International Journal of Recent Technology and Engineering (IJRTE)
ISSN: 2277-3878, Volume-8 Issue-3, September 2019

Smart Precision Agriculture using LORA and WeIO Interface

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Abstract: ***The capability to exploit smart technologies possibly will formulate today's farmers need to direct their farming practice in a better efficient way. To ensue this, technology advancement towards the data access gathered by satellites and drones are vital. The skill of executing these requires real time data transfer with precise and cost-efficient method to foresee and protect the development of farming crops. In this paper, we propose a LORA based smart farming where WeIO interface module is implemented for accurate response to the farmer. Here different parameters pertaining to the growth of crops in agriculture like temperature, light, PH, humidity, soil moisture etc are considered. The method is tested and found to be less cost effective and accurate than existing methods.***

Keywords : LORA, WeIO, smart farming, agriculture, cost effective.

I. INTRODUCTION

Agriculture is one of the most vital component for living. Increasing food and water demand imposes a greater necessity to produce more. Food and Agriculture Organization estimated that global food production needs to be increased by 70% in order to face the growing demand. Farmers mostly rely on their field insight to manage their farm. With proper precision data and some calculations, a farmer could easily identify the aspects of his land which is far away and maintain it accordingly to yield higher production and quality from his place.

Talking about precision farming, it involves the usage of sensors to monitor the crop field and needs energy and manpower for operation and maintenance. A farmer's salary is between 3,000 to 15,000 INR depending upon seasonal changes. Some precision farming set ups which are being used in foreign countries are very expensive and a middle scale farmer cannot afford to buy it. So, to make a model which is affordable and carries out precise calculations to enhance productivity is the main aim of this Smart Precision Agriculture.

The Web of Things (WoT) exploit different approaches, software architectural techniques and programming prototypes to facilitate real-world objects to be an element of the World Wide Web. The Web of Things uses the Web as he application layer. Despite the diverse physically connected devices , WoT provides a distinct widespread application layer protocol to communicate with each other.

The Web of Things provides a readily accessible Web protocol that can be reused.

WeIO can be opened with several browsers and provides an integrated development environment for programmers to build applications. It provides an excellent development board through which various electronic devices can be connected. WeIO software provides two Application Programming Interfaces: Python and Javascript. The WeIO interface is shown in figure 1.

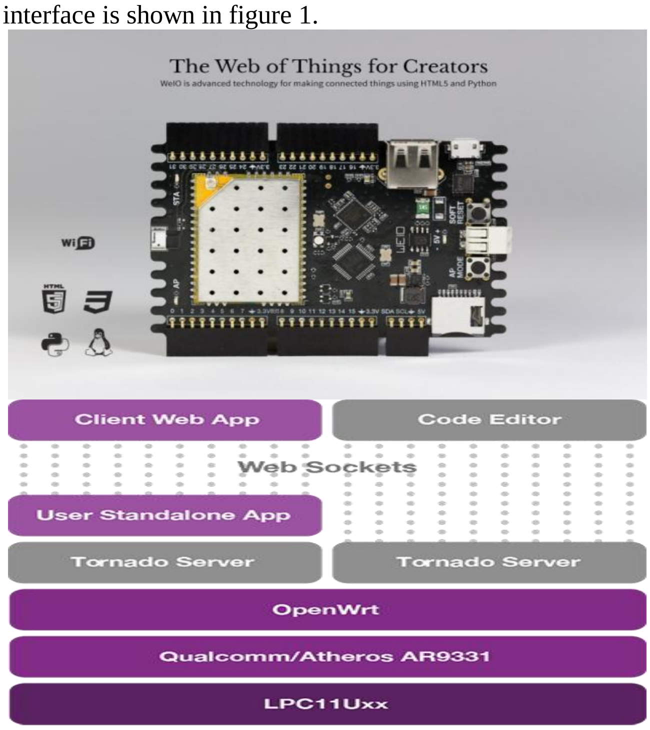

FIGURE 1: WEIO INTERFACE (SOURCE: HTTP://WWW.WE-IO.NET/FEATURES.HTML)

II. RELATED WORK

The authors in [1] developed the MyJohnDeere Mobile (MJDM) mobileapp which maintain client assessment of apps and concepts to John Deere's manufacturing environment. In [2] ,the wireless sensor network and the fuzzy logic theory is combined for esticide reduction towards smart farming.

Manuscript published on 30 September 2019

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The weed detection is employed in [3] to reduce harm to existing surrounding plants where the images are gathered by a micro aerial vehicle (MAV). It uses the encoder-decoder cascaded convolutional neural network, SegNet for implementation,

In [4] the Wireless sensor networks is used to explore possible WSN-based analytics towards precision farming. Precision farming practices used in [5] drastically progress farm production and improves the overall profit and minimizes the ecological pollution . The authors in [6] propose methods to enumerate plantation region . They employ diverse methods to take into account the low elevated images.

The authors in [7] propose an algorithm that employs Bayesian localization based on message passing. It is used in precision agriculture applications, for example pest management and pH sensing in big farms.

In [8] , the water productivity of the annual crops like wheat, barley,corn and biennial crop such as alfalfa, Rhodes grass crops cultivated under centerpivot irrigation located over desert areas of the Al-Kharj region in Saudi Arabia is studied.

III. METHODOLOGY

The model description is designed to monitor a field of size 1 hectare which is the average field size that an Indian farmer owns. Sensors fixed at appropriate regions of the field collects data about the field and sends it the IoT node station. The station transmits the data wirelessly to a transceiver module named LoRa WAN (Long Range wireless Wide Area Network). It is a Low Power Wide Area Network (LPWAN) specification intended for wireless battery-operated Things in a regional, national or global network. The LoRa WAN specification provides seamless interoperability among smart Things without the need of complex local installations and gives back the freedom to the user, developer, businesses enabling the roll out of Internet of Things. The data is received at the user end by the WeIO module and it is converted into smart user interface where one could easily trigger some actions and assess the condition of the field by a simple click from the mobile device.

A. Applications of Smart Precision Agriculture

Monitoring agricultural parameters like temperature, sunlight, humidity, health of a crop, amount of fertilizers used, soil properties can be precisely calculated and necessary actions are taken automatically. Some of the actions performed are turning on the sprinkler when the temperature is high and humidity is low, calculating ph. levels in the soils and forming a quality map, control the location of tractors by tracing the paths using GPS thus reducing fuel consumption, maintaining optimum levels of fertilizers being used, generating predictive analysis based on the collected data which gives the farmer a greater insight of the positives and cons of his field.

B. Architecture Planning for field

The architecture plan for one hectare is shown in figure 2. The software requirements is given in Table 1 and hardware requirements is given in Table 2.

Table 1: Software requirements

Software Requirements
WeIO IDE
Thingspeak
Cloud platform
Python, JS
Mobile Application

Table 2: Hardware requirements

Hardware Requirements
Temperature and humidity sensor(LM35/DHT11), Optical sensor(LM393)
Light Sensor(LDR), GPS(Neo-6m)
Ph Sensor (ph. meter), Mechanical sensor
Soil moisture(Hygrometer), Camera(ov7670)
LoRa WAN, NRF24 transceiver

Various sensors are required from the implementation, for example, the LM35 sensor is used for temperature prediction, The different sensors required for the implementation is shown in table 3. It also highlights the different parameter levels required for the good growth of plants.

Table 3: Sensors and its parameters

Sensor	Parameter level
Temperature (LM35)	10 to 25-degreeCelsius (c3 plants) 30 to 45-degreeCelsius (c4 plants)
Light (LDR)	32000 to 100000 LUX
pH	5.5-6.5
Humidity	50 – 70%
Soil moisture	50 - 70%

Some of the existing models which are available in the foreign markets costs more than a lakh and does only few smart farming applications. Table 4 gives the existing methods available in the market along with its cost details.

Table 4: Existing mehods with cost

Some existing models	**Cost**
Standard sensor solution (basic sensoring interface)	Rs. 1,17,063
Inversion measurement solution (basic sensors)	Rs. 1,00,395
CropX (cloud data)	Rs. 58,304/ year

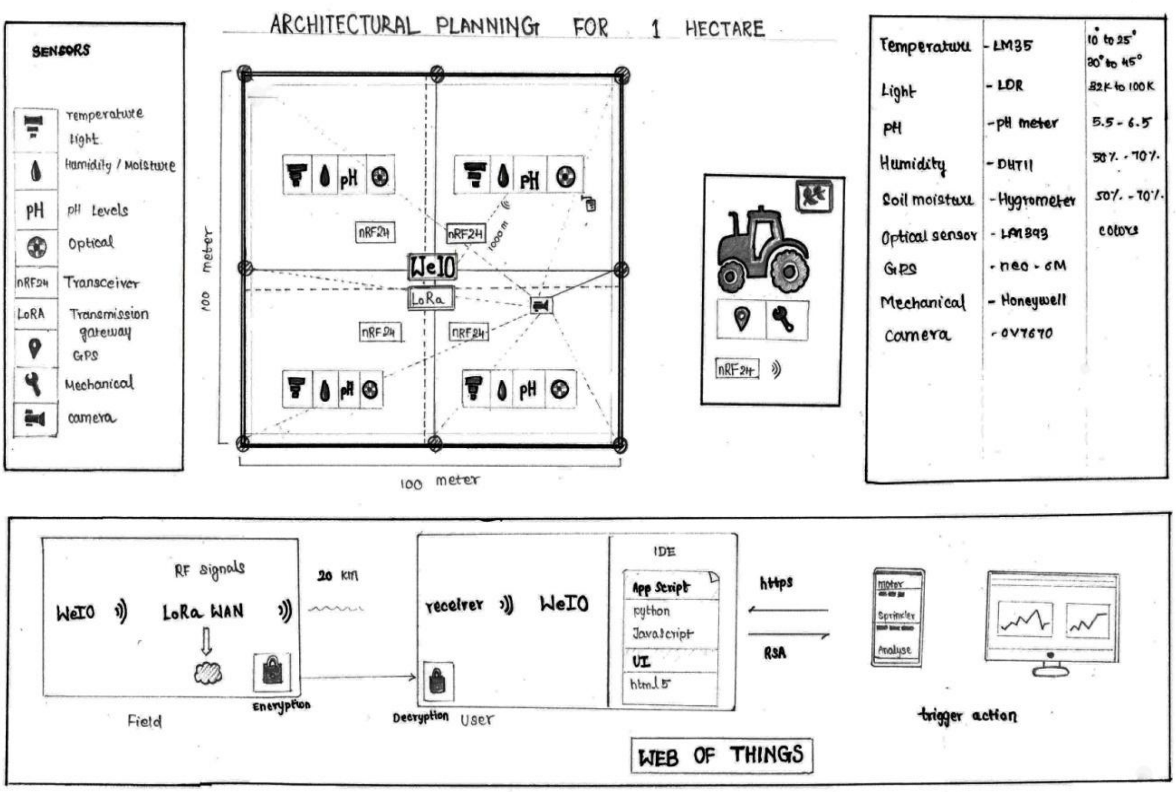

FIGURE 2:Architechture Planning for one hectare

IV. RESULT AND DISCUSSION

The total rough estimated cost of the proposed model costs around 15,000 INR to 20,000 INR with all the monitoring factors and enabling the user to interact and trigger actions from his mobile device on the field even if the farmer is far away from the field. Our method is feasible and cost effective.

V. CONCLUSION

In this paper, a LORA based smart farming is proposed where WeIO interface module is implemented for accurate response to the farmer. Here different parameters pertaining to the growth of crops in agriculture like temperature, light, PH, humidity, soil moisture etc are considered. The method is tested and found to be less cost effective and accurate than existing methods.

FUTURE DEVELOPMENTS

Compared to the available devices which are very expensive for a farmer to buy, the proposed system comes with an affordable amount which is even compensated by the increased production using smart farming within a year. Testing the first model on the field and proceeding with iterative development to increase efficiency and accuracy and also reducing the cost. Analytics in thingspeak platform using MATLAB produces predictive analysis which will be very beneficial to the farmer.

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