16 shows the functional block diagram of the fire detection system; FIG. 17 shows the workflow of the fire detection system; FIG. 18 is depicts the structure of the database of the system; and FIG. 9 illustrates the general structure of graphical user interface.

DETAILED ESCRIPTION OF THE INVENTION A block diagram of the proposed radio frequency identification (RFID)-based embedded system for livestock management and automation system of the present invention is shown in FIG.1. The multiband RFID-based embedded system for livestock management and automation system (100) comprises an auto animal detection system (101), an automation system (102), Server (103), internet connection (104), and clients/users (105).The server (103) is adopted to save the received data from auto animal detection system (101) and automation system (102). The internet connection (104) is used to send data to the clients or users (105). FIG.2 shows the functional block diagram of connectivity of the server to other systems. It consists of a database (201) and graphical user interface (202). The data is transferred from automation system (102) to database

(201) by graphical user interface (202). The auto animal detection (101) saves the data into the database (201) directly. The clients or users (105) can retrieve data from the database (201) by graphical user interface (202).

FIG.3 illustrates the block diagram of the auto animal detection system (101). It comprises an RFID tag (301), RFID antenna (302), RFID reader (303), application programming interface (API) (305), and router (304). The RFID tags (301) are microchips used as the UHF passive RFID tag in the system. The MM3 chip is an ultra High Frequency (UHF) passive RFID tag that is compatible with EPC global Classl Generation 2. Its operation frequency is 850-960 MHz. It can read multiple tags with anti-collision. The user memory and capacity is 512 bits.

The RFID antenna (302) is preferably a CS-771-2 antenna. The dimensions of this antenna are 30 cm length, 30 cm height, and 30 cm width with 2.27 Kg weight. It is a linear polarized UHF RFID far field antenna for long-range operation. It works in the range of 865-868 MHz or 865-867 MHz, 902-928 MHz or 952-954 MHz. The antenna connects via a 3-metre cable to a TNC reverse polarity plug connector to the reader.

The CSL CS-461 RFID reader is used as RFID reader (303) in a preferred embodiment of the livestock management system of the present invention. It is about 3 kg in weight with 29.5 cm length, 30 cm width, and 8 cm height. It has four NTC duplex antenna ports to send and receive data. The RFID reader frequency range is 800 KHz or 900 KHz. Its tag-to-reader data rate is 650 kbps. The reader can read maximum 1 ,000 tag/sec and the maximum speed of tag can be 660 ft/min. The reader is an EPC global Class 1 Gen 2 protocol with dense reader mode. It can manage large streams of tag data on local area network (LAN) resources efficiently. In addition, it has a low LAN traffic and server loading and high performance in dense reader environments. This reader is powered by Impinj technology, with an extremely high inventory rate, tag velocity and true dense reader mode.

The RFID tags (301) are read by the RFID antennas (302) and then the read data is sent to the RFID reader (303). The received data from RFID reader (303) will be sent to the application programming interface-API (305) via router (303.) and internet connection (104). In addition, the API (305) saves the received data in database (201) in the server (103) and shows it to the users (105) via graphical user interface (202). The users can achieve the current data by the help of the internet connection (104). The workflow of the API (305) application is demonstrated in FIG.4. As long as the server (103) is on the API, it should be run on the server. Since the API gets the tag information, it will save to the corresponding tables in database and then shows to users by graphical user interface. The server administers can observe current read data in each parts (such as incoming cows, milking process in progress, completed milking process).

FIG. 5 shows the main page of the API. There are two options, which is write to tag (see FIG.6) and trace animal (see FIG. 7) in the main page.

FIG. 6 illustrates the write to tag page. This page is used for writing the data to the tag. It has options that can write to tag, to database, to tag and database together, and delete a tag with a specified EPC value from the database. When the corresponding page is started, the user setting of the RFID reader will be loaded and the components will be initialized. All features such as writing loop, number of tag, ideal bank, and the action should be specified by the user on the page.

In order to write to bank 3 of the tag, the "New User Memory" or "Fill Bank 3 with Default Value" in "Write to Bank 3" category should be selected. When the "New User Memory" option is chosen, the users' ideal information can be written to tag. The default value of bank 3 is the animal's birthday. The default value will be saved to bank 3 of the tag by choosing the "Fill Bank3 with Default Value option". In this case, the "New EPC" field should be filled up. The birthday of an animal with a tag 10, which is equal to the "New EPC", will be obtained from the database and written to bank 3.

Writing to bankl is possible by writing the EPC value (24 characters) in its corresponding box and choosing the ideal action.

The process of writing to tag is repeated for all tags according to the value of the 'Write Loop# ". The number of tags that should be written on them is specified in "Number of Tags" box. The FIG. 7 shows the trace animal page which is shown by clicking on the "Trace Animal" button. It is used to observe the saved data in the databases and real-time data. This page consists of three parts (incoming animal, milking process in progress, and completed milking). Each part has "Brows AH" and "history" options. By clicking on the "Start Test" button, reading process of tag is started and displayed in corresponding part. In addition, the read data is saved to the corresponding table in database (201) in order to retrieve by clients and users (105). The screen of this page can be cleared by clicking on the "Clear" button.

By clicking on the "Browse AN" button the "Browse All" page will run and all components will be initialized. All the information on the tags that belong to the farm is displayed on this page. By the help of the "Delete" button in this page, the selected rows can be deleted from the database. The information displayed on the screen will be updated by clicking on the "Update" button.

The information of the tags that are read by the RFID is displayed in the "History" page. The page is accessible by clicking on the "History" button in the "Animal Monitoring" page. The function of this page is the same as the "Browse All" page.

The block diagram of the automation system is shown in FIG. 8. The automation system is used to control equipments of livestock's home automatically such as light, water container, food container, and temperature. In addition it is able to monitor online the current status of the equipments. The system consists of four parts: (i) automated water container system (802), (ii) automated food container system (803), (iii) automated lighting system (801), and (iv) fire detection system (804). The current status of the equipments is specified by the corresponding system and sent to the graphical user interface (202) in the server (103) in order to save into the database (201).

The functional block diagram for automated water container system is illustrated in FIG.9. The system consists of three parts: (i) water level sensor (901), (ii) controller board (902), and (iii) driver circuit (903) for electronic valves (904). The input signal of the controller board (902) comes from two water level sensors (901), and then the controller board (902) will send the input to the driver circuit

(903) . The driver circuit (903) will interpret the input signal and the solenoid valve

(904) starts to operate.

The workflow of the automated water container system is illustrated in FIG.10. Firstly, the water level sensor 1 (WLS1) (901) is checked in the system. If it is closed, it means the water container is full. Otherwise, the water level sensor 2 (WLS2) (901) is checked. If it is open, the solenoid valve (904) will turn on until the WLS1 (901) closes.

The FIG. 1 illustrates the block diagram of automated lighting system. It consists of three parts: (i) photocell (1101) to detect the amount of light in the room, (ii) controller board (1102) and (iii) driver circuit (1103) for lamps (1104). The input of the controller board (1102) comes from the photocell (1101). The output signal of the controlling board (1102) is sent to the circuit driver (103). The input signal of the driver circuit (1103) will be interpreted and subsequently will turn on the lamp (1 104). The workflow of automated lighting system is shown in FIG.12. According to the system workflow, if the resistor of the photocell (1101) is less than 10KΩ the lamps (1104) are turned off, otherwise they are turned on automatically.

FIG.13 illustrates the block diagram of automated food container system. Infrared (IR) sensor (1301) is used to detect the existence of food at certain levels. Controller board (1302) and driver circuit (1303) for valve of the main food container (1304) are three other components of the system.

The workflow of automated food container system is shown in FIG.14. After reading the corresponding analogue ports, if the IR sensor (1301) detects an obstacle, the system will wait for 15 minutes in order to ensure the existence of an obstacle. After a 15 minute delay, the analogue ports will be read again. If there is an obstacle in front of the IR sensor (1301), the green infrared light emitting diode (LED) will be turned on and the valve of main food container (1304) will be opened. Otherwise, the LED should be turned off and the valve of main food container (1304) will be closed.

The FIG.15 illustrates the block diagram of a fire detection system. The fire detection system consists of the temperature detection means (1502) and smoke detection means (1501).

The functional diagram of the fire detection system is illustrated in FIG.16. The system includes a thermistor (1601), smoke detector (1602), controller board (1603), and alarm (1604). The thermistor (1601) is used to measure the temperature and the smoke detector (1602) detects the smoke in the environment.

Workflow of the fire detection system is shown in FIG.17. The system shows the environmental temperature on seven segments. When the smoke detector (1602) detects smoke, the yellow LED will blink and the temperature will be checked. If the temperature is above 40°C, the red LED and alarm (1604) will turned on. Once the temperature decreases or the smoke is removed, the alarm (1604) will be turned turn off.

The FIG.18 shows the structure of the database of the system according to the present invention. The database stores and manages information about the animals. The tables are databases comprising the veterinarian, staff, farm administrators, animals' previous home information, and the animals' house equipment status. The database is designed for five types of animals (i.e. cow, deer, goat, sheep, and horse). The function of the database is the same for all kinds of animals. Each type of the animals has fifteen tables.

Access to the database is allowed for authorized users through the use of username and password.

The main function of the database is provided below:

Veterinarian information: here, necessary information for the veterinarian, such as name, last name, phone number, and e-mail, is recorded. Staff information: All necessary information pertaining to the staff is recorded.

General information of animal: This table covers all general data about the animal, such as breed, weight, gender, mother and father breed, and mother and father 10 number of animal.

Tracking of animal's disease: Here all information about an animal's disease is recorded. The table includes the name of the disease, cause of disease, the treatment, schedule of taking drug and injection, last date of using drug, data about the veterinarian in charge and staff, etc.

Tracking of animal's vaccination: All information related to an animal's vaccination is recorded. Apart from the data related to the veterinarian in charge and staff, the next vaccination and its date, date of using last vaccine, etc.

Tracking of animal's nutrition: Information about the animal's nutrition including the type and date and amount of food and supplement is recorded, along with the last date and the amount of last food and supplement.

Tracking of animal's medication: This covers an animal's history, such as number of calves born, all medical substances given to animal, where is it from originally, which places did it live, etc.

Tracking animal's production: The information about the quantity of production (e.g. milk, fur), the date and time of taking, and the preferred slaughtering time is recorded.

Tracking status of the animal's house equipment: This is divided into five tables, each of which specify the equipment, such as door, temperature, light, water container, and food container. The status of each item of equipment is recorded in its corresponding table.

Online Monitoring of Animal: All the information pertaining to an animal, including the latest information, is read by the RFID system and stored in the database. The general structure of graphical user interface is illustrated in FIG.19. The designed PHP graphical user interface (202) was the middleware of the communication between the reader (303) and the MySQL database (201). PHP graphical user interface (202) is used as the web-based page that interacts with the user (105) to offer customized information to manage the information. It is used to show the animal information and status of the animal house equipment such as the door, light, water container, food container, and temperature.

In a preferred embodiment, the database (201) of the system is created with MySQL database. The information or data of each user or animal is collected and stored in a specific table of the database (201). The tables are managed by PHP graphical interface (202) and application programming interface (API) (305). The graphical user interface (202) is designed for two groups of users in five different working areas - the cattle house, sheep house, goat house, horse house, and deer house - and the farm's administrator. The users should login to the website according to their occupations and working sections. Each user can only access their specific pages and information according to their duties.

The graphical user interface (202) consists of the five kinds of animals (i.e. cattle, deer, goat, horse, and sheep. Each group of animals has their special pages like animal general information page, animal disease information page, animal production information page, animal vaccination information page, animal nutrition information page, animal house equipment status page, online animal monitoring page. Moreover, the latest status of the animal house equipment can be obtained and displayed to the users upon their request.

PATENT CITATIONS

Cited Patent	Filing date	Publication date	Applicant	Title
WO2010091686A1 *	Dec 11, 2009	Aug 19, 2010	Aarhus Universitet Det Jordbrugsvidenskabelige Fakultet	An apparatus and method for surveillance of individual animals' liquid intake behaviour
KR20070111720A *				Title not available
KR20100001011A *				Title not available
KR20100137312A *				Title not available
US20040030531 *	Jan 10, 2003	Feb 12, 2004	Honeywell International Inc.	System and method for automated monitoring, recognizing, supporting, and responding to the behavior of an actor
US20070137584 *	Mar 17, 2006	Jun 21, 2007	Travis Bryan R	System for monitoring animal feed consumption

* Cited by examiner

CLASSIFICATIONS

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