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# Multidisciplinary Sustainabilty and Green Innovation-2024

(ICMASGI – 2024)

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*Editors*

Dr. Kaustubh Kumar Shukla

Dr. Vikas Kumar

Dr. Bir Abhimanyu Kumar

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*Edited By*

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# INTEGRATING DEEP LEARNING TECHNIQUES FOR DISEASE DETECTION AND REMEDIATION IN SMART AQUAPONICS SYSTEMS

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## Abstract

Aquaponics represents a transformative approach to sustainable agriculture, integrating aquaculture and hydroponics into a single, symbiotic ecosystem. This innovative method not only optimizes resource usage but also reduces the environmental footprint of farming, making it an increasingly popular solution to address global food security challenges. However, despite its numerous advantages, aquaponic systems face critical hurdles in maintaining the health and productivity of fish and plants. Chief among these challenges is the timely detection and effective management of diseases, which, if left unchecked, can lead to significant economic losses and system failures.

This paper presents a state-of-the-art solution that leverages advanced technologies to overcome these challenges. At the heart of the proposed system lies the integration of deep learning algorithms, including convolutional neural networks (CNNs) and recurrent neural networks (RNNs). These models are employed to monitor and analyze complex data streams from the aquaponic environment in real time, enabling the early detection of diseases in both aquatic organisms and plants. By identifying disease symptoms at an early stage, the system empowers farmers with actionable insights and timely alerts, reducing the risk of widespread outbreaks and minimizing losses.

The proposed framework relies on continuous data monitoring facilitated by cron jobs, which automate the seamless collection, processing, and archiving of data on Raspberry Pi devices. This ensures uninterrupted functionality, even in resource-constrained settings. The integration of Internet of Things (IoT) technologies allows for the aggregation of diverse data sources, such as water quality parameters, plant health metrics, and fish behavior patterns, into a unified analytical platform. This data is then processed using the deep learning models to detect anomalies and provide precise diagnoses.

To enhance usability and accessibility, an external application has been developed as part of the system. This application is designed to notify farmers in real time about detected issues, offering detailed disease diagnostics and tailored remedies for both fish and plant ailments. By providing actionable solutions, the

application ensures that farmers can take swift corrective measures to maintain the overall health and productivity of their aquaponic systems.

In addition to disease detection and management, the system emphasizes scalability and robustness, ensuring its adaptability to various aquaponic setups, from small-scale operations to commercial enterprises. The integration of these advanced technologies not only addresses the immediate challenges faced by aquaponics practitioners but also sets the stage for the broader adoption of this sustainable farming methodology.

The results of this study demonstrate the transformative potential of combining IoT and deep learning in agricultural systems. By fostering a healthier and more resilient aquaponic environment, this solution contributes to the advancement of sustainable agriculture and aligns with global efforts to achieve food security in an environmentally responsible manner. The amalgamation of artificial intelligence, IoT, and automated monitoring highlights a promising path forward for the agricultural sector, showcasing how technology can bridge the gap between innovation and sustainability.

**Keywords:** Aquaponics, Deep Learning, Internet of Things, Fish Disease Detection, Plant Leaf Disease Detection, Cron Jobs, Agricultural App.

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## About the Conference

Man's capability to transform his environment can bring the benefits of economic development and an opportunity to enhance the quality of life. But this same power incorrectly applied for a long span of time has led to depletion of resources and at the same time caused immense harm to the natural environment and consequently to human like. Delayed remedial action will cost considerably more and the damage will become irreversible. The need of the hour is to plan a balanced system giving due importance to socio-economic, technological and ecological factors for the proper allocation of resources in order to fulfil the needs and aspirations of present and future generations without degrading the environment.

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