IoT in Agriculture

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Abstract— Agriculture plays vital role in the development of agricultural country like India. Issues concerning agriculture can be solved using smart agriculture by modernizing the current traditional methods of agriculture. Internet of Things (IoT) plays a vital role in smart agriculture. With the advent of Internet of Things (IoT) and industrialization, the development of Information Technology (IT) has led to various studies not only in industry but also in agriculture. Traditional agriculture is transmuting into smart agriculture due to the distinction of the Internet of Things (IoT). A remote-controlled vehicle functions on both automatic and manual modes, for various agriculture processes like spraying, cutting, weeding etc. The controller keeps monitoring the temperature, humidity, soil condition through sensors using Arduino board and in case of any discrepancy send a SMS notification as well as a notification on the application developed for the same to the farmer's smartphone using Wi-Fi/3G/4G and accordingly supplies water to the field. Low-cost and low-power are the key factors to make any IoT network useful and acceptable to the farmers.

Keywords: IoT, Smart Agriculture, Remote Control

I. INTRODUCTION

FARMING and agriculture are the basis of human life which gives food, grains, and other raw materials. India's principal source of income is from agricultural sector and 70% of farmers and general people depend on agriculture for livelihood. In order to improve to the crop productivity there is a crucial need to replace manual method to automation. Agricultural automation began with information technology and the collection of crop growth.

We want to improve the scalability and usability of the new smart farm system by overcoming the problem of application limitations of wired devices in agriculture by using wireless communication module. The technology which plays a key role in this is the Internet of Things (IoT).

Internet of Things (IoT) has opened up a suitable solution for smart farming and agriculture, however, it remains a dream till the connectivity is not reached to rural areas. Internet of Things (IoT) is widely used in connecting devices and collecting data information. Internet of Things are often used with IoT frameworks to manage and transact with data and information. In the system users can register their sensors, create streams of data and process information. IoT are applicable in various methodologies of agriculture. Applications of IoT are Smart Cities, Smart Environment, Smart Water, Smart Metering, Security and Emergency, Industrial Control, Smart Agriculture, Home Automation, e-Health etc. 'Internet of Things' is based on device which is capable of analyzing the sensed information and then transmitting it to the user.

A. Why do we need IOT in agriculture?

Agriculture is the basis for the human species as it is the main source of food and it plays important role in the growth of country's economy. It also gives large ample employment opportunities to the people. The farmers are still using traditional methods for agriculture, which results in low yielding of crops and fruits. So, the crop yield can be improved by using automatic machineries. There is need to apply modern science and technology solutions in the agriculture for increasing the yield.

II. SYSTEM CONSTRUCTION

The overall structure of the system consists of nodes, gateways, servers, databases, and smartphones as system accessors.

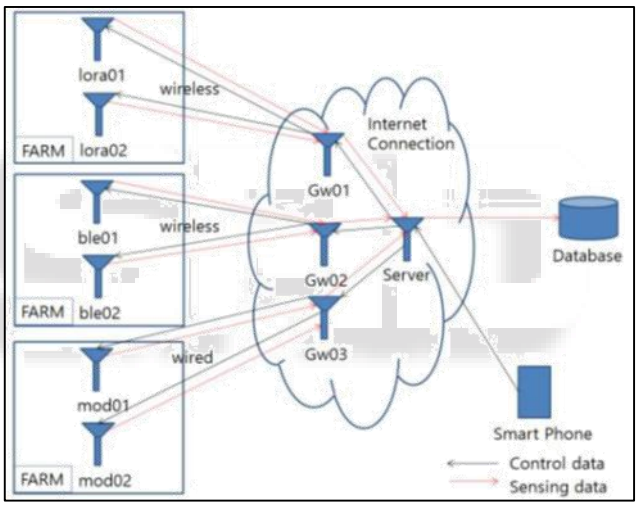

Fig. 1: The physical structure of smart farm system.

The nodes are classified into LPWAN, Bluetooth, and RS485 communication, and the environmental data collected through the sensors on the node in the farm are transmitted to the gateway through each communication network. The sensors used are temperature, humidity and soil moisture sensor, and the sensing data is transmitted in real time. The gateways responsible for each communication network are connected to the Internet and relay the communication between the server and the nodes. The server collects sensing data in real time through each communication network and records it in the database or transmits the command of the service accessor to the gateway.

III. HARDWARE DESIGN

All systems are equipped with sensors and communication modules based on Arduino, and consist of two sensor nodes and one gateway. All gateways have a wireless Internet module, which enables MQTT communication based on IP with the Server. MQTT is a lightweight messaging protocol

that enables asynchronous communication of devices with limited resources.

The communication module used in the LPWAN communication network is a low-power and high-efficiency radio frequency communication module Bluetooth has interoperability with all smart phones, enabling direct communication with each node as well as through the server, enabling sensor communication and device control at close range.

RS485, which is used as a wired communication network, issued as a serial communication module used in most wired equipment installed in a greenhouse to implement a hybrid wired / wireless system.

A. Soil Moisture Sensor

Precision soil moisture consists of two probes that are inserted in to soil. When the current pass through the probes, the soil contains low moisture offer a less resistance and passes high current. That is variable resistance is the parameter to identify the level of soil moisture

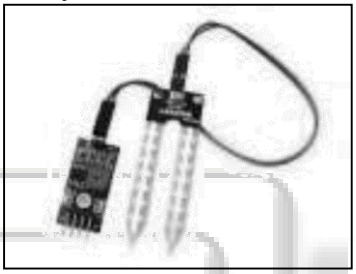

Fig. 1: Soil Moisture Sensor

B. Temperature Sensor (LM 35)

The LM35 sensor series are precision integrated circuit temperature sensors as shown in, whose output voltage is linearly proportional to the Celsius (Centigrade) temperature.

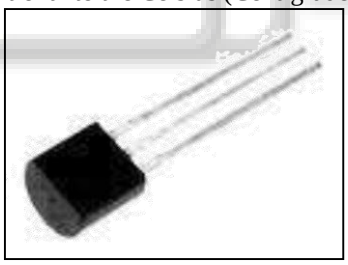

Fig. 2: Temperature Sensor

C. LM 358

LM 358 IC contain a dual high gain and band width product operational amplifiers that are designed and operated over high range of voltages. These devices are used instrumentation applications at low power values.

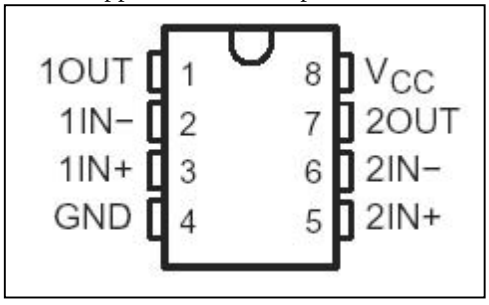

Fig. 3: LM358

D. Relay

A relay is used to control the A.C motors from the controlled DC signal. It can isolate one operated electrical circuit to another. The principle behind the electromagnet operates the close and opens the circuit. Relays are applied wide area electronics circuits such as industrial control circuits a high-power amplifier, telephone exchanges etc.

Fig. 4: Relay

E. Buzzer

A buzzer or beeper is an auditory warning signal device, which could be mechanical, electromechanical, or electronic. Various types of buzzers presently available such as alarms, timers, mouse click or keystroke.

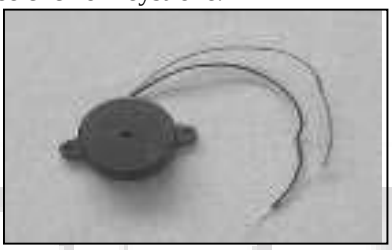

Fig. 5: Buzzer

The data obtained from sensors are stored in the cloud and can be monitored by farmer through his mobile/ PC. The accurate values which actually occur from the system are observed by farmer; with his intervention at his crop fields the irrigation ran automatically. Micro controller processed and correlated huge data obtained from the sensors checks at every time to the threshold values. The system displays temperature value and condition of soil moisture.

IV. LITERATURE SURVEY

[2] In spite of the modern technology found everywhere, the agriculture area is following the old conventional technology. The farmers still resort to traditional methods like manual distribution of seeds and ploughing, two crops per year pattern, unscientific systems of cultivation. The monsoons are irregular, and unevenness of availability of water throughout the year poses a major problem. All this leads to inadequate yield and low productivity.

[3] Agricultural automation involves many steps. The data collection requires a sensor to collect environmental and growth data and a server to store the data, and the farmer adjusts the environment and cultivates plants based on the collected data. There has to be an improvement in scalability and usability of the new smart farm system by overcoming the problem of application limitations of wired devices in agriculture by using wireless communication module.

[4] The system estimates the quantity of water needed based on the information gained from the sensors. 2

sensors are used to measure the temperature and humidity of the soil and the information is sent to the base station. The major advantage the system is optimizing the usage of water fertilizers while maximizing the yield of the crops and also will help in analyzing the weather conditions of the field. One of the systems maintains the water levels in the crop field at power consumption in the crop field.

IoT monitoring and automation from anywhere in the world is replacing human being and hence yielding more benefits in agriculture. [5] It is becoming popular with the promise to deliver all time visibility of soil and crop health, used machinery, storage conditions, fertilizer used, energy consumption and animal behavior. The deployed sensors/actuators across farms and machinery, farmers can gain as an abundance of insightful data such as temperature, fertilizer used, water used, etc. Farmer can easily monitor variety of environmental parameters and do analytics once an IoT enabled smart system is placed.

[6] Precision agriculture (also known as smart farming) is set to provide higher productivity and a better use of resources when compared to traditional methods and this will result in lower costs with higher yields. It consisted mainly of map-based technologies using geo-statistical methods like GIS and satellite remote sensing and the main application was to manage fertilizer use. Sensors use was not widespread since sensors were either too costly and too inaccurate or unavailable for the applications required. The rapid development of IoT and Big Data, and decreased cost of sensors has changed with the development and testing of prototype precision agriculture systems. Monitoring through sensors, analysis and planning, and smart control all linked by a wireless network connected to cloud service.

[7] Agriculture has seen many transformations and has adopted many machines to increase the yield. Field and crop health monitoring are important factors for the yield to be of better quality and in larger quantities. Technological advancements in the agriculture led to an increase in productivity and immunity of the crops. IoT networks are reducing human labor requirements by monitoring crop health and field environment remotely. Wireless sensor network (WSN) as the backbone for gathering information for these monitoring and control applications. IoT helping farmers by monitoring growth stages of the crop, diseases and estimation of the yield by giving otherwise restricted low power, low cost devices access to greater processing capabilities via the Internet.

[8] With IoT farmers can remotely monitor their crop and equipment by phones and computers. Agriculture process can easily observe of crop growth based on collected information from a crop field with the help of precision. The mechanism is also called as satellite farming or site-specific crop management. Water and energy are the most significant inputs and their costs can improve or disrupt the agricultural business. Due to leaky irrigation structures, ineffective field application methods and the planting of water intensive crops in the off beam growing location water wastage is done. Water use can be made smarter for agriculture by monitoring and changing water volume, location timing and period of flow can be done with IoT.

[9] 'Internet of Things' is based on device which is capable of analyzing the sensed information and then transmitting it to the user. Agriculture is the basis for the human species as it is the main growth of country's economy. It also gives large ample employment opportunities to the people. The farmers are still using traditional methods for agriculture, which results in low yielding of crops. The crop yield can be improved by using automatic machineries. Can expect the increase in production with low cost by monitoring the efficiency of the soil, temperature and humidity monitoring, rain fall monitoring, fertilizers efficiency, monitoring storage capacity of water tanks and also theft detection in agriculture areas.

V. Conclusion & Future Works

The system can be used in green house and temperature dependent plants. The application of such system in the field can definitely help to advance the harvest of the crops and global production. The studies showed that the wireless sensor networks were feasible with an improvement over traditional method.

Soil moisture sensor is used to measure soil parameter. The humidity, light intensity, ambient temperature sensors are used for measuring other environmental parameters These IoT solutions will improve farming methods and result in more productivity and a better use of resources.

Implementation of such a system in the field can definitely help to improve the field of the crops and overall production. With the help of this approach the irrigation system completely automated also provides real-time information about the lands and crops that will help farmers make right decisions. Cloud computing is the contemporary method of computing which involves vigorously scalable and frequently virtualized resources are provided as a provision over the Internet". Here two sensors are used to control the irrigation system so the troubleshooting easily done whenever it necessary. Hardware resources in agricultural information network are integrated into resource pool by using vitalization technology, achieving dynamic distribution of resource and balance of load, significantly improve efficiency.

In future, we can plan to use drone based remote monitoring and also solar-powered feature of sensor nodes for precision agriculture.

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