A Review on Auto Indoor Hydroponics Fodder grow Chamber Using IOT

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Abstract—The auto indoor hydroponic fodder grow chamber is an innovative agricultural system aimed at transforming livestock feed production. This automated hydroponic environment enables efficient, nutrient-rich fodder cultivation by optimizing water and nutrient use. Designed for indoor use, the chamber offers year-round production, minimizing dependence on seasonal cycles and reducing manual labor through automation. Its integration with IoT allows real-time monitoring and remote management, enhancing resource efficiency and sustainability. This system represents a significant advancement in precision agriculture, providing a reliable, high-quality feed source that is sustainable and suitable for various environments.

Keywords—Hydroponic, Fodder, Automation, IoT, Chamber, Sustainability, Innovative Agriculture System.

I. INTRODUCTION

The "Auto Indoor Hydroponics Fodder Using the IoT" project addresses the need for innovative, efficient agricultural practices to produce livestock feed. Traditional farming methods face limitations such as seasonal constraints, dependency on soil quality, and high water consumption. This automated indoor hydroponic system leverages IoT technology to create a controlled environment for year-round fodder cultivation without soil, using minimal water and space. By integrating IoT sensors, the system monitors, and controls key environmental factors, such as temperature, humidity, and light, ensuring optimal conditions for plant growth. Automation reduces manual labour and allows remote monitoring and management, giving farmers real-time access to data and control over the growing conditions. This setup not only improves resource efficiency but also enables feed production in areas with limited arable land or unfavourable climates.Traditional farming methods face limitations such as seasonal constraints, dependency on soil quality, and high water consumption. This automated indoor hydroponic system leverages IoT technology to create a controlled environment for year-round fodder cultivation without soil, using minimal water and space. By integrating IoT sensors, the system monitors, and controls key environmental factors, such as temperature, humidity, and light, ensuring optimal conditions for plant growth. The "Auto Indoor Hydroponics Fodder Using IoT" project introduces a modern approach to sustainable fodder production through the integration of Internet of Things (IoT) technology and hydroponics. This system is designed to grow nutrient-rich fodder indoors without soil, using controlled environments that allow for year-round cultivation. IoT-enabled sensors continuously monitor the growing environment, providing real-time data that can be accessed remotely. This setup not only reduces the need for manual labour but also enables precision agriculture, as farmers can adjust conditions based on live data to enhance yield and quality. The system is particularly valuable in regions facing challenges like limited arable land, variable climates, or water scarcity. Ultimately, this innovative approach aligns with sustainable farming goals, providing a consistent, high-quality feed supply for livestock, which helps mitigate the limitations of traditional farming methods.

II.LITERATURE REVIEW

The literature review for "Auto Indoor Hydroponic Fodder Using IoT" explores the foundations and evolution of hydroponics and indoor cultivation. Traditional agriculture often struggles with challenges such as dependency on soil quality, climate variations, and resource inefficiencies. Hydroponic systems, by contrast, grow plants in nutrient-rich water solutions rather than soil, allowing for precise control over nutrient delivery and reduced water use. Research has shown that hydroponics enables faster growth, higher yields, and efficient resource management, particularly in constrained spaces and urban settings. The integration of IoT technology has further enhanced hydroponic systems by allowing remote monitoring and control over key environmental parameters, including temperature, humidity, and light. Studies emphasize that automation within hydroponics not only reduces labour requirements but also provides consistent growing conditions. IoT-enabled hydroponic systems are particularly relevant for sustainable agriculture, addressing the needs of areas with limited arable land or water scarcity. The literature suggests that automated hydroponic fodder systems offer a reliable, high-quality feedsolution that can mitigate traditional farming challenges and contribute to a resilient agricultural future.

The study "Automated Hydroponics grow chamber using Arduino" Rapid industrial development of the global economy and ominously increasing population forces countries like India to upgrade their agricultural techniques to meet the needs of the people. Soil less agricultural techniques like hydroponics have gained a lot of importance over the years, one of the most popular hydroponic technique in which the crops are grown in nutrient solutions is now gradually being employed for commercial agriculture. India, in spite of being an agro-based nation, has found it very stimulating to implement hydroponics on a commercial scale due to the lack of knowledge and special apparatus required and other agriculture encounters. Sensitivity of hydroponics to technical faults is a major limiting factor when it comes to their commercially wide scale implementation. In addition to this, agriculture in India is largely being practiced by unskilled farmers which makes imparting knowledge on hydroponics even more challenging. Considering the wide range of advantages which hydroponics offer over conventional agriculture techniques and increasing need to meet the goods requirements of the growing population with the limited agricultural land available, practicing hydroponic procedures has become the need of the hour.

P Sihombing, N A Karina, JT Tarigan and M I Syarif designed a paper "Hydroponics FodderGrow Chamber" explores an automated hydroponic irrigation system using Arduino Uno Microcontroller supported by Android is presented by this paper. Nutritious water flowsystem through the sensor range to be effective done. The water level inside the hydroponic tube is normal prepared in accordance with the hydroponic requirement, too this can be done as a basic irrigation guide or not.

III.OVERVIEW OF THE REVIEW LITERATURES

The study, "Auto Indoor Hydroponic Fodder Grow Chamber Using IoT" presents an innovative agricultural systemthat utilizes hydroponics and Internet of Things (IoT)technology to automate the growth of nutrient-rich fodder in a controlled indoor environment. This approach addresses limitations in traditional farming by allowing year-round cultivation, optimizing water and nutrient use, and enabling precision control over environmental factors like temperature and humidity.

Key features of the system include:

Automation and IoT Integration:

The system is fully automated and allows remote monitoring and adjustments through IoT connectivity. Sensors collect real-time data on environmental conditions, which can be accessed and managed via a mobile or web application.

Efficiency and Sustainability:

Hydroponic methods reduce water usage and eliminate the need for soil, making it suitable for areas with limited water or poor soil quality. The use of energy-efficient lighting and precise nutrient management contributes to its sustainability.

Applications and Benefits:

Primarily aimed at livestock fodder production, the system is also suitable for urban farming, small-scale agriculture, and areas with limited arable land. Its space-efficient design and consistent nutrient delivery make it a reliable and effective feed source.

Challenges and Future Scope:

High initial setup costs, technical expertise requirements, and energy demands are noted challenges. Future advancements could focus on reducing costs, enhancing energy efficiency, and making the system more scalable and user-friendly.

Overall, this study underscores the potential of automated hydroponics combined with IoT to create a sustainable, resource-efficient solution for modern agricultural challenges.

The study "Automated Hydroponics Fodder Grow Chamber Using Arduino" explores an efficient, automated hydroponic system designed to cultivate plants without soil. Key aspects include:

System Design and Functionality:

This system leverages Arduino technology to automate water flow, temperature, and humidity, ensuring optimal conditions for plant growth. Sensors

(DHT22 for humidity and temperature, water, and ultrasonic sensors) monitor these parameters, while a GSM module enables real-time alerts to users about water levels and other vital metrics.

Applications and Benefits:
The system is intended for cattle farming, urban agriculture, and even Martian environments due to its water-efficient, soil-free setup. It minimizes water use and provides artificial light, making it a sustainable solution for challenging climates.

Future Potential:
This study highlights that by automating hydroponics, maintenance can be reduced, potentially leading to broader adoption in urban and agricultural settings where water conservation and efficient food production are essential.

The study "Hydroponics Fodder Grow Chamber"explores a hydroponic system for growing cattle fodder in rural areas of India where traditional farming faces challenges like limited land and water resources. The authors propose an automated hydroponic chamber that grows fodder without soil, using 80% less water than conventional methods. In seven to eight days, the chamber produces fodder suitable for livestock, monitored and regulated by sensors for moisture, temperature, and humidity. The system employs an Atmega328p microcontroller to automate water delivery and light control, making it nearly maintenance-free and efficient.The chamber is designed to support sustainable, year-round fodder production in a controlled environment. This approach benefits cattle health, boosts productivity, and is particularly advantageous in areas where green fodder is scarce. The paper highlights the hydroponic system's cost-effectiveness, low space requirement, and potential to enhance livestock nutrition while reducing manual labour and resource demands.

IV. PARAMETERS USED IN THE STUDIES

1. A Study on Auto Indoor Hydroponic Fodder Grow Chamber Using IoT -

The parameters for the studies presented in both articles are focused on hydroponic systems for indoor fodder production with automation.
Environmental Parameters:
*Humidity: Maintained with DHT11 sensors to ensure optimal levels for fodder growth.
*Temperature: Controlled and monitored to provide a stable environment using cooling fans and sensors.
*Lighting: LED or UV lighting is used to simulate sunlight, controlled for intensity and duration.
*Water: Precisely regulated using microcontrollers and sensors to maintain moisture levels, utilizing minimal water (about 80% less than traditional methods).

System Components:

*Microcontrollers: Atmega328p (first article) and ESP8266 (second article) microcontrollers for automating and controlling system functions.
*Nutrient Delivery: Nutrient-rich water solution is circulated without soil, with precision control over nutrient ratios.
*Sensors: Humidity, temperature, moisture, and light sensors, including IoT-based real-time monitoring.
*Other Electronics: Water pumps, motor drivers, relays, exhaust fans, and displays for user interfacing.

• Operational Parameters:
*Automation Level: Both systems minimize manual intervention through automation, from seed germination to harvest.
*Growth Time: Fodder is fully grown within 7–8 days.
*Monitoring: Remote monitoring capability through IoT (Arduino IoT Cloud in the second article), providing real-time updates and remote control.

Output Parameters:

*Fodder Yield: Expected to enhance year-round production with consistent yield and quality.
*Nutrient Density: Precise nutrient control aims to produce nutrient-rich fodder beneficial for livestock health.
*Space Efficiency: Compact design suitable for urban or space-limited environments.
These parameters are essential for optimizing the hydroponic chamber's efficiency, environmental sustainability, and ease of use, making it a feasible solution for modern, resource-efficient farming.

2. A Study on Automated Hydroponics Fodder Grow Chamber Using Arduino –

The parameters for the study described in the article "Automated Hydroponics Fodder Grow Chamber Using Arduino" include the following:
Environmental Parameters:
*Temperature: Managed by a DHT22 sensor and controlled by fans to maintain optimal levels for plant

growth.
*Humidity: Monitored and adjusted to create an ideal environment within the grow chamber.
*Light Intensity: Artificial LED lights provide controlled lighting, ensuring sufficient light for photosynthesis regardless of external conditions.
*Water Level and Moisture: Sensors maintain the necessary moisture and water levels, with automatic alerts sent via GSM if levels are low.

System Components:

*Microcontroller:Arduino is used to automate control of the environmental conditions.
*Sensors:
- DHT22 sensor for temperature and humidity.
- Light-dependent resistor (LDR) for monitoring light levels.
- Water level sensor for moisture control.
- pH sensor for monitoring nutrient solution acidity.

*Actuators:
- Fans for temperature control.
- Motors for water circulation and maintaining desired water levels.
- GSM module for alerting users via text message.

Operational Parameters:
*Automation: The system operates automatically, minimizing manual intervention by using Arduino-controlled sensors and actuators.
*Data Communication: GSM module enables remote monitoring by sending real-time alerts to the user's mobile phone.
*User Interface: Text alerts allow users to receive status updates on water level, temperature, and humidity.

Output Parameters:
*Plant Growth: The controlled environment promotes rapid and healthy plant growth, suitable for hydroponic fodder production.
*Resource Efficiency: The system uses less water compared to traditional farming methods, making it suitable for regions with limited water resources.
These parameters help ensure optimal growth conditions for hydroponic plants by controlling and automating key environmental variables. The GSM communication provides added convenience for remote monitoring, making it feasible for use in both agricultural and experimental settings.

3.A Study on Hydroponics Fodder Grow Chamber-

This study describes the parameters used in a hydroponic fodder grow chamber system, which automates the production of green fodder for cattle. Here are the primary parameters and components involved:
• Microcontroller: ATmega328P microcontroller, responsible for automating various aspects of the system.
• Sensors:
*DHT11 Sensor: Measures temperature and humidity.
*Moisture Sensor: Regulates the water supply based on soil moisture levels.
• Lighting: UV or LED light to simulate sunlight, essential for plant growth.

Water Management:

-Controlled by moisture sensors and microcontroller, which calculate the amount of water needed.
- Water truck and a simple tap water solution used for irrigation.

• Nutrient Solution: Although not critical, nutrient-rich solutions can be added to support plant growth.
• Cooling System: Maintains optimal temperature and humidity using cooling fans.
• Enclosure: Room is made of aluminum or fiber, fully enclosed to control environmental conditions.

V.ADVANTAGES AND DISADVANTAGES

1. A Study on Auto Indoor Hydroponic Fodder Grow Chamber Using IoT –

ADVANTAGES:
• Year-Round Cultivation: Allows for consistent fodder production throughout the year, independent of seasonal variations.
• Water Efficiency: Uses significantly less water than traditional farming, optimizing water usage by directly feeding nutrients to plant roots.
• Nutrient Precision: Provides precise control over nutrient delivery, leading to nutrient-rich fodder that can benefit livestock health.

DISADVANTAGES:
• High Initial Investment: Automation and environmental control systems can make setup costs prohibitive for small-scale farmers.
• Technical Expertise Required: Operating and maintaining an automated system may require specialized knowledge and training.
• Energy Consumption: Automated components such as cooling systems and artificial lighting increase energy usage, which may be costly.

2. A Study on Automated Hydroponics Fodder Grow Chamber Using Arduino –

ADVANTAGES:
• Efficient Water Usage: Uses significantly less water than traditional farming, which is beneficial in areas with limited water resources.
• Year-Round Cultivation: Allows for continuous fodder production regardless of seasonal changes, ensuring a steady supply.
• Controlled Environment: Automated control of temperature, humidity, and light allows for optimized growing conditions, leading to faster growth and higher yields.

DISADVANTAGES:
• High Initial Investment: Initial setup costs for automated hydroponic systems can be high due to the required sensors, controllers, and other equipment.
•Technical Expertise Required: Operating and maintaining the system requires knowledge in handling sensors, software, and hydroponics, which may be a barrier for untrained farmers.
• Energy Consumption: Automated components such as artificial lighting and climate control systems require electricity, which can increase operational costs, especially where energy is expensive.

3. A Study on Hydroponics Fodder Grow Chamber-

ADVANTAGES:
• Space Efficiency: Requires no soil and less space, allowing for use in confined areas.
• Automation: Operates fully automatically, reducing the need for manpower.
• Organic Growth: No need for excessive fertilizers, as it relies on nutrient-rich solutions.

DISADVANTAGES:
• Initial Setup Cost: Requires investment in automated systems, sensors, and controlled environment technology.
• Dependency on Technology: Relies on electronic components, which may need regular maintenance and troubleshooting.
• Limited Crop Variety: Primarily suitable for certain types of fodder, which may not cover all livestock dietary needs.

VI. SUGGESTION

Expand on how the system's water and space savings directly compare to traditional fodder production, offering specific statistics or case studies to strengthen the impact. Provide additional context on the benefits of year-round cultivation, particularly for regions where traditional fodder is unavailable in certain seasons. The high setup cost is a potential barrier; including suggestions for making the system more cost-effective or modular could be beneficial. Highlighting maintenance requirements, especially in terms of technical support and training, can make the article more practical for prospective users. Highlighting the importance of education and training to assist farmers in adapting to the new technology would add value, especially for those in areas where technical expertise may be limited. The article should mention how energy usage could be minimized, such as using renewable energy sources (solar panels) to power the automated system. Consider discussing any trade-offs related to energy use for climate control and lighting.

VII. CONCLUSION

In conclusion, the Auto Indoor Hydroponic Fodder Grow Chamber using IoT represents a transformative step in sustainable agriculture, providing an efficient and controlled environment for year-round fodder cultivation. By integrating hydroponic methods with IoT technology, this system enables precise control over essential growing conditions—such as temperature, humidity, and nutrient delivery—ensuring consistent, nutrient-rich feed for livestock. The automation minimizes labour requirements and reduces water usage significantly compared to traditional farming methods, making it especially beneficial in water-scarce regions. The system's IoT-enabled monitoring and remote accessibility allow farmers to oversee and adjust conditions in real time, further optimizing growth outcomes.

This approach addresses key challenges faced in conventional farming, such as seasonal dependencies and soil quality constraints, offering a viable solution for urban, arid, or soil-deficient areas. As demand for sustainable food production grows, this technology holds potential for scalability and wider adoption.

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