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# IoT Based Smart Agricultural System for Efficient Crop Growth

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## Abstract:

Population growth has made agriculture the most important growth sector in the world. The challenge in the agricultural industry right now is to improve the efficiency and quality of agriculture without regular physical monitoring to meet the rapidly increasing food demand. Along with population growth, climatic condition is also a major challenge in agriculture. The purpose of this study is to propose an internet-based smart agricultural model of things that uses clustering to deal with adverse conditions. This model uses different types of sensors for different purposes, such as soil moisture, barometric pressure, rainfall detection, and humidity sensors. The data is collected in the cloud and calculated automatically. Intelligent agriculture is automatically taken over by plant management, useful data collection and analysis. The purpose of this white paper is to implement the Internet of Things (IoT) to monitor humidity, soil conditions, temperature and field water supply, water levels, and climatic conditions. The IoT-based smart farming system envisioned in this report is integrated with a variety of sensors and a Wi-Fi module that produces live data feeds that can be accessed online.

***Keywords: Smart farming, IOT, Clustering, Sensors, Cloud.***

## I. Introduction

The Internet of Things has a pleothra of applications in a variety of fields, including smart cars, connected roads, smart cities, smart homes, smart industries, smart agriculture, connected campuses and buildings, and others. The main advantage of using IoT is that it connects the real and virtual worlds by using the Internet as a communication medium to exchange data and information. The Internet of Things (IoT) is a network of interconnected computing devices, mechanical machines, digital machines, objects, the internet, animals, or people that have unique identification and the ability to move data over networks without requiring any human-to-human, human-to-machine, or human-to-computer interaction.

Smart agriculture is the application of various technologies and devices such as the internet, cloud, and sensor devices. As it is today, the world population is increasing every day and is expected to reach 9.8 billion by 2060. In order to feed those billions of people, crop productivity must increase. The world's population is increasing every day, while agricultural land is shrinking due to a variety of factors such as industrialization, housing developments, and commercial markets being built on agricultural parkland. To feed these billions of people, crop productivity must be increased. The Internet of Things (IoT) can be implemented in the agriculture industry. Precision farming is another term for smart farming.

Traditional farming employs the oldest and most traditional methods of agriculture, employing old machinery and producing crops without regard for market demands or weather forecasts, whereas smart farming employs cutting-edge technologies such as smart devices, IoT sensor nodes, the Internet, and cloud storage for data collection. Farmers chatting community, regular measurement of various factors such as the best environment for plantation growth, how much nutrients, soil quality, water quality, and air pressure are required. Farming has become much easier, more economical, and cost-effective as a result of the use of smart technology. Farmers can use smart technology to reduce labor costs while increasing crop yields.

## II. Background Study (Literature)

The author of [1] has developed a fully computerized observation in the field of agriculture. This greatly reduces human effort and improves crop quality. Sensor data is responsible for establishing relationships between water content, temperature, light, etc.
The authors of [2] have developed algorithms for their system. The main improvement of the proposed system is the ability to send soil data to the right users via IoT technology for irrigation. The soil moisture meter processes saturated water from the soil and the results produced are sent to the amplifier to provide an extension of the value.

The creators of [3] Experimented with pH, soil moisture, LM35, PIR, and pressure sensors, among others. The detected values of these sensors are displayed on the LCD screen. If the detected values change, the program's starting values and corresponding pump will be switched ON/OFF by communicating the circuit.

In [4] the emphasis is on IOT-based agriculture using Raspberry Pi. This is a clever solution for overcoming the employment of strenuous while also controlling the water supervision system.

[5] The sensor data is used to estimate soil dampening as well as water.

In [6] the goal is to save farmers time and energy while making their daily lives easier. The proposed system is specifically designed for farmers, allowing them to understand the status of their fields.

[7] Employed a variety of sensors, including a soil moisture sensor, a temperature sensor, and a pH sensor. After receiving the data from the sensors, the relays built into the Raspberry Pi will attempt to turn the motor on or off.

[8] Proposed a paper in which humidity and soil moisture sensors are placed within the plant's root area. The microcontroller is used to regulate the availability of water to the sector based on the sensor values. This technique is highly inefficient for the farmer as it does give the status of the field.

In [9], a paper was proposed in which soil parameters such as pH, humidity, and temperature are measured in order to obtain a high result from the soil. This process is fully automated and switches the motor pump ON/OFF based on the moisture content of the soil.

In [10] proposed a paper in which photo voltaic cells are used to receive power. No electricity is required for this system. A soil moisture sensor is used to support the recorded values. The PIC microcontroller is used to turn the motor pump on and off. Meteorology is not included in this system.

In [11], a system using drip irrigation using IOT is proposed. Humidity, temperature, pH sensors, etc. are used. Update the irrigation using a computer. To access the field conditions internet is required.

[12] States that Proposed an IoT-based irrigation system that uses a network of wireless sensors containing various sensors to measure different soil components. The system is remotely controlled via a web interface. Its limitations include the lack of weather monitoring.

In [13], a prototype that receives sensor data, activates actuators, and transmits data to a server is proposed. It contains photovoltaic panels and has a two-way communication link based on a mobile internet interface that aids in data inspection and irrigation time scheduling
Via the web.

## III. Methodology

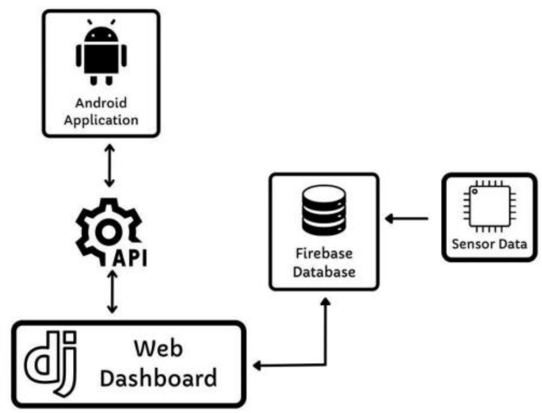


Figure 1: Block Diagram of System.

The fig 1 depicts, the methodology used in this project is that we collect the field parameters such as soil moisture, soil pH, humidity, temperature and light intensity using sensors. All the sensors are connected to the Pico board accordingly. Real time data is sent by the sensors for better monitoring and decision-making. The data from the Pico board is collected and accessed by the cloud firebase using Wi-Fi. All the data is stored in the firebase database and data is updated is real time. The data is then accessed by the web dashboard where computations and operations take place for weather predictions and automation of field parameters such as irrigation system and fertilization process. The data which needs to be visualized is then sent to android application by using rest API's. All the data which needs to be visualized is shown in the android application in which the farmer will be able to access the field data and take better decisions to automate his field using sensor data of the field variables and weather prediction

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## IV. Hardware Used

### 1. Raspberry Pi Pico

Raspberry Pi Pico is the lowest cost and smallest size development board from Raspberry Pi Foundation ever. It is made up of RP2040 microcontroller chip which is developed by the Raspberry Pi Foundation. It is their first dual-core ARM Cortex M0+ processor-based latest small-sized and a budget-friendly microcontroller.

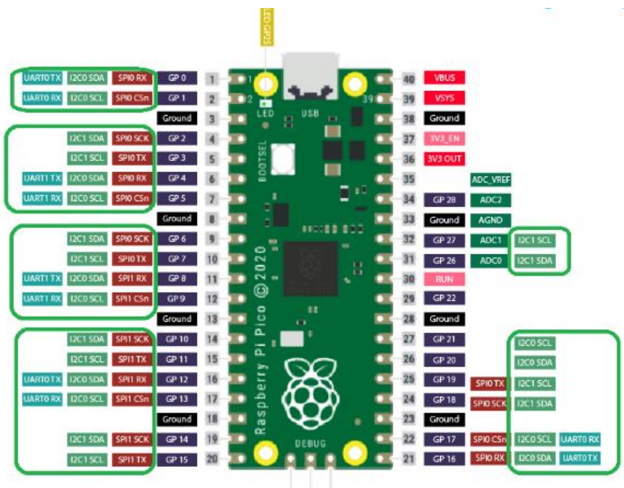

Figure 3: Raspberry Pi Pico Board

### 1. Humidity and temperature sensor(DTH11)

It is a digital sensor for monitoring and collecting information on the temperature and humidity in the greenhouse. It operates with a maximum current of 2.5 mA and a voltage of 3 to 5 volts. The temperature range is fixed at 0 to 50 degrees and the humidity percentage is set between 20 and 80 percent. The internal thermistor detects the negative temperature measurements and detect humidity and determine the moisture content in the air.

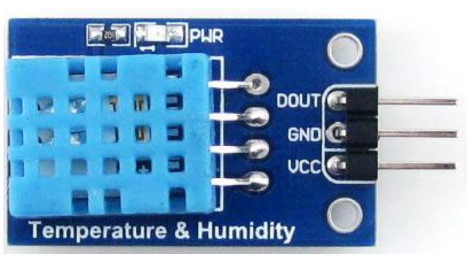


Figure 4: Humidity and temperature sensor(DTH11)

### 2. Soil moisture sensor

The automated system utilizes the YL69 moisture sensor to sense the moisture in the soil. The soil moisture sensor is powered by the operating voltage of 3.3v to 5v and a current of 35mA. The two electrodes found in the moisturizer are placed in contact with the soil. When it is placed into the soil the voltage fluctuates, an increase in the voltage is found in the soil moisture is less and the voltage decrease with the increase in the soil moisture.

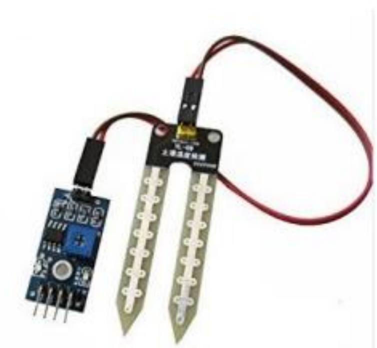

Figure: 5: Soil moisture sensor

### 3. Light Sensor (BH1750)

BH1750 module is a digital ambient light sensor, IIC I2C communication. It is a light intensity sensor breakout board which has a 16-bit AD converter built-in which can directly produce a digital signal there is no need for complicated calculations. This is a more accurate and easier to use version of the simple LDR which only outputs a voltage that needs to be calculated to obtain meaningful data. Using the BH1750 Light Sensor intensity can be directly measured by using the luxmeter, without needing to make calculations. The data which is output by this sensor is directly output in Lux (Lx).When objects which are lighted in homogeneous get the 1 lx luminous flux in one square meter, their light intensity is 1lx. To take advantage of the illuminant, we can add a reflector to the illuminant. So that there will be more luminous flux in some directions and it can increase the illumination of the target surface

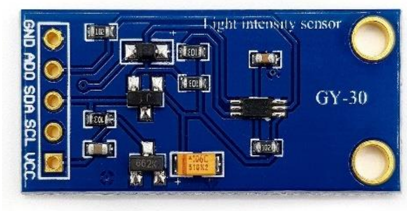


Figure: 6: light sensor(BH1750)

### 4. Soil Ph Sensor

The analog pH sensor kit has a simple, convenient and practical connections and features. It features an LED that acts as a power indicator, a BNC connector, and a PH 2.0 sensor interface. To use it, simply connect the pH sensor to the BND connector and the PH 2.0 interface to the analog input connector of any controller. If pre-programmed, you can easily get the pH. Comes in a compact plastic box with foam inserts for easy portability

Figure: 7: Soil Ph Sensor

## V. Conclusion

Advances in networking technology in the agricultural sector are very important for agricultural development, but they are also an important sign of a distant level of agricultural development. It will be a long-term plan for agricultural development.Build the hardware of intelligent agricultural assistance systems, analyze and investigate the characteristics, functions, and software architecture of the corresponding precision irrigation systems of the network hierarchy, detect soil conditions. Impact on the efficient use of available water resources and ensuring the efficiency, accuracy and stability of agricultural production.

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