Indoor Hydroponic Farming System Via ThingsSpeak IoT

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Abstract—**Population growth and rapid economic growth in a country, especially in cities, can cause housing, nutrition, education, health, poverty, etc. in cities. brings with it many problems. Alternative farming methods are sought that produce large crops with minimal land use. This farming method promises to be inexpensive to operate and allows for easy monitoring of growth factors such as light, water level, temperature and humidity. This article discusses the design and development of automated monitoring systems for indoor hydroponic systems. Our core will be designed and built using technology. First of all, it is an indoor hydroponic module with IoT technology. Secondly, Telegram app for monitoring and controlling operations. Finally, Thingspeak cloud-based platform to improve the security of the system, store information, update information and monitor the performance of the system in terms of temperature, humidity, light usage. The results obtained showed progress and opportunity for the designed system.**

Keywords-IOT,cloud based system,Indoor hydroponics system,Telegram app

Introduction

The importance of the population and the development of the country has led to an increase in the need for licenses and land problems. Therefore, the desire to reduce large-scale cultivation in order to provide more housing and improve the area is inevitable. Alternative agriculture is widely used around the world designed to help alleviate food insecurity. One of the modern farming techniques adopted to reduce this is indoor farming. Indoor farming is a great way to grow crops with beautiful eco-friendly farming tools.

Indoor hydroponic systems replace the soil with useful water when growing plants indoors. Using sensors and other connected devices, IoT (Internet of Things) platforms can be used to monitor and control various components of a hydroponic system.

Indoor Hydroponic systems using IoT platforms have many advantages, including the ability to optimize and improve the growth process, increase efficiency, and monitor and solve problems that may occur. Integrating sensors and other devices into the system to collect data and control various aspects of the growing process, including lighting, temperature, and humidity, will require the implementation of the IoT platform in home hydroponic farming. Through the IoT platform, this data can be accessed and analyzed to gain insights and determine how the system should work.

Overall, the use of IoT platforms in hydroponic farming can help increase the productivity, sustainability and efficiency of the cultivation process.

This development for indoor vertical hydroponic farming equipment has 4 elements: .

1. An indoor growing system with an Internet of Things controller.
2. Various forms of plant sensors are used to make it automated and may be monitored best through the usage of cellular programs
3. A cloud-primarily based gadget evolved the usage of Thingspeak cloud based platform as a statistic server is used to store, collect, and acquire records from customers and flowers themselves.
4. Using telegram we will be creating a bot token and chat id with which we can view the command for on and off of LED when the intensity of light is low Therefore, the owner or owner of that application can access the collection data anytime, anywhere. They can access information through mobile devices connected to the Internet. The web utility allows customers to view and analyze their facilities in real time.

LITERATURE SURVEY

[1] L. Audahb, "Vertical farming monitoring system using the internet of things (IoT)"

A vertical farming monitoring system using the Internet of Things (IoT) would involve the integration of sensors, devices, and other IoT technologies into a vertical farming operation in order to collect data and optimize growing conditions.Sensors to measure temperature, humidity, and light levels: These sensors could be used to optimize the growing environment for different crops and ensure optimal conditions for plant growth.Water and nutrient sensors: These sensors could be used to monitor the levels of water and nutrients in the growing system, helping to ensure that plants are getting the right amount of moisture and nutrients they need to thrive.Soil pH sensors: These sensors could be used to measure the acidity or alkalinity of the soil, which can impact the growth and health of plants.Pest and disease monitoring: Sensors and cameras could be used to monitor for signs of pests or disease in the crops and alert farmers to take action.

[2]D. Yendri, “Two Sequential Authentication Method on Locker Security System”. Using Open-Source SmartphoneSequential authentication methods involve using multiple steps to verify the identity of a user before granting access to a system or device. These methods can be effective in increasing the security of a system, as they make it more difficult for unauthorized users to gain access. In the context of a locker security system, sequential authentication methods could involve using a combination of a key, a PIN, and/or biometric data to verify the identity of the user before allowing access to the locker.

PROPOSED METHOD

The significant increase in population and improvement of a country has caused an growth in agreement call for and land crisis. Thus, the want to lessen large-scale land farming to offer greater housing and constructing improvement area is inevitable. Alternative farming practices were broadly utilized in maximum evolved international locations to assist ease problems at the same time as non supplying meals demands. One of the modern-day opportunity farming practices brought to reduce this is indoor vertical farming.This farming method is used to be operated at a lower cost with easy monitoring of essential plantation necessities such as light, temperature, and humidity. It includes authentication process and we can access the above data in both pc and any devices. This improvement on an automated indoor vertical hydroponic farming gadget is made of 3 elements, namely:

1. An indoor planting module with IOT enabled controller.
2. Various forms of plant sensors are used to make it automated and may be monitored best through the usage of cellular programs.
3. A cloud-primarily based totally gadget evolved the usage of ThingSpeak platform as a statistic server is used to store,collect, and acquire records from customers and flowers themselves.
4. Using telegram we will be creating a bot token and chat id with which we can view the command for on and off of LED when the intensity of light is low

Therefore, the person or proprietor of this farming gadget can get right of entry to the records approximately their flowers every time and anywhere. They can get the records through the usage of cellular tools that are related to the internet. A web based utility lets in customers to view and screen their plants in real-time.

Technologies Used

NodeMCU Microcontroller Module

NodeMCU Microcontroller Module Based on the ESP-12 module, the NodeMCU ESP8266 is a lightweight, complete and breadboard board. It has the same connectivity and functionality as the UNO board in a smaller form factor. NodeMCU ESP8266 and pinout. Microcontroller NodeMCU ESP8266 is used to operate the device connected to WIFI. The NodeMCU ESP8266 was chosen because of its small size and ease of use.Write the code using the Arduino integrated development environment (IDE) and submit it to run on the NodeMCU ESP8266.

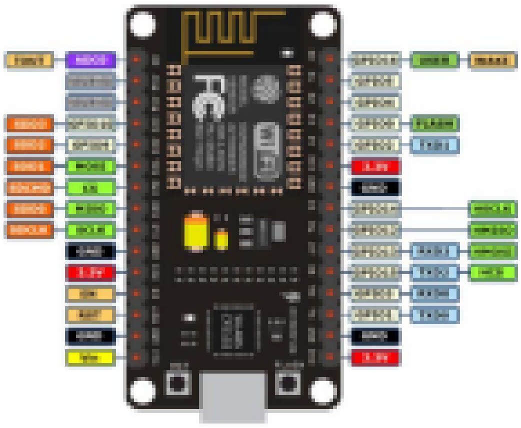

fig 1:nodeMCU microcontroller module

Temperature and Humidity Sensor

DHT11 is used to collect temperature and humidity data for this system. It can control real-time and changing environment such as temperature and humidity data. DHT11 is an integrated digital temperature and humidity sensor with digital output for calibration. Using digital data acquisition technology and measuring temperature and humidity ensures high reliability and long-term stability.

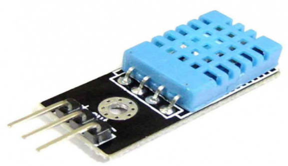

fig 2:Temperature and humidity sensor

Light Sensitivity Sensor

In this project, LM393 Light Dependent Resistor (LDR) sensor module was used to measure light sensitivity. It has analog and digital output pins. The module works when LDR resistance decreases with light intensity and LDR increases with low light intensity. The sensitivity of the LDR can be adjusted using the potentiometer knob on the sensor.

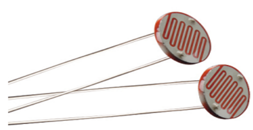

fig 3:light sensitivity sensor

Light Emitting Diode

LED stands for Light-Emitting Diode. It is a semiconductor device that emits light when an electric current passes through it. LEDs have become increasingly popular due to their energy efficiency, long lifespan, and versatility. They are used in a wide range of applications, including lighting for homes, offices, and outdoor spaces, as well as in electronic displays, indicator lights, and automotive lighting.

fig 4:organic light emitting diode display module

ThingSpeak cloud based platform

ThingSpeak is an Internet of Things (IoT) analytics platform developed by MathWorks. It is a cloud-based service that enables users to collect, store, and analyze data from connected devices and sensors.

ThingSpeak allows users to create custom dashboards and visualizations of their data, which can be shared with others. It also provides APIs that enable developers to integrate ThingSpeak with other systems and applications.

In addition, ThingSpeak offers a range of features such as real-time data visualization, data logging, and automatic alerts. These features allow users to monitor and analyze their data in real-time, and to receive notifications when certain conditions are met.

fig 5 Thingspeak iot platform

Telegram App

Telegram can be utilized in a hydroponics system to provide a bot that enables remote monitoring and control of the system. Here are some potential uses and benefits of integrating Telegram into a hydroponics setup:

Monitoring sensor data: You can connect sensors to your hydroponics system, such as those measuring temperature, humidity, pH levels, or nutrient levels. By integrating a Telegram bot, you can receive real-time updates and monitor these parameters remotely. The bot can periodically send sensor readings or notify you if any parameter goes beyond the desired range.

Alert notifications: Telegram can send alerts and notifications to your mobile device or computer. If there's an issue with your hydroponics system, such as a pump failure or a drop in pH levels, the bot can immediately notify you. This enables you to take prompt action to address the problem and prevent potential damage to your plants.

Control system parameters: With a Telegram bot, you can also remotely control various aspects of your hydroponics system. For example, you can send commands via Telegram to turn on or off specific equipment, adjust lighting schedules, or activate irrigation cycles. This allows you to make adjustments or perform tasks without physically being present at the hydroponics setup.

Data logging and analytics: Telegram can serve as a convenient platform for logging and storing data from your hydroponics system. The bot can record sensor readings and other relevant information, creating a historical log. This data can be later analyzed to identify patterns, optimize growing conditions, or troubleshoot any recurring issues.

Access to resources and support: Telegram provides a messaging platform where you can connect with other hydroponics enthusiasts, experts, or communities. By joining relevant groups or channels, you can seek advice, share experiences, and learn from others who are also interested in hydroponics. This can be a valuable resource for troubleshooting, expanding knowledge, or discovering new techniques.

Integrating Telegram with a hydroponics system via a bot offers flexibility, convenience, and remote control capabilities, enabling you to monitor and manage your hydroponics setup from anywhere at any time.

Data Authentication Method

Accreditation can be defined as a two-way process; It is clear that the information was obtained from an authorized/appropriate personal or digital source. This is also the process of verifying data integrity. Authentication is key to secure communications, technology, cloud, IoT and more.

Today, authentication technologies are often categorized according to the different features they use. Events are divided into three groups according to the differences in their use

•**Something you know**: Password-based authentication is a commonly used method for verifying the identity of a user and granting access to a system or service. It involves the use of a unique password that is known only to the user and the system administrator. Here's how password-based authentication typically works:

User registration: When a user creates an account or signs up for a system or service, they are typically required to choose a password. The user selects a password that meets the specified security requirements, such as a minimum length, inclusion of special characters, or a combination of letters and numbers.

Password storage: The system securely stores the user's password. Ideally, passwords should be hashed and salted, which means they are transformed into a non-reversible and unique representation using cryptographic algorithms. This ensures that even if the password database is compromised, the actual passwords remain protected.

Authentication process: When the user attempts to access the system or service, they are prompted to enter their username or email and the associated password. The system verifies the entered password against the stored password hash. If the entered password matches the stored password hash, authentication is successful, and the user is granted access.

Password security measures: To enhance the security of password-based authentication, various measures can be implemented. These include enforcing strong password policies (e.g., minimum length, complexity requirements), using multi-factor authentication (e.g., combining passwords with one-time codes sent to a mobile device), and implementing account lockout policies (e.g., temporarily locking an account after multiple failed login attempts).

•**Something you have:** a token such as software token, smart card, hardware device. Token-based authentication is the hardest technique to abuse since it relies on a unique physical object that one must have in order to log on.

Token-based authentication is an authentication method that uses tokens instead of passwords to verify the identity of a user. It is commonly used in modern web and mobile applications. Here's how token-based authentication typically works:

User authentication: When a user attempts to log in to a system or service, they provide their username and password. The server verifies the credentials and, if valid, generates a token for the user.

Token generation: The server generates a unique token for the authenticated user. This token contains information about the user's identity, along with an expiration time and any other relevant data. The server signs the token using a secret key or private key to ensure its integrity.

Token storage: The server stores the generated token, usually in a database or cache, associating it with the user's session or account. The token is then sent back to the client (web or mobile application) as a response.

Subsequent requests: For subsequent requests to protected resources or API endpoints, the client includes the token in the request header or as a parameter. This allows the server to authenticate and authorize the user without requiring the user to provide their username and password again.

Token verification: When the server receives a request with a token, it verifies the token's authenticity by checking its signature and expiration time. Token renewal: Tokens typically have a limited lifespan to enhance security. If a token is about to expire and the user is still active, the client can request a token refresh by sending the expired token to a designated endpoint.

ARCHITECTURE

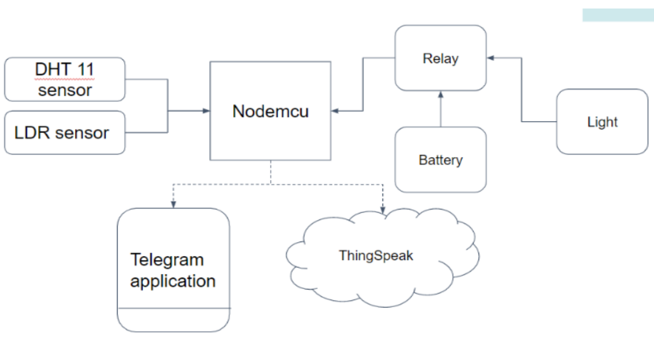

fig 5:Architecture

Relay: A relay is an electronic switch that allows a low voltage signal to control a high voltage circuit. In this architecture, the relay could be used to turn on and off a light or other electrical device.

DHT 11 sensor: The DHT11 is a temperature and humidity sensor that is commonly used in IoT projects to measure environmental conditions. It can provide accurate readings of both temperature and humidity, making it useful for monitoring conditions in a room or other indoor environment.

Nodemcu: NodeMCU is an open-source firmware and development kit based on the ESP8266 WiFi module. It allows you to build IoT applications with Lua programming language and is widely used for IoT projects because of its low cost and ease of use.

Light: The light in this architecture refers to an electrical device that produces visible light. It can be controlled by the relay and monitored by the LDR sensor.

LDR sensor: LDR stands for Light Dependent Resistor, which is a passive component that can detect the intensity of light. In this architecture, the LDR sensor could be used to detect the brightness of the room or environment and adjust the light accordingly.

Battery: A battery provides power to the system and allows it to operate without being plugged into a wall outlet. The type of battery used in this architecture would depend on the specific requirements of the project.

Telegram application: Telegram is a cloud-based instant messaging app that can be used to send messages and files. In this architecture, it could be used to send notifications or commands to the NodeMCU or to receive data from it.

ThingSpeak: ThingSpeak is an IoT analytics platform that allows you to collect, analyze, and visualize data from sensors and other IoT devices. In this architecture, it could be used to store and analyze data from the DHT11 and LDR sensors, as well as to send notifications or commands to the NodeMCU via the Telegram application

FLOW CHART

The flowchart outlines the steps involved in monitoring and controlling an indoor hydroponics system through IoT, starting with collecting sensor data on environmental parameters such as temperature, and humidity then transmitting the data to a central server, analyzing the data to determine the appropriate actions, and finally, triggering the IoT devices to adjust parameters like lighting, irrigation, and nutrient dosing based on the analysis results.

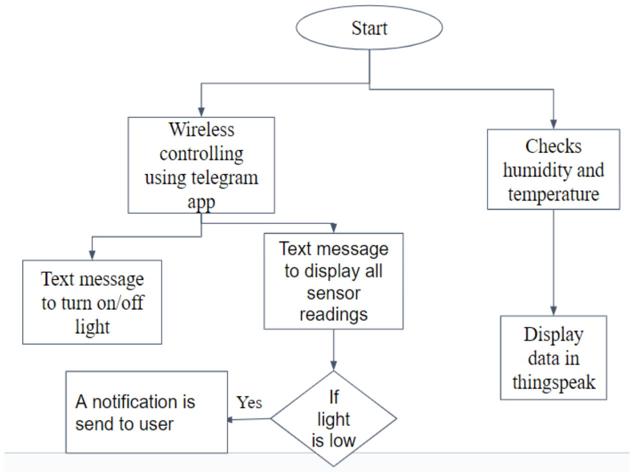

fig 6: flow chart

RESULT ANALYSIS

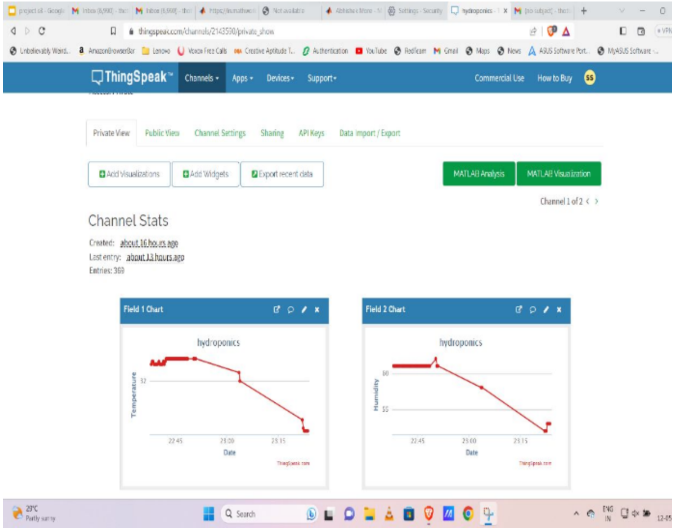

Fig 7:Thingspeak application

fig 9:Telegram app

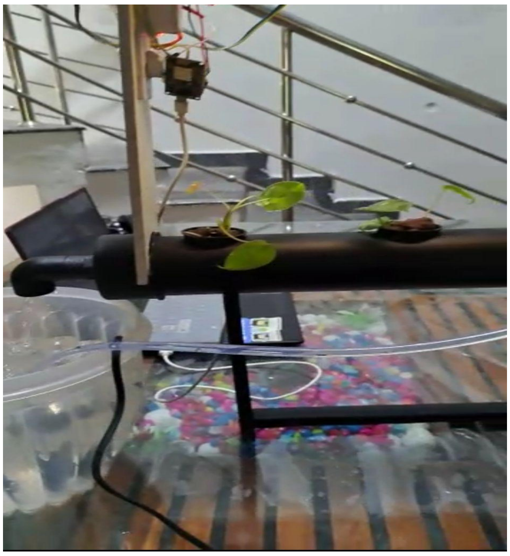

fig 8: water flowing

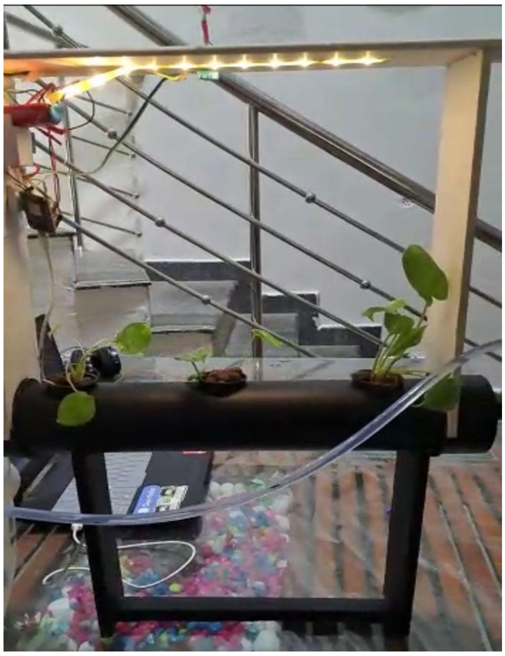

fig 10 :light control

Future Scope

The indoor hydroponic system using IoT has a lot of future scope and potential for further development. Here are some possible areas for future improvements:

- Integration of Artificial Intelligence (AI) - The use of AI algorithms can help in automating the system, predicting the best crop yields and optimizing plant growth.
- Expansion of the System - The system can be expanded to cover a larger area, and more hydroponic modules can be added, increasing the quantity and variety of crops grown.
- Use of Blockchain - The integration of blockchain technology can improve transparency and traceability in the food supply chain, giving consumers confidence in the safety and quality of the food they eat.
- Integration with other Smart Home Devices - The hydroponic system can be integrated with other smart home devices such as thermostats and lights, making it easier for users to monitor and control their indoor environment.
- Data Analytics - The system can be further developed to collect more data and use advanced data analytics to analyze plant growth patterns, identify trends, and predict potential problems.
- Automated Nutrient Management - The hydroponic system can be further optimized by integrating automated nutrient management systems, which will ensure plants receive the right nutrients at the right time.
- Use of Renewable Energy - The hydroponic system can be powered by renewable energy sources such as solar power, making it more environmentally friendly and sustainable.

Conclusion

In conclusion, the development of an automated monitoring system for indoor hydroponic farming using IoT technology, Telegram app, and Thingspeak cloud-based platform has great potential for addressing the challenges of population growth and economic development in cities. This innovative farming method allows for efficient and eco-friendly cultivation of crops with minimal land use, making it a promising solution for food insecurity. The integration of IoT technology and cloud-based platforms enables real-time monitoring and control of various aspects of the farming process, including temperature, humidity, and lighting. The results of this project demonstrate the feasibility and effectiveness of this approach, and suggest opportunities for further research and development to improve productivity and sustainability of indoor hydroponic farming. Overall, this project offers a valuable contribution to the field of agriculture and sustainable development.

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