

SUMMER RESEARCH 2024/25

PROJECT ABSTRACT



THE UNIVERSITY OF
WAIKATO
Te Whare Wānanga o Waikato

PROJECT # 39

SUPERVISOR/S:	Dr. Benjamin McGuinness & Ajit Pal Singh
PROJECT TITLE:	Kiwifruit detection and manipulator control system for an autonomous kiwifruit harvester
FIELD:	Mechatronics engineering
DIVISION/SCHOOL:	HECS - Te Kura Mata Ao School of Engineering
PROJECT LOCATION:	Hamilton

PROJECT ABSTRACT:

The horticulture industry relies on manual labour for in-field tasks such as pruning and harvesting. There are issues with manual labour, such as securing the required numbers to perform the work (much of which is imported from overseas), high costs, and health and safety. Therefore, recently there has been much research directed towards horticultural robotics for precision tasks, typically performed by people.

Kiwifruit is NZ's largest horticultural export and there have been efforts to automate the process, however nothing is available commercially. Current robots locate fruit using convolutional neural networks (CNNs), detect clusters and subsequently harvest fruit. One area for development is around smart scheduling picking sequences and approach paths to optimise picking fruit in clusters.

This project will investigate a smart scheduling system for an automated kiwifruit harvester. This requires labelling and training a CNN to detect (and localise) kiwifruit from an existing dataset. A path planning strategy will be developed based on kiwifruit distribution and manipulator dimensions and kinematics. A UR5 robot arm will be used with existing kiwifruit grippers.

The system will be used to test a range of kiwifruit grippers in a lab setting. Field testing is beyond the scope of the project due to timing of the kiwifruit harvesting season. The system will allow quantification of the performance of a range of grippers, in a controlled and repeatable manner. Additionally, it will address limitations with existing harvesters which do not optimise approach paths when dealing with clusters of fruit.

STUDENT SKILLS:

- Mechatronic engineering
- Programming (e.g. python, pytorch)
- Robot control (kinematics/path planning)

PROJECT TASKS:

1. Train a convolutional neural network to detect and localise kiwifruit from RGB images
2. Investigate path planning and scheduling strategies to optimise the movement of a UR5 robot arm/gripper into kiwifruit clusters
3. Test and evaluate the system in a lab setting on an artificial kiwifruit canopy
4. Create and present a final research poster describing the project

EXPECTED OUTCOMES:

- Student's Research Poster (as per clause 6 of the [Scholarship regulations](#))
- A trained CNN for detecting kiwifruit with performance metrics
- A path planning strategy for harvesting kiwifruit from clusters simulated and tested in lab environments

