Automated Fertigation System

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Abstract

The growing need for food is causing a rise and expansion in the process of changing farming and agricultural production.Its dependability for farmers will be increased by using IOT inagricultural and crop production, which is an urgent need. Increasing crop productivity is necessary due to the rapid rise of the population. For crops to be more productive, the amount of N (nitrogen), P (phosphorus), and K (potassium) in the soil is essential. The minerals in the soil allow us to determine how quickly the crops absorb nutrients. The minerals in the soil allow us to determine how quickly the crops absorb nutrients. The lack of nutrients causes a decline in agricultural yield.The phrase "macro nutrients" describes the primary nutritional needs for necessary plant growth. But a proper fertilizer balance is required for higher development. The industry's current problems can be solved by smart farming, which places a focus on encouraging creativity and innovation in agricultural and agronomic production. IOT devices and sensors can also be used for that. Agricultural laborers could easily keep an eye on their harvests, crops, or fields and gather the relevant data and information.

I. INTRODUCTION

The productivity of agriculture greatly depends on precise and accurate soil monitoring. In order to boost agricultural or crop production yields, a soil monitoring system that is powered by Internet of Things (IoT) technology is claimed to monitor or oversee soil properties and wirelessly provide the required information to farmers.

Agriculture is the main industry in all emerging economies. Planters are unable to properly utilize their agricultural resources because of the isotropic environment in countries like India. Agricultural labourers ought to be cognizant of the amount of fertilizers present on their land to prevent the misuse of chemical fertilizers. It is customary to determine the distribution of soil micronutrients by transporting soil samples to testing labs and waiting for the findings, but many producers don't seem to be interested in doing that.

Overuse of fertilizers deteriorates soil health, taints groundwater, and contaminates nearby water sources in the event of surface runoff. NPK levels should be kept constant because the macronutrients affect crop yield. To enable farmers to turn a profit without negatively impacting the ecosystem and soil terrain, the concentration of these micronutrients needs to rise or even fall. This experiment will ascertain the amount of nutrients present in the soil, notwithstanding the removal of a soil specimen. Farmers may remotely and quickly evaluate the nutritional condition of their land using this technology.By taking this proactive approach, we may prevent overfertilizing crops while still providing fertilizer where it is required.

II.RELATED WORKS

1. The "Green Growth Management by Using Arm Controller" was given by Bachkar Yogesh Ramdas and Prof. S.G. Galande [1]:Bachkar Yogesh Ramdas, Prof. S.G Galande, (March 2014), “Green Growth Management by Using Arm Controller”, International Journal of Engineering Research and Applications, Vol. 4, Issue 3
In this study, the author developed a scheme that requires instruments to monitor the soil's wetness, humidity, and phosphorus content while also checking up on the heat and sunshine in a crop land. By gathering sensor readings, this mechanism can gather an optimum level of liquid for drip irrigation and phosphorous for plants. This 's major goal is to boost crop yield by providing the right volume of fluid and fertilization. This system produces a workable alternative for use in agricultural monitoring and controls that has been designed, developed, and refined.
2. Purvi Mishra, Sudha Mapara and Preeti Vyas, (Nov 2015) “Testing/ Monitoring of Soil Chemical Level Using Wireless Sensor Network Technology”, International Journal of Application or Innovation in Engineering & Management Volume 4, Issue 11 [2]:

The Testing/Monitoring of Soil Chemical Level Using Wireless Sensor Network Technology [2] that We explored and led us to the conclusion that wireless sensor technology can assist farmers in knowing the precise moment to deliver fertilisers & composting to the crops in order to boost production, reduce timeframe, cost, & labor. The Nitrogen, Phosphorus, and Potassium values of the ground could be measured with this sensing technique.

3. Jianhan Lin, Maohua Wang* , Miao Zhang, Yane Zhang, Li Chen, “Electrochemical sensors For Soil Nutrient Detection: Opportunity And Challenge”, pp 1362-67 [3]:

The researchers of this article explained how soil sampling creates the foundation for nutritional recommendations and fertiliser formulas. In this work, potentiometric electrochemical sensors (ISE and ISFET) for soil NPK detection were briefly reviewed. In soil analysis, the advantages and disadvantages of electrochemical sensors were examined. We discovered that such benefits of potentiometric electrochemical sensors are piqueing interest in their applicability in soil chemical analysis after investigating electrochemical sensors for soil nutrient detection:opportunity and challenge [3]. These have the capacity to quickly and automatically identify soil nutrients across many targets. They consequently have to contend with the difficulty oftheir dependability.

III. OBJECTIVE

1. Precision Nutrient Management:

- Ensure accurate and targeted delivery of fertilizers toplants based on their specific nutrient requirement.
- Minimize wastage of fertilizers by avoiding over-application or under-application.

2. Water Conservation:

- Optimize water usage by delivering the right amount of water needed by plants based on factors such as soil moisture levels, weather conditions, and plant growth stage.
- Implement water-saving technologies like drip irrigationor soil moisture sensors.

3. Automated Monitoring and Control:

- Continuously monitor soil conditions, nutrient levels, and environmental factors to make real-time adjustments to the fertigation system.
- Implement automation to adjust nutrient delivery and irrigation based on predefined parameters.

4. Data-Driven Decision Making:

- Collect and analyze data related to soil health, plant growth, and environmental conditions to make informed decisions.
- Utilize data analytics to optimize fertilization schedules and irrigation patterns for different crops.

IV. WORKING

Agricultural laborers could easily keep an eye on their harvests, crops, or fields and gather the relevant data and information. IOT connects the entire system with the use of web servers, microcontrollers, and sensor systems. The elements including potassium, phosphorus, and nitrogen are shown on this nutrition monitor. In order to utilize the Arduino IDE to create a responsive ESP8266 NodeMCU web server that is available from any device with a web browser, the user would also need to connect the device to their local area network. This suggests that the ESP8266 NodeMCU device and the PC need to be connected to the same network.

Components Needed:

1. NPK Sensor:
 - This optical electrical detecting sensor is used to detect metallic elements (K), such as potassium, and soil gases (N), such as nitrogen and phosphorus (P).

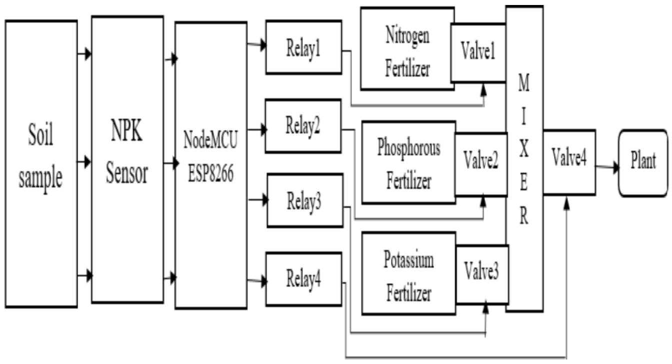
2. ESP8266 NodeMCU:
 - The ESP8266 NodeMCU microcontroller, like the Arduino microcontroller, combines several vital parts into a single circuit board system. There will be visible components such as Micro- USB interfaces, GPIO pins, ADCs, and voltage regulators.

3. Solenoid Valve:

 - Solenoid valve used to regulate irrigation according to nutrientlevels in the soil. An electrically operated valve is a solenoid valve. The valve's solenoid is an electric coil with a movable ferromagnetic core (plunger) in the center.

4. 16X2 LCD display:
 - Liquid crystal display is shortened to LCD.There are severalcircuits and devices that use this specific kind of electronic display module, such as TVs, computers, calculators, cell phones, and more. These displays are mostly used in seven- segment and multi-segment light-emitting diodes.

V. BLOCK DIAGRAM



Plants are subject to a variety of environmental conditions thatvary regularly in both space and time. Soil properties can be determined with the use of heterogeneous Internet of Things devices, like sensors and NodeMCU ESP8266.

The suggested plan operates as follows:

1) Each sensor communicates with the NodeMCU by sensingthe relevant soil properties.

2) The amount of fertilizer in the soil is approximated using theinformation the NPK sensor provides.

3) Through NodeMCU, the detected data is transmitted toThingSpeak Cloud.

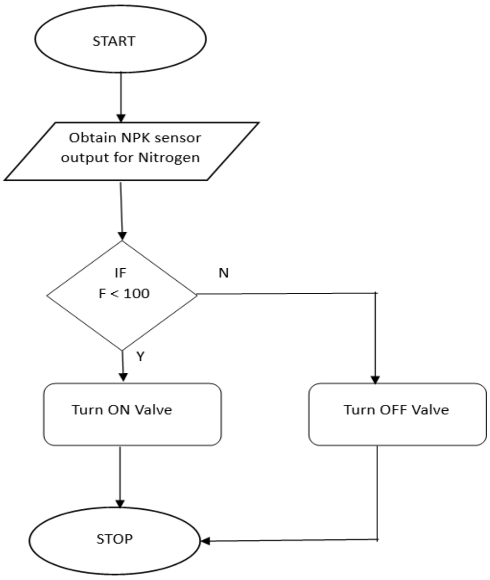
4) Real-time data obtained from sensors is kept on cloud storage.

5) ThingSpeak cloud uses a categorization algorithm to examineand classify stored data.

6) Once the identified data above the threshold values, ananalysis is conducted and the user is notified to take the appropriate action.

7) The NPK sensor's data that are analyzed automatically when they surpass threshold levels Relays are utilized in the fertilizer dispensing process.

VI. FLOWCHART



The dispensary system, microcontroller, and sensor system make up its three key components. Based on the findings of a soil test, the control system determines how much fertilizer needs to be added. Fertilizer is assessed based on the amount of nutrients present and added accordingly. The amount of fertilizer provided as a supplement to crops at different stages of their growth to maintain balance—that is, while the nutrient levels are within optimal ranges—is known as the maintenance dosage.

VII . RESULTS

TABLE II. MAINTENANCE DOSAGE FOR VARIOUS CROPS

CROP	Optimum nitrogen (kg/ha)	Optimum phosphorous (kg/ha)	Optimum potassium (kg/ha)
Rice	100	50	50
Maize	150	75	40
Wheat	100	40	40

Measured value of N = 60. Therefore , Nitrogen valve will open till the value reaches to 100.Same for Phosphorous & Potassium

1. Increased Crop Yield:

Increased crop productivity is the outcome of precise and timely fertilizer supply made possible by automated plant fertigation systems. When fertilizers are applied to plants at the correct times for growth, they become more productive.

2. Resource Efficiency:

By optimizing the use of fertilizer and water, these technologies help cut down on waste. The devices support resource efficiency and conservation by supplying nutrients straight to the root zone and modifying irrigation in response to current conditions.

3. Improved Nutrient Management:

By limiting nutrient runoff, precision nutrient management guarantees that plants get the precise nutrients they require. This lessens the negative environmental effects of too many nutrients entering water bodies and improves crop health.

4. Water Conservation:

Effective management of water resources is made possible by the integration of automated sensors and controllers. These devices help save water in agriculture by monitoring soil moisture levels and modifying irrigation as necessary.

5. Data-Driven Decision Making:

Important insights are obtained from the data gathering and analysis of automated plant fertigation systems. Better results can be achieved by farmers who make educated decisions regarding the timing of irrigation, the application of nutrients, and crop management in general.

6. Remote Monitoring and Control:

Farmers benefit from increased convenience when they can remotely monitor and control the fertigation system. When conditions change or a system alarm occurs, they may react quickly even if they are not physically on the farm.

Discussion Points:

[1] Examine how these systems maximize fertilizer and water consumption, saving resources and lessening their impact on the environment.

[2] In order to make well-informed decisions about crop management, irrigation timing, and nutrient applications, emphasize the value of data gathering and analysis.

[3] Talk about probable problems, such technological difficulties, inaccuracies in the sensors, or breakdowns in the system, and how to solve them.

[4] Talk about how these systems save energy, taking into account the usage of energy-efficient parts and, where appropriate, the incorporation of renewable energy sources.

[5] Analyze the costs and benefits of installing an automated plant fertigation system, taking into account the initial outlay, ongoing expenses, and long-term financial gains.

Additional Considerations:

- The significance of keeping an eye on and maintaining proper soil pH and electrical conductivity levels because these elements might affect how readily available
- systems can modify irrigation schedules and
- nutrient delivery based on expected environmental conditions by incorporating weather forecasts and climate data.

- need for pesticides, and encourage environmentally friendly pest management techniques.

- To evaluate the automated plant fertigation system's overall environmental impact, do a lifecycle study that considers aspects including component disposal, installation, operation, and manufacture.

- Examine how, by optimizing water use and guaranteeing that irrigation is exactly matched with plant needs, automated systems can help lessen the effects of droughtand water scarcity.

VIII . FUTURE SCOPE

AI has the potential to significantly improve water and nutrient management. Large-scale data analysis by machine learning algorithms enables the generation of accurate fertilization and irrigation recommendations that account for crop responses and changing environmental circumstances. More complex and affordable sensors may be created as a result of developments in IoT and sensor technologies. The accuracy and effectiveness of fertigation can be improved by using these sensors, which can deliver real-time data on crop health, soil conditions, and environmental variables. In doing so, issues with food safety and authenticity are addressed by guaranteeing the origin and qualityof produce.

IX . CONCLUSION

The results of this investigation can be summed up as follows: The NPK sensor-module will monitor the nutrients in the soil and communicate the data to the web server online so that it can be watched via any device that has a web page, making seeding easier for farmers and farmworkers. Because the data the sensor detects is posted to a web server, monitoring the nutrient levels in the soil is made easier. Various sensors (NPK) have been tested to measure the presence of soil macro-nutrients, and it has been found that these techniques are identical overall.However, there are a number of issues in independently measuring the nutrients, including the expense of spectrometers and other sensors.

nutrients are for plants to absorb.

- Examine how automated

- The automated system may incorporate tools for monitoring diseases and pests in order to treat plant health concerns quickly, reduce the

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