PROJECT ABSTRACT:
There is increasing demand in New Zealand for the use of robotics, smart automation, and artificial intelligence in horticultural/agricultural sectors to improve efficiency, productivity and overcome labour shortages. Significant research effort is underway for the development of autonomous orchard vehicles, versatile robotic arms and innovative end-effectors to automate many time consuming and labour-intensive processes. The proposed project is part of the same endeavour, and it focuses on the design and development of robotic grippers for blueberries harvesting. Grippers are essential end-of-robot arm components that play an important role in many manipulation tasks such as fruit harvesting, pollination, thinning, pruning, and spraying while causing minimum damage to plants/orchards.

Student will kick start research in two areas:
1) Explore the potential pneumatic gripper design capable of blueberries harvesting through conventional mechanisms consisting of rigid links connected at movable joints.
2) Investigate the feasibility of using compliant mechanisms for blueberries harvesting grippers and study their fabrication using advanced additive manufacturing techniques.

A compliant mechanism is a monolithic structure that gains its mobility from the deflection of flexible members when subjected to the applied force rather than from movable joints. Hence, compliant mechanisms can avoid difficulties generally encountered by conventional mechanisms such as backlash, friction, wear, lubrication, assembly cost, weight, and downtime for maintenance. Therefore, it is essential to explore the utilisation of compliant mechanisms in blueberries harvesting application along with conventional rigid body mechanisms. Student will explore these two research directions simultaneously and will develop 3D-printed prototypes for field testing during the harvesting season.

The student who will undertake this project will gain an in-depth knowledge of robotic gripper development process, compliant mechanism design and exploration of 3D-printing techniques to build prototypes. Students will also be involved in field trials (real farms/orchards) to validate the performance of resulting robotic grippers. In addition to this, student will also learn about literature search and processes to critically analyse existing designs of grippers for harvesting. The prospective selected student will be trained and supervised in all aspects of the project. This project is suitable for 3rd/4th year mechanical engineers. Exceptional 2nd year engineering student might be considered.

STUDENT SKILLS:
- Proven record of solving challenging engineering problems through project-based learning
- Must have fundamental knowledge of engineering mechanics, materials, and material selection process
- Should have a sound knowledge of mechanisms and engineering design process
- Strong computer-aided design (Solidworks) proficiency
- Should be able to critically analyse the results to explain the correlation
- Ability to rapidly learn new concepts such as compliant mechanism design method, 3D-printing technologies and any testing/evaluation process
- Excellent written and verbal skills and must be a great team player
- Must have good project management skills to track the project progress and ability to meet the deadlines
PROJECT TASKS:
• Perform a short literature survey to gain understanding of various existing robotic gripper designs for fruit harvesting
• Engage with the external partner and other researchers from Waikato Robotics, Automation and Sensing (WaiRAS) research group to understand the difficulties associated with blueberries harvesting
• Apply the standard design process to generate key design specifications and basic concept ideas for robotic grippers using conventional mechanisms as well as using the compliant mechanism
• Choose the best designs and develop the 3D CAD models
• Perform the material selection and choose the appropriate additive manufacturing technique for the fabrication of selected designs
• Develop proof of concept to test the functionality of each gripper
• Evaluate the performance of the finalised prototypes in actual farms/orchards
• Write a technical report and showcase the research by developing a poster

EXPECTED OUTCOMES:
• Student’s Research Poster (as per clause 6 of the Scholarship regulations)
• Initiate the development of next generation robotic grippers for fruit harvesting
• Develop 3D-printed proof of concepts
• Strengthen the relationships with external partners and end users
• Possible groundwork for external funding