Development of Smart Agricultural Water Management System using IoT Technology

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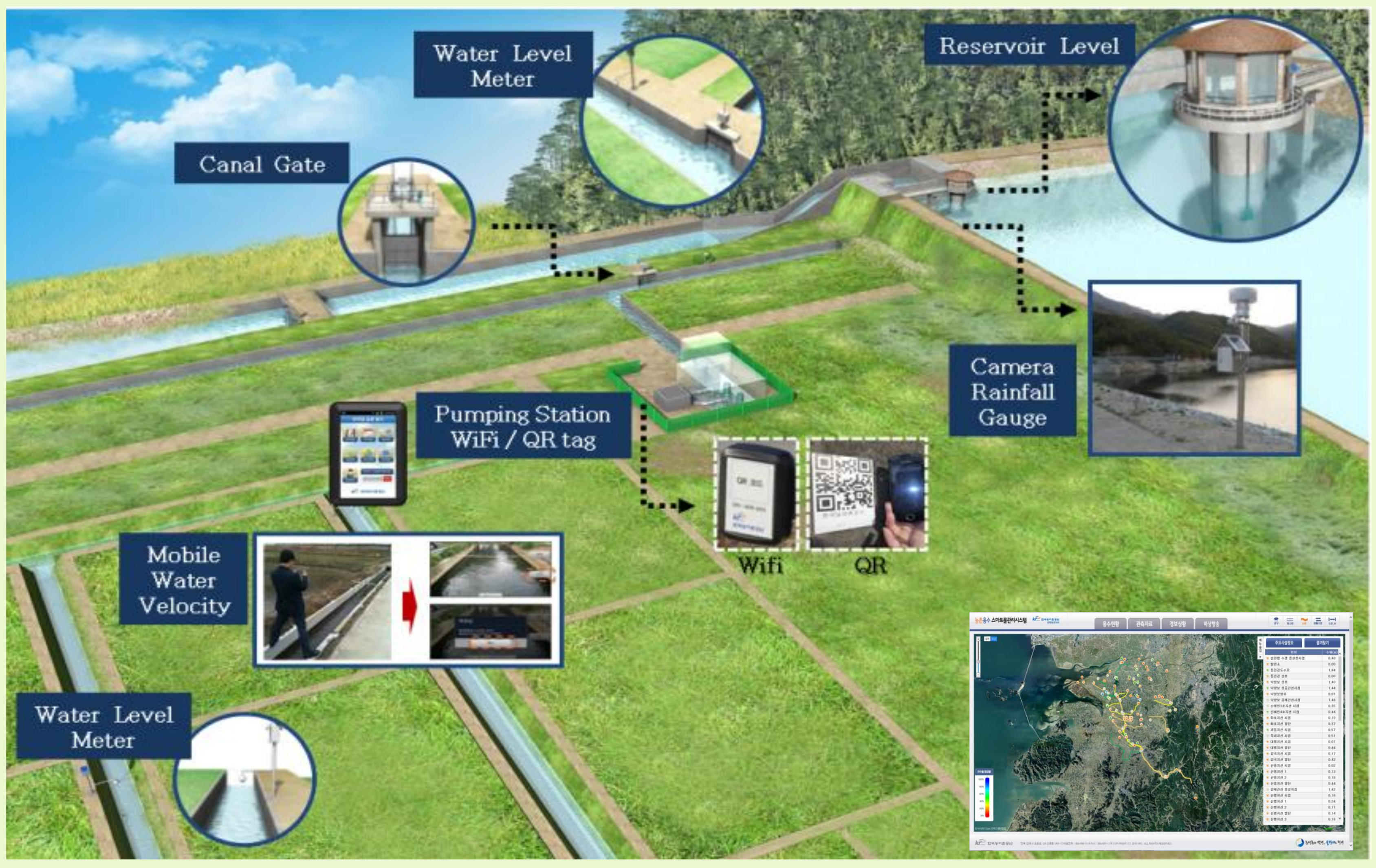
Abstract

The propose of this study is to develop a smart agricultural water management system that utilizes IoT-based information communication technology (ICT). The smart agricultural water management system can provide enhanced systematic management of agricultural water resources that can mitigate climate change impacts and water shortage problems. The developed smart water management system is standardized so that it can be applied to various sites. The system provides water supply information through the web and mobile devices so that a systematic support for the irrigation system operation and management. The system contributes in natural disaster mitigation and perservation agricultural water use through supplying appropriate amount of water to beneficiary sites.

Fig1. Smart Water Management System



1. INTRODUCTION

In the field of agriculture, water management comes down to sourcing and delivering an appropriate amount of water at an appropriate time to maximize the productivity of crop, as well as minimizing the flooding of agricultural fields to optimize the growth environment of crop. The agricultural facilities of South Korea focused on a single water source facility using a top-down irrigation method based on gravity to maximize the area where water is supplied (Choi et al., 2012). This has raised the need for many water-related facilities such as water gates and fountain gates in fields. While an appropriate management of water resources was possible thanks to sufficient workforce in the rural areas, the aging and overall decrease of the rural population has posed a need to develop a system for the management of water used for agriculture. This study applies the cutting-edge IoT (Internet of Things) technology to measurement systems on sites so that the systems are linked to the internet, allowing real-time information to be delivered regardless of time or space to the decision-maker. An information support system over the web and through mobile devices allows an effective management of water resources, including the current status of water supplied and the overall capacity of the facilities. In addition, a standardized module for the supply of an appropriate amount of agricultural water resources is applied on site to analyse the current status of how an appropriate amount of water is supplied in each year.

2. METHODS

1) Development of an IoT-based measurement system

An IoT-based measurement system on site, unlike the existing SCADA system, forms an autonomous network based on the internet and enables wireless communication of water-related information within the network so that remote monitroing of water resources is possible. Such a measurement system relays information to the mediating device that serves as a gateway, and again relays it to the user through an upper network. To form a wireless sensor network, low consumption of power, a gridwork of sensors (mesh topology) and a self-organizing Ad-hoc network technology are required.

Fig2. Field Application of IoT-based measurement system

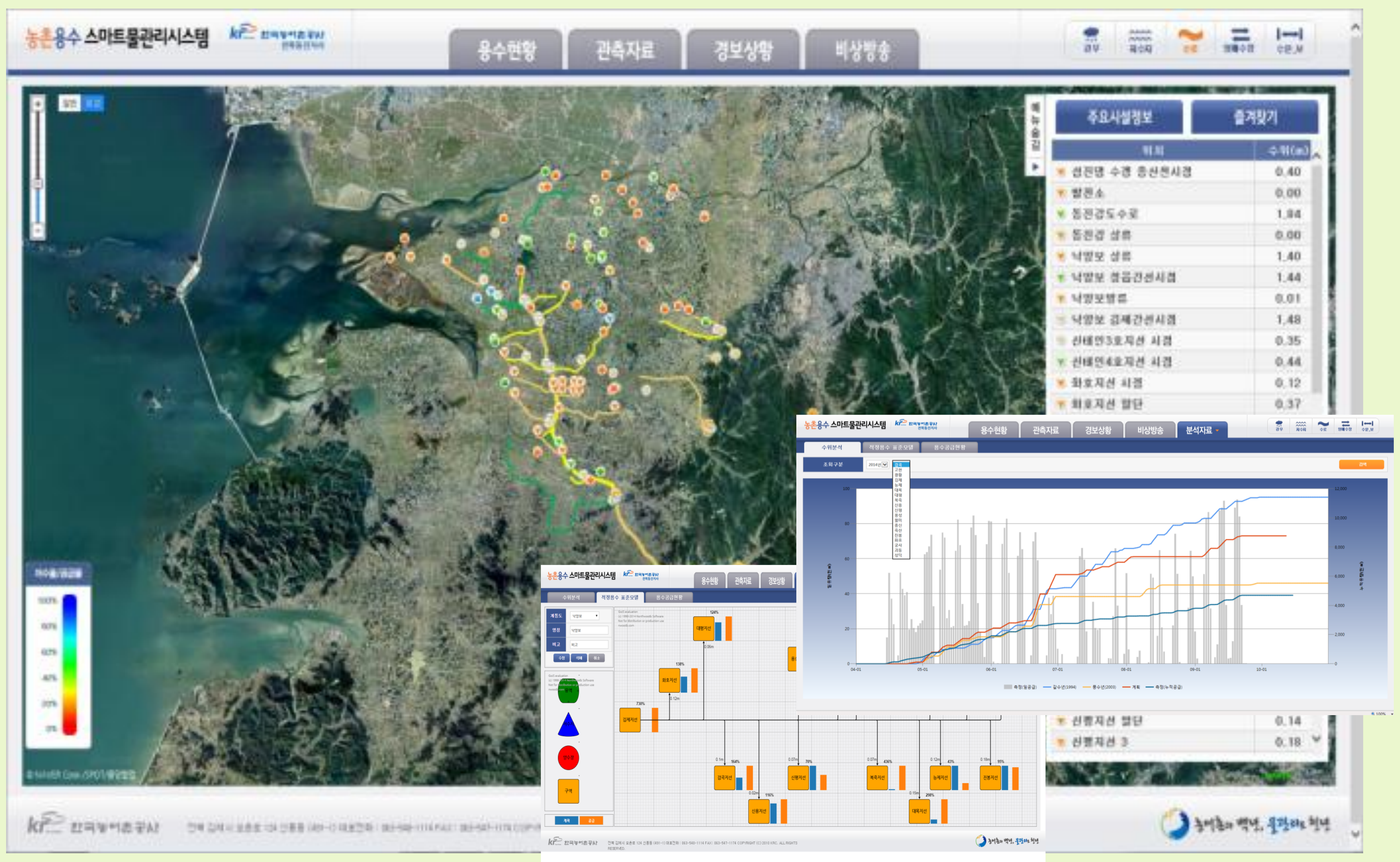
2) Development of a standard model for the supply of appropriate amount of water

In general, the supply of water is affected by the type of water source facilities and the crops grown in the irrigated area. The supply is operated by taking into account the loss rate on the site, in accordance with the water supply measure for the chosen method (Hong et al., 2014). The existing model for supplying an appropriate amount of water assume continuous irrigation to calculate the water supplied. However, beacuse irrigation water in this area is supplied intermittently due to the irrigation water shortage, it is necessary to develop an irrigation water supply model and to compare the estimated irrigation demands with the actual water supplies for decision making to maintain the water supply (Nam et al., 2013). This paper reflects the concept of the date of supply onto the model to calculate the appropriate amount of water to be supplied and developed a standard model that allows the user to easily compare the this amount with the actual amount supplied.

3) Development of an operation system using the web/mobile network

The smart water management system is based on the web or mobile network to recieve data from the on-site measurement device that is based on the water systems chart. Information such as the amount of rainfall, water levels, river levels and images are provided in real time, along with the current status on the water supplied through each branch of water source and warnings sounded for abnormal water levels. In addition, a mobile system is used to deliver real-time data regardless of time and space.

Fig 3. Web/Mobile Operation System and Standard Model for Smart Water Management System



3. APPLICATION

The site to which the developed system was applied has a total area of 16,567 ha (59 km), with area consists of 16 canal and branch line. For this region, itis difficult to secure enough water to be used for irrigation through the local streams or rivers alone. Therefore the water source facilities (Seomjin Dam) which is located upstream is being converted to the region for agricultural use. Compared to the area that is irrigated, there is a significant lack of agricultural water resources available in the region and therefore simultaneous supply of water in all areas is not possible. This has led to an operation method of classifying the upstream and downstream by the day of the week for running the irrigation system. Application on the site consists mostly of major facilities (reservoirs, water pupming and distribution systems and weirs). In particular, 141 measurement facilities have been installed where the regional stream starts and ends in the field, and at water gates in order to prevent natural disasters and measure rainfall, amount of water flow and water levels anc capture images.

4. CONCLUSION

In general, the supply of water used for agricultural purposes varies by season due to climate factors and by regional requirements such as the characteristics of the nearby river, the water level and the area of the site in question. The manner in which water is used also differs depending on the growth cycle of the crops. Imbalance between supply and demand leads to undermined efficiency in supply and management. In this aspect, this study sought to develop a measurement system appropriate for the sites, and develop a standard model that can calculate the optimal amount of water to be supplied to the area in question and provide relevant information. The system also allows the user to receive such information via the web or the mobile network. By doing so, the system allows for a real-time evaluation of the efficiency in the amount of water used, better allocation of water resources and improved services in providing water services to farmers.

5. REFERENCES

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