

FEEG2001 – 3D Printer Project Outline

Project Overview

The overall aims of this project are to build, program, improve, test and commission a Reprap 3D printer. Figure 1 illustrated an example of such printer. The basic requirement is to build a Prusa Mendel printer (Figure 1 (a)) but you are highly encouraged to build improved versions like the one in Figure 1 (b). There are hundreds of variants designs available. (a) and (b) are just two examples. You are not limited to stick with them.

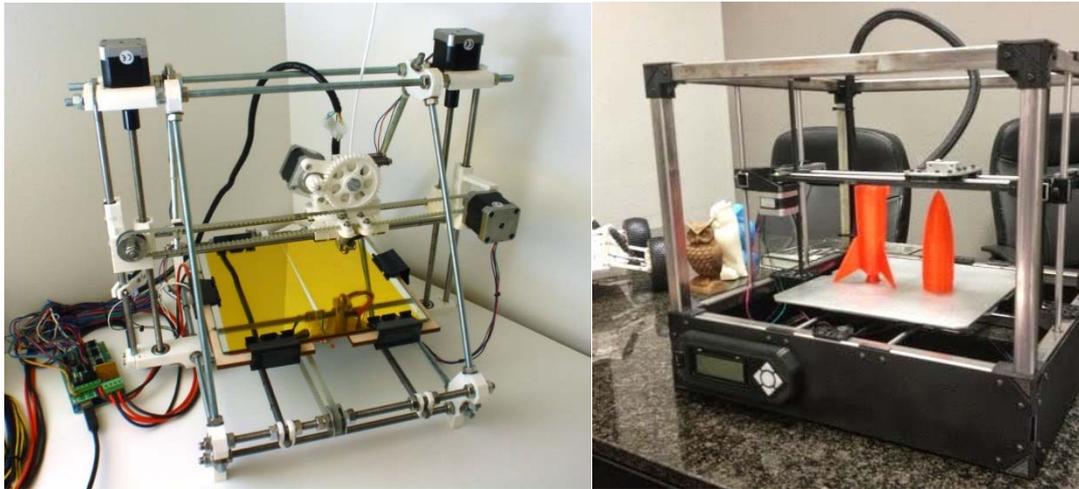


Figure 1 - An example of a reprop 3D printer. (a) Prusa Mendel (b) Rigidbot

Components and Facilities

As part of this project, the majority of mechanical components will be provided along with a number of electronic components. The provided structural and electronic components consist of:

1. mechanical components
 - 8mm stainless steel smooth rods (1x3m)
 - 8mm Threaded bars (6x1m)
 - BZP Steel Mudguard Washer,M8x30
 - Zinc plated steel nut,M8
 - Zinc plated steel plain washer,M8
 - Zinc plated steel hexagon full nut,M3
 - Zinc plated steel plain washer,M3
 - BZP cap screw,M3x20
 - BZP cap screw,M3x10
 - Plywood plates (you need to laser cut them)
2. electronic components
 - Power supply (200w, 12vDC)
 - heated bed
 - limit switch
 - NEMA 17 step motors (5x)
 - timing belt (2x1m)
 - timing pulley (2x)
 - linear bearing (9x)
 - bearing 608zz (6x)
 - motor coupler
 - Ramps 1.4
 - Arduino 2560

A4988 motor drive
A4988 Sink
Hobbed Bolt
Hotend
Cable, connectors, heat shrink sleeves, cable ties
Multiple meters (need to return after project)
Project boxes (need to return after project)

You will have timetabled access to the new Design Studio (56/2003) and the new Design Workshop (13/1055) every Thursday during Semester 2, in order to undertake the work. As a student you will, in addition, be able to use the main engineering workshop and computer labs as required.

3D Printer design

Each group is free the design their 3D printers however they can build. The final design must meet the design criteria and must be able to print 3D parts. The groups are encouraged to start from Prusa Mendel model, for which majority of the components and detailed assembly instruction are supplied.

Design constraints

There are a number of important design constraints which must be met when designing this 3D printer:

1. the provided electronics Arduino 2560 and RAMPS1.4 must be used in the first 3D printer built (It's OK to change to other electronics if you want to change the electronics later.)
2. the printer should be able to print at least 100mmx100mmx100mm
3. the overall size of the printer should be less than 600mmx600mmx600mm
4. the printer must be safe to use
5. the power supply should be wired safely
6. the power supply should be fixed on the printer
7. the electronic system should be boxed and fixed on the printer
8. when you need to build a printer rather than Prusa Mendel, the budget to cover extra components (outside the components we provided) should be no more than £50. To use recycled components are encouraged, for example, a step motor from an faulty home inkjet printer, a ATX computer power supply from an outdated desktop computer, or components from scrap yard, in which case budget constraint would not apply.

The Team

Your design team will consist of five or six members of second year students, who have been selected to work together. You should elect your team leader. Other team members should undertake certain roles as well. I suggest that you select team member roles based on their strengths, interests and likely contribution to the success of the project.

Note: The team leader can be replaced **at any time** by the majority consent of the team.

Assessment Scheme

A total of 80% of the module mark for FEEG2001 will be assessed during this exercise with the remaining 20% from the lab sessions attended during Semester 1. The remaining 80% will be broken down as follows:

- 10% - Conceptual Design Report – Week 2
- 20% - Interim Design Review – Week 5
- 20% - Final project report and presentation
- 30% - 3D Printing Competition

A peer review form **must** be filled out by each team member at the end of the project. This will be used to **scale** the final mark for each team member.

Conceptual Design Report (10%) – Week 2

Each group must provide an initial conceptual design report by Week 2. This report should be around 5-6 pages in length and contain the following:

- Name of the team and a list of team members and their roles on the project.
- Literature review different 3D printers, outline the pros and cons.
- Concepts the 3D Printer to be built in this project, including mechanical support system, XYZ motion systems, step motors, motor drives, limit switches and role of the electronics. A final design concept does not have to be selected at this stage rather the report is used to outline those concepts ruled out and those to be investigated further.
- Organization – An A3 Gantt chart using MS Project – outline what will be done, when and by whom (folded correctly to A4).

The report should be handed in to the school office by **4pm, 14th February, 2014**.

Interim Design Review (20%) – Week 5

Each group will attend a design review meeting with a number of staff members during Week 5. At this meeting they are expected to present a short PowerPoint presentation illustrating all progress to date including:

- The final design concept and why it was selected.
- Any design analysis performed to date on the design.
- Progress against the project plan outlined in the conceptual design report.

As part of the review, groups are free to bring with them any physical components already manufactured and/or any control systems developed up to that point. The presentation must last no longer than 10 minutes and will be followed by a further 10 minutes of questions.

Final Project Report (20%):

The final project report should be either a detailed website/blog, or a joint report between all group members and be no more than 30 pages in length. The report should be handed in to the school office (if website/blog, the majority of the website should be printed to avoid further updating) by 4pm 16th May 2014 and can contain:

- Details on the conceptual design study and selection of the final design
- Details of any design analysis performed on the final design
- A description of printer assembling and fabrication process
- A description of the firmware set up and any testing performed

- A costing report
- Future design improvements
- An analysis of the print test results
- Any other information that the group feels is relevant to the design and development of their printer

Competition Rules & Scoring (30%):

The printing competition will be held at design studio during weeks 12 of the second semester. Each team will be given a total of 2 hours to perform two printings:

- Printing 1: a test model will be given to all groups to test speed, dimension accuracy, surface finishing and structure integrity (5%)
- Printing 2: the group can print anything on site which they believe can impress the judges (5%)
- Printing 3: the group can bring anything which were printed using their printer before the final competition to impress the judges. Pictures evidence need to be provided to prove the parts were actually printed on their printer. (5%)

In addition to each of these printing tests, each printer will also be evaluated by the judges based on:

- The printers adherence to the design constraints (2%)
- The neat and aesthetic of the printers (8%)
- The safety of power supply and electronic components (5%)

The judges and Jury

The judges and jury are appointed from academic staff (weighted 40%) and all of the students involved in the 3D printer project (weighted 60%).