IJCRT.ORG ISSN : 2320-2882

INTERNATIONAL JOURNAL OF CREATIVE RESEARCH THOUGHTS (IJCRT)

An International Open Access, Peer-reviewed, Refereed Journal

Integrating Iot And Fog Computing For Smart Agriculture

[1]Dulla Veerababu, [2]B Srinivas Raja, [3]Dodda Naga Vara Poojitha, [4]Chittipothu Devendra

[1]Student, [2]Professor, [3]Student, [4]Student

[1,2,3,4] Department of Electronics and Communication Engineering,

[1,2,3,4]Godavari Institute of Engineering and Technology(A), Rajamahendravaram, A.P, India

Abstract: This project suggests a new smart farming paradigm that combines the Internet of Things (IoT) and fog computing. The system consists of transmitter and the receiver. The transmitter, built with Raspberry Pi Pico, and various sensors collects real-time data on soil moisture, temperature, humidity, and light. Such data is compared with preset values. This leads to the DC motor control and the adaptive control of light. The data is next sent via LoRa to the receiver. At the receiver, a Raspberry Pi and Raspberry Pi Pico which act as a fog node, process the data, collected in a real time, with the predefined values. On the basis of the processed data, it sends alerts and real-time data to the farmer through the Telegram app. This system enables minute-to-minute monitoring and control of agricultural parameters, which might lead to increased productivity and sustainability in agriculture.

Keywords - IoT (Internet of Things), Fog Computing, Smart Agriculture Sensors, Real-time Monitoring, Data Processing, Wireless Communication, Productivity

I. Introduction

The agricultural sector is the main source of livelihoods and economic backbone of many economies; modern Agriculture has facing problems in using resources efficiently and improving productivity. These challenges are addressed by introduction of Smart Agriculture system skilled to use both IoT and Fog Computing technologies. This system architecture consists of a transmitter with a Raspberry Pi Pico containing various sensors (DHT11, soil moisture, LDR); a DC motor, an LED, and a LoRa module; and a receiver which contains Raspberry Pi and Raspberry Pi Pico performing as fog node. Irrespective of their involvement, the transmitter autonomously gets the main data, what include soil moisture, temperature, humidity, and light intensity. The system updates adjustment to the operation of a DC motor and intensity of lighting during tacit comparison of this data with predetermined values in order to optimize agricultural processes. Using LoRa communication the transmitter sends the data to the fog node evaluating it and objecting locally. Fog computing has advantages of making real-time decisions and rapidly responding in the moment by enabling the system to do so at the edge, thereby reducing latency accordingly. Variances in data collected causes triggered alerts, and the farmer receives updated information in real time using Telegram Apps, enabling the farmer to make decisions beforehand. It integrates precision farming by scaling and efficient application of adaptive control of agricultural components alleviating the environmental conditions leading to higher yields and sustainability.

II. LITERATURE SURVEY:

The First article [1] Rehan Qureshi, Syed Haris Mehboob & Muhammad Aamir (2021): "Sustainable Green Fog Computing for Smart Agriculture" The proposed system of this project is a green fog computing framework for smart agriculture, which uses single board computers (SBCs) as fog nodes to process data from IoT sensors and actuators on the agricultural land.

The Second article [2] Othmane Friha, Mohamed Amine Ferrag, Lei Shu, Leandros Maglaras, Xiaochan Wang (2021): “Internet of Things for the Future of Smart Agriculture: A Comprehensive Survey of Emerging Technologies” This paper is a exclusive research on updated technologies for the internet of things (IoT)- deals with smart agriculture1. It covers various IoT applications, platforms, and techniques for smart agriculture, and presents real projects and open challenges in this field.

The Third article [3] Yogeswaranathan Kalyani and Rem Collier (2021): "A Systematic Survey on the Role of Cloud, Fog, and Edge Computing in Smart Agriculture" The paper proposes a three-layered architecture for smart agriculture that combines Cloud, Fog, and Edge Computing. Each layer has specific roles in data storage, real-time analytics, and data collection from the field.

The Fourth article [4] Neena Alex, C. C. Sobin & Jahfar Ali (2023): proposed "A Comprehensive Study on Smart Agriculture Applications in India". The paper proposes a smart agriculture architecture and a prototype for smart irrigation and price prediction1. It uses IoT devices and cloud computing for data collection, processing, and providing services to farmers.

The Fifth article [5] Mukesh Kumar, Mohit Kumar, Jitendra Kumar Samriya (2023): "Smart and Reliable Agriculture Application using IoT enabled Fog-cloud Platform" The paper proposes an IoT-enabled fog-cloud platform for smart agriculture. It uses sensors, fog nodes, and cloud servers for data collection, processing, and providing services to farmers.

The Sixth article [6] Gurpreet Singh, Jaspreet Singh (2023): "A Cost Effective IoT-Assisted Framework Coupled with Fog Computing for Smart Agriculture" The paper proposes a fog-based model with IoT support for smart agriculture. It uses sensors, fog nodes, and cloud for data collection, processing, and providing services to farmers.

The Seventh article [7] Jagruti Sahoo, Kristin Barrett (2023): "Internet of Things (IoT) Application Model for Smart Farming” The paper proposes a DDF-based model for smart farming using IoT, cloud, and fog computing. It collects and analyzes soil data and provides status, alerts, and recommendations to users.

III. EXISTING SYSTEM:

The predeveloped systems adopt fog computing for the sensory data of IoT sensors in the field of agriculture. It incorporates the use of Li-Fi technology, a wireless transceiver technology which use light as a means of providing fast and reliable data transmission between the fog nodes and the IoT devices. This system created other challenges like Lifi technology which requires a direct point of contact between the transmitter and the receiver; hence, environmental factors such as smoke, rain, fog, rain, and obstacles on the field may block the point of communication thus, affecting communication. This system operates only on Realtime data and the mechanism of it controlling the parameters using the feature of responsive action based on data is missing.

IV. PROPOSED SYSTEM:

The smart farming project is a combination of IoT and fog computing, and it includes a transmitter and a receiver. The Raspberry Pi Pico and various sensors that are mounted on the transmitter gather the real-time data on soil moisture, temperature, humidity, and light in particular. The data is compared with the predefined values; this shall lead to triggering of DC motor control and adaptive control of a light. The data is transmitted through LoRato the receiver. On the receiver end, a Raspberry Pi and a Raspberry Pi Pico as fog nodes, process the real-time collected data with the predefined values and send an alert if necessary, keeping the farmer updated via Telegram app.

V. BLOCK DIAGRAM:

TRANSMITTER

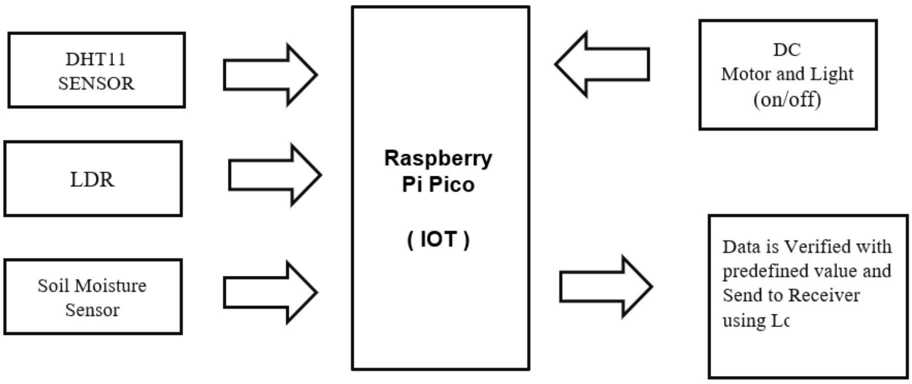


Fig.1. Block Diagram of Transmitter for Integrating IoT and Fog computing for smart agriculture.

RECEIVER

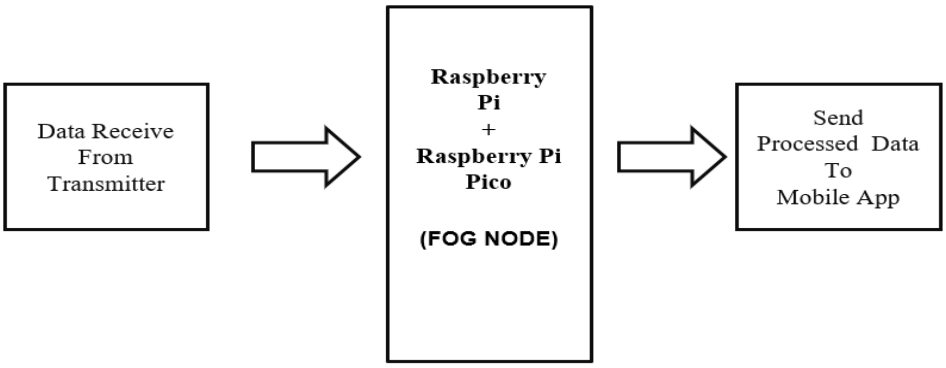


Fig.2. Block Diagram of Receiver for Integrating IoT and Fog computing for smart agriculture

VI. Flow Chart

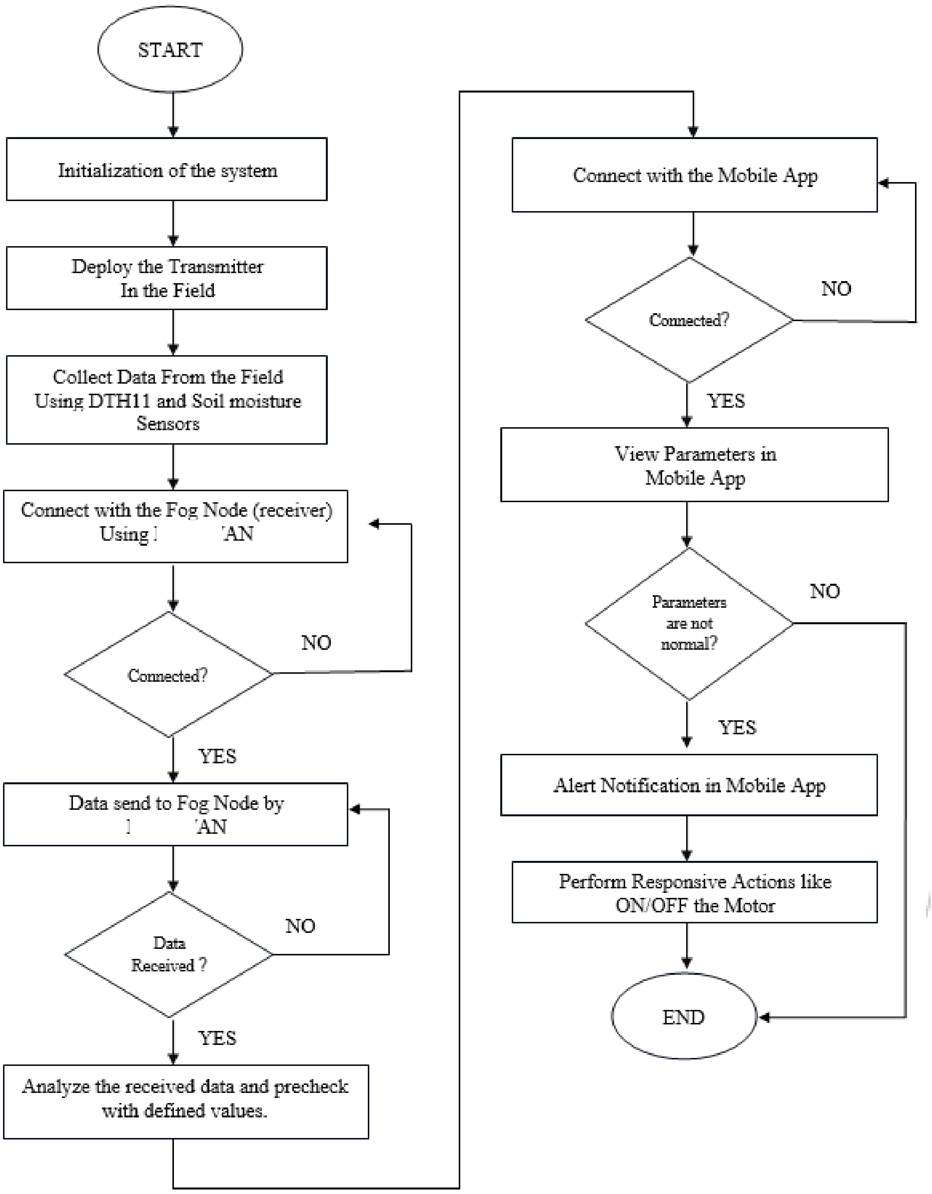


Fig.3. Flowchart for Integrating IOT and Fog computing for smart agriculture.

VII. Results:

Our smart farming system, integrating IoT and fog computing, demonstrated promising results in a controlled environment. With the help of a Raspberry Pi Pico and a number of sensors, the system's transmitter was able to gather data on temperature, humidity, light, and soil moisture in real time. By comparing this data with predetermined values, a DC motor and adaptive light control may be operated effectively. LoRa enabled the data to be sent to the recipient without experiencing any notable loss or delay. The receiver processed the real-time data effectively. It was a fog node made up of a Raspberry Pi and a Raspberry Pi Pico. Minute-by-minute monitoring and management of agricultural parameters was made possible by the system's ability to give the farmer warnings and real time data via the Telegram app. The suggested smart farming system has the potential to completely transform agricultural methods. This system enables real-time data collecting and analysis on a range of agricultural metrics by utilizing fog computing and the Internet of Things. Agriculture may become more sustainable and productive with the use of this data-driven strategy. Notable is the application of LoRa for data transport. Because of its extended range and low power consumption, it is perfect for Internet of Things applications in agriculture, where sensors may be dispersed across wide regions. The device has the potential to revolutionize farming practices by providing farmers with real-time data and alarms. Giving farmers access to current agricultural information allows them to make better decisions, which may result in higher yields and greater sustainability.

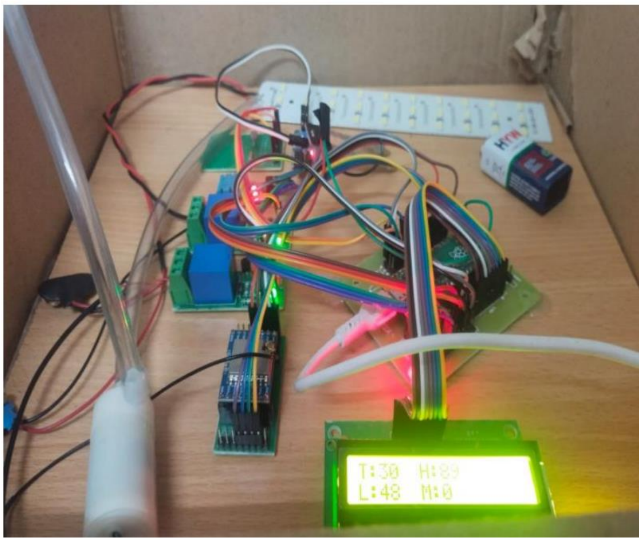
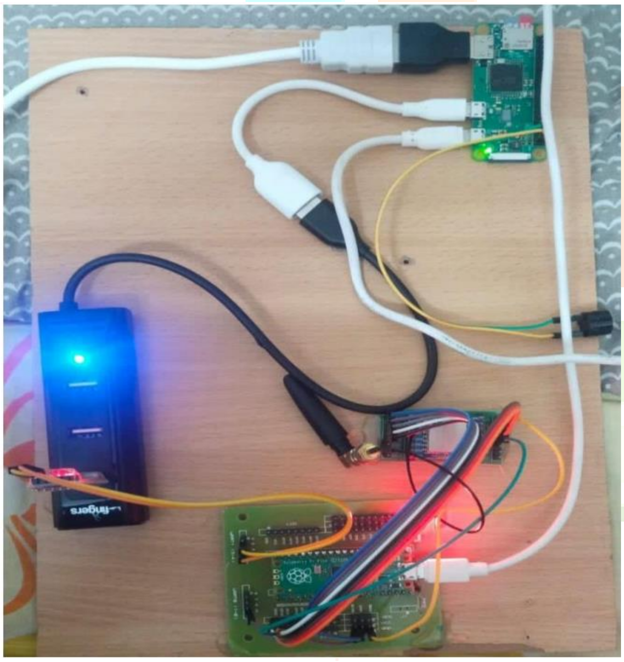


Fig.4: Hardware implementation of Transmitter for Integrating IOT and Fog computing for smart agriculture.

Fig.5: Result for Integrating IOT and Fog computing for smart agriculture in Telegram App



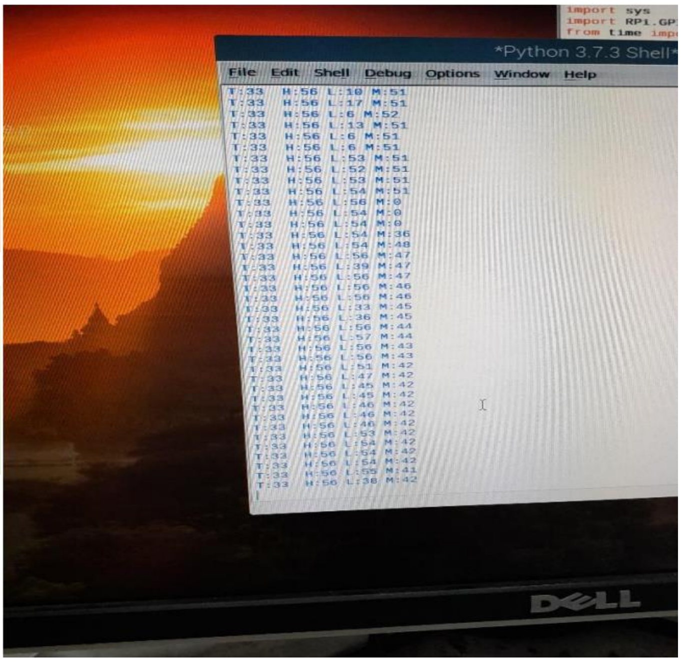


Fig.6: Hardware implementation of Receiver for Integrating IOT and Fog computing for smart agriculture.

Fig.7: Realtime data for Integrating IOT and Fog computing for smart agriculture.

VIII. Conclusion:

The deployment of IoT and fog computing technologies in this project, which connect Raspberry Pi, Raspberry Pi Pico, DHT11, LDR, and soil moisture sensor, and DC motors and LEDs, provides a complete solution for smart agriculture. The collection of instantaneous environmental data related to plant growth and health factors including temperature, humidity, light intensity, and soil moisture content is enabled by the system, which permits the accurate monitoring and control of growing conditions in agriculture. The system can process intelligent data and compare the obtained results with pre-defined thresholds, thus making real-time decisions such as the control of DC motors and the adaptive light control to optimize plant growth conditions. In that sense, LoRa communication enables efficient data transmission between field nodes situated far away from fog computing devices and makes the system highly scalable and coverable. In this regard, the Telegram app is also used as a resource channel for instant alerts and data delivery that enable farmers to make informed interventions on time when necessary. Overall, this project depicts an innovative idea that could be the future of conventional farming as it is an eco-friendly tool for agriculture production improvement and attainment of maximum yield.

IX. Future Scope:

Taking a glance at the future beyond this project, a number of promising options for further development exist e.g. incorporating machine learning algorithms and predictive analytics for predicting environmental trends and for real-time optimization of agricultural operations. The other development is by expanding the sensors to gauge factors such as levels of carbon dioxide, concentrations of nutrients and atmospheric pressures for more all-inclusive knowledge of Agri-ecosystem. Context integration of drones and Satellites Imageries for broader coverage of the monitoring of remote areas and data collection, advance scalability and coverage for vast agricultural farms, and remote locations.

X. References

[1] Qureshi, Rehan, et al. "Sustainable Green Fog Computing for Smart Agriculture." *Wireless Personal Communications*, vol. 121, no. 2, Springer Science and Business Media LLC, Aug. 2021, pp. 1379–90. *Crossref*, https://doi.org/10.1007/s11277-021-09059-x.

[2] Friha, Othmane, et al. "Internet of Things for the Future of Smart Agriculture: A Comprehensive Survey of Emerging Technologies." *IEEE/CAA Journal of Automatica Sinica*, vol. 8, no. 4, Institute of Electrical and Electronics Engineers (IEEE), Apr. 2021, pp. 718–52. *Crossref*, https://doi.org/10.1109/jas.2021.1003925.

[3] Kalyani, Yogeswaranathan, and Rem Collier. "A Systematic Survey on the Role of Cloud, Fog, and Edge Computing Combination in Smart Agriculture." *Sensors*, vol. 21, no. 17, MDPI AG, Sept. 2021, p. 5922. *Crossref*, https://doi.org/10.3390/s21175922.

[4] Alex, N., Sobin, C. C., & Ali, J. (2023, March 23). A Comprehensive Study on Smart Agriculture Applications in India. *Wireless Personal Communications*, *129*(4), 2345–2385. https://doi.org/10.1007/s11277-023-10234-5

[5] Jha, Mukesh Kumar, Mohit Kumar, and Jitendra Kumar Samriya. "Smart and Reliable Agriculture Application Using IoT-Enabled Fog-Cloud Platform." Industrial Reliability and Safety Engineering. CRC Press, 2023. 47-65.

[6] G. Singh and J. Singh, "A Cost Effective IoT-Assisted Framework Coupled with Fog Computing for Smart Agriculture," 2023 IEEE 8th International Conference for Convergence in Technology (I2CT), Lonavla, India, 2023, pp. 1-8, doi: 10.1109/I2CT57861.2023.10126231.

[7] Sahoo, Jagruti, and Kristin Barrett. "Internet of things (IoT) application model for smart farming." SoutheastCon 2021. IEEE, 2021.