Integrated Design Project

Michaelmas, M2 2018

The lab lasts for four weeks, with three weekly timetabled sessions:

- Thursday 9-11
- Monday 11-1
- *Tuesday 9-11 (first week only!)*
- Wednesday 9-11

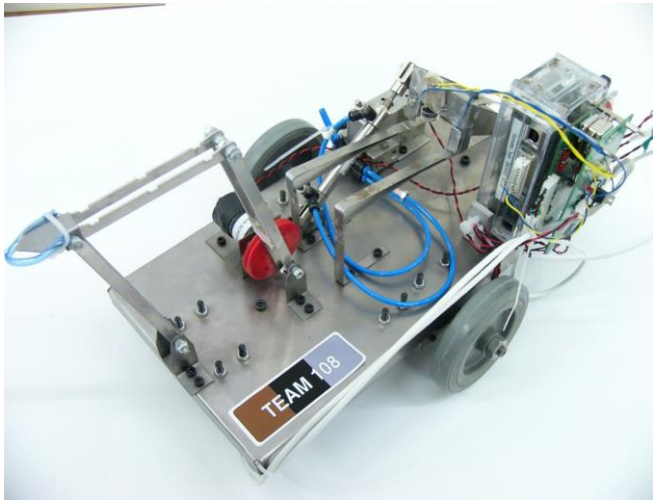
Integrated Design Project

We are trialling a new approach to IDP focusing on **rapid prototyping** with an increased focus on **integration.**

- Please give us feedback, the more the better ☺
- If something could be better during the project let us know and we will do our best to fix it
- (Bear with us any potential teething issues)

IDP: Aims & Objectives

- Mobile robot design
- Teamwork
- Construct and test
- Integration
- Team work
- Project Management
- Competition

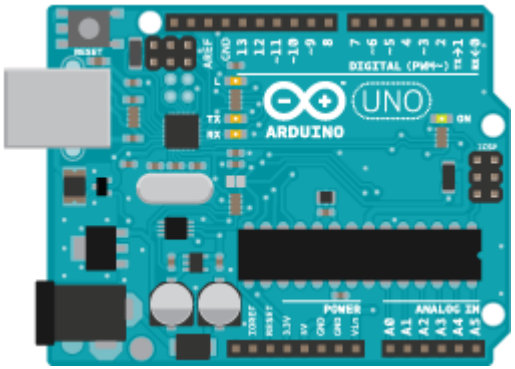


Wednesday 28th November:
Robot Competition

IDP: Rapid Prototyping Approach

Rapid Prototyped Robot

Microcontroller: Arduino (well Orange Pip…)



- C++ IDE
- Analogue, Digital I/O
- PWM

Mechanics: Chassis Development

- Laser cutting (MDF/Plywood)
- 3D printing (PLA)
- Metal parts (right angle section, tubing)
- Fastenings – bots/glue
- Wheels, castors other parts provided

Interface electronics

- Motor shield provided
- Prototyping shield/strip board
- Bank of standard electronics given
- Sensors: Ultrasound, IR, compass, accelerometer, microswitch + many more

IDP: Rapid Prototyping Approach

Mechanical Development

- Cardboard will be provided (which an be used in the laser cutting) to test develop a Chassis
- 2 sheets of 300x600 MDF/Ply (2mm, 3mm or 6mm) can be obtained from the Dyson Centre Technicians for laser cutting.
- Once trained laser cutter keys can be obtained from the Dyson Centre technicians
- Two 3D printers will be on the IDP benches. Use these – if busy can try the others (if they are not busy)
- Be mindful that there are other students using the Dyson centre facilities….
- If there is something you believe you can't do MDF/Ply and want to use metal come and talk to us!

IDP: Rapid Prototyping Approach

Arduino software can be downloaded for free:

https://www.arduino.cc/

Student editions of CAD software can be downloaded for free:

- Creo (supported)
- SolidWorks
- Fusion 360

Laser cutting/3D printing information can be found on the Dyson Centre website:

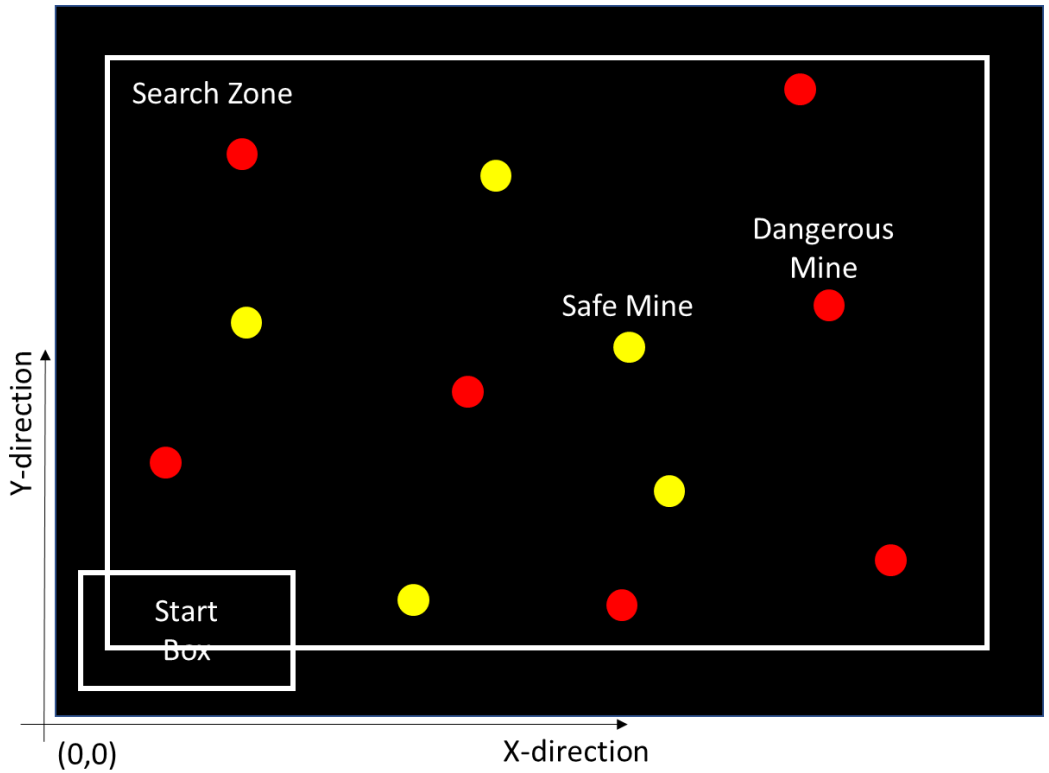
https://www.dysoncentre.eng.cam.ac.uk/

Use Google!!! So much support for Arduinos/CAD online.

The Task: Mine Detection & Removal

- Efficiently search the area
- Identify ‘safe’ and ‘unsafe’ trainers
- Remove safe mines outside the search area (white box)
- Return the co-ordinates of the red mines
- Robot must be autonomous and must fit within the start box

Plan View of Table



The Task: Mine Detection & Removal

Each team has 8 minutes to find detect as many dangerous mines as possible, and, if possible report back the location of the mines.

To identify safe yellow mines, the robot should:

- Stop for at least 3 seconds, within a 5cm of the mine
- Give a LED signal to identify that this is a safe mine (e.g. a yellow LED)
- Provide the x,y co-ordinate of the mine detected (to within +/- 10cm accuracy)
- If possible the mine should be moved to outside the search zone (the white box), so it can be made safe

To identify dangerous red mines, the robot should:

- Stop for at least 3 seconds, within a 5cm of the mine
- Give a LED signal to identify that this is a dangerous mine (e.g. a Red LED)
- Provide the x,y co-ordinate of the mine detected (to within +/- 10cm accuracy)

Team Allocations

- Team work is crucial!
- Teams predetermined based on your sub-team choices at registration
- Choose a team leader
- Sub-team composition is flexible within a team (discuss within team)

M201 SEs 26 jg851 Guo,J. CHU
M201 SEs 26 sh952 Hu,S. CHU
M201 MEm 6 drh52 Harwood,D.R. PEM
M201 MEm 6 dtb34 Barlow,D.T. PEM
M201 ESe 12 jg854 Gnanakumaran,J. SE
M201 ESe 12 sjp230 Park,S.J. SE

M202 SMs 29 ad895 del Ser,A. CHU
M202 MEs 29 maab3 Bin Affian,M.A.A. CHU
M202 EMm 5 jsa41 Allen,J.S. PEM
M202 MEm 5 th539 Hadjimatheou,T. PEM
M202 SEe 32 cv334 Vogdanos,C. SID
M202 ESe 32 jjrr2 Ruaux,J.J.R. SID

M203 ESs 16 phmn3 Nunn,P.H.M. CL
M203 SEs 16 zxyt2 Tan,Z.X.Y. CL
M203 MEm 36 acyl4 Lam,A.C.Y. G
M203 EMm 36 amgl3 Loubens,A.M.G. G
M203 ESe 4 tk520 Kosteletos,T. PEM
M203 ESe 4 zal22 Lambert,Z.A. PEM

M204 SEs 11 hz337 Zheng,H. SE
M204 ESs 11 rs966 Shao,R. SE
M204 MEm 17 jb2160 Bradley,J. CL
M204 MEm 17 jh2121 Hwang,J. CL
M204 ESe 24 tg415 Guo,T. CHU
M204 ESe 24 zs323 Song,Z. CHU

M205 SEs 18 laja2 Anderson,L.A.J. CL
M205 ESs 18 tcac2 Crossley,T.C.A. CL
M205 EMm 33 styw2 Wong,S.T.Y. SID
M205 MEm 33 zhk25 Keh,Z.H. SID
M205 MSe 38 hgj24 Jenkinson,H.G. G
M205 EMe 38 mc2022 Chakrabarty,M. G

M206 SMs 22 pe272 Eagling,P. CHU
M206 ESs 22 wjw27 Wong,W.J. CHU
M206 MEm 40 fml34 Lopes Marques Estaca,F.M. G
M206 SEm 40 jw2002 Wu,J. G
M206 EMe 10 acgr2 Rigby,A.C.G. SE
M206 ESe 10 bdm31 Moore,B.D. SE
M206 SM 15 rve21 R.V. Earl MUR

M207 EMs 7 ccn28 Norwood,C.C. PEM
M207 SEs 7 tkc26 Chung,T.K. PEM
M207 MSm 23 ap2021 Papadopoulos,A. CHU
M207 MSm 23 at771 Theocharous,A. CHU
M207 ESe 31 ajs320 Smallwood,A.J. SID
M207 SEe 31 av502 Vuolo,A. SID
M207 AAs 21 aw765 Wardle-Solano,A. CL

M208 SEs 2 hz336 Zhou,H. PEM
M208 SEs 2 yh402 Hou,Y. PEM
M208 MEm 25 ac2150 Chellappa,A. CH
M208 EMm 25 hiww2 Wright,H.I.W. CH
M208 EMe 35 abp33 Poland,A.B. SID
M208 ESe 35 ama86 Athar,A.M. SID
M208 MEm 9 kjb83 Bassil,K.J. SE

M209 SEs 1 csy22 Yeo,C.S. PEM
M209 MAs 1 ig348 Grega,I. PEM
M209 MEm 27 ck537 Kenyon,C. CHU
M209 MEm 27 em702 Morrin,E. CHU
M209 ESe 39 da460 Alexandridis,D. G
M209 EMe 39 es758 Saunders,E. G
M209 SEs 21 pt404 Tower,P. CL

M210 MAs 14 gm600 Mba,G.O. MUR
M210 SEs 14 sz359 Zhang,S. SE
M210 EMm 28 hw488 Wallace,H. CHU
M210 MEm 28 mr741 Rapeanu,M. CH
M210 EMe 3 ops24 Saldanha,O.P. PEM
M210 EMe 3 wmc24 Catton,W.M. PEM
M210 SEm 9 zeb24 Bull,Z.E. SE

M211 SEs 19 ajl205 Lezard,A.J. CL
M211 SEs 19 jjp54 Parke,J.J. CL
M211 ESm 8 jtm44 Massingham,J.T. PEM
M211 MEm 8 pjc212 Cumner,P.J. PEM
M211 EMe 34 ooo30 Olawore,O.O. SID
M211 EMe 34 rlj36 Jones,R.L. SID
M211 EMe 30 fs470 Szepkuti,F. CHU

M212 MSs 13 hfc38 Chang,H.F. SE
M212 SEs 13 shc49 Chawla,S.H. SE
M212 MSm 20 mv448 van der Lande,M. CL
M212 EAm 20 ptrr2 Rowe,P.T.R. CL
M212 ESe 37 ns723 Sun,N. G
M212 ESe 37 rs967 Streltsov,R. G
M212 ES 15 ek471 E. Kemmish MUR

Project Management

- Communication between the team is key. Although you may use sub-groups, this is an integrated challenge.
- Consider using slack/messenger or other tools for communication and organisation, google docs could be useful for group presentations

- Make sure you have a team leader
- Plan the time (Gantt chart) set realistic goals. Leave enough time for integration

Make sure you attend the project management lecture, today 2pm in LR4.

Documentation

- Task Sheet (Hard copy)
- Lab Summary (Hard copy)
- Moodle (for parts list/online submission)
- Online documentation

https://jaehughes.github.io/IDPDocs/

Please make sure you read through this documentation. Some parts of the documentation are still to be added.

Work Areas

EIETL

- Main base for the project – team desks
- Electronics work desk
- Competition Tables
- Some mechanical parts

Open 8 – 5pm

Dyson Centre

- Workshop Area
- Laser cutting + 3D printing
- Metal working facilities
- Technician Support during technical sessions and afternoons 2-4:45

Open 8 – 5pm. ***Out of hours access required for work outside this area (see Dyson centre website)***

DPO

- Clusters booked during IDP timetables sessions

You must sign in for each session in the EIETL before 5 past the hour by using the card reader to not loose marks! Check your card works today!

Introductory Lectures & Talks

Project Week	Day	Activity
Week 1	Thursday	**9:00:** Introduction Session, *EIETL Projector* **14:00:** Project Management Lecture
	Monday	**11:30:** Workshop Introduction (Teams 1-6), *Dyson Centre* **11:30:** Software Introduction (All teams), LR3B **11:30:** Electrical Introduction (All teams), *EIETL Projector* **12:00:** Laser Cutter Introduction (Teams 1-4, 1 person per team), *Dyson Centre* **12:15:** Workshop Introduction (Teams 7-12), *Dyson Centre* **14:00:** CAD + Rapid Prototyping Introduction, *Dyson Centre*

- Laser cutting 1 person per group pre-booked. If you can't make these times, try swapping with another team/let us know
- If you wish to book further laser cutting sessions visit the Dyson Centre website

Schedule

Start early – don't wait until it is to late!

Project Week	Day	Activity	Deadline
Week 1	Thursday	**9:00:** Introduction Session, *EIETL Projector* **14:00:** Project Management Lecture	
	Monday	**11:30:** Workshop Introduction (Teams 1-6), *Dyson Centre* **11:30:** Software Introduction (All teams), LR3B **11:30:** Electrical Introduction (All teams), *EIETL Projector* **12:00:** Laser Cutter Introduction (Teams 1-4, 1 person per team), *Dyson Centre* **12:15:** Workshop Introduction (Teams 7-12), *Dyson Centre* **14:00:** CAD + Rapid Prototyping Introduction, *Dyson Centre*	
	Tuesday		**First Presentation,** find the timetable and room allocation here
	Wednesday	**12:00:** Laser Cutter Introduction (Teams 5-8, 1 person per team), *Dyson Centre* **14:00:** Laser Cutter Introduction (Teams 9-12, Dyson Centre)	
Week 2	Thursday		**First Report Due**
	Monday	*Feedback on 1st Report returned to teams*	
	Wednesday		**Deadline for Design Acceptance**
Week 3	Thursday	System Integration Presentation. Quick 5 min update to present the integration progress/challenges	
	Monday		
	Wednesday		**Functional Demonstration Deadline**
Week 4	Thursday		
	Monday		
	Wednesday	AM: Last scheduled session	**2pm: Final Presentation & Competition**
Week 5	Monday		**Final Report Deadline. Submit on Moodle.**

Laser Cutting Training Schedule

Lasts 1 hour – 1 ½ hours, meet in the Dyson Centre by the laser cutters

- Monday, 12 : Teams 1 -4 (1 team member per team only)
- Wed, 12 : Teams 5 -8 (1 team member per team only)
- Wed, 14 : Teams 9 -12 (1 team member per team only)

Please let us know names of those who will be attending the session by the end of todays session!

For other people to book training sessions visit:
https://www.dysoncentre.eng.cam.ac.uk/laser-cutting

Assessment

Assessment	Weighting	Deadline
Initial Presentation (Group)	10%	Week 1, Tuesday
Initial Report (Group)	10%	Week 2, Thursday
Design Assessment (Sub-Group)	5% [2% if deadline missed]	Week 2, Wednesday
Functional Demonstration (Group)	5% [2% if deadline missed]	Week 3, Wednesday
Competition Performance (Group)	20%	Week 4, Wednesday
Final Presentation (Group)	20%	Week 4, Wednesday
Robot Quality (Sub-Team)	10%	Week 4, Wednesday
Final Report (Individual)	20%	Week 5, Monday

- Some group, sub-team and individual marks
- Assessment criteria will be uploaded to the online documentation

First Presentation/Report

First Presentation: First Tuesday

- Brief overview describing overall design concept
- Why any design decisions have been made
- Any experimental tests of ideas/concepts
- Project management/Gantt Chart

10 minute presentation with 10 mins for Q&A

First Report (Group Report): Submit by Thursday 4pm

- Brief overview describing overall design concept
- More detailed plans of mechanics/electronics/software
- Updated Gantt Chart

Max 6 pages, submit on Moodle.

Feedback will be given on the Monday. Make use of this.

Design Acceptance/Functional Demo

Design Acceptance

- Each sub-team must produce documents detailing their designs
- Get feedback from Demonstrators as you go
- **Electrical** – layout diagrams + circuit diagrams
- **Software/Overall** – overall integration of system + algorithmns
- **Mechanics** – CAD model and appropriate drawings

Avoid doing any non-reversible work before getting design acceptance

Functional Demonstration

- Encourage teams to integrate early!!

Level 1: Move out of the start box and move around avoiding walls
Level 2: Move around and detect a mine (any colour any location)

Competition/Robot/Report Marks

Competition Marks → See competition score sheet

Robot Quality → See advice online. We want to see well constructed systems (not held together with tape!), neat electronics and a well designed system.

Final Presentation → The system developed, how it should work

Final Report (Individual) → Summary of the overall system, summary of students work, assessment of the work and project management.

<u>Structure of Wednesday Competition Afternoon</u>

Each team will have 30 minutes of presentation/competition:

- 10 minute final presentation (on EIETL screens)
- 8 minute competition run
- 5-10 min Q&A why it worked/didn't?

Storage & Team Tables

- Electronic kits, prototyping boards etc. to be kept in labelled Drawers in cabinets in the EIETL.
- Robots under construction and software kits to be kept in labelled Tubs under the playing tables in the EIETL
- Some temporary storage in Dyson Centre

Please try and keep your team tables tidy!

Staff

- Mechanical Support & Expertise:
  Dr. Peter Long
- Software Support:
  - Tim Love
- Electrical Support:
  - Dave Paterson, Eric, Josie

- Assessors
  Dr. Peter Long, Dr. Fumiya Iida, Dr. Seb Savory

- Dyson Centre Workshop Technicans
  - Mark Vining (Fabrication + Metal Work)
  - Kevin Bullman (Laser cutting + 3D Printing)

- EIETL Technicans (Electrical + General Support)
  - Dave Paterson
  - Kevin Barney

& Many Demonstrators

Session 1: Tasks

- Head to the EIETL, find your team table
- Get your group together (you can spread out in the EIETL)
- Agree on a team leader and provisional sub-groups
- Start on concepts for your robots
- Check you card works on the sign-in system
- Decide who will be attending the laser cutting sessions, and let us know.

- Table layout will be updated by Monday
- Team parts will be provided by Monday

Any problems, please come and speak to us!

Contact Points

Any problems:

- First point of call: EIETL – talk to a technician (Kevin/Dave)
- Email Josie (jaeh2), or dave (dip26)

Come and find us as soon as you have any problems/question

Any feedback:

- Come speak to us in a timetable session
- Send us an email
- There is always the department fast feedback

IDP Table Allocations