IB Integrated Design Project

Group Name: *“Not quite M1”*

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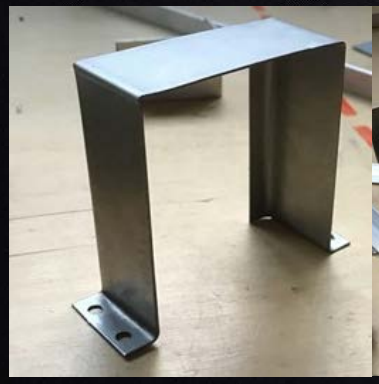
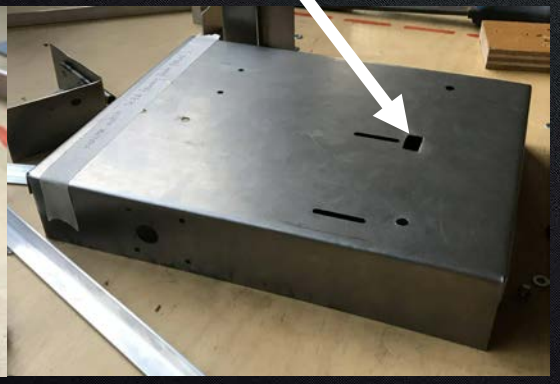
Mechanical Sub-team

Max & Sebastian

Overall design

- Initial tests show lift mechanism to have very low friction (see video)
- Motors and components fit with good tolerance in chassis
- Some modification required to rack fitting





Mechanical Sub-team

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Design Modifications Summary

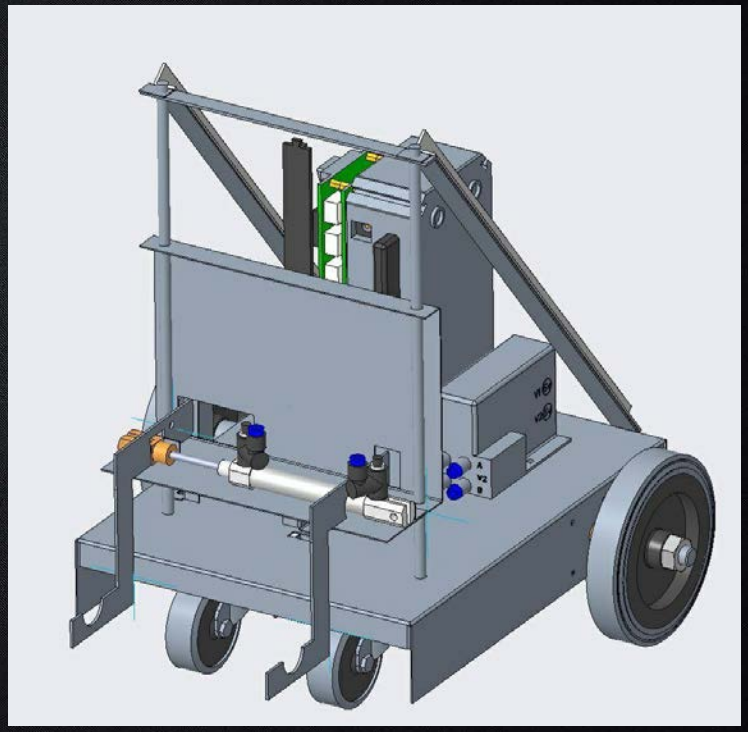
Original	Modification	Reason
Valve assy and PCB in middle	Valve assy and PCB on sides	Prevent sagging in chassis
Bracing on inside of motor raise unit	Bracing along the length of the robot	Better support against buckling
Grabber arms made of steel	Grabber arms made of alum.	Thicker, for better hold on box, and no conductivity
Grabber arms height = 30mm	Grabber arms height = 90mm	Account for wheel height
	Added flats to grabber arms	Improve slide along plate
Lift mechanism back plate height = 200mm	Back plate height = 110mm	Material savings
30 spoke gear	20 spoke gear	Improved torque

Mechanical Sub-team

Max & Sebastian

To do:

- Scrap metal construction of grabber arm mounts and bracing
- Complete assembly:
  - Welding steel tabs (chassis and motor raise unit)
  - Pop riveting Al – Steel interfaces
- Calibrate and testing in conjunction with electrical and software
- Simplicity of the design and promising lift mechanism performance lend confidence to the performance of the robot in the final competition

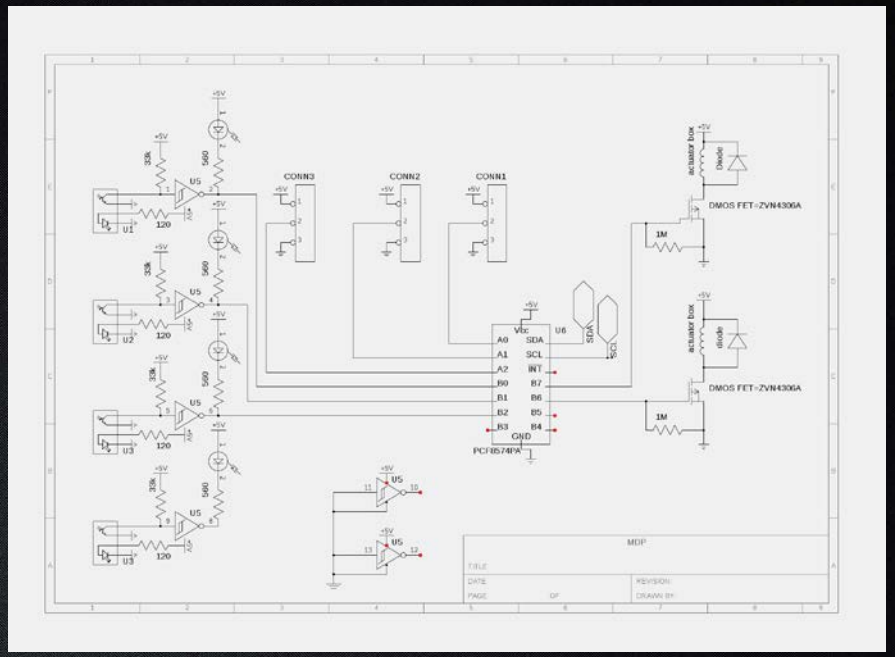


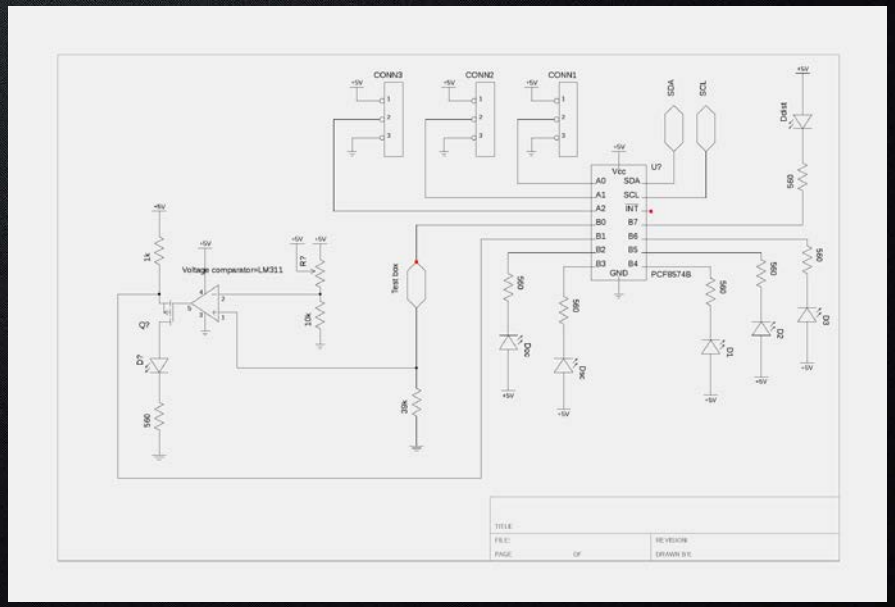
Electrical Sub-team

Sinéad & Niall

Initial designs and issues

- Two PCBs laid out as shown
- Line following on first board with actuators
- Box tester on second board with indicator LEDs
- Indicator LEDs had to be on visible board
- PCB1 in use so could not be added to during testing
- Box testing circuit development delayed
- Issues with box tester due to insufficient power supply from PCF8574A
- Issues with comparator part of box tester due to voltage at which box signal decayed
- Issues with actuator drive circuits due to component placement



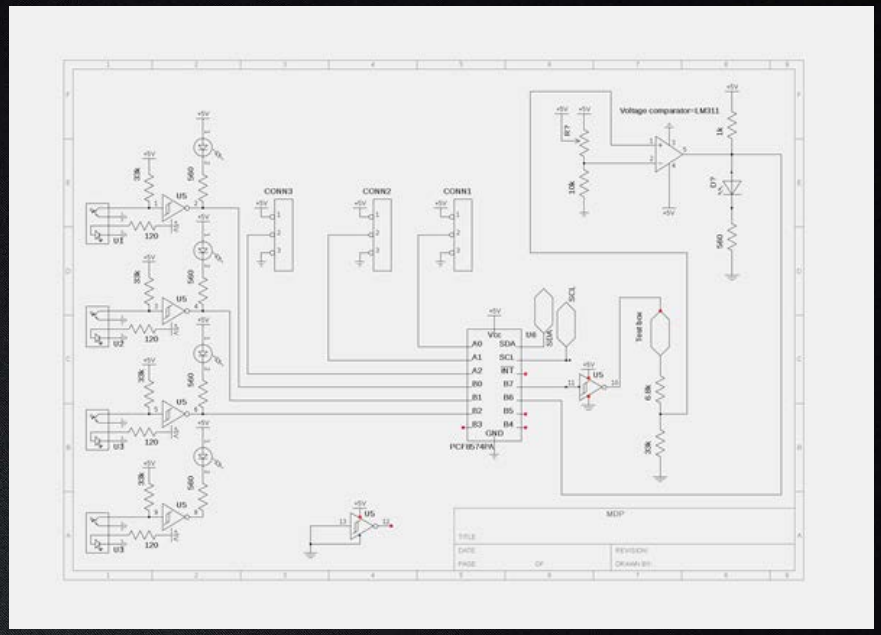


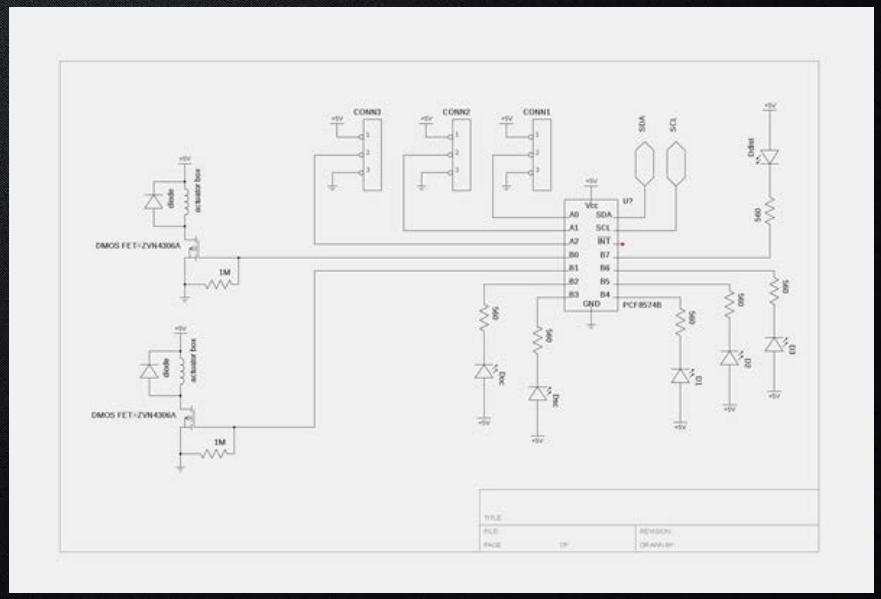
Electrical Sub-team

Sinéad & Niall

Final designs

- Both line following and box testing on PCB1
- Box testing signal routed through Hex inverter to supply necessary power
- Only one Hex inverter required as both circuits on same board
- New potential divider added to change decay voltage for easier voltage comparison
- LED indicators and actuator drive circuits on PCB2
- LEDs easily visible on upper board
- Actuator drive circuit components rearranged and corrected





Software Sub-team

Alicia, Léa & Diego

Overall Software Design

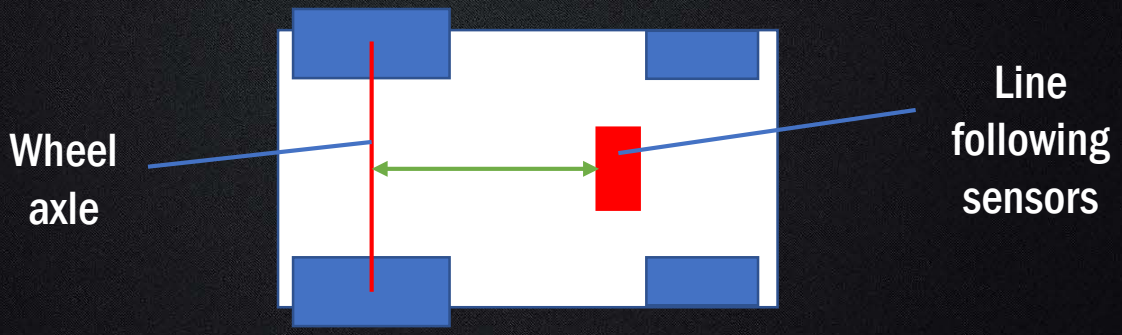
Compatibility	Modularity	Maintainability
Capable to operate under different connections with robot	Divided into independent components (i.e. functions and headers)	Functional modifications can easily be accomplished
Reusability	**Performance**	**Fault-tolerance**
Could be used with any other robot	It performs the task in the time required without requiring too much memory	Resistant to and able to recover from robot failure

Software Sub-team

Alicia, Léa & Diego

Problems encountered

- Change of the sensors readings after implementation of additional circuits on the board by the Electrical Team
- Lack of alignment between line-following sensors and powered wheels



- Reliability of the distance sensor
- Trying to write the code so that it is as easy as possible to calibrate when we test it with our actual robot
- In rare cases, failure to detect a junction when it should

Software Sub-team

Alicia, Léa & Diego

Changes to the design

Number of light sensors

Original Sensor Layout

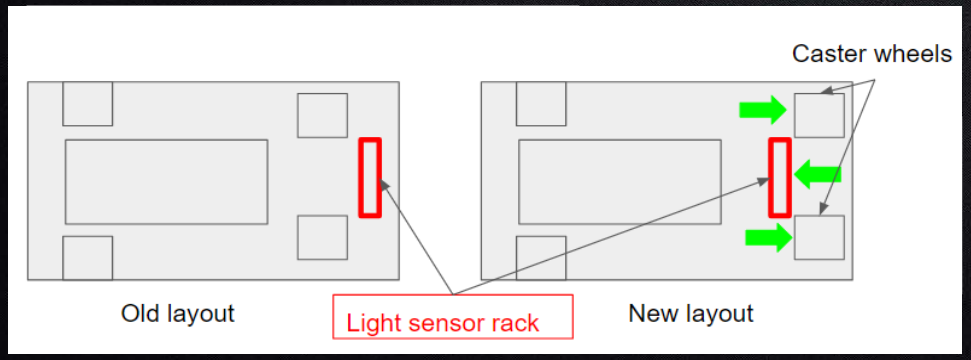
New sensor layout

4 bit number rather than 3

16 cases rather than 8

Improves accuracy of line following tremendously

Positioning of sensors



Light sensor behind the caster wheels

No longer hits the ramp

Accuracy involved with closeness to floor

Likely Performance

- **2-3 boxes delivered, instead of 5, but** in the correct position (real speed under estimated 0.45 m/s.)
- Measurement of distance between robot and box is inconsistent, which might lead to **difficulties in collection**.
- Wall detection is relatively reliable, but there is a *small probability* of the robot **hitting the wall** before stopping.
- **Line following** will be **smooth**, but turns will be constrained by space.
- **Box testing** is sensitive to **shaking** when taking measurements (grabber vibrations will play an important role).