A Study on the Context Service Model for Livestock Estrus Detection

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Abstract

This paper proposes a context service model to detect the livestock estrus using the activity information of livestock. The proposed context service model is to define the hierarchical context which could be used for livestock farm domain and make it contextual using activity information of livestock so as to provide the users with intelligent livestock estrus detection context service. The optimum fertilization time of livestock understand by providing intelligent livestock estrus detection context service to user through the proposed context service model. The livestock farmers will enhance the productivity and competitiveness of the livestock.

Keywords*: Context Model, Context-Aware, Livestock Estrus, Ubiquitous Livestock Farm, Agricultural service automation*

1. Introduction

Context refers to users and other users, users and system or the person affecting the interactions between devices, locations and information defining the current situation. Context technologies are applied to various areas including e-commerce, medical services, legal services, search services and cultural contents [1, 2, 3].

Particularly, multiple language-based agricultural ontology services to provide agricultural terminologies are used [4, 5].

Detecting livestock estrus is closely related to the productivity and earnings of livestock farmers and is very critical to livestock farmers feeding breeding livestock. Currently pregnancy rate is not high because of irregular livestock estrus cycle [6].

Among the methods to solve such problem is the method using livestock estrus cycle schedule indicating the first livestock estrus in 18 to 24 days after delivery counting from 30 days before delivery and the second livestock estrus at same cycle and the color former method which attaches the color former to livestock strunt which is broken by mounting and red pigment flows down to mark on the white cloth. Another is crayon method which marks on livestock strunt with a crayon which spreads when livestock estrus comes.

However livestock estrus cycle schedule has low pregnancy rate because of irregular livestock estrus cycle and when it comes to color former and crayon method, capsule may not be broken or crayon mark disappears [7].

In this study, thus, a context service model which defines the hierarchical context that could be used for livestock farm domain and provides the users with the intelligent

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livestock estrus detection service using the activity information is proposed. This method is expected to enhance the productivity and earnings of livestock farmers by identifying the optimum estrus of livestock. For intelligent livestock estrus detection, a diverse context shall be collected from entity to provide the optimum context service.

The composition of this paper is as follows. Chapter 2 examines the existing studies on context model. Chapter 3 explains hierarchical context model for livestock farm and Chapter 4 explains the proposed context service model for livestock estrus detection. Chapter 5 explains experimental scenario that could occur based on the proposed model. Lastly, Chapter 6 will conclude this paper through conclusion.

2. Related Work

2.1. Context Model

Computing becomes increasingly mobile and pervasive today, these changes imply that applications and services must be aware of and adapt to their changing contexts in highly dynamic environments. building context-aware systems is a complex task due to lack of an appropriate infrastructure support in intelligent environments. A context-aware infrastructure requires an appropriate context model to represent, manipulate and access context information.

There are various studies being conducted on context model for processing intelligent context information in ubiquitous environment. Context models in ubiquitous computing environment include context model with expanded E-R diagram to better understand context, and object-oriented context model that helps to understand the attributes and actions of context and conveniently develop object-oriented program, and context model based on First-Order-Logic to provide effective expression with consistency to the context, and RDF-based context model [8].

2.2. Middleware for context awareness in agriculture

Computers of various forms and purposes are becoming pervasive in the form of PDAs, mobile phones, and increasingly advanced GPS units. However, except for location based services, like knowing your location based on GPS.

In modern agriculture, computers are pervasive, but only in the sense that they are present everywhere. All types of equipment, ranging from feeding- and ventilation systems to tractors computers, and, in most cases, can also be queried or controlled remotely. These systems provide an excellent base for gathering context, which may then be exploited to ease the work of the farmer. Furthermore, additional sensors may collect context about the individual agricultural worker, *e.g.*, in the form of location or current activity. Knowing the context of the farm and the workers may then be utilized for building pervasive computing applications to support the daily work at farms, *e.g.*, by easing access to information which is useful in the current context, or even automatic registration of work carried out.

The challenges for building a middleware which supports collection and sharing of context from the heterogeneous sources and environments found at a farm as well as context reasoning, and design a middleware to overcome these challenges, using semantic technologies. New ways of designing such middleware, in that we make the end user of the applications built with the middleware participate in the requirement gathering and design phases [9].

2.3. Context aware system

Context-aware systems offer entirely new opportunities for application developers and for end users by gathering context data and adapting systems behavior accordingly. Especially in combination with mobile devices these mechanisms are of high value and are used to increase usability tremendously.

Most of them differ in functional range, location and naming of layers, the use of optional agents or other architectural concerns. Besides these adaptations and modifications, a common architecture in modern context-aware applications is identifiable when analyzing the various design approaches. As depicted in Figure 1, layers for detecting and using context by adding interpreting and reasoning functionality [10].

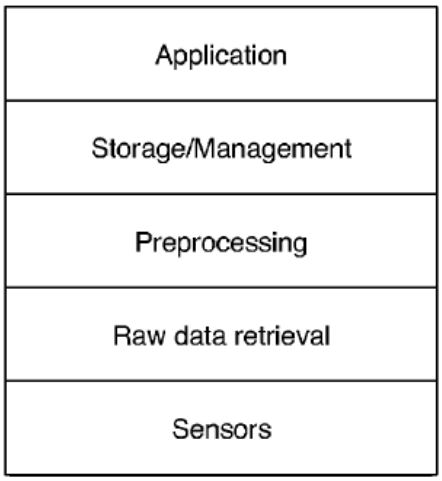

Figure 1. Layered conceptual framework for context-aware system

2.4. Workflow technologies for Agriculture

Recently, many researches have applied workflow technologies into the various fields such as smart home, u-health care, u-city, u-port, and u-agriculture. However, many current workflow service have difficulty to control work processes and execute services according to context information in u-agricultural environment.

In agricultural processes, many works may need to be automated, because those are very hard labors or time-consuming jobs for farmers. Workflow technologies, which have successfully been a good model for a service automation in various computing environments, can be used as a possible service automation model in agriculture. A workflow for u-agriculture may need various contexts sensed from real sensor networks for service automation [11].

context-aware service model for u-agriculture is based on workflows and is aimed at supporting smart workflow services based on ubiquitous sensor networks in u-agriculture.

context-aware service model of developers can easily integrate various service demands into a service workflow, and can easily develop a context-aware workflow service for u-agriculture. Therefore, the context-aware service model can be greatly helpful in the development of smart applications or the work automation in the fields of u-agriculture [12].

2.5. Wireless sensor network based livestock activity monitoring system

Wireless sensor network based livestock activity monitoring system is necessary to develop collection and analysis technology of livestock biometric data which enables early diagnosis of livestock diseases. it is intended to propose the system which is able to collect and monitor livestock activity data by using WSN technology. The system measures livestock activity by attaching the sensor node on the livestock, compares the collected livestock activity data with the data of activity changes by livestock diseases stored in a database and informs the producer for prompt actions if it is over or under the reference values. Livestock farmers will be able to increase production efficiency and productivity and to minimize damage from livestock diseases by early diagnosis of livestock diseases through biometric monitoring of livestock [13, 14].

3. Hierarchical Context Model for Livestock Farm

3.1. Context range definition for livestock farm domain

Context is information about recognizing situation to conduct intelligent service. For intelligent livestock estrus detection, a diverse context shall be collected from entity to provide the optimum context service.

Figure 2 defines the entity used for detecting the livestock estrus at livestock farm domain. Entity used for detecting the livestock estrus was defined as Livestock Farm, Livestock, Activity, Computing Device, Sensor, Time. deducing context information through monitoring the change to entity will allow to provide the users with intelligent services.

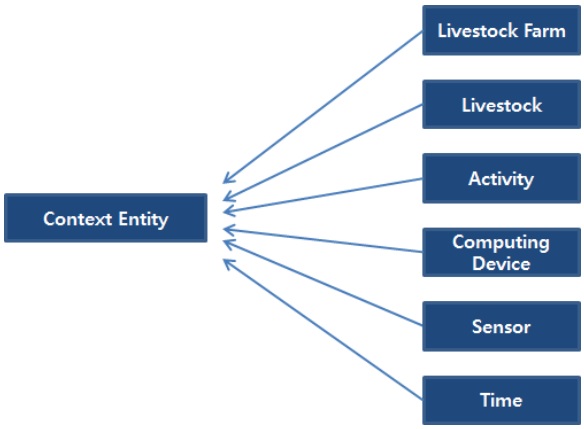

Figure 2. Hierarchical context model for detecting the estrus of livestock

3.2. Context model for livestock farm domain

Figure 3 is Context Model for livestock farm domain. Sub Class of livestock farm entity defines Pig Farm, Dairy Cattle Farm, Cow Farm. Sub Class of Livestock entity defines Pig, Dairy Cattle, Cow. Sub Class of computing device entity defines PC, PDA, Smart Phone. Sub class of time entity define month, date. Sub Class of Sensor Entity defines Acceleration Sensor, Pressure Sensor, GPS. Sub Class of activity entity defines Down, Stand, Move.

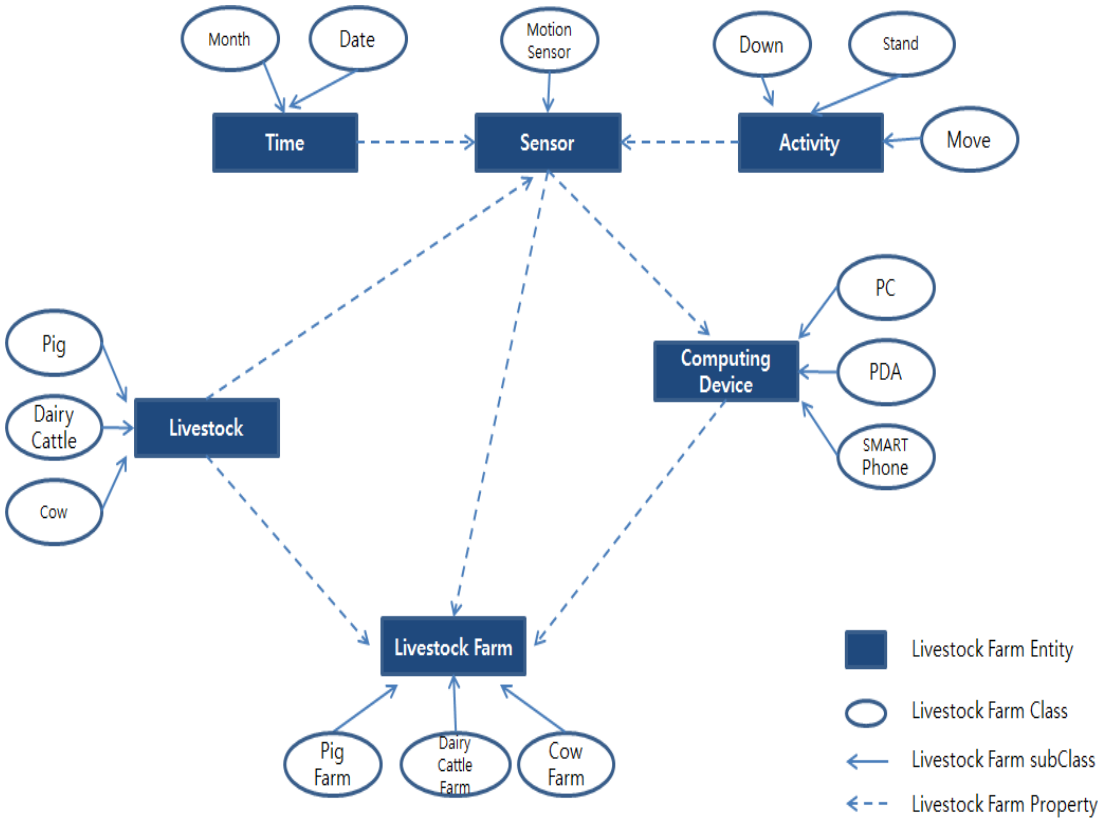

Figure 3. Context Model for livestock farm domain

4. Context Service Model for Livestock Estrus Detection

Figure 4 is the context service model to detect the livestock estrus of livestock. A context service model comprises the Physical Layer, Middle Layer and Application Layer.

Physical Layer includes livestock activity measurement device such as Acceleration Sensor, Pressure Sensor and GPS. Raw sensing data which the user can hardly understand are obtained from measuring device.

A Middle Layer consists of Context Widget, Context Model, Context Controller, Context Distributer and Engine/Server. Context Widget makes the sensing data from measuring device contextual. Context Model is the data model to convert sensing data to RDF-based context information. Context Controller creates the middle-level context which the user could understand using context model. Context Distributer distributes Middle-Level context created by Context Controller to Engine/Server, which then infers the context inside livestock farm and stores the intelligent context services to provide to the users.

Lastly application provides the users with the context service produced for detecting livestock estrus through PC, PDA and Smart Phone.

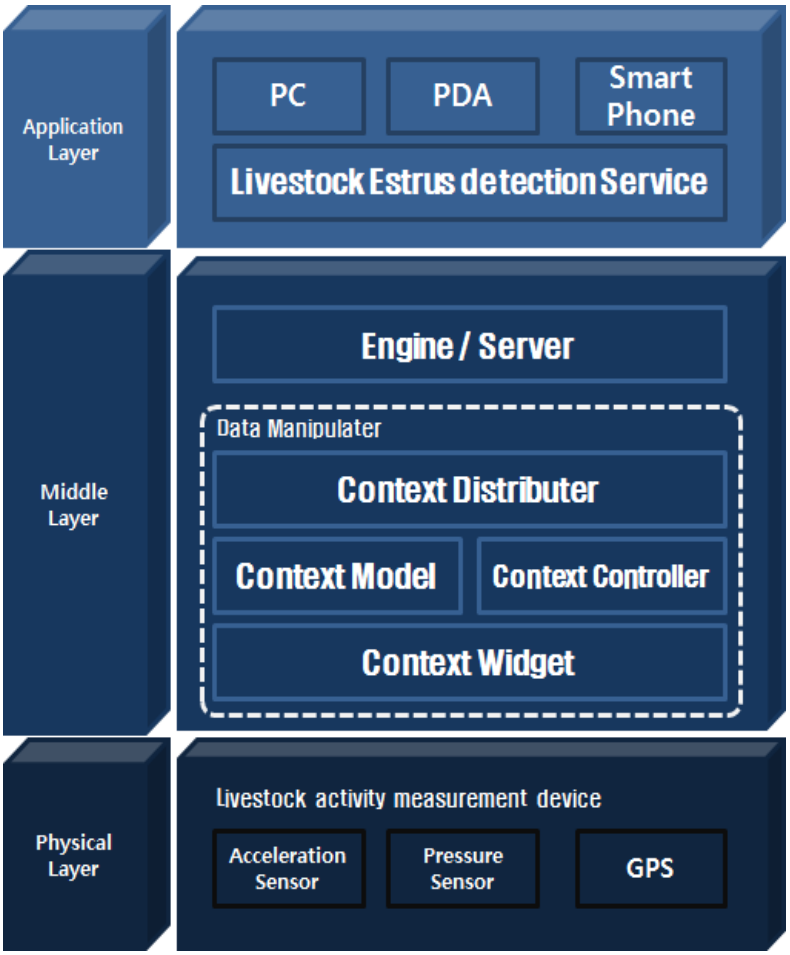

Figure 4. Context service model for detecting the estrus of livestock

5. Experimental Scenario

The following is the experimental scenario comprising the context service that may occur at livestock farm through the context service model to detect the estrus of livestock.

Matthew is the owner of the large livestock farm, who wants to have active estrus detection context service to identify the livestock estrus cycle for fertilization in timely manner so as to improve the pregnancy rate. The texture is made based on activity-based information for providing livestock estrus detection context service.

6. Conclusion

In context service model, to support services that user wants is necessary to convert high-level contextual information from low-level context data. Therefore, researches for ontology based context model with reuse and extensibility have been trying. But, most researches have been trying to model for specific situation.

To realize the livestock estrus detection context service, various context shall be collected from the entity and optimum service shall be provided to the users depending on situation.

The context service model proposed in this study for detecting estrus of livestock is aimed at making the context on livestock based on activity information so as to provide the users with the active estrus detection context service.

Such intelligent livestock estrus context service will help the users identify the optimum fertilization time, thereby enhancing the productivity and earnings of livestock farmers.

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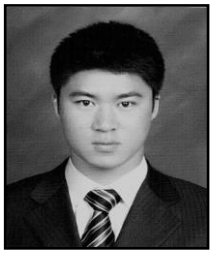

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