ADDITIVE MANUFACTURING WITH REPRAP METHODOLOGY: CURRENT SITUATION AND FUTURE PROSPECTS

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i. Introduction to RepRap community

- Fused Deposition Modeling (FDM)
- Self-replicating
- Open source
- Adrian Bowyer, University of Bath (2004)
- Fused Filament Fabrication (FFF)
- GPL version 2 licence
- RepRap machines → surnames of famous biologists
ii. RepRap models and features

FEATURES

- FFF machines
- Thermoplastic compounds (ABS; PLA)
- 4 models with different versions
- Accuracy of the models: 0,4 – 0,5 mm

MODELS

- MENDEL
- DARWIN
- HUXLEY
- WALLACE
COMPONENTS BY TYPE

- Plastic components
- Non-replicable structural components
- Electronic components
- Software

iii. Basic components of RepRap machines
COMPONENTS BY FUNCTION

- Support structure
- Y axis
- X axis
- Z axis
- Extruder
- Print bed/heated bed

iii. Basic components of RepRap machines
COMPONENTS BY FUNCTION

- Fusor
- End stop sensor
- Microcontroller
- Stepper motor/stepper driver
- Software
- Thermoplastic filament

iii. Basic components of RepRap machines
iv. User and exchange communities

- Knowledge and experience ➔ Print system improvement
- Exchange platforms of 3D models: Thingiverse, Rascomras, The Pirate Bay,..
- Clone Wars Project
- FabLabs: USA (+30), Holland (9), France (8), Spain (7), Germany (6).
v. Difficulties, development and assembly of a RepRap machine

RepRap Mendel Prusa + modifications

Which modifications?

a) Much more powerful controller: Arduino ➔ Beaglebone

b) Communication with RepRap: HTTP server installed on the new controller

c) STL ➔ GCODE without external help

d) Print structure improving

RepRap Azara
This controller change has involved the development of:

- An expansion plate of Beaglebone, with capacity to control stepper motors, heaters, end stop and temperature sensors.
- A new resident software driver (firmware), which is capable of transforming the GCODE commands into motor movements, control temperatures, etc.
- A web server, allowing calibration, the sending of three-dimensional design (STL) files or GCODE files, direct control of motors and temperature, etc.

v. Difficulties, development and assembly of a RepRap machine
The new design has also added advantages which are linked through a web server using:

- The printer can be used directly from any computer connected to the local network.
- The printer may be used at a distance, by configuring the router that connects it to the internet.
- A remote printer management can be done, which facilitates the maintenance of the machine.

v. Difficulties, development and assembly of a RepRap machine
vi. Improvements and possible application fields

- Edit the thermistors tables from the browser, and access to the complete skeinforge calibration.
- Add an user control to the web page. If you log in as an administrator you can manage print permissions, change of tail order, calibration, etc.
- Create a remote administrator of the machine which access a log to be able to monitor the printed parts, changes, problems, etc. This remote administrator may be used to diagnose remote problems suffered by the printer.
- Add camera video, that could be used as a complement to the remote administrator, or to visualize at a distance the progress in the printing of the pieces. The images would be transmitted by the website of the printer.

IMPROVEMENTS THAT CAN BE DEVELOPED:

- ADDITIVE MANUFACTURING WITH REPRAP METHODOLOGY
IMPROVEMENTS THAT CAN BE DEVELOPED:

- Improve the algorithm that makes movements in the printer to achieve more appropriate speeds and accelerations.
- Vary the design of the RepRap MendelMax, made of extruded aluminium profiles.
- Add an emergency button which instantly cuts the movement of the machine.
- Modify the expansion plate to allow a touch screen connection. In this way, you can completely manage the printer without having to connect to its website.
- Develop a simple visualization software to facilitate the use of this type of machines to users without technical knowledge.
vi. Improvements and possible application fields

**APPLICATION FIELDS:**

Architecture, industrial design, engineering, robotic, education, toys, jewelry, medicine, feeding

ADDITIVE MANUFACTURING WITH REPRAP METHODOLOGY
vii. Conclusions

- Low-cost, self-replicating, GPL license, ease of assembly, existence of user and exchange communities,... but less precision than other 3D printers.

- The RepRap technology will allow many small companies and engineering or architecture studies to have their own prototyping machine.

- The RepRap machines still have a long way to go on improvement and research fields. That is the reason why the people working in this area is increasing.