

## From Seeding to Harvest: Real-Time IoT Integrated Soilless Farming System with Physicochemical Assessment of Indoor Cultivated *Lactuca sativa*

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### Abstract

This paper presents a real-time data from integrated IoT farming monitoring system across one complete cycle and parallel physicochemical assessment on *L. sativa* cultivated via soilless indoor farming system. The system employs a four-layer architecture integrating multi-sensor perception, Raspberry Pi-based edge computation, MQTT cloud communication, and a web-driven application interface. Continuous measurement points of pH, TDS, temperature, humidity, air quality, turbidity, and water level enables precise monitoring of plant growth conditions are presented throughout the whole cycle. Physicochemical evaluation including visual physical characteristics, morphological assessment, proximate analysis, chlorophyll quantification, ascorbic acid measurement using HPLC and phenolic determination via the Folin-Ciocalteu method was conducted to characterize plant development under the controlled conditions. Findings confirm the system's reliability, accurate data acquisition, and its effectiveness in correlating farming environment with plant growth rate. The proposed platform offers a scalable tool for precision indoor farming and intelligent agricultural management towards sustainability practices.

### Keywords

Indoor Farming, Internet-of-Things (IoT), Real-time monitoring, Physicochemical Assessment, Nutrients Analysis.