PORTFOLIO

Samuel Bain

PROJECTS

Weeding Robot

Wacky Racers

Robocup

UC Bike Trailer Build

Weeding Robot

An internship and final year project with Plant Research Limited, Christchurch

The Demand: Weeding and monitoring row crops is a labour-intensive task. The labour to fulfil this role is becoming increasingly difficult to find, which is jeopardizing yield quality and economic returns.

The Challenge: To create an autonomous robot that can effectively navigate around crop rows while identifying and eliminating invasive weed species. Furthermore, Plant Research wanted the vehicle to be a suitable base for future module development.

The Solution: A fully customized 4WD robot featuring: GPS navigation with 5 cm accuracy, real time obstacle detection and avoidance using a vision system and weed identification, tracking and spot spraying. All easily controllable through a webpage accessed from the user's smart phone.

My Contribution: This project was conducted between myself and a fellow intern, before continuing it as a final year project. We were tasked with developing the robot from the ground up, including mechanical design and manufacture, power management, and software implementation and communication. My focus area for the final year project has been the navigation system, including generating robust control algorithms, and integrating this with the obstacle avoidance vision system to overcome real time navigational challenges. A video of this functionality can be seen here.

Wacky Racers

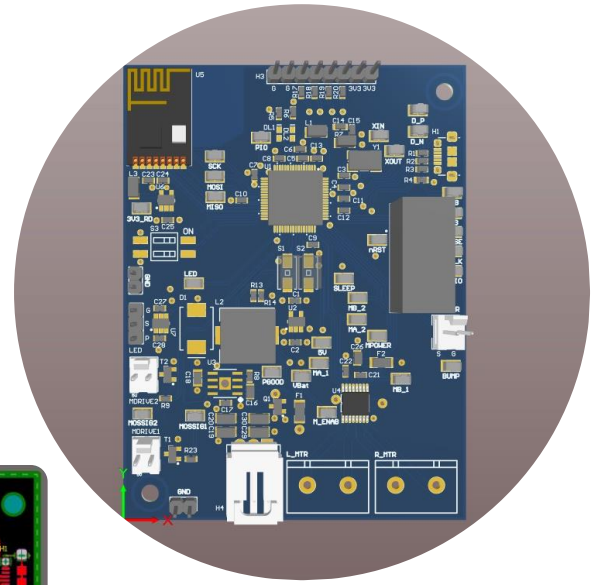
A university team project involving embedded systems design.

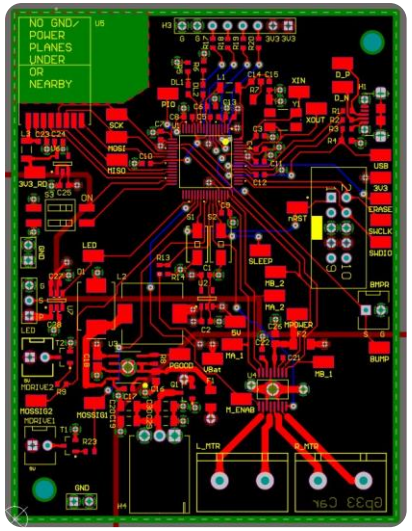
The Demand: The team was required to design and manufacture a PCB for a car controlled by head tilt via radio communication.

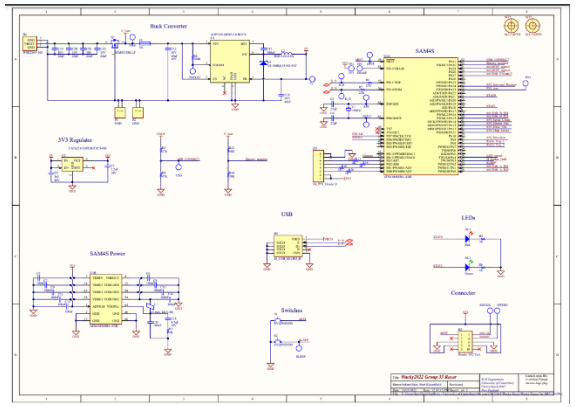
The Challenge: The main pinch point of this assignment was surrounding PCB layout and the use of passive termination in order to maintain signal integrity while achieving real time signal processing and actuation.

The Solution: A four-layer PCB was designed using Altium. After manufacturing, the team assembled the components on the PCB and coded the MCU. The team's design and control algorithm were extremely effective and reliable, which ultimately meant the team won the competition.

My Contribution: My area of focus was on the PCB that was on the car. I was involved in all sections of the development, from designing and assembling the PCB through to coding the MCU using C.







Robocup

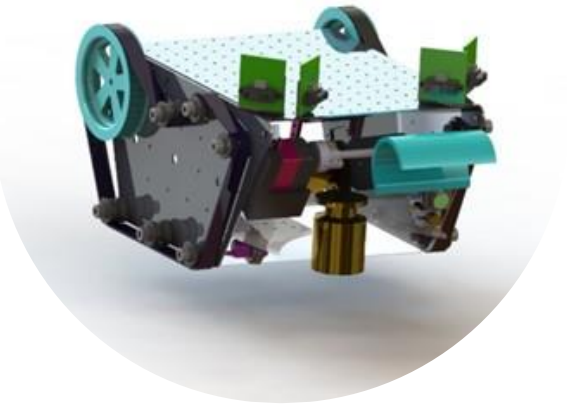
A university group project to design a robot to compete in a competition.

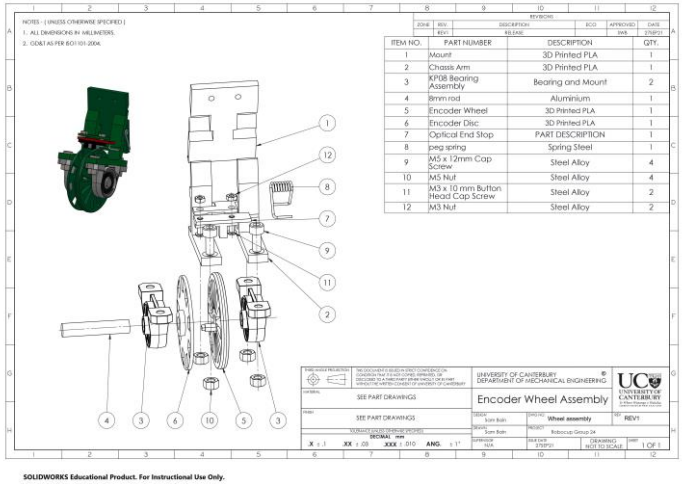
The Demand: A competition was created for 3rd Year Mechatronics students. The premise of the competition was to build an autonomous robot capable of capturing and storing metal weights in an arena, before returning them to the team's base.

The Challenge: The robot had to be extremely fast at detecting and collecting weights while being able to accurately position itself to return the weights to base for bonus points.

The Solution: The team implemented a robot capable of detecting weights using a laser pointer and IR camera, and reliably picking up weights using a scoop mechanism. The team utilized a wheel encoder, gyroscope and multiple IR range sensors to create a rudimentary SLAM algorithm capable of running on the supplied Arduino Mega 2560.

My Contribution: As the leader of the team for this project, I had a large responsibility to ensure to project was completed to an acceptable standard. My main areas of contribution were in the weight detection and positioning subsystems.





UC Bike Trailer Build

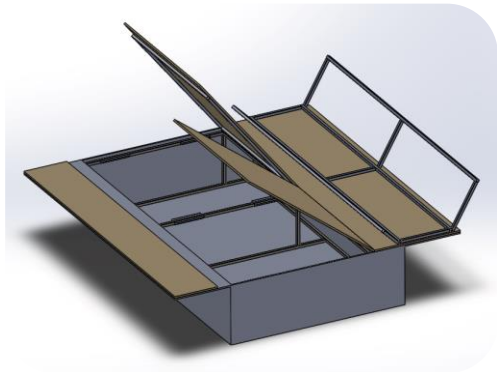
A voluntary project for the University Bike Club

The Demand: The UC Bike trailer was no longer fit for purpose and required extensive upgrades. The previous trailer was clunky, time consuming and had a history of damaging bikes.

The Challenge: Create a new means of mounting bikes securely on the trailer. The trailer had to carry 6 bikes and additional luggage, pose little risk to damaging bikes and be quick and easy to use. The real challenge came with the variation in bikes it must carry, having to cater for bikes of all different wheel and frame sizes.

The Solution: A six bike mount and storage bay were custom designed and manufactured which met the needs of the bike club. The trailer was tried and tested on the Queenstown bike trip and was largely successful.

My Contribution: This was purely an individual project and required me to be highly resourceful and take accountability for issues that I foresaw.



Extracurriculars