Environmental Engineering and Management Journal

xxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxxx
http://www.eemj.icpm.tuiasi.ro/; http://www.eemj.eu

"Gheorghe Asachi" Technical University of Iasi, Romania

DEVELOPMENT AND EVALUATION OF AN IOT BASED AUTOMATED DATA ACQUISITION NFT HYDROPONICS SYSTEM

Shahala Madathil[1*], Shyla Joseph[2], Asha Joseph[3], Mini Abraham[4], Sathian Kontham Kulangara[5], Bhindhu Prabhath Sarojiniamma[6]

[1]Department of Soil and Water Conservation Engineering, Kelappaji College of Agricultural Engineering and Technology, Kerala Agricultural University, Tavanur, Kerala, India
[2]Department of Soil and Water Conservation Engineering, Agronomic Research Station, Kerala Agricultural University, Chalakudy, Kerala, India
[3]Department of Irrigation and Drainage Engineering, Kelappaji College of Agricultural Engineering and Technology, Kerala Agricultural University, Tavanur, Kerala, India
[4]Professor and Head, Agronomic Research Station, Kerala Agricultural University, Chalakudy, Kerala, India
[5]Department of Soil and Water Conservation Engineering, Kelappaji College of Agricultural Engineering and Technology, Kerala Agricultural University, Tavanur, Kerala, India
[6]Department of Soil Science and Agricultural Chemistry, Krishi Vigyan Kendra, Kerala Agricultural University, Kottayam, Kerala, India

Abstract

Hydroponics is an efficient soilless cultivation method that enables higher yield and resource conservation, however, its success depends on the precise control of nutrient and microclimatic parameters. Hence, it is necessary to continuously monitor and control these parameters for better crop production. Manual monitoring of these parameters is difficult and time-consuming. This study presents the development and evaluation of an Internet of Things (IoT) based automated data acquisition Nutrient Film Technique (NFT) hydroponics system. The system integrates various sensors including Electrical Conductivity (EC) sensors, nutrient solution temperature sensors, ultrasonic sensors, depth sensors, air temperature and Relative Humidity (RH) sensor, light intensity sensor with actuators (fans and foggers) and an Arduino MEGA microcontroller linked to the ThingSpeak IoT cloud platform for real-time monitoring and control. A separate unit for pH sensors was implemented using an Arduino UNO. Spinach (*Spinacia oleracea*) was cultivated in NFT systems installed in a naturally ventilated polyhouse. The system automatically measured these parameters in real time and regulated fans and foggers to maintain optimal conditions inside the polyhouse. Gathered data were accessed and displayed on a laptop and mobile phone using the IoT platform called ThingSpeak as graphical insights and tables in Microsoft Excel file format. Validation showed low sensor error rates and the automation reduced the air temperature by 0.6 °C and increased RH by 1.5% inside the polyhouse compared to outside conditions. The system exhibited strong efficiency and reliability, highlighting its potential for scalable, automated hydroponic farming applications.

Key words: arduino, automated data acquisition, automation, hydroponics, nutrient film technique

Received: February, 2025; Revised final: November, 2025; Accepted: January, 2026

* Author to whom all correspondence should be addressed: E-mail: me.shahala1997@gmail.com; Phone: +918593951192