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# SMART FARMING WIFI BASED AGRICULTURE SYSTEM

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**ABSTRACT:**
In the world of digital era, an advance development with internet of things (IoT) were initiated, where devices communicate with each other and the process are automated and controlled with the help of internet. An IoT in an agriculture framework includes various benefits in managing and monitoring the crops. In this paper, an architectural framework is developed which integrates the internet of things (IoT) with the production of crops, different measures and methods are used to monitor crops using cloud computing. The approach provides real-time analysis of data collected from sensors placed in crops and produces result to farmer which is necessary for the monitoring the crop growth which reduces the time, energy of the farmer.The data collected from the fields are stored in the cloud and processed in order to facilitate automation by integrating IoT devices. The concept presented in the paper could increase the productivity of the crops by reducing wastage of resources utilized in the agriculture fields. The results of the experimentation carried out presents the details of temperature, soil moisture, humidity and water usage for the field and performs decision making analysis with the interaction of the farmer.

## I. INTRODUCTION

### 1.1 INTRODUCTION

Agriculture plays a very important role where economic growth of a country like India is considered. In a scenario crop yield rate is falling consistently, there is a need of smart system which can solve the problem of decreasing crop yield. For farmers, it's such a complex when there is more than one crop to grow especially when the market prices are unknown to them. Citing the Wikipedia statistics, the farmer suicide rate in India has ranged between 1.4and 1.8 per 100000 total population, over a 10-year period through 2005. While 2014 saw 5650 farmer suicides, the figure crossed 8000 in 2015. Therefore, to eliminate this problem, we propose a system which will provide crop selection based on economic, environmental and yield rate to reap the maximum yield out of it for the farmers which will sequentially help meet the elevating demands for the food supplies in the country.

As the world is trending towards new technologies and implementations it is a necessary goal to trend up in agriculture too. Many researches are done in the field of agriculture and most of them signify the use of wireless sensor network that collect data from different sensors deployed at various nodes and send it through the wireless protocol. The collected data provide the information about the various environmental factors. Monitoring the environmental factors is not the complete solution to increase the yield of crops. There are number of other factors that decrease the productivity. Hence, automation must be implemented in agriculture to overcome these problems.

In order to provide solution to such problems, it is necessary to develop an integrated system which wills improve productivity in every stage. But, complete automation in agriculture is not achieved due to various issues. Though it is implemented in the research level, it is not given to the farmers as a product to get benefitted from the resources. Agriculture is considered as the basis of life for the human species as it is the main source of food grains and other raw materials. It plays vital role in the growth of country's economy. It also provides large ample employment opportunities to the people. Growth in agricultural sector is necessary for the development of economic condition of the country. Unfortunately, many farmers still use the traditional methods of farming which results in low yielding of crops and fruits. But wherever automation had been implemented and human beings had been replaced by automatic machineries, the yield has been improved. Hence there is need to implement modern science and technology in the agriculture sector for increasing the yield.

Most of the papers signifies the use of wireless sensor network which collects the data from different types of sensors and then send it to main server using wireless protocol. The collected data provides the information about different environmental factors which in turns helps to monitor the system. Monitoring environmental factors is not enough and complete solution to improve the yield of the crops. There are number of other factors that affect the productivity to great extent. These factors include

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attack of insects and pests which can be controlled by spraying the crop with proper insecticide and pesticides. Secondly, attack of wild animals and birds when the crop grows up. There is also possibility of thefts when crop is at the stage of harvesting. Even after harvesting, farmers also face problems in storage of harvested crop. So, in order to provide solutions to all such problems, it is necessary to develop integrated system which will take care of all factors affecting the productivity in every stage like; cultivation, harvesting and post harvesting storage.

This paper therefore proposes a system which is useful in monitoring the field data as well as controlling the field operations which provides the flexibility. The paper aims at making agriculture smart using automation and IoT technologies. The highlighting features of this paper includes smart GPS based remote controlled robot to perform tasks like; weeding, spraying, moisture sensing, bird and animal scaring, keeping vigilance, etc. Secondly, it includes smart irrigation with smart control based on real time field data. In India, most people living in rural areas are dependent on agriculture. Water is a scarce resource in agriculture and its optimal management is emerging as key challenges. The role of various technologies in the agriculture sector is becoming more and more visible. Research has been going on to increase the yield on a farm but if the fields and crops are not monitored properly the results may not be as per expectation. The use of modern techniques can help the farmer to not only remotely.

**1.2 OBJECTIVES**

- To measure the soil moisture
- To check the water level in the tank.
- Through Data Mining suggest the user which configuration is better, based on the classification of the soil and plant.
- To reduce the labour work and make a cost-efficient system.
- To work accordingly to the soil condition.
- To conserve energy and water resource

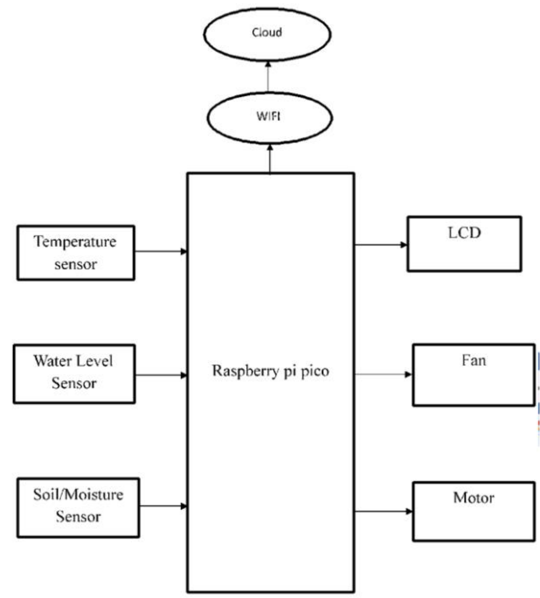
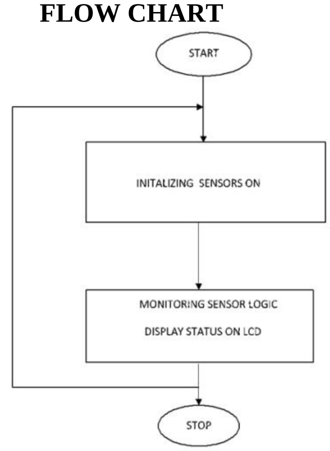



Fig:1. Block Diagram of Smart Farming WIFI Based Agriculture System

The block diagram includes All basic components used in the system. Fig.1 shows that the soil moisture sensors, temperature sensor and humidity sensor give information to Arduino and it forwards the information as per the program that is inserted in it to the other parts of system that includes LCD display, relays, buzzer and DC motors. In this we are using soil moisture sensor- to know whether it is dry or wet.

**1.4 FLOW CHART**




**1.5 WORKING**

A smart farming WiFi-based agriculture system typically consists of several working modules that collaborate to provide enhanced monitoring and control capabilities for agricultural operations. Here are the key modules commonly found in such a system:

Sensor Module: This module includes various sensors that measure environmental parameters critical to agriculture, such as temperature, humidity, soil moisture, light intensity, and pH levels. The sensors collect data from the farm and send it wirelessly to the central control system.

WiFi Module: The WiFi module enables wireless communication between different components of the system. It connects the sensor module, control system, and other modules to the local network or the internet, allowing seamless data transmission and remote control.

Central Control System: The central control system acts as the brain of the smart farming system. It receives data from the sensor module and processes it to make informed decisions. The control system may include a microcontroller or a more powerful computing device that runs specialized software. It can analyze sensor data, trigger automated actions, and provide real-time insights to farmers.

Data Storage and Analysis: This module stores the collected sensor data for further analysis. It may use a local database or cloud-based storage solutions. By performing data analytics and applying machine learning algorithms, the system can extract valuable insights, identify patterns, and make predictions related to crop health, irrigation needs, and disease detection.

Actuator Module: The actuator module allows the control system to take physical actions based on the analyzed data. It can control irrigation systems, adjust nutrient supply, open/close valves, or activate devices like fans or heaters. The actuator module receives commands wirelessly from the control system and performs the desired actions in the field.

Mobile/Web Application: To provide farmers with a user-friendly interface and remote access to the system, a mobile or web application can be developed. This application allows farmers to monitor real-time data, receive notifications or alerts, control the system remotely, and access historical data and analytics. It serves as a convenient tool for farmers to manage their agricultural operations efficiently.

Power Management: Since the system involves multiple modules and devices, efficient power management is crucial. This module ensures that each component receives adequate power supply, manages power consumption, and may incorporate features like battery backup or energy harvesting techniques to ensure uninterrupted operation.

Security and Authentication: Given the sensitivity of agricultural data and the need to protect against unauthorized access, a robust security module is essential. It implements encryption protocols, authentication mechanisms, and secure communication channels to safeguard data integrity and privacy.

The integration of these modules enables farmers to monitor and control their farming operations remotely, optimize resource utilization, make data-driven decisions, detect anomalies, and automate tasks for increased efficiency and productivity.

## II. DESIGN OF HARDWARE

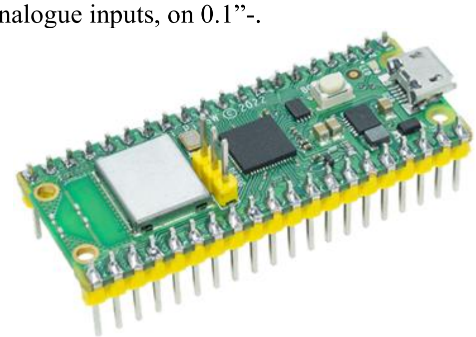
This chapter briefly explains about the Hardware. It discuss the circuit diagram of each module in detail.

RASPBERRY PI

Raspberry Pi, developed by Raspberry Pi Foundation in association with Broadcom, is a series of small single-board computers and perhaps the most inspiring computer available today.

Raspberry Pi Pico W is a new Raspberry Pi product that adds Wi-Fi capability to the Raspberry Pi Pico, allowing you to connect the device to a Wi-Fi network. In this guide, you will learn how to use a Raspberry Pi Pico W, how to connect it to a Wi-Fi network, and then how to turn it into a web server to control digital outputs from a browser, and to receive sensor data.

Raspberry Pi Pico W offers 2.4GHz 802.11 b/g/n wireless LAN support, with an on-board antenna, and modular compliance certification. It is able to operate in both station and access-point modes. Full access to network functionality is available to both C and Micro Python developers. Raspberry Pi Pico W pairs RP2040 with 2MB of flash memory, and a power supply chip supporting input voltages from 1.8–5.5V. It provides 26 GPIO pins, three of which can function as analogue inputs, on 0.1”-.



**POWER SUPPLY:**

The power supplies are designed to convert high voltage AC mains electricity to a suitable low voltage supply for electronic circuits and other devices. A power supply can by broken down into a series of blocks, each of which performs a particular function. A d.c power supply which maintains the output voltage constant irrespective of a.c mains fluctuations

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or load variations is known as "Regulated D.C Power Supply".

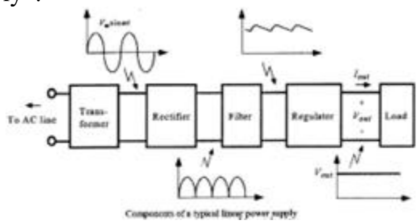


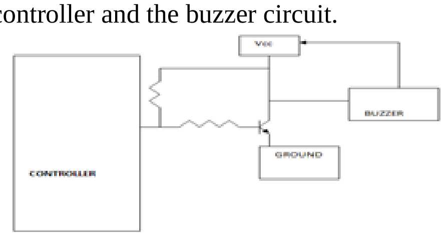

Fig:2. Block Diagram of Power Supply

**LCD DISPLAY**

A model described here is for its low price and great possibilities most frequently used in practice. It is based on the HD44780 microcontroller (Hitachi) and can display messages in two lines with 16 characters each. It displays all the alphabets, Greek letters, punctuation marks, mathematical symbols etc. In addition, it is possible to display symbols that user makes up on its own. Automatic shifting message on display (shift left and right), appearance of the pointer, backlight etc. are considered as useful characteristics.


Fig:3. LCD BUZZER

Digital systems and microcontroller pins lack sufficient current to drive the circuits like relays, buzzer circuits etc. While these circuits require around 10milli amps to be operated, the microcontroller's pin can provide a maximum of 1-2milli amps current. For this reason, a driver such as a power transistor is placed in between the microcontroller and the buzzer circuit.




## III. WIFI MODULE:

The ESP8266 is a low-cost Wi-Fi microchip with full TCP/IP stack and microcontroller capability produced by Shanghai-based Chinese manufacturer, Espressif Systems.[1]

The chip first came to the attention of western makers in August 2014 with the ESP-01 module, made by a third-party manufacturer, Ai-Thinker. This small module allows microcontrollers to connect to a Wi-Fi network and make simple TCP/IP connections using Hayes-style commands. However, at the time there was almost no English-language documentation on the chip and the commands it accepted.[2] The very low price and the fact that there were very few external components on the module which suggested that it could eventually be very inexpensive in volume, attracted many hackers to explore the module, chip, and the software on it, as well as to translate the Chinese documentation.[3]

The ESP8285 is an ESP8266 with 1 MiB of built-in flash, allowing for single-chip devices capable of connecting to Wi-Fi.[4]

The successor to these microcontroller chips is the ESP32.

**3.1 DHT11 SENSOR**

DHT11 Temperature & Humidity Sensor features a temperature & humidity sensor complex with a calibrated digital signal output. By using the exclusive digital-signalacquisition technique and temperature & humidity sensing technology, it ensures high reliability and excellent long-term stability. This sensor includes a resistive-type humidity measurement component and an NTC temperature measurement component, and connects to a high performance 8-bit microcontroller, offering excellent quality, fast response, anti-interference ability and costeffectiveness. Each DHT11 element is strictly calibrated in the laboratory that is extremely accurate on humidity calibration. The calibration coefficients are stored as programmers in the OTP memory, which are used by the sensor's internal signal detecting process. The single-wire serial interface makes system integration quick and easy. Its small size, low power consumption and upto-20 meter signal transmission making it the best choice for various applications, including those most demanding ones. The component is 4-pin single row pin package. It is convenient to connect and special packages can be provided according to users' request.

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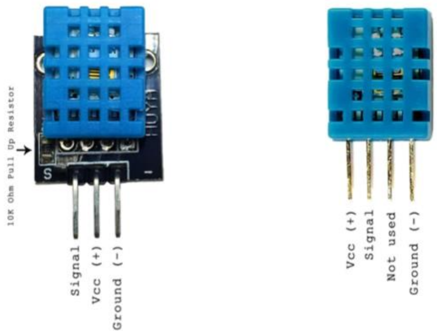


Figure:3.1 Front view of DHT11 sensor

Figure:3.2 DHT11 Temperature & Humidity Sensor

**3.2.3 THE SOIL MOISTURE SENSOR MODULE**

The soil moisture sensor module is there to convert the incoming analog signal to digital signal; this is designed in such a way that the sensor can be used without microcontroller support. The module consists of two signal input pins where the probe gets connected. It also has four other pins two of which are VCC and GND. The other two are Digital Output and Analog Output pins

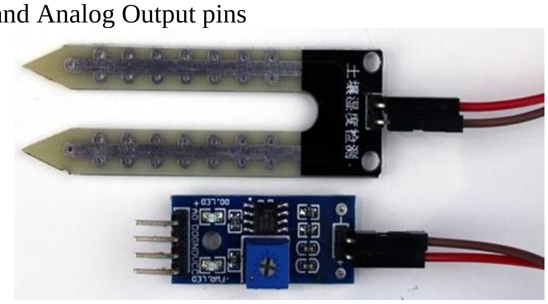

Fig.4: Soil Moisture Sensor Module

This module also consists of a High Precision Comparator, LM393 that is used to digitize the analog signal coming out of the sensor probe. The module has a built-in potentiometer that is used for sensitivity adjustment of the digital output. The main objective of the potentiometer is to set a threshold, so that when the moisture level exceeds the threshold value, the module will output LOW otherwise HIGH. This feature of the module can come in very handy because when a certain threshold is reached, you can trigger a relay that can start pumping water.

Sensors should be placed at several different depths and locations in the field. Typically, sensors are placed in pairs at one-third and two-thirds the depth of the crop root zone and at two or more locations in the field, preferably away from high points, depressions and slopes.The schematic itself is very simple and needs a handful of generic components to build. If you don't have a prebuilt module on hand but still want to test your project, the schematic below will come in handy.

**3.2.5 Flame Sensor Module**

The pin configuration of this sensor is shown below. It includes four pins which include the following. When this module works with a microcontroller unit then the pins are

- Pin1 (VCC pin): Voltage supply rages from 3.3V to 5.3V
- Pin2 (GND): This is a ground pin
- Pin3 (AOUT): This is an analog output pin (MCU.IO)
- Pin4 (DOUT): This is a digital output pin (MCU.IO)

**RESULTS**

**7.1 RESULTS:**

Fig 5. Without power supply

Fig 6. With power supply

## IV. ADVANTAGES, DISADVANTAGES & APPLICATIONS

**4.1 ADVANTAGES:**

1. Increased Efficiency: By automating various processes and providing real-time data, the system helps farmers optimize their farming operations. It enables precise irrigation scheduling, targeted pest

control, optimized nutrient management, and timely intervention in case of crop diseases. This leads to improved resource utilization, reduced wastage, and increased overall efficiency.

2. Enhanced Crop Yield and Quality: The system provides farmers with valuable insights into crop health, environmental conditions, and nutrient requirements. By monitoring and managing these factors effectively, farmers can improve crop yield and quality. They can identify and address issues promptly, ensuring healthy crop growth and maximizing production.

3. Water Conservation: With precision irrigation capabilities, the system helps farmers optimize water usage. By monitoring soil moisture levels and delivering water only when needed, it minimizes water wastage and reduces the risk of over-irrigation. This promotes water conservation and supports sustainable farming practices.

4. Cost Savings: By optimizing resource utilization, such as water, fertilizers, and pesticides, the system helps farmers reduce costs. Precision irrigation prevents unnecessary water usage, while targeted pest control and nutrient management minimize the need for excessive chemical inputs.
This can result in significant cost savings for farmers.

5. Remote Monitoring and Control: WiFi-based systems provide farmers with remote access to real-time data and control of their farming operations. They can monitor crop conditions, receive alerts or notifications, and control devices or systems from anywhere using mobile or web applications. This enables farmers to make informed decisions and take immediate actions, even when they are not physically present on the farm.

6. Early Disease Detection and Pest Management: By continuously monitoring crop health and environmental conditions, the system can detect signs of diseases or pest infestations at an early stage. This allows farmers to implement timely interventions and minimize crop losses. Early detection and targeted pest management reduce reliance on broad-spectrum pesticides, promoting environmentally friendly farming practices.

7. Data-driven Decision Making: The system collects and analyzes a vast amount of data from various sensors and sources. This data, combined with analytics and machine learning algorithms, provides farmers with valuable insights for informed decision making. They can optimize crop selection, planting schedules, resource allocation, and pest control strategies based on data-driven recommendations.

8. Sustainability and Environmental Stewardship: By promoting efficient resource management, reduced chemical usage, and sustainable farming practices, the system contributes to environmental stewardship. It helps minimize water pollution, soil degradation, and environmental impact while ensuring long-term agricultural sustainability.

9. Scalability and Adaptability: WiFi-based agriculture systems can be scaled to different farm sizes and adapted to various crop types or farming methods. They offer flexibility to accommodate changing agricultural needs and can be expanded or modified as the farm evolves.

Overall, the smart farming WiFi-based agriculture system provides farmers with advanced monitoring, control, and decision-making capabilities. It helps optimize productivity, resource utilization, and sustainability, leading to improved profitability and a more efficient agricultural sector.

**4.2 DISADVANTAGES:**

1. Initial Cost and Complexity: Implementing a WiFi-based agriculture system requires an upfront investment in the necessary hardware, sensors, WiFi modules, and infrastructure. The initial cost can be a significant barrier, particularly for small-scale farmers or those with limited financial resources. Additionally, setting up and configuring the system may require technical expertise, which can add to the complexity and initial challenges.

2. Reliance on Stable WiFi Connectivity: The system heavily relies on stable and reliable WiFi connectivity. In remote or rural areas with limited internet access or unstable network coverage, maintaining consistent connectivity can be challenging. Interruptions in WiFi connectivity can impact the real-time data collection, remote monitoring, and control capabilities of the system.

3. Security Risks: WiFi-based systems are vulnerable to security risks and potential data breaches. The wireless nature of the communication opens up possibilities for unauthorized access or hacking. Protecting the system against cyber threats and ensuring data privacy and security require robust security measures, including encryption protocols, authentication mechanisms, and secure communication channels. Failure to address these security risks adequately can compromise the integrity and confidentiality of sensitive agricultural data.

4. Technical Dependencies and Maintenance: WiFi-based agriculture systems rely on various technical components, including sensors, WiFi

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modules, and software applications. These components require regular maintenance, calibration, and updates to ensure their proper functioning. Failure to maintain and update the system adequately can lead to inaccurate data, reduced system reliability, and increased downtime. Farmers may require technical expertise or support to handle system maintenance effectively.

It is essential to carefully consider these disadvantages and address them during the planning and implementation stages of the smart farming WiFi-based agriculture system. Adequate training, technical support, security measures, and reliable network infrastructure can help mitigate these challenges and ensure the successful deployment and operation of the system.

## V. CONCLUSION & FUTURE SCOPE

### 5.1 CONCLUSION

In Lighting is a vast and quickly developing area of energy management and ozone harming substance outflows. In the meantime, the saving capability of lighting power is high even with the present innovation, and there are new energy effective lighting advances going ahead the market.

Energy proficient lighting additionally incorporates considerations of the control of light and the utilization of natural light. A supportable lighting arrangement incorporates perceptive theory, high aspect and energy productive lighting model appropriate for the application. In this paper Smart Road lighting system is depicted that combines new advances offering simplicity of maintenance and power is saving.

It handles the issue of energy wastage which thus decreases control utilization, builds safety of roads and gives proficient approach to deal with controlling on/off streetlight by utilizing programmed approach. The use of new technology opens new perspectives toward the developing of high efficiency systems, which allow saving energy and money.

For its reliability, simplicity and low cost, the proposed system makes itself a serious candidate to efficiently manage a set of sensors applicable in different fields including monitoring of energy consumption, smart grids and smart cities which need to a sensor network to realize an efficient management of the system under control.

A smart remote street light system outlined in our project, facilitate the application by overcoming the errors and consequently monitoring and controlling which results in power saving. This is achieved by the use of highly economical LED technology. Remote urban and rural areas are the suitable places for implementation of such street lighting system where the traffic is low most of the times. The system can be extended easily, is flexible and also adjustable according

to the need of user. Use of GSM technology made the system wireless, less complex. In this proposed paper an automatic street light is designed using Wireless Sensor Network to detect the vehicle, human movements and atmospheric condition. This system also helps to increase and decrease the intensity of LED.

Results are found to be satisfied, since it is a prototype module, the system is designed with only 4 street lights & to simulate street lights 4 metal poles are provided in the demonstration module. For the real applications, any number of street lights can be controlled and they can be monitored effectively. To achieve this, the same system with enhanced technology and with required modifications can be implemented. The LDR used for sensing the natural light can be kept in a suitable glass container and it can be kept at outdoor, the arrangement of LDR is very important, care must be taken that the street light intensity should not fall on this LDR, otherwise entire system may misbehave.

The system developed here is cost effective, practical oriented, eco-friendly and the safest way to save the energy. It clearly tackles the two problems that world is facing today, saving of energy and also disposal of incandescent lamps, very efficiently. According to statistical data we can save more that 40 % of electrical energy that is now consumed by the highways. Initial cost and maintenance can be the draw backs of this project. With the advances in technology and good resource planning the cost of the project can be cut down and also with the use of good equipment the maintenance can also be reduced in terms of periodic checks.

The LEDs have long life, emit cool light, donor have any toxic material and can be used for fast switching. For these reasons our project presents far more advantages which can over shadow the present limitations. Keeping in view the long-term benefits and the initial cost would never be a problem as the investment return time is very less.

The project has scope in various other applications like for providing lighting in industries, campuses and parking lots of huge shopping malls. This can also be used for surveillance in corporate campuses and industries.

### 5.2 FUTURE SCOPE:

1. Integration of Advanced Technologies: The project can benefit from the integration of advanced technologies such as Internet of Things (IoT), artificial intelligence (AI), and big data analytics. By

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combining IoT devices with the WiFi-based system, farmers can gather data from a wide range of sensors and devices, enabling more comprehensive monitoring and control capabilities. AI algorithms can analyze large datasets to provide more accurate insights and predictive analytics for improved decision making.

2. Autonomous Farming and Robotics: The future scope of the project involves incorporating robotics and autonomous systems into the farming processes. WiFi-based systems can communicate with robotic devices, allowing for automated tasks such as autonomous planting, harvesting, and crop maintenance. This can increase operational efficiency, reduce labor requirements, and enhance overall productivity.

3. Smart Farming Ecosystem: The project can expand into a broader smart farming ecosystem by integrating with other agricultural technologies and platforms. For example, the WiFi-based system can interface with weather forecasting services, market demand analysis tools, or supply chain management systems. This integration enables farmers to make more informed decisions and streamline their operations within a larger agricultural ecosystem.

4. Cloud-Based Solutions and Remote Collaboration: Leveraging cloud computing, the project can enable centralized data storage, processing, and analytics. Cloud-based solutions provide scalability, accessibility, and collaboration opportunities among farmers, agricultural experts, and stakeholders. Remote collaboration and knowledge sharing can enhance decision-making capabilities and facilitate collective learning within the farming community.

5. Blockchain for Transparency and Traceability: Integrating blockchain technology into the project can enhance transparency, traceability, and trust in the agricultural supply chain. Blockchain can provide secure and immutable records of farming practices, certifications, and transactions, ensuring transparency and accountability from farm to consumer. This can enhance consumer confidence and support sustainable and ethical farming practices.

6. Predictive Analytics and Prescriptive Recommendations: By utilizing historical and real-time data, the WiFi-based system can employ advanced analytics techniques to provide predictive and prescriptive recommendations. Machine learning algorithms can identify patterns, correlations, and optimal farming practices based on data from multiple sources. This empowers farmers with personalized recommendations for efficient resource allocation, crop management, and risk mitigation.

7. Integration with Smart Cities and Sustainability Initiatives: WiFi-based agriculture systems can align with smart city initiatives and sustainability goals. By integrating with urban farming projects, rooftop gardens, or community-supported agriculture (CSA) programs, the system can contribute to local food production, reduce food miles, and promote sustainable urban agriculture practices.

8. Environmental Monitoring and Climate Change Adaptation: As climate change impacts agriculture, WiFi-based systems can play a vital role in monitoring environmental conditions and assisting farmers in adapting to changing climates. By integrating weather data, satellite imagery, and climate models, the system can provide early warnings, adaptive strategies, and precision farming techniques to mitigate climate-related risks and optimize crop production.

The future scope of the smart farming WiFi-based agriculture system lies in the continual advancements and integration of cutting-edge technologies, expanding collaborations, and addressing emerging challenges in the agricultural sector. These developments can revolutionize farming practices, increase sustainability, and contribute to global food security.

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