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PROCEEDINGS OF JOHOR INTERNATIONAL INNOVATION INVENTION COMPETITION AND SYMPOSIUM 2024 (JIIICaS 2024)



*“Flourish and Nurturing Sustainable
Innovation for a Prosperous Nation”*

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Preface

In the name of Allah, the Almighty who gives us the enlightenment, the truth, the knowledge and with regards to Prophet Muhammad (peace be upon him) for guiding us to the straight path. We thank to Allah for giving us guidance and strength to write this e-book.

This e-book compiles the extended abstracts that submitted to Johor International Innovation Invention Competition and Symposium 2024 (JIIICaS2024), where JIIICaS2024 is a virtual platform for all creative minds to share and present their invention and innovation. Each abstract gives a brief background on the innovation or project.

We hope that this e-book will help the readers to get to know the innovation done by the students and get some ideas to develop future innovation products.

Foreword Rector



Assalamualaikum warahmatullahi Wabarakatuh,
Salam Sejahtera, Salam Malaysia MADANI and
Salam UiTM Dihatiku.

In the name of Allah, the Most Gracious, the Most
Merciful.

It is a great honor to welcome you to the Johor
International Innovation, Invention, Competition, and
Symposium 2024 (JIICaS 2024). This event

connects various disciplines, focusing on education and engaging educators,
students, researchers, and innovators from all walks of life.

Innovation is not just about ideas; it demands perseverance, creativity, and
determination to turn those ideas into reality. The remarkable projects
showcased today highlight the dedication and spirit of all participants.
Initiatives like this not only explore new technologies but also cultivate skills
and leadership among our youth. At Universiti Teknologi MARA (UiTM) Johor
Branch, we are fully committed to fostering a dynamic culture of innovation,
promoting the commercialization of new products, and encouraging
meaningful collaborations with industry and society.

As we celebrate this event, I would like to extend my heartfelt gratitude to all
sponsors, judges, the College of Computing, Informatics and Mathematics,
UiTM Pasir Gudang Campus as the event organizer, as well as to the
researchers and participants for their hard work in making this event a
success. Let us continue striving for innovation and excellence. May the
ideas presented today inspire us and lay the groundwork for future
achievements.

Thank you.

Associate Professor Dr. Saunah Zainon
Rector
Universiti Teknologi MARA (UiTM)
Johor Branch

(A-ST020) m-DAL v2 - MODULAR DATA LOGGER WITH SMART MONITORING SYSTEM FOR HERBACEOUS ROOF ECOSYSTEM SERVICE EVALUATION

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ABSTRACT

This project introduces the Modular Multichannel Data Logger (m-DAL), a versatile system tailored to assess herbaceous roof ecosystems' services. Unlike conventional and expensive data loggers, the m-DAL allows for concurrent measurements across multiple channels at a fraction of the cost, while enhancing adaptability and modularity. It is capable of gathering real-time ambient plant temperature and relative humidity data, enabling the investigation of leaf transpiration cooling through water supply manipulation in tropical climates. Utilizing open-source technology, it incorporates an Arduino Giga R1 WiFi microcontroller board interfaced with twelve channels, including type-K thermocouples with MAX6675 amplifiers and DHT22 sensors, with real-time monitoring via the Arduino IoT Cloud. Calibration is conducted using a two-point cross-calibration method with the Ambient Weather WH32B Thermometer-Barometer-Hygrometer for accuracy ranging from 96.15% to 99.72% for temperature sensors and 97.46% to 97.55% for humidity sensors. In field testing, it effectively demonstrates its capabilities in data collection, logging, real-time monitoring, environmental tracking, data storage, retrieval, validation, and cost-effectiveness. Finally, the recorded data offers opportunities for further analysis and modeling of herbaceous transpiration cooling as an ecosystem service. Embrace the versatility of the m-DAL for ecological research and beyond.

Keywords: Temperature sensor; Humidity sensor; Environmental data logger; Arduino IoT; Modular data logger system (m-DAL)

1.0 INTRODUCTION

This project introduces the modular multichannel data logger system (m-DAL) designed specifically for assessing herbaceous roof ecosystem services, addressing the limitations of existing data loggers by enabling concurrent measurements across multiple channels with enhanced adaptability and modularity at a reduced cost. The study emphasizes the importance of urban nature-based solutions like vegetated roofs in regulating ambient humidity to balance urban temperatures. While sensors are crucial for monitoring these services, existing data loggers lack modularity and adaptability, hindering their effectiveness. Commercial loggers have limitations such as limited customization options, fixed sampling rates, and constrained channels.

2.0 OBJECTIVE(S)

The objective is to develop a low-cost modular data logger system for evaluating vegetated roof plant ecosystem services, meeting various assumptions including concurrent

measurement of multiple channels, employment of fast-reading sensors, flexibility in programming, and cost-effectiveness in production.

3.0 METHODOLOGY

Leveraging open-source technology, the system utilizes an Arduino Giga R1 WiFi microcontroller board interfaced with twelve channels, incorporating type-K thermocouples with MAX6675 amplifiers, DHT22 sensors, and real-time monitoring via the Arduino IoT Cloud. Sensor calibration was conducted using a two-point cross-calibration method with the Ambient Weather WH32B Thermometer-Barometer-Hygrometer for the WS-2000 weather station. Accuracy assessments revealed temperature sensor accuracy ranging from 96.15% to 99.72% and humidity sensor accuracy from 97.46% to 97.55%. The block diagram illustrating the conceptual system's flow is depicted in Fig. 1 below.

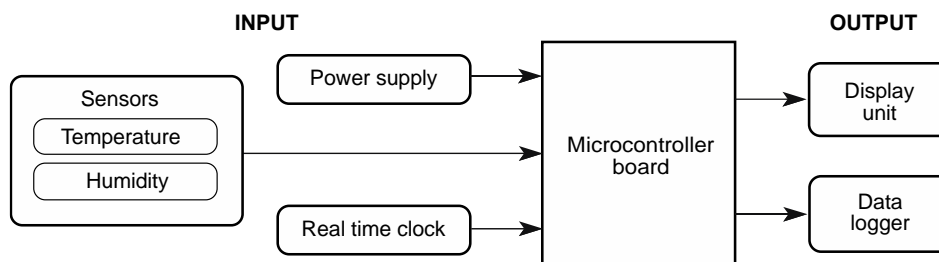


Figure 1: Block diagram of the developed system

3.1 System algorithm

In this setup, we've created a system flow algorithm to guide programming activities from device start to shut down. The algorithm has two parts: "Void Setup" (run once) and "Void Loop" (repeatedly). It starts with initializing the serial monitor, RTC, sensors, and SPI for the micro-SD card. In "Void Setup," the system checks and prepares the SD card for logging, showing an error message if unsuccessful. Moving to "Void Loop," sensors transmit data every 5 seconds with timestamps. Data is sent to the serial monitor and IoT Cloud before logging on the microSD card. These activities in "Void Loop" continue until the device is turned off.

3.2 Components

Components include in this configuration are, the Arduino Giga R1 WiFi microcontroller board, Real-Time Clock (RTC), data logger, temperature sensor (MAX6675 module with K-Type thermocouple), temperature and humidity sensor (DHT22), power supply unit, and necessary assembly components sourced from reputable suppliers.

3.3 Programming Code

Programming code for the Arduino Giga R1 WiFi microcontroller was written in Arduino IDE, involving downloading necessary function libraries, writing sketches based on the algorithm, selecting the microcontroller board and serial port in the IDE, compiling the code, and uploading it to the device, ensuring compatibility and functionality as depicted in the Fig. 2 below

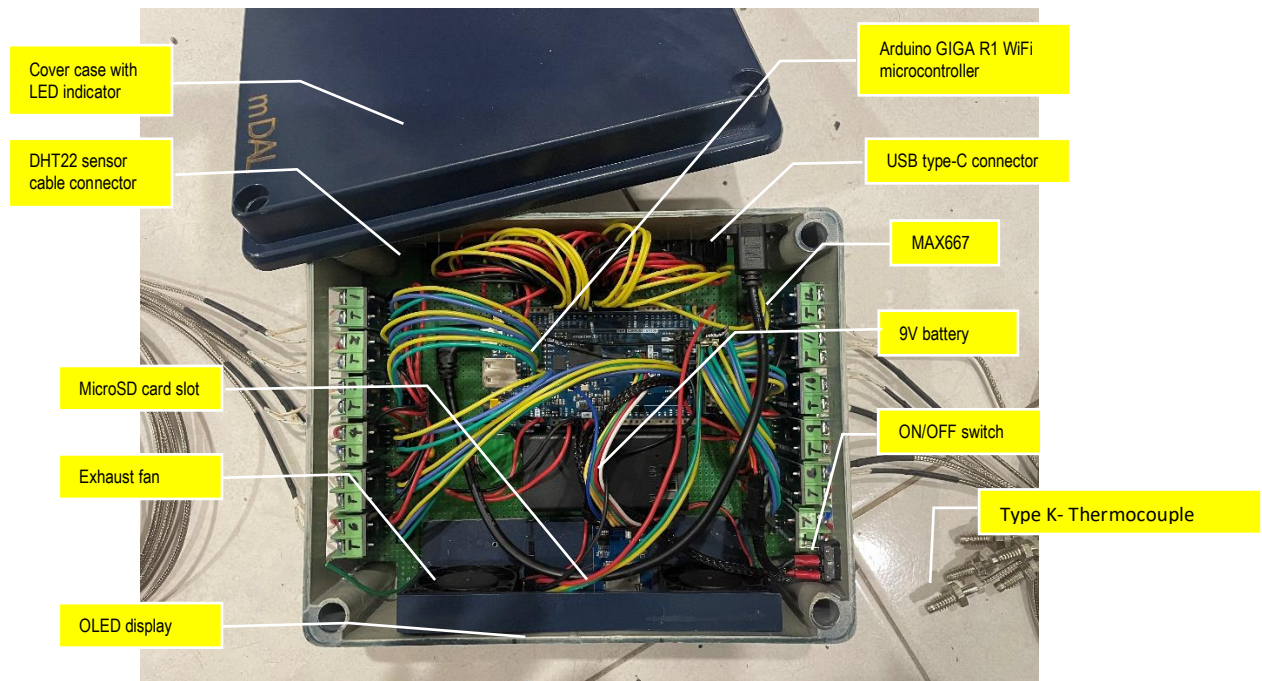


Figure 2: m-DAL v2 configuration system layout

4.0 RESULTS

The m-DAL system effectively logged real-time ambient leaf temperature and relative humidity data for two *Coleus* species (herbs), showcasing its capabilities in data collection, logging, real-time monitoring, environmental tracking, data storage, retrieval, validation, and cost-effectiveness. The collected data is available for further analysis and modelling of herbaceous transpiration cooling as an ecosystem service. However, the newly launched Arduino Giga R1 WiFi used poses a limitation as many function libraries and third-party shields have not yet been updated to accommodate the full functionality.

5.0 CONCLUSION

The system excels in various aspects, offering cost-effective solutions in data collection, logging, real-time monitoring, and environmental tracking. Despite the time-consuming development process, it enhances research skills and fosters a deeper understanding of data and equipment. Future plans include integrating capacitive soil moisture sensors to expand data collection for plant-water relations in urban vegetated roofs.