Integrated Design Project V2.0

In the integrated design project (IDP) teams work in teams of 6 to develop an autonomous robotic system to solve a problem inspired by a real-world challenge. These will required the development of hardware, electronics and sensing and the accompanying control and software systems. Over 4 weeks teams develop a robot and at the end of the project there is a competition to assess the performance of the robots developed.

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

The EIETL is open from 8am-5pm, and can be used during these times. The Dyson Centre is also available for use however there is only technician support (which limits when some equipment can be used) for limited periods. The laser cutter can be used from 8am-5pm, and the 3D printers likewise. If you require out-of-hours access to the Dyson Centre, you must fill in the relevant forms.

It is expected per week you spend twice the scheduled time on this project. You must use your university card to sign in for the lab before the five past the hour official start of the project failure to do so will mean you are not marked as attending the lab. Even when not working in the EIETL you must head there first to sign in.

The full timetable of events and deadlines is given below in the schedule and deadlines section.

Aims & Objectives

The key aim of the project is to develop an understanding of systems design and integration and also project management and team work skills to design and manufacture a system. In particular, this involves:

• developing an understanding for systems design and systems integration.
• appreciate the importance of co-ordinated teamwork and project management.
• apply and integrate the engineering principles taught in Part I.
• understand how to produce detailed design proposals.
• gain experience of building and testing a system once it has been designed.

In this project, rapid-prototyping techniques are used which enables quick development, integration and testing of systems, allowing for multiple iterations of the system to be produced.

Task and Team Allocation

Each IDP cohort has a different task and rules set. A challenge set will be produced for each group, and the current (and existing challenges can be found here):

- Michaelmas 2018, M2 Task

With the team allocations give here:

- Michaelmas 2018 Team Allocations

If you have any questions about the task, please email Dave Patterson (dip26) and Josie Hughes (jaeh2).

Project Management

Team work is key to the success of this project. Teams should elect one team leader during the first session. This is an *integrated* design project. Therefore, the main key elements (mechanics, electronics and software) cannot be considered in isolation, and for successful integration teams members can not just be aware of one of these elements. However, it may be useful to loosely assign two team members to each of these areas, with the understanding that communication and inter-disciplinary work is required. Additionally, the project may require agile distribution of the work force, for example with a greater focus on mechanical first to get a chassis built to enable successful integration. *There is a project management session at 2pm first thursday. Make sure you attend this session.*

Technologies & Approach

In this project, electronics and manufacturing approaches will be use which allow for rapid manufacturing, allowing for design integration and early integration of the system. At the heart of the robot will be an Arduino Mega (or direct equivalent) Micro-Controller which can be programmed in C++. Interface electronics will be created on prototyping board or vero-board, with the Arduinos providing digital and analogue interfaces.

The manufacturing techniques that will be use include:

- Laser Cutting MDF/Plywood
- 3D Printing

These rapid manufacturing approaches will be augmented by using metal parts/cross section, and fastening methods including bolting and glueing. We will also make cardboard available for creating mock-ups of the mechanical systems.

The Arduino software can be downloaded for free, and likewise a student edition of Creo/Fusion 360 CAD software can be downloaded from their website, alternatively Solidworks can be downloaded or USB sticks from the library can be borrowed to install the software. It may be useful to download and use this software on your personal computer.

Resources

Full resources including getting started guides and a list of parts can be found on the resources page here.

Assessment

The assessment of the course has a number of different components. These are summarised below and the weighting and deadline given. Some assessment is performed at a group level, other at a sub-group level (e.g. for the electronics/software/mechanics) and the final report is assessed individually. The weeks of the deadline correspond to the weeks into the project:

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

Detailed requirements and examples of the materials which must be submitted can be found here. Reports and presentations should be submitted online on the IDP Moodle Page, which can be found here.

Schedule & Deadlines

The following table summarises the key activities and deadlines at each session. The weeks refer to the number of week of the project - thus ifs you are doing the project in the second half of the term Week 1 will correspond to Week 5.

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	Thursday	System Integration Presentation. Quick 5 min update	

3		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 sessions have been pre-booked, such that one person from each team is guarenteed a training session. If other team members wish to book other training sessions, the booking link can be found here.

Feedback

Suggestions for improvements in the organisation, structure of this project, choice of hardware and also the task, would be extremely welcome. If you have any suggestions during the course, please feel free to email Dave Patterson (dip26) or Josie Hughes (jaeh2), and we will do our best to make necessary changes. Please also feel free to use the fast feedback reporting mechanism. We will send out a feedback questionaire at the end of the course, we would appreciate all team members returning this promptly.

Contact

Should you have any questions or concerns during the project please in the first instance see a demonstrator who will be there at each lab session, the EIETL Technical Team, or email Dave Patterson (dip26) or Josie Hughes (jaeh2).