The production of the robotneedle, step by step

List of required materials
- PLA for 3D printing
  - Printed parts (2D-drawings), using the Ultimaker and Formlabs
    - Main frame (divided and printed in two pieces)
    - Reinforcement top
    - Reinforcement sides (2x)
    - Leading part thread small
    - Leading part axle
    - Leading part thread big
    - Connection motor – axle (2x)
    - Servo holder
    - Servo holder flat (2x)
    - Part reinforcement system
    - Connection axle – rollbearing (4x)
    - Connection pen long
    - Connection pen short
- M5 Thread (Biltema) (250 mm)
- 2 x continuous servomotors
- 180 degree servomotor
- 2,5 mm axle (500 mm)
- 4 rollbearings (outside D4 mm, inside ⌀2,5 mm)
- 5 mm axle (150 mm)
- 2 x M5 nut
- Pen
- Axle ⌀2 mm (20 mm)

Frame and 2 coordinate system
1. Print the frame and all other parts with the Ultimaker and Formlabs 3D printers.
2. Collect all buying parts.
3. Cut axles and thread on right lengths.
4. Glue nuts in the printed parts (leading part thread big (1) & leading part thread small (2)).
5. Put nuts (surrounded by part) around the thread. Number 1 on the long thread and number 2 on the short thread.
6. Place roll bearing in the frame and glue it (only one side).
7. Place and glue one rollbearing in the part "leading part thread big" and one in the part "leading part axle".
8. Glue part "connection axle – rollbearing" on the long thread (one side, to be able to disconnect leading part it necessary).
9. Glue part "connection axle – rollbearing" on both ends of the short thread.
10. Glue the parts "connection axle – roll bearing" on the both roll bearings in the leading parts (the big one and the axle one).
11. Place the short thin axles through the holes of the leading parts (the big one, the small one and the one for the 5 mm axle) and glue them at the ends.
12. Place long thin axles through the holes of the frame and the big leading part and glue them at the ends.
13. Place the 5 mm axle through the holes of the frame and the hole of the leading part and glue it at the ends.
14. Glue the "connection axle – rollbearing" at the end of the long thread to the roll bearing in the frame.

15. Glue the leftover part "connection axle – rollbearing" to the other end of the long thread and glue it.
16. Place the leftover roll bearing at the other end of the frame and glue it, together with the connection part in the roll bearing.
17. Place the part "part reinforcement system" on top of the two leading parts (the big one and the axle one) and glue it.
18. At one end of the frame there has to be placed a servomotor. The connection part is sticking out of the frame. Glue this part to the part "connection motor – axle".
19. Squeeze the part "connection motor – axle" around the servomotor.
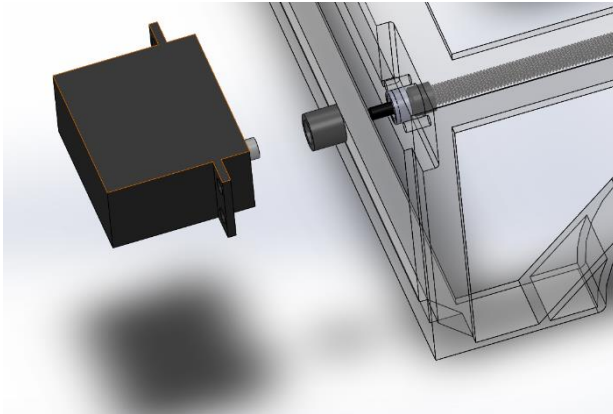
20. Do the same for the other servomotor, but connect it to the part "leading part thread big".
21. To reinforce the holding of the servomotors:
    a. Glue the part "servo holder" underneath the part "part leading thread big" and connect this part to one of the servomotors with double sided tape.
    b. Glue the parts (2 times) "servo holder flat" to the frame and connect it to the second servomotor with double sided tape.
22. Drill a hole in the frame for the IR camera (ø16 mm).
23. Drill small holes in the frame to put the LEDs through (x10))
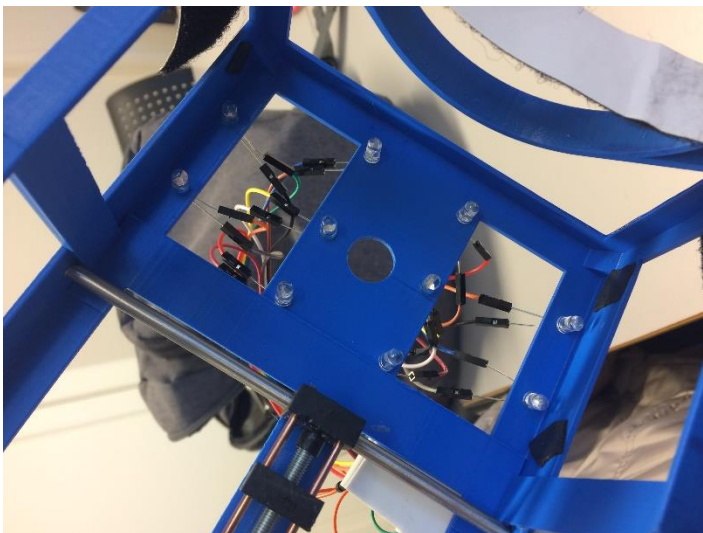
Pen movement
1. Print the parts "connection pen long" & "connection pen short".
2. Drill the holes in the part with a diameter of 3 mm.
3. Squeeze the axle (ø2 mm) into the hole of the 180 degree servomotor
4. Connect the pen between the two printed parts, using M3 bolts
5. Connect the white part of the servo to the printed parts, using one of the bolts
6. Squeeze this white part around the connection part of the servomotor
7. Glue the servomotor to the part "leading part thread small"

END RESULT: