International Journal of Multimedia and Ubiquitous Engineering
Vol. 9, No. 10 (2014), pp. 223-230
http://dx.doi.org/10.14257/ijmue.2014.9.10.21

Design and Implementation of Mobile Integration System for Smart Farming

Sungwook Yoon[1] and Hyenki Kim[1*]
Dept. of Multimedia Engineering, Andong National University,
388 Seongcheon-Dong, Andong-City, Gyeongsangbuk-Do, Republic of Korea
*uvgotmail@nate.com, *hkkim@anu.ac.kr*

Abstract

Climate data, agricultural crop related data, etc. are being provided in real time as the national statistics by using the public data portal infrastructure. On this account, it is possible to process and provide customized data including those individually important elements and geographic information by personalizing them. This thesis designed and implemented the mobile integration system that can push customized data that combined the cultivation information as to the selected crops and the local climate forecast information based on the local based service of a smartphone.

Keywords: *Public data, RSS, XML parsing, Open data*

1. Introduction

With the growing use and development of Internet and smart devices, a large quantity of information is being created [1]. The quantity of information is growing at a significant rate and the amount of information that each corporation or individual is utilizing is growing even at a faster rate [2]. Furthermore, the quantity of public data, which is the data owned by the government and public agencies, is also growing substantially. Public data is to be obtained during the course of undertaking tasks of public agencies; thus, they are relatively high value data. Those developed countries such as the United States, the United Kingdom, etc. are utilizing public data in the government's public services [1, 2]. As for the types of public data, there are Seoul's GIS map information, knowledge portal, national portal, country record search, etc. that are being operated domestically in South Korea. In addition, the information system for each institution is in operation.

The value of usage thereof is growing from several perspectives such as production and utilization of economic and cultural contents in terms of using such public data. Of those, the contents that could be used in the personalized information provision area through local based service are emerging. It would be possible for an user to extract, process and utilize information in accordance with user environment with the necessary data for an user since those institutions producing public data or information are producing and delivering data suitable for each purpose in real time.

As for the required information for farming, an appropriate information hereof has been hardly operated in the farms because of the limitation of being directly and physically transferred to the field. Those farms have found it hard to analyze appropriate information since most of the necessary information have been transferred by mass media such as TV, radio, etc. In addition, they have found it hard to apply a cultivation method at an appropriate time as for those crops to be cultivated. Moreover,

* Corresponding Author

ISSN: 1975-0080 IJMUE

it is true that it is hard to obtain the essential information for farming including the yield per region, period and crop and trading price from the conventional PCs or Internet. However, the accessibility thereto is outstanding with personal devices due to the recent diffusion of smartphones and furthermore, it is even possible to process customized information for each individual by using an appropriate sensor network.

The technology and trend of information exchange is being upgraded everyday; however, the rural areas should be relatively late in terms of utilizing timely information related to cultivation. In addition, it is difficult to apply new training such as cultivation method for each crop, production technique, application techniques, etc. in the rural areas. The preliminary provision of such information or techniques should be conducted by the government or special purpose public authorities in the form of public data. Citizens can access the information as to the existing public infrastructure in various ways. The service is being provided in the form of raw data through Internet so that citizens can process the information when necessary. Most notably, the weather forecast data of the National Weather Service is opened to general public so that it can be subscribed as special news and then transferred to individuals. Such weather data can be connected with the localized data by forecast per time and region, and then the weather forecast required for the current location can be provided in real time[3].

The needs for information system that can contribute to diversification of crops and stable production have been demanded by transferring accident information and the information related to weather, climate, disease and insect pest for smart farming to the farms using GPS and also automatically scheduling the production manual for each crop and the work history for each climate and period. This study aimed to provide user-customized data by combining the climate information provided by the National Weather Service and various real time information on crop cultivation, disease and insect pest, etc., which are produced at the Rural Development Administration.

2. Related Research

Globally, the value of Open data of each government is growing in terms of data utilization; thus, the interest and efforts for the opening of information is being expended. The opening as to public data owned by the governments, the local governments, the public agencies, etc. has been steadily implemented based on the major developed countries such as the United Kingdom, Japan, *etc.*, with the United States as the first country to implement it since the second half of 2000s. A variety of open data portals are being in operation for each country as follows: data.gov in the United States, data.gov.uk in the United Kingdom, open-data.europa.eu in EU, data.gov.fr in France, *etc.* In South Korea, open data is being provided at data.go.kr. The national resources can be utilized for the creation of various social and economic values in the private fields in addition to the public fields; therefore, there is a growing demand for opening and sharing the national resources in the form that can facilitate creation of new businesses through the integration and convergence with the resources in the private fields. In particular, the degree of preference as to the Open API technology as a tool for opening public data was only 1.9 percent in 2009; however, it became 36.4 percent in 2010 (KDB, 2010) and 44.98 percent in 2011 (NIA,2011) [4]; thus, the utilization rate is growing gradually. It would be possible to reduce the development cost and easily develop various functions by developing mash-up services using the open information through Open API. Therefore, we can now respond to user demands promptly. On the other hand, there is a tendency that the information is being expanded through the opening and sharing of contents and service even at the major academic information service institutes at home and abroad. These institutes are ultimately maximizing by overcoming the limitations of resources owned

by each institute through sharing of information, service and system with the related institutes and also activating the flow of resources as for the academic communities.

One could expect the following effects since a joint activity of information resources would be possible conducted if an academic information provider offered Open API service. Moreover, a variety of information service would be possibly implemented by connecting and integrating the external resources as for the limited information resources of a library in terms of utilization of information. Also, the development cost and time could be reduced since the already opened resources are utilized. Through granting new values, new services that were not available previously could be easily created. In terms of providing information, it has the advantage that the monitoring system for data quality control could be naturally established.

If Open API is introduced to the telecommunication network, then the development time for a new service can be reduced [5]. Also, IT development staffs can be utilized as a service development staff and it will be possible to supply services to the market in a timely fashion for needs. Lastly, it allows us to actively cope with increasingly diversified service demands of customers since the development of creative services that integrate information technology with telecommunication technology becomes possible. RSS (Really Simple Syndication) utilizes such technologies as mash-up, etc. that mix more than two resources or services including Really Simple Syndication, Rich Site Summary and XML (eXtensible Markup Language) to create new resources or services [6, 7].

3. Design of Smart Farming System

If an individual or institute obtains a legitimate right, then the national knowledge portal search service (http://www.knowledge.go.kr), which is being served based on the national knowledge established through the cooperation with the national knowledge provision institutes, will allow them to utilize it freely using Open API.

The Rural Development Administration is providing a variety of farming information services through Open API. Also, many government agencies such as Korea Information Center for Agriculture, Forestry & Fisheries are providing a lot of related information. This information is provided in the form of XML and this can be subscribed through RSS (Rich Site Summary). The data delivered from XML can express necessary information for users by parsing the result values after configuring and acquiring the pre-defined necessary tags.

Table 1 represents Open API that is provided as public data; thus, it is to be parsed and processed based on the necessary tags after receiving the required API Key. The climate related data and farming related data, which are received from the village forecast of the National Weather Service, the Rural Development Administration, etc., are being provided on overall.

Table 1. Open API that is Provided as Public Data

Open API	Contents	Provider
Weekly farming information API	Weekly farming information Open API provides weekly farming information as to rice farming, farm products, vegetables, fruit, flowers, animal husbandry, crop management for special crops, disinfection tips for disease and insect pest, etc.	RDA
Agricultural technology information API per each crop	Information on kind of crops and product item Technology information classification for each crop Technology list for each crop Detailed technology information for each crop	RDA

Prevalence information API on disease and insect pest	Open API for occurrence information of disease and insect pest provides occurrence information of disease and insect pest that is classified into forecast, caution and warning.	RDA
Management manual APO for each product item	Open API for management manual for each product item provides crop information as to the period or method of cultivation for crops.	RDA
Product kind information API	Open API for breed information provides new breed information as to food crops, special crops, vegetables, fruit and flowers.	RDA
Manual API for each product item of strong farming	Manual Open API for each product item of strong farming summarizes and provides manual for each product item of strong farming at Rural Development Administration.	RDA
Climate data RSS	Providing climate data	NWS, Portal

Users personalizes the information in accordance with the setting values after setting the crops of interest, the current location or the location of cultivation region after logging in. The personalized data was designed to push or view a message via smart devices.

To select necessary tags through the production of public data in the form of XML and receive real time information through those tags, the server was configured by including the Open API of the National Weather Service, the Rural Development Administration, etc. The server was parsed and processed so that it could be expressed as a response type by HTML5 using the external API required for farming. The parsed data is to be provided after reading the crops of interest and GPS information suitable for users by using the pre-defined log information DM of users. Figure 1 represents the parsing and processing process of data.

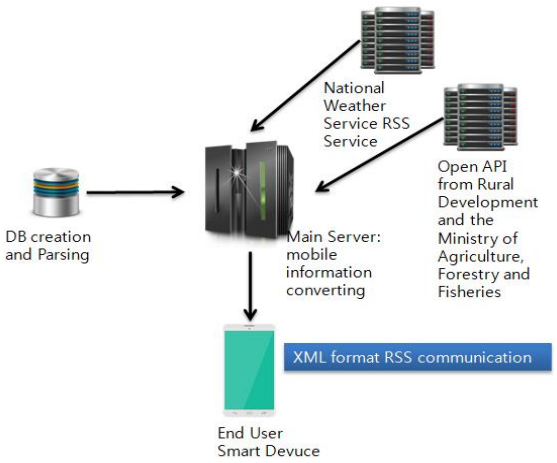

Figure 1. The Parsing and Processing Process of Data

Through this process, the mobile integrated application was composed of agricultural technology information for each crop, daily weather information, local information of disease and insect pest, daily work history, farming diary, annual yield search and search of surrounding farms.

As for the agricultural information for each crop, the detailed information of technology contents for each crop is to be provided through the classified technology information from the agricultural information for each crop, whereas the village forecast of the National Weather Service is to be processed to extract location based data as for daily weather information. As for local disease and insect pest information, disease and insect pest information is to be processed selectively in accordance with the cultivation crop of a selected region. As for daily work history and farming diary, the work history is to be recorded and it is processed so that related pictorial data or blogs can be created. It was also configured to allow users to extract necessary information for farming by searching the cultivation list of surrounding farms or annual yield.

A method to provide crop and climate information for each region based on the LBS information was configured to provide such services as local weather, disease and insect pest information, surrounding farms, data download, *etc*.

Figure 2 represents a diagram to provide personalized custom data by combining Open API information of each party. The procedure for providing real time information of system server and mobile devices through mobile device is as shown in Figure 2.

Those personalized information is passed to smart devices through the information about daily work method for each crop and the weather information and it facilitates the identification work of cultivation trends through the related policy, training, crop production quantity, market price, etc. In addition, it was designed to allow for securing sales channel through direct sales with consumers (Table 2).

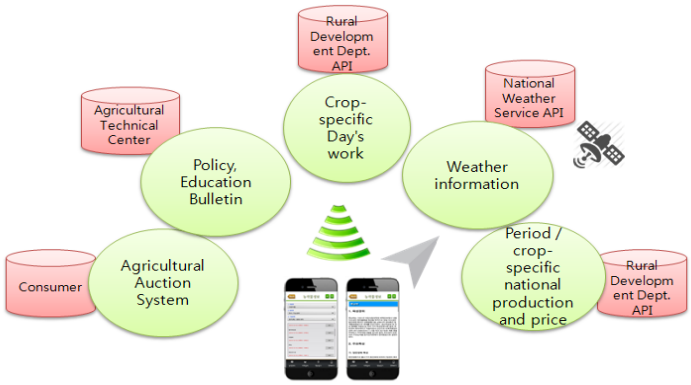

Figure 2. Diagram to provide Personalized Custom Data by Combining Open API Information of Each Party

Table 2. Features Implemented

Per item	Contents of functions
Crop information	Real time market price of crop and crop cultivation
Related news	Providing public notice or news information of related institutes in regard to crop
Weather information	Weather information is exposed in accordance with location information or location of selection
Disease and insect pest information	Utilizing the Rural Development Administration API

The Rural Development Administration provides the agricultural technology information for each crop, the list of farming information, the disease and insect pest information, the management manual for each product item, the video of agricultural technology, the income information of farm products and new breed information in the form of Open API. Upon reception of this information, it is to be first saved in the DB and then parsed when receiving a request from the application viewer of a mobile device. The National Weather Service provides the climate information in the form of RSS as for the data in the form of XML as to the climate information; thus, one can acquire information by subscription whenever new information is updated.

The below Figure 3 is the system structure diagram to provide climate information and disease and insect pest information. In the area of server, the climate information RSS data from the National Weather Service and the crop and disease insect pest information from the Rural Development Administration's Open API data are to be received and saved in the server respectively in the non-processed form (1). In the area of users, the location information is to be received from the GPS of a terminal and the base station (2) and then the information related to disease and insect pest and crops as well as the climate information are requested at the mobile application to the server (3). Lastly, the corresponding data is to be processed at the server and then transferred to a smartphone (4).

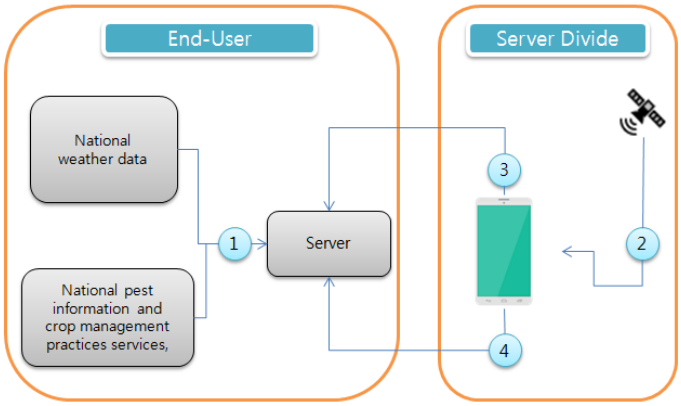

Figure 3. System Structure Diagram to Provide Climate Information and Disease and Insect Pest Information

4. Implementation of Mobile System

As for the functions for each page of the essential application that was implemented in this study, they include crop information, disease and insect pest search, yield search, crop market price, direct sales page, etc. As for crop information, crop and product item information, technology information classification for each crop and information on the list of technology contents for each crop are contained in accordance with log information. In addition, technology content information is provided.

As for prevalence information of disease and insect pest, the occurrence information that is classified into forecast, caution and warning is to provided via viewing or pushing service by filtering the crops set for the user environment and the location based information.

It could be utilized as preliminary data in terms of establishing cultivation plan as to the yield of crops to be cultivated by individuals through the yield search of crops. In addition, the trends could be drawn by confirming the market price via graph. Moreover, it was

designed to post various farming products harvested by several users through configuring a bidding system that could connect consumers directly with the harvest farming products. Also, it was configured to secure farmers' fixed sales routes.

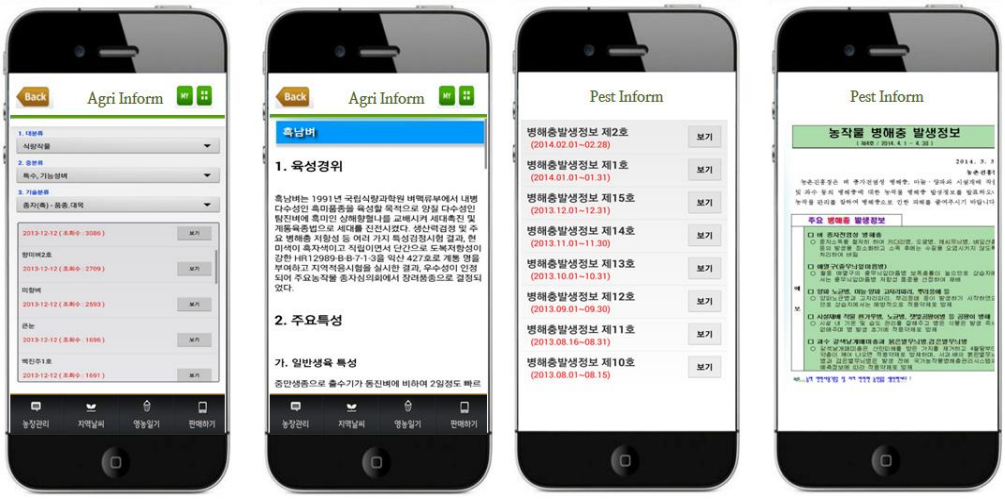

Figure 4. Crop Information, Disease and Insect Pest Search Page

5. Conclusion and Future Studies

This study designed and implemented of the mobile integrated system for smart farming. The information required for farming such as weather, accident information and disease and insect pest information was passed to the farms in each region by using GPS and the pre-defined production manual and crop cultivation for each crop and the information as to the work history for each period were provided. In this way, the information system to contribute to stable production was designed and implemented. As for the climate information of public data or various real time information such as crop cultivation or disease and insect pest, the system was designed to provide necessary data to suit the needs of users.

The recently available smartphones and personal devices are outstanding in terms of accessibility and also it would be possible to provide individually customized information by using an appropriate sensor network. Therefore, the optimized farming information was produced by utilizing the climate data and cultivation related information that were available in real time as for the agricultural crop cultivation of interest. Also, the system was configured to utilize push information or search information in order to better cope with climate situations.

As for this system, those contents worth being utilized are emerging in the field of personalized information provision through location based services. Therefore, users could extract, process and utilize necessary data in accordance with user environment in terms of transferring data suitable for the purpose of producing public data or information.

Acknowledgements

This work was supported by a grant from 2013 Joint-industry-academic Research Fund of SMBA, Korea.

References

[1] K.-R. Park, J.-Y. Jung and W.-Y. Ahn, "A study on energy consumption predictive modeling using public data", vol. 20, no. 2, **(2012)**, pp.329-330.
[2] S.-Y. Yoon, "A Study on National Linking System Implementation based on Linked Data for Public Data" , KOSIM, vol. 30, no. 1, **(2013)**, pp. 259-284.
[3] [3] J.-H. Ki, "Citizen Participation-Based Smart Phone Application's Potential Development throughout Open API Mashup, Journal of the Korea society of computer and information", vol.17, no. 5, **(2012)**, pp. 93-101.
[4] [4] M.-H. Hyeon, S. Sin and H. Kim, "OpenAPI service trends at home and abroad for the sharing of information", kisti knowledge reports, No. 38. Seoul: Korea Institute of Science and Technology Information **(2013)**.
[5] R. Li and H.-b. Wang, "A Syntax Parsing Method Based on Adaptive Genetic Annealing Optimization HMM, International Journal of Hybrid Information Technology", vol. 7, no. 2, **(2014)**, pp. 269-282.
[6] [6] H. Lee and J. Kwon, "Personalized RSS Search Service Using RSS Characteristics and User Context", INTERNATIONAL MULTICONFERENCE OF ENGINEERS AND COM, **(2008)**.
[7] Y.-J. Lee, "A Semantic-Based Mashup Development Tool Supporting Various Open API Types", Journal of Korean Socieity Internet Information, vol. 13, no. 3, **(2012)** April, pp. 115-126.

Authors

Sungwook Yoon, he received the B.S. degree in Russian Language & Literature from Kyungpook National University, Korea, 2001. and He is studying Doctor course in multimedia engineering from Andong National University, Korea. His research interests include multimedia contents, e-book and Internet of Things.

Hyenki Kim, he received the B.S. and M.S. degree in electronics engineering from Kyungpook National University, Korea, 1986 and 1988 respectively. He received Ph. D. in electronics engineering from Kyungpook National University, Korea, 2000. He joined Andong National University in 2002, where he is currently a professor at Dept. of multimedia engineering in Korea. His research interests include multimedia system, mobile app. and Multimedia communication.

