ISSN: 2454-9940

INTERNATIONAL JOURNAL OF APPLIED SCIENCE ENGINEERING AND MANAGEMENT

E-Mail :
editor.ijasem@gmail.com
editor@ijasem.org

www.ijasem.org

INTERNATIONAL JOURNAL OF APPLIED SCIENCE ENGINEERING AND MANAGEMENT

ISSN2454-9940

www.ijasem.org

Vol 18, Issue.2, 2024

MICROGREENS KIT AUTOMATION USING IoT

[1] Prof. Ankita Rekkawar, [2] Shantanu Talmale

[1] HOD

[1,2] Department of Electronics and Telecommunication

[1,2] Swaminarayan Siddhant Institute of Technology, Nagpur

Abstract

Microgreens are young, edible plants that have gained popularity recently due to their variety of colors and flavors, high concentration of phytonutrients, quick development cycle, and low space and nutritional requirements. They may be grown in a range of systems, from straightforward home gardens to intricate vertical farms with computerized lighting, irrigation, and fertilizer supply. Space agencies have also been interested in microgreens, presumably because of their sensory properties that might improve astronauts' diets in microgravity and because their cultivation could support crew members' physical and mental well-being during extended spaceflight missions. Nonetheless, there are still a lot of unanswered technological questions and data gaps about the growth of microgreens on and outside Earth. This study outlines recent research on a variety of topics related to microgreens, such as their nutritional and economic advantages, growing methods, and operating circumstances, creative solutions, self-contained buildings, and possible space uses. A new method for growing microgreens that uses the Mqtt protocol to allow for remote parameter control. Lighting is crucial in an indoor growing environment without an external or natural light source, but not all bulbs are made equal. Depending on the type of crop and the stage of growth, plants require different amounts and qualities of light. As a result, automation is required. Using a clever method, the microgreens automation system keeps your plants in the necessary amount of light. You may typically grow year-round with indoor farming since it is not dependent on external factors like sunshine or rain. Smart microgreens farming is an automated system that can regulate any season.

Keywords: Microgreens , Nodemcu, grow lights.

I Introduction

Recently, there has been a surge in the popularity of microgreens, which are little plants that are picked at the complete cotyledon growth and appearance of real leaves. These seedlings have benefits over mature plants because of their flavor and color combinations, quick growth cycle, and other characteristics. Furthermore, the nutritional profiles of microgreens vary greatly depending on the species and are rich in phytonutrients. Microgreens may be generated by a variety of sophisticated methods, from mass production using

cutting-edge controlled environment agriculture (CEA) technology to at-home growing on potting mix or capillary mat. The plethora of advantages associated with microgreens has spurred research and development of new technologies, a trend that has intensified in the 2020s. The nutritional makeup and health advantages of a number of neglected species and cultivars have been studied. Numerous thorough in vivo and in vitro investigations. Research at the molecular nutrition level provided more understanding. Constant work has been done to improve growing conditions, with a particular emphasis on managing nutrients and light intake. Furthermore, a range of cutting-edge cultivating techniques, creative therapies, and the ground-breaking Internet of Things have all helped to advance microgreen production (IoT). Microgreens have been proposed as a potential dietary supplement for space station crew members, beyond Earth. Microgreens' distinct nutritional profile and strong flavor may encourage hunger and preserve astronauts' homeostasis. Additionally, microgreens are a fantastic option for horticulture treatment due to their brilliant color and ease of growth. The fundamental control unit is the ESP8266 microcontroller, which is renowned for its adaptability and connection. Equipped with a temperature-humidity sensor, it keeps an ongoing eye on the environmental conditions that are essential for the growth of microgreens. The sensor allows for exact modifications to be made in order to maintain optimal growth conditions by providing real-time data on the temperature and humidity levels within the cultivation space. Moreover, humidity management is made easier by a fan system that is managed by the ESP8266.

II. Literature Review

Automation in agriculture has witnessed substantial advancements in recent years, driven by the integration of cutting-edge technologies such as Internet of Things (IoT), artificial intelligence (AI), and wireless communication systems. These technologies offer opportunities to optimize resource utilization, improve crop yield, and minimize manual intervention in farming operations (García et al., 2020). Microgreens, defined as immature greens harvested at the cotyledon or first true leaf stage, have gained popularity for their intense flavors, vibrant colors, and concentrated nutrient profiles (Mir et al., 2017). However, the cultivation of microgreens often involves labor-intensive processes, including seeding, watering, and monitoring environmental conditions such as light, temperature, and humidity. When it comes to enabling wireless communication between electrical devices over short distances, Bluetooth technology has shown great promise. An array of characteristics, including soil moisture levels, nutrient concentrations, and ambient conditions, may be monitored and controlled in agriculture through the integration of Bluetooth-enabled sensors and actuators into automated systems (Son et al., 2019). Real-time data gathering and analysis are made possible by Bluetooth technology, which empowers farmers to maximize resource management techniques and make well-informed judgments. Agricultural applications in remote or geographically separated places can benefit from the ubiquitous connection and remote monitoring capabilities provided by Global System for Mobile Communications (GSM) technology. Farmers may remotely monitor and regulate crucial microgreens growing factors, such irrigation scheduling, pest control, and greenhouse climate control, by utilizing GSM-enabled sensors and actuators (Bui et al., 2018). Additionally, GSM technology makes it easier for data to be transmitted and for people to communicate via mobile networks, giving farmers access to timely warnings and notifications about the health of their crops and about operational operations. The potential for automating many parts of microgreens growth through the integration of GSM and Bluetooth technology is enormous. Growth chambers and greenhouse conditions may be equipped with Bluetooth-capable sensors to keep an eye on important variables like humidity, light intensity, and temperature. Real-time data may be sent by these sensors to a central control unit that has GSM connection capability. After processing the data, the control unit can carry out preprogrammed actions, such modifying watering schedules, turning on extra lights, or sounding an alert in the event of abnormalities or departures from ideal circumstances.

III. Methodology

Simply said, plants improve themselves through a process called photosynthesis, in which they employ chlorophyll and sunshine to convert carbon dioxide and water into glucose and oxygen.

$$6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$$

chemically The idea behind the Internet of Things, or IoT for short, is to use sensors, actuators, and other electronic parts that can connect to the internet to gather information or operate devices. The Internet of Things (IoT) is a concept that has gained popularity recently and is used in many different industries, including agriculture, electronics, health, and others. Numerous procedures may be automated with the help of the Internet of Things, and the acquired data can be accessed and managed from any location. IoT is frequently used in the agriculture industry to monitor in order to keep an eye on the farming environment, gather information on plant health, and control the possibility of crop damage Automated farming in confined places may be achieved by combining the idea of microgreen planting with the use of IoT and artificial light sources such as LED lights or specific farming lights (GrowLight). As a result, every household—especially those in large cities—can automatically complete the planting through harvesting process.

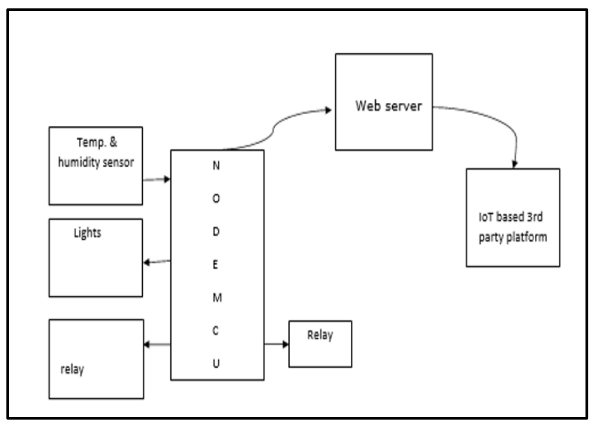

Fig 1: Block diagram of microgreens automation using IoT

The primary goal of utilizing IoT in indoor farming is to reduce labor requirements to the absolute minimum, requiring each family to only plant the seeds and come back when the seeds are ready to be harvested into microgreens. Furthermore, every home device has the ability to transmit data about the planting environment to an integrated server, allowing simplifying data analysis, management, and monitoring. A novel

ISSN2454-9940

www.ijasem.org

Vol 18, Issue.2, 2024

vegetable class is called microgreen. This vegetable is picked once the cotyledons—the initial pair of leaves from the seed—have fully developed and the real leaves have begun to emerge. Microgreen is another name for vegetable confetti or microherbs. It has vibrant colors and a delicious taste profile. It is 3–10 cm tall. Microgreens' delicate texture makes them suitable as a main course, an accompaniment to sandwiches or burgers, or even as a component in salads. Vegetable seeds from peas, chard, beets, spinach, kale, cilantro, any crop used in salads, and even sunflower seeds can be used to make microgreens. Typically, they are cultivated in a tray using any kind of plant media, such as soil, rockwool, or cocopeat. The capacity to cultivate microgreens indoors (indoor gardening) is one of the factors that contributed to the popularity of microgreen farming. By doing this, they may also spread more energy and power to the plant's leaf and stem development while also using relatively less roots. Space is saved as a result of the aforementioned as well. We now have the ability to produce more plants in an area that was previously thought to be barren since the same plant can be grown in a smaller space than it ever could thanks to its stronger stem and smaller roots. However, none of these systems are sophisticated enough to forecast plant development based on patterns of daily nutrient consumption, which is crucial for regulating nutrient pumping and reducing nutrient shortages. The humidity sensor module makes an assessment of the environment's temperature and stickiness. Four DHT11 pins are included on this 8-bit microcontroller: NC, VCC, Data pins. The DATA line sends begin signals to DHT11 to initiate the communication process. DHT11 receives the signs and responds with an answer flag. After receiving the proper response flag, the host then begins to receive 40-bit humidity data in the form of an 8-bit stickiness number, an 8-bit dampness decimal, an 8-bit temperature whole number, an 8-bit temperature decimal, and an 8-bit checksum. An artificial light source, usually an electric one, called a glow light or plant light is intended to promote plant development by providing a light suitable for photosynthesis. At that time, the mechanical action is performed and the switch is opened and closed using the attractive field. A physical device with a fixed engine, the submersible pump's whole assembly is immersed under liquid to siphon. In contrast to fly siphons, submersible siphons force the liquid to the surface. Via an entrance screen, liquids enter the siphon and are raised by the siphon stages.

Steps:

- Keeps the time
- Reads sensors
- Communicates with the web interface
- Turns the fan on / off
- Turn the lights on / off
- Transmits data to IoT user interface

The sensor allows for exact modifications to be made in order to maintain optimal growth conditions by providing real-time data on the temperature and humidity levels within the cultivation space. Moreover, humidity management is made easier by a fan system that is managed by the ESP8266. Excess moisture is efficiently circulated and removed from the environment by carefully turning on the fan in response to humidity readings. This helps to avoid the formation of mold and other harmful situations. This dynamic method for controlling humidity guarantees the ideal atmosphere for the robust and healthy development of microgreens. Compared to conventional farming techniques, the suggested approach has a number of benefits, including improved automation, accuracy, and resource economy. Growers may increase scalability and ease incorporation into current agricultural operations by using IoT technology to remotely monitor and modify production settings. To sum up, the ESP8266 integration, temperature-humidity. The combination of the temperature-humidity sensor, fan system, and ESP8266 offers a viable way to maximize the growth of microgreens in regulated settings. This creative method has the potential to completely transform the microgreens industry by allowing for year-round, reliable yield and quality production.

IV Results

A sensor for both temperature and humidity is the DHT 11. Through Wi-Fi connectivity, NodeMCU may transfer data to the server on the IoT platform. Real-time direct monitoring of sensor data is possible. Sensor-derived parameter data is sent to the internet to enable more thorough and efficient monitoring. An important development in indoor farming techniques is the automation of microgreens growing using the NodeMCU ESP8266, which is outfitted with a DHT11 sensor to monitor temperature and humidity as well as a cooling fan and LED grow lights. This integrated system provides a comprehensive method for improving microgreens' growing conditions, yield, and general quality. Accurate environmental monitoring is made possible by the seamless connection and real-time data collecting made possible by the NodeMCU ESP8266 central control unit. Growers may obtain useful insights into the growth environment with the continuous tracking of essential factors, such as temperature and humidity, thanks to the integration of a DHT11 sensor. By taking preventative measures, the likelihood of mold, fungal development, and other environmental stresses is reduced, resulting in a favorable growing environment for microgreens. Furthermore, the use of LED grow lights improves the development process even more by offering certain light spectra that are ideal for photosynthesis. This increases the rate at which microgreens grow, facilitates the absorption of nutrients, and fosters the development of desired characteristics including color, taste, and nutritional value. Growers may get consistent results year-round, expedite the cultivation process, and minimize manual intervention by integrating these elements into a single automated system. This method's scalability and versatility make it appropriate for a range of indoor farming configurations, from modest home gardens to large-scale commercial enterprises. Essentially, utilizing NodeMCU ESP8266 to automate the growth of microgreens is a prospective paradigm change.

V. Conclusion

We concluded that in the face of global environmental crises, the role of sustainable business practices has never been more critical. We agree that the cultivation of microgreens was one sector where this is particularly evident. Microgreens, the young seedlings of edible vegetables and herbs, have been recognized for their nutritional density and are increasingly popular in various culinary applications. It is known for high nutrient contents and calories produced from seeds of various kinds of herbs, vegetables and other plants. Seeds of green leafy vegetables, salad greens, herbs, seeds of plants having edible flowers can be used for raising microgreens. The nutrient levels varied with variation in growing medium, both hydroponically and in different soil condition and also the time of harvesting. The cultivation and consumption of micro greens at home will not only provide nutrition but also will ensure good health because of organic origin. Keeping in view with the progressive growth of human population, micro greens production will not require much land areas and any one can grow it within home with little open space like terrace or balcony and can transform the home in to a year round vegetable garden. But beyond their dietary benefits, microgreens also represent a sustainable and innovative approach to urban agriculture. Technology plays a crucial role in microgreens businesses by enhancing sustainability and efficiency. It aids in optimizing growth conditions, reducing resource waste, and improving yield, thus contributing to a more sustainable and profitable business model. A controlled environment would increase its sustainability and hence we have designed this project where use grow lights and fan ensure controlled environment. Web interface ensure a good user interface experience. Most microgreen research has been conducted by a small number of researchers in conjunction with relatively narrow focus areas. There is a vast amount of territory yet to be explored. Few species of microgreens have been studied and have not necessarily correlated with the varieties most likely to be commercialized. The effect of photoperiod on microgreen growth and nutrition has been largely overlooked. Similarly, the effect of cool night-time temperatures on plant growth, nutrition, and food safety of microgreens has not been assessed. Identifying prevention and intervention treatments that are beneficial for maintaining both quality and safety of microgreens is still in its infancy. A final field of research that has not been specifically explored is new uses, e.g. foods or ingredients from wasted microgreens or microgreens at shelf life end. Even though shelf life extension of microgreens is critical, and has been summarized in this review to reduce waste,

ISSN2454-9940
www.ijasem.org
Vol 18, Issue.2, 2024

novel processing and reformulating of wasted microgreens into new products is a future research direction.

References

[1] García, J.C., Fernández, J.E., Martín, C. (2020). IoT-Based Systems for Smart Farming: Applications and Challenges. Sensors, 20(11), 3073.

[2] Mir, S.A., Shah, M.A., Mir, M.M., et al. (2017). Microgreens: Production, shelf life, and bioactive components. Critical Reviews in Food Science and Nutrition, 57(14), 2730-2736.

[3] Son, J.E., Jeong, J.H., Lim, H.W., et al. (2019). Development of a Bluetooth-based Crop Monitoring System for Smart Agriculture. Journal of Sensors, 2019, 3150373.

[4] Bui, T.D., Tran, H.T., Nguyen, T.H., et al. (2018). Design and Development of a Low-Cost Wireless Sensor Network System for Precision Agriculture. Sensors, 18(2), 557.

[5] Ningtyas AS, Santosa B. Minat Pemuda Pada Pertanian Hortikultura Di Desa Kelor Kecamatan Karangmojo Kabupaten Gunungkidul. Journal of Development and Social Change. 2019 Apr;2(1):49-60.

[6] Thind S, Bidhan K. Simulation Model for the Spiral Software Development Life Cycle: A Review. Journal of Software Engineering Tools & Technology Trends. 2015 May 27;2(2):1-6.

[7] Ciptadi PW, Hardyanto RH. Penerapan Teknologi IoT pada Tanaman Hidroponik menggunakan Arduino dan Blynk Android. Jurnal Dinamika Informatika. 2018;7(2):29-40.

[8] Crisnapati PN, Wardana IN, Aryanto IK, Hermawan A. Hommons: Hydroponic management and monitoring system for an IOT based NFT farm using web technology. In2017 5th International Conference on Cyber and IT Service Management (CITSM) 2017 Aug 8 (pp. 1-6). IEEE.

[9] DHT11 D. Temperature Sensor DHT 11 Humidity & Temperature Sensor. Datasheet. 2010.

[10] Eridani D, Wardhani O, Widianto ED. Designing and implementing the arduino-based nutrition feeding automation system of a prototype scaled nutrient film technique (NFT) hydroponics using total dissolved solids (TDS) sensor. In2017 4th International Conference on Information Technology, Computer, and Electrical Engineering (ICITACEE) 2017 Oct 18 (pp. 170-175). IEEE.

[11] Fikri R, Lapanporo BP, Jumarang MI. Rancang Bangun Sistem Monitoring Ketinggian Permukaan Air Menggunakan Mikrokontroler ATMEGA328P Berbasis Web Service. POSITRON. 2015 Nov;5(2).

[12] Fitriani Y.D., Abdul A. Literasi Era Revolusi Industri 4 . 0. Senasbasa. 2019:100–104. [9] Furqaana IF. Irrigation Scheduling Untuk Tanaman Selada Hidroponik Dengan Metode Nft Menggunakan Arduino.

[13] Mas' ud H. Sistem hidroponik dengan nutrisi dan media tanam berbeda terhadap pertumbuhan dan hasil selada. Media Litbang Sulteng. 2009 Dec;2(2).

INTERNATIONAL JOURNAL OF APPLIED SCIENCE ENGINEERING AND MANAGEMENT

ISSN2454-9940

www.ijasem.org

Vol 18, Issue.2, 2024

[14] Andrian N, Sitepu FE. Pertumbuhan dan Produksi Bawang Merah (Allium ascalonicum L.) pada Pemberian Hidrogel dan Frekuensi Penyiraman dengan Sistem Vertikultur: Growth and Production of Shallot (Allium ascalonicum L.) on Hydrogel Application and Watering Frequency with Verticulture System. Jurnal Online Agroekoteknologi. 2018 Apr 17;6(2):286-93

[15] Pambudi WR. Prototipe Sistem Pemeliharaan Otomatis Pada Pertanian Hidroponik Menggunakan Metode Aeroponik (Doctoral dissertation, Universitas Muhammadiyah Surakarta).

[16] Pamungkas RB, Handaga B. Sistem Monitoring Keadaan Ruang Laboratorium Fakultas Komunikasi dan Informatika di Universitas Muhammadiyah Surakarta. Emitor: Jurnal Teknik Elektro. 2019 Sep 10;19(2):66-73.