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Support of Wireless Sensor Networks Technology in Agriculture

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ABSTRACT

Agriculture is one of the major sectors that influence economic system and plays a vital role in overall development of the country. Majority of the people in India still nurture agriculture for their livelihood. It offers employment opportunities and serves as a best resource for different kinds of food materials, medicines etc. It provides bio feed stocks that help to manufacture significant value added products. Traditional agricultural methods may not meet the increasing demand for food and other products due to population problems and changing environmental factors. So there is a need for modern technology that increases productivity by facilitating farm operations and post harvest management. In this context, Wireless Sensor Networks (*WSNs*) could be utilized for screening the environment factors in the farm level such as ambient temperature, humidity, barometric pressure, ambient light, soil humidity and temperature etc. which are significant in view of quality and crop productivity. In this paper, a novel, low cost and energy efficient device, capable to interface with various up scalable things is proposed. Data related to different environment factors in the field is collected by deploying various sensor nodes placed on a microcontroller board and moved to cloud through an aggregator using ZigBee protocol. Required analytics can be performed on cloud data to facilitate farm operations.

Keywords: *Agriculture, Crop production, Environmental parameters, Wireless Sensor Networks (WSNs), Zig Bee*.

In the era of contrasting technological interventions and developments farmers need support to inculcate the growth of the agriculture in a vast range. Any country's development lies in the hands of the farmers and farming plays an important role especially in the countries like INDIA farming should not be treated as a business paradigm it should be treated as a way of life. Farmers are the backbones for any nation. In order to inculcate the farming strategies in every individual, there is a great deal of support necessary in order to abandon adequate crop production within the limits of the time bound. Which deserves the crop production cost rate and the amount of crop that can be predicted in future times to manage the higher yield.

A wireless sensor network (WSN) may consist of hundred or even thousands of nodes. A sensor node collects the information from the environment and sends it to the main node called sinks. Each node is equipped with one or more sensor, a wireless communication device, processor and energy source usually a battery. Wireless topology for such networks can be dynamic or static because node may drop or move for various reasons and can be static where sensors are at fixed location. The topologies that discussed in this wireless sensor network uses the aspects of ZigBee protocol to indulge new eras in the field of agriculture to enhance a progressive outcome.

A wireless sensor network (WSN) consists of sensors which are densely distributed to monitor physical or environmental conditions, such as temperature, sound, pressure, etc. The sensor data is transmitted to network coordinator which is heart of the wireless personal area network. In the modern scenario wireless networks contains sensors as well as actuators. ZigBee is newly developed technology that works on IEEE standard 802.15.4, which can be used in the wireless sensor network (WSN). The low data rates, low power consumption, low cost are main features of ZigBee. WSN is composed of ZigBee coordinator (network coordinator), ZigBee router and ZigBee end device. The sensor nodes information in the network will be sent to the coordinator, the coordinator collects sensor data, stores the data in memory, process the data, and route the data to appropriate node.

The major challenge to a farmer at the time of irrigation is not having full control over the activities on the farmland and its unpredictable environment factors which in most cases, if not well managed, brings about low agricultural productivity. In this paper, as against the traditional manual control procedures which are time consuming, labour expensive, and most time led to taking bad key decisions concerning the three important environmental factors *viz:* temperature, humidity, and moisture of the farmland. To address such problems a new design and implementation of farm management support system using WSN to sense and sent SMS about these three important farm field parameters to farmers using ATmega 328 controller.

Wireless Sensor Network (WSN) connects the physical and computational world by monitoring environmental phenomena through ubiquitous devices called sensor nodes or motes. India ranks second in agriculture activities. The agriculture production process is affected by different factors such as temperature, light, soil humidity, soil moisture. Precision agriculture is a field which provides suitable scenarios for the deployment of wireless sensor networks (WSNs). WSNs provide accurate information about environmental characteristics to farmers. This knowledge represents a valuable resource because it helps in real-time decision making such as establishing water management policies. In India there are different types of problems and one of the main problems is the water shortage. Farmers crops are unreliable due to the variability in rainfall amount as well as its distribution. we describe the use of wireless sensor networks(WSN) to improve water management and for controlling other parameters such as temperature, light, humidity, moisture. Wireless Sensor Network(WSN) and other agricultural techniques might help farmer to utilize and store the available water, improve their crop productivity, reduce the production cost and instead of depending on prediction, WSN uses the real time values in the model.

The environmental data from the fields are sensed or measured by the sensors. In the proposed system various sensors such as rainfall sensor, hygrometer sensor, temperature sensor and LDR used to sense different environmental parameters. Sensed parameters have to upload in cloud and convert into proper values. Users are able to see information in terms of graph on computer or in smart phone. Finally our objective is to propose and provide a proof of concept of a layered architecture of WSN over Cloud through the Internet of Things (IoT) for agricultural management.

MATERIAL AND METHODS

1. WSN using the Zigbee Protocol

The System Architecture has two sections. They are

a. Crop field Section

b. Monitoring Section

a. Crop Field Section

It shows the paddy crop field section. Paddy crop field section consist of sensors with ARM processor, temperature sensor is used to find the temperature of atmosphere, Humidity sensor is used to find moisture of soil, ph sensor is used to find the level of the water and IR sensor is used to detect whenever any object occur and those information will send to field crop monitoring section using Zigbee module.

b. Monitoring Section

The paddy data from section is received by Zigbee receiver in crop field monitoring section. Here the system program will check the crop field information and stores in the database. By using the values it can monitor the agriculture environment.

2. The Atmel microcontroller

The coding will be done by embedded c language. This project kit contains microcontroller (ATMega328p), DHT11, light intensity sensor, Soil temperature sensor. These are input Sensors, whichsenses the respective values and the values will fed to the microcontroller. The environmental parameter values will display on LCD. Whenever the microcontroller catches the determined values from input sensors, it checks temperature value by using the condition written in program of embedded c. If the value of temperature is greater than it required, the microcontroller makes the relay to turn ON. The relay causes the motor ON and provides water to the crop automatically. If the temperature level is sufficient to the crop, relay will be stable and it does not causes to turn ON the motor to provide water for the crop. This data is sent to the cloud platform. Additionally, this kit gives graphical representation to the environmental parameters through the microcontroller. Graphical representation will be shown in Cloud platform that is Thing Speak cloud page. This activity is controlled by the Microcontroller

3. Data Acquisition with Different Sensors

The sensor nodes consists of different sensors namely temperature, humidity and soil moisture. These sensing modalities exists in market in variations of hardware, for example, MTS400 sensor contains.

a). The Temperature Sensor LM35 IC, used for sensing the temperature. It is an integrated circuit sensor that can be used to measure temperature with an electrical output proportional to the temperature (in °C). The sensor circuitry is sealed and not subject to oxidation, etc. it has a converter that accurately provides linear and directly proportional output signal in mill volts over the temperature range of 0°C to 155°C.

b). The Humidity Sensor HIH4000, used for sensing the humidity. It delivers instrumentation quality RH (Relative Humidity) sensing performance in a low cost, solderable SIP (Single Inline Package). The voltage is converted to the digital form by the ADC and then sent as input to the microcontroller which reads the data

4. Moving Data to cloud

In 2016 The Edge Computing Consortium (ECC) was created by several organisations: Huawei,

the Shenyang Institute of Automation (SIA) of the Chinese Academy of Science, Intel, ARM, iSoftStone and China Academy of Information and Communications Technology (CAICT). On the other hand, the Chinese Academy of Telecommunications Research (CATR) together with the Ministry of Industry and Information Technology (MIIT) formed the Industrial Internet Alliance (IIA) in 2016 with the aim of boosting the development of industrial Internet in China [20]. The Edge Computing Reference Architecture (EC-RA) 2.0 was proposed from the joint work between the ECC and the AII and it is based on a horizontal layers model with open interfaces. However, vertically this architecture uses the following services: management, data life-cycle and security, with the aim of providing intelligent services throughout the life cycle. The development of this architecture was based on international standards such as ISO/IEC/ IEEE 42010:2011 and it presents Edge solutions and frameworks to industries

Smart Services: this layer is based on a model-driven service framework. Intelligent coordination between service development and operation service framework. These frameworks enable coherent software interface development and automatic implementation and operations.

- Service Fabric (SF): defines the tasks, technological processes, path plans, and control parameters of the processing and assembly phases, implementing fast deployment of service policies and fast processing of multiple types of products.
- Connectivity and Computing Fabric (CCF): the Operation, Information and Communications Technology (OICT) infrastructure is responsible for deploying operations and coordinating between the computational resource services and the needs of the organisation.
- Edge Computing Node (ECN): in this layer the intelligent Edge Computing Nodes (ECNs) have real time processing and response capacities, are compatible with diverse heterogeneous connections and the security is integrated into the hardware and software

The Edge Computing Consortium proposed a Smart Water use case in this a water supply system represents a key urban infrastructure since its correct functioning is essential for the construction of safe smart cities. Based on Edge Computing platforms, the smart water solution uses advanced sensing, networking, computing, control, and intelligence technologies to monitor equipment such as secondary water supply facilities. The urban water supply equipment, information system, and service processes are integrated to support the large-scale exchange of a vast amount of data between multiple systems. This enables full process control, automatic fault diagnosis and predictive maintenance, reducing energy consumption and ensuring water security. The core contributions of Edge Computing to the smart water solution include. Smart gateways collaborate with Cloud-based platforms to receive data analysis models, so that they can analyse data and respond in real time to requests based on company policies. Edge devices are deployed in a distributed way and their number can be expanded on demand. The solution supports life-cycle management of multiple apps for the flexible addition of new services. Hardware platforms have an industry-grade design and multiple interfaces that comply with various protocols.

RESULTS AND DISCUSSION

The following results are obtained while the smart farming technique is implemented in the following diagram that shows the primary thing of WSN applied in order to get Smart farm application for the flow of data. When ATmega microcontroller is connected to Arduino board shown in the below figure.

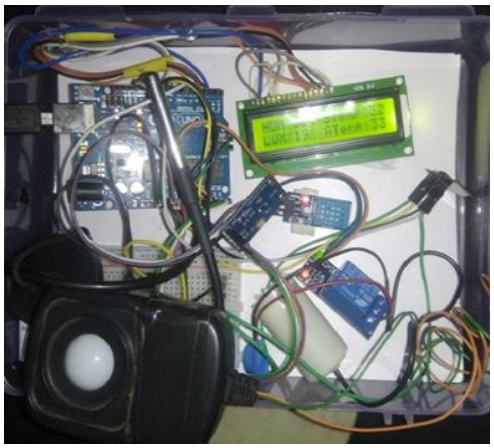

Fig. 1 ATmega micro controller board setup

The following figures shows the variations of humidity, Soil temperature, Ambient temperature and intensity of ambient light when the sensors are used.

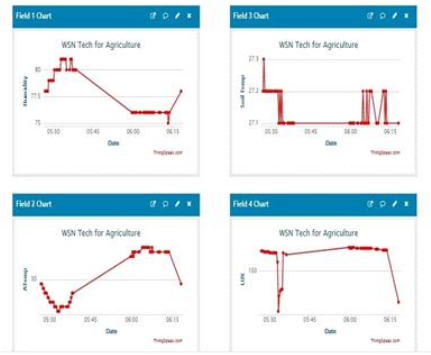

Fig. 2 Observation of various parameters changes with ThingSpeak

Smart farming which takes place by using the WSN with Zigbee and other methodologies make awaken as the best farming methods in the field of agriculture to get good results.

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