

EVALUATION OF AN IOT-BASED INFRARED LEAF TEMPERATURE MEASUREMENT SYSTEM

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Accurate measurement of leaf temperature is required for inferring the complicated relationships among internal energy, physiological conditions, and external factors. This study aimed to assess the effectiveness of an Internet of Things (IoT)-based infrared leaf temperature measurement system. The experiment was conducted in a controlled environment facility at the Faculty of Agriculture, Rajarata University of Sri Lanka. A measurement probe was designed to house MLX90614 contactless infrared temperature sensors. Four infrared sensor probes were fabricated for each of the three greenhouse chambers. These sensors were aligned to black pepper plant leaves which were grown inside the greenhouse. Temperature readings were remotely acquired to a cloud-based database. The optimal distance to place the sensors was investigated by systematically increasing the distance between the leaf and the sensors at 3, 6, 9, 12, and 15 cm intervals. A comparison was made between these sensors and a research-grade infrared thermometer (BRANNAN Infrared thermometer 38/701/0, UK). When kept closer to the leaves (at 3 and 6 cm), the sensors detected the highest variation compared to the ambient air temperature (within a 4°C difference), with a high standard deviation (σ) of 0.86°C in 3 cm and (σ) of 0.71°C in 6 cm, respectively, suggesting their capacity to detect leaf temperature only from objects positioned close to the sensors. Thus, the sensors were placed at a distance of 3 cm from the leaves for further analysis. As the ambient temperature increased, the leaf temperature also increased, corresponding with the pattern of the relationship. The temperature detected from the infrared thermometer and the infrared sensors had a positive linear relationship ($R^2=0.92$). In conclusion, we found that this IoT-based Infrared leaf temperature measurement system could effectively measure leaf temperature in research experiments when the leaf and infrared sensor are placed at a 3 cm optimum distance.

Keywords: Controlled environment facility, IoT based Infrared sensors, Leaf temperature measurements