

IOT Based -Smart Agriculture Monitoring System for Improving Production and Cultivation

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Abstract – Internet of Things (IoT) has upset numerous fields in the current past. It addresses numerous viewpoints identified with the information administration, stockpiling and availability. This work will center around the utilization of IoT to programmed water system framework. The framework will utilize a microcontroller, ideally of 8-bit. Microcontroller utilizes remote sensor hubs put in the ranch and gathers data, for example, temperature, soil dampness, water level, weight, stickiness. This data assembled is then put away on cloud. Microcontroller utilizes a WiFi module associated in station mode. The WiFi module builds up an association with a switch and posts the information occasionally to the cloud. It utilizes the normal IEEE 802.11 standard convention stack for correspondence amongst gadget and the web. Information transmitted to the cloud can be utilized to control the water system. The framework can be additionally reached out to caution the rancher to make vital strides as per the climate parameters.

Keywords – Internet of Things (IoT), Microcontroller,

I. INTRODUCTION

The world is confronting new difficulties in this progress organize, where issues like worldwide warming and elective vitality sources are of major concerns. Practical advancement is essential as opposed to financial development. Previously ecological, social and financial angles are seen as particular elements yet they are by and by seen as a consolidated entity. Good administration must advance strategies with maintainability in all areas for example, assembling, agribusiness, and administrations. Climatic change, populace development and craving happen on account of

the exhaustion of common assets. To effectively address some of these issues, we require multidisciplinary approaches. Farming generation and development has a huge effect in filling the essential human requirement for nourishment. Salary can be created from generation, readiness, bundling and appropriation of sustenance

II. LITERATURE SURVEY

1. Existing framework

The adequacy of an agrarian framework is essentially relies upon the exact arrangement of continuous estimations. In [1], parameters, for example, soil condition and stickiness are assumed control over a more drawn out periods. This information is amassed and dissected. The valuable data

after the examination is passed on to the rancher for direction. This can be connected for computerized strategies to the yield development process chain moreover.

In [2], a remote multi-work custom stage was created. It is a specially Printed Circuit Board (PCB) that is outlined as simple to utilize stage that contains ATmega128 microcontroller. This controller can have working frameworks, for example, Contiki or TinyOS. This board likewise contains a locally available IEEE802.15.4 with a superior built-in reception apparatus that can accomplish a scope of 300m in line of-locate conditions when the yield control is 3mW.

In [3], creators proposed a savvy Agriculture Framework (AgriSys) that can examine a situation what's more, mediate to keep up its amplex. The framework utilizes surmising rules which can be redesigned effectively what's more, controls the agrarian condition. It takes care of soil pH, temperature and dampness inputs. The framework is all climate consistent and functions admirably in leave particular climate, for example, clean, sandy soil, wind bearing, low stickiness. It can likewise withstand diurnal and occasional temperatures. The framework created was omnipresent and gives remove access with improved security, and expanded efficiency.

III. INTERNET OF THINGS

Web OF THINGS The Internet of Things (IoT) is the interconnection of interestingly identifiable implanted

Figure ring gadgets inside the current Internet framework. Web of Things speaks to a general idea for the capacity of system gadgets to detect and gather information from our general surroundings, and after that offer that information over the Internet where it can be handled and used for different fascinating purposes. Some additionally utilize the term modern Internet conversely with IoT. This alludes principally to business uses of IoT innovation in the realm of assembling. The Internet of Things isn't restricted to mechanical applications. Some future customer applications imagined for IoT seem like sci-fi, yet a portion of the more functional and sensible sounding conceivable outcomes for the innovation include:

- Accepting notices on your telephone or wearable gadget when iot systems distinguish some physical threat is identified adjacent.
- Self-stopping vehicles.
- Programmed requesting of basic needs and other home supplies.
- Programmed following of activity propensities and other everyday individual action including objective following and customary advance reports.
- Potential advantages of iot in the business world include.
- F. Area following for singular bits of assembling stock.
- Fuel investment funds from astute natural displaying of gas-controlled motors.
- As good as ever wellbeing controls for individuals working in perilous conditions.

1. Iot Communication Models

Web of Things Communications Models From an operational viewpoint, it is helpful to consider how IoT gadgets interface and convey regarding their specialized correspondence models. In March 2015, the Internet Architecture Board (IAB) discharged a managing compositional report for systems administration of savvy objects (RFC 7452), which diagrams a structure of four normal correspondence models utilized by IoT gadgets. The discourse underneath presents this system and clarifies key attributes of each model in the structure.

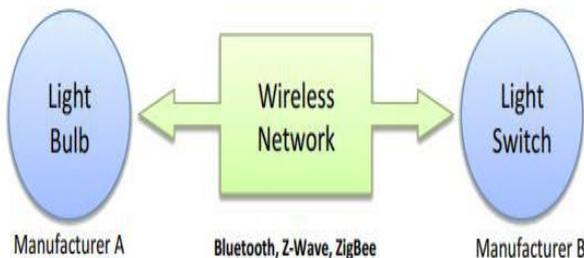


Figure1: Example of gadget to-gadget correspondence demonstrate.

2. Gadget To-Device Communications

The gadget to-gadget correspondence demonstrates speaks to at least two gadgets that straightforwardly associate and

impart between each other, instead of through a go-between application server. These gadgets impart over numerous sorts of systems, including IP systems or the Internet. Frequently, however these gadgets utilize conventions like Bluetooth, Z-Wave, or ZigBeeto build up guide gadget to-gadget interchanges, as appeared in Figure 1

3. Gadget To-Cloud Communications

In a gadget to-cloud correspondence demonstrate, the IoT gadget associates straightforwardly to an Internet cloud benefit like an application specialist organization to trade information and control message activity. This approach often exploits existing correspondences components like conventional wired Ethernet or Wi-Fi associations with set up an association between the gadget and the IP arrange, which eventually interfaces with the cloud benefit. This is appeared in Figure 2.



Fig. 2 Gadget to-cloud correspondence show chart.

This correspondence show is utilized by some well known purchaser IoT gadgets like the Nest Labs Learning Thermostat and the Samsung Smart TV. On account of the Nest Learning Thermostat, the gadget transmits information to a cloud database where the information can be utilized to break down home vitality utilization. Further, this cloud association empowers the client to acquire remote access to their indoor regulator through a cell phone or Web interface, and it additionally bolsters programming updates to the indoor regulator. This is generally alluded to as "merchant secure", a term that incorporates different features of the association with the supplier, for example, responsibility for access to the information. In the meantime, clients can for the most part have certainty that gadgets intended for the particular stage can be coordinated.

4. Gadget To-Gateway Model

In the gadget to-entryway model, or all the more regularly, the gadget to-application-layer door (ALG) demonstrate, the IoT gadget interfaces through an ALG benefit as a conductor to achieve a cloud benefit. In more straightforward terms, this implies there is application programming working on a nearby portal gadget, which goes about as a delegate between the gadget and the cloud benefit and gives security and other usefulness, for example, information or convention interpretation. The model is appeared in Figure3.



Fig. 3 Gadget to-portal correspondence demonstrate outline.

A few types of this model are found in purchaser gadgets. As a rule, the neighbourhood passage gadget is a cell phone running an application to speak with a gadget and hand-off information to a cloud benefit. This is regularly the model utilized with well known customer things like individual wellness trackers. These gadgets don't have the local capacity to interface straightforwardly to a cloud benefit, so they often depend on cell phone application programming to fill in as a middle person door to associate the wellness gadget to the cloud.

5. Back-End Data-Sharing Model

The back-end information sharing model alludes to a correspondence design that empowers clients to trade and examine keen protest information from a cloud benefit in blend with information from different sources. This design underpins "the [user's] want for giving access to the transferred sensor information to outsiders". This approach is an expansion of the single gadget to-cloud correspondence show, which can prompt information storehouses where "IoT gadgets transfer information just to a solitary application specialist organization". A back-end sharing design permits the information gathered from single IoT gadget information streams to be collected and investigated. The back-end information sharing model recommends a unified cloud administration's approach or cloud applications developer interfaces (APIs) are expected to accomplish interoperability

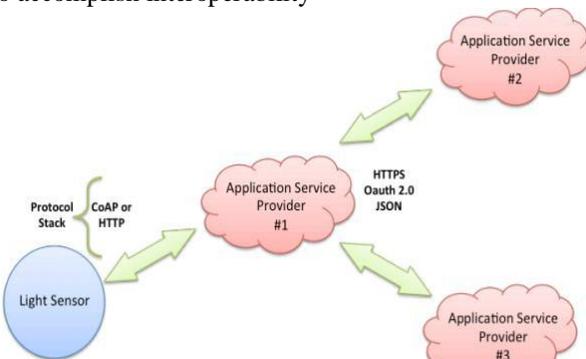


Fig. 4 Back-end information sharing model graph.

This engineering model is a way to deal with accomplish interoperability among these back-end frameworks. As the IETF Journal proposes, "Standard conventions can assist yet are not adequate to dispense with information storehouses since normal data models are required between the sellers." at the end of the day, this correspondence show is just as powerful as the fundamental IoT framework plans. Back-end information sharing structures can't completely defeat shut framework plans. Web of Things Communications Models Summary The four essential correspondence models exhibit the fundamental outline techniques used to enable IoT gadgets to convey.

IV. FRAME WORK OVERVIEW

The framework we are creating will centre around the utilization of IoT to programmed water system framework. The framework will utilize a microcontroller, ideally of 32-bit. Microcontroller utilizes remote sensor hubs set in the homestead and gathers data, for example, temperature, soil dampness, water level, weight, stickiness. This data assembled is then put away on cloud. Microcontroller utilizes a Wi-Fi module associated in station mode. The Wi-Fi module builds up an association with a switch and presents the information occasionally on the cloud. It utilizes the basic IEEE 802.11 standard convention stack for correspondence amongst gadget and the web. Information transmitted to the cloud can be utilized to control the water system. The framework can be additionally reached out to caution the rancher to take essential. The general framework configuration is appeared in Figure. 5

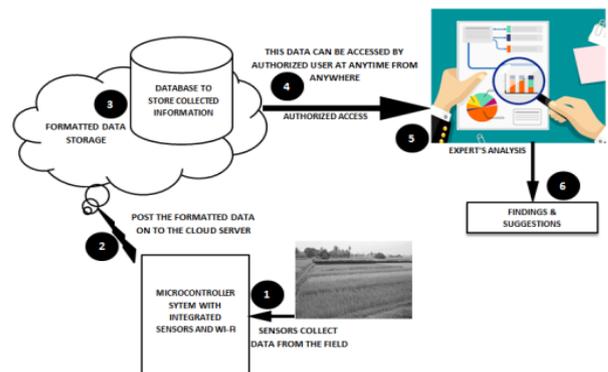


Fig. 5 General System View

Figure5 demonstrates the piece outline of the framework. As should be obvious, there is microcontroller to which we have sensors connected in the field. These sensors are utilized to quantify

- Soil pH esteem
- Soil Moisture Content
- Ground and Surface Water Levels
- Temperature and Humidity

The whole setup is introduced at a ranch. The sensors gather the information from the introduced ranch and give this

information to the microcontroller. The microcontroller will process this information and organizations this into an appropriate bundle that can be utilized to post information. The server on the cloud handles this information and stores it as information esteem table. A specialist or any approved client can get to this information utilizing a key and influence examination on the information keeping in mind the end goal to provide for proposals to the rancher in light of the broke down information.

1. Equipment

Arduino Uno is a microcontroller board in view of the ATmega328P (datasheet). It has 14 computerized input/yield pins (of which 6 can be utilized as PWM yields), 6 simple sources of info, a 16 MHz quartz precious stone, a USB association, a power jack, an ICSP header and a reset catch. It contains everything expected to help the microcontroller; essentially interface it to a PC with a USB link or power it with an AC-to-DC connector or battery to begin.. You can tinker with your UNO without worrying a lot about accomplishing something incorrectly, most dire outcome imaginable you can trade the chip for a couple of dollars and begin once again once more.

"Uno" implies one in Italian and was denoted the arrival of Arduino Software (IDE) 1.0. The Uno board and form 1.0 of Arduino Software (IDE) were the reference adaptations of Arduino, now advanced to more up to date discharges. The Uno board is the first in a progression of USB Arduino sheets, and the reference demonstrate for the Arduino stage; for a broad rundown of present, past or obsolete sheets see the arduino list of sheet.

1.1 ATMEGA328



Fig.6 MEGA328 Microcontroller Board

Table 1. MEGA328 Specifications

Micro Controller	ATmega 328
Operating Voltage	5V
Input Voltage(recommended)	7-12V
Input voltage(limits)	6-20V
Digital I/O pins	14(of which 6 provide PWM output)
Analog input pins	6
DC current per I/O Pin	40mA
DC current for 3.3V Pin	50mA
Flash memory	32KB(ATmega328)of which 0.5KB used by boot loader)
SRAM	2KB(ATmega328)
EEPROM	1KB(ATmega328)
Clock speed	16Mhz

The Duemilanove board includes an Atmel ATmega328 microcontroller working at 5 V with 2Kb of RAM, 32 Kb of blaze memory for putting away projects and 1 Kb of EEPROM for putting away parameters. The clock speed is 16 MHz, which means about executing around 300,000 lines of C source code every second. The board has 14 computerized I/O pins and 6 simple information pins. There is a USB connector for conversing with the host PC and a DC control jack for associating an outside 6-20 V control source, for instance a 9 V battery, when running a program while not associated with the host PC. Headers are given to interfacing to the I/O pins utilizing 22 g strong wire or header connectors.

The specific subtle elements of ATMEGA 328 are given in table 1.

1.2 Soil Moisture Sensor

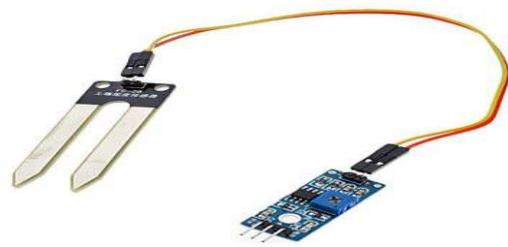


Fig. 7 Soil Moisture Sensor

Fig7 demonstrates the dirt dampness sensor. This Moisture Sensor can be utilized for identifying the dampness of soil or judge if there is water around the sensor, let the plant in your garden ready to connect for human's assistance when they are parched. This sensor is anything but difficult to utilize, you can essentially embed in into the dirt and read the information. The Soil Moisture Sensor utilizes capacitance to quantify the water substance of soil (by estimating the dielectric permittivity of the dirt, which is an element of the water content). Basically embed this tough sensor into the dirt to be tried, and the volumetric water substance of the dirt is accounted for in percent.

- Range: 0 to 45% volumetric water content in soil (equipped for 0 to 100% VWC with substitute alignment)
- Accuracy: $\pm 4\%$ ordinary
- Typical Resolution: 0.1
- Power: 3 mA @ 5VDC
- Operating temperature: -40°C to $+60^{\circ}\text{C}$

By perusing the current between the two anodes changes, the sensor utilizing two tests, the current through the dirt, and after that peruses the subsequent dampness substance of the resistor. More on account of water, the dirt all the more effortlessly control (diminish protection), and dry soil poor electrical conductivity (resistance). The sensor surface made of metalprocessing, can expand its life. Embed it into the dirt, and after that read it utilizing the AD converter.

1.3 Soil pH Sensor

Figure 8 shows the earth pH sensor which is used to measure the soil nature. Plant roots absorb mineral supplements, for instance, nitrogen and iron when they are separated in water. In case the soil course of action is too much destructive or dissolvable, a couple of supplements won't separate easily, so they won't be available for take-up by roots.

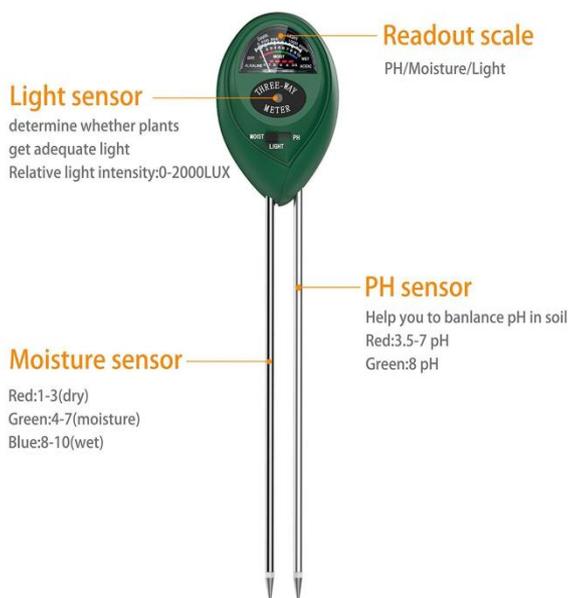


Fig. 8 Soil pH Sensor

Most supplements that plants need can separate viably when the pH of the earth game plan ranges from 6.0 to 7.5. Underneath pH 6.0, a couple of supplements, for instance, nitrogen, phosphorus, and potassium, are less open. Right when pH outperforms 7.5, iron, manganese, and phosphorus are less available. Many common components, including measure of precipitation, vegetation compose, and temperature, can impact soil pH. At the point when all is said in done, locales with overpowering precipitation and timberland cover respectably destructive soils. Soils in territories with light precipitation and prairie cover close impartial. Droughty locales tend to have fundamental soils. In any case, the pH of created and made soils consistently differentiates from that of nearby soil, because in the midst of advancement of homes and distinctive structures, topsoil is occasionally removed and may be supplanted by a substitute sort of soil.

1.4 Temperature Sensor

The temperature sensor (LM 35) is utilized to distinguish the encompassing temperature in the field.



Fig8 Pin Diagram of LM 35

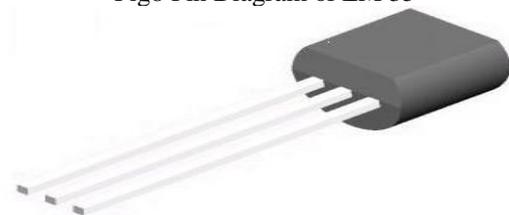


Fig 9 temperature sensor.

Highlights of LM 35:

- Adjusted straightforwardly in $^{\circ}\text{C}$ (Centigrade)
- Straight $+10.0\text{ mV}/^{\circ}\text{C}$ scale factor
- 0.5°C precision guaranteeable (at $+25^{\circ}\text{C}$)
- Evaluated for full -55° to $+150^{\circ}\text{C}$ territory
- Appropriate for remote applications
- Minimal effort because of wafer-level trimming
- Works from 4 to 30 volts
- Under $60\text{ }\mu\text{A}$ current deplete
- Low self-warming, 0.08°C in still air
- Nonlinearity just $\pm 1/4^{\circ}\text{C}$ common
- Low impedance yield, 0.1 W for 1 mA stack.

1.5 Humidity Sensor

Dampness is the nearness of water vapor in air (or some other gas). In surrounding air there is regularly around 1 % water vapor, yet this can differ to a vast degree.

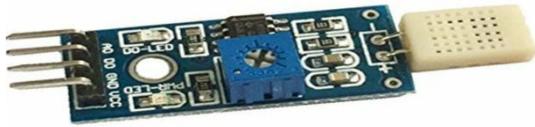


Fig. 10 Humidity sensor.

1.6 Hcsr-04 Ultrasonic Sensor:

The ultrasonic sensor is utilized as level indicator in this framework. It will give a brief explanation of how ultrasonic sensors work in general. It will also explain how to wire the sensor up to a microcontroller and how to take/interpret readings. It will also discuss some sources of errors and bad readings. It shows the water level in the container.



Fig. 11 HCSR-04 Ultrasonic Sensors.

2. Programming

2.1 ARDUINO IDE

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a word processor for composing code, a message zone, a content reassurance, a toolbar with catches for basic capacities and a progression of menus. It interfaces with the Arduino and Genuino equipment to transfer programs and speak with them.

Projects composed utilizing Arduino Software (IDE) are called draws. These portrayals are composed in the content manager and are spared with the document expansion .ino. The manager has highlights for cutting/sticking and for seeking/supplanting content. The message territory gives criticism while sparing and sending out and furthermore shows mistakes. The support shows content yield by the Arduino Software (IDE), including complete mistake messages and other data. The base righthand corner of the window shows the designed board and serial port. The toolbar catches enable you to confirm and transfer programs, make, open, and spare portrays, and open the serial screen. Variants of the Arduino Software (IDE) preceding 1.0 spared portrays with the expansion .pde. It is conceivable to open these records with form 1.0, you will be provoked to spare the draw with the .ino expansion on spare.

Confirm

Checks your code for blunders aggregating it.

 Transfer

Compiles your code and transfers it to the designed board. See transferring underneath for points of interest. Note: If you are utilizing an outer developer with your board, you can hold down the "move" key on your PC when utilizing this symbol. The content will change to "Transfer utilizing Programmer"

- New

Creates another outline.

- Open

Presents a menu of all the portrayals in your sketchbook.

Clicking one will open it inside the present window overwriting its substance.

Note: because of a bug in Java, this menu doesn't scroll; in the event that you have to open a portray late in the rundown, utilize the File | Sketchbookmenu.

- Save

Saves your draw.

- Serial Monitor Opens the serial screen.

Extra orders are found inside the five menus: File, Edit, Sketch, Tools, Help. The menus are setting delicate, which implies just those things important to the work at present being completed are accessible.

2.2 Thingspeak Cloud

Keeping in mind the end goal to send information on cloud we require a server. Thing Speak server enables clients to transfer sensor information upto 50 MB free of cost. Thing Speak is an IoT examination stage benefit that enables you to total, picture and break down live information streams in the cloud. Thing Speak gives moment perceptions of information presented by your gadgets on Thing Speak. With the capacity to execute MATLAB® code in Thing Speak you can perform online examination and preparing of the information as it comes in. A portion of the key capacities of Thing Speak incorporate the capacity to:

- Easily design gadgets to send information to ThingSpeak utilizing well known IoT conventions.
- Visualize your sensor information continuously.
- Aggregate information on-request from outside sources.
- Use the energy of MATLAB to understand your IoT information.
- Run your IoT examination naturally in light of timetables or occasions.
- Prototype and fabricate IoT frameworks without setting up servers or creating web programming.
- Automatically follow up on your information and impart utilizing outsider administrations like Twilio or Twitter.

V. RESULTS

The information from the sensors is presented on the ThingSpeak server. The server give office of Graphical show of the sensor information after some time.

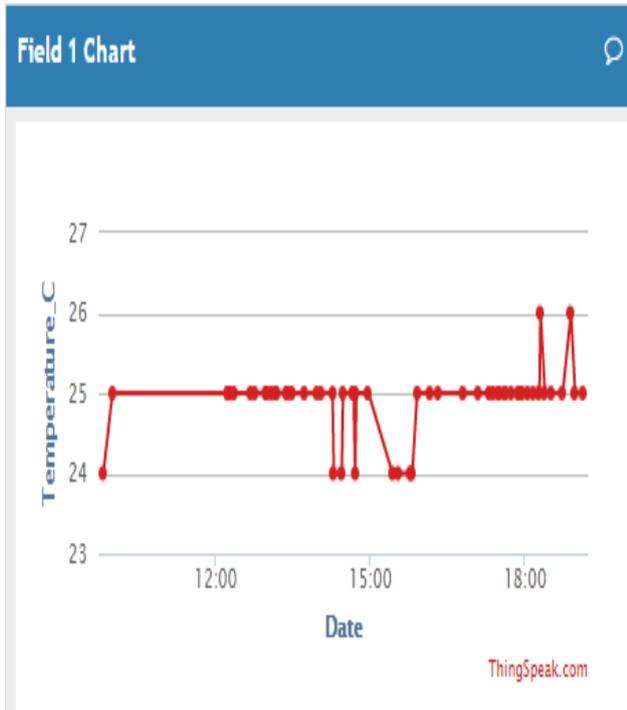


Fig. 12 Temperature Variations

Fig.12. demonstrates the variety of temperature after some time. The sensor has a resilience of $\pm 0.50C$.hence these readings are exceptionally precise.

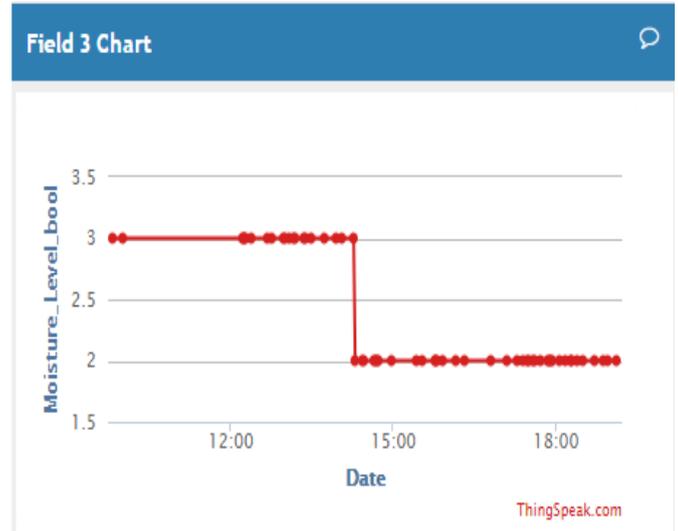


Fig. 14 Soil Moisture Variations.

The dirt dampness readings are appeared in Fig. 14 with a specific end goal to assess the framework we intentionally added water substance to the framework. We have separated the dampness levels into four divisions as appeared in Table 5.1. Voltage is incited between the two stack of the dampness sensor relying on the dampness content. Correspondingly, esteem is created in view of the initiated in the sensor. The same is customized in like manner.

Table 2. Dampness Level Programming

Esteem	Dampness Level
0	Very low
1	low
2	normal
3	high
4	Very high

Figure 15 demonstrates the variety of soil pH. We purposely changed the organization of the dirt by adding to it a known pH esteem answer for test its usefulness. Investigations ended up being bound to the first outcomes.

- Correcting corrosive soil: If your dirt is excessively corrosive, you should include basic material, a procedure regularly called liming. The most widely recognized liming material is ground limestone. The measure of lime you should add to redress pH depends on your dirt kind as well as on its underlying pH.

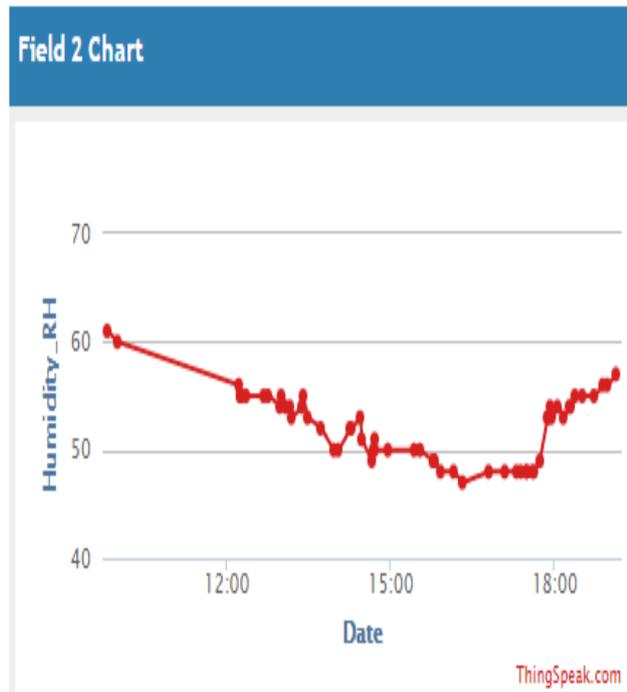


Fig. 13. Mugginess Variations.

The variety of stickiness as far as %RH is appeared in above figur. The %RH Figureuring has a resistance of $\pm 5\%$.

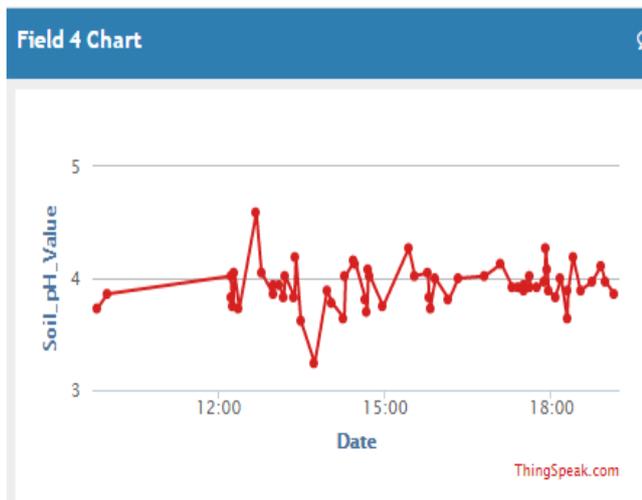


Fig.15 Soil pH varieties.

- Correcting basic soil: If your dirt is excessively soluble, include a wellspring of acidity. The most widely recognized material to include is powdered natural sulfur. As a dependable guideline, include 1 pound of sulfur for every 100 square feet to bring down pH 1 point. Be that as it may, as with lime, the right sum will rely upon your dirt sort and its underlying pH. Testing your dirt and following lab suggestions is the best approach on the off chance that you need to bring down the pH of a whole bed or territory of your yard.

VI. CONCLUSION

In this venture, we propose a shrewd Agriculture System that uses an Internet of Things design. This framework can dissect a domain and intercede to keep up its adequacy. The framework has a simple to-update bank of deduction guidelines to control the farming condition. It predominantly takes a gander at inputs, for example, temperature, dampness, and pH. A answer for observing horticultural situations was displayed. A model framework is created, showing its usefulness for recovering information from sensors, transferring these information through an entryway and putting away and breaking down the information on a server. Along these lines, the outcomes are exhibited to clients by means of a web interface. The framework includes a custom sensor outline for control proficiency, information encryption for security, cost adequacy utilizing off-the rack, shabby segments, and also versatility end simplicity of use. It utilizes the normal IEEE 802.11 standard convention stack for correspondence amongst gadget and the web. Information transmitted to the cloud can be utilized to control the water system. The framework can be additionally reached out to alarm the agriculturist to make fundamental strides as per the climate parameters. As a designer it is our obligation to use the innovative availabilities and shape them such that they are valuable to the general population and agriculturists and

enable them to develop and there by building a more intelligent nation

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