

IOT BASED REMOTE MONITORING AND AUTOMATION SYSTEM FOR POLYHOUSE

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Abstract — In modern agriculture, a pressing concern is the lack of efficient monitoring and automation systems. Critical parameters such as temperature, humidity, CO₂ levels, light, and soil moisture require seamless integration of various sensors for accurate measurement. The remote monitoring and automation system for polyhouse that is based on the Internet of Things (IoT) addresses an urgent concern in the field of modern polyhouse agriculture. This project aims to develop an IoT-based polyhouse monitoring system that is affordable, scalable and user-friendly. The main difficulty lies in the seamless integration of various sensors responsible for measuring critical parameters such as temperature, humidity, CO₂ levels, light, and soil moisture. The precision and real-time transmission of this data pose an additional layer of complexity. It is crucial to establish a robust hardware infrastructure and a cloud based IoT platform for data storage and advanced analytics alongside an intuitive web interface. The system maintains a vigilant approach to the operations, ensuring that the system responds promptly and effectively whenever the parameter in question falls below a predefined reading. The primary goal of the system is to safeguard against any potential mishaps or hazards, guaranteeing the safety and well-being of the farmer involved. The system continuously monitors, assess and takes decisive actions, ensuring that the operations consistently adhere to the highest standards of safety and excellence. The expected results include increased crop productivity, sustainable farming methods, and accessibility for farmers with limited resources.

Keywords: - IoT, Polyhouse, Remote Monitoring, Automation, Sensors

I. INTRODUCTION

IoT-based remote monitoring system for polyhouse aims to revolutionize polyhouse agricultural practices by providing polyhouse owners with real-time insights into polyhouse health and productivity. By leveraging advanced sensor technologies, microcontrollers, and cloud-based data analytics, this innovative project enables polyhouse owners to remotely monitor critical parameters within the polyhouse. The system offers a user-friendly mobile app and web interface, empowering polyhouse owners with data-driven decision-making to ensure the well-being of their crops and maximize crop production while promoting sustainable agricultural practices.

II. COMPONENTS AND SOFTWARE USED

A. ESP-32:

The ESP32, which is a microcontroller manufactured by Espressif Systems, functions based on a 32-bit architecture. This specific device serves as an enhancement over the highly regarded ESP8266, with the added advantage of having integrated WiFi, Bluetooth, and BLE capabilities. Furthermore, it is available in several commonly used modules, making it an excellent option for Internet of Things (IoT) devices and designs that require IoT and Internet connectivity.

B. TSL2561 :

The TSL2561 Light Sensor Breakout may be a exceedingly perplexing light sensor that exhibits a steady level reaction over a wide run of wavelengths inside the obvious range. In differentiate to easier light sensors, the TSL2561 capitalizes on its special capability to degree both infrared and unmistakable light, in this manner empowering a more exact guess of the human eye's reaction to light. This advanced sensor has the momentous capacity to lock in in coordinate I2C communication, easily encouraging the location of particular light ranges that span a noteworthy range from 0.1 to 40k+ Lux.

C. ACD10 :

ACD10 utilizes the non-dispersive infrared (NDIR) principle as a means of identifying and measuring the concentration of carbon dioxide within the surrounding atmosphere. This particular method offers numerous advantages, including but not limited to exceptional selectivity, a notable lack of dependence on oxygen levels, and an impressively long lifespan. Furthermore,

the ACD10 boasts the inclusion of built-in temperature compensation, thus ensuring accurate readings even in varying thermal conditions. Moreover, this sensor is designed to be user-friendly, with the added convenience of a digital interface output. It is worth noting that the ACD10 is a sensor of exceptional quality, as it combines the cutting-edge technology of infrared absorption gas detection with the meticulous design of both the optical and signal detection circuits, resulting in a truly highperformance device.

D. DHT22:

The DHT22 sensor, which is widely recognized for its costeffectiveness, offers a highly advantageous and economical solution for the measurement of both digital temperature and humidity. One of the key features of this sensor is its incorporation of a single-wire digital interface, which not only enhances its efficiency but also contributes to its overall effectiveness. Additionally, this sensor has gained significant acclaim for its exceptional calibration precision, which plays a fundamental role in ensuring the delivery of highly accurate and reliable readings of relative humidity and temperature. Furthermore, it is crucial to highlight the fact that this sensor is designed in such a way that it eliminates the necessity for any additional components, thereby streamlining the measurement process. However, it is important to bear in mind that meticulous timing considerations must be taken into account. These considerations dictate that data retrieval can only be performed at intervals of no less than 2 seconds, signifying the criticality of maintaining precise timing to achieve accurate and consistent results.

E. FC28:

The FC-28 soil moisture sensor is an indispensable and crucial instrument in the realm of soil hygrometry, functioning as an exceptionally proficient and skillful soil hygrometric transducer, meticulously dedicated to evaluating and assessing the moisture content within its immediate vicinity, encompassing the surrounding soil environment. Operating with utmost efficiency and accuracy, this remarkable sensor effectively employs a dual probe system, ingeniously designed to facilitate and enable the smooth and seamless passage of electrical current through the soil, subsequently harnessing and utilizing the measured resistance readings to precisely determine and ascertain the moisture levels present in the soil. The underlying principle on which this sensor operates is grounded in the well-established and widely acknowledged fact that an increased and heightened water content significantly and positively impacts the overall soil conductivity, thereby resulting in a noticeable and discernible decrease in the electrical resistance. Conversely, when confronted with dry soil conditions, the conductivity of the soil is severely impaired and compromised, leading to a notable and considerable elevation in the electrical resistance levels.

F. 3.3V Two-Channel Relay Module:

The 3.3V Two-Channel Relay Module, an electronic device of considerable versatility, has been meticulously crafted to serve as an invaluable aid in enabling the management of numerous electrical circuits through the utilization of lowvoltage microcontrollers, notably including the highly acclaimed ESP32. This particular relay module, which boasts a commendable degree of adaptability and unwavering dependability, has proven to be an indispensable asset within the realm of diverse electronic projects that necessitate the utilization of dual-channel switching mechanisms.

G. DC Power Jack PCB Mount:

The DC Power Jack PCB Mount is an essential and indispensable electronic component that has been meticulously engineered and intricately crafted with the utmost precision and ingenuity, specifically tailored to cater to the needs and requirements of a wide array of electronic devices across diverse industries and sectors. It functions as a cornerstone and linchpin in the realm of power supply connections, serving as an indispensable and irreplaceable element that ensures the establishment and maintenance of secure, steadfast, and seamless power transmission and distribution within the intricate and interconnected circuitry of these electronic devices. Moreover, this remarkable and groundbreaking innovation acts as a pivotal and central point, facilitating and enabling the smooth and uninterrupted flow and influx of direct current (DC) power input, thereby bestowing and endowing these electronic devices with an unwavering and dependable energy source that is characterized by its utmost reliability, efficiency, and efficacy, thereby rendering them capable of operating optimally and performing at peak levels of functionality, productivity, and performance.

H. Structured Query Language (SQL):

Structured Query Language (SQL), also known as SQL, is an exceptionally potent programming language specifically designed for the management and manipulation of relational databases. It offers a standardized and uniform approach to interacting with databases, thereby enabling users to execute a wide range of tasks, including but not limited to data querying, record insertion, updating and deletion, as well as the creation and modification of base schemas data and rights management. The ubiquity of SQL is evident in its extensive utilization across diverse industries, where it effectively and efficiently processes copious amounts of data.

I. Power BI:

Microsoft's Power BI is a sophisticated business analytics application that allows users to visualize and share insights from their data. It enables users to connect to a variety of data sources, convert and clean data,

generate interactive reports and dashboards, and share them. Power BI's straightforward interface and numerous visualization options enable organizations to efficiently make data-driven choices.

III. FINDINGS FROM LITERATURE SURVEY

1. Current systems implemented by various organizations are mainly aiming at automation of agricultural electrical and not remote monitoring.
2. Current systems use older technologies, thus making them inefficient and unreliable.
3. Less emphasis on analytics report generation which can be used later developing scientific predictive models.
4. No alert systems implemented

IV. GAP IDENTIFICATION

Concurring to the existing writing and the state of information in question location, there are a few confinements which will emerge within the technique, watched discoveries and a few questions which may be unanswered. The underneath table contains all the gaps/limitations which were recognized amid the investigation of the papers. This paper portrays the existing strategy, the plan and definition, strategies for information collection and their downsides. Based on this examination it is possible to address issues that had been confronted within the past inquire about papers. Around 10 papers were examined, out of which 10 holes were recognized as said in underneath:

Implementing smart agriculture technologies poses various challenges and drawbacks that hinder their full potential [1]. Information is not provided on the specific techniques or components used in the proposed method for controlling temperature and humidity inside a plastic house using a microcontroller [2]. GSM technology typically offers lower data transfer speeds compared to newer technologies like 4G or 5G. This could potentially impact the real-time transmission of sensor data or notifications to end users [3]. The lack of monitoring sunlight received by crops in the IoT-based system is a significant gap. Sunlight is essential for crop growth, and tracking its variability can optimize management practices and resource efficiency. database structures by the user interface of the universal relationship system [4]. The lack of building Power BI analysis of historical sensor data in the proposed Polyhouse automation system limits the ability to analyze trends and make data-driven decisions, hindering optimization of plant growth conditions and resource efficiency [5]. Constraints in the envisioned cost-effective automation for Polyhouse farming [6]. The absence of IoT-based microcontrollers has limited real-time monitoring and control, and monitoring carbon dioxide levels has overlooked a critical factor in plant growth, thus hindering overall environmental management in polyethylene greenhouse automation [7]. Relying on outdated 3G technology for alarms restricts efficiency, while the absence of Power BI analysis overlooks opportunities for data-driven insights, hindering optimization in Polyhouse environmental management [8]. The absence of automated switching on of agricultural lights when natural sunlight levels drop represents a significant gap in the

Polyhouse system. This oversight hinders optimal plant growth and productivity during periods of low natural light, highlighting a missed opportunity for enhancing environmental management and crop yield [9]. Potential economic or accessibility challenges associated with implementing a proposed IOT-based automated system, leaving a gap in considering broader impacts and considerations reality [10].

V. BLOCK DIAGRAM

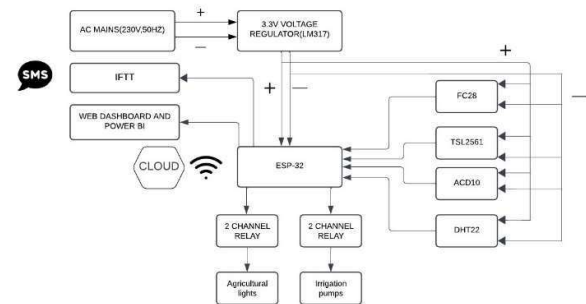


Fig 1. Block Diagram

The optimized hardware architecture of proposed advanced Internet of Things (IoT) based Polyhouse management systems has been carefully designed and implemented with the goal of increasing the precision of agricultural practices. In the heart of this system is the ESP-32 microcontroller, which acts as a central processing unit, orchestrates seamless communication with a suite of critical sensors. These sensors, which include the FC28 soil moisture sensor, the ACD 10 sensor, TSL2561 light sensor, DHT22 temperature and humidity sensor, connected to the microcontroller via GPIO pins, analog pins, and well thought out distribution Available Transmit and as Receiver PIN. To ensure easy data acquisition and processing, the system is powered by a reliable 5V power adapter, which acts as a constant power source. In addition, a protective cover is carefully constructed durable by 3D printing technology to protect the entire hardware assembly from the environment in an appropriate manner placed. This cover filled with slotted transparent plastic sheet does not appear to protect the hardware not only but plays a key role in enabling sensors to accurately detect and measure key environmental conditions. By incorporating this advanced and robust hardware infrastructure have laid the foundation for innovative agricultural solutions that it is an accuracy that promises to significantly increase efficiency and accuracy in agricultural management.

VI. SCHEMATIC AND PCB LAYOUT

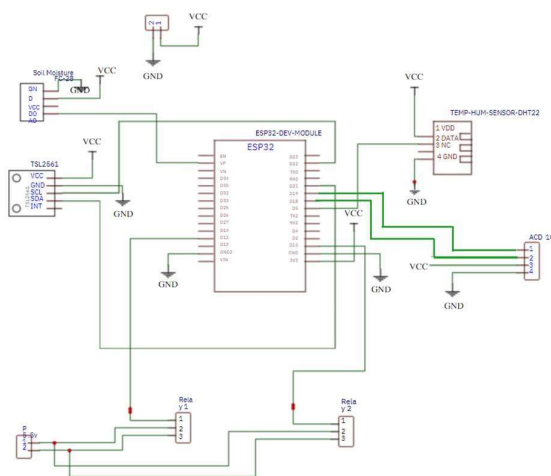


Fig 2. Schematic of Circuit

In the circuit, the A0 pin of the soil moisture sensor FC-28 is connected to Vp pin of ESP 32. The SDA pin of TSL 2561 i.e the light sensor, is connected to D19 pin of the ESP. The DATA pin of DHT 22 sensor is connected to D5 pin of the ESP module. The pins 1 and 2 of ACD 10 sensor are connected to D19 and D18 respectively. The pin 1 of relay 1 is connected to D12 pin of ESP. Pin 2 and 3 of relay 1 are connected to a power supply of 5.5V. Now the pin 1 of relay 2 is connected to D15 pin of ESP and pin 2 and 3 are connected to the 5.5V power supply.

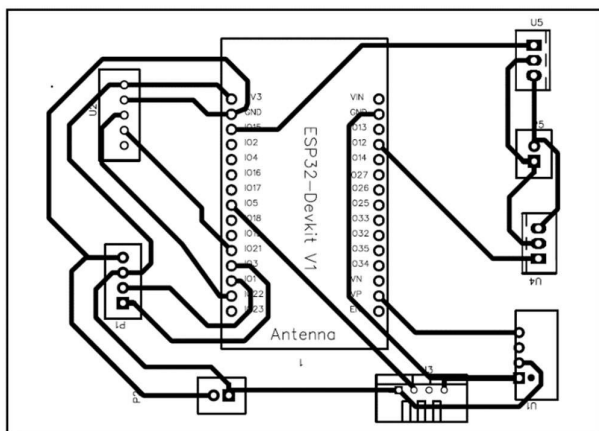


Fig 3 . PCB Layout

The below figure shows the PCB layout of the circuit which will be used.

VII. FUTURE SCOPE

1. Environmental Data Integration
2. Integration of AI and Machine Learning
3. Energy Efficiency
4. Customizable Alerts

VIII. CONCLUSION

In conclusion, the development of an IoT-based Polyhouse monitoring system represents a significant step forward in promoting sustainable agricultural practices. By offering real-time data on crucial polyhouse parameters, this system empowers agricultural enthusiasts with the tools they need to make informed, data-driven decisions. Its cost-effectiveness and scalability ensure accessibility to a wide range of users, regardless of their resources. Ultimately, the IoT-based Polyhouse monitoring system not only improves agricultural productivity but also contributes to the broader goal of promoting efficient and environmentally friendly agricultural practices, marking a turning point key in the pursuit of sustainable agriculture.

IX. REFERENCES

- [1] Reshu Agarwal et al. "Smart agriculture using polyhouse". In: Advanced Computational Paradigms and Hybrid Intelligent Computing: Proceedings of ICACCP 2021. Springer. 2022, pp. 13–20. B. Rieder, Engines of Order: A Mechanology of Algorithmic Techniques. Amsterdam, Netherlands: Amsterdam Univ. Press, 2020.
- [2] GK Banerjee and Rahul Singhal. "Microcontroller based polyhouse automation controller". In: 2010 International Symposium on Electronic System Design. IEEE. 2010, pp. 158–162
- [3] Javvaji, Kumar Sai Sankar, et al. "Prototype model of poly house farming using sensor and IoT technologies." 2019 10th International Conference on Computing, Communication and Networking Technologies (ICCCNT). IEEE, 2019.
- [4] Agale, Rashmi R., and D. P. Gaikwad. "Automated irrigation and crop security system in agriculture using Internet of Things." 2017 International Conference on Computing, Communication, Control and Automation (ICCUBEA). IEEE, 2017.
- [5] Raja, G., et al. "Smart polyhouse farming using IOT environment." Int. J. Trend Sci. Res. Dev 2.3 (2018): 691–697. Snehal Karle et al. "Design & Development of Low Cost Automation for Polyhouse". In: Journal of emerging technologies and innovative research (2019). url: <https://api.semanticscholar.org/CorpusID:214017797>.
- [6] Manhotra, Tanvir, et al. "Automated polyhouse for optimal growth of plants." International journal of emerging technology and advanced engineering, Vol4 (5) (2014): 563–567. Xianghang Mi et al. "An empirical characterization of IFTTT: ecosystem, usage, and performance". In: Proceedings of the 2017 Internet Measurement Conference. 2017, pp. 398–404.
- [7] Sonawane, Yogesh R., et al. "Environment monitoring and control of a polyhouse farm through internet." World Bank: India Country Overview 6 (2008). Adesh Kumar Pandey and Minakshi Chauhan. "IOT based smart polyhouse system using data analysis". In: 2019 International Conference on Issues and Challenges in Intelligent Computing Techniques (ICICT). Vol. 1. IEEE. 2019, pp. 1–5. doi: <https://ieeexplore.ieee.org/abstract/document/8977665/>.

- [8] Bhosale, Shubhangi, and S. S. Sonavane. "Controlling and Environmental Monitoring Of Polyhouse Farm Through Internet." International Journal of Advanced Research in Computer Science 7.3 (2016).
- [9] Pandey, Adesh Kumar, and Minakshi Chauhan. "IOT based smart polyhouse system using data analysis." 2019 International Conference on Issues and Challenges in Intelligent Computing Techniques (ICICT). Vol. 1. IEEE, 2019.
- [10] Karle, Snehal, et al. "DESIGN & DEVELOPMENT OF LOW COST AUTOMATION FOR POLYHOUSE." International Research Journal of Engineering and Technology (IRJET) 6.4 (2019): 3926-