



Implementation Of Smart Irrigation And Smart Agriculture Using WSN

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ABSTRACT

Smart Irrigation and Agriculture System helps attain easy food production in climate change scenarios. In case of extreme weather conditions, you can easily grow fruits or vegetables using a nutrient solution that contains minerals instead of soil or breed crop varieties that are drought-resistant and disease-resistant. By making farming more connected and intelligent, precision agriculture helps reduce overall costs and improve the quality and quantity of products, the sustainability of agriculture and the experience for the consumer. To improve the crop Yield, we have to measure the important nutrient of the farm area. we have to used Innovative and latest technology such as Arduino, Cloud Technology, Multiple sensors for measuring Nitrogen, Phosphorus and Potassium along with Wireless Sensor connectivity to design an Intelligent Smart Irrigation and Agriculture System. Using Blynk Wireless Sensor cloud data monitoring user can view real-time values. Controller and Sensors network are used to monitor and control the hardware devices present in the Farming Area. For Irrigation purpose water pump is controlled using Soil moisture sensor automatically. Smart Agriculture system is designed using a Highly Precision NPK sensors to measure the soil quality that is required for better crop growth. This data is processed using Micro-controller and sent to the wireless network using Cloud server. User can monitor this from anywhere

Keywords: Sensor Connectivity, Blynk Wireless Sensor, Cloud Data Monitoring, Sustainability, Intelligent Farming, Real-time Monitoring, Crop Yield Improvement

INTRODUCTION

In most regions of the world, population growth has resulted in water scarcity. Agriculture wastes a significant amount of water. Water logging during irrigation is the leading cause of water waste in this area. As a result, there is a need to convert to alternate irrigation methods. Agriculture is the primary occupation in India and is the backbone of the Indian economic system . Agriculture provides employment opportunities to rural people on a large scale in underdeveloped and developing countries in addition to providing food. It is the process of producing food, fibre and many other desired products by the cultivation and rising of domestic animals. Agriculture is the primary source of livelihood for about more than 58% of India's population. Rainfed agriculture, groundwater irrigation, and irrigation systems are some of the techniques introduced to produce healthier crops that may not use water efficiently, but climate change will restrict crop productivity in areas where irrigation is most needed and increase water demand.

In order to use water efficiently a smart system is designed. In the system farmers need not make the water flow into fields manually, but the system automatically does that efficiently. A rain-drop (Soil Moisture) detecting sensor intimates the controller if there is rainfall, making the water supply to reduce or stop depending upon the moisture content at the moment. The crop requirements such as amount of humidity,

temperature and moisture content are to be studied and can be installed again in the controller to meet its circumstances

Agriculture is the primary occupation in India and is the backbone of the Indian economic system. Agriculture provides employment opportunities to rural people on a large scale in underdeveloped and developing countries in addition to providing food. It is the process of producing food, fiber and many other desired products by the cultivation and rising of domestic animals. Agriculture is the primary source of livelihood for about more than 58% of India's population. Climate changes will have a significant impact on agriculture by increasing water demand and limiting crop productivity in areas where irrigation is most needed. Irrigation system, rain fed agriculture, groundwater irrigation are some of the methods introduced to produce healthier crops which may not use water efficiently. In order to use water efficiently a smart system is designed. In the system farmers need not make the water flow into fields manually, but the system automatically does that efficiently. The traditional methods practiced by people may result in huge wastage of water. Hence, the concept of robotized farming with a mix of IoT has been developed. The technological advancements began to increase the efficiency of production remarkably thus, making it a reliable system. The knowledge of properties of soil determines the water supply to be driven in a smart way. The practice of agriculture in a smart way helps to acquire knowledge of soil and temperature conditions.

An NPK sensor is a highly accurate sensor used to measure three essential soil nutrients: nitrogen (n), phosphorus (p), and potassium (K). These nutrients play an important role in plant growth and overall soil health. NPK sensors are usually integrated into smart agricultural systems to assess soil quality and optimize fertilizer applications.

The sensor works by detecting the concentration of these nutrients in the soil and by transporting the data to a microcontroller or cloud-based monitoring system. This information helps farmers to make data-operated decisions, improves crop yield and stability. In smart irrigation systems, NPK sensors are used with other sensors such as soil moisture sensors to ensure efficient resource use.

Zuraida Muhammad. Et.al, The term "Internet of Things" refers to the connection of objects, equipment, vehicles, and other electronic devices to a network for the purpose of data exchange (IoT) [1].

Divya J., Divya M. Janani V: Agriculture is essential to India's economy and people's survival [2].

H.G.C.R. Laksiri, H.A.C. Dharmagunawardhana, J.V. Wijayakulasooriya: Development of an effective IoT-based smart irrigation system is also a crucial demand for farmers in the field of agriculture [3].

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METHODOLOGY

In this project we have designed a Innovative solution for Smart Agriculture and Irrigation System using WSN Technology and Blynk server. Arduino based Controller board, LCD module, NPK Sensor, DHT Sensor are used a major key element of the system. This sensor data is processed using Arduino controller and further this data are displayed on LCD Module. In Smart Irrigation, this system monitors the water level in the agriculture field, if it crosses the threshold level than pump will on or else the pump will be switched off Condition. In Smart Agriculture, NPK Sensor is used to monitor the Nitrogen, Phosphorus and Potassium content of the Soil along with DHT Sensor it monitors the Temperature and Humidity of the Environment.

Relay module is used to Switch on or off the pump based on microcontroller signals. Moisture sensor is used to monitor the Soil dry and wet status. If the Soil is in dry condition than Water pump will on and if it is wet condition, water pump will be off. AC and DC Pump will be use demonstrate the IoT based Blynk cloud server is used to monitor this Sensor data from anywhere in the world. Nodemcu is used for Wi-Fi Connectivity and upload this data on Cloud server. User can monitor this data Blynk based Cloud Application on Mobile Phone.

Embedded C Programming language is used program this entire system. Onboard usb programmer is used to upload the code in the Arduino controller. Sensor modules are analog pins of Microcontroller and Output devices are connected to the Digital pins of microcontroller board.

The power supply setup of the system contains a 12V Battery, Voltage Regulators, Filter Capacitors and Charging Circuit. 12V Output form 7812 Voltage regulator and 5V Output from Voltage regulators is used to power Microcontroller, and Ultrasonic Sensor. Filter capacitor are used to remove ripples from DC Voltage. Charging Circuit along with 12V adapter is used to charge the 12V battery.

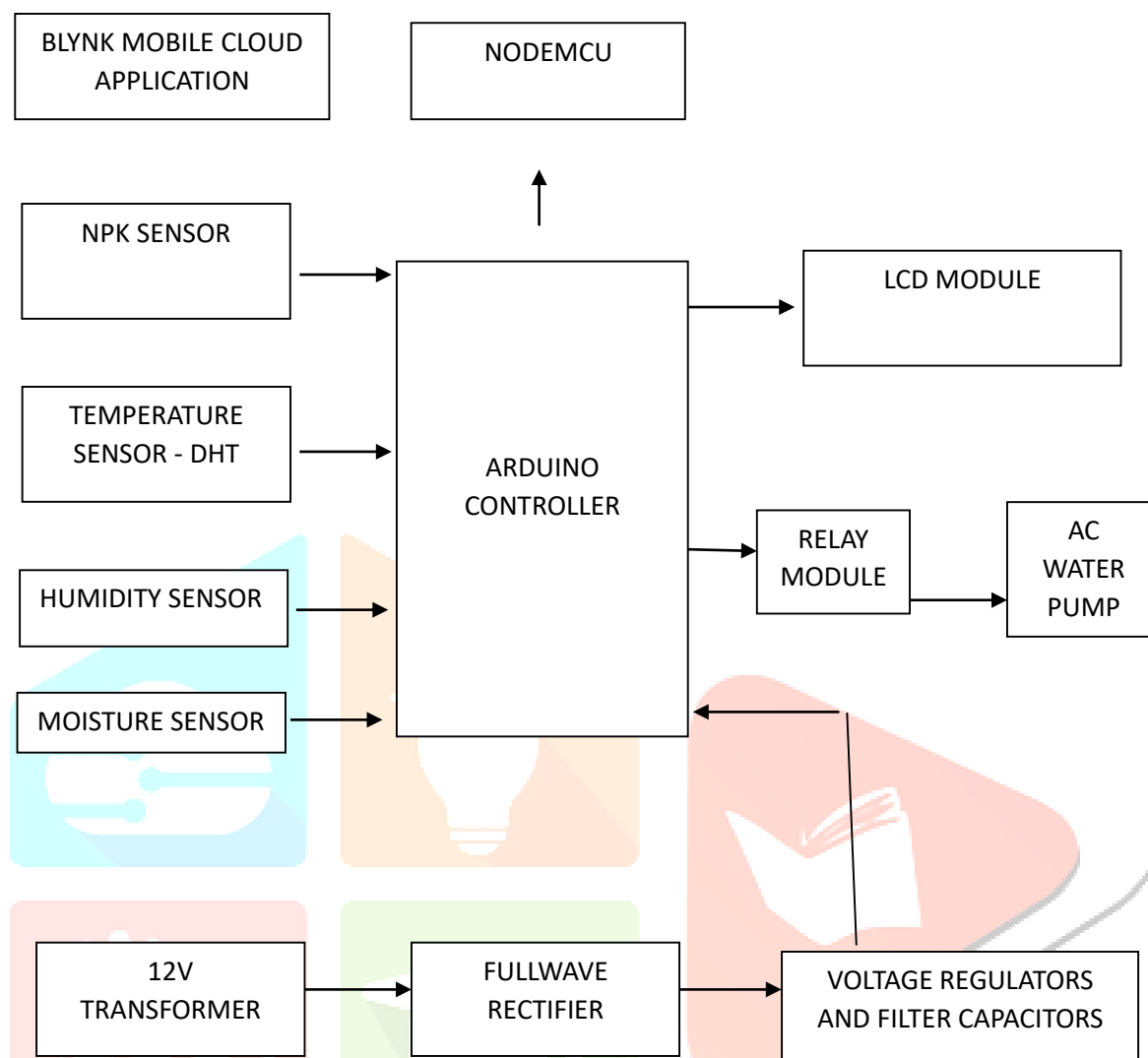
Block Diagram :

Fig (a): Smart irrigation and smart agriculture block diagram

fig(a) shows the smart irrigation system using an Arduino controller, which integrates multiple sensors to monitor soil and environmental conditions. It includes NPK, temperature, humidity, and moisture sensors to gather data, which is displayed on an LCD module and transmitted via Node MCU to a cloud-based application (Blynk). The system also features a relay module that controls an AC water pump based on real-time soil moisture levels, ensuring efficient irrigation. A 12V transformer, full-wave rectifier, and voltage regulators provide stable power to the system. This setup enhances precision agriculture by automating irrigation and optimizing resource use.

result:

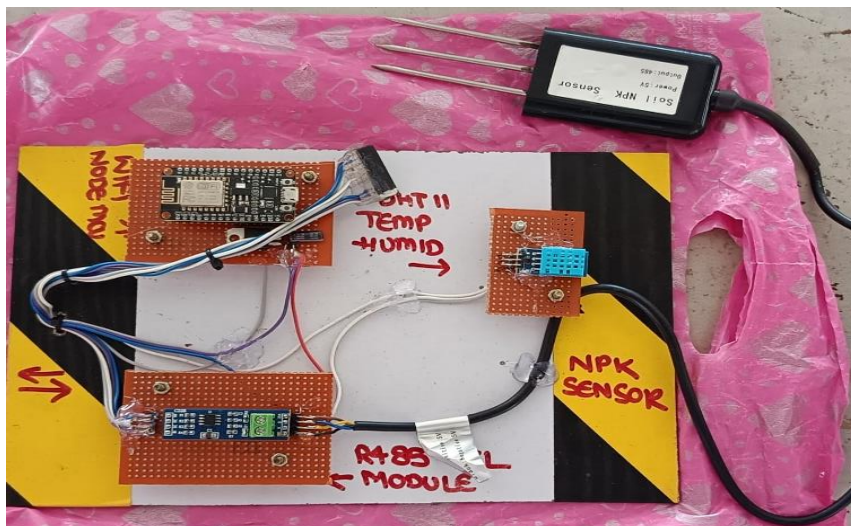


Fig. 1: The image showcases a smart irrigation system prototype integrating Arduino UNO, sensors, and a relay-controlled water pump for automated irrigation.

fig (1) shows the smart irrigation system prototype features an Arduino UNO as its central controller, interfacing with various components such as an LCD module, moisture sensor, relay module, and a water pump. The system is powered by a 12V transformer and a rectifier circuit to ensure stable operation. It collects real-time soil moisture data and automatically activates the water pump when needed, optimizing water usage. This setup demonstrates an efficient and automated approach to precision agriculture, reducing manual intervention and enhancing crop health.

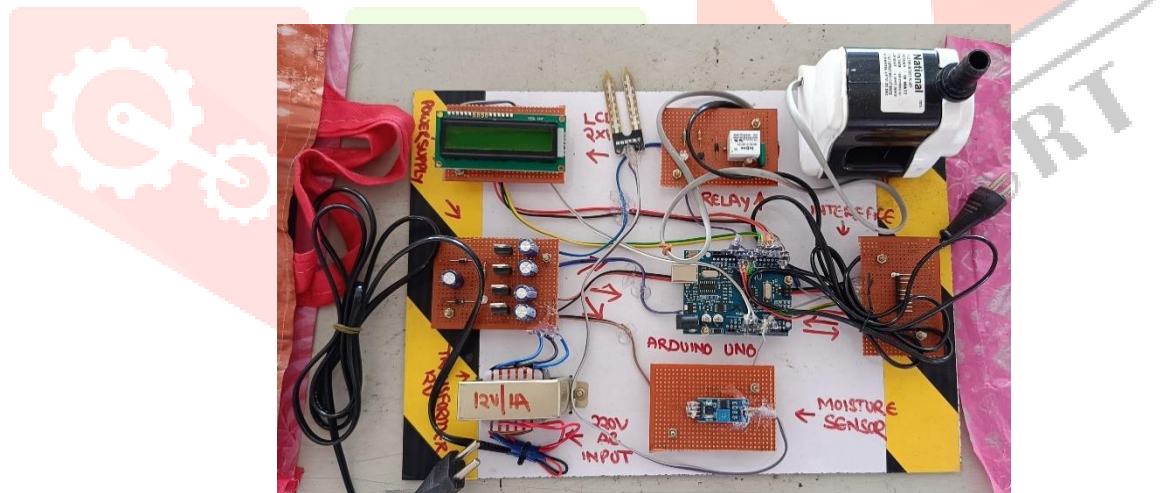


Fig. 2 : The image depicts a smart agriculture system prototype incorporating a Node MCU, NPK sensor, DHT11 sensor, and RS485 module for real-time soil and environmental monitoring.

fig (2) shows the agriculture system prototype is designed to monitor soil nutrients and environmental conditions using IoT technology. The Node MCU microcontroller processes data from an NPK sensor, which measures soil nutrient levels, and a DHT11 sensor, which tracks temperature and humidity. An RS485 module facilitates communication between components, ensuring reliable data transmission. This system enables real-time monitoring and data visualization, helping farmers make informed decisions on irrigation and fertilization for optimized crop growth and resource efficiency.



Fig .3: The image displays a complete smart irrigation and soil monitoring system integrating Arduino UNO, NodeMCU, multiple sensors, and an automated water pump for precision agriculture.

fig (3) shows the smart agriculture system combines Arduino UNO and Node MCU to automate irrigation and monitor soil health. The left module handles irrigation, featuring an Arduino-based controller, moisture sensor, relay module, and AC water pump for automatic water flow control. The right module focuses on soil and environmental monitoring, using a Node MCU with an NPK sensor for soil nutrients and a DHT11 sensor for temperature and humidity. An RS485 module ensures reliable data transmission. This integrated setup enables efficient water and fertilizer management, optimizing crop growth while conserving resources.

Irrigation-part:



Fig. 4: The image shows a smart irrigation system deployed in an outdoor environment, integrating sensors, an Arduino-based controller, and an automated water management setup.

fig (4) shows the automatic irrigation system uses an Arduino Uno, a moisture sensor, a relay module, and a water pump. The sensor detects soil moisture and sends data to the Arduino, which controls the pump via a relay. An LCD display provides real-time monitoring, and a power supply module ensures operation. This system conserves water and reduces manual effort by irrigating only when needed.



Fig .[5]: The image shows a drip irrigation setup controlled by a smart system, delivering water directly to plant roots for efficient water usage.

fig (5) shows a soil moisture sensor being inserted into the ground near plant roots. Soil moisture sensors help monitor water content in the soil, ensuring optimal irrigation for plant growth. By measuring moisture levels, farmers and gardeners can prevent overwatering or underwatering, leading to healthier crops and efficient water use.



Fig .6: A water pump drawing water from a container as part of a smart irrigation system for automated plant watering.

fig (6) shows a water pump connected to a tube. By optimizing water usage, these systems help conserve resources, reduce manual effort, and ensure that plants receive the right amount of water at the right time, improving crop health and sustainability.



Fig .7: An LCD screen displaying temperature, humidity, and soil moisture readings from a smart irrigation system when it is in dry condition

fig (7) shows the LCD module connected to a smart agriculture system, displaying real-time environmental parameters such as temperature (T), humidity (H), and soil moisture levels. These values are obtained from various sensors integrated with a microcontroller, helping farmers monitor and automate irrigation efficiently. By analyzing soil moisture levels, the system can trigger a water pump when needed, ensuring optimal plant growth while conserving water.



Fig .8 : Water is being dispensed through a pipe for irrigation in an automated smart farming system.

fig (8) shows the water from the tube after sensing the value of the soil moisture sensor the water is automatically pumped in to the soil, This system likely utilizes sensors to monitor soil moisture levels and trigger a water pump when necessary. By automating irrigation, the system ensures efficient water usage, reducing manual labor and optimizing plant hydration based on real-time environmental condition.



Fig .9: An LCD screen displaying temperature, humidity, and soil moisture readings from a smart irrigation system when it is in wet condition

Fig (9) shows the value ,to increase the plant health in the moisture condition and no need to water the plant. The system likely activates a water pump when moisture levels drop below a threshold, ensuring optimal watering. Such smart agriculture technology helps conserve water and improve crop yield by maintaining ideal soil moisture levels with minimal manual intervention.

Agriculture part:



Fig .10 : shows smart irrigation and agriculture system set up near a tree ,by using the npk sensor ,it shows the value of NPK in the plant

fig (10) shows the system is designed to monitor environmental parameters such as soil moisture, temperature, and humidity. By using real-time data, the setup ensures that water is supplied only when needed, reducing wastage and promoting sustainable agriculture. This technology is particularly beneficial for precision farming, improving plant health while conserving valuable water resources.

Fig. 11: A smartphone screen displays real-time data from a smart agriculture monitoring system.

Fig (11) shows the real-time data from a smart irrigation and agriculture monitoring system. The system tracks key environmental and soil parameters, including temperature, humidity, moisture levels, and essential soil nutrients such as nitrogen, phosphorus, and potassium. This data-driven approach helps farmers and gardeners optimize irrigation and fertilization, ensuring efficient resource use and improved crop health.

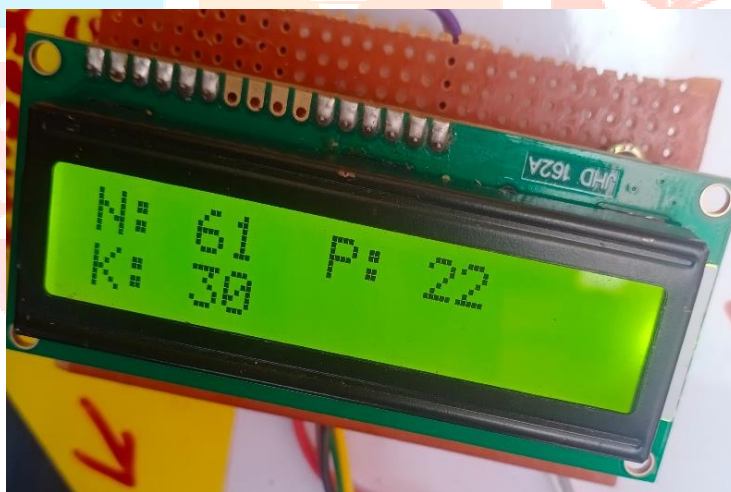


Fig .12: A LCD screen displays real-time data from a smart agriculture monitoring system, showing soil nutrient levels.

fig (12) shows the values of NPK (Nitrogen, Phosphorus, and Potassium) values, which are essential nutrients for plant growth. The readings indicate nitrogen (N) at 61, phosphorus (P) at 22, and potassium (K) at 30. These values help in assessing soil fertility and determining the required fertilizers for optimal plant health. Proper NPK balance is crucial for improving crop yield, root development, and overall plant strength.

Table 1: The optimal NPK application rate for horticultural crops.

The table 1 displays the NPK (Nitrogen, Phosphorus, and Potassium) requirements for various fruit plants. Each plant has different nutrient demands essential for its growth and productivity. For instance, papaya requires the highest levels of all three nutrients (925 each), while mango has relatively lower requirements. Pomegranate needs a high potassium supply (975), whereas grapes demand a significant phosphorus amount (600). Understanding these values helps in efficient fertilizer application, ensuring optimal plant health and fruit yield.

Fruits	Nitrogen	Phosphorus	Potassium
Banana	620	310	620
Mango	75	20	70
Citrus	110	35	55
Papaya	925	925	925
Guava	250	175	175
Apple	320	320	320
Pineapple	275	70	200
Sapota	100	50	50
Grapes	300	600	600
Pomegranate	500	425	975
Litchi	50	50	25

Conclusion:

The application of agriculture networking technology is need of the modern agricultural and Irrigation development using WSN technology. In this manner we are increasing the system which able to control the agriculture monitoring in fields where the human being not capable to provide security. Such system we are developing in the field where the crops are costly are monitored and all the climatic conditions are well maintained important.

Thus, this effective and reliable system helps in agriculture monitoring and Irrigation control. Apart from the main objective, the system also helps in reducing the global warming to a great extent. Using the help of NPK Sensor we can closely monitor the Nitrogen, Phosphorus and Potassium content of the Soil and can add fertilizer according to the requirement. Using Blynk application we can monitor this data from anywhere in the world. The plants can also be protected from fire by using this system. This in turn helps in reducing crop destruction. Thereby, the ecological balance is maintained.

Future Scope:

Further this system can be interfaced with GSM technology to get SMS based notification if any pump is switched On or Off. SIM 800L Module is used for this application for send SMS based on Microcontroller signals.

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