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Just raw data is stored in cloud no analysis method is proposed

A Cloud based Soil health Digitalization and Monitoring Technique for Optimum Resource Utilization in Smart Farming

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***Abstract*— The journey of an Agricultural crop from seed germination to the harvesting stage encounters several stages of physical and biochemical changes. The Soil parameters like moisture, macronutrients, and micronutrients play a decisive role to get a healthy agriculture crop with minimal investment and maximal productivity. The information about real-time values of Soil parameters to the end users (farmers) along with scientific advice is essential to avoid over-use or under-use of resources like water and fertilizers, leading to optimal resource utilization. The paper presents Soil sensing technique using spectroscopy and other conventional methods, and its IoT interfacing to measure and digitally disseminate the real-time on-the-soil / information of soil health to the farmers. Further, a cloud based prognostic approach is adopted to assist the farmers for their pilot crops via Maize, Sorghum, and Gram. The proposed technique can be a novel effort in digitalization of manual Soil Health card (Mrida card), and help farmers to increase crop productivity through minimal investigation water and fertilizers.**

Index Terms*— *Soil Parameters, Internet of Things, sensors, spectroscopy method, Cloud computing.

I. INTRODUCTION

India is a country of farmers in which one third of the population depends on agriculture production, with substantial impact on the food production and economic growth of Country [1]. The precision Agriculture can easily monitor and control the changes occur in the Soil parameters. The Site-Specific management IoT based platform uses the design of SmartFramNet to collect the environmental soil and fertilization irrigation data. Manually it can't able to collect such huge information on real time because there is less number of laboratories in the states of country for testing the Soil parameters. It is difficult for farmers to get correct and precise information about their Soil status [2]. Presently, chemical techniques are in practice to measure the valid soil parameters using Soil testing kits confined to laboratories to test more than about 1 crore soil samples every year, which is in the form of soil health card (Mrida card) and provide to the farmers of India [3]. This card only gets physical intervention and give information through very long process. To solve this problem, IoT can help the farmers to control their crops remotely and take appropriate action. Advantage of proposed technique is to digitalize the traditional methods and reduce the testing time, less cost and make it energy efficient [4]. In this paper, a survey of smart adaptive irrigation and fertilization technique based on IoT platform is described. The two parameters which we discussed in this paper are: Soil moisture and Macronutrients like nitrogen (N), phosphorous (P) and potassium (K) [5]. These precious resources must optimally used to maximize the crop growth. The aim of proposed paper is to develop a low-cost cloud-based module used to determine the level of soil moisture and trace macronutrients. The module is to be interfaced with gateways and cloud data to the user as agriculture input. These efforts would help farmers to increase the crop production and also for optimum resources utilizing via fertilizers and water. This paper explores the changes current manual chemical methods into digitalization, which shows the main disadvantages of time consumption for detection of soil.

In IoT research work some literature review is been described, Vani et al. [1] described he monitoring of soil parameter system using IoT with interfacing of Cloud Computing. Mekala et al. [2] explores the information of information of agriculture and sensor monitoring using Cloud IoT technology for store the performed data on field. Jayaraman et al. [4] presents the design of SmartFarmNet an IoT based information of environment of field, irrigation data etc. Athani et al. [5] had developed an automated model to monitor and measure the moisture level using Arduino microcontroller to another Wi-Fi module. This paper based on soil management for North Karnataka- India. Ferrandez et al. [8] proposed technique using IoT with low cost sensors and actuators networks to interface protocols in agriculture field.

II. PROPOSED SYSTEM MODEL

The proposed system model describes hardware and processing sections are as follow:

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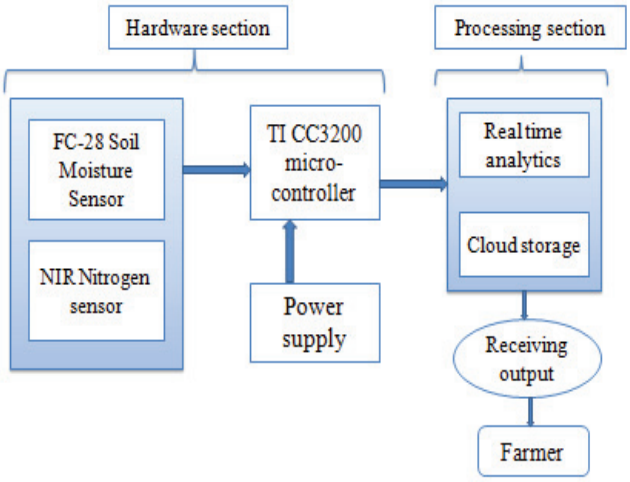

Fig. 1: Schematic of proposed technique

System model consist of major sections via, Hardware section, Software section and Cloud computing unit. Sensing method and receiving method are the part of hardware section where IoT enables TI microcontroller CC3200 Launchpad is used, which is ARM Cortex-M4 80 MHz. Figure 2 describes the CC3200 Lauchpad microcontroller.

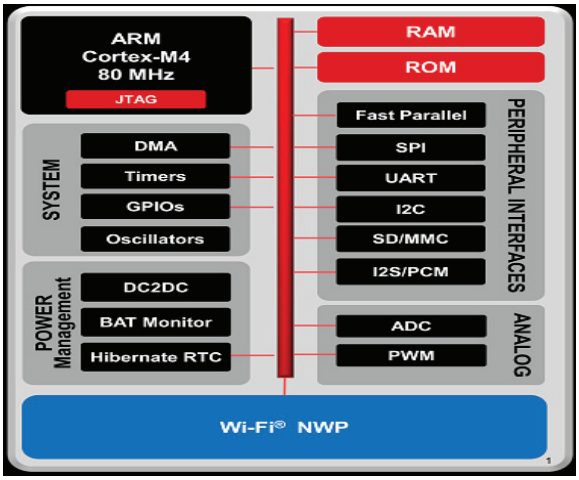

Fig. 2: Launchpad with CC3200

Sensing part consist of sensors like Soil moisture sensor and Near-infrared sensor. Soil can easily to adopt and can depict various soil health parameters. FC-28 is a Soil moisture sensor work in terms of analog voltage also the sensor module has a potentiometer to adjusting the sensitivity level. The operating voltage is 3.3 – 5v [5]. These two probes putting into soil sample and get output signals, LM293 comparator having GND, VCC A0 and D0 pins.

For measurement of Urea content, we will take three test tube fitted it with the light source and a color sensor each, this color sensor used to detect the NPK element. We have to use a chemical method (spectroscopy method) to measure the output in terms of current and voltage, and using near-infrared sensor it can detect the energy level of soil [6]. Urea contains Nitrogen (N), Phosphorous (P) and potassium (K), the total percentage of nitrogen availability is 46% while phosphorous and potassium are becoming Null.

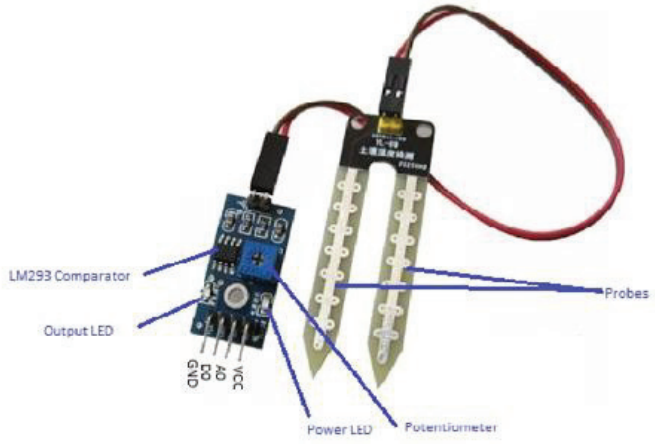

Fig. 3: The Soil Moisture Sensor

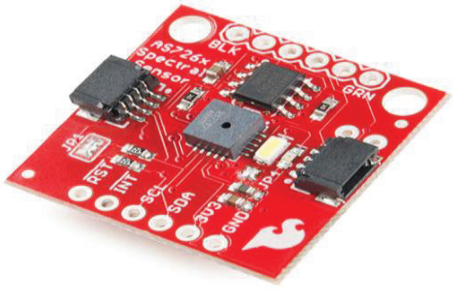

Fig. 4: Near-Infrared sensor

Software part consist of Energia™ software which is an open source and integration development environment (IDE) driven and framework software. Output will be seeing on serial monitor.

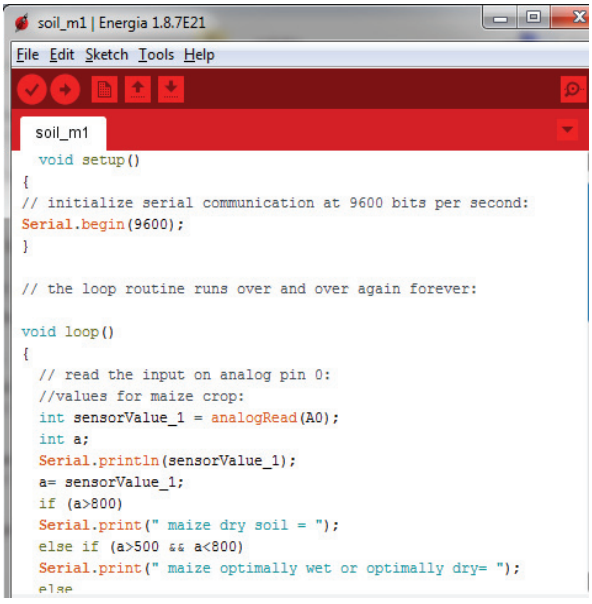

Fig. 5: Energia™ software

III. PROPOSED ALGORITHM

In this paper we have discussed about three main crops these are: Maize (Makka), Gram (Hara Chana) & Sorghum (Jowar). Maize is the third most important food and cash crop in India. It is generally cultivated during or after monsoon. Other way Gram crop, it is also known as chickpeas and this will be cultivated mainly in winter season. Similarly Sorghum which is known as Jowar crop can be cultivated in March to August month. Proposed algorithm describes Soil parameters (Soil moisture and Urea content) are given as input and this input is checked with sensors.

TABLE I: ALGORITHM FOR SOIL PARAMETER SENSING

Algorithm for Soil Parameters
• Take output soil parameter = x. • Now store the standard parameter of soil for comparison. • IF x > database or x < database, then compare with correction factor. • Also send massage to the user, that water quantity or urea quantity is more or less. • User can change according to the database. • If x = database, send a message to the user.

Maize	In percentage	In mm
Total water required	100	500-800 mm
Gram		
Total water required	100	300-450 mm
Sorghum		
Total water required	78	400-500 mm

Fig. 6: The standard parameters for soil moisture of different crops (in mm).

CROPS	NITROGEN	PHOSPHOROUS	POTASSIUM
MAIZE	135 KG/HA	62.5 KG/HA	50 KG/HA
SORGHUM	85.5 KG/HA	42.5 KG/HA	13.6 KG/HA
GRAM	20-30 KG/HA	40-60 KG/HA	17-25 KG/HA

Fig. 7: The standard parameters for macronutrients of different crops (in kg/ha).

IV. METHODOLOGY

The method to execute the proposed technique is as indicated in flow diagram of figure 8:

i. According to the initial process, we take soil samples for interfacing the sensors with CC3200 microcontroller by the use of analog to digital converter.
ii. Other two sensors are active and examine the moisture level and urea content present in the given soil.
iii. Developing a code with standard database in Energia IDE.
iv. Now, transmit the data serially and comparing it with dry or wet condition of soil.
v. After comparison, it generates correction factor.
vi. After getting decision of received information data is interface with cloud based module.
vii. Finally get message in mobile phones.

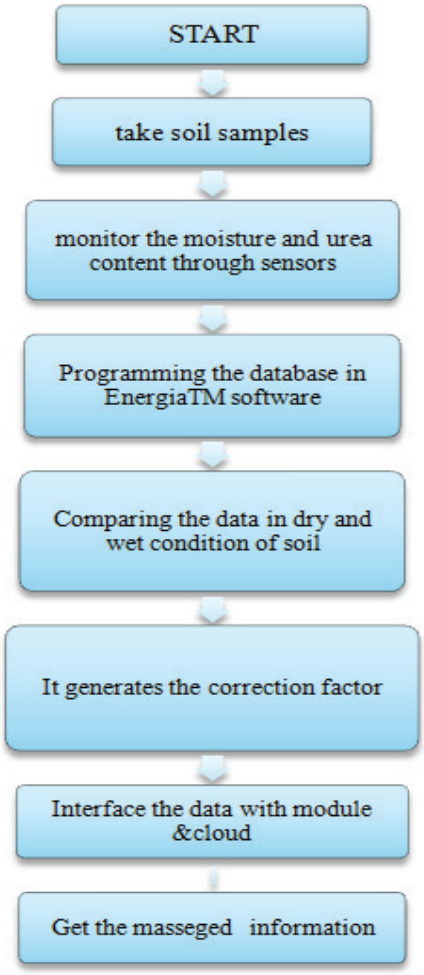

Fig. 8: Flowchart of the proposed work

Some results have been described that how sensing technique is much better than physical method which happens in laboratories. Comparison table shows the Physical methods readings and sensing technique readings for soil moisture.

TABLE II: READINGS OF SOIL MOISTURE USING CC3200 MCU AND LABORATORY TESTING

S.No	Water added (ml)	Thermo-gravimetric (%)	CC3200 readings (%)
1.	80	11.3	10.1
2.	100	12.36	14.12
3.	120	15.1	15.81
4.	140	17.2	17.2
5.	160	20.3	18.11
6.	180	24.5	18.9
7.	200	27.8	19.11
8.	220	27.9	20.02
9.	240	32.2	22.0
10.	260	32.4	23.8

The above table shows how sensing technique is much better than physical methods for measuring soil moisture for one crop. It is similar way to find the Urea availability in the given soil sample and compare the physical data with our proposed technique data. After getting data from sensor we can interface with cloud computing and messaging system applied to give instant information to the user. Thus user can also take appropriate decision according to the parameters.

V. CONCLUSION

A novel sensor based Soil Health Monitoring technique is proposed and discussed. Combining Soil moisture level and Urea concentration parameter provides a very good data results in terms of low cost, time consuming, accurate and precise data given by device and energy efficient. Thus as conclusion this proposed technique will be very helpful for the farmer to get information in real time and save laboratory testing time, also this paper plays a decisive role to get a healthy agriculture crop with minimal investment and maximal productivity.

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