3D DC PRINTER

Plastična kirurgija

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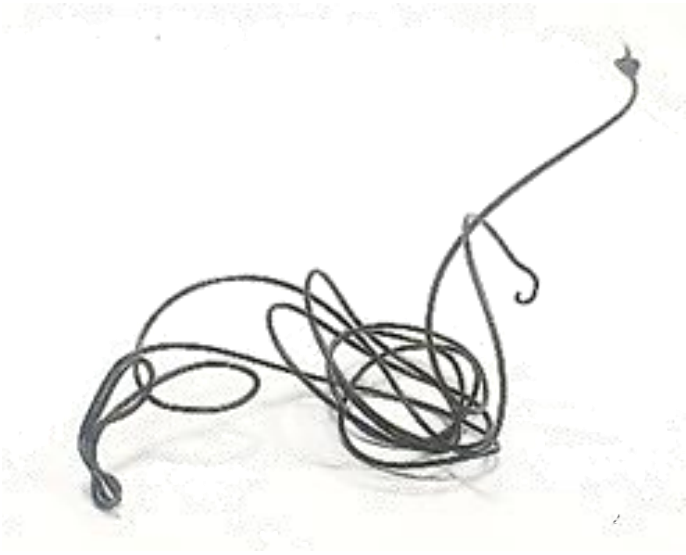
Zašto na elektroboj?

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



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- 3D DC printer
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- Mehanička konstrukcija
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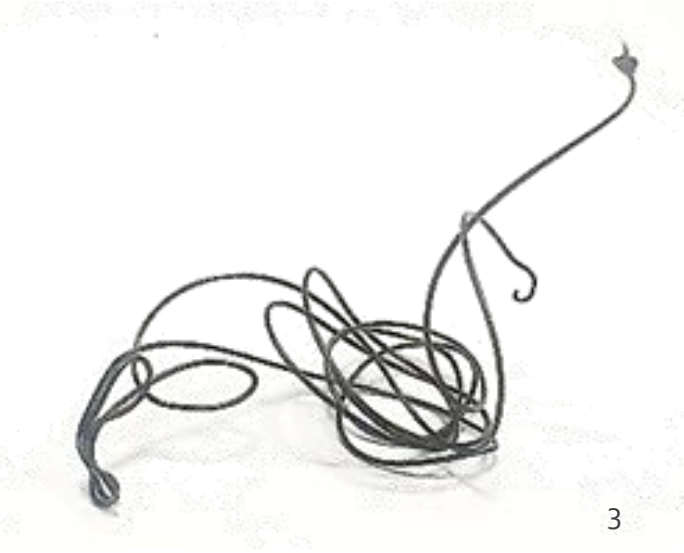
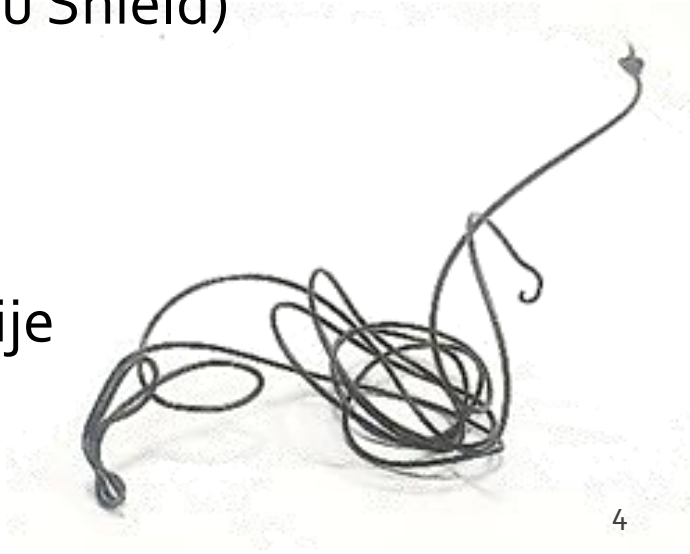


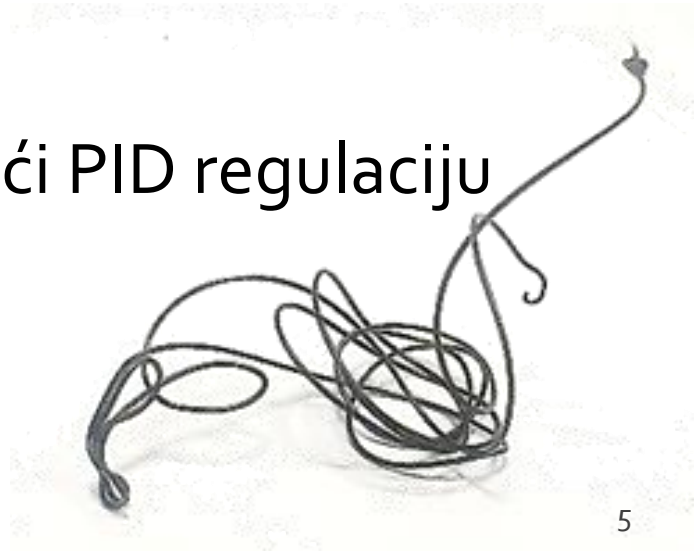
3D printeri

- 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
- samorepli cirajući strojevi
- problemi trenutnih printera
  - ograničena precizost zbog konstrukcije
  - nema smisla jako precizni motori



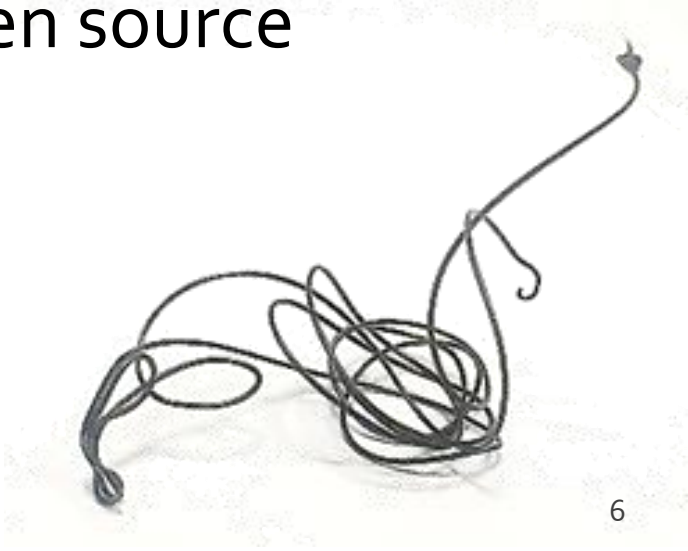
3D DC printer

- 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



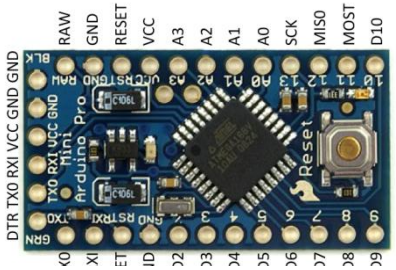
3D DC printer

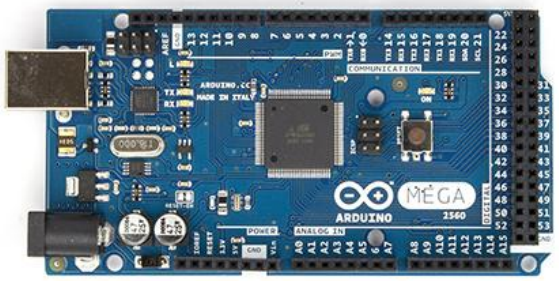
- DC motori i enkoderi
  - za X i Y os
- koračni motori za Z os
  - dovoljno velika preciznost (microstepping)
  - nisu bitni kontinuirani koraci
  - držanje pozicije
- kompatibilno sa postojećim open source rješenjima
- prenosivo
- jeftino
- vlastita konstrukcija

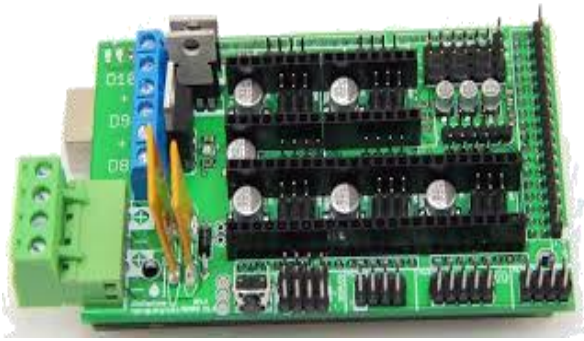


Opis rješenja

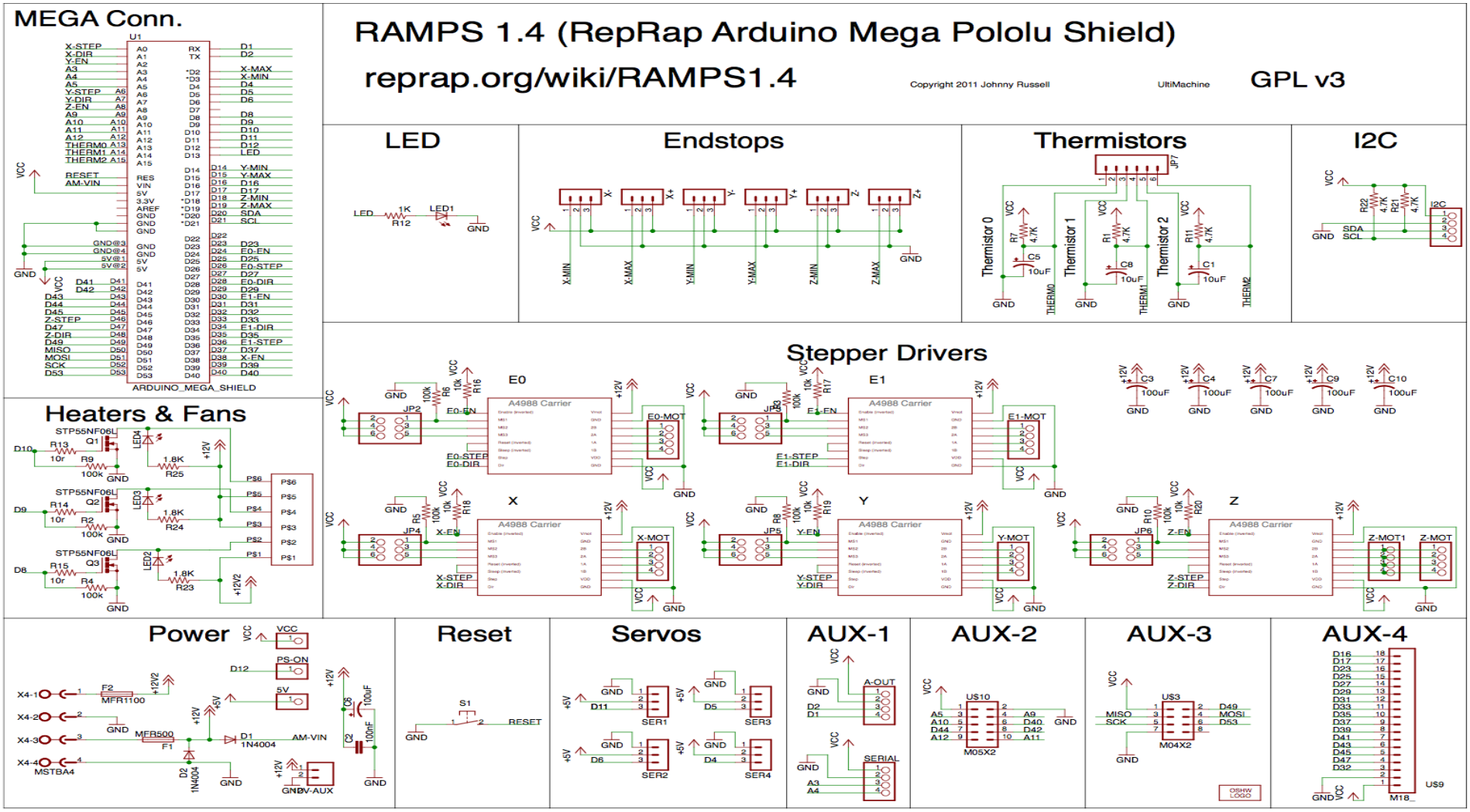
- Arduino Mega
  - Marlin firmware
  - Configuration.h
  - brine o tome gdje motori trebaju ići
    - G kod
- RAMPS (RepRap Arduino Mega Pololu Shield)
  - stepper motor driveri
- Shield za upravljanje DC motorima
  - na mjesto stepper drivera za X i Y os
    - kompatibilno
  - on u stvarnom vremenu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





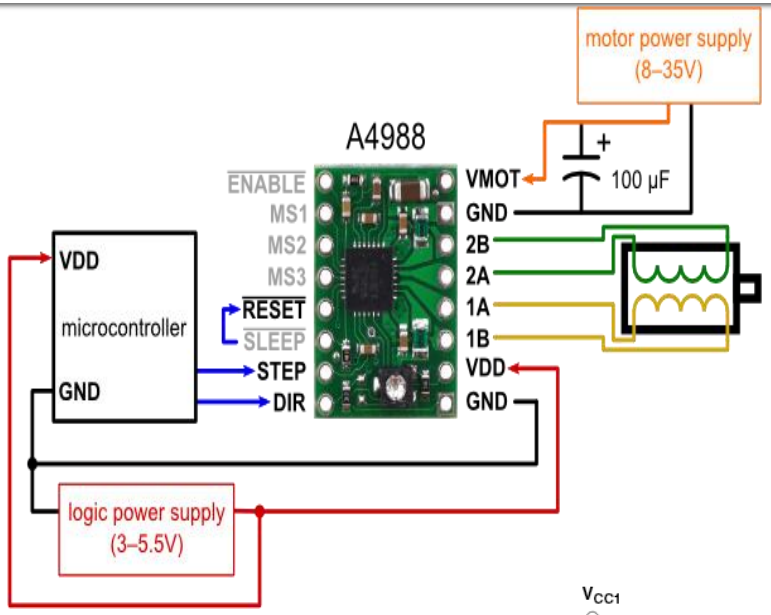


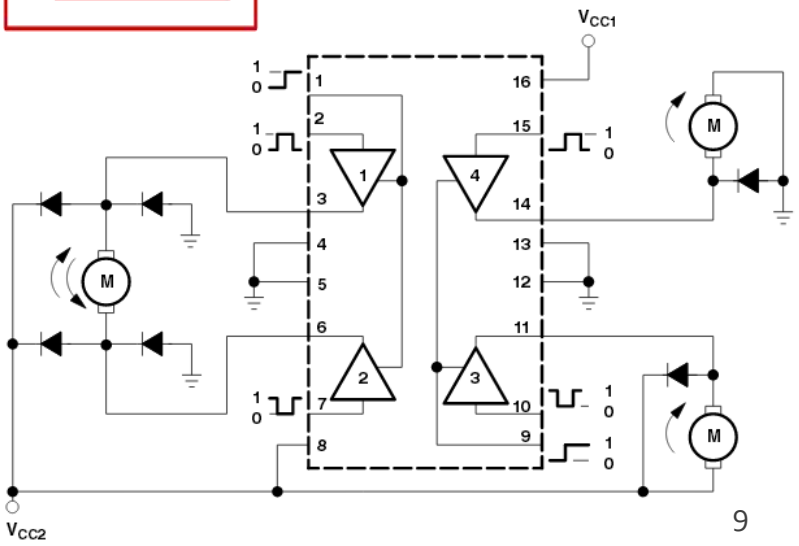
Električne sheme



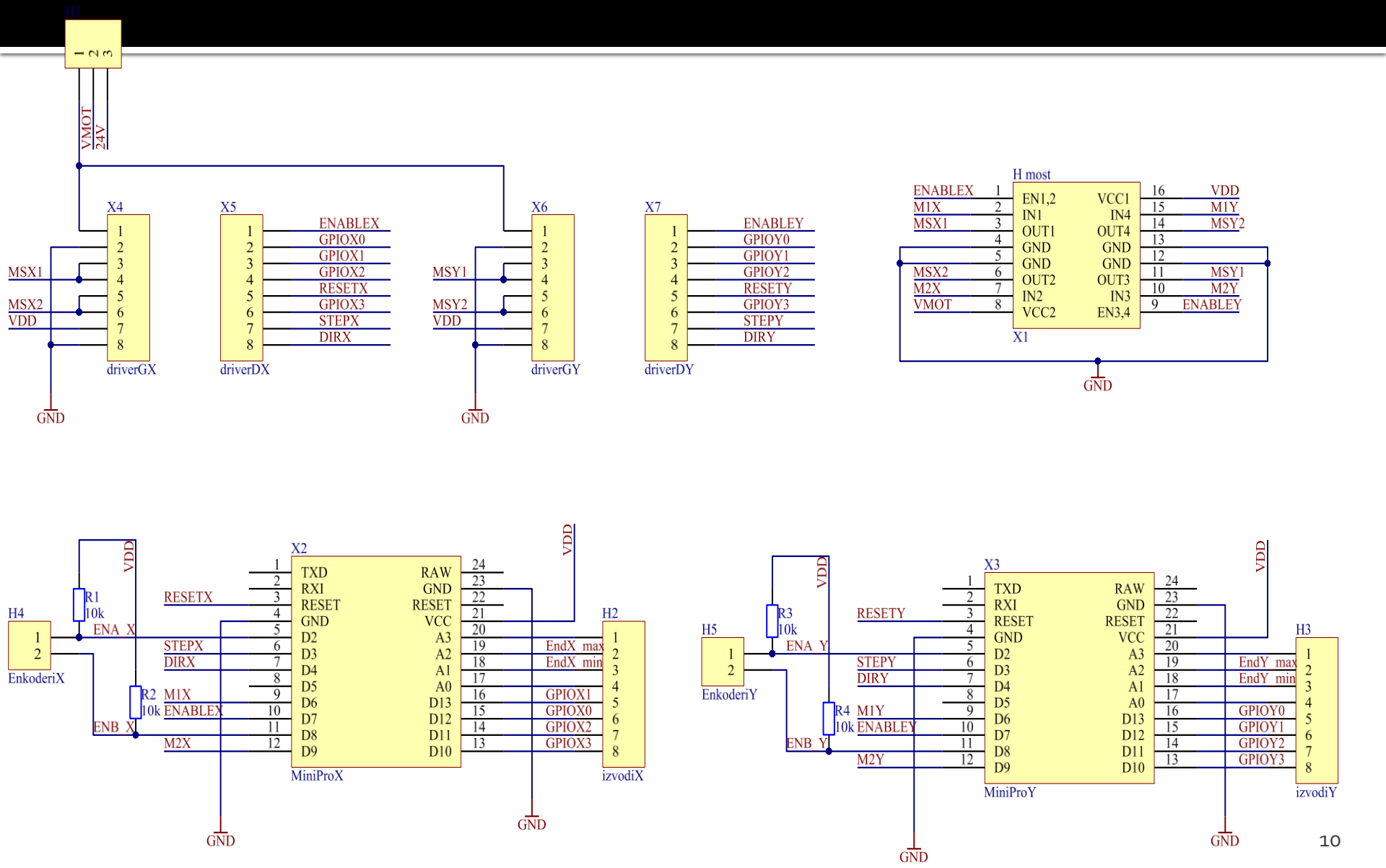
Električne sheme

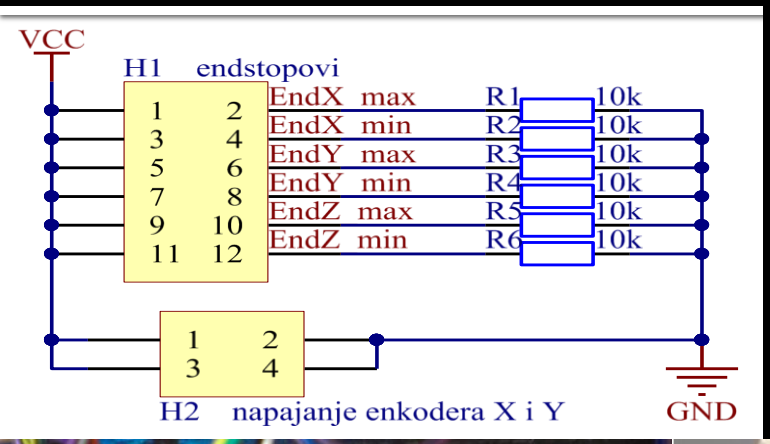
- Zamjena stepper drivera sa shieldom za DC
  - STEP i DIR
    - određuju referencu
    - prekid na STEP
  - A i B kanali enkodera
    - određuju trenutnu poziciju
    - prekid na jedan kanal
  - PID regulacija
    - izlaz PWM [-255,255]
  - H most
    - SN754410

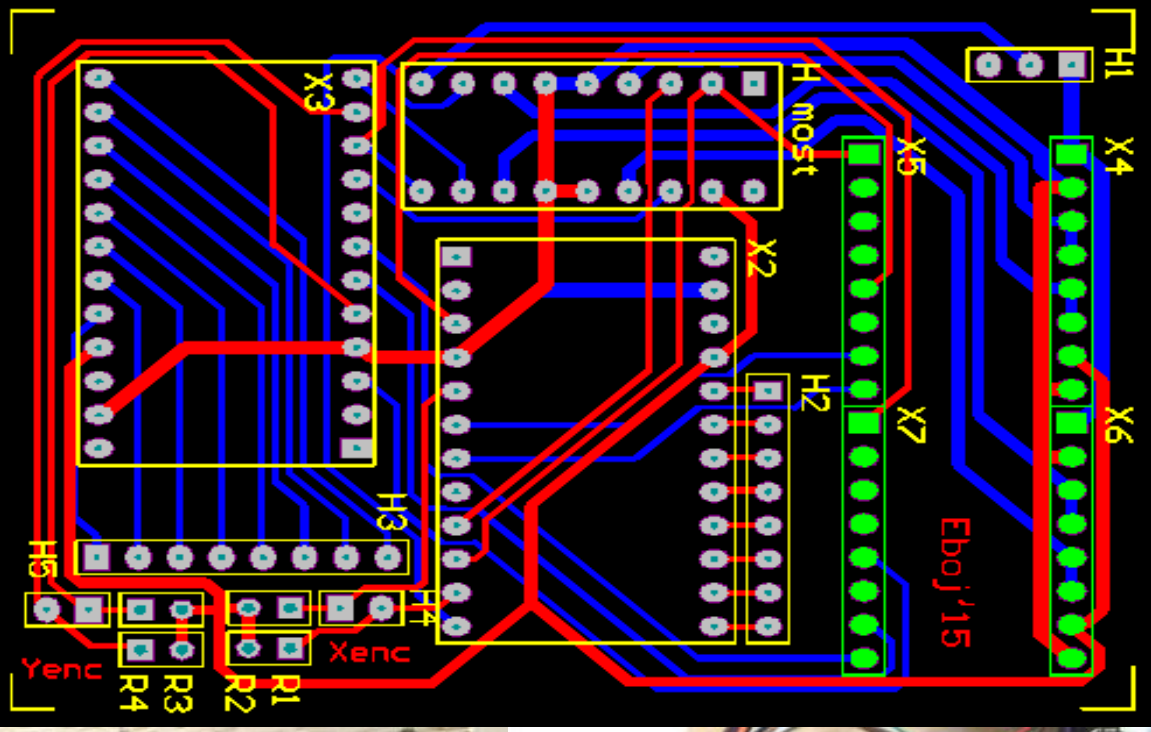


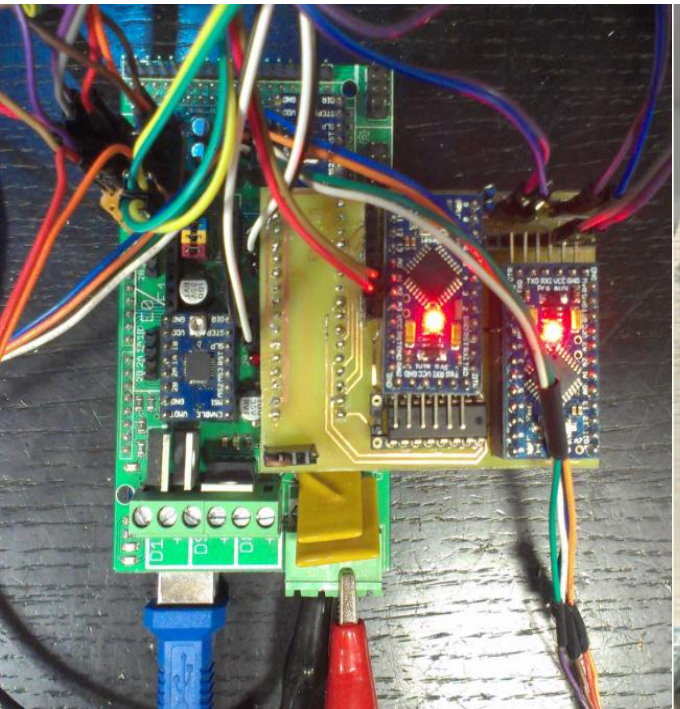


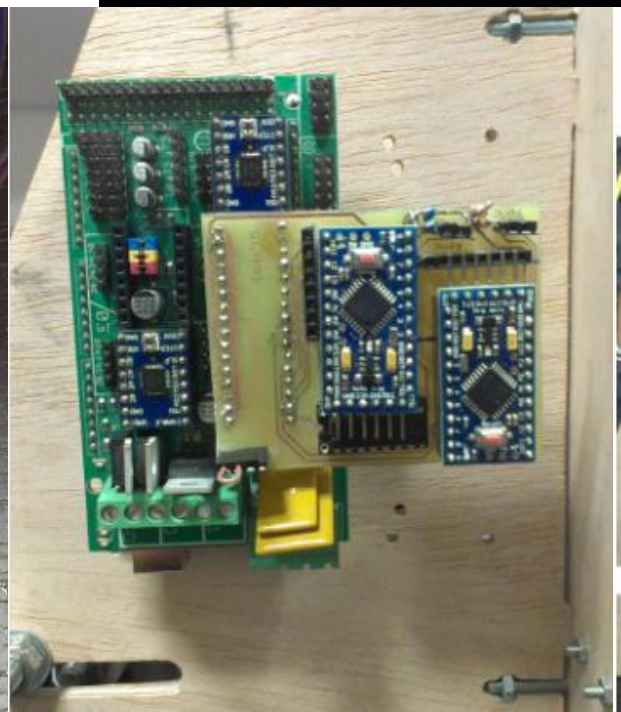
Električne sheme

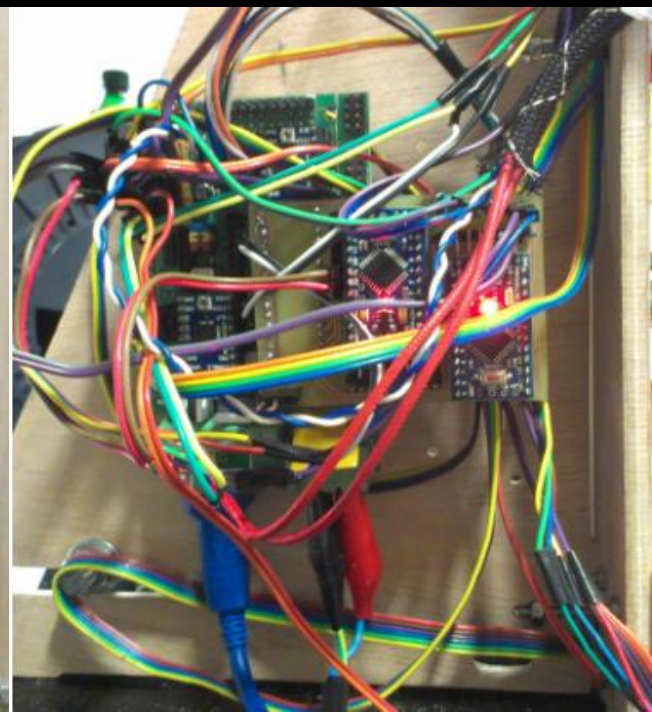



VCC
H1 endstopovi
1 2
3 4
5 6
7 8
9 10
11 12
EndX max R1 10k
EndX min R2 10k
EndY max R3 10k
EndY min R4 10k
EndZ max R5 10k
EndZ min R6 10k
1 2
3 4
H2 napajanje enkodera X i Y
GND


X3
H most
X5
H1
X4
X2
H2
X7
X6
H3
H5
H4
Yenc
Xenc
R4
R3
R2
R1
Eboj '15



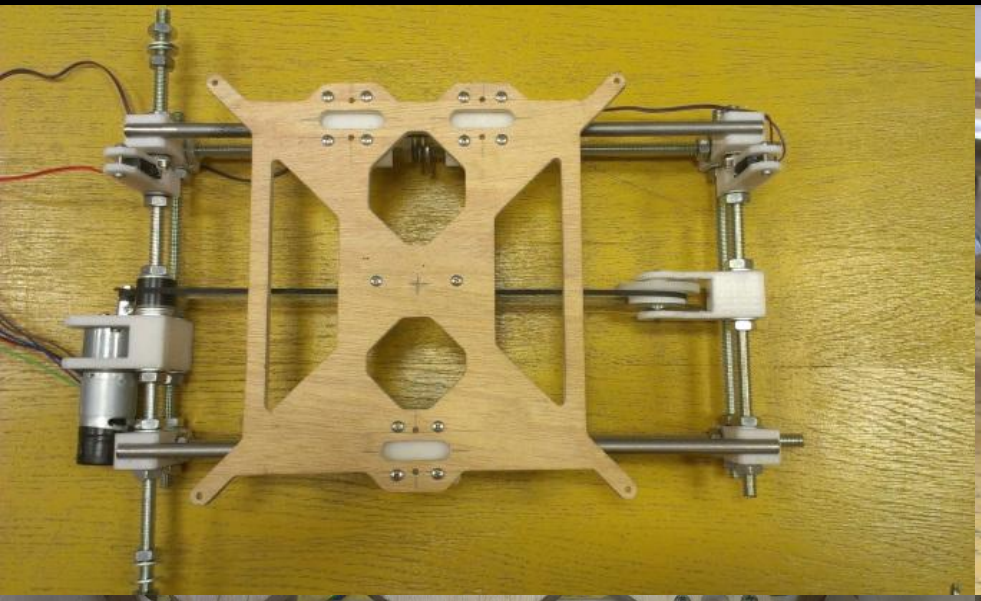


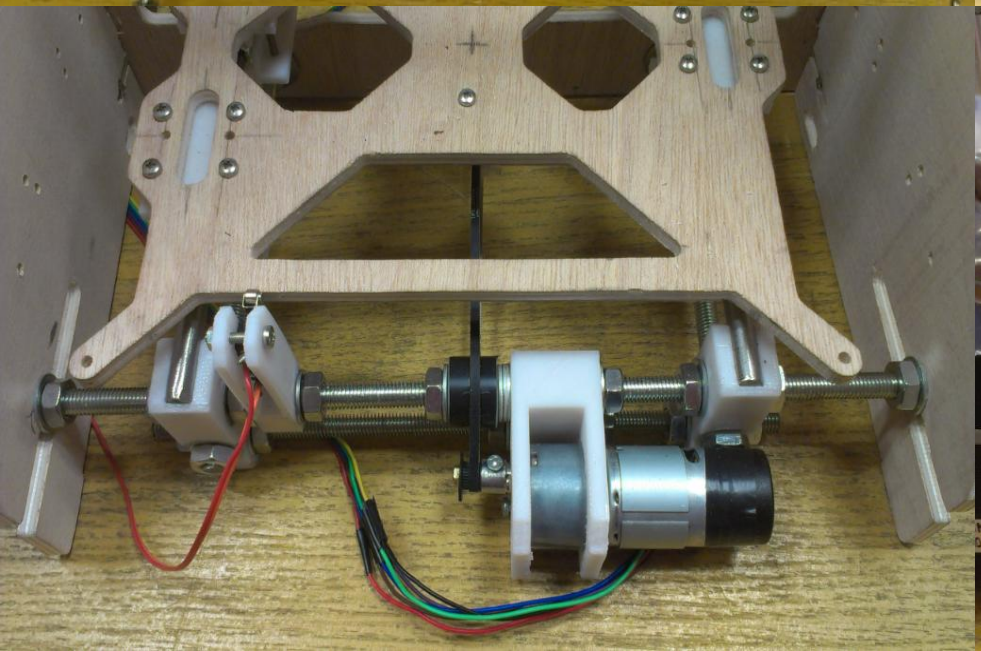


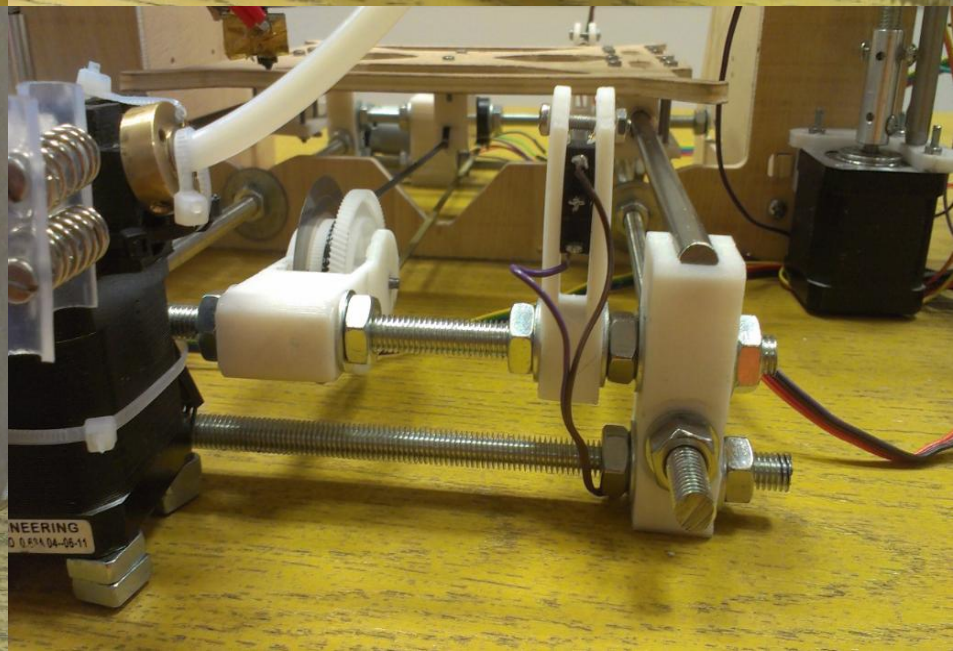
Mehanička konstrukcija

- 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

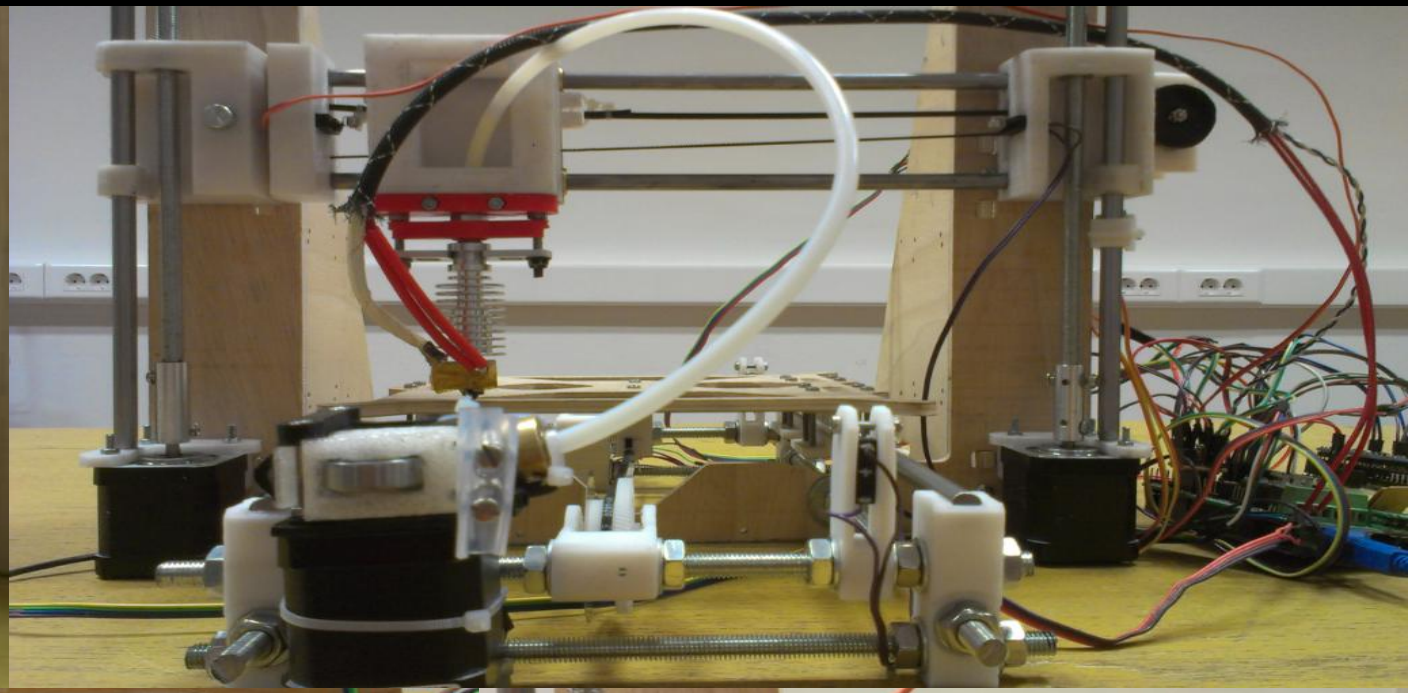
Y os

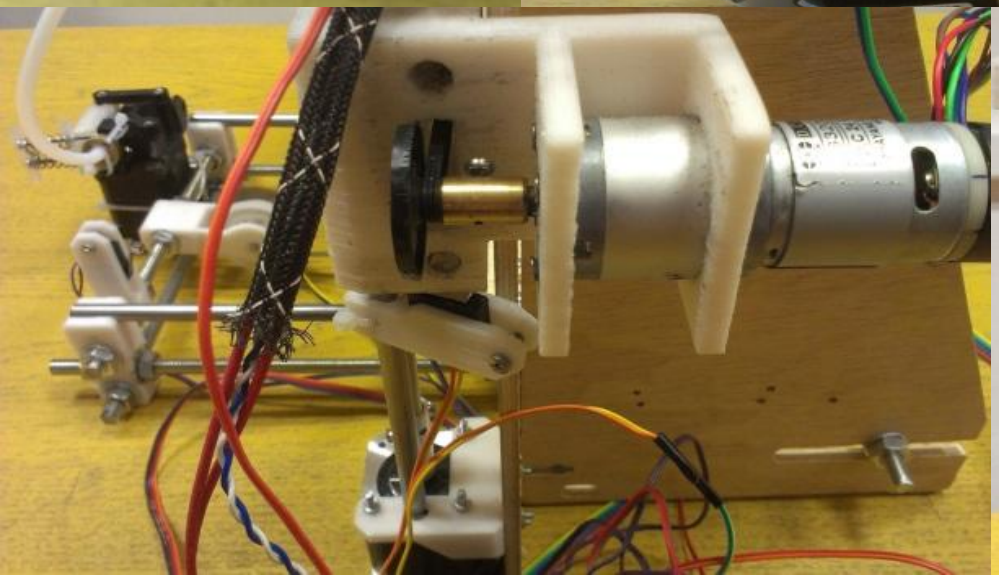


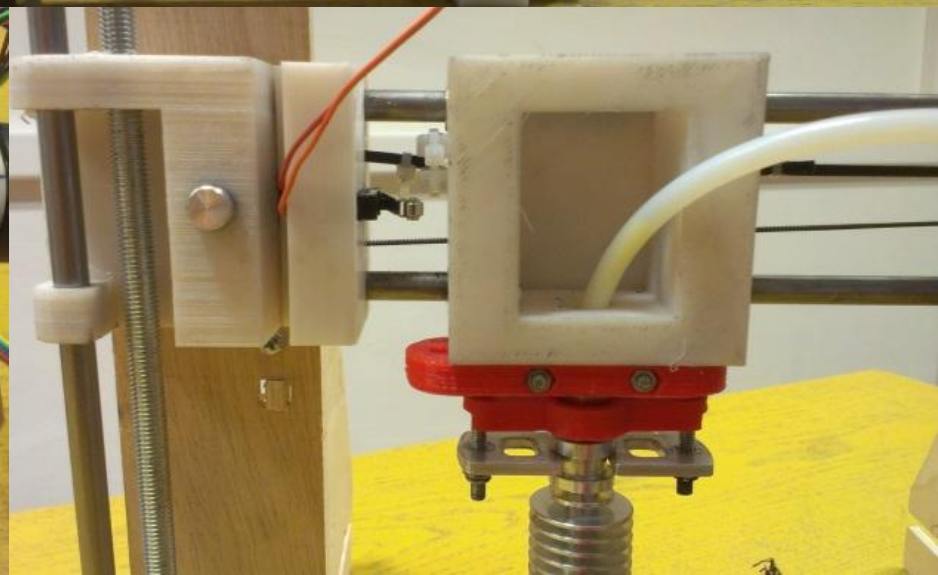




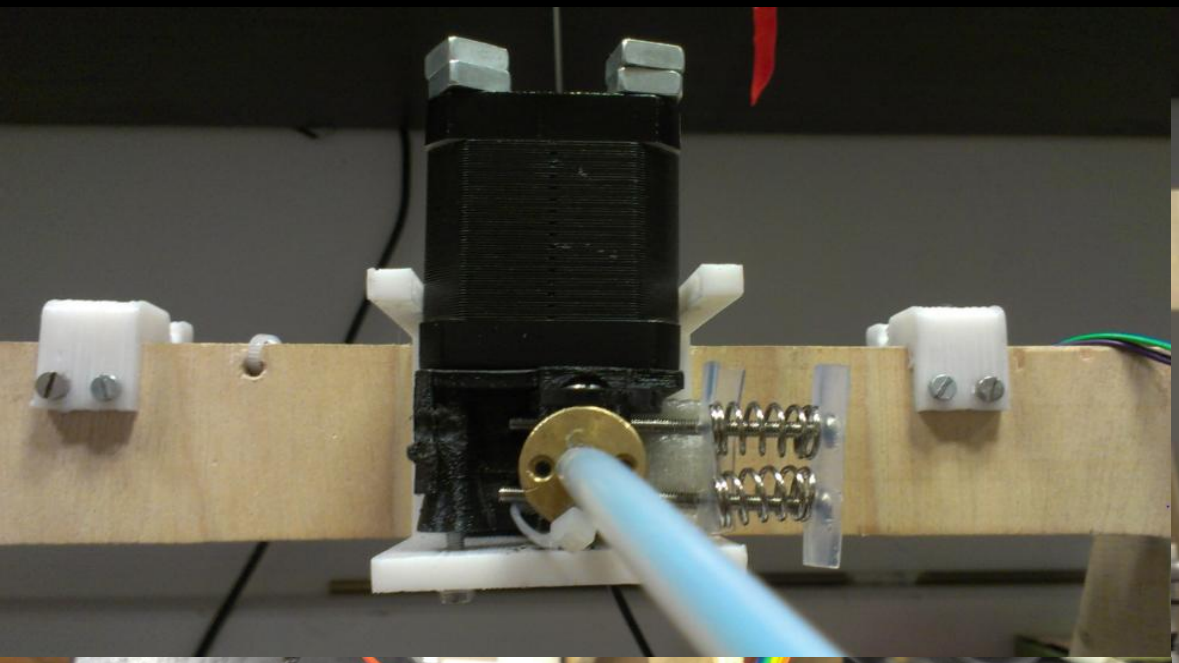
X i Z os

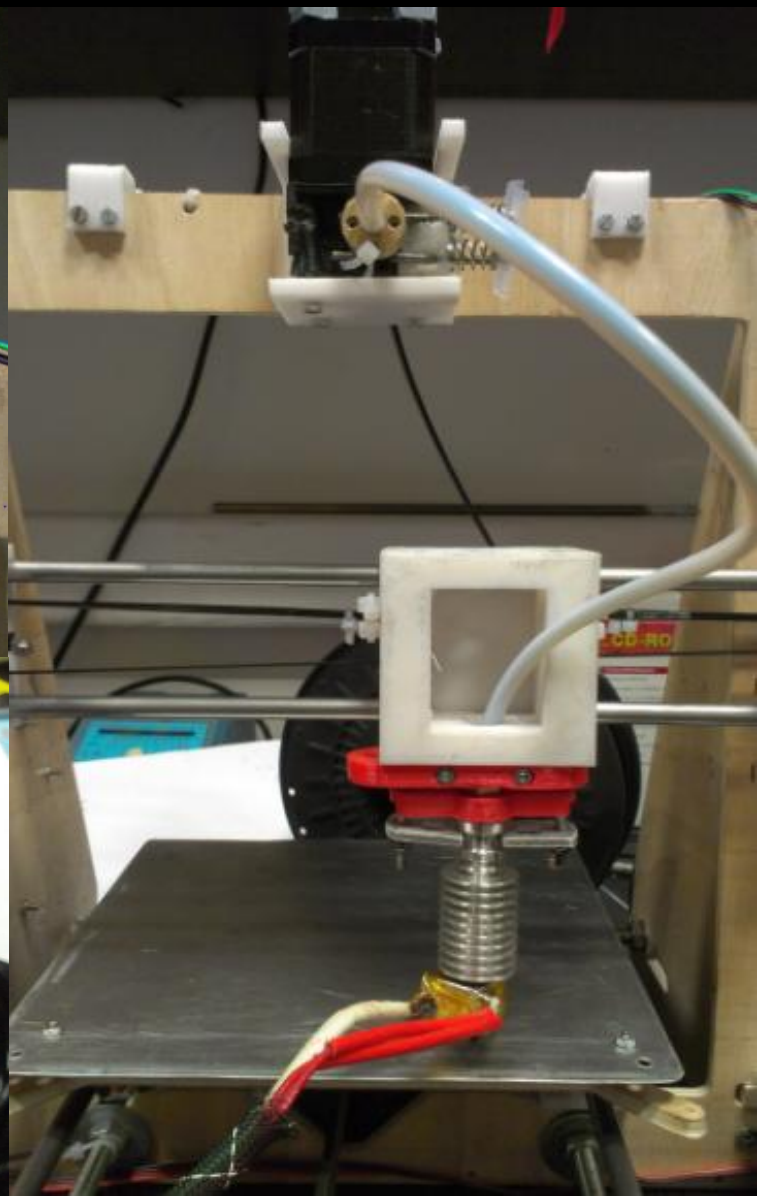


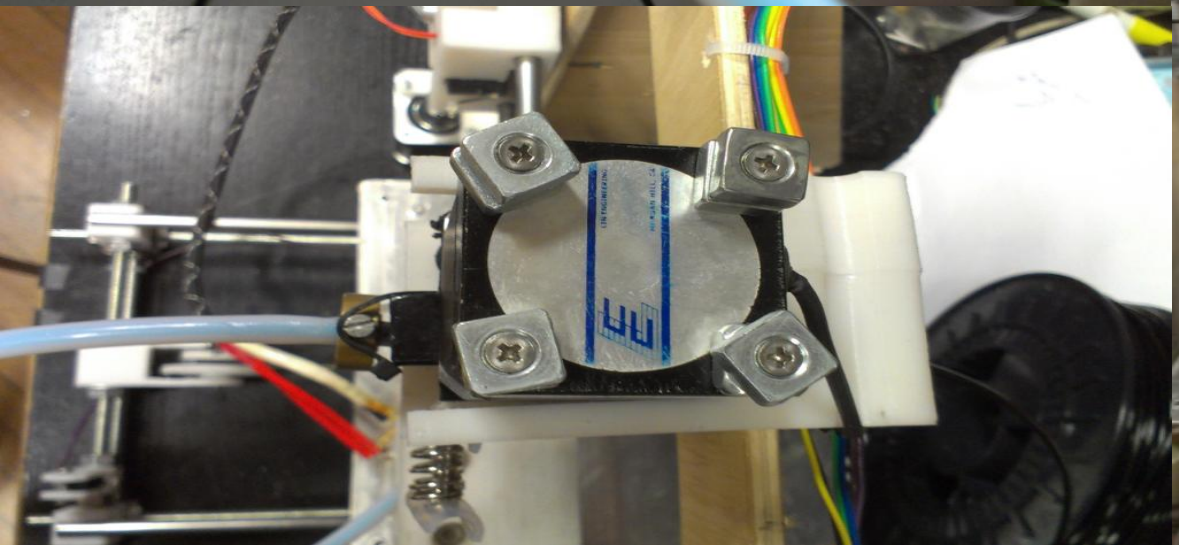




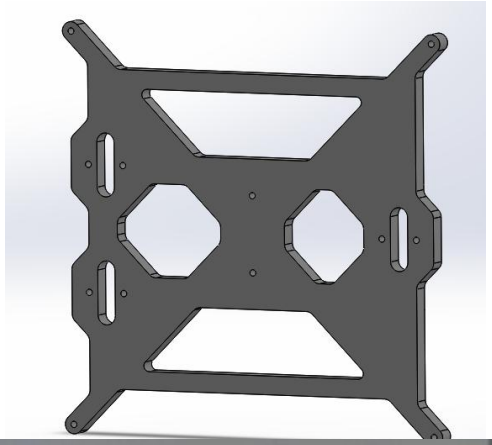
Ekstruder i grijaća glava

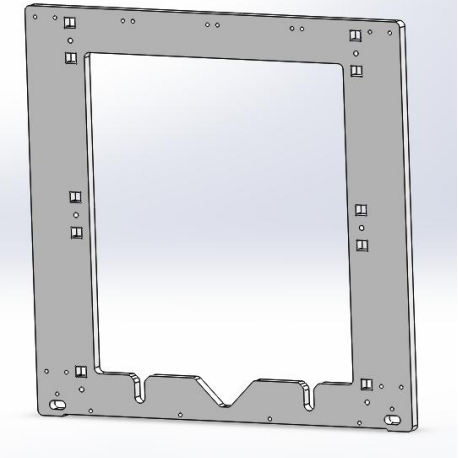


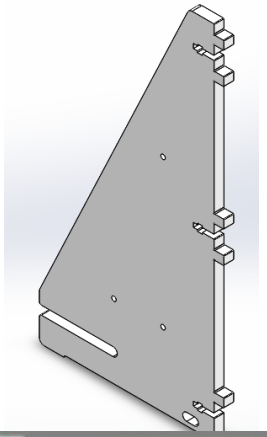


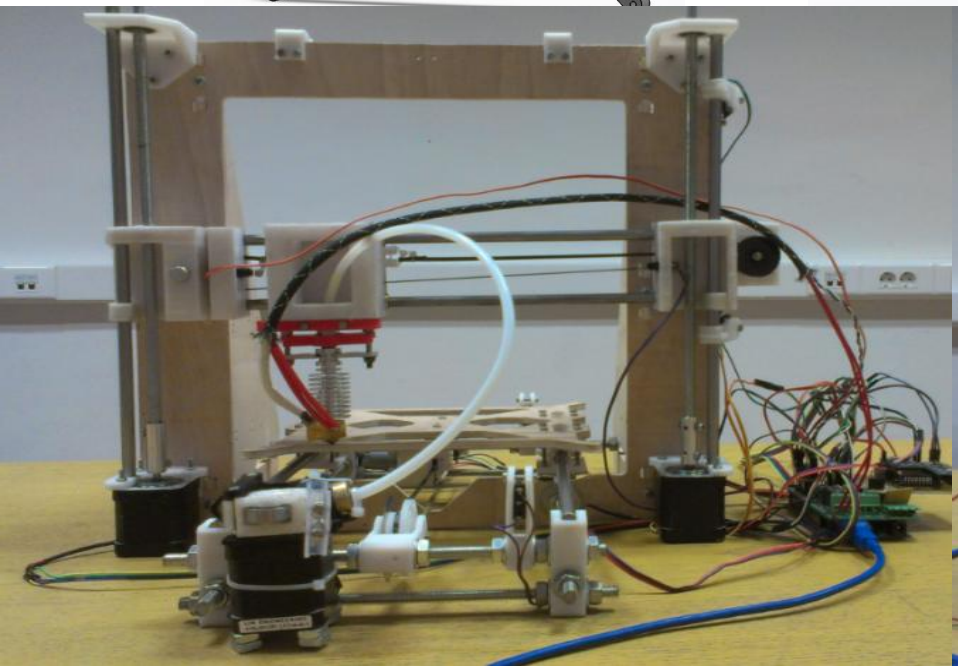


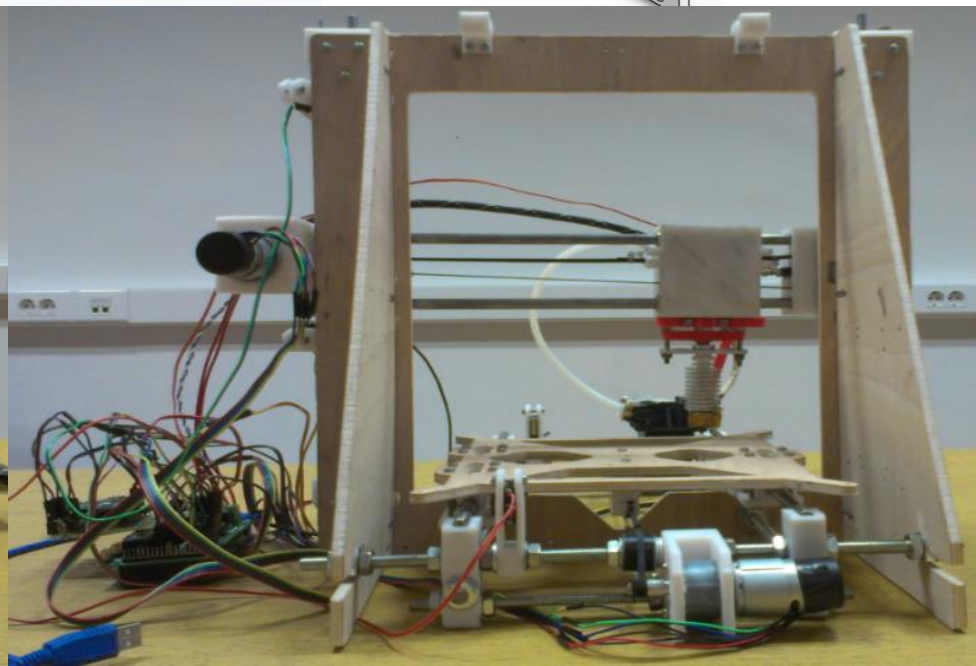
Okvir



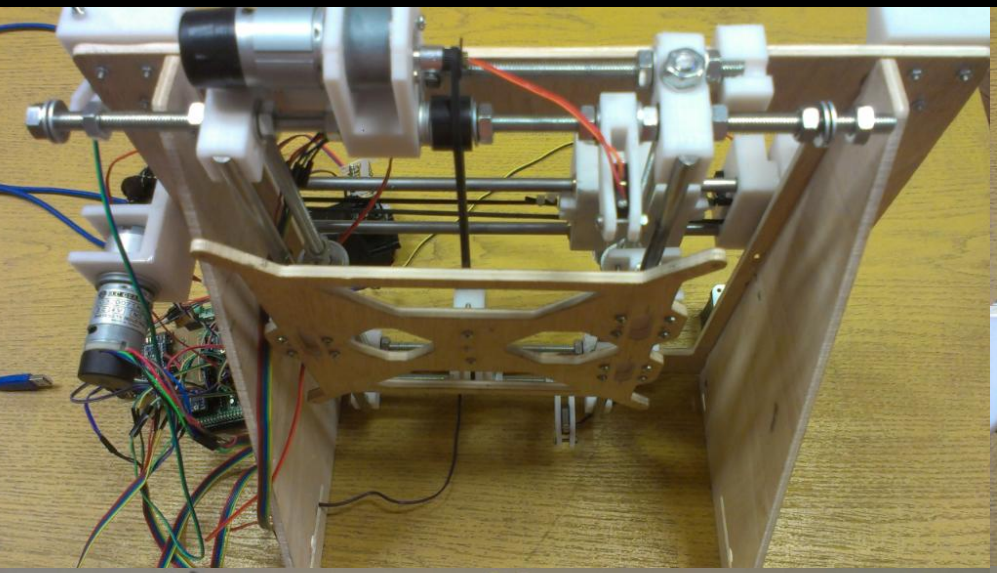


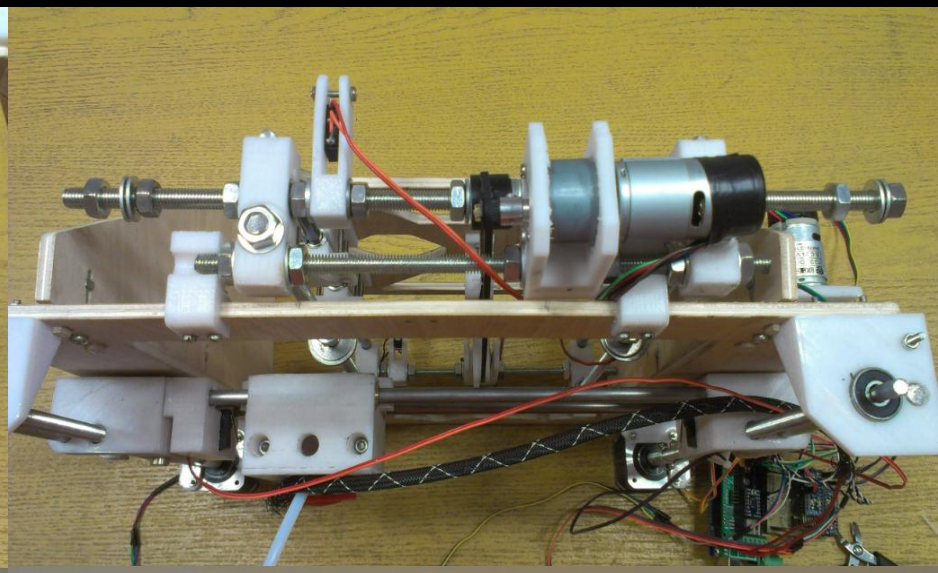


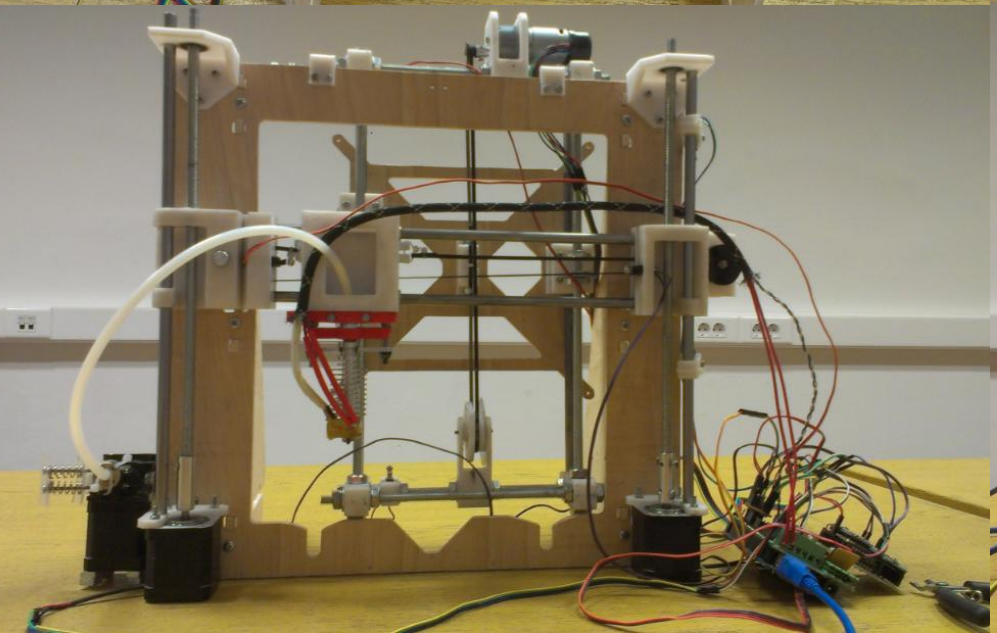


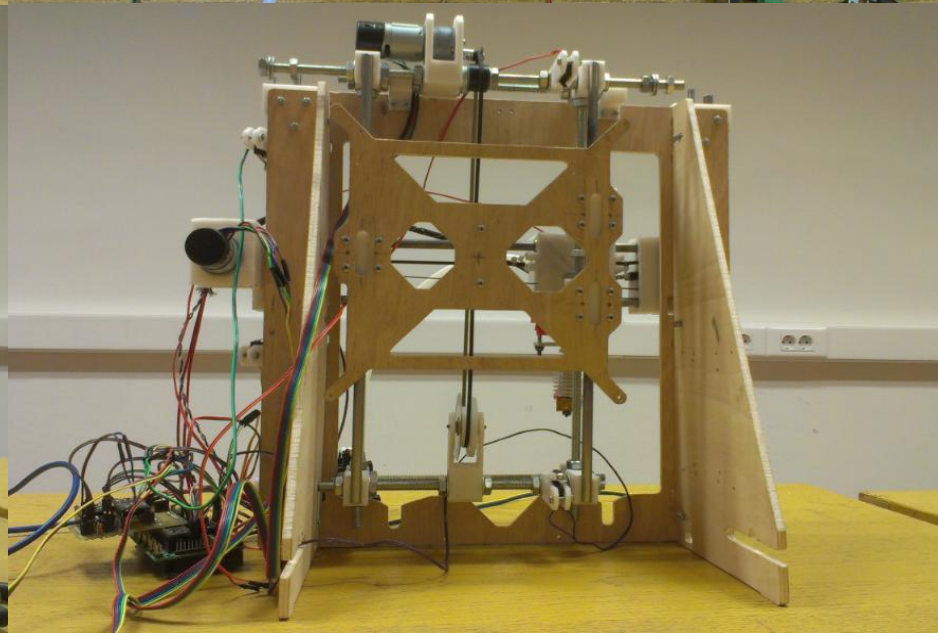


Sklopivost

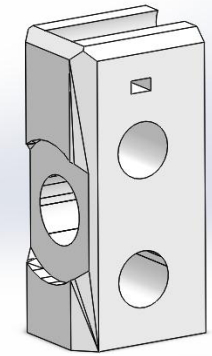
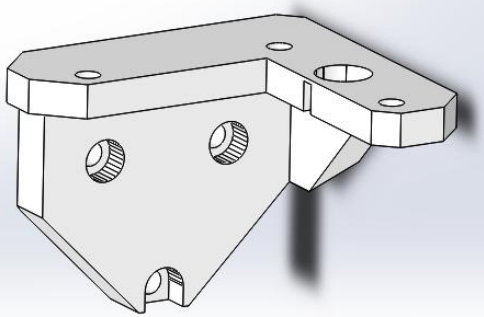
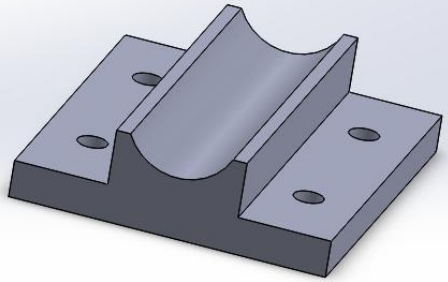
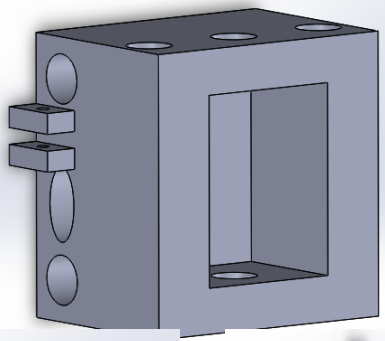
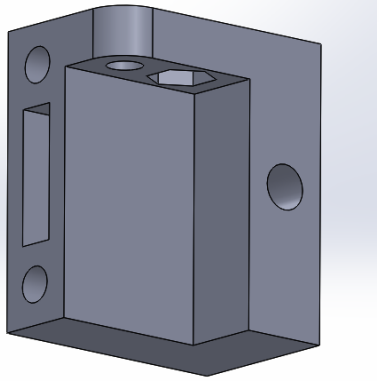
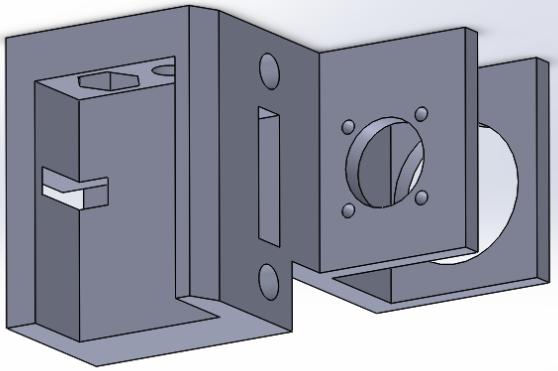
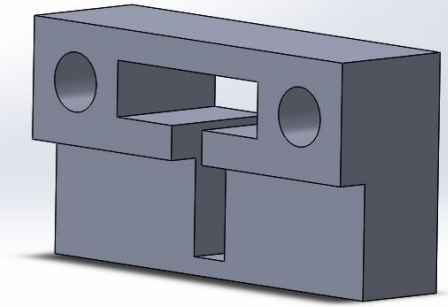
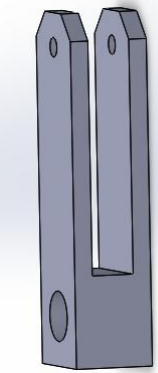
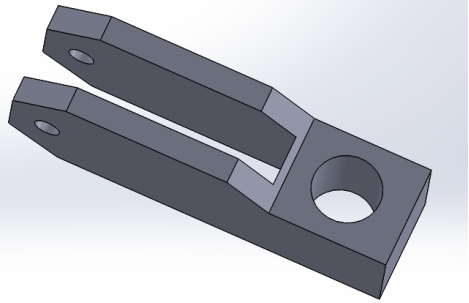
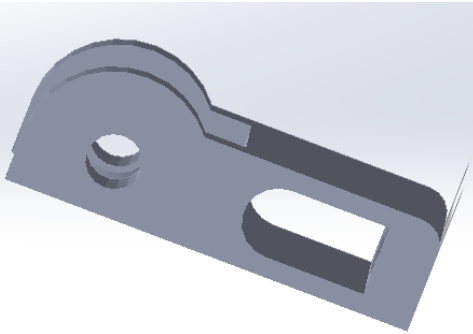
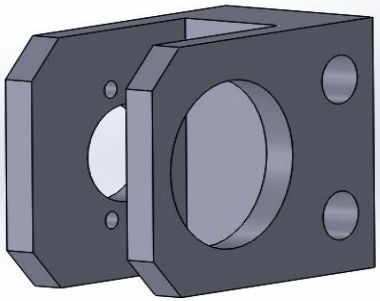
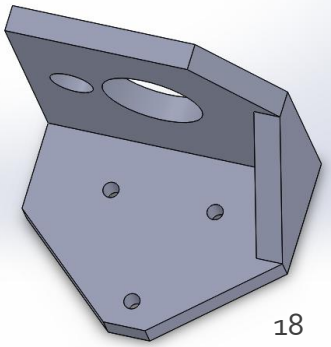




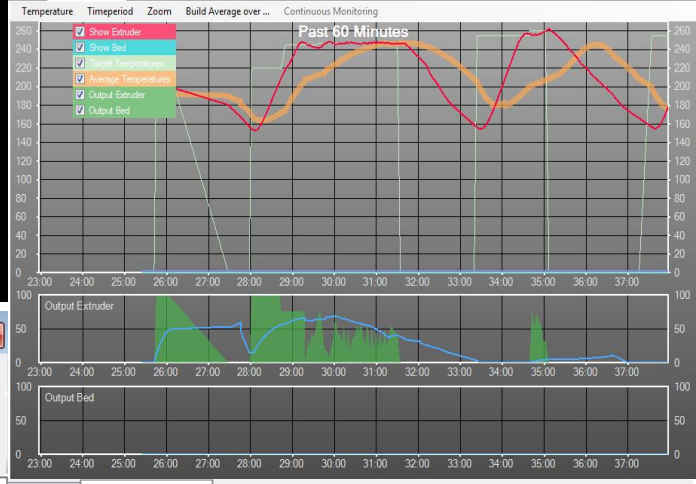


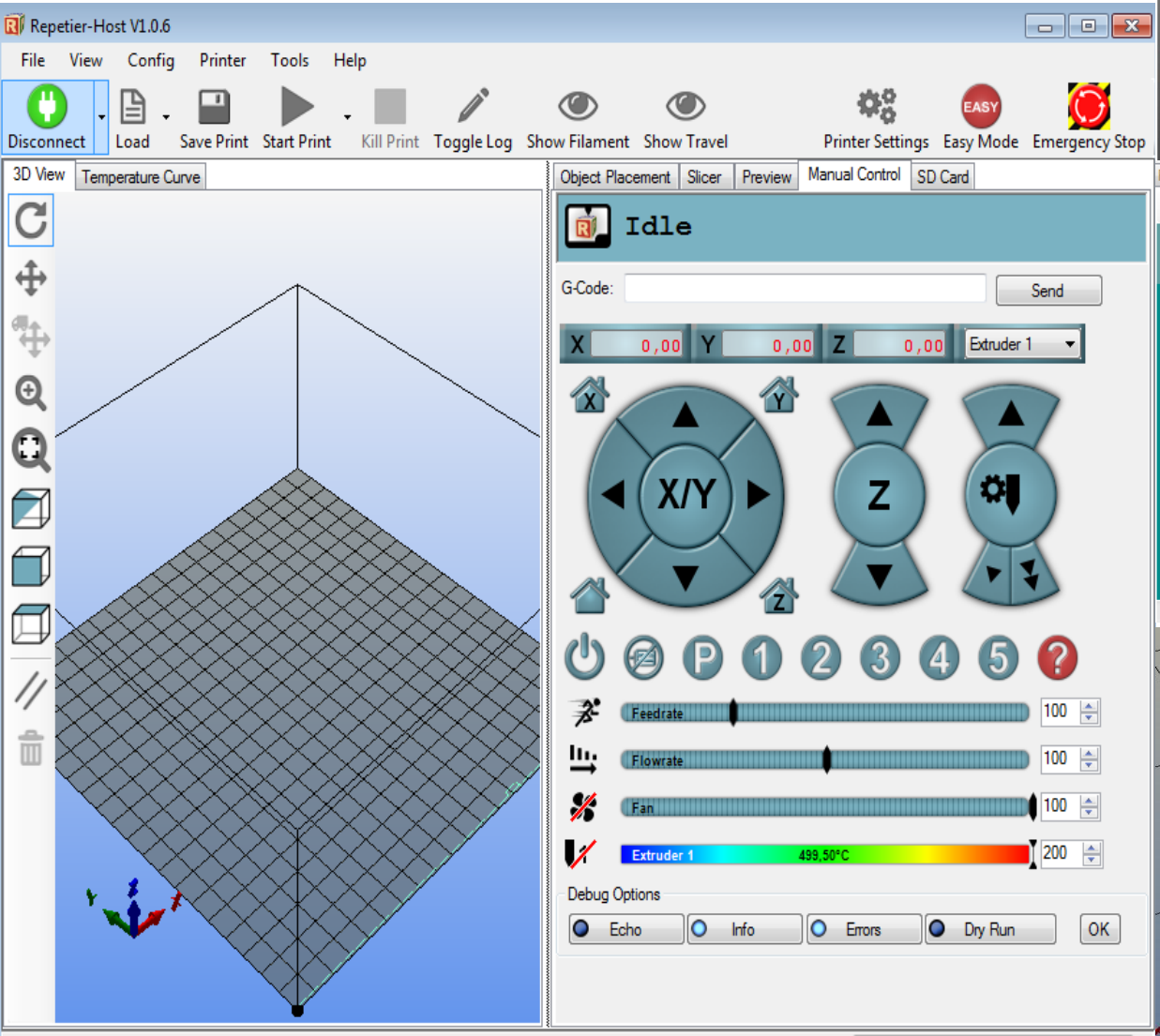


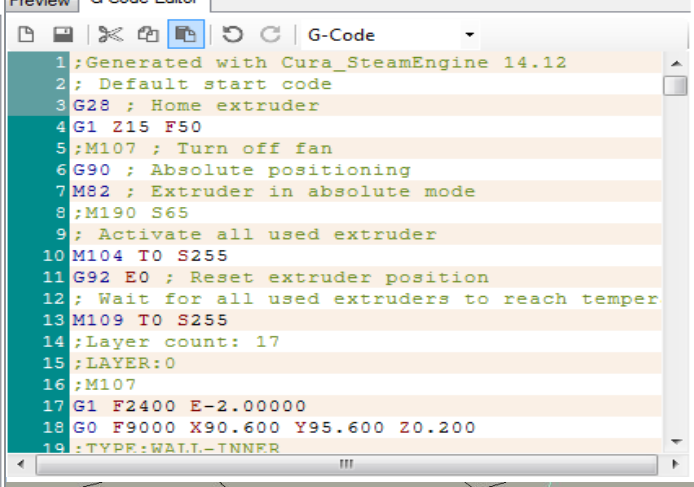
Modelirani dijelovi

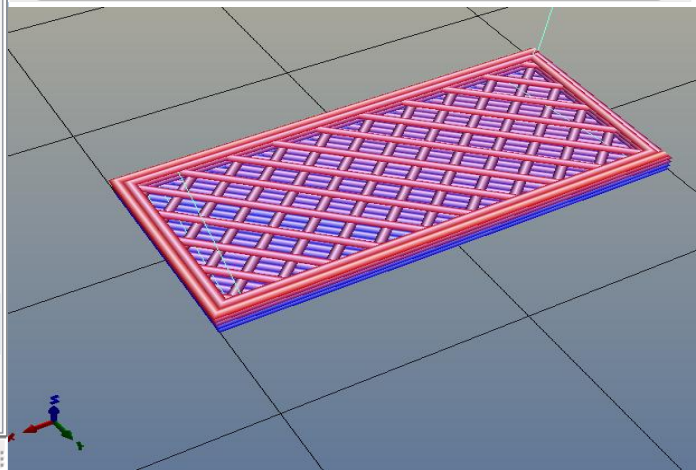













Upravljanje









Zaključak

- Izrađen printer
  - velike preciznosti (<50 μm)
  - 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, grijaču glavu i podlogu
  - planiranje puta kako bi se smanjili trzaji
  - čitanje G koda sa SD kartice
  - LCD pokaznik

Hvala na pažnji!