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IoT Smart Farming System with Blynk Server

ABSTRACT—This project's Smart Agriculture System, which utilizes Internet of Things technology, gathers information from soil moisture, water level, and temperature and humidity sensors (DHT11) through an ESP32 microcontroller. The data collected is sent to the Blynk app for remote monitoring and control. The microcontroller-analog-to-digital converter converts the analog signals from the soil and water sensors into digital format. The DHT11 sensor captures temperature and humidity readings.Additionally, a relay module enables the remote operation of devices such as water pumps.The Blynk app serves as a scalable and efficient platform for smart agriculture , providing a real-time interface for data management and display

Keywords: IoT, Agriculture, ESP32, Soil Moisture Sensor, Water Level Sensor, DHT11, Relay Module, Blynk App, Remote Monitoring, Control.

I. Introduction

A smart farm is a farm that utilizes advanced technologies and contemporary communication methods for its management. India is an agricultural country. These days, farmers frequently engage in manual irrigation of the fields, which may lead to potential increases in water consumption or delays in water reaching its intended destination, ultimately contributing to crop desiccation. Real-time temperature and humidity monitoring are crucial in many agricultural disciplines. Nonetheless, the traditional approach of using wired detection control proves to be rigid, leading to a variety of constraints in its application. This project addresses the issue by implementing irrigation automation, which serves as a critical solution. The primary objective of our project is to simplify supervision and eliminate the need for continuous monitoring. Our system enables the implementation of smart agriculture, incorporating IoT-based agricultural monitoring. The Internet of Things (IoT) is bringing about a transformation in the agricultural sector, effectively addressing the substantial challenges and formidable obstacles faced by farmers in their daily work. To assess soil moisture levels, a soil moisture sensor is inserted into the ground to determine soil wetness. When the soil moisture level is low, routine monitoring of the relay unit connected to the motor switch becomes crucial. The motor is activated when the soil is dry and deactivated when the soil is moist.Thus, temperature is the factor for farming system and it will measure the temperature. On the contrary, Ph will also be measured to know the quality of water. It will display on a LCD and can also be accessed from Blynk Server manually.

The fast progress in technology across many sectors has driven innovation, especially in agriculture. As the world population increases, improving agricultural systems is crucial to ensure food security, make better use of resources, and reduce environmental harm. In this situation, integrating IoT technology has been groundbreaking. It allows advanced agricultural systems to monitor, assess, and manage crop production and livestock management, enabling sophisticated agricultural systems that monitor, analyze, and manage aspects of crop production and livestock management [1]. Previously, the energy sources adopted by the Internet of Agricultural Things systems for the purpose of operating sensors and data transfer units were electricity or batteries. However, access to reliable electrical infrastructure has been restricted, especially in off-grid locations. Furthermore, the question arises whether those sources can be relied upon for sustainability and scalability [2]. As a result of these obstacles, the self-powered mode of IoT devices for IoT applications has emerged as a new way of meeting these challenges. It combined energy aggregators with efficient energy management algorithms. This allowed autonomy and responsibility in the work of Internet of Things devices for agricultural applications. These platforms have been able to adapt, durable and cost-effective by using alternative energy sources such as wind, sun and movement [3].

The aim of this study is to demonstrate that a revolution in agriculture can see the light of day if the transformative potential is relied upon so that IoT systems are self-powered. Where there is no dependence on external sources of energy, these systems can provide farmers with real-time observations, improved resources in terms of allocation, as well as sustainable agricultural practices and improved production crops. By scrutinizing the subject, this study sought to drive research ideas to probe innovation in smart agriculture, to make the future of agriculture more efficient and more durable.Presents a kind of IoT based system that takes into account the difficulties of greenhouse rose cultivation. Also, It have being intelligent and environmentally friendly [4]. It has been demonstrated that aerial imagery, machine learning, and Internet of Things-based automation systems all increase agricultural output and soil fertility [5, 6] talks about a cloud-based software solution that uses the Internet of Things to automate irrigation plans based on input from agricultural professionals and environmental data gathered in the field [7]. Lastly, the architecture and subsystems of the AREThOU5A IoT platform, including its utilization of RF energy harvesting for power, are explored in the study of Boursianis et al. [8].

Innovations in smart agriculture have seen significant advancements. A study proposed a low-cost, wireless sensor network (WSN)-based intelligent irrigation scheduling system that accounts for crop and soil water variability [9].

Another research developed an intelligent irrigation management system employing IoT technologies and a ZigBee wireless sensor network [10]. The creation of a communication protocol for smart irrigation within a Smart City framework is discussed, highlighting the use of low-cost instruments and minimal packet loss [11]. The monitoring of soil moisture and the automated control of plant irrigation using IoT are investigated in the study of Shobana et al. [12].

Problem Statement

The statement of the problem in a smart agriculture system usually focuses on the issues that traditional farming methods face and the role of technology in improving efficiency, productivity, and sustainability. Here are some key points to consider regarding this problem:

Challenges in Traditional Agriculture:
Mention the inefficiencies and limitations of traditional farming practices such as overutilization of manual labor, unpredictable weather patterns and unnecessary wastes of resources.

Need for Efficiency and Sustainability; emphasize the growing necessity of sustainable agriculture and the need to optimize the usage of resources, minimize the environmental degradation and ensure food security.

Data-Driven Decision Making: Explain the importance of using information to make decisions, best utilize resources, and forecast crop yields, all to enhance farm management.

Limitations:

There are few limitations of this projects.They are-

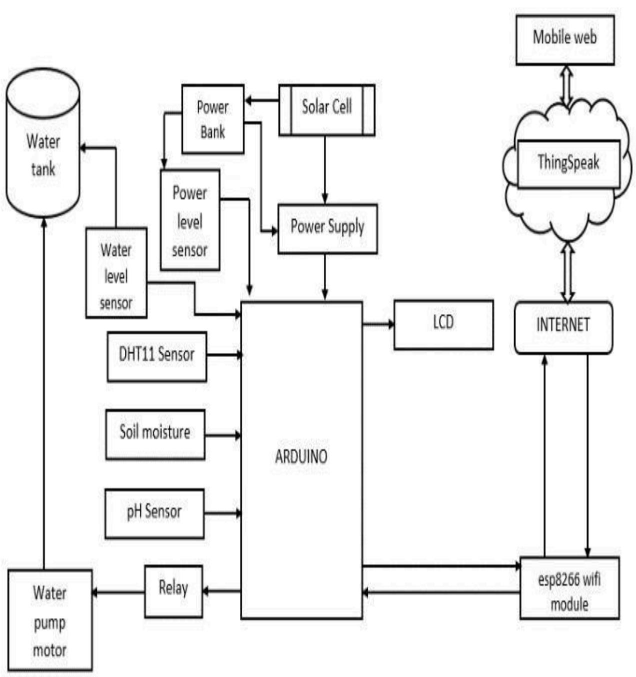
- Internet Dependency
- Scalability
- Sensor Accuracy
- Limited range of wire coverage
- Security issue
- Environmental Durability

Literature Review

II. Methodology

II.I.System Architecture

The architecture of the proposed system is on a microcontroller-sensor-cloud system, specifically designed to monitor environmental conditions in real time**.** ESP32 is the central controller that communicates with three major sensors: the soil moisture sensor, DHT11, and Ph. Each sensor is tasked with collecting corresponding data pertinent to plant health and water requirements. The NodeMCU periodically reads the sensor values and uploads them to the Blynk IoT platform via HTTP over Wi-Fi. The data is then presented on Blynk in the form of graphs and widgets, allowing users to easily understand field conditions. A block diagram describes the major components and their intercommunication sensors (input units).



II.II Hardware Components

The hardware revolves around the ESP32, which is a Wi-Fi microcontroller that is small in size, programmable, and simple to integrate. It has digital and analog I/O pins that can be used to interface sensors. The soil moisture sensor is used to measure the water content in the soil, which is useful in deciding irrigation requirements. It gives analog voltage proportional to moisture content. The DHT11 sensor gives digital temperature and humidity readings with moderate accuracy and low response time.Power is supplied through USB or a battery-powered 5V power supply. Ph sensor and temperature sensor will also used in this system. The components are soldered on a breadboard for prototyping, which offers flexibility in circuit designing. All hardware components used are low-cost, and hence the solution is cost-effective for local farming communities. The sensors are chosen based on their application to agricultural parameters, accuracy, and ease of availability. Each sensor was properly calibrated and tested before deployment.So,all the components will be,

- Power supply
- ESP32
- Temperature and humidity sensor(DHT11)
- Soil moisture sensor
- Ph sensor
- Relay module
- LCD display
- Water level sensor
- Water pump
- Buzzer
- Breadboard

II.III Requirement analysis:

Functional Requirement:

The system read the data from sensors:

1. Temparature
2. Soil Mostuire pH level of soil
3. Soil Mosture and Water Level

After readin the data from sensor the system send data to the blynk server. After connection wifi through the esp 32 the OLED diplay activated. The system stores data to the cloud and get fetch data by the cloud. With the help from the system the ouput devices known as actuator pump and buzzer turned on. Pump motor turned on when the soil is dry which is measured by soil mosture sensor. Buzzer gives alert. We can control the system automatically and manually.

Non Functional Requirements:

Reliability: system should be run 24 without failure

Usablity: It should be easy to monitor with the help of OLED display and cloud server known as Blynk Server

Performance: The system must response smoothly without any failure and also response to sensor changes

Scalabilty: it can be added more sensors and devices(such as light sensor, fertilizer pump) in future to ehanced the project quality.

Low power consumption: system should reliable with low power.

Estimate Budget:

No	Component's name	price
1	ESP 32	500
2	Soil Moisture Sensor	300
3	Breadboard	80
4	Jumper wires	50
5	Water Level Sensor	50
6	Water Pump	450
7	DHT 11	120
8	PH Sensor	2500
9	1 channel Relay module	100
10	OLED Display	150
11	Buzzer	50
12	Plant	150
	Total	4500

The total cost of our budget are 5000tk around. There are other charge in the project tha cost . the esp 32 around than 500, soil mosture 300, ph sensor cost 2500tk , water pump sensor 450.The ultrasonic sensor cost 100 tk water level sensors cost 50 tk , humidity sensor 120 tk, there is also a flower palnt which cost is 1500 tk .There are other things cost which is charted in the table.

III, Implementation

The Smart Farming is implemented based on some sensors,actuators and server. To implement all the functionalities, we need to take a breadboard including all the sensors and actuators. All the sensors like soil moisture sensor, water level sensor,DHT11 should be placed on a ESP32 which will work as arduino including wifi feature. All the sensors will be connected with ESP32 according to the pin.After connecting all the sensors and actuators with ESp32, we will connect the ESP32 with a power supply which can be a battery or powerBank.While all the sensors are connected and we give power to the system it will start and all the lights will turn on which indicates that the system is working property.Then we need to collect soil and water to collect data from the sensors. We will also measure the humidity and temperature and will get the sensor data.The system need Machine Learning algorithm to know the ideal conditions for all the sensor data.As the sensors data are collected , they will visualize in the LCD display.Thus, it will also be shown in Blynk Server which can be manually detect or control the system.As we will work on crop, we will select a chilli plant and give all the information for an ideal chilli plant growth.If we see that, the soil moisture level is low, the water pump will start automatically and water in the soil to fix the moisture level. Thus, there will be a water level sensor to know that what is the water level on the tank.If, there are low amount of water, it will signal and the buzzer will start on. That's how it will work on the system. The ideal data for chilli plant or all the sensor are given below on the chart.

Parameter	Ideal Range / Value	Importance
Soil Moisture	60% – 70% (field capacity)	Avoids water stress and root rot
Air Temperature (Day)	25°C – 30°C	Best for vegetative & flowering growth
Air Temperature (Night)	18°C – 22°C	Prevents flower drop and fruit deformation
Soil Temperature	20°C – 25°C	Ensures root development and nutrient absorption
Humidity	50% – 70% RH	Prevents fungal diseases and supports pollination
Soil pH	5.8 – 6.5	Slightly acidic soil enhances nutrient uptake

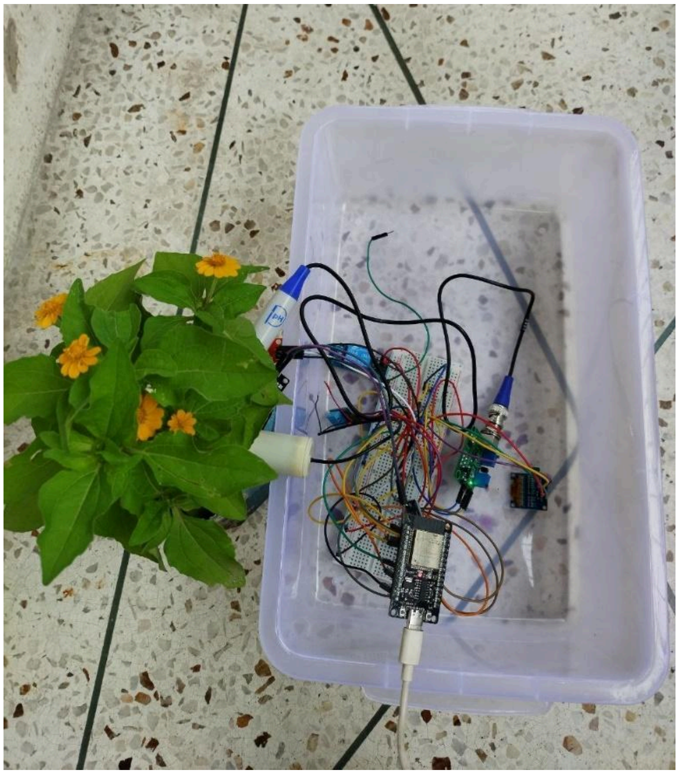
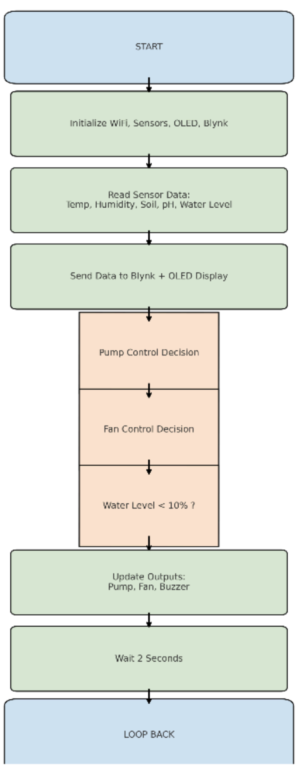


Fig: Smart Farming Live Picture

IV. Data flowchart



First of all after supplying the power the system will on. Wifi sensors such as DHT ,soil, pH sensor , Water Level , OLED display all the system will be turned in and connect with the blynk server. The system read temperature , humidity ,soil moisture , pH level and water level. The system send data to the blynk and OLED display.If soil moisture is below 40% the punp will activate, we can active also manuallay. The Fan control will take decision if water level below 10% and also check humadity <60% or tempature >30 C. Pump fan Buzzer states are updated based on the decisions and logic. Small delay before repeating the loop . After that that the process repeats continuously.

V.Implementation code:

```
#define BLYNK_TEMPLATE_ID
"TMPL6jMKB9ZtT"
#define BLYNK_TEMPLATE_NAME "Jihad
Project"
#define BLYNK_AUTH_TOKEN
"A0QSGC0AfgHjB39hHO6bkTs91iNBIljh"

#include <WiFi.h>
#include <BlynkSimpleEsp32.h>
#include <DHT.h>
#include <Wire.h>
#include <Adafruit_GFX.h>
#include <Adafruit_SSD1306.h>

// === WiFi Credentials ===
char ssid[] = "Jihad";
char pass[] = "12345678";

// === Sensor Pins ===
#define DHTPIN 14
#define DHTTYPE DHT11
```

```
#define SOIL_MOISTURE_PIN 34
#define PH_SENSOR_PIN 35
#define WATER_LEVEL_PIN 36  // VP pin
#define BUZZER_PIN 25

// === Output Pins ===
#define RELAY_PIN 26      // Water Pump
Relay
#define FAN_PIN 27        // Humidity/Temp Fan

// === OLED Setup ===
#define SCREEN_WIDTH 128
#define SCREEN_HEIGHT 64
Adafruit_SSD1306 display(SCREEN_WIDTH,
SCREEN_HEIGHT, &Wire, -1);

// === Global Variables ===
DHT dht(DHTPIN, DHTTYPE);
bool pumpManualState = false;
bool pumpForceOn = false;
bool fanManualState = false;

void setup() {
  Serial.begin(115200);

  // Initialize pins
  pinMode(RELAY_PIN, OUTPUT);
  digitalWrite(RELAY_PIN, HIGH); // Pump
OFF
  pinMode(BUZZER_PIN, OUTPUT);
  digitalWrite(BUZZER_PIN, LOW); // Buzzer
OFF
  pinMode(FAN_PIN, OUTPUT);
  digitalWrite(FAN_PIN, LOW); // Fan OFF

  // Init sensors and WiFi
  dht.begin();
  Blynk.begin(BLYNK_AUTH_TOKEN, ssid,
pass);

  // Init OLED
  if
(!display.begin(SSD1306_SWITCHCAPVCC,
0x3C)) {
    Serial.println(F("OLED init failed"));
    while (true);
  }
  display.clearDisplay();
  display.setTextSize(1);
  display.setTextColor(WHITE);
  display.setCursor(0, 0);
  display.println("Smart Irrigation");
  display.display();
  delay(2000);
}

// === Blynk Controls ===
BLYNK_WRITE(V3) {
  pumpManualState = param.asInt();  //
ON/OFF pump control
}

BLYNK_WRITE(V5) {
  pumpForceOn = param.asInt(); // Force pump
ON regardless of soil
}

BLYNK_WRITE(V7) {
  fanManualState = param.asInt(); // Manual
fan ON/OFF
}

void loop() {
  Blynk.run();

  float temp = dht.readTemperature();
  float humidity = dht.readHumidity();
  int soilRaw =
analogRead(SOIL_MOISTURE_PIN);
```

```
  float soilPercent = map(soilRaw, 4095, 0, 0,
100);

  int phRaw = analogRead(PH_SENSOR_PIN);
  float voltage = phRaw * (3.3 / 4095.0);
  float pH = 3.5 * voltage;

  int waterLevelRaw =
analogRead(WATER_LEVEL_PIN);
  float waterLevelPercent =
map(waterLevelRaw, 0, 4095, 0, 100);

  // === Send to Blynk ===
  Blynk.virtualWrite(V0, temp);
  Blynk.virtualWrite(V1, humidity);
  Blynk.virtualWrite(V2, soilPercent);
  Blynk.virtualWrite(V4, pH);
  Blynk.virtualWrite(V6, waterLevelPercent);
  Blynk.virtualWrite(V8, fanManualState); //
Optional fan status

  // === OLED Display ===
  display.clearDisplay();
  display.setCursor(0, 0);
  display.print("Temp: "); display.print(temp);
display.println(" C");
  display.print("Hum: "); display.print(humidity);
display.println(" %");
  display.print("Soil: ");
display.print(soilPercent); display.println(" %");
  display.print("pH: "); display.println(pH, 2);
  display.print("Water: ");
display.print(waterLevelPercent);
display.println(" %");

  display.print("Pump: ");
  if ((pumpManualState && soilPercent < 40) ||
pumpForceOn) {
    display.println("ON");
  } else {
    display.println("OFF");
  }

  display.print("Fan: ");
  if (humidity < 60 || temp > 30 ||
fanManualState) {
    display.println("ON");
  } else {
    display.println("OFF");
  }

  display.display();

  // === Pump Logic ===
  if ((pumpManualState && soilPercent < 40) ||
pumpForceOn) {
    digitalWrite(RELAY_PIN, LOW);  // Pump
ON
  } else {
    digitalWrite(RELAY_PIN, HIGH); // Pump
OFF
  }

  // === Buzzer Alert ===
  if (waterLevelPercent < 10) {
    digitalWrite(BUZZER_PIN, HIGH);
  } else {
    digitalWrite(BUZZER_PIN, LOW);
  }

  // === Fan Logic ===
  if (humidity < 60 || temp > 30 ||
fanManualState) {
    digitalWrite(FAN_PIN, HIGH);  // Fan ON
  } else {
    digitalWrite(FAN_PIN, LOW);   // Fan OFF
  }

  delay(2000);
}
```

VI. Result and Analysis

This system was laid out and tested in a small agricultural field with different soil and environmental conditions. The soil moisture sensor reflected accurately the change in soil moisture after irrigation events, proving the utility of it by determining the water level. The DHT11 sensor provided a stable reading for temperature and humidity throughout the day. The data was transmitted and shown on lead near real time with minimal delays. The data on the cloud platform clearly showed a change in sensor reading that corresponds to the conditions of the real field. The system was also responsible for fluctuations in the Wi-Fi signal, and demonstrated its credibility. Conclusions confirm that the system is reliable for regular surveillance operations. Interview with local users suggested that it can cause significant water savings when used with an automated irrigation valve. In addition, the simple interface made it easy for non-technical users to analyze data effectively. Smaller limitations include a limited sensor area and sliding delay in areas with poor network connection.

VII. Conclusion

This project showcases an Internet of Things (IoT) tracking system designed for agriculture the use of Blynk and coffee-fee sensors. It permits farmers to display crucial area parameters like soil moisture, temperature, humidity, and sun exposure from a distance. With cloud technologies, the device helps information-driven selections which could greatly improve irrigation efficiency and crop yields. It is affordable and modular, making it specially suitable for small-scale and remote farming operations. Future upgrades could include adding solenoid valves for vehicle-irrigation, GSM modules for regions without Wi-Fi, and solar panels for self-sufficiency. Incorporating machine learning for predictive irrigation and crop disease detection could in addition enhance the gadget's skills. This prototype serves as a foundation for scalable smart farming solutions that promote sustainable agriculture and empower generation use in rural regions.

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