

# **DESIGN AND DEVELOPMENT OF A SOLAR ENERGY–BASED MODIFIED AEROPONIC SYSTEM USING A *MOISTURE CONTENT***

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## **ABSTRACT**

Limited agricultural land, increasing food demand, and constraints on water and energy availability require the application of efficient and sustainable agricultural technologies. This study aims to design and evaluate a Solar Energy–Based Modified Aeroponic System (AT-BES) equipped with a soil moisture sensor for automatic irrigation control. The system was developed using a 50 Wp solar panel integrated with a Maximum Power Point Tracking (MPPT) controller, a 12V 33Ah VRLA battery, an Arduino Mega 2560 microcontroller, a 25W DC water pump, and a soil moisture sensor to monitor root zone humidity. System performance was quantitatively tested on lettuce and water spinach plants at Mambaul Ulum Orphanage, Jember. The results show that the system was able to maintain stable root moisture levels within the range of 65%–78% for lettuce and 35%–70% for water spinach according to the predefined setpoints. The water pump operated automatically when moisture reached the minimum threshold and stopped at the maximum threshold, indicating consistent sensor response and control performance. The AT-BES system operated independently without reliance on grid electricity and improved water and energy use efficiency. Therefore, the developed system has strong potential as a practical solution for modern agriculture on limited land and in areas with restricted access to electricity.

**Keywords:** *aeroponics; solar energy; moisture content; Arduino.*