

3D DC PRINTER

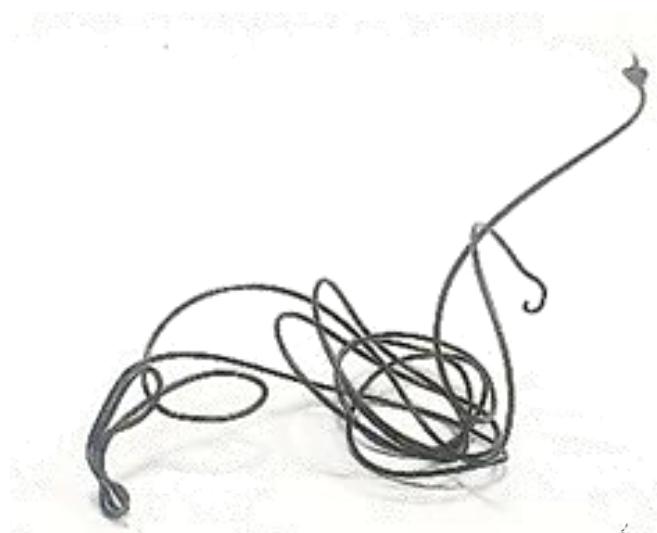
Plastična kirurgija

Goran Popović, Una Pale, Ivan Soldo, Filip Kovačić Popov

Lipanj 2015.

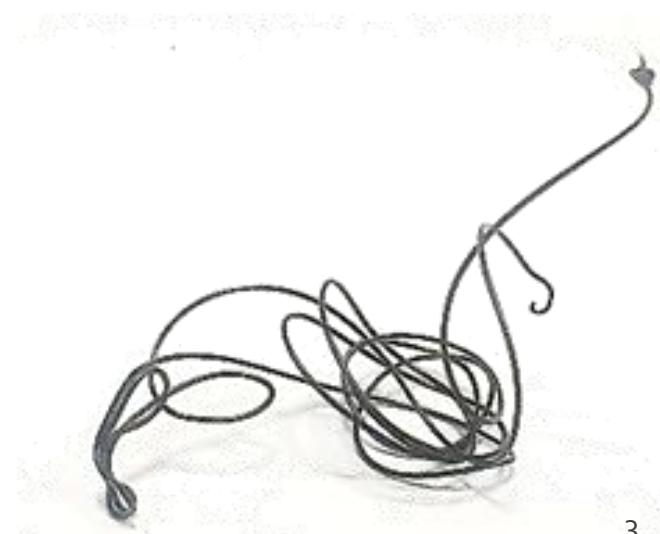
Zašto na elektroboj?

- Želja za izradom **mehanički zahtjevnijeg uređaja**
- Za razne projekte **potrebni dijelovi specifičnog oblika i dimenzija**
 - teško sam napraviti
 - skupo naručiti



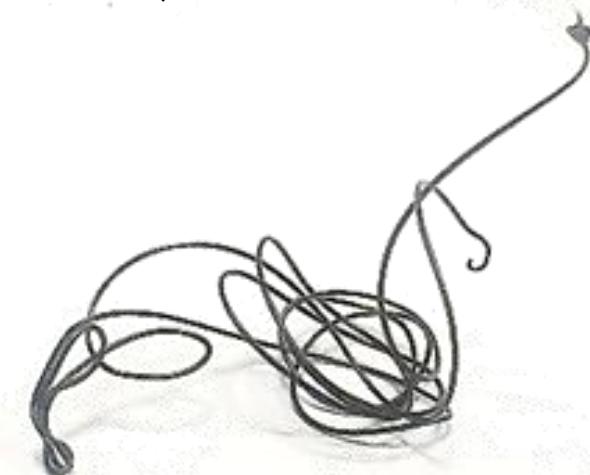
Sadržaj

- 3D printeri
- 3D DC printer
- Opis rješenja
- Električne sheme
- Mehanička konstrukcija
- Upravljanje
- Zaključak
- Planovi



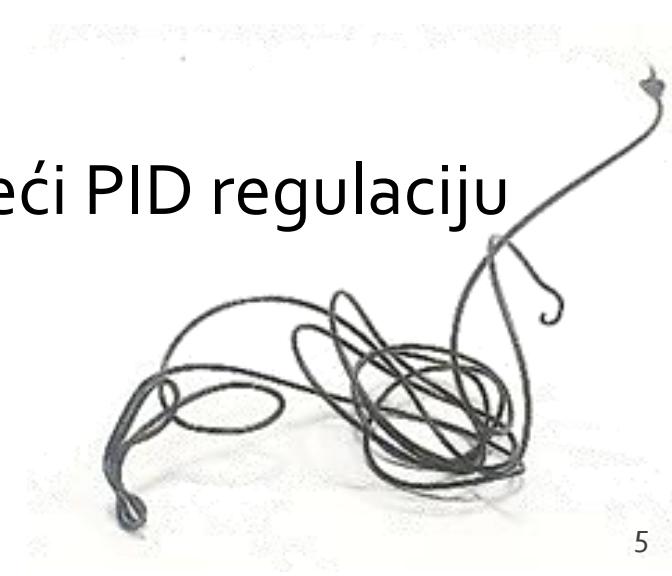
3D printeri

- aditivnom tehnologijom sloj po sloj
 - kod DIY printera je FDM (eng. fused deposition modeling)
- koračni (stepper) motori
 - bez povratne veze
- gotovi razvojni moduli
 - Arduino Mega
 - RAMPS (RepRap Arduino Mega Pololu Shield)
- firmware
- samoreplicirajući strojevi
- problemi trenutnih printera
 - ograničena precizost zbog konstrukcije
 - nema smisla jako precizni motori



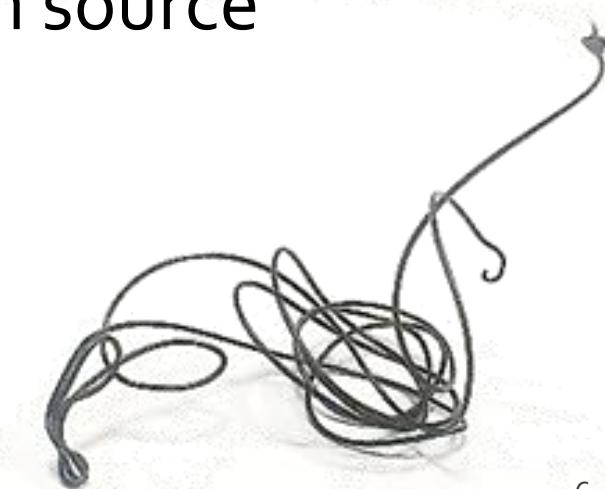
3D DC printer

- enkoderi
 - povratna informacija o stvarnoj poziciji
 - spriječavanje preskakanja koraka
 - veća preciznost
- DC motori
 - kontinuirano gibanje
 - bolja i složenija kontrola koristeći PID regulaciju
 - bolja energetska efikasnost
- nešto novo i izazovno



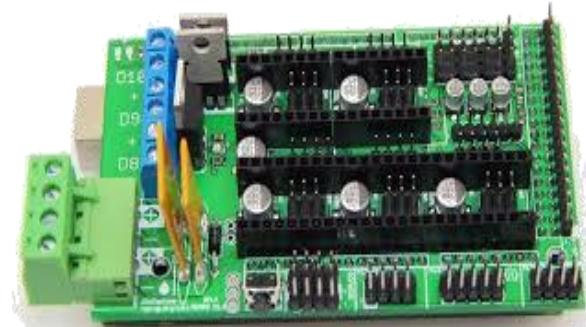
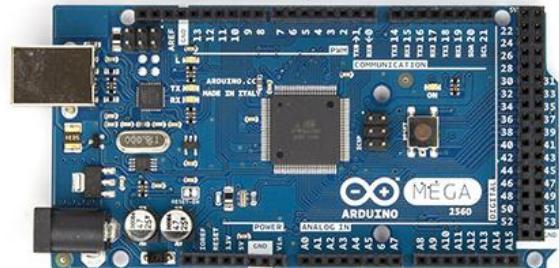
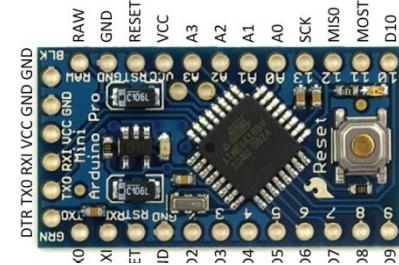
3D DC printer

- DC motori i enkoderi
 - za X i Y os
- koračni motori za Z os
 - dovoljno velika preciznost (microstepping)
 - nisu bitni kontinuirani koraci
 - držanje pozicije
- kompatibilno sa postojećim open source rješenjima
- prenosivo
- jeftino
- vlastita konstrukcija



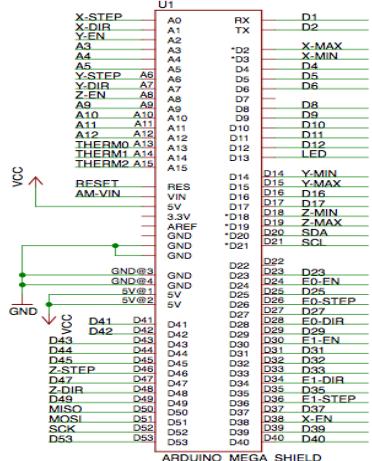
Opis rješenja

- Arduino Mega
 - Marlin firmware
 - Configuration.h
 - brine o tome gdje motori trebaju ići
 - G kod
- RAMPS (RepRap Arduino Mega Pololu Shield)
 - stepper motor driveri
- Shield za upravljanje DC motorima
 - na mjesto stepper drivera za X i Y os
 - kompatibilno
 - on u stvarnom vremenu upravlja DC motorima
 - PID regulacija
 - Arduino Mini Pro
- Repetier Host software za upravljanje printerom



Električne sheme

MEGA Conn.



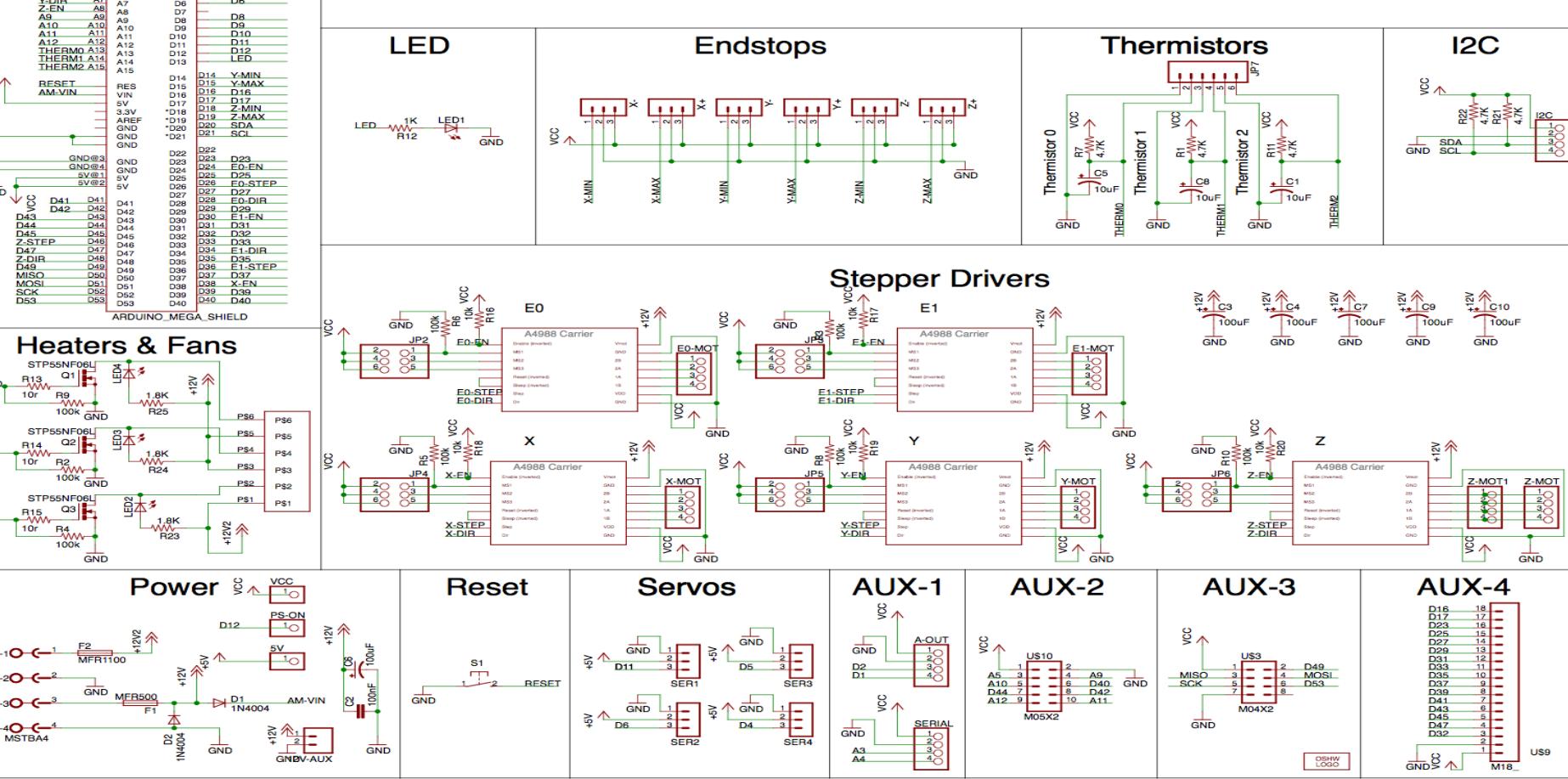
RAMPS 1.4 (RepRap Arduino Mega Pololu Shield)

reprap.org/wiki/RAMPS1.4

Copyright 2011 Johnny Russell

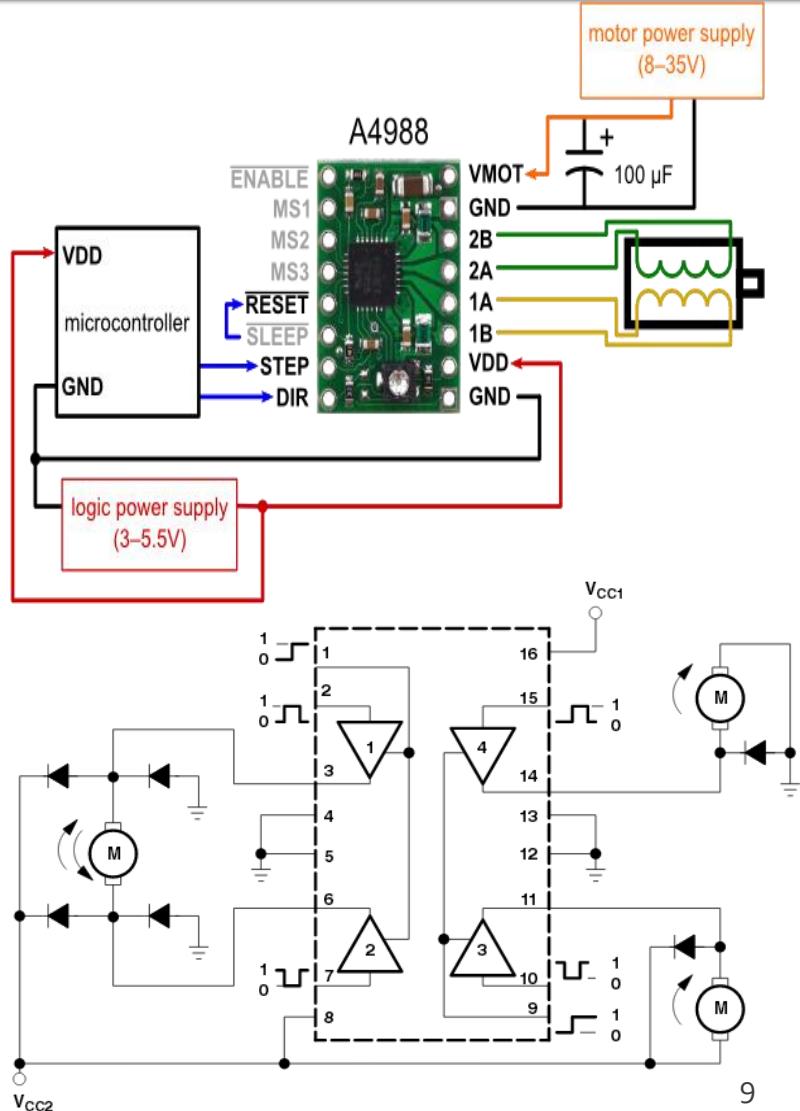
UltiMachine

GPL v3

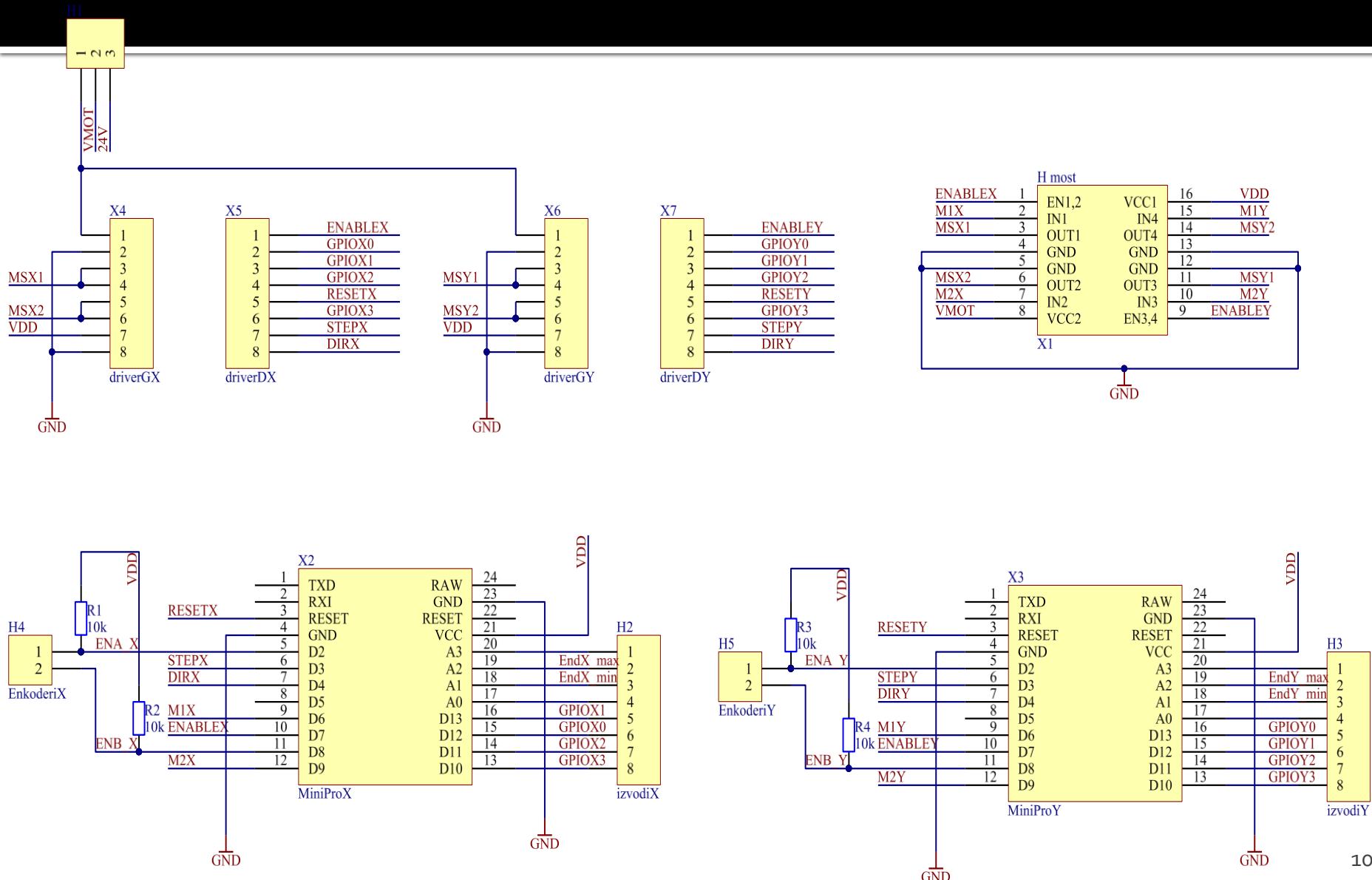


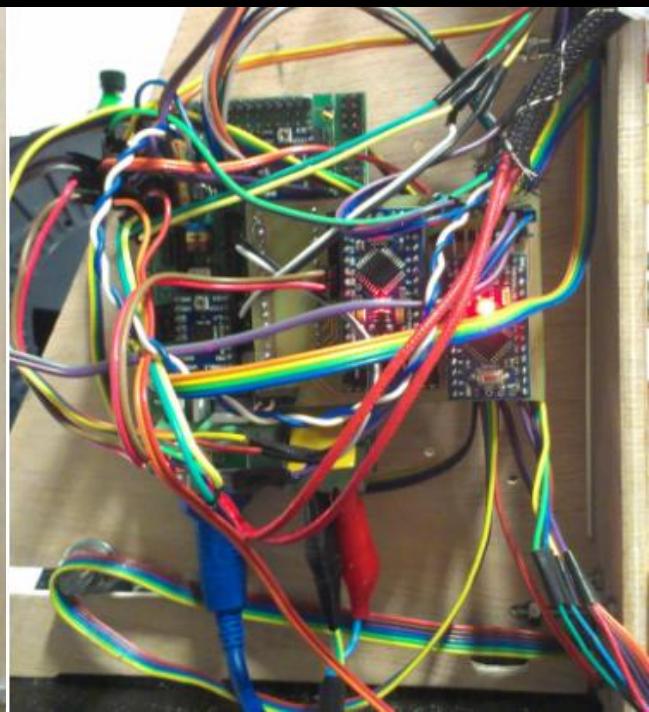
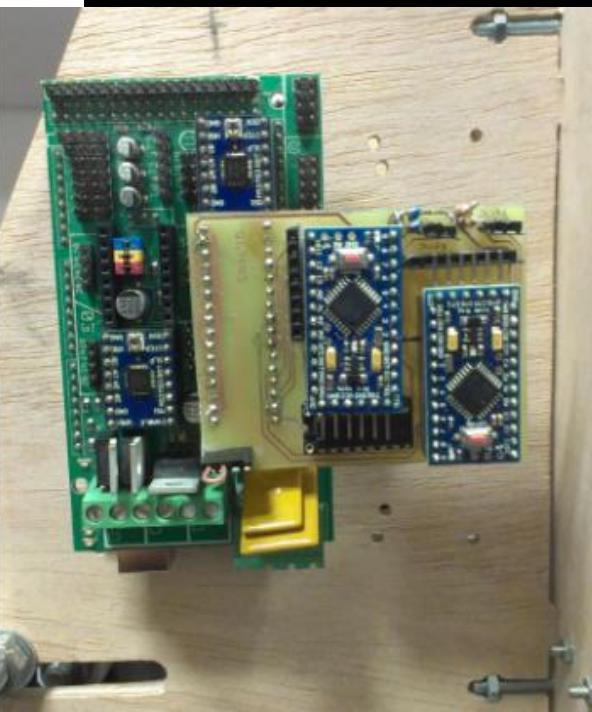
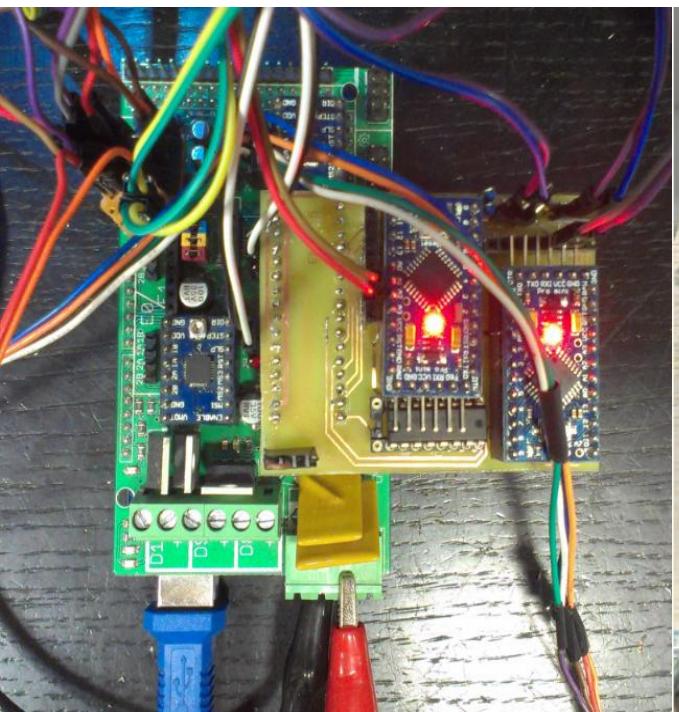
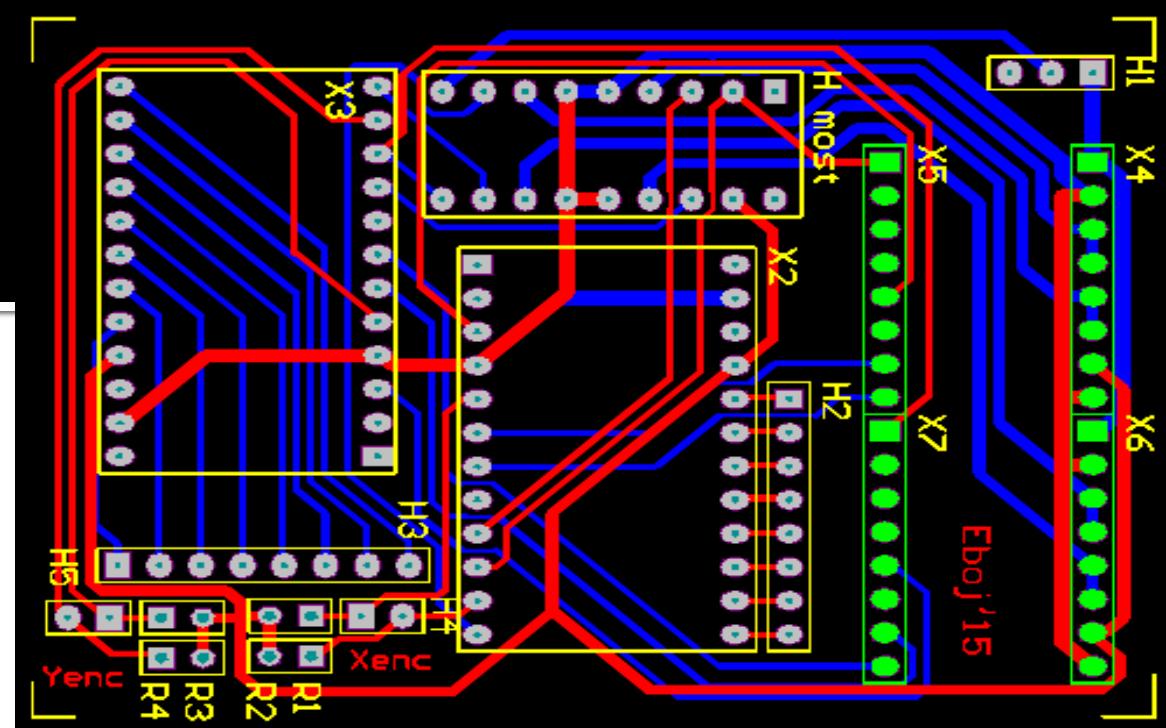
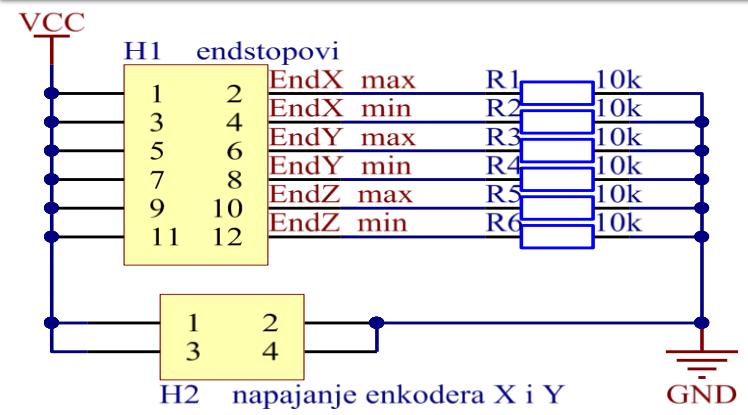
Električne sheme

- Zamjena stepper drivera sa shieldom za DC
 - STEP i DIR
 - određuju referencu
 - prekid na STEP
 - A i B kanali enkodera
 - određuju trenutnu poziciju
 - prekid na jedan kanal
 - PID regulacija
 - izlaz PWM [-255, 255]
 - H most
 - SN754410



Električne sheme



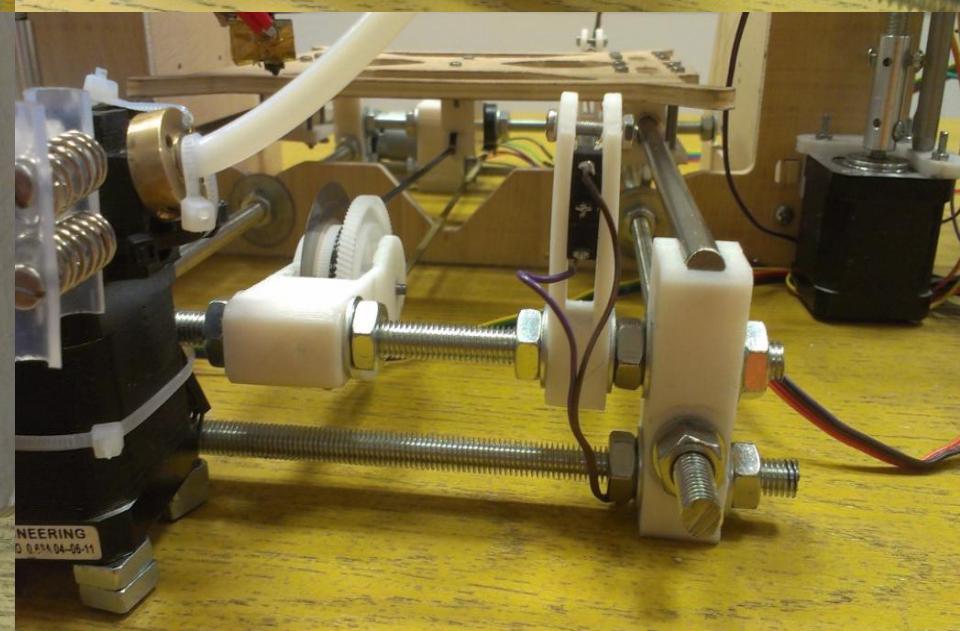
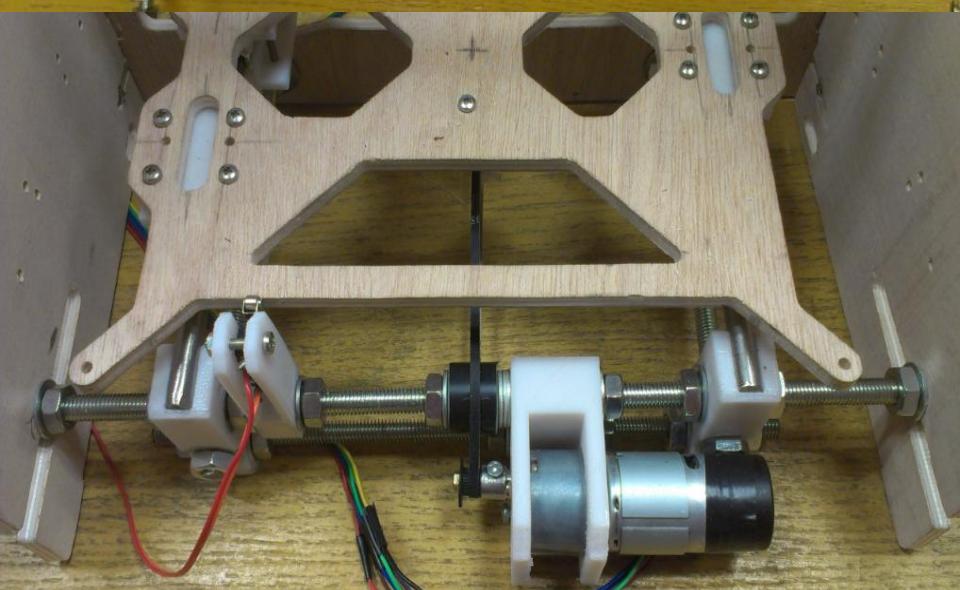
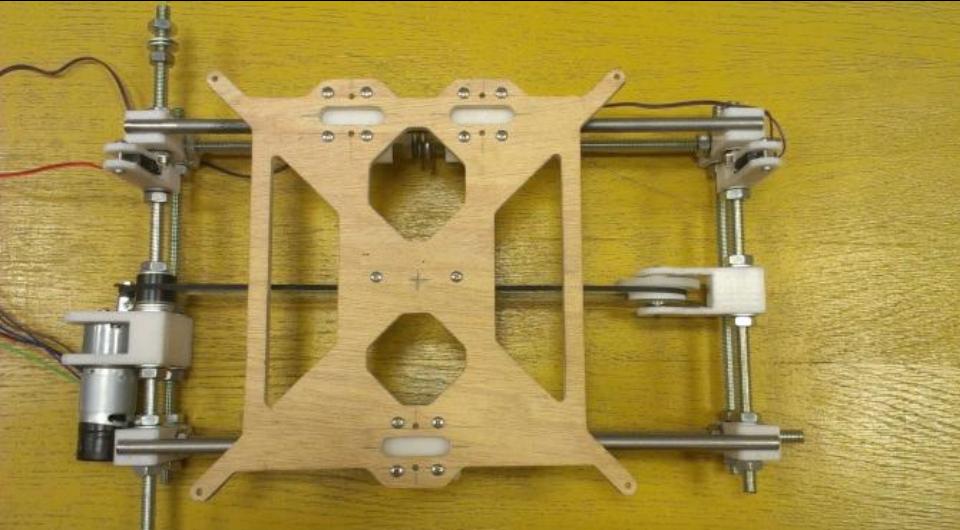


Mehanička konstrukcija

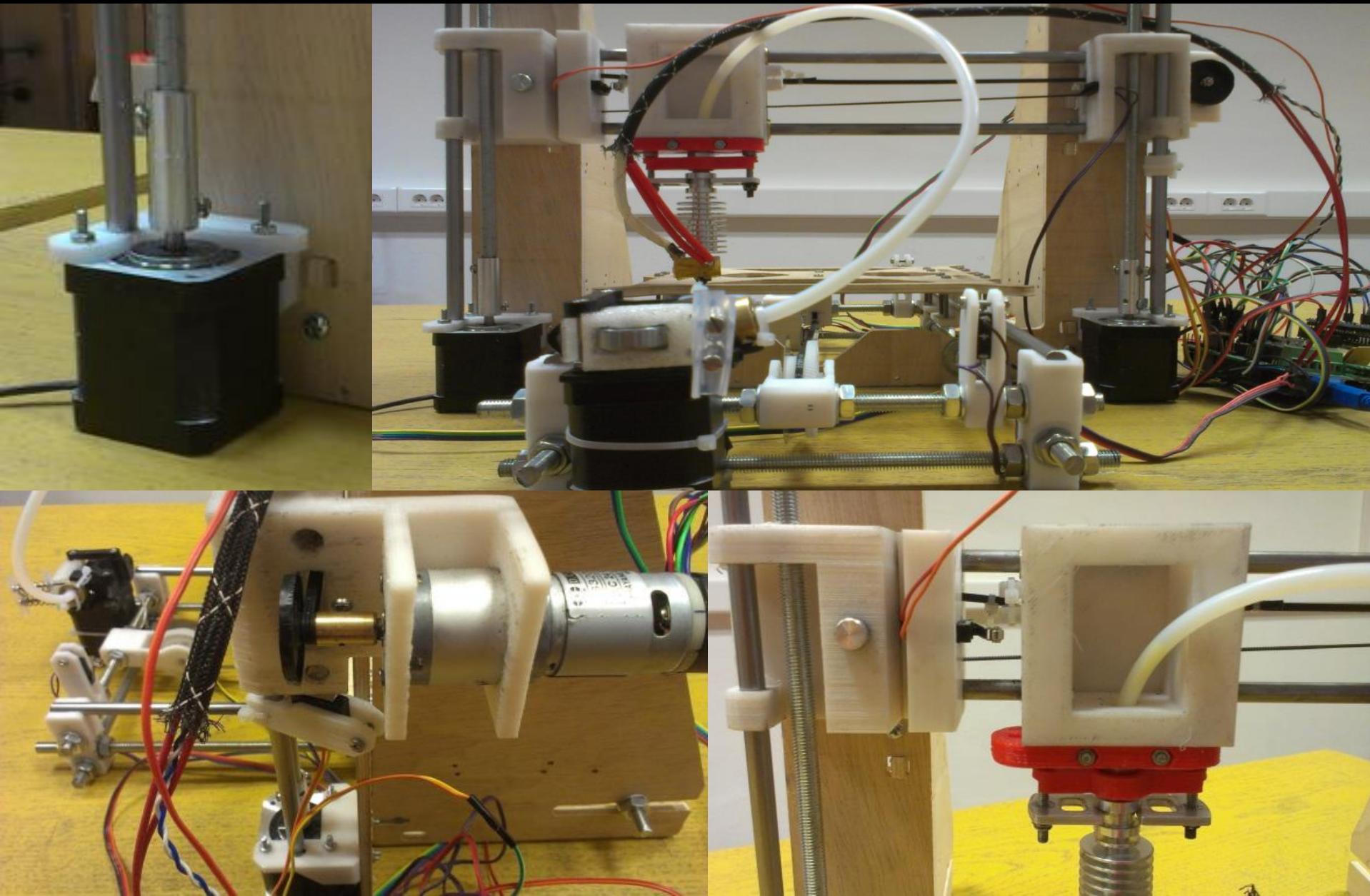
- po uzoru na Prusa i3 model
 - podloga u Y osi
 - Z os nosi X os
 - na X osi ekstruder
- ručno rađeni i modelirani dijelovi
 - printani na 3D printeru
 - tokareni
 - rezani CNC glodalicom
- sklopivo i prenosivo



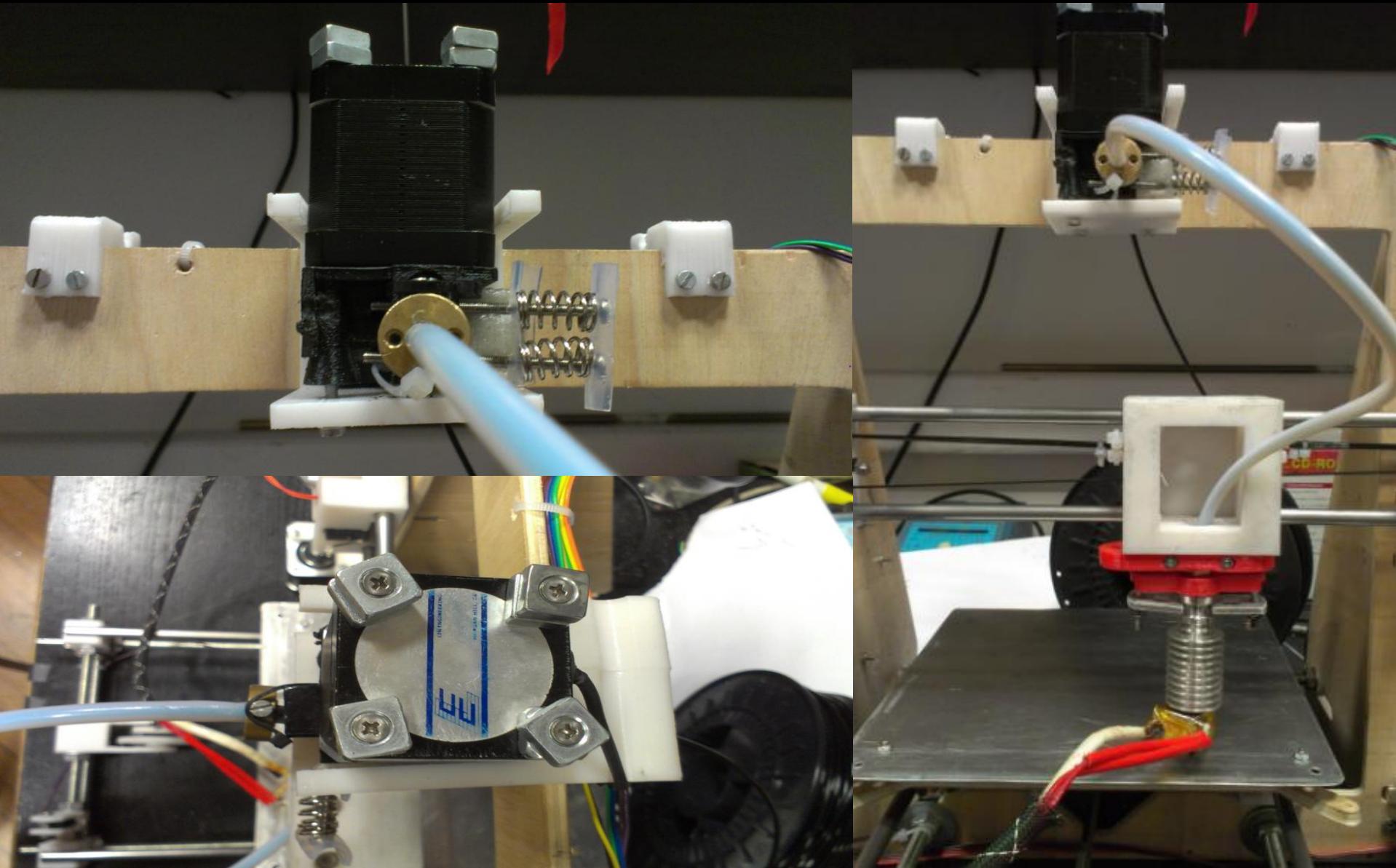
Yos



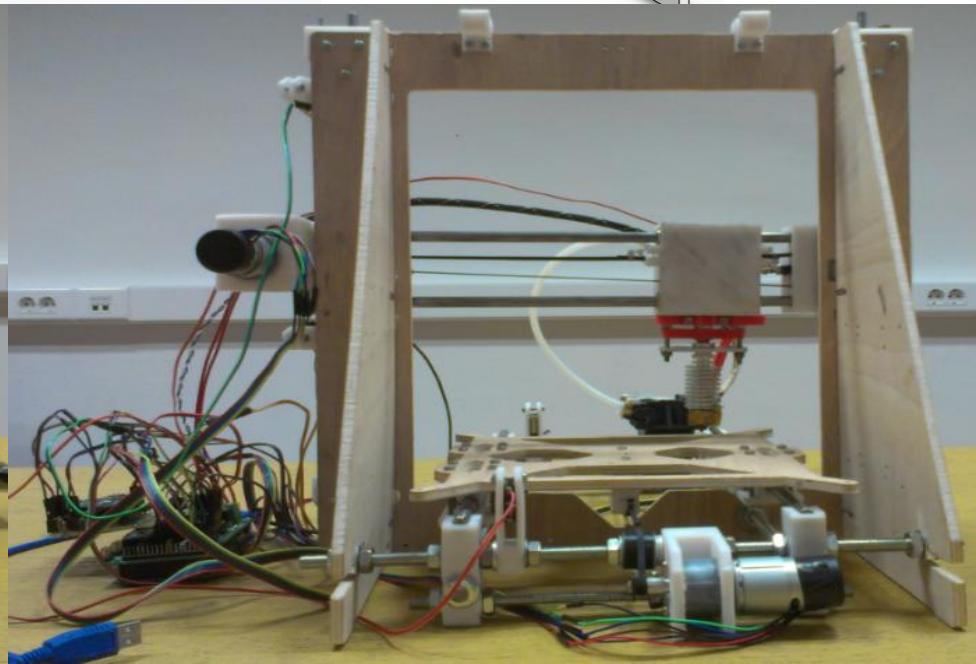
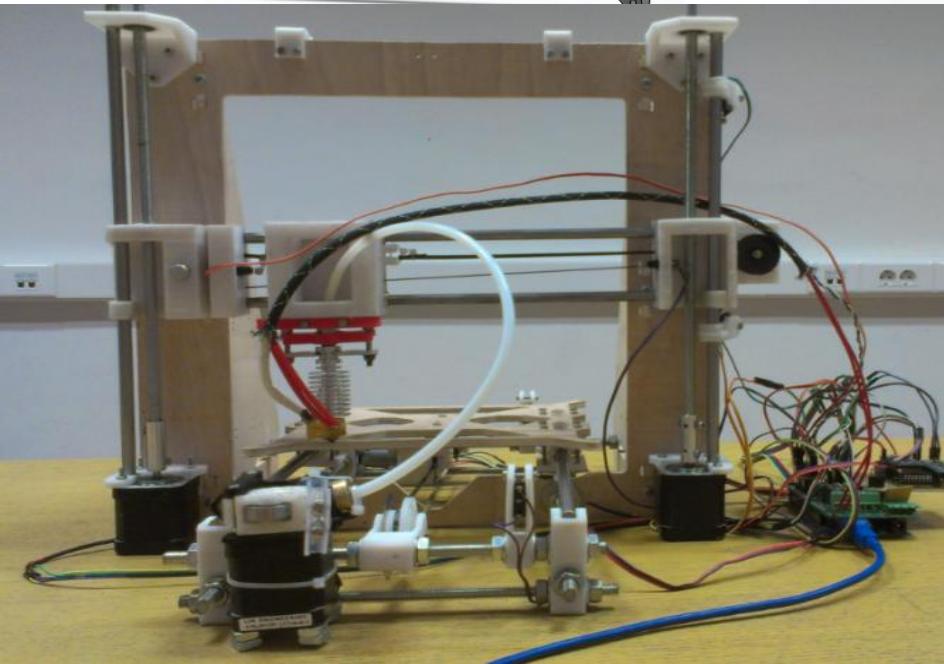
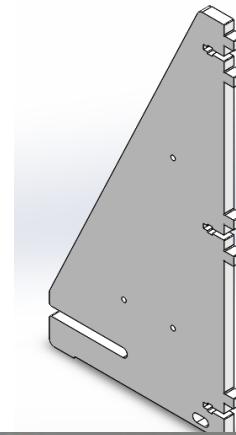
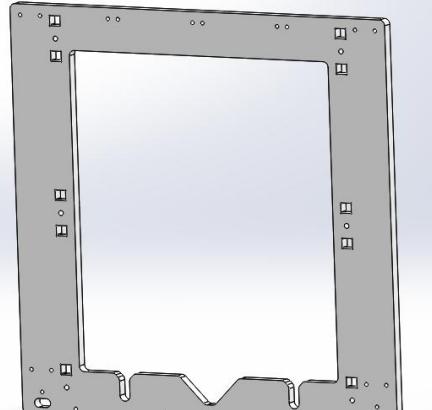
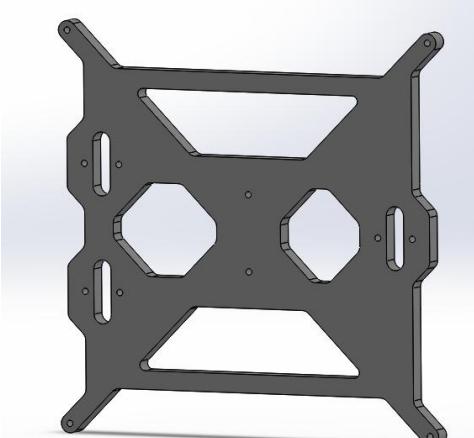
xiz os



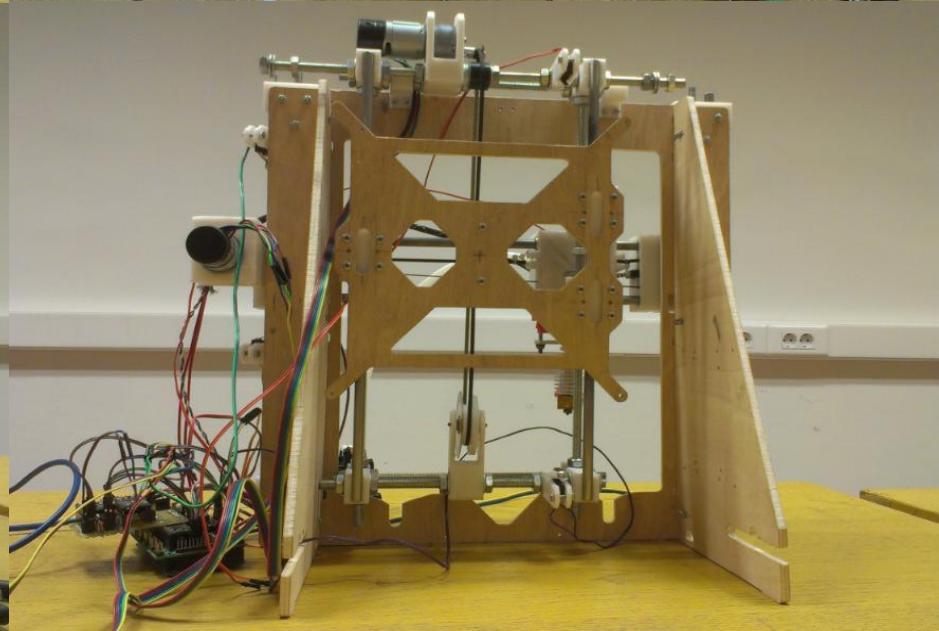
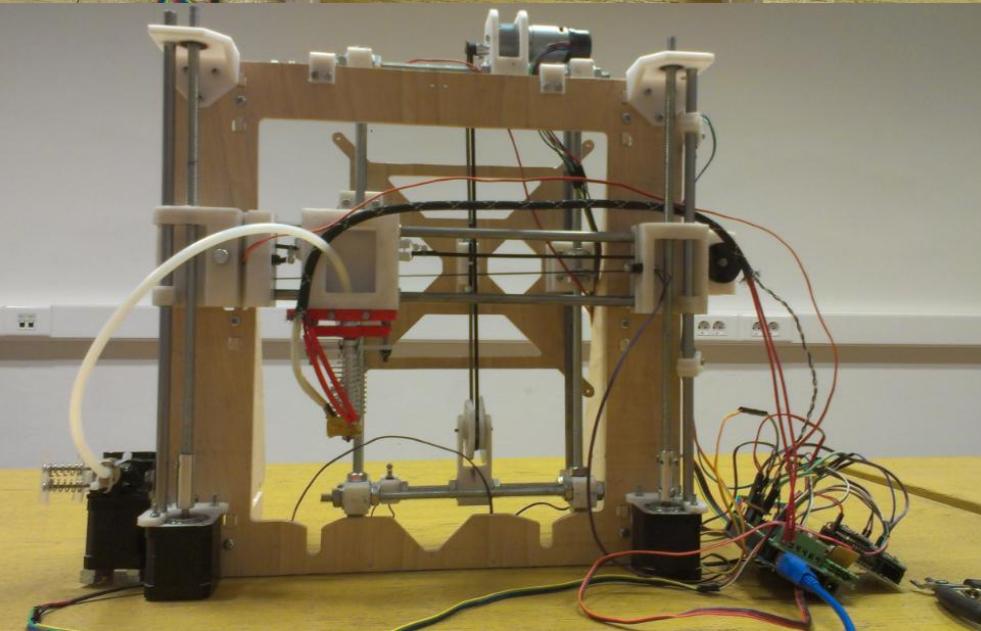
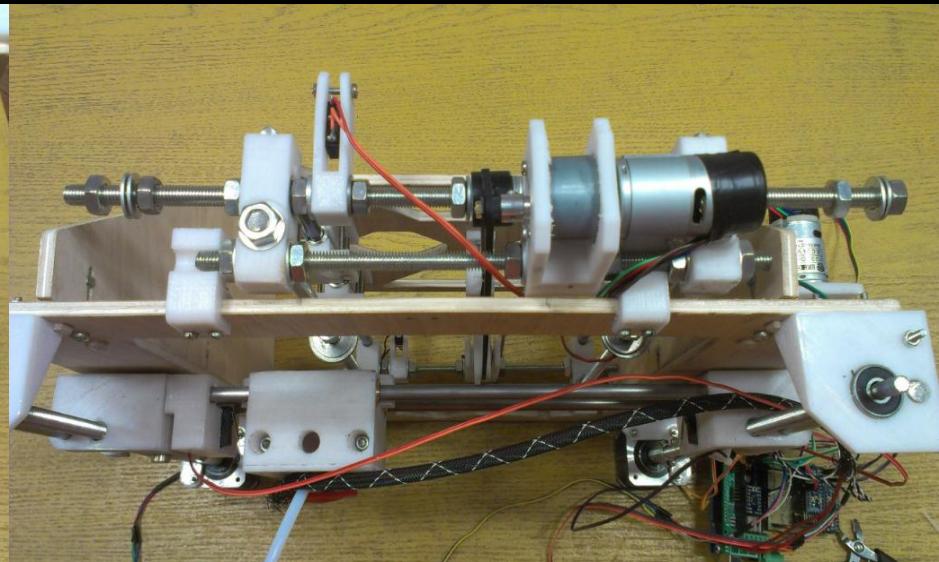
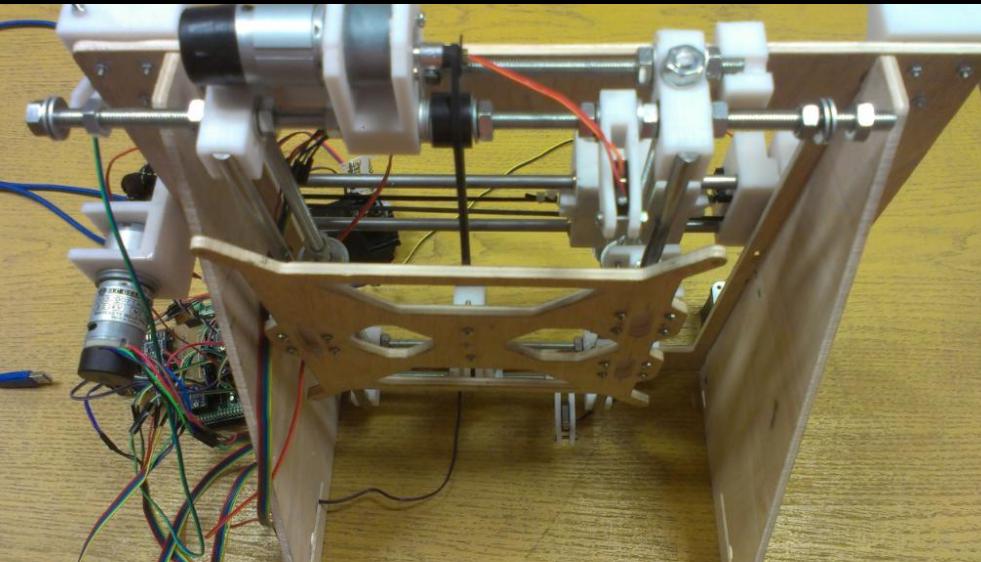
Ekstruder i grijaća glava



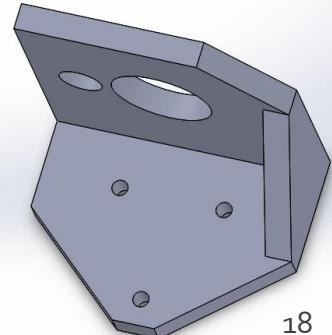
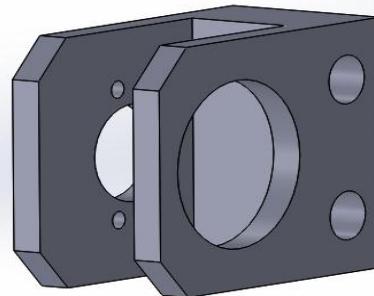
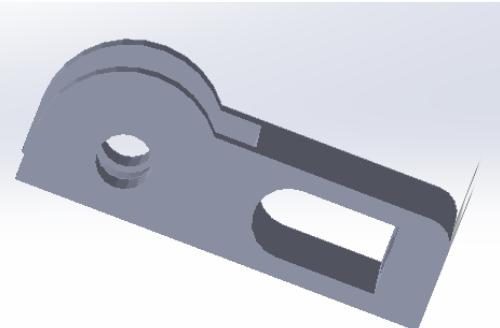
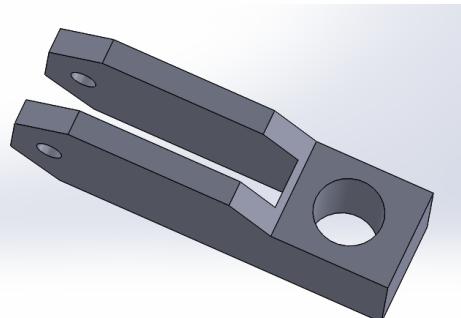
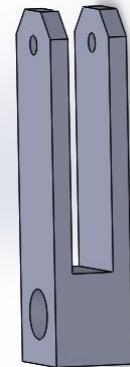
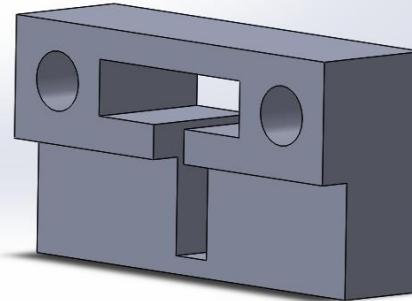
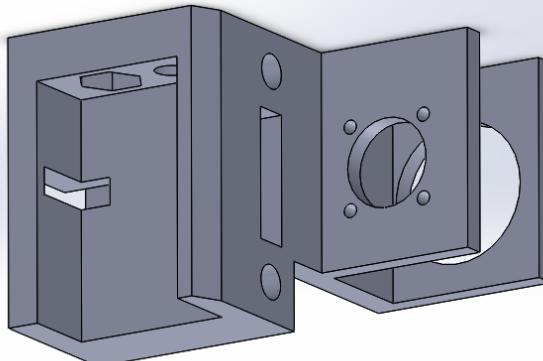
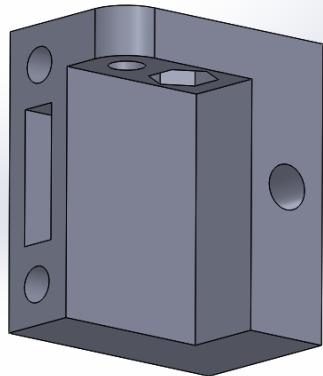
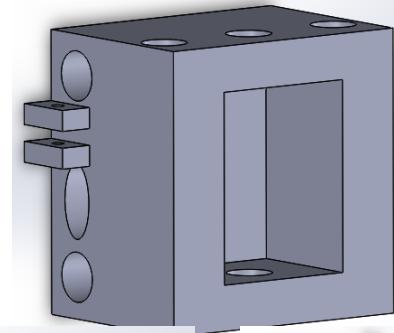
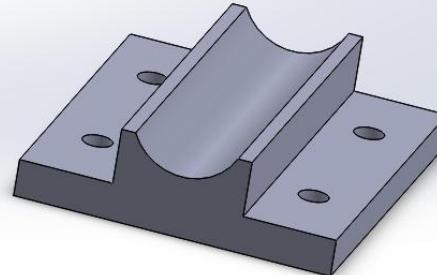
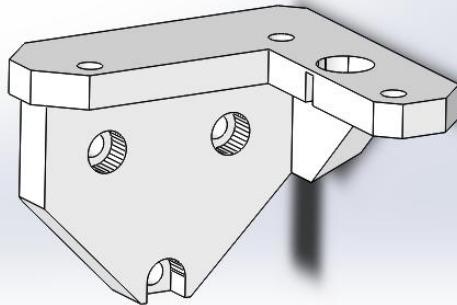
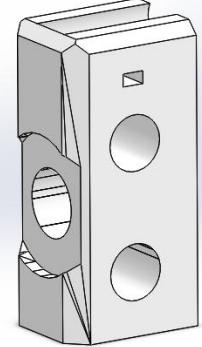
Okvir



Sklopivost



Modelirani dijelovi



Upravljanje

Repetier-Host V1.0.6

File View Config Printer Tools Help

Disconnect Load Save Print Start Print Kill Print Toggle Log Show Filament Show Travel Printer Settings Easy Mode Emergency Stop

3D View Temperature Curve

Idle

G-Code: Send

X 0,00 Y 0,00 Z 0,00 Extruder 1

X/Y Z

Power, Feedrate, Flowrate, Fan, Extruder 1 (499,50°C)

Debug Options: Echo, Info, Errors, Dry Run, OK

Temperature Timperiod Zoom Build Average over... Continuous Monitoring

Past 60 Minutes

Output Extruder, Show Extruder, Show Bed, Target Temperatures, Average Temperatures, Output Extruder, Output Bed

Output Extruder

Output Bed

Preview G-Code Editor

G-Code

```
1 ;Generated with Cura_SteamEngine 14.12
2 ; Default start code
3 G28 ; Home extruder
4 G1 Z15 F50
5 ;M107 ; Turn off fan
6 G90 ; Absolute positioning
7 M82 ; Extruder in absolute mode
8 ;M190 S65
9 ; Activate all used extruder
10 M104 T0 S255
11 G92 E0 ; Reset extruder position
12 ; Wait for all used extruders to reach temperature
13 M109 T0 S255
14 ;Layer count: 17
15 ;LAYER:0
16 ;M107
17 G1 F2400 E-2.00000
18 G0 F9000 X90.600 Y95.600 Z0.200
19 ;TYPE=WALL_TNNFR
```

Connected: default

Extruder: 499,5°C/Off

Idle

The screenshot displays the Repetier-Host V1.0.6 software interface. On the left, a 3D view shows a triangular mesh model. In the center, the 'Idle' control panel includes a G-code input field, coordinate inputs (X 0,00, Y 0,00, Z 0,00), and a dropdown for 'Extruder 1'. It also features a circular control dial for X/Y movement, a dial for Z movement, and various control buttons for power, feedrate, flowrate, and fan. Below these are sliders for 'Feedrate', 'Flowrate', and 'Fan', and a color-coded progress bar for 'Extruder 1' at 499,50°C. A 'Debug Options' section with checkboxes for Echo, Info, Errors, and Dry Run, along with an OK button, is also present. On the right, a large graph area shows temperature and fan output over time, with tabs for 'Temperature', 'Timperiod', 'Zoom', 'Build', 'Average over...', and 'Continuous Monitoring'. The 'Temperature' tab is active, showing a red line for 'Past 60 Minutes' and several smaller graphs for 'Output Extruder' and 'Output Bed'. At the bottom right, a preview of the printed model is shown.

Zaključak

- Izrađen printer
 - velike preciznosti ($<50 \mu\text{m}$)
 - čvrste, ali prenosive konstrukcije
 - omogućeno ručno upravljanje
 - ispod 1500 kn
- Naučeno jako puno mehaničkih vještina
 - CNC, tokarski, 3D printeri
- Dobivena podloga za izradu vlastitog razvojnog modula i firmwarea

Dalje

- poboljšati parametre printanja
- Beaglebone
 - pisanje firmwarea
 - parsera za G kod
 - PID regulaciju za DC motore, grijajuću glavu i podlogu
 - planiranje puta kako bi se smanjili trzaji
 - čitanje G koda sa SD kartice
 - LCD pokaznik



Hvala na pažnji!