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A CASE STUDY

Agriculture operation monitoring system with Wireless Sensor Network (WSN) including RFID, GPS and CCTV

■ **DEVEN J. PATEL**, KAPIL K. SHUKLA **AND** BANKIM L. RADADIA

ABSTRACT

This manuscript proposes an agricultural environment monitoring server system for monitoring information concerning an outdoors agricultural production environment utilizing Wireless Sensor Network (WSN) technology. The proposed agricultural server collects environmental, agricultural land, seeds and soil information on the outdoors through WSN-based environmental and soil sensors, collects snaps information through CCTVs, area information through RFID and collects location information using GPS modules. This collected information is converted into data and saved into a database through the agricultural server consisting of a sensor manager, which manages information gathered from the WSN sensors, an image information manager, which manages image information collected from CCTVs, RFID and a GPS manager, which processes location information of the agricultural server system, and provides it to producers. In addition, a solar cell-based power supply is implemented for the server system so that it could be used in agricultural environments with insufficient power infrastructure. This agricultural server could even monitor the environmental information on the outdoors, and it could be look forward that the use of such a system could participate to increasing crop yields and improving quality in the agricultural field by supporting the decision making of crop producers through analysis of the collected information.

KEY WORDS : Agriculture operations, Monitoring system, Wireless sensor devices, RFID, GPS, CCTV, Agricultural environment monitoring server system, Wireless sensor network (WSN), Monitoring servers, Agriculture crops

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INTRODUCTION

Recently, an innovation in information communication technology have been increasing the convergence between different industries. The fact of convergence and act and integration of IT with agricultural technology is expected to be an area that could increase the added value and productivity of agriculture by applying the ubiquitous technology to the agricultural sector which is a primary industry.

To increase production in agricultural and promote efficient management in next generation agriculture world, it is important to monitor the land environment, crop conditions, and agricultural operations instead of simply relying on farmers' experiences and senses. However, it is problematic to realize that such monitoring automatically of farming and precisely, because agricultural areas are widely spaced and have few infrastructures, monitoring targets vary according to crop selection and other perspective and many operations are performed flexibly by manual labour. One approach to monitoring in open fields under croaking conditions is to use a radio frequency, infrared or any other sensor network of many sensor nodes comprised of small sensor units with radio data transfer links.

In current digital technology world sensor network for agricultural use is called an agricultural server that enables

effective crop and environment monitoring by equipped sensors and autonomous management (Akyildiz *et al.*, 2002 and Burrell *et al.*, 2004). Monitoring with an agricultural servers facilitates growth diagnosis and risk by co-operating with some agricultural applications such as crop growing simulations, manual evaluations, maturity evaluations, and pest predictions. However, it is insufficient to collect manual and automated and gathering detailed information about farming operations, because these operations are executed flexibly in every processes depending on crop and environment conditions.

An agricultural environment monitoring system provides environmental monitoring services and facility controlling services for control on data gathering, and thus maintains the crop growing environment in a minimum status. This system also increase in improving the convenience and productivity of users. However, existing monitoring systems are mostly used and utilized in closed agricultural environments such as pig farms, greenhouses, etc., as it is difficult to apply agricultural monitoring server in outdoors locations such as paddies, crop monitoring and maintaining, agricultural areas, etc. because of a lack of IT infrastructure. In general, when analyser analyses the monitored information and data in existing monitoring systems, the analyser manually checks the status through installed sensors and devices or terminals installed in the agriculture facilities.

Concept :

Our farm is a versatile concept in the performance of monitoring system, provides an expansive area in detailed recognizes the practical behaviour of users, and user-friendly monitoring system under different situations. To develop a useful monitoring system, we must consider the following requirements :

- The system should not obstruct the activities of farmers in farming operations.
- The system without complicated procedures. It should be easy to use for non-experts.
- The system should be available without having to change the facilities or equipment.
- The system should monitor the performance of agriculture in detail under different conditions.
- The system should be able to easily co-operate with various applications.

To meet these requirements, we propose a recognition method for cultivation operation using an RFID reader that is comfortable to wear-embedded wearable devices, they monitor and you are supposed to have unimpeded access to the cultivation conditions sufficient sensitivity to the RFID tag (Finkenzeller, 2003). Items can identify or track, the typical RFID systems, some areas are used for individual recognition without the logistics, security control and traceability system. For example, the livestock industry, RFID tag is attached to Embedded or animal body, such as disease control, some applications, such as fattening management, milking management and tracking behaviour is applied for checking and detecting in combination with other measurement data using RFID tags and the information. Our system, however, we use in RFID system adopted in recognition of farming this pattern is detected by analyzing the performance of RFID tags. Following steps are used for procedure :

- RFID tag farming operations such as farming is equipped with all the related items materials, tools, machinery, facilities, plants and fields.
- A farmer farming operations with RFID readers or wearable devices on them.
- RFID tag is detected during a sequence of activities that the farmer, does.
- The system is expected to farming operations by analyzing the pattern of data.

Traditional applications, RFID tag is attached to objects which are themselves important milestones that can be seen. However, a farmer puts on an RFID tag but in order for a RFID reader applies this system for easy to perform various operations. Also, the system, not only detected tags but are also used to derive a range of detected tags unlike traditional programs, information required.

Environmental monitoring :

WSNs have become an important tool in environmental monitoring. This relatively low-cost devices that can adequately represent the environment variable nodes allow for the installation of a dense population. For example, at the onset of frost damage they warn farmers and provide a better micro climate, such as awareness, knowledge of

assessment for risk and provide informations.

WSN short-range transmissions, analyse, monitor agro climate in the Amazon. They nodes near the sink, while more distant nodes to maintain the level of their through put, which suffered a loss of performance. Another example of climate monitoring can detect wireless rain sensors, water level and weather conditions are predicted by means of a flood. These sensors provide information to the central database system (Yoo *et al.,* 2007).

A GIS (Geographic Information System) with a moisture content obtained through the integration of WSN presents distribution maps. Wireless nodes were located in predetermined locations with humidity sensor; Geographic co-ordinates of the points of all the data was evaluated using the GIS, and was then obtained with GPS (Kwon and Kim, 2007 and Manavadariya *et al*., 2013).

At low water crossings in real-time remote monitoring of sediment erosion developed a wireless data transmission system using wireless ZigBee motes, flourished Han *et al.* (2010; 2011). Using the GPRS gateway sensor signals transmitted on an Internet server. Hamrita and Hoffacker (2005) developed a laboratory prototype wireless measurement of soil temperature. The system was based on commercial 13.56 MHz RFID tag. The size of a high correlation with those obtained using a thermocouple (more than 99%) showed.

Greenhouses :

Automation and efficiency of monitoring and control of greenhouse environment is crucial. To control and monitor environmental factors, sensors and actuators are required.

Greenhouse WSN was informed in 2003 that the first application of the monitoring and control system was developed by Bluetooth (Park *et al.,* 2009). Since then, most of them in many applications of IEEE 802.15.4 / ZigBee, making use, have been developed. As such, Gonda and Cugnasca ZigBee control and monitoring system using distributed a proposed greenhouse. Melons and cabbages grown and was being monitored, where the greenhouse environment control system, a WSN deployment of IEEE 802.15.4 compliant described results Yoo *et al.* (2007). Water substrate in real time, temperature, electrical conductivity, the daily photosynthetic radiation and leaf wetness that integrates a variety of sensors that can measure the greenhouse in a WSN, developed. Benefits, together with the reduction of disease problems associated with over-watering, an improved plant growth, were more efficient water and fertilizer applications Lea-Cox *et al.* (2007).

With a two-part framework for greenhouse prototype report a WSN. In the first part, many sensor nodes, temperature, light, and were used to measure soil moisture Liu *et al*., 2007; Joshi and Tyagi, 1994; Zellmer, 2009 and Weinberg *et al*., 1993. Another part of the database running on a GSM module and remote PC based management software is included.

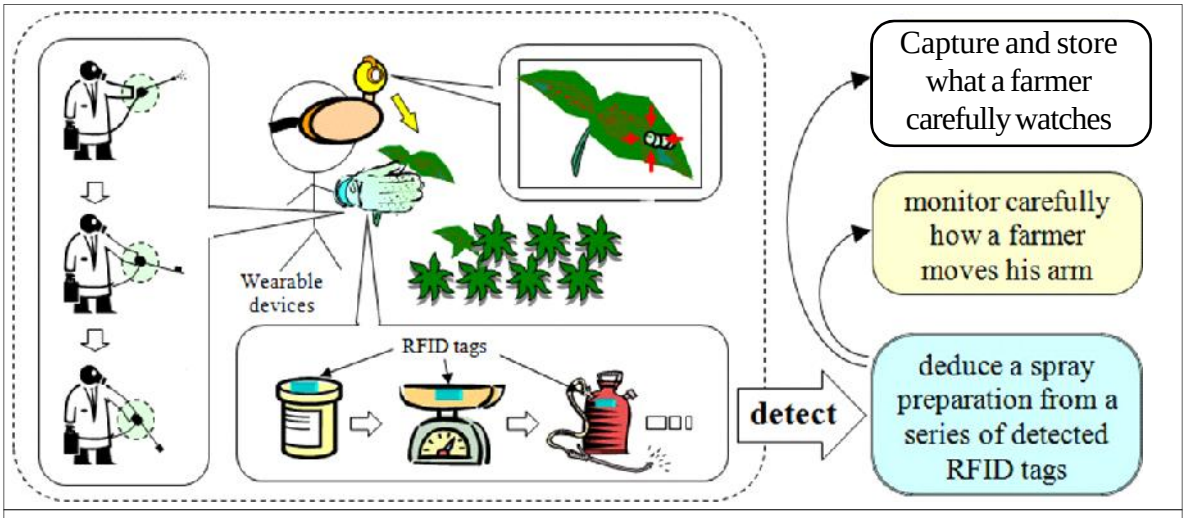

Fig. 1 : Farm monitoring system using sensor devices, RFID and CCTV

Inside the greenhouse, greenhouses and a star network topology and mesh topology for the connection between the operating system using, ZigBee-based monitoring system to be ready (Zhou *et al.*, 2007). Greenhouse environmental sensing spectral imaging and multi-functional remote sensing system that integrates RFID technology with the report Yang *et al.*, 2008. The multi-spectral imaging system was used for remote sensing of canopy of cabbage seedlings. Greenhouse temperature, relative humidity, and lighting conditions were measured at harvest (Tripathi, 1993 and Delin and Jackson, 2000).

Product tracking using RFID :

Concept of agricultural products' safety :

Primary production refers to agriculture, including agricultural production plant, animal, bacteria, etc. Safety is an important component of agricultural production, *i.e*. the quality of food hygiene, real or potential negative effects on human health. Safe agricultural production, which refers to the elements that includes customers and acute or chronic diseases that threatens the health of their offspring.

Function of RFID :

Identification (RFID) is commonly known as radio frequency electronic tag, it a target for non-recognition technology to share information contact duplex based on the electro-magnetic coupling, such as communication signals in space induction, radio waves and microwaves and so on. Traditional ticket, label and RFID tags are more compared with tracing cards benefits. It can not only collect and analyse data from the source or destination, but also, long-distance, fast speed, high data security can be an excellent ability (Finkenzeller, 2003).

The principle of operation of the RFID system is shown Fig. 2 Magnetic effective space RFID system is the basic premise. Data enters an electronic tag magnetic space emits radio signals at the antenna of the reader, while version. This is enabled by the power from the electronic tags faradic current, internal antenna then sends messages

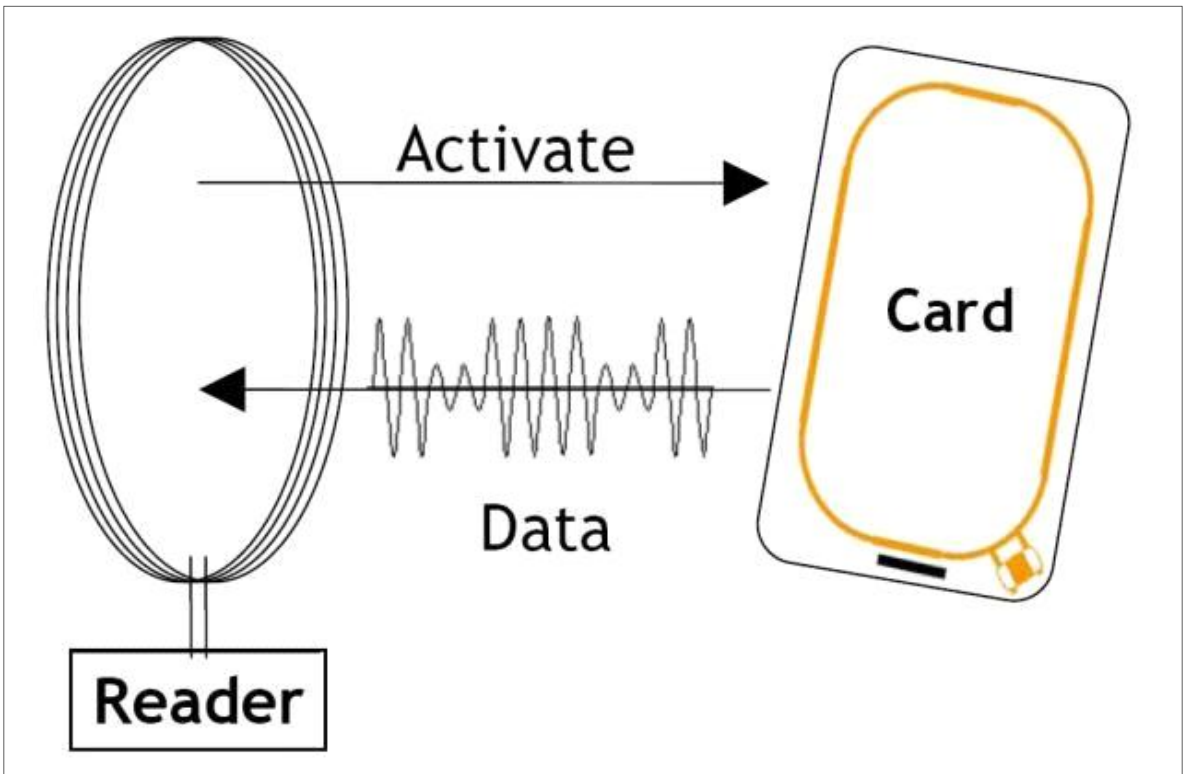

Fig. 2 : Operation principle of RFID system

stored in the chip decoding. The receiving antenna gives signals to the reader. Reader decode the signals, the decoded signals are conveyed to the information.

Through process management platform and application system software controlled.

Conclusion :

Easily and automatically to keep an eye on the operations of agriculture, proposed farming operation wearable sensor devices, including RFID readers and tags with the monitoring system. By various objects such as farm equipment and agricultural setting performing RFID tags working with portable devices, including RFID readers, the agricultural monitoring server system can recognize and detected by analysing the performance of RFID tags and sensor data information. The offer without interrupting their activities or can easily control system performance for farmers. You need to change their facilities or equipment. Furthermore, this system can facilitate and provide useful information for farmers or effective response to support requests. Valid operations, to evaluate the possibility that the system performes several, experiment with the original system. Through these experiments, we can prove that this is effectiveness of our proposed monitoring system.

REFERENCES

Akyildiz, I.F., Su, W., Sankarasubramaniam, Y. and Cayirci, E. (2002). Wireless sensor networks: a survey. *Computer Networks*, **38**(4): 393-422, ISSN 1389-1286.

Bange, M.P., Deutscher, S.A., Larsen, D., Linsley, D. and Whiteside, S. (2004). A handheld decision support system to facilitate improved insect pest management in Australian cotton systems. *Comp. & Electro. Agric.*, **43**(2): 131-147, ISSN 0168-1699.

Burrell, J., Brooke, T. and Beckwith, R. (2004). Vineyard computing: Sensors networks in agricultural production. *Lect. Note. Comp. Sci.*, **3** (1) : 38-45.

Cox, P.G. (1996). Some issues in the design of agricultural decision support systems. *Agric. Sys.*, **52**(2): 355-381, ISSN 0308-521X.

Delin, K.A. and Jackson, S.P. (2000). Sensor web for *in situ* exploration of gaseous bio-signatures, Proceedings of IEEE Aerospace Conference, **7**: 465-472, ISBN 0-7803-5846-5, Big Sky, MT, USA, March 18-25, 2000.

Devadas, R., Lamb, D.W., Simpfendorfer, S. and Backhouse, D. (2009). Evaluating ten spectral vegetation indices for identifying rust infection in individual wheat leaves. *Precision Agric.*, **10**(6): 459–470.

Duthie, J.A. (1997). Models of the response of foliar parasites to the combined effects oftemperature and duration of wetness. *Phytopathology*, **87**(11): 1088-1095, ISSN 0031-949X.

Finkenzeller, K. (2003). *RFID handbook*: fundamentals and applications in contactless smart cards and identification (2nd Ed.), John Wiley and Sons, ISBN 978-0-470-84402-1, NewYork, NY, USA.

Han, Y., Park, M. and Chung, T. (2010). Secdeach: Secure and resilient dynamic clustering protocol preserving data privacy in wsns. Computational Science and Its Applications–ICCSA, 142–157pp.

Han, S., Zhu, X., Mok, A., Chen, D. and Nixon, M. (2011). *Reliable and Real-time Communication in Industrial Wireless Mesh Networks*. 17th IEEE Real-Time and Embedded Technology and Applications Symposium (RTAS) .

Joshi, P.K. and Tyagi, N.K. (1994). Salt affected and waterlogged soils in India: A review. Joint study of the Indian Council of Agricultural Research, New Delhi and the International Food Policy Research Institute, Washington D.C.

Kwon, O.B. and Kim, J.H. (2007). A basic direction for building agricultural radio frequency identification logistics information system, Research Report M85, Korea Rural Economics Institute: Seoul, Korea, December.

Lea-Cox, J.D., Kantor, G., Anhalt, J., Ristvey, A. and Ross, D.S. (2007). A wireless sensor network for the nursery and greenhouse industry. In: Southern Nursery Association Research Conference, **52**.

Liu, H., Meng, Z. and Cui, S. (2007). *A wireless sensor network prototype for environmental monitoring in greenhouses*, presented at Wireless Communications, Networking and Mobile Computing 2007 (WiCom 2007), International Conference on 21-25 Sept., 2007, 2344–2347pp.

Manavadariya, Kaushik I., Faldu, Ankit J., Shukla, Parag C. and Patel, Deven J. (2013). Computer based human gesture recognition with study of algorithms, *IOSR J. Comp. Engg.* (IOSR-JCE), e-ISSN: 2278-0661, **11**(2):41-50.

Park, D.H., Kang, B.J., Cho, K.R., Sin, C.S., Cho, S.E., Park, J.W. and Yang, W.M. (2009). A study on greenhouse automatic control system based on wireless sensor network. Wireless Pers Commun. DOI: 10.1007/s11277-009-9881-2.

Rai, P. and Handa, A.K. (2001). *Agroforestry Newsletter*. National Research Centre for Agroforestry, Jhansi, India. **13**(3&4) : 1-12.

Sandip, Lahiri (2005). RFIDSourcebook, ISBN-0131851373, IBM Press Edition August 31-2005.

Self, Sharmistha and Grabowski, Richard (2007). Economic development and the role of agricultural technology. *Agric. Econ.*, **36** (3) : 395-404.

Tripathi, A.K. (1993). *Biogas slurry-A boon for agriculture crops*. Biogas Slurry Utilisation, New Delhi cited in Karki, A.B., Shrestha, J.N., and Bajgain, S. (2005). (Eds.) Biogas as renewable source of energy in Nepal: Theory and Development, BSP-Nepal, Kathmandu.

Upadhayay, B.M., Young, D.L., Wang, H.H. and Wandschneider, P.R. (2003). How do farmers who adopt multiple conservation practices differ from their neighbors? *American J. Alternative Agric.*, **18**(1):27-36.

Vaidyanathan, A. (2000). India's agriculture development policy. *Econ. & Political Weekly*, **35**(20).

Weinberg, M., Kling, C.L. and Wilen, J.E. (1993). Water markets and water quality. *American J. Agric. Econ.*, **75**(2):278-291.

Yang, I.C., Chen, S., Huang, Y.I., Hsieh, K.W., Chen, C.T., Lu, H.C., Chang, C.L., Lin, H.M., Chen, Y.L., Chen, C.C. and Lo, Y.M. (2008). RFID-integrated multi-functional remote sensing system for seedling production management. In: 2008 ASABE Annual International Meeting. Providence, Rhode Island, USA.

Yoo, S., Kim, J., Kim, T., Ahn, S., Sung, J. and Kim, D. (2007). A2S: automated agriculture system based on WSN. In Proceedings of ISCE 2007. IEEE International Symposium on Consumer Electronics, Irving, TX, USA.

Zellmer, Sandra (2009). *United states: The emergence of environmental considerations*, The evolution of the law and politics of water, J.W. Dellapenna and J. Gupta (Eds.), Springer Science and Business Media B.V., 205-230pp.

Zhou, Y.M., Yang, X.L., Guo, X.S., Zhou, M.G. and Wang, L.R. (2007). *A design of greenhouse monitoring & control system based on ZigBee Wireless Sensor Network*. In: Proceedings of the International Conference on Wireless Communications, Networking and Mobile Computing (WiCom 2007), Shanghai, China, 21–25 September 2007. 2563-2567pp.

MEMBERS OF RESEARCH FORUM

AUTHOR FOR CORRESPONDENCE :

Deven J. Patel
Atmiya Institute of Technology and Science,
RAJKOT (GUJARAT) INDIA
Email: djpatel@aits.edu.in

CO-OPTED AUTHORS :

Kapil K. Shukla, B.H. Gardi College of Engineering and Technology, Anandpar, RAJKOT (GUJARAT) INDIA
Email: kapilshukla2006@gmail.com

Bankim L. Radadia, Navsari Agricultural University,
NAVSARI (GUJARAT) INDIA
Email: bankim.radadiya@gmail.com