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INTERNET OF THINGS (IOT) ENABLED AGRICULTURE SYSTEM: A STUDY

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ABSTRACT

This study is a review of designing an Internet of Things (IoT) enabled platform for monitoring and controlling agriculture parameters through web-based applications for precision agriculture. Moreover, this study will develop a low-cost, high-performance, and flexible distributed monitoring system not incorporating expensive components such as high-end personal computers. Also, it offers full control of the system, not by constant manual attention from the operator but to a large extent by wireless sensors. Thus the review describes several designs of a smart monitoring system using intelligent techniques (wireless sensors). There are three principal components in this study, which are an electronic device, software development, and system prototype internet protocol layer. The purpose is to combine all three components to make a web application. Furthermore, the adoption of intelligent techniques in monitoring systems could enhance the concept of the usefulness of monitoring and controlling processes.

Keywords: Internet Of Things, Wireless Sensor Networks (WSN), Microcontroller.

I. INTRODUCTION

In recent years, to improve crop production and quality of agricultural operations and to reduce labor's cost a concept "precision agriculture" that is remotely observing, measuring the environmental condition of the farm from anywhere, anytime by IoT has been attracting a lot of attention.

The IoT is a network of physical objects to exchange data with other devices and systems over the internet. By means of low-cost computing, the cloud, WSN, and mobile technologies, physical things can share and collect data with minimal human intervention. Wireless Sensor Network (WSN) technology is an essential component of IoT as it has great potential for monitoring different agriculture parameters with better accuracy. In a WSN-based system, the environmental information (e.g., temperature, humidity) is collected from a large number of sensor nodes installed in the farm this information is transferred to the sink node using low-power wireless communications (e.g. ZigBee). ZigBee has emerged as the most promising standard owing to its low power consumption and simple networking configuration. Wireless-based smart sensors networks can combine sensing, computation, and communication into a single, small device that reduces the cost of construction, maintenance, size, and weight of the whole system.

In this study, Arduino and NodeMCU were used. The Arduino is an open-source electronics platform used to build electronics projects. It consists of a physical programmable circuit board that can be connected using a USB cable (i.e. a microcontroller) and an IDE (Integrated Development Environment) software that has text editor, debugger and complier all in one. Arduino IDE uses a simplified version of C++, which makes it easy for a programmer to learn and understand. Additionally, Ethernet Shield is used for providing IP services on Arduino and PC to be able to connect to the internet. Similar to Arduino, NodeMCU is also an open-source software and hardware development environment based on ESP8266. IT contains the pivotal elements of a computer: CPU, RAM, and networking (Wi-Fi). That makes it a good choice for Internet of Things (IoT) projects of various kinds.

The system design consists of three layers: perception layer, network layer, and application layer, which provides users with various kinds of functions. The function of the perception layer is to provide all kinds of sensing data needed by the platform. With these data, users will have a better understanding of the state of their lands. The network layer is the link between the perception layer and the application layer. It implements the function that sends the sensing data generated by the perception layer to the database server located in the cloud. These data will be stored in the database server later. Lastly, the application layer, contains an application server, a database server, and various kinds of clients. The core function is processing the data stored in the database server located in the cloud, so as to realize remote monitoring. In addition, the platform will automatically determine the current state of land and inform users of the results in real-time. The primary aim of this study is to design a monitoring system using a wireless sensor network with the help of the internet where the presence of the farmers in the field is not compulsory.

Objective

The aim of this study is to understand the design and development of an automated and remotely controlled agriculture system using a wireless sensor network with the help of the internet where the presence of the farmers in the field is not compulsory. Specifically, these are the goals set for this study:

(a) To design and develop a microcontroller-based wireless sensor network using various environmental sensors;

(b) To analyse and monitor the moisture content of the soil alongside temperature and humidity via a customized server.

II. LITERATURE REVIEW

In recent years, the development of environmental monitoring systems has been implemented in many applications in order to improve crop production, support people in their work, and reduce cost and time. These monitoring systems can be used for, such as industrial, home, office, agriculture, and weather and forest monitoring. The following table shows the differences. All the previous projects are user-friendly as the system is literally used to monitor a particular region. It is a reliable system as it causes no precarious harm to the environment.

Paper No.	Components used	Method	Cost	Power	Advantage	Disadvantage
1	-	Based on the RBF network, the paper uses the Levenberg-Marquardt (LM) algorithm	-	-	This model predict the temperature and humidity of a greenhouse based on improved LM-RBF. As LM algorithm along with RBF neural network deals with over-parameterization problems, redundant parameters and costs less.	This type of model has a complex structure with many parameters, and many parameters are difficult to determine and can only be obtained through experience.
2	IoT nodes based on Arduino, Raspberry Pi, and PC.		high	high		
3	The system is based on a wireless sensor network which	Aeroponics: It is an Air-water plant growing	high	-	Aeroponics is a new way of cultivation technique, where the plant is cultivated in air	A failure to accurately control and monitor the parameters could significantly affect the growth of the

	comprises a data server, a wireless convergence node, a plurality of wireless routers, and a plurality of wireless sensor nodes. Temperature Sensor, pH sensor, EC sensor, Light intensity sensor, Humidity sensor, CO_2 sensor, Water level sensor, Timer sensor.	technique where lower portions such as the roots of the plant are hung inside the growth chamber under complete darkness in controlled conditions.			surroundings, without any soil. In the system, the plant is grown for around a year by artificially adapting to the surrounding environmental conditions. It offers full control of the system, by wireless sensors.	plant and cause financial loss. Main drawback is the amount of attention required of the farmer with a high level of expertise and judgment.
4	Includes sensor units, Zigbee transceiver, an MCU, an SoC platform, and Web Server.		low	-	monitoring system with wireless sensor network (WSN) which integrates a System on a Chip (SoC) platform to reduce the cost and physical size of the system and Zigbee wireless network technologies because of its low power consumption and simple networking configuration.	ZigBee-based wireless monitoring and control system in one greenhouse is composed of a coordinator and several end devices including sensor nodes and actuator modules organized as a star network.
5	The proposed system uses 3D Robotics's 3DR SoLo as a UAV, which is capable of stable flight based on GPS coordinate and can be		low	low	This system uses UAV i.e. a wireless power transfer technology and Bluetooth Low Energy (BLE) to collect the environmental information related to crop	While landing a UAV, if it is not able to detect the sensor node correctly, the UAV rises its altitude and tries to detect it again until then the wireless power transfer

	controlled by Receiving the commands from the embedded system through the wireless. In addition, the embedded system on the UAV is based on a Raspberry Pi 4 Model B, which is a single-board computer supporting Wi-Fi and Bluetooth.				growth from sensor nodes installed at multiple locations of a large farm. In addition, by using technology sensor nodes can run without a battery, which eliminates the cost of periodic battery replacement.	cannot be started. This is repeated until the UAV detects the sensor node correctly it might require a few trials.
6	The sensor consists of a soil pH and humidity sensor. RF 433 MHz is used as a module sending data from the sensor to the microcontroller.		high	low	The monitoring system is able to display pH and soil moisture values in real-time with an average error value of the soil pH sensor which is equal to 1.66% and the YL69 sensor error average is 1% compared to a commercial soil analyzer.	-
7	three sensor nodes, central node, DHT22 humidity and temperature sensors, Wi-Fi router, Water flow sensor, and solenoid valve and server. The wireless sensor nodes		low	low	An advantage of this system is that a field sensing system does not take extensive time and costs to install and maintain. The system is planned to be implemented using distributed wireless sensor networks using soil moisture,	-

	are composed of: WEMOS D1 Mini, which is the main controller of the system; WEMOS D1 Mini Battery Shield, which is the power supply of the device; and the soil moisture sensor module. Also, the DHT22 shield, which is connected to the central node, measures the reading for the temperature and humidity of the air.				temperature, and humidity sensor real-time sensing to control and store the monitored data.	
8	The perception layer consists of a large number of ZigBee SNs. ZigBee is a low-rate, low-power, low-cost wireless network technology for automation and wireless control.		low	low	As using WSN on large scale is costly and difficult to construct. This system uses a mobile sink (MS) along with a UAV to collect data from sensor nodes (SNs) of large farms and thereby save energy and cost.	For this system it can be concluded that it works normally, the only thing that users need to do is follow the system's countermeasures.
10	It includes NodeMCU, Arduino Nano, sensors like soil moisture and		low	low	The main feature of this methodology is its cheap cost for installation and multiple	The smart agriculture needs availability of internet continuously.

	Dht11, Ssolenoid valves, relays.				advantages. Here one can access it as well as control the agriculture system on a laptop, cell phone, or computer.	
11	The system consists of three main modules: the micro Web server, the hardware interface module, and the software Package (Smart phone app).		low		The system does not need a server PC and offers a new communication protocol to monitor and control the home environment with added switching functionality.	The system is only used to control devices and appliances remotely by using an android smartphone.
12	Made of three components: a soil moisture sensor, a sensing node that is responsible for scheduling and reporting soil moisture readings, and a controller node responsible for controlling and scheduling irrigation events.		low	low	The system could monitor the environmental information the outdoors remotely, and by supporting the decision-making of crop producers through analysis of the collected information.	The system required a CCTV to monitor a real-time video and a GSM module to transfer information and high technologies are needed.

Designing and applying IoT, in the areas of accuracy farming and ecological monitoring can be demanding, thus an orderly approach is required. The main need in these projects was to concentrate on the use of open-source software. Also to develop a low-cost, high-performance, and flexible distributed monitoring system with increased functionality. By comparing the project [1] and [2] with The IoT-Based Monitoring Systems for Humidity and Soil Acidity Using Wireless Communication the system design is divided into 3 parts, namely sensors, controllers, and web servers. Firstly several IoT sensor nodes were installed throughout the field to collect, process, and convert signals of field parameters into digital data. Secondly, the IoT nodes were wirelessly communicating to the servers to transmit digital data to the microcontroller also display it on the webserver. Then, a system was created in which field signal values were displayed on a Web page which was accessed by a personal computer (PC) and smartphone.

Other than that, in [3] and [5] the project explained about UAV, in this type of system the typical Internet of things (IoT) architecture was adopted. The system was divided into perception layer, network layer, and application layer. In the perception layer, a large number of sensor nodes are installed within the large farm for collecting the sensor data.

In the network layer, a mobile sink (MS) that consists of a gateway carried by an unmanned aerial vehicle (UAV) is used to gather data from the perception layer and transfer it to the application layer. On the other hand, UAVs can fly stably for a long time and has a large charging capacity.

After acquiring sensor data from all sensor nodes, UAV returns to the start point of the flight and sends the collected sensor data to the server via HTTP communication. The server manages and analyses the data received from the UAV, and provides the visualized data to the browser of the smartphone, tablet, and PC browsers.

III. DISCUSSION

By comparing all methods mentioned above there are various techniques that can be used to monitor a piece of land whether inside or outside fields such as WSN, UAV, and many more with the help of IoT these systems can also be employed at the home, office, public, farming, etc. As the proposed system is user-friendly, reliable, flexible, easier to install and maintain it can be used without any worries. Unlike previous studies systems using WSN via IoT can lessen human labor in many fields. Besides that an electronic board with all control functions built in it makes the system execute well. To boot, connecting board to IoT may be able to develop a feedback system that sends current status from sensors connected to the board to the application which makes the system more reliable.

IV. CONCLUSION

Based on the study, the conclusions drawn are the following: (1) the design and development of a microcontroller-based wireless sensor network using various environmental sensors improves the way of agricultural system with effective functionality of every components in the system. (2) The system is accurate in terms of its sensing capabilities and provides high accuracy for every setup made. (3) The objectives are obtained and achieved during the experiments with certain valuable data and interpretation.

V. REFERENCES

[1] Youjun Yue, Jun Quan, Hui Zhao and Hongjun Wang. 2018. "The Prediction of Greenhouse Temperature and Humidity Based on LM-RBF Network"

[2] Tomo Popovic , Nedeljko Latinovic´, Ana Pešic´, Zˇarko Zecˇevic´, Bozˇo Krstajic , Slobodan Djukanovic´. 2017. "Architecting an IoT-enabled platform for precision agriculture and ecological monitoring: A case study"

[3] Imran Ali Lakhiar ,Gao Jianmin ,Tabinda Naz Syed, Farman Ali Chandio ,Noman Ali Buttar and Waqar Ahmed Qureshi. 2018. "Monitoring and Control Systems in Agriculture Using Intelligent Sensor Techniques: A Review of the Aeroponic System"

[4] Jzau-Sheng Lin, Chun-Zu Liu. 2008. "A Monitoring System Based on Wireless Sensor Network and an SoC Platform in Precision Agriculture"

[5] Shota Nishiura, Hiroshi Yamamoto. 2021. "Large-term sensing system for agriculture utilizing UAV and wireless power transfer"

[6] Lia Kamelia, Yuga Setya Nugraha, Mufid Ridlo Effendi, Tedi Priatna. 2019. "The IoT-Based Monitoring Systems for Humidity and Soil Acidity Using Wireless Communication"

[7] Christine Joy H. Pornillos, Mark Stephen O. Billones, Joel DLC. Leonidas, Erica May A. Reyes, Bennyvic Joyce J. Esguerra, Dominic P. Bolima, Ronnie Concepcion II. 2020. "Smart Irrigation Control System Using Wireless Sensor Network via Internet-Of-Things"

[8] Anqi Rao, Hanqin Shao, Xiaotong Yang. 2019. "The Design and Implementation of Smart Agricultural Management Platform Based on UAV and Wireless Sensor Network"

[9] Sanku Kumar Roy, Arijit Roy, Sudip Misra, Narendra. S. Raghuwanshi, Mohammad S. Obaidat. 2015." AID: A Prototype for Agricultural Intrusion Detection Using Wireless Sensor Network"

[10] K. Jyostsna Vanaja, Aala Suresh, S. Srilatha, K. Vijay Kumar, M. Bharath. 2018. "IOT based Agriculture System Using NodeMCU"

[11] Rajeev Piyare. 2013."Internet of Things: Ubiquitous Home Control and Monitoring System using Android based Smart Phone"

[12] Dr . Ryad Jabbar, Sara Taher Abbas. 2019. "Review on Agricultural Environment Monitoring by Using Wireless Sensor Networks".