

Application of Information and Communication Technology to Agriculture and Animal Husbandry

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Abstract

NTT DOCOMO is poised to revitalize Japanese agriculture by using information and communication technology (ICT) to tackle the industry's major issues: enhancing productivity and saving labor. This article introduces agriculture and animal husbandry solutions that utilize NTT DOCOMO's nationwide mobile networks and cover the entire range of data handling, from collection to management and presentation of sensor information. These are the positive outcomes of co-creation efforts with venture companies that have professional expertise and are aggressively applying ICT to agriculture.

Keywords: ICT, agriculture, animal husbandry

1. Introduction

NTT DOCOMO is introducing information and communication technology (ICT) to agriculture with an emphasis on providing mobile networks and cloud solutions that are useful for farm organizations and municipalities. Together with venture companies that have professional expertise and are aggressively applying ICT to agriculture, NTT DOCOMO is co-creating solutions that use wireless networks. These are a stable communication environment available nationwide even in remote rural or mountainous areas.

Our activities are not limited to providing smartphones and tablets. We have held hearings with the JA (Japan Agricultural Cooperatives) Group and agricultural production corporations in order to learn about their problems and listen to their requests so that the ICT solutions we offer will be carefully crafted to fit their needs.

At AGRINEXT 2015, held in October 2015, NTT DOCOMO exhibited sensors and cameras for use in agriculture and animal husbandry, agricultural management applications, and examples of their use by the JA Group.

2. ICT solutions for agriculture

Our booth exhibiting PaddyWatch, a paddy field sensor developed and provided by Vegetalia, Inc., attracted a particularly large number of visitors. PaddyWatch automatically measures the water level and water temperature in paddies, both of which are critical in rice cultivation, and stores the data. It can also record changes in temperature and humidity above the ground (**Fig. 1**). It is resistant to water and mud and can measure the water level to within a few millimeters. The measured data are recorded in the memory unit in its main body and sent to a dedicated server via a mobile phone network and the Internet. Producers can check the state of their fields using a dedicated application on their smartphones or tablets. In this way, PaddyWatch can reduce the amount of labor required for water management.

In May 2015, the Niigata Prefectural Government, Vegetalia, Water Cell Inc., and NTT DOCOMO signed an agreement on the "Demonstration Project on the Innovative Rice Cultivation Management System," which is designed to enhance productivity and increase added value in rice production. This project is intended to support the introduction of PaddyWatch by farm organizations that are seeking to

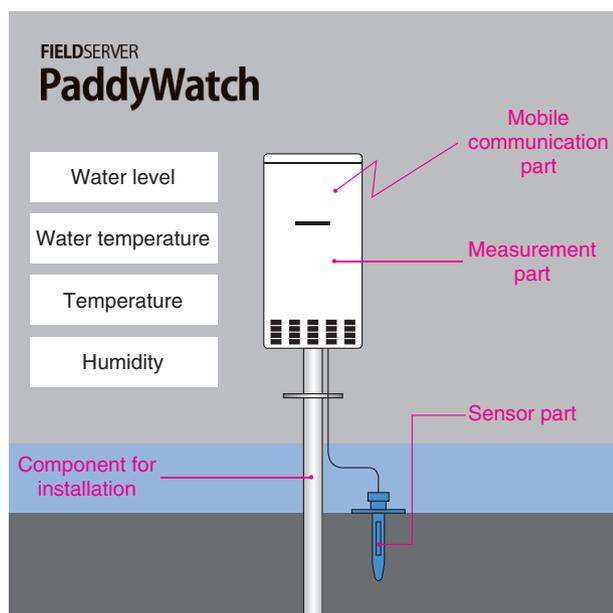


Fig. 1. Paddy field sensor: PaddyWatch.

revitalize large-scale farming in Niigata City, which has the country's largest area of rice paddy fields and has been designated a national strategic district (special district practicing innovative agriculture).

In addition, since June 2015, NTT DOCOMO has been collaborating with the Ministry of Agriculture, Forestry and Fisheries to carry out the "Demonstration Project on Introduction of ICT to Agriculture by Technology Diffusion Organizations Using Rice Paddy Sensors," in which PaddyWatch devices and NTT DOCOMO's tablets are rented to applicants in areas covered by the Ministry's Regional Agricultural Administration Offices in 36 prefectures. Since the latter project covers many areas around the country, it will give momentum to the initiative of the use of ICT to agriculture and to the use of NTT DOCOMO's networks.

NTT DOCOMO is involved in other initiatives designed to provide comprehensive support for agricultural ICT through co-creation with venture companies. One is FieldServer (developed and provided by Vegetalia), a system that monitors not only water-related data in rice paddy fields but also a variety of environmental data related to light, water, soil, and air, all of which are essential for the growth of plants. Another is agri-note (developed and provided by Water Cell), which is a farm work reporting and management tool that uses maps and aerial photos available on the Internet.

3. ICT solution in the area of animal husbandry

NTT DOCOMO is also making efforts to apply ICT to animal husbandry. Today, the number of livestock farmers is decreasing, resulting in a declining number of calves being traded and rising livestock prices. Under these circumstances, it is critical for livestock farmers to enhance productivity by eliminating any failure to detect signs that cows have come into season or that they are about to deliver. Conventionally, such monitoring was done by farmers, who had to stay at the barn around the clock. The use of ICT can reduce their workload dramatically and improve productivity.

Mobile Gyuonkei is an agricultural ICT solution developed and provided by Remote, Inc., a venture company in Oita Prefecture (Fig. 2). Since there are few mobile ICT solutions for animal husbandry and Mobile Gyuonkei seems promising, NTT DOCOMO signed a tie-up agreement with Remote. Mobile Gyuonkei is a service that monitors the body temperature of female cows to detect the subtle signs that the delivery process is about to begin or indications that they are ready for mating, and notifies farmers of these signs by email. To use this service, farmers need to insert a body temperature sensor inside the vagina of the cow. The sensor is equipped with a stopper to prevent it from falling out. Additionally, child terminals and a parent terminal are installed in the barn. The sensor has been certified as a medical instrument for animals, so farmers can use the sensor with no concerns about safety. It has a built-in weak wireless device. A child terminal can cover several sensors up to 7.5 m away from it. Wi-Fi is used for communication between the child and parent terminals. The distance between them can be up to 30 m. The parent terminal sends data to a server via NTT DOCOMO's 3G (third generation) network.

Each sensor measures the body temperature of a cow to an accuracy of 0.1 °C every five minutes. The server monitors changes in temperature (Fig. 3). When the server detects a drop in body temperature, which is a sign that delivery is imminent, it sends a *get-ready* email, which arrives at the farmer's domicile about 24 hours before delivery. When the server detects a sharp drop in temperature as a result of the sensor being pushed out when the animal's water breaks, it sends a *rush-to-barn* email. A joint patent application was filed on the system configuration and monitoring algorithm of this service by the Industrial Science and Technology Center, the Agriculture, Forestry and Fisheries Research Center (both of Oita

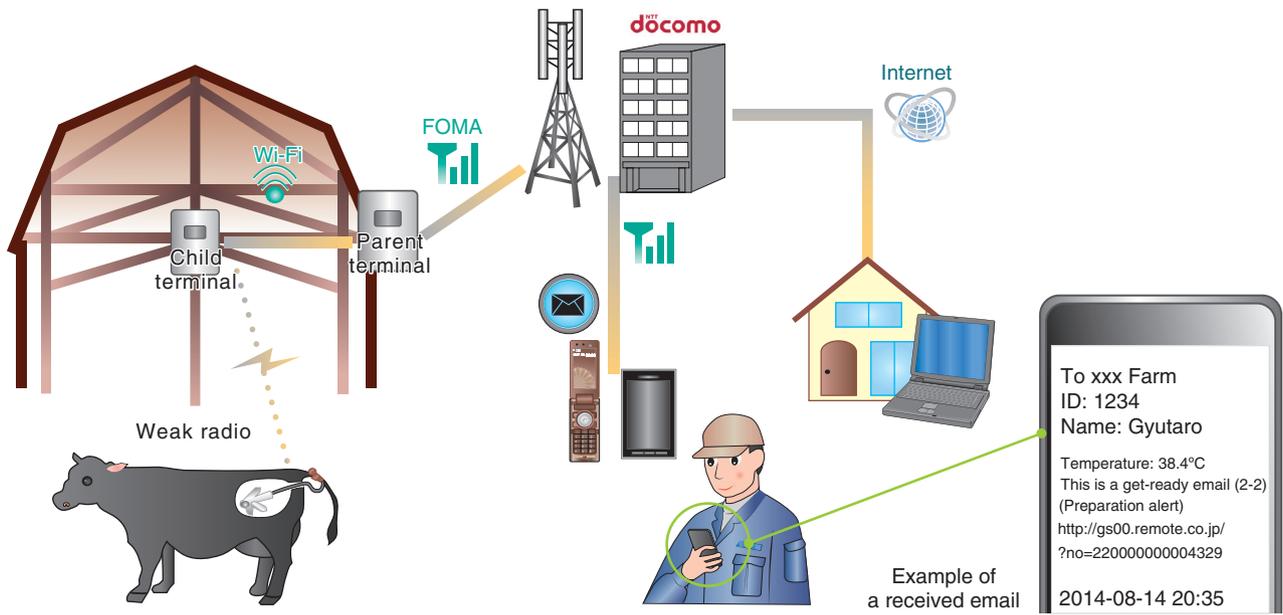


Fig. 2. Mobile Gyuonkei.

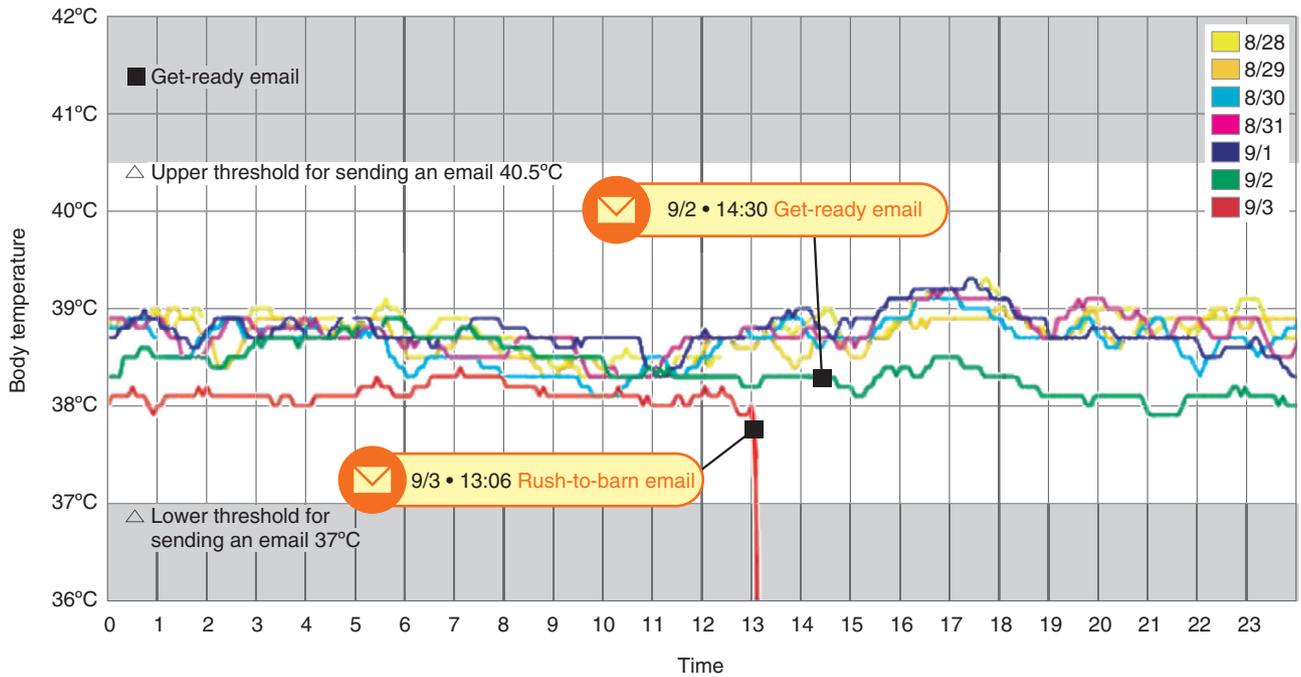


Fig. 3. Delivery monitoring graph.

Prefecture), and Remote, and a patent (No. 3938786) was granted under the title of “Delivery Anticipation and Notification System” in 2007.

Systems that assist farmers in being present at the

time of delivery can reduce complications when farm animals are born. In fact, farmers who have introduced Mobile Gyuonkei say that the number of birth-related problems has been reduced dramatically. This

is thanks to the high accuracy of detecting subtle changes in a cow's body temperature. In addition, livestock farmers are freed from the burden of being constantly present at their barns, and they say that they could no longer live without this service.

In July 2014, Zen-Noh Livestock Co., Ltd., a subsidiary of the National Federation of Agricultural Cooperative Associations (Zen-Noh; a JA Group organization responsible for the marketing and supply business), concluded a distribution agent agreement for Mobile Gyunkei. The service is now being sold through JA Group channels, and sales have been growing. NTT DOCOMO is working with its branch offices nationwide to support the construction of mobile communication environments for Mobile Gyunkei.

By January 2016, about 200 orders had been received. Nearly half of them have come from the Kyushu region, which has many farmers that raise beef cattle. NTT DOCOMO will continue to promote Mobile Gyunkei throughout the country in collaboration with the JA Group.

4. Future plan

NTT DOCOMO will utilize its nationwide mobile networks to provide total support ranging from collection to management and presentation of sensor information, to agriculture and animal husbandry. By working with companies that provide agricultural ICT solutions, NTT DOCOMO will assist in the development of agriculture through the use of ICT.



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During the 1980s, he was in charge of system development at a regional bank. He joined NTT DOCOMO in 1999 and was in charge of planning multi-media services. He is now the project leader of the agricultural ICT team and is also responsible for corporate marketing of the regional banking industry. He is a member of the Information Processing Society of Japan and the Japanese Society for Artificial Intelligence (JSAI). He is also on the expert committee of the Special Interest Group on Business Informatics of JSAI. He has a Ph.D. in business administration.
