Extending IT to the Dairy Farm

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Abstract

Information technology (IT) can bring valuable benefits to the dairy farm. We present an overview of systems for managing data about individual animals and the status of a barn. We also describe a traceability system to allay the growing concerns of consumers over food safety and quality.

1. Initiatives for extending IT to the dairy industry

It is widely expected that the extension of information technology (IT) to the farming sector will not only enhance the quality of life of producers, but also put the minds of consumers at ease by enabling them to obtain information about the food they eat from the actual farms where it is produced. With these objectives in mind, we are seeking to extend IT to farming by exploiting sensing and networking technologies.

In collaboration with the Hokkaido Branch of NTT East, field trials are now being conducted at an actual dairy farm to evaluate an individual animal data system that keeps digital records about dairy cows and a cattle barn status management system for collecting data from the structure where the cattle are actually kept.

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2. Livestock farm network

The various systems available and deployed on livestock farms up to now were developed for single farm units, so they involve considerable initial investment and burden on the family to run the system. These systems are also generally implemented as standalone systems, which makes it extremely difficult to share data with other farmers and interested parties. This led us to develop an individual animal data system supporting centralized control through a data management center enabling the management of data on each farm and dairy cow, and a farm network linking all the buildings and facilities on the farm including the cattle barn, the workroom, the calving shed, and the farmer's own residence. Figure 1 shows an overview of the trial network that was deployed on an actual working dairy farm. Any and all information in the data management center can be accessed over the Internet and viewed on a PC or i-mode ter-

Table 1. Functions of the individual animal data system.

	Description	i-mode support
Digital ledger	Stores cow's name, various registration numbers, photographs. Information was previously kept in paper ledgers by various organizations.	Partial
Milk testing data	Displays milk testing results (milk components, volume, *etc.*) from the Dairy Herd Improvement Association.	No
Schedule	Records and displays communication with inseminator, antibiotic dosages, and other relevant info. noticed while working with the animal.	Yes
Temperature, humidity data	Displays readings from temperature and humidity sensors in the barn.	Yes

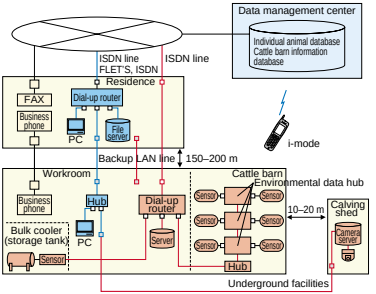

Fig. 1. Overview of the livestock farm network.

Fig. 2. Screen shots of the individual animal data system.

minal from anywhere on the farm, thus making the data available at actual work sites where it is most needed.

3. Individual animal data system

Most of the data kept on dairy farms is maintained in regular hardcopy paper ledgers and logs. As a major improvement over this old approach to record-keeping, we have developed and are now evaluating an individual animal data system that permits farmers to record and keep this kind of data in digital format where it can be viewed along with sensor readings from sensors installed in the cattle barn. Table 1 summarizes the functions supported by the individual animal data system, and Fig. 2 shows several screen shots of the system. In addition to the four main functions described here, we plan to add a bulk cooler (raw milk storage tank) temperature display function (see sec. 4.2).

3.1 Digital ledger

The digital ledger is used to record and manage detailed information about each dairy cow: name,

nickname, various registration numbers, photos of distinguishing marks, and so on. This information used to be kept separately in separate ledgers, but having the information available in one place makes it much easier to correlate and compare different categories of data.

3.2 Milk testing data

Milk testing data refers to test results obtained from the Dairy Herd Improvement Association (DHIA) regarding milk components and amounts of milk produced. The test results are divided into two categories: "dairy herd milk testing data" and "dairy cow milk testing data."

3.3 Schedule

The schedule provides a way to keep track of information on each dairy cow including contacts with the inseminator, antibiotics dosage and schedule, and other information that may be noted while working with the animal. Data is entered using a PC or i-mode terminal, and can later be displayed in the individual animal data system by specifying the date of entry.

Any problems or irregularities with livestock are usually discovered during work, so the farmer observing the abnormality usually must remember to record the information in the daily work log and ledger after returning to the house, which may be much later. Human memory being fallible, it is easy for the farmer to forget to enter this information later or to make mistakes. With the schedule function, the worker can enter a brief memo in the individual animal data system right there on the spot using an i-mode terminal. Going further, we are now evaluating a "bulletin-board" type capability that will allow farmers and veterinarians to share the schedule-related information.

3.4 Cattle barn temperature and humidity

The cattle barn management system permits users to view the readings taken by temperature and humidity sensors installed in the cattle barn. In the future we plan to upgrade the system to support raw milk temperature control data too, which is important from the standpoint of traceability.

4. Cattle barn status management system

Most dairy farms are family-run operations with just a few people doing all the work, but the farm facilities can be quite extensive and scattered over a large area. This led us to implement a cattle barn status management system that collects data from sensors deployed around the farm over a network. We are now evaluating a pilot implementation of the system that saves considerable time and effort that would normally be required in running around the farm checking everything, and also keeps track of some kinds of data that previously were not monitored. The data collected by the system can be viewed on the individual animal data system.

The experience gained through collaborative research between Hokkaido University and NTT proved very valuable in implementing the cattle barn status management system. Our environmental data hub [1] was used to control the sensors and collect the data.

4.1 Calving shed camera

In monitoring and managing cows on a dairy farm, it is especially important to keep close track of the animals during late pregnancy and calving and when the animals are sick. On many farms the general practice is to separate cows that are ill or in late pregnancy from the rest of the herd and put them in the calving shed for close monitoring and treatment. A Web camera and a microphone are installed in the shed to enable effective monitoring, and the sound and images can be seen and heard in the house and workroom on a PC monitor (Figs. 1 and 3).

Through these trials we discovered that sound plays a critical role in monitoring the calving shed. From a side image of a cow you cannot tell whether the cow is sleeping or suffering in pain. With the addition of sound, however, it becomes very obvious.

4.2 Temperature-humidity sensors

Dairy cows produce less milk if the ambient temperature climbs above about 25˚C, so it is important to control the temperature in the barn, particularly during the summer months. For this system we installed six sensors in the barn that measure both temperature and humidity. The data is sent from the server in the workroom to individual animal data system, so it can be viewed via the Web (Fig. 2). Note that this system can also be applied for other general purposes, so it can also be used to collect data from the sensors used by the raw milk monitoring system.

4.3 Raw milk temperature monitoring system

For quality control purposes, it is extremely important to regulate the temperature of the raw milk—that is, milk that has just come from the cow. Raw milk is temporarily kept in a special refrigerated storage tank called a bulk cooler, which is picked up by a tanker

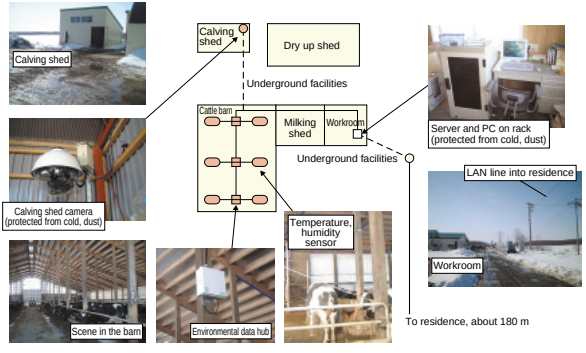

Fig. 3. Overview of farm.

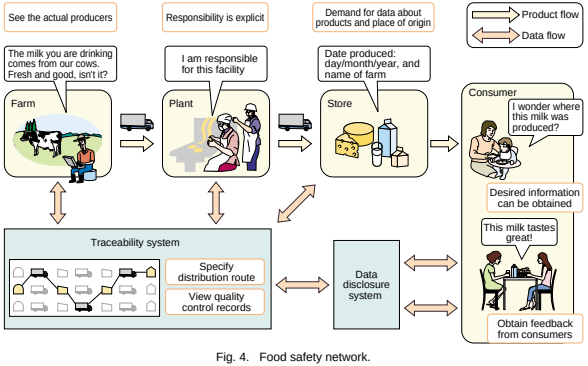

Fig. 4. Food safety network.

and delivered to the dairy processing plant. To suppress the growth of bacteria while the milk is stored, it is cooled to below 10˚C for a set period of time after it has been collected from the cow. The problem with the bulk tanks that are currently available is that they do not have any capability to record and save temperature data.

In future, temperature data will be collected by the server in the workroom and sent to the individual animal data system. The server in the workroom will

detect whether there is any problem regarding the temperature, and if there is, the system will automatically call a telephone number set by the user and dispatch a problem notification message. When the producer receives such a notification, he can check the temperature data on the individual animal data system.

5. Proposed food safety network

There is now a very definite demand for traceability to restore confidence and put consumers' minds at ease regarding the safety and quality of the food they eat. This would provide information not only about where food products are produced—information that is demanded in the wake of E. coli O157, BSE (mad cow disease), fraudulent labeling cases, and other recent scares—but also about food distribution routes and processing en route to local supermarkets. However, much of this data is highly technical, so some kind of public disclosure system would also be required to convert the data into a format that consumers can easily understand. And just as a traceability system is needed to give consumers access to producers' data, a system is needed to give producers access to information from distributors and consumers. Currently, they have a hard time getting such feedback. What is needed is an interactive system in which all interested parties—especially, producers, distributors, and consumers—can share information and maintain open dialogs.

To satisfy these various requirements, we propose the food safety network illustrated in Fig. 4. The traceability system has access to the individual animal and cattle barn status management systems, and it is integrated with the data public disclosure system and interactive system.

6. Future development

Through ongoing trials of the individual animal data system and cattle barn status management system, NTT is seeking to develop systems that are beneficial to dairy farmers through IT—the collection and management of data at the actual site of production. We will continue to investigate how IT might be used to enhance the efficiency of farm operations through field trials.

Reference

[1] M. Mizunuma, T. Katoh, S. Hata, "Applying IT to Farm Fields—A Wireless LAN," NTT Technical Review, Vol. 1, No. 2, pp. 56-60, 2003.

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