Henry Craw
Engineering Portfolio

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I’m Henry Craw, a mechanical engineer that completed a Bachelor of Engineering (Hons) at the Queensland University of Technology and since have worked in the manufacturing industry at an OEM of dust collection machines. This small portfolio is to demonstrate projects I have worked on during my career as a mechanical engineer and in addition shows work I’ve done for professional development and personal interest.

A particular project that demonstrates my ability to rapidly prototype was the electrification of an On-Board Dust Collector for a John Deere Skid-Steer. An overview of the product can be found here https://www.grydale.com.au/onboard-dust-extractor-for-skid-steers/.

Project Outline:

Originally, the fan of the on-board dust collector was driven by the auxiliary hydraulic circuit and accessories run off the skid steers alternator. Electrification was viewed as a simple way to allow the on-board dust collector to be attached to a broader range of skid-steer units due the problems with power constraints of the hydraulic systems on smaller equipment. To electrify the dust collector the scope was to change the hydraulic driven motor to electric and design a battery power system to power the electric motor and other accessories (compressor, pulse controller, etc.).

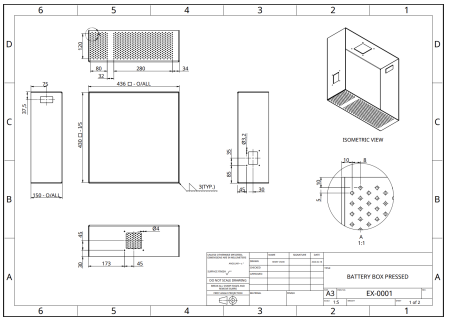
Responsibilities:

- Full design of battery solution including selection of the batteries and charge.
- Full design and manufacturing drawings of battery enclosure and mounting.

Concept:

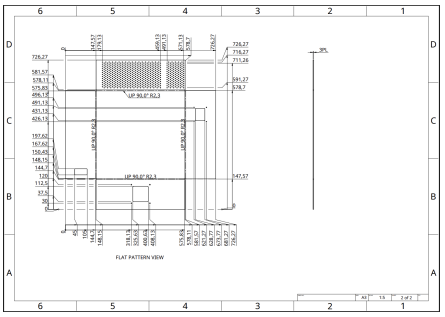
Different battery options were researched and presented to the engineering team as well as the ideas for the enclosure including the cooling and mounting. Final design was to include:

- Active air cooling triggered by thermistor.
- Split pack across two parallel 4.8kW, 48 V batteries capable of 100 A discharge current (current capacity required to run fan and other equipment).
- Vibration mounts to protect electronics and connectors from machine and fan vibration.
- Ergonomic battery swapping and mechanical and environment protection.



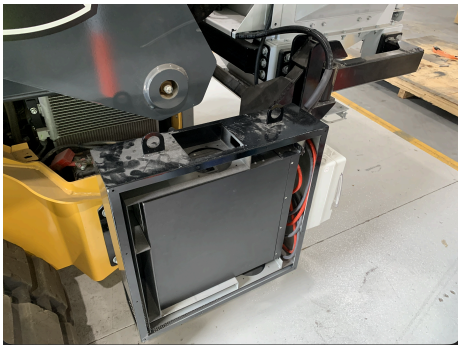
CAD:

In inventor, I modelled all sheet metal parts, gaskets, the main weldment and the top-level assembly including electronics and fasteners. As an example I quickly modelled and did a drawing for the outer pressed part of the battery box using OnShape.



Build:

- The final box was cut and pressed from sheet metal using a CNC laser cutter and bend press then welding and assembled.
- Issues with warping meant that a larger weld interval was used and sealant applied to fill any gaps remaining.
- Miscommunication between me and the assembly team meant it was painted black, it should have been a brighter more thermally reflective colour for outdoor use.
- Neglected a design for a machined quick change mounting to instead use fasteners.



Test:

- Testing showed the initial proof of concept worked. The fan runtime was within the range we designed for.
- Temperature values were taken using a heat gun and were within the acceptable range while operating indoors.

Some key issues identified were the location of the batteries had to change as the chances of users damaging them was too high, better cooling system was required for outdoor use especially in high temperatures and a lighter battery pack because of the mechanical problems of moving the weight further from the COG.

Iterate:

- There were many iterations through the design process to get to the final CAD model. In the end a simpler design was arrived at as it was only a proof of concept.
- I made a concept design of a smaller and lighter battery pack that was to be integrated into the unit itself and had begun sourcing third party battery manufactures to collaborate with.

This version of the machine was eventually scrapped due to budget constraints, however I believe if this concept was to work, integration of the battery pack of the machine would be required as well as making the dust collector lighter with capacity to accommodate a wider variety of machines.

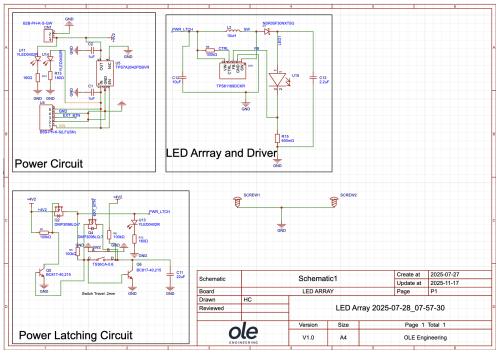
Lamp and Watch Design - Personal Projects to Learn PCB and Product Design

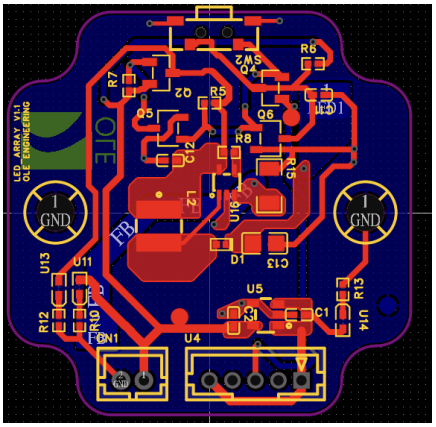
The objective of this project was to learn key aspects of electronic product design including PCB design, low voltage electronics, embedded software and demonstrate design for CNC machining and prototyping with 3D printing. This was to build the foundations to eventually design and build a semi-smart watch. The watch is to be battery powered, detachable from a wrist-strap, water resistant, with a display and chip that displays the time and various other functions.

I learnt PCB design using online tutorials in KICAD to create STM32 based microcontroller boards mainly for doing PWM motor control and control of LEDs. To test my ability to design a PCB myself, I designed a portable LED bicycle headlight. This is the schematic and PCB design below. I ordered the PCB and SMD components and did the assembly and reflow solder myself. I designed this board using EasyEDA, a PCB design software from JLCPCB, because I thought that it would streamline the ordering process.

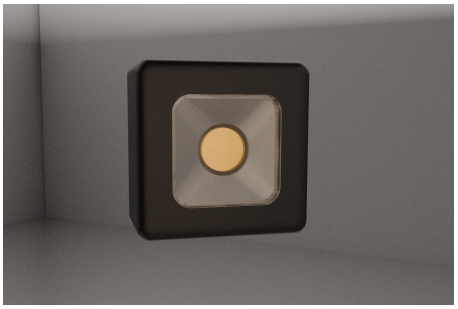
Below are the designs in CAD, a render of the bicycle light and a schematic/PCB design for the LED, LED driver and charging circuit of the bicycle headlight. Also shown is an initial CAD model of the watch I am currently working on.

Schematic and PCB Design





Bicycle Light CAD Model



Watch CAD Model