

# IoT based Smart Agricultural Management and Recommendation System

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**Abstract** — About 1/3rd of the world work-force are now employed in the field of agriculture and amount is steadily falling only due to economic crisis faced by the farmers. The major reason for this particular financial loss is due to lack of the technology in the field of Agriculture. The continuous usage of crops and also using the fertilizer again and again causes significant decline in productivity of the soil and it also effects environment too. Due to Improper usage of irrigation system which results in the wastage of water. This paper gives a glimpse on how the soil efficiency can be streamlined by implementing the present technology like IoT (Internet of Things) in the current existing system. Specifically, the paper describes four key features which makes farming easier. One of those is to recognize the measure of soil supplements like nutrients and also natural conditions. The key supplements that are responsible for plant development are Nitrogen, phosphorous and potassium. The moisture of soil, pH level and natural conditions likewise impacts the profitability of producing crops. Proper use the drip irrigation system saves a lot of water and also gives better yields. In this work, the framework fused with different synthetic compounds and to report level of NPK, level of pH, Temperature of the soil, moisture level of the soil, climate conjecture and the utilization of computerized drip irrigation water system framework using sensors. In the system proposed, the sample soil is taken as input to perform chemical reaction, later color sensors senses the changes that occur due to chemical reactions and it is decoded by colorimetry technique. The sensed data will be utilized to develop an android application based on the suggestions and test report. In order to monitor the soil temperature, humidity and water saving irrigation we have installed a wireless irrigation control system in each of the irrigation management. A valve regulator is automatically turned on for water to flow through the water system (drip irrigation system), in this way decreasing wastage of water. This paper has proposed a logical method to build up a robust, completely computerized and minimal effort savvy cultivating farming solution to suit the financial states of limited scope ranchers in agricultural nations.

**Keywords** – Soil, Nutrients, Agriculture, NPK level, pH level, soil moisture level, Arduino, Automated Drip Irrigation System.

## I. INTRODUCTION

In India the primary occupation is agriculture. According to the survey held by India Brand Equity Foundation, about 58% of the people from rural areas in India are dependent on the agriculture. As per the statistics revealed from Central Statistics Office 2nd advised estimate, contribution from agriculture is roughly around 10% to the gross value addition in India. For this the crops should be carefully maintained and it is needed and should take utmost care for good yields.

Abiotic parts including geography and soil are the elements affecting creation of plants. Today, agribusiness happens for huge scope yet the agrarian driven development, neediness decrease, and security of food are in question. The environmental changes could decrease the harvest yields, particularly on the planet's most food unsure areas. All the plants require a good set of micronutrients, for its development. Among every supplement which are important for plant development, Nitrogen, Potassium and Phosphorous are the essential macronutrients needed by plants for strong development. Usually Urea (incorporates nitrogen) utilized for plant development gets hydrolyzed enzymatically to ammonia by a protein called as urease, which is found in the soil microorganisms. Since the change is exceptionally quick, and surpasses the pace of which the plants can use the delivered Ammonia. Just 45% - 60 % of Urea applied in regular manures gives off an impression of being used by plants, while rest filters into water, or lost to air by denitrification process. Phosphorous is a significant part in the plant RNA and DNA. It is basic in creation of seed, development of crops and improvements in roots. Composts like di ammonium phosphate and ammonium phosphate are a few hotspots for Phosphorous. The job of Potassium is circuitous as it's utilized to enact more than eighty compounds all through the plant. It assists the plants with making solid stems, it expands the capacity of the plant to cope outrageous climatic conditions and causing to develop quick and battle with the diseases. It expands water use proficiency and also converts the sugar to starch in grain filling measure. Potassium chloride or Potash is one hotspot for potassium. The acidity of the soil or the pH is key

factor that ensures solid plant development. Explicit plants differ in the dirt pH they incline toward generally. Henceforth, soil observing is the fundamental system for cultivating. The uncommon harvest yields because of troublesome climate conditions and barren soil drove the ranchers to deal with monetary issue causing numerous self-destructive cases across the entire world. In this way, as to limit such disadvantages there is the need of organized, adjusted system which is useful for rough advancements of agribusiness.

## II. EXISTING SYSTEM

For improvement of crops, and to also shield the plant from natural defilement, soil testing is significant. By soil testing reason, farmers are encouraged to take the soil tests to research facilities in laboratories. Laboratory soil test has its own positive benefits, yet it takes a longer effort for test results to show up. Electro-chemical sensors are additionally utilized for checking the soil supplements. It utilizes particle specific anodes (ISE) and particle particular field impact semiconductor (ISFET) for soil supplement identification and is unequipped for continuous detecting executions on account of the suspension in the execution time. Electro-chemical sensors are regularly costly and is also bigger in size, which makes it unaffordable for the farmers.

To know about weather, they need to check in the news or any other private app and to avoid intruding animals they need separate systematic arrangement to manage it. They do not have any unified system at low cost which can help them.

## III. PROPOSED SYSTEM

### A. Automated Drip Irrigation System

The proposed system has also concerned with automatically irrigating the fields noting the content of moisture in soil and actual need for plants to grow and give a better yield.

#### 1. Block Diagram

For a water irrigation system execution, a field is regularly partitioned into water system the executive units dependent on soil attributes, crop water necessities, and financial variables before the establishment of the control framework. A remote incorporated water system control framework is introduced in every water system the board unit to screen soil temperature, humidity and guarantee water-saving water system. The valve regulator created is intended to work independently without hard-wire associations between each control units. Every regulator is intended to work on Motor force. Soil moisture judgments and water system choices happen at fixed standard stretches set by the controller. Regulators are synchronized for estimation and water system choices. After estimations and water system choices are made, controller focus conveys message to valve regulators. Every regulator introduced in framework is modified to handle control orders got from controller focus to independently open a water system solenoid valve, setting off hand-off support driver unit. At long last, every regulator stores the relating valve status input data from state criticism. It comprises of the control unit, power unit, remote correspondence unit, hand-off support driver unit, state input switch.

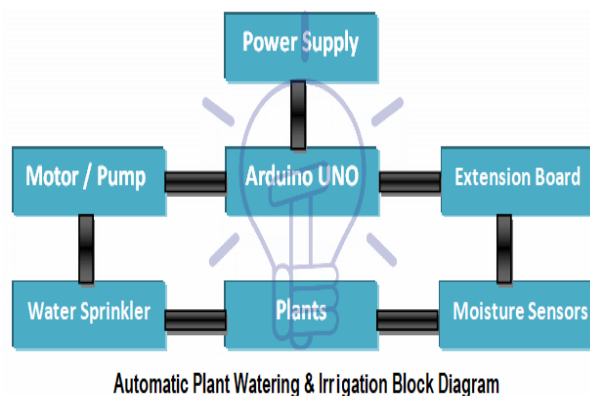


Figure 1 – The Block Diagram of Proposed System

2. Solenoid valve

A solenoid valve is an electromechanical valve. The valve is constrained by an electric flow through a solenoid coil. Solenoid valves may have at least two ports: on account of a two-port valve the stream is turned on or off; on account of a three-port valve, the outpouring is exchanged between the two outlet ports.



FIGURE 2 - Solenoid Valve

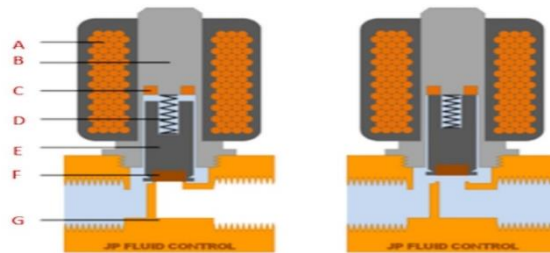


FIGURE 3 - Working of Solenoid Valve

3. Soil Moisture Sensor

Soil moisture sensor is basically used to gauge the amount of water content in the soil. Soil moisture sensor that is been utilized in the current work, has two tests that can be embedded into our soil. Soil moisture sensor gives the yield in simple structure which is changed over into computerized structure. The Soil moisture sensor is utilized in different fields like water system frameworks and in various field of Agriculture.

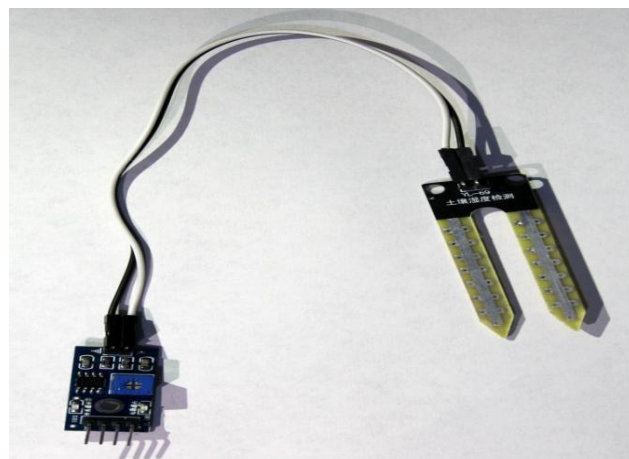


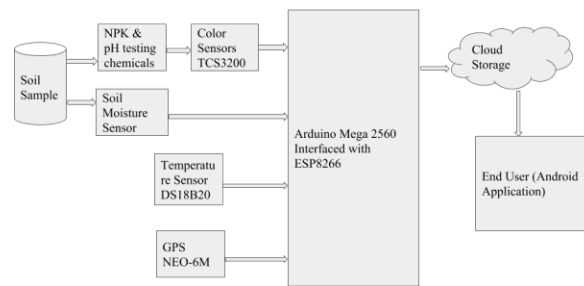
FIGURE 4 - Soil Moisture Sensor

**B. NPK Tester Kit**

For a brief glance into the soil reports, cost-effective house kits have been given that are prepared to study the information stored by the sensors. The framework depends on shading diagrams to coordinate with the supplement levels in a soil solution. The kit gives a fundamental report of the pH and supplements that are promptly accessible and they are best for farmers from different segment measurements. An easy to use portable application has been enabled so that any farmer and landscaper can get ongoing admittance to information the executives, climate determining, soil checking, and the Internet of Things. In this manner, the farmers can strategize appropriately with the information that have been assembled and can unequivocally gauge the means to expand the viability of composts and irritations and use them wisely.

**1) The Block Diagram**

The proposed system encloses with pH testing chemicals and NPK, colour sensors, temperature sensors, soil moisture sensors, Arduino Mega, GPS, and Android application.



**FIGURE 5 – Block Diagram**

**2) NPK and pH testing chemicals**

Substance test utilizes turbidimetry and colorimetry to gauge four factors normal in the soil testing – Potassium, Nitrogen, Phosphorus, and the pH. The test is provided with a Nitrate reagent, Phosphate reagent, Potassium reagent which on responding with arrangement gives shifted colors. Furthermore, in view of the force of shading delivered, we can anticipate whether the power of supplements is high or low. Soil pH goes from pH 5.4 to 7.0 is inactive for most plants. Be that as it may, a few animal categories tells to have more acidic or soluble nature. Regardless of that, each plant advance inside a particular pH range that emphatically impacts the accessibility of supplements in the soil.



**FIGURE 6 – NPK and pH Testing Chemicals**

### 3) Color Sensor

The color sensor is utilized to distinguish the shading as RGB recurrence. TCS3200 shading sensor has been utilized in this framework. The sensor has of four diverse photodiodes, where the red channel comprise of 16 photodiodes, blue channel comprises of 16 photodiodes, green channel comprises of 16 photodiodes, and the rest 16 comprises of clear without any channels. Each channel has its own comparing tone. The TCS3200 estimates the recurrence of light. The sensor comprises of eight pins. In the sensor, there are four LEDs fitted, which are for the most part used to picture the article tone accurately.



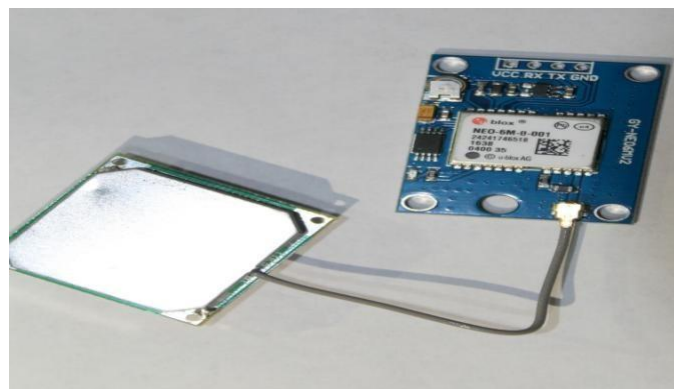
**FIGURE 7 - TCS3200 Color Sensor**

### C. Environmental Condition Readings

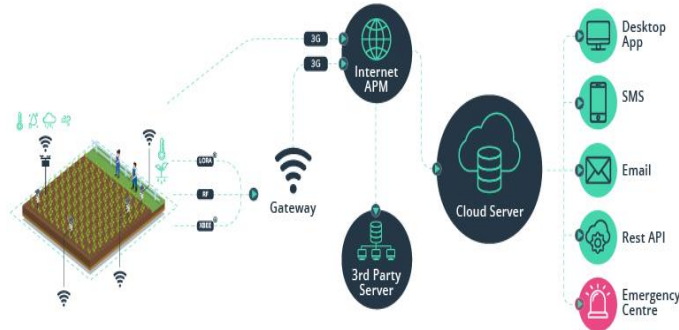
#### 1) GPS

GPS, It is utilized in different spots like in military applications, the horticulture field, and hence GPS NEO 6M has been utilized in this framework. NEO 6M GPS module is a finished GPS beneficiary with a fired receiving wire. NEO 6M GPS gives a solid satellite inquiry ability.

With the assistance of force and sign pointers, the situation with the module can be checked. With the assistance of the information reinforcement battery, the module can save the information when the fundamental force is closed down incidentally or erroneously. The necessary force supply for NEO 6M GPS is 2-5V and the default baud rate is 9500 bps.



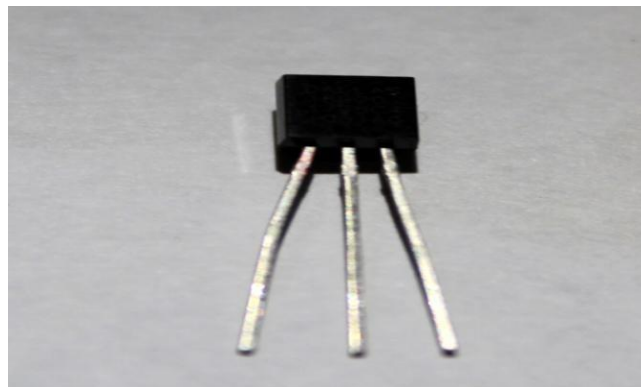
**FIGURE 8 - GPS NEO - 6M**



**FIGURE 9 – Working of Proposed System**

2) *The Temperature Sensor*

The temperature sensor is utilized to identify the temperature. The DS18B20 temperature sensor has been utilized in this framework. The DS18B20 can quantify the temperature from - 54°C to +126°C with an appropriate exactness of  $\pm 6^\circ\text{C}$ . The DS18B20 is the ideal decision for estimating the temperature at a few focuses. This sensor is little in size and takes a low measure of energy.



**FIGURE 10 – Temperature Sensor**

**IV. WORKING**

The NPK testing system working model is divided into three parts –

1) Soil Sampling

First and foremost, the soil example has been taken in such a manner with the goal that it should genuinely address the region being inspected. Following steps have been taken –

1. The field is been separated into different homogeneous units dependent on the visual perception.
2. The surface waste has to be eliminated from the examining territory.
3. The soil test has been attracted in the wake of burrowing to a furrow profundity of around 15 centi-meters.
4. The examples have been gathered similarly from each testing unit and have been put in a can.
5. The examples have been completely blended and all unfamiliar materials like stones, roots, rocks, and other unnecessary things have been taken out.

6. The soil test and water must be taken into a pail in the proportion 1:2.
7. The example has been completely blended, left until the dirt gets settled down.
8. The testing cups has to be taken out from pack and the example has been put up to the checked level.
9. The soil test has been taken in each other box to distinguish the dirt dampness level.

2. Soil Processing

1. pH and NPK testing synthetics have been placed in the particular inspecting cups.
2. The example has been blended until the synthetic compounds get broken down.
3. The example has been left for 20 minutes for the shading to be changed.
4. The pack has been turned on by driving up the stockpile.
5. All the sensors have been actuated and begun to detect information.
6. All detected information have been shipped off distributed storage with the assistance of the ESP8266 module.

3. Report

The android application and the website has been launched to get the corresponding soil report and other important recommendation for farming.

**V. EXPERIMENTAL RESULTS**

A methodology has been continued in planning the Internet of Things based recommendation system using soil nutrient and environmental condition detection. The exploratory outcome acquired from the planned framework has shown that the framework execution is exact and solid.

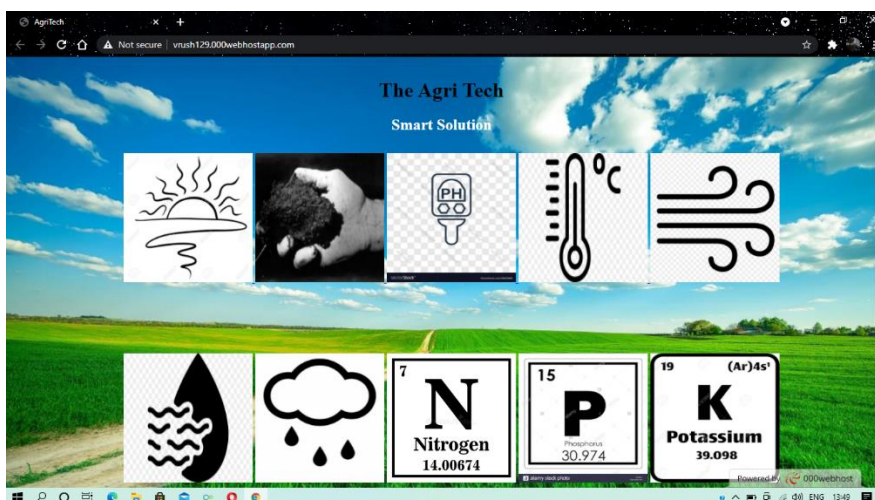


FIGURE 11 - Website

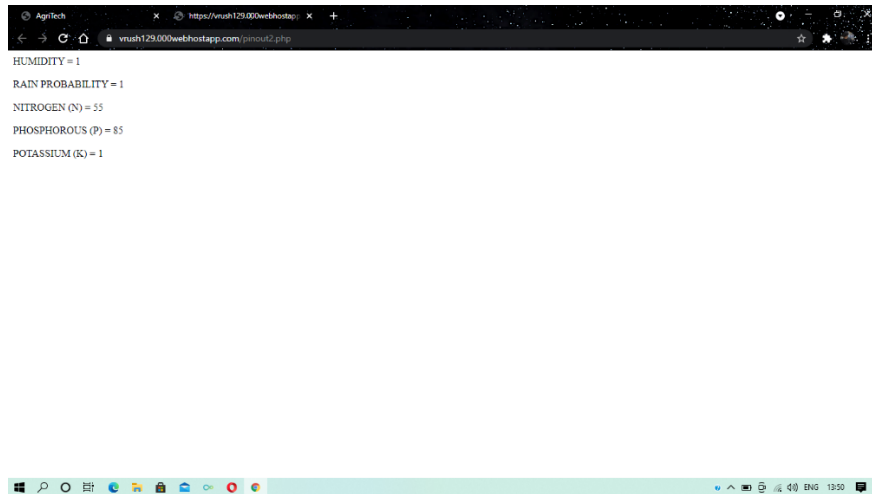


FIGURE 12 – Experimental Results 1

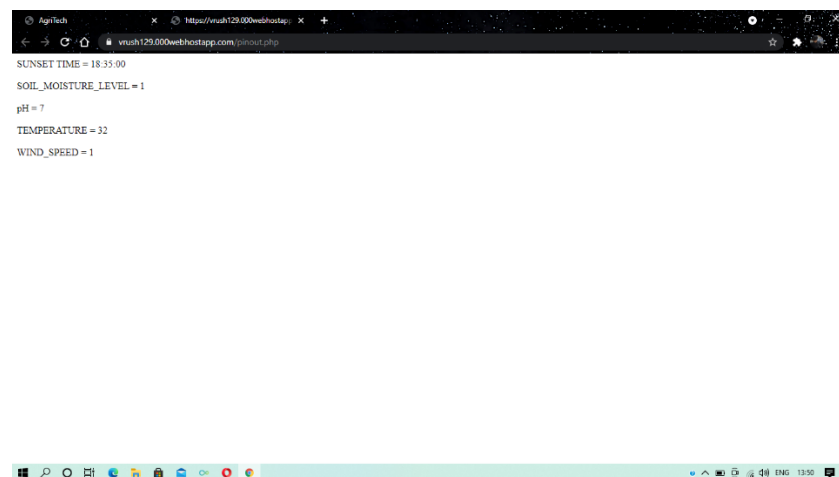


FIGURE 13 – Experimental Results 2

Figure 12 and 13 shows the real trial result on the website. The outcome contains the hour of the trial, entry identity, potassium level, phosphorous level, pH, soil dampness, nitrogen level and temperature.

## VI. CONCLUSION

This paper shows how extreme research facility soil tests can lead the way to a sensible and practical soil test utilizing the kit. Thinking about all prospects of errors that occur, the kit has been fabricated and the framework is coded and tried with good details to obtain. The proposed framework has taken the soil example as the information and played out the substance responses utilizing reagents. The comparing changes in the colour of the example have been detected by the colour sensors and decoded by the colorimetry procedure. Soil moisture sensors and temperature sensors have additionally been utilized to check the temperature and the moisture level. A GPS has been utilized to get the area of the field so the climate conjecture can be gotten from the closest climate station. Arduino Mega interfaced with Wi-Fi central processor has been utilized to get the information from the sensors and to send that information to the cloud. A website and an android application has been worked to show test report. The examination has recommended that instead of depending on tedious research facility soil reports, the client can have elective methods for checking the dirt reports utilizing a versatile IoT - cloud-based soil pack. Besides, synthetic substances and sensors have been utilized in the framework rather than electro-chemical sensors to make it moderate for the end-clients. Likewise, the exceptional plan of the proposed unit has expanded the maintainability of the framework.



## CONFLICT OF INTEREST

It has been proclaimed that the decision of all equipment gadgets and programming applications utilized in the current work was exclusively on an expert premise. There is no immediate monetary connection with the brand names referenced in this paper that may prompt an irreconcilable situation.

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