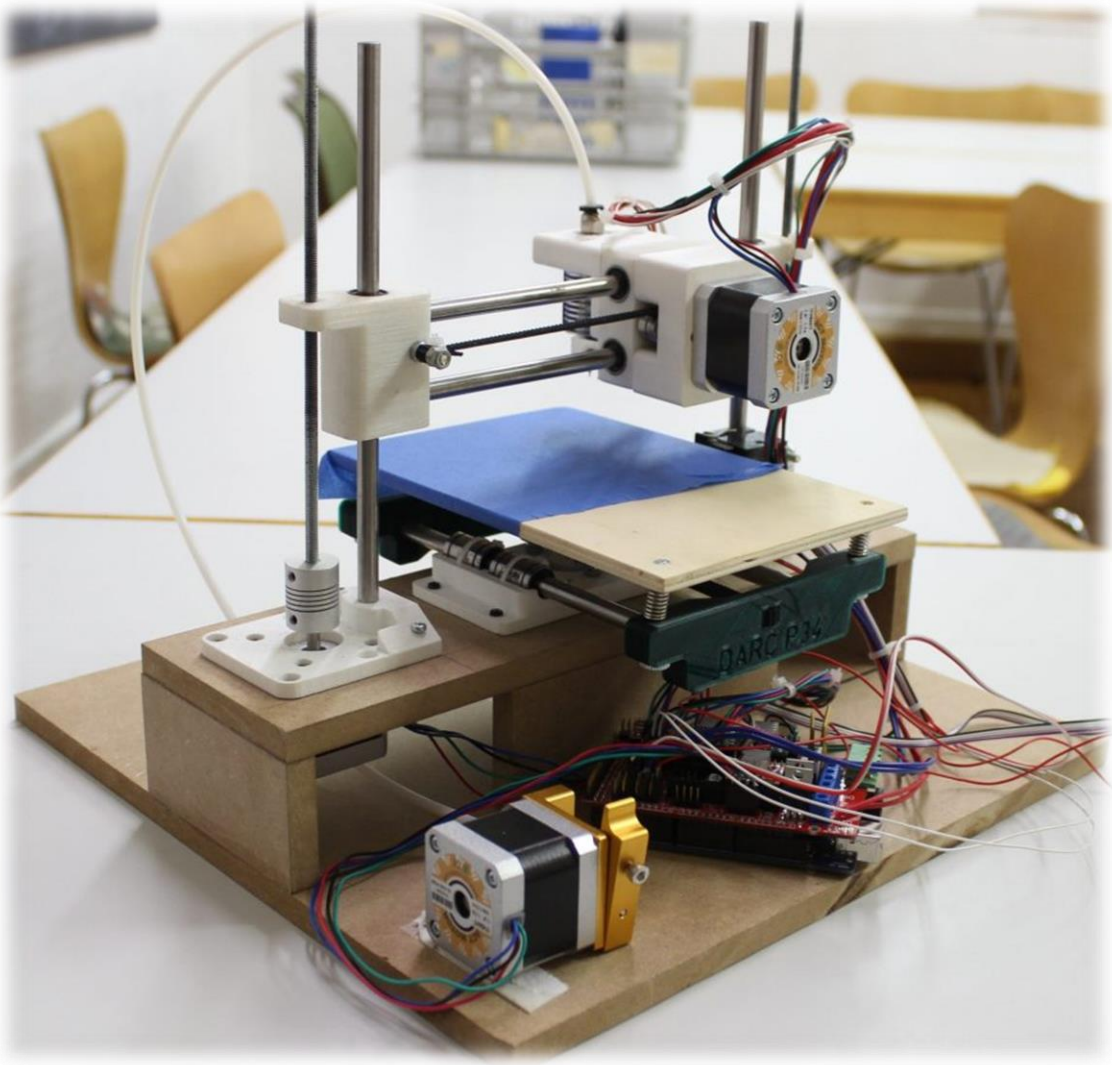
Documentation Cherry 3D-Printer



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Introduction

On the internet we found building instructions for a 3D-printer with an estimated price of 60€.

http://www.instructables.com/id/Cherry-60-3D-Printer/

This printer really impressed us and so we deiced to build two printers of this kind as well. In this report we want to describe our experiences with the build an the printer itself.

The modifications we sucessfully applied to the printer to increase the price performance ratio even more. @@@ Bitte beachtet hierzu unbedingt den Abschnitt ***Fehler! Verweisquelle konnte nicht gefunden werden.***.

Material

Elektronics

Amount	Description	Price	Total
1	Power supply Meanwell LPV-60-12	16,00 €	16,00 €
1	Arduino MEGA 2560 R3	16,07 €	16,07 €
1	RAMPS 1.4	^	
4	A5988 Stepper motor driver	^	
5	ACT Motor GmbH Nema17 17HS4417 stepper motor 1.7A 40mm 4000g.cm	9,95 €	49,75 €
3	Micro switch	1,15 €	3,45 €
			85,27 €

Also we required some additional wires, solder and cable ties.
The motor drivers that have been killed while testing are not included.

Mechanic

Amount	Description	Price	Total
1	MDF Baseplate 30x34x1cm	0,82 €	0,82 €
1	MDF Core board 34x10x1cm	0,28 €	0,28 €
2	MDF Baseplate 5x10x1cm	0,04 €	0,08 €
1	MDF Baseplate 5x15x1cm	0,06 €	0,06 €
1	Extruder E3D V6	7,48 €	7,48 €
1	Extruder clamp for PFTE-Tube	0,42 €	0,42 €

2	Flexible shaft coupler 5mm/5mm	2,84 €	5,68 €
12	Linear bearing LM8UU	0,47 €	5,64 €
1	PFTE-Tube for 1.75mm-Filament	1,08 €	1,08 €
10	Ball bearings 624	0,15 €	1,46 €
1	MK8 Extruder gear	0,76 €	0,76€
1	GT2-6 belt 2m	3,09 €	3,09 €
2	GT2-6 pulley	^	
1	Extruder spring 31mm, Ø7,5mm, 0,9mm thick	1,98 €	1,98 €
2	Threaded rod M5		
2	Stainless steel rod Ø8mm, 220mm		
2	Stainless steel rod Ø8mm, 175mm		
			28,83 €

Not included in this price list are screws, nuts, washers that we took out of our workshop.

The prices fort he printed parts including the misprints are not listet since this is hard to calculate.

Remarks

We bought normal steel rods, but it is important to have them polished and deburred, so that the linear bearings will glide smoothly. Please do not use sandpaper since this will only make it worse.

Software

Firmware

We're using the current version of Repetier (0.92.x).

Control software

To control the printer via a PC we decided to use the Repetier Host-Software.

The biggest advantage of this combination is, that we can modify internal settings of the printer in this software directly.

So we were able to easily test different printer speeds to get the fastest prints whilst keeping the print quality and reliability at its highest.

The PC or laptop that is used to control the printer should never fall into sleep mode, otherwise the printer will not get any further commands and therefor the print will be screwed and the printer will keep it's temperature for a unnecessarily long time which could be dangerous.

Printer server

Since it is not always possible neither useful to have a full-sized pc running to control the printer, we used a Raspberry PI running “Repetier Server” on the HAM-Radio.

By doing so the printer can be controlled and monitored by various devices.
Also all printing models can be saved on the server to make the use even more convenient.

Slicer

Since we (at first) did not like the slicer that’s built in into the Repetier Host software we decided to get started using Cura.
We especially liked the clean user interface of Cura.

Thanks to the experience of some of our OMs we were able to fast get some good-looking results.

Preparation

Printed parts

The parts used to build the first printer where printed on a K8200 made by Vellemann.

The Mounting pieces for the Motors aswell as the base parts for the Z axis did not cause any problems.

Since none of the parts was optimized for the printer, the pieces containing the linear bearings had to be corrected a bit. We did so by the use of a drill press and a 15mm forstner drill, which seem to be not too easy to come by.

After these minor adjustments the pieces fit nice and snug.

The most difficult parts to modify where those using two linear bearings in series.
After drilling the holes the pieces fit, but the alignment was a bit off so the construction was not moving as planned.

We corrected that by carefully heating up the parts using a heat gun on the lowest setting.

Assembly

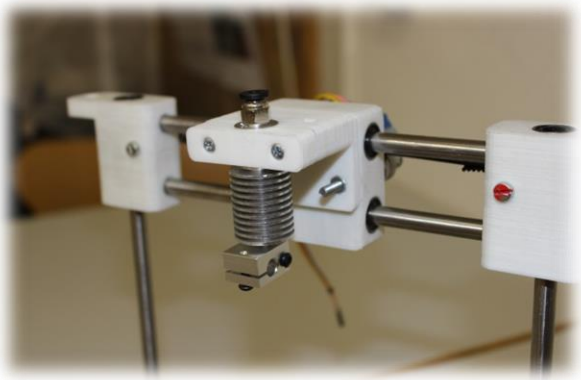
Baseplate

The construction was done using 10mm strong MDF wood. The cross beam was glued exactly in the middle of the 30 x 34cm big baseplate.

To get a bit more stability we also decided to increase the width of the cross beam to 10cm in contrast to the 6cm of the original build.

Since we're using Nema 17 motors we also increased the stand offs to 5cm, to get sufficient clearance for our motors. Therefore the stand offs are now 10x5cm and 15x5cm in size.

X-axis



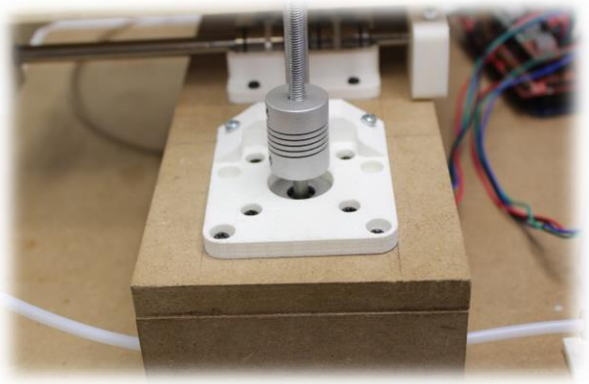
The print head was mounted according to the instructions. For easier handling we removed the fan and heater.

When attaching the timing belt, always make sure that they are properly tensioned.

If the timing belt is straight and does not warp, the tension is sufficient.

To check if the belt is tensioned enough after mounting everything you can press against the print head (when the motor is powered). The assembly should only move a tiny bit (in out case it was less than half of a millimeter).

Y- and Z-axis



At first the motors for the Y- and Z-axis where equipped with motors and then mounted on the wooden base.

To do so the ball bearings already containing a matching rod where strapped to the Y-Plate using cable ties.

Also the ball bearings for the belt of the Y-axis were mounted to the plate as well as the pulley was mounted to the motor.

The finished assemblies then where mounted to the wooden base using wood screws.

After doing so we mounted the Y end caps but it is recommended to do so before screwing everything together so you don't apply unnecessary force to the rods.

Lastly the belt for the Y-Axis was added by tensioning them by hand and locking them in place with cable ties at the Y end caps.

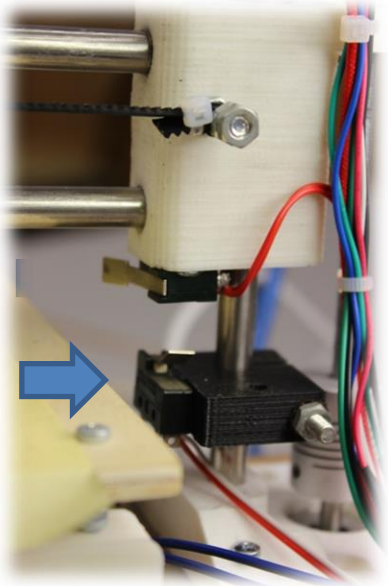
Just like on the X-Axis you have to make sure the tension of the belt is sufficient.

Since we increased the width of the cross beam to 10cm, we sanded the Y end pieces a bit to make sure that they would not touch the beam.

End stops

The end stop of the X axis was mounted on the bottom of the guide for the Z-axis. [1]

For the Z-axis we printed an additional part that was screwed to the rods so we could easily reposition it. [2]



[1]

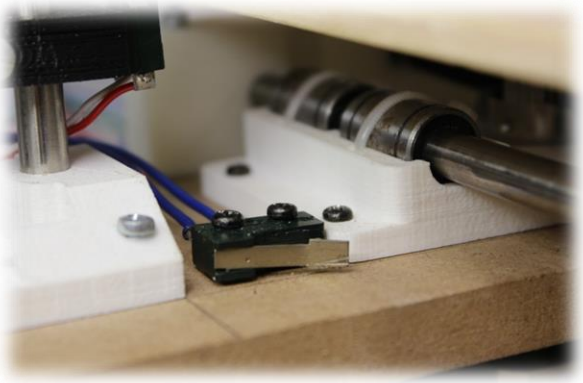
[2]

The Y-end stop was mounted directly to the cross beam next to the Y-carriage. [3]

This construction allows the printer to use most of the space available – in this case 10cm.

After adding our print bed adjustment we had to move the Endstop onto the Y-carriage. [4]

[@@@ end stop-Position after redesign]



Wires and chaos

To make the printer look cleaner and more professional we used spiral tubing to get the wires look more tidy.

[@@@ image of final printer missing]

Commissioning

First tests

To test if the hardware was working correctly we first moved all the axis.

It's important to know that the printer will start, thinking it's in its zero position.
This means you can not lower the Z-axis or move the X-axis to the left.

Homing the axis via the software will correct the position so the printer can be moved freely.

If your motors are spinning the wrong way just give the connectors on the ramps board a 180° spin.

First prints

As a first printing object we used a 12x12x12mm cube, since this reveals a lot about the settings of the printer.

If this cube will be printed nicely your settings are fine for nearly everything else.

As a print gets bigger the speed of the printing can be increased.
How much the speed can be increased can be found out by doing some test prints.

Configuration (Cura)

[@@@ Konfiguration (Cura) beschreiben]

Configuration (Printer firmware)

[@@@ Konfiguration (Druckerfirmware) beschreiben]

Imprivements

Print bed-adjustment (Rev. 1)

Since no construction is 100% flat, we added two nuts to adjust the print bed.

The upper nut held the screw fixed to the print bed and the second nut was used to raise or lower the bed to make it level.

By the use of a small wrench the print bed was easily adjustable.

After some prints re realized that this construction was tended to bob.
In addition to that it is not very handy to always require a wrench next to the printer.

So we designed a better way to adjust the bed.

Print bed-adjustment (Rev. 2)

To simplify and improve the way of adjusting the bed we just modified the Y-end pieces, so that the adjustment could be made by turning on knurled thumb nuts.

For this the newly designed part was printed, the screws in the print bed were replaced by longer ones, springs where put between the bed ant the Y-end piece and then the screws where equipped with the knurled thumb nuts.

After that the print bed was mounted properly and did not move more than we wanted it to.

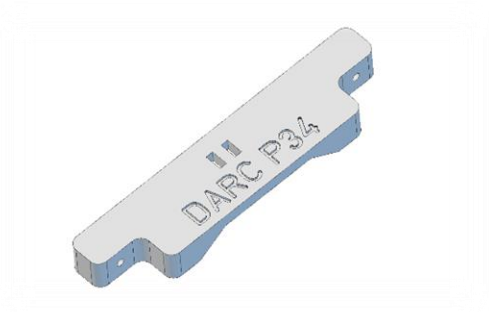
In the end this construction is very similar to many high end printers.

The cost of this addition is about 90 cents and well worth it.
As written before the end stop of the y axis had to be moved.

In our first apptempt we used springs of 7,5/5mm x 20mm and a wire diameter of 1.2mm.
These springs are pretty strong and are not recommended when using small knurled thumb nuts.

This modification has proven to be very useful.

Die Erweiterung an sich hat sich jedoch nach einigen Tests als sehr sinnvoll erwiesen.



Das fertige Teil könnt ihr auf unserer Internetseite herunterladen.

Size of print bed

In generall we recommend to increase the print bed by 50mm.

This will mean we'll have a printable area of about 150x100x100mm and we're able to print all the parts for such a printer using this printer.

By doing so you can help others build their printer or you can print some spare parts for yourself.

Problems

Motors

We were not able to get the motors mentioned in the original instructions to run for mire than 2 seconds.

If this was caused by a design/quality problem or some screwed up setting is not quite clear.

After we found out that the creator of the instructions also released parts for Nema 17 motors we also decided to use these.

Z-axis

In our printer the printed shaft couplers failed after some prints. This is most likely caused by the high torque and speed of the nema 17 motors.

To get rid of that problem we used flexible shaft couplers for 5mm shafts made from aluminium.

These couplers are mounted by two small screws to the motor shaft as well as the threaded rod.

Abnehmen eines Ausdrucks

Printing on the wooden print bed works like a charm but removing the print will most likely cause damage to the print bed.

Therefor we recommend to always use some tape over the bed to get the print off without destroying the print bed itself.

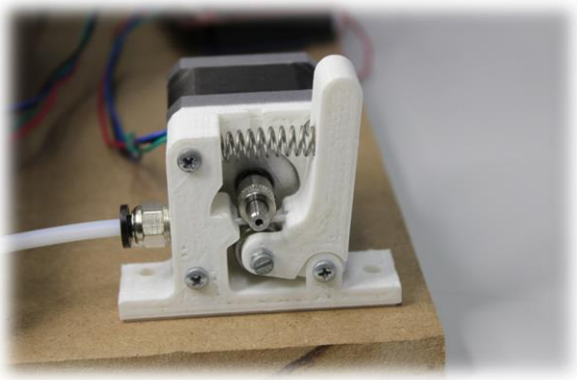
We’re currently working on an improved technique to get your prints of as easy as possible.

Incomplete prints

Sometimes the printer stopped pushing filament or it did not push the filament evenly.

This was caused by the Extruder gear that only had very small teeth and the printed part, that was not able to press the filament to the gear hard enough.

We solved this by increasing the pressure of the lever of the mechanism whichwas achieved by overstretching the spring.

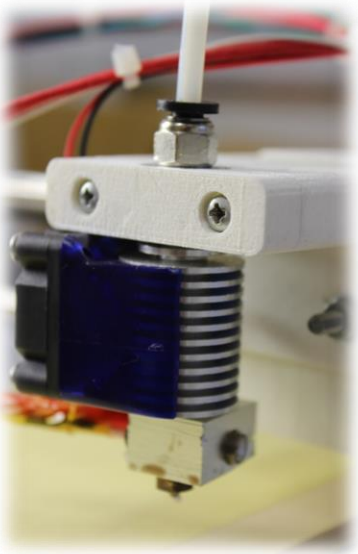


Jammed print head

As we remove the fan from the print head for mounting we sadly did not keep track of it's orientation.

To make sure the cooling won't cause any trouble the fan has to be mounted so, that the flat side of the clip faces the print heads heating block.

Otherwise air turbulences may cause an insufficient cooling of the bottom part.



Conclusion

We were not able to get the printer build for the mentioned price of 60€ due to the bigger motors we used.

The Construction caused several problems, but for a project of this scale that's completely acceptable and expectable.

After some changes of the parts we now got a pretty well working printer for our craft projects.

Even a printing resolution of 0.05mm was tested successfully but may not be useful due to the enormous printing time.

Often asked questions and problems

Problem: Der Druck hält nicht am Druckbett.
Ursache: Der Druckkopf hat zu viel Abstand zum Druckbett.
Lösung: Abstand von Druckkopf und Druckplatte verringern.
Hierzu empfiehlt es sich ein Blatt Papier auf das Druckbett unter den Druckkopf zu legen und beim Einstellen zu bewegen.
Das Papier sollte sich bewegen lassen, jedoch sollte es spürbar am Druckkopf kratzen.

Problem: Der Druck hält nicht am Druckbett.
Ursache: Die verwendete Druckbett-Oberfläche hat schlechte Hafteigenschaften.
Lösung: Verwendung eines (anderen) Klebebands auf der Druckfläche.
Hier bietet sich das „Scotch Tape“ bzw. ein anderes der vielen blauen 3D-Drucker Klebebänder an.

Problem: Der Druck hält nicht am Druckbett.
Ursache: Im Raum herrscht eine sehr hohe Luftfeuchtigkeit oder das Klebeband hat Feuchtigkeit (z.B. während des Lagerns) gezogen.
Lösung: Neues Klebeband aufbringen, ggf. einen anderen Raum zum Drucken suchen.

Problem: Die Wände/Ober- bzw. Unterseite oder das Infill ist nicht ordentlich.
Ursache: Der Drucker kann nicht schnell genug Filament nachschieben.
Lösung: Die Druckgeschwindigkeit reduzieren.

Problem: Die Wände/Ober- bzw. Unterseite oder das Infill ist nicht ordentlich.
Ursache: Der Drucker kann nicht schnell genug Filament nachschieben.
Lösung: Extrudermotor-Getriebe auf Verschmutzungen prüfen.
Bei Bedarf anpressdruck des Filaments an das Getriebe erhöhen.

Problem: Die Wände/Ober- bzw. Unterseite oder das Infill ist nicht ordentlich.
Ursache: Der Drucker kann nicht schnell genug Filament nachschieben.
Lösung: Temperatur des Druckkopfs vorsichtig in 5°C-Schritten erhöhen.
Bitte beachtet, dass PLA niemals über 230°C gedruckt werden sollte.

Problem: Mein Filament ist regelmäßig verknotet.
Ursache: Fehlerhafte Lagerung des Filaments.
Lösung: Wird eine angefangene Rolle gelagert, so sollte das Endstück direkt nach der Entnahme aus dem 3D-Drucker durch eines der Löcher an der Rolle gefädelt oder an selbige geklebt werden, damit sich die einzelnen Layer nicht verknoten können.

Problem: Mein Filament lässt sich nicht mehr gut drucken, vor … Monaten hat’s noch funktioniert.
Ursache: Das Filament hat beim Lagern Feuchtigkeit gezogen und daher die Eigenschaften etwas verändert. Probleme tauchen i.d.R. aber nur bei Filament auf, das über 1 ½ Jahre alt.
Lösung: Beim Lagern von Filament immer eine verschließbare Tüte oder Box verwenden und die Feuchtigkeits-Pads dazu legen.

Problem: Ich würde gerne mit ABS drucken.
Lösung: Vergiss es.

Frage: Wie viel Infill sollte ich verwenden?
Antwort: Das ist Abhängig von der Belastung des Druckteils und der jeweiligen Form.
i.d.R. wird nicht mehr als 25% Infill benötigt.

Contact

If you face any problems while building your printer, sourcing parts or if there are any questions don't hesitate to contact us directly or visit us at one of our meetings.

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