IFN712 Research Project Form

(Submitted to [y.feng@qut.edu.au](mailto:y.feng@qut.edu.au) by 30 June 2025)

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| Project agency (school, industry, ) | School of Computer Science/NRSAG project |
| Industry/project supervisor and contact emails |  |
| Academic Supervisor name(s) and contact emails | Yanming Feng [y.feng@qut.edu.au](mailto:y.feng@qut.edu.au),  Zhenguo Shi, [zhenguo.shi@qut.edu.au](mailto:zhenguo.shi@qut.edu.au) |
| Information Technology major(s) | Software Development, Computer Science and Data Science, Networks and cybersecurity |
| Project title | IoT-Based Spectral Sensing and Machine Learning for Plant Health Monitoring |
| Brief description of the research problem, aims, method and expected outputs (100~200 words) | **Background:** In agriculture and environmental monitoring, early detection of plant stress caused by factors such as nutrient deficiency, disease, or inadequate water supply is critical. Traditional approaches often depend on manual observation or the use of high-end multispectral imaging systems, which tend to be expensive and difficult to scale. Spectral reflectance analysis provides a non-invasive and cost-effective alternative, particularly when used with controlled lighting and compact spectral sensors.  When plant leaves are illuminated with red, green, and blue light, their reflectance patterns vary depending on their physiological condition. These differences can be measured using spectral sensors and analyzed to assess plant health. By integrating this sensing process into an IoT-based system, it becomes possible to continuously monitor plant status and transmit data in real time. This project focuses on building a complete solution that combines sensing, data processing, wireless communication, and visualisation, enabling both automatic classification and manual control through a remote dashboard.  **Objectives:**   1. Spectral Data Acquisition: Use RGB LEDs to illuminate plant leaves and collect reflected light data using a spectrum sensor under different channel conditions. 2. Feature Extraction and Classification: Analyze multi-channel reflectance data and develop machine learning models to classify plant health status (e.g., healthy, stressed, unhealthy). 3. IoT System Development” Build an Arduino-based system to collect sensor data, transmit it to a remote server, and support real-time data streaming. 4. Dashboard and Remote Control: Develop a web-based dashboard to display real-time sensor data, system status, and allow remote control of the RGB lighting. 5. System Integration and Testing: Integrate all components into a complete monitoring and control system and evaluate its performance in controlled and semi-realistic environments..   **Expected Outcomes:**  A functional prototype will be developed that demonstrates the use of spectral sensing and machine learning for real-time plant health monitoring. The system will include a working IoT device, a server-side data pipeline, and an interactive dashboard with remote lighting control. Performance evaluation will cover classification accuracy, system latency, and usability. The project will showcase a low-cost, scalable solution for precision agriculture applications. |
| Key words | * Plant Health Monitoring * Spectral Reflectance * RGB Lighting * Machine Learning * IoT and Arduino * Remote Sensing Dashboard |
| Answerable research questions for 3-5 students (desirable) | Research Questions:   * **How accurately can plant health conditions be classified using RGB-based spectral reflectance data?** * **Which machine learning models are most suitable for small-scale spectral data classification?** * **What are the optimal LED illumination patterns for maximizing class separability?** * **How responsive and reliable is the IoT system in transmitting data and executing control commands remotely?** * **Can the system be generalized to different plant species or deployed in varying environmental conditions?** |
| 3-5 key references (desirable) and website resources | 1. Nguyen, Canh, et al. "Early detection of plant viral disease using hyperspectral imaging and deep learning." Sensors 21.3 (2021): 742. 2. Anand, Rohit, et al. "Spectral data driven machine learning classification models for real time leaf spot disease detection in brinjal crops." European Journal of Agronomy 161 (2024): 127384. 3. Chung, Soo, Lane E. Breshears, and Jeong-Yeol Yoon. "Smartphone near infrared monitoring of plant stress." Computers and Electronics in Agriculture 154 (2018): 93-98. 4. Arduino IoT Cloud Documentation – https://docs.arduino.cc 5. AS726x Spectral Sensor Datasheet – AMS AG |
| Required major of studies, desirable skill sets, knowledge, and speciality | Software development and computer science majors. It is desirable if students have or willing to develop skills in the following areas:   * Working with Arduino and sensor interfacing * Basic understanding of optics and spectral reflectance * Programming in Python using machine learning libraries such as scikit-learn or TensorFlow * Web development for dashboards * Practical experience in data collection, system integration, and remote testing |
| **Industry-based project: Student IP Agreement.** This is the IP model agreed between the parties. Please note that it is QUT policy that where possible students should be allowed to keep their IP. If students are asked to assign their work, then please **provide a brief rationale** as additional permissions are needed by QUT to approve. | Project IP vests in the student with a license back to Industry Partner **(licence)**  OR  Project IP vests in the Industry Partner/Project owner with a licence back to the student **(assignment)**  OR  Academic project (No IP agreement needed) |
| Number of students | 5 |
| The message from supervisor(s) about the acceptance for this project |  |
| Student name(s)  (Print your name and submit this form by the end of Week 2) |  |
| Date |  |
| Remarks on conditions of offer |  |