**Building a 3D printer**

An Automatic Manufacturing Systems I. project

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Purpose and introduction:

Trying to solve problems with thinking and creativity instead of just living from the mercy of luck it soon became obvious that the mind can have wings but the material is constrained to physics and is hard to bend to our will. There were blueprints I had to make that would take months to be realized with manual labor. Creating something unique, something new often involves parts that cannot be found in stores. An automatic manufacturing systems engineer candidate could only escape this problem by changing course. So I thought would be wise to create something that can be used to create parts like these. Of course owning a machine that could substitute work and produce profit seems also beneficent on its own.

3D printing is a relatively new technology as the first 3D printer was made in 1984. It developed in close relation with material science and electronics. Immensely high prices of the technology were pushed down by now as it became more widespread. There are 12 established ways of 3D printing. As of 2016 from edible chocolate through spaceship parts functioning and implanted human organs were printed. Some consider DNA printing also a 3D printing process. Despite these successes the technology still lacks several improvements and is in its infancy.

Requirements:

My main goal is to create a 3D printer, the outcome of a 3D printer development can be the combinations of nothing, destruction and printing. The parts that a 3D printer prints define the printers the most. Lacking resources like high precision machining, time, hard to obtain and/or expensive materials DNA printing and spaceship parts are out of question. I set myself an easier achievement as a requirement for this project by intending to print out a plastic matchbox car that:

* Stays in one piece when hold in hand.
* Accurate to its blueprint to a level of +/- 1 mm/cm tolerance.
* In two hour.

If these conditions are fulfilled then I have a “decent” printer. The measure of a 3D printer can be its accuracy, its speed, and the physical properties of the workpiece it can produce. These are a compound result of electronic solutions, mechanical accuracy, chemical reactions and external physical actions, so the goals set above are considered ambitious for a solo project.

Features:

My 3D printer will have a cartesian coordinate system axis set. Will be able to use 1,75 mm plastic filament as the printing material. Will print from a computer using a data connection. Will use a common CAM file format, and a common communications interface. Additionally it will have a detachable print head for the functionality of extension/conversion of the device to a CNC router machine in the future.

Functional description:

plastic filament

CAM file

electricity

3D

PRINTER

INPUT:

OUTPUT:

MY DEVICE:

Figures of the setup/architecture:

X axis

Z axis

Y axis

plastic filament

filament holder

heated injector

heated bed

The basic conception:

Electrical and electronic block diagram:

CONTROL

CIRCUIT

G code

interpret-er

PC

CAD/

CAM

software

PSU

X axis

power

electronics

Y axis

power

electronics

Z axis

power

electronics

XYZ Axis end stop

sensors

Injector heater

pow. el.

Bed heater power electronics

X axis

stepper

motor

Y axis

stepper

motor

Z axis

stepper

motor

Injector heater

module

Bed heater

module

Injector heater

sensor

Bed heater

sensor

E-STOP

230V (AC)

5 V DC

12 V DC

230 V AC

230 V AC

DCOM1-5

SENS

0-2

DCOM0

PREG1-5

Verification (test) against requirements:

These 3D printers are basically robots that manipulate objects in space. Their most crucial part is their linearity, if they have uncompensated flexibility in them it is easy to see that they will manipulate the objects inaccurately, in this case resulting in inaccurate 3D prints. Even with the largest care taken during the project there will be some inaccuracy left in the system. The role of the 3D printed part defines the tolerance of it. I estimate my 3D printer will be turn out decent enough and will have of +/- 1 mm/cm tolerance. I will measure this with a caliper and document it.

If I can take the printed matchbox in my hand it also fulfills a criteria. A photo will be made from it for the documentation. This test looking to be childish at the first glance is very important because fused deposition of materials can result in the material being struck to the workspace, in this case the printer bed. Also improper layer deposition because of level mismatch and temperature errors can result in separation of layers. So there is a very high possibility that the print will not be staying in one piece.

The other factor is the time, which is by the 3D printers inversely proportional to the accuracy of printing. More complex prints can take days even with commercial machines. Time will be measured via a stopwatch and also to be documented.