Project Portfolio

CALEB BARNES

Accurate Object Measurement from Smartphone Images

Specific details on this project have been left out to respect client confidentiality.

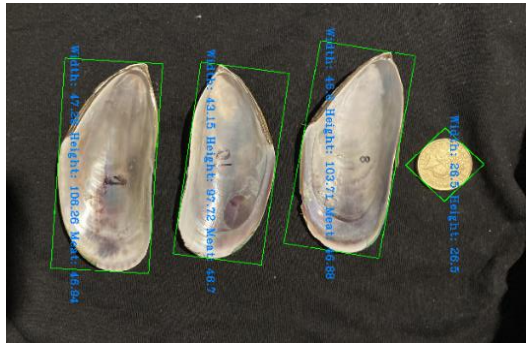
As a team we had a goal to build a platform that predicts shellfish dimensions yield from a smartphone image.

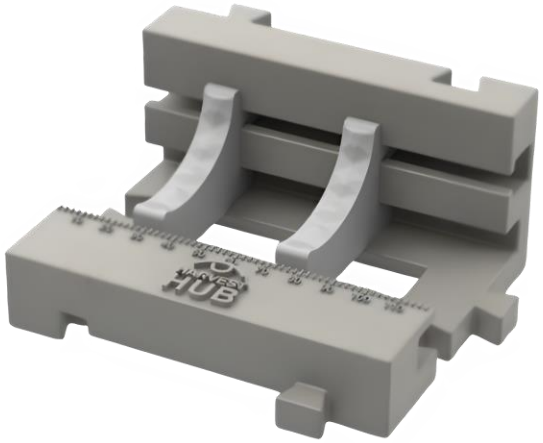
Accurate harvest assessments can significantly increase yield, resulting in economic gains without increasing the environmental footprint of the industry.

The objective was to create a computer vision and machine learning algorithm that can take images from any smartphone and calculate the maturity of the sub-set of mussels that represent the rest of the long-line. As well as creating an inert tray to assist this algorithm.

Learning Objectives/Outcomes:

- Intrinsic and extrinsic camera calibration
- Client/Customer interaction
- User-friendly backend development
- Computer vision algorithms
- Machine learning algorithms
- Profitable solutions
- Project management
- Customer/User driven design
- Fatigue studies





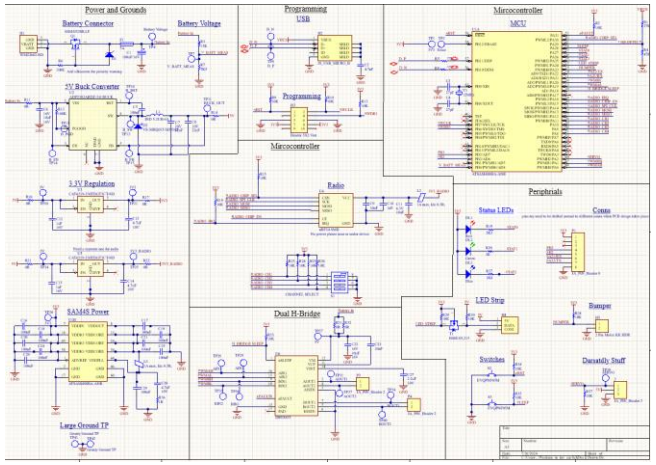
Remote-Control Car

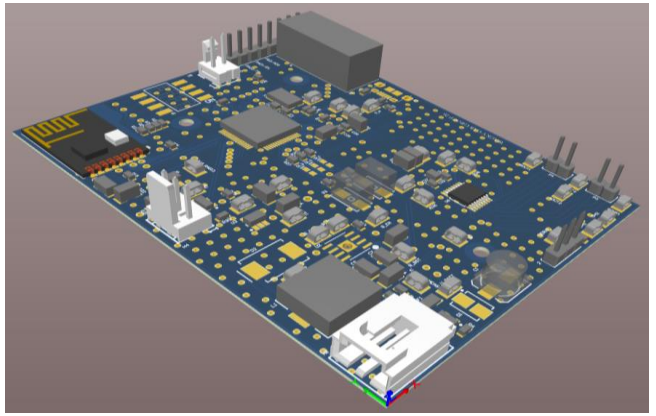
This project required us to design and implement an embedded system featuring two components: a gyroscopic remote-control PCB and a corresponding motor driving PCB.

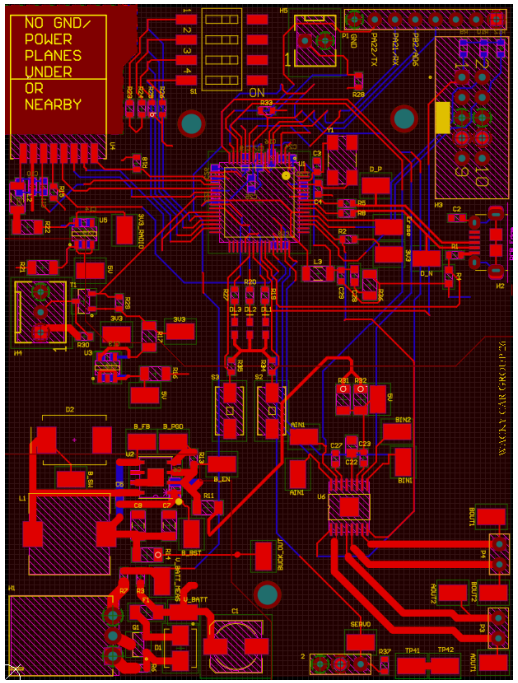
The objectives of this project were to: analyse the electrical and performance characteristics of CMOS devices, apply signal integrity considerations in the design of an embedded system, program & design interfaces for peripherals, and design, build, program, debug, and evaluate a microcontroller-based embedded system.

Learning Objectives/Outcomes:

- Advanced PCB design
- Electrical design
- MCU tool-chain utilisation
- SoC architecture
- Signal integrity focused design
- System design tools
- C/C+ programming
    - Version control (Git)
- Signal processing/filtering
- Project management
- Utilisation of various sensors
- Teamwork
- Surface-mount soldering







Autonomous Search and Collect Robot

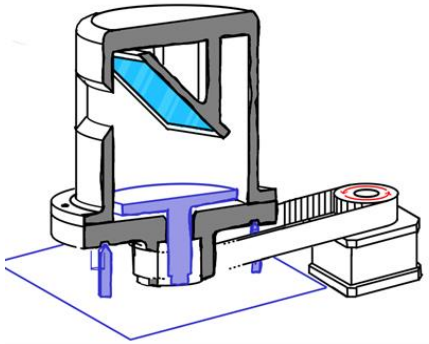
This project was the first completely autonomous robot that I undertook. The robot was made to compete in the university's 2023 RoboCup challenge.

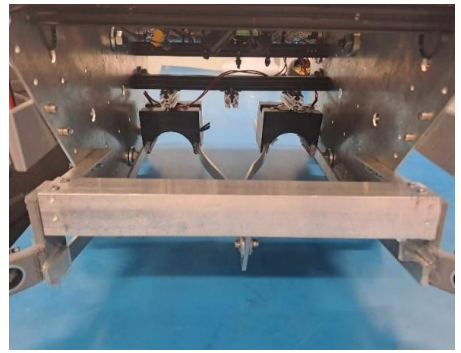
The objective of this competition was to autonomously navigate an area and collect more of the target weights than the opposing robot. We achieved this by ultising an array of ultrasonic sensors, time of flight sensors, and a hall-effect metal detecting circuit that I made myself.

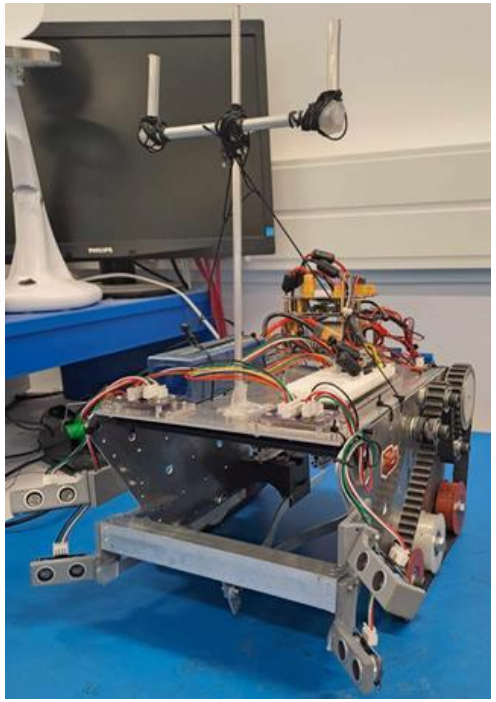
Our robot performed well and collected every weight it navigated to with 100% accuracy. The weight retrieval system was designed to be simple, static, and reliable. This system is what put our robot above our competitors which used overly-complex systems

Learning Objectives/Outcomes:

- Team leadership
- System design tools
    - Modelling
    - Reliability and hazard analysis
    - Version control (Git)
- Signal processing/filtering
- Project management
- Utilisation of various sensors
- Sensor Fusion







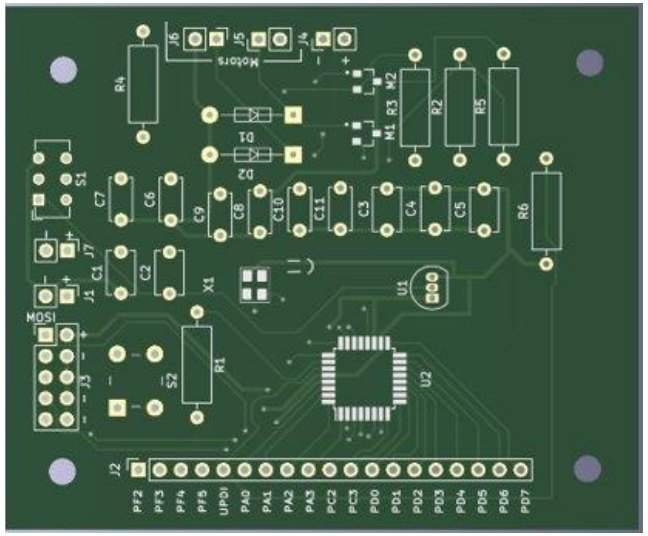
Line Following Robot

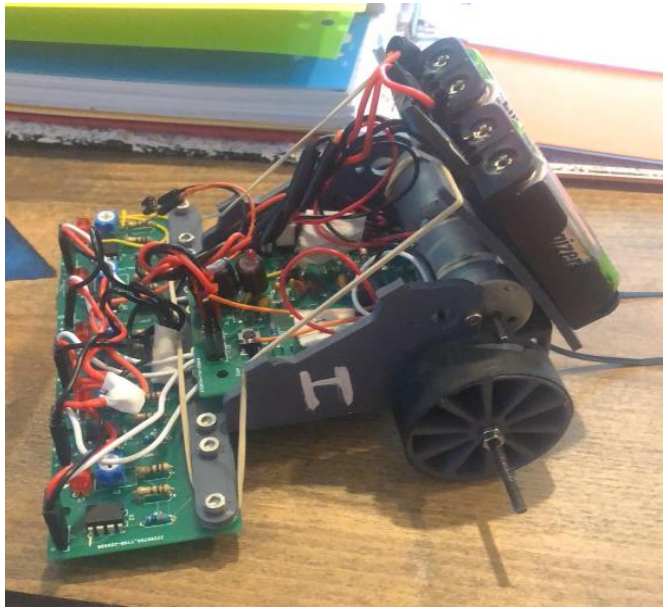
The line following robot was the first semi-autonomous robot that I was involved in constructed. The objective of this project was to take a complete mechatronic design from inception to completion. This involved designing electrical circuits to accommodate IR sensors and a mirco-controller. Taking these circuits to create to a PCB layout which subsequently got manufactured. The chassis then had to designed and printed, finally the mirco-controller was programmed in C to create a functional robot.

Our robot placed highly against the competing robots.

Learning Objectives/Outcomes:

- Usage of Git Repositories
- C/C+ programming
- Mechatronic design
- PCB/Design
- Circuit simulation
- CAE
- Algorithm design
- Realtime embedded software
- Altium Design CAE software





Infrared Communications and Computer Architecture

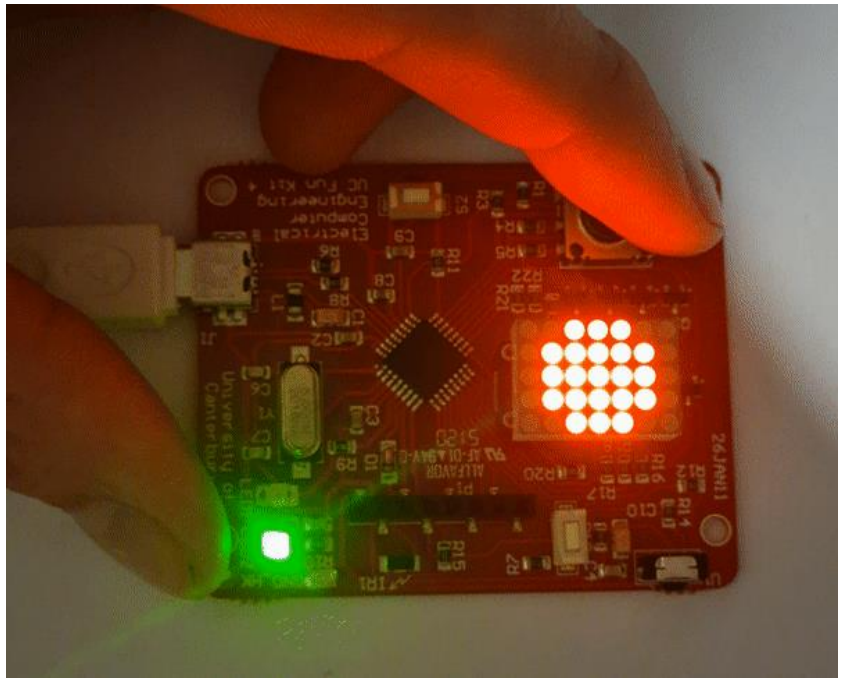
Early into my degree we were tasked with creating a programme that utilised infrared communications to interface two boards together to play "Paper, Scissors, Rock."

This was our first introduction to an embedded system and subsequently C/C+ programming.

The board provided intentionally was not able to perform all the tasks that we required. This created an interesting challenge wherein the architecture of the chip had to be considered and effectively used to achieve our desired outcome

Learning Objectives/Outcomes:

- Usage of Git Repositories
- C/C+ programming
- Effective utilisation of computer architecture
- Time management
- Collaborative programming
- Algorithm design
- Realtime embedded software implementation



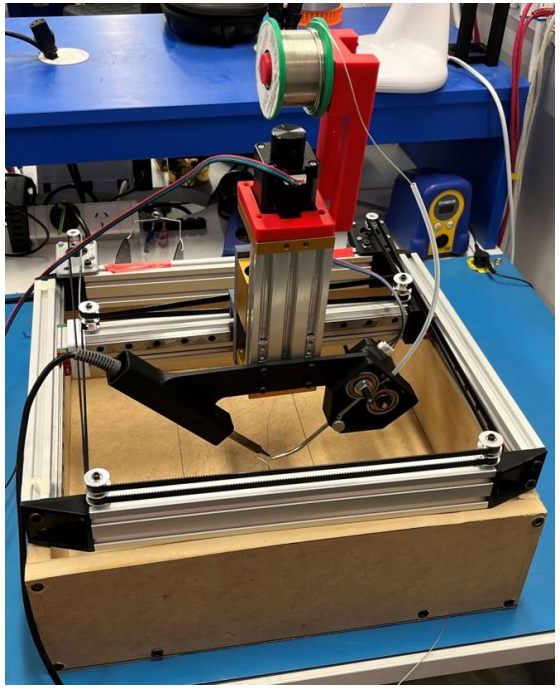
CNC Soldering Machine

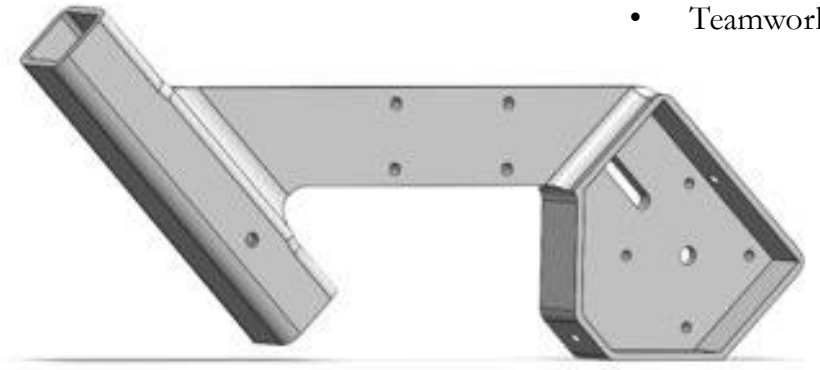
The first project assigned to us was designing and building a CNC machine. My team specifically built a CNC soldering machine.

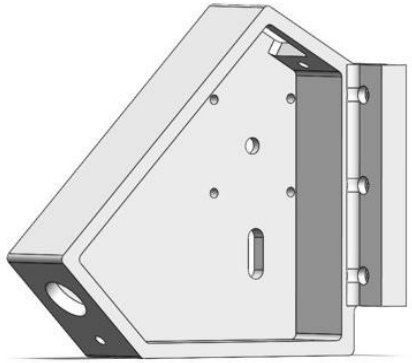
This introduced us to designing for specific manufacturing techniques. It also taught us how to refine our designs as well as how to analyse the possible point of failures.

Learning Objectives/Outcomes:

- CAD Modelling
- Rapid Prototyping
- Topology studies
- 3D Printing
- DfAM/DfSM
- Fault tree analysis
- Teamwork







Extra-Curricular Learning

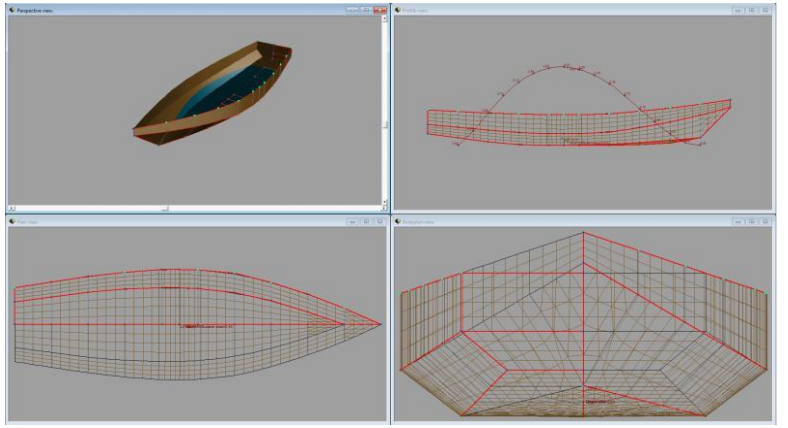
Throughout my time in university, I have completed a few courses primarily through MIT Open Courseware. The following courses were completed to expand my knowledge on different topics, all learning is self-directed. Because some of these courses lack complete content, I often use additional resources like publicly available lecture notes, related textbooks, and open-source software to enhance my learning.

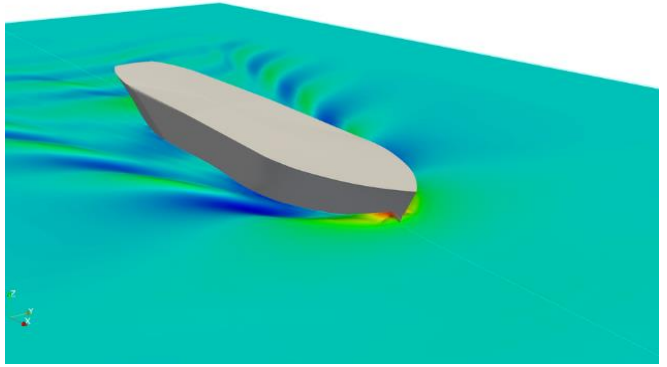
Courses:

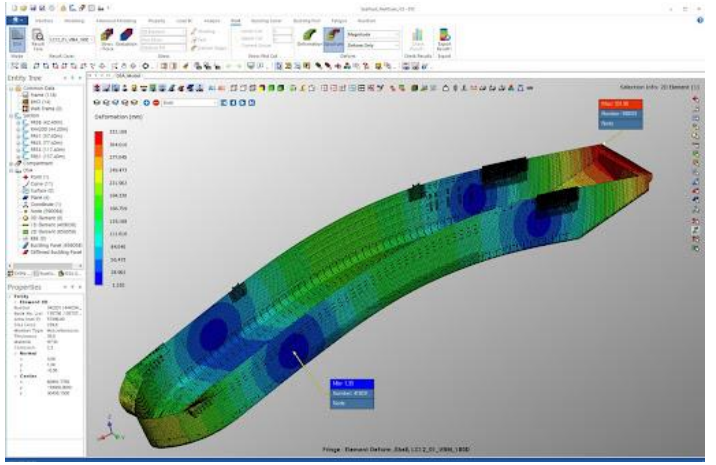
- Principals to Naval Architecture
- Sailing Yacht Design
- Basics of Hull Digitisation (not through openMIT)
- Marine Hydrodynamics (in progress)
- Ship Structural Analysis and Design (in progress)

Learning Objectives/Outcomes:

- CAD Modelling
- Fault Tree Analysis
- Self-directed Learning
- Practical Thinking
- Exposure to Marine Technology
- Time Management
- Material Analysis







Practical Projects

I have always been practically minded and therefore strive to find the simplest solution to any challenge.

Because I enjoy working with my hands, I have developed skills that often come in handy. A few examples of this are designing and building a lightweight stern anchor to partially rebuilding an engine and replacing its head gaskets.

There are countless more examples that go undocumented, I work hard to simplify every process in my life.

Learning Objectives/Outcomes:

- Low-cost solutions
- MIG/TIG/Stick welding
- Metalwork
- Machining (lathe and mill)
- Project management
- Self-driven learning
- Task identification and breaking complex systems to their root