Final Report on 3D-printed camera stand for photographing the night sky

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S-92.3299 Astronomical View of the World 2013

Introduction

This 3d-printed camera mount was our project for the Aalto University's *S-92.3299 Astronomical View of the World* course and was partly printed with help of Aalto ADDLAB. Our goal was to build a camera mount that would rotate as the earth rotates and thus keep the stars in place. This enables the mounted camera to take long exposure photographs of the night sky with more visible stars. This kind of mount also enables time-lapse videos of the sky with relatively static stars.

Inspiration for the project

We wanted to do something physical and if possible get to use 3d-printers as much as possible. We also had thought about photographing the sky before, but we were missing mount for a camera. The design was inspired by countless articles in the internet about camera mounts and by a ready project that I once saw at my friend's garage.

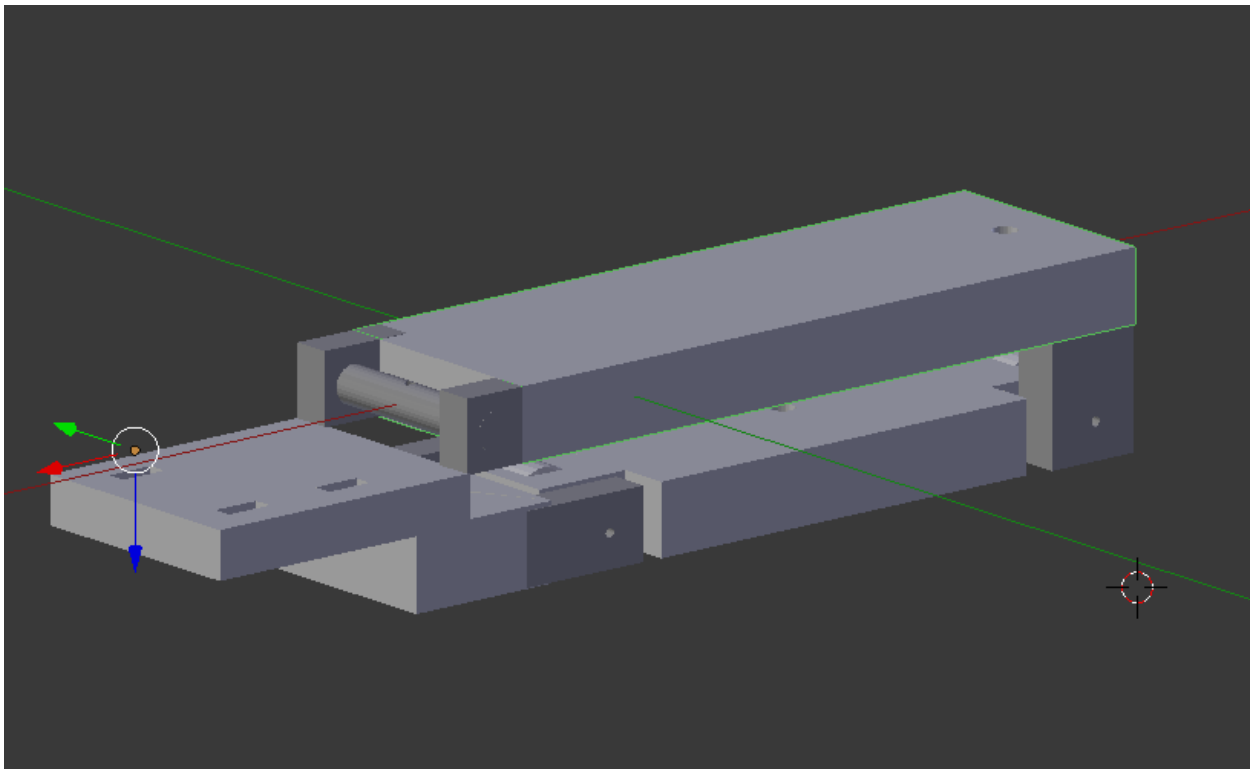
Project goals

1. Make a mount that will follow the sky (Not tested, but should work)
2. Make it automatic, so that no human interaction is not needed while it is operating (Done, it rotates itself automatically)
3. Publish the design openly (published on github with CC license)
4. Add more features(camera control etc. Not ready)

Removing excess material from a printed part with a drill

Design of the parts

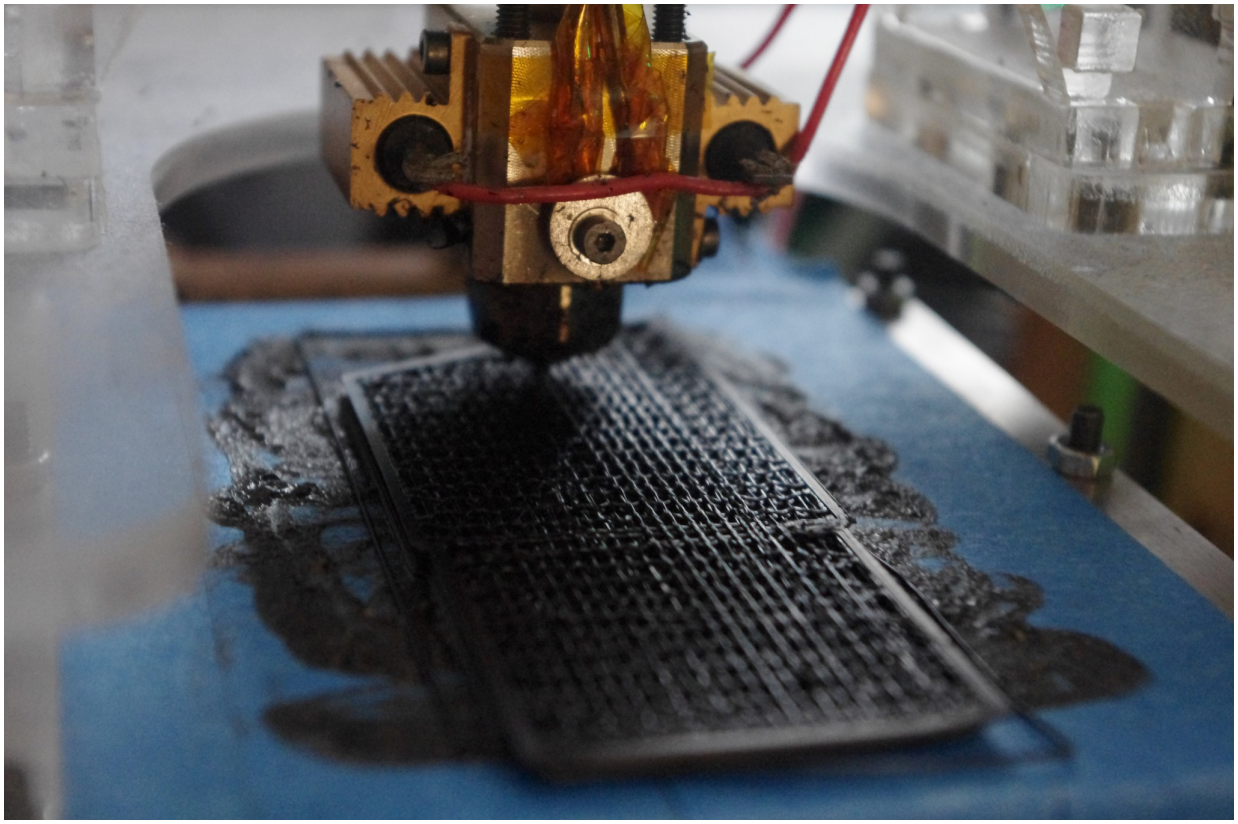
Parts were designed in Blender 2.66 and printed with 3dTouch printer and with Cupcake CNC -printer. We ran into some trouble with getting the dimensions right with Blender and stl-export. Blender also included non-needed geometry in the design files, which confused the printers and had to be manually fixed.



Model of the parts in Blender

3D Printing

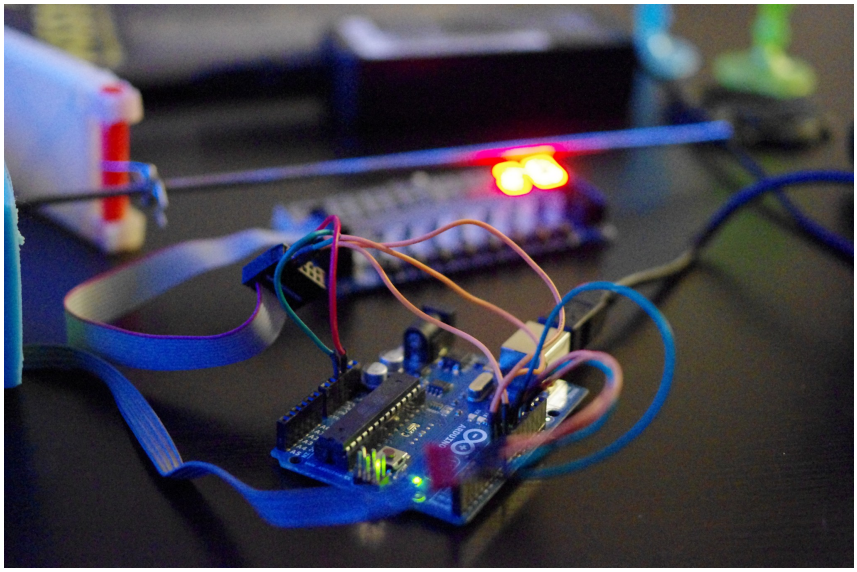
Gcode was generated with axon2 for 3dtouches and with skeinforge for Cupcake. Some parts were printed in PLA(Upper mount, motor mount and the upper axle) and other with ABS(lower mount). Generally the performance was better with ABS and the Cupcake printer, but 3d-touches much bigger print area helped to make the bigger parts in one go. Parts printed with PLA warped more because of the uneven cooling, ABS parts did not warp, because those were printed with the Cupcake with Heated Build Platform that remedies the warping almost completely. ABS slurry was used on Cupcake to ensure the sticking of the print to the print platform.



Cupcake CNC printing ABS on ABS slurry. Part being printed is the second half of the lower mount.

Electronics

We are using Arduino Uno as microcontroller for the project, pololu stepper drivers for driving the motor(will be changed to something else, we broke 3 of these while testing :<) and jy-lkm1638 display/led/button board for the user interface. Electronics work, except for the stepper driver, so no loads can be driven, only rotation tests.



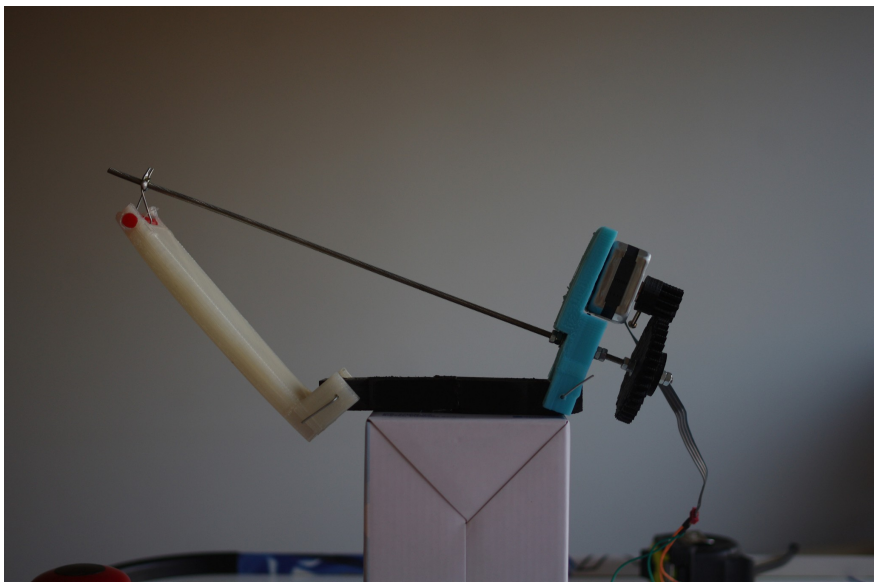
Arduino Uno is used to control the motor and display

Software

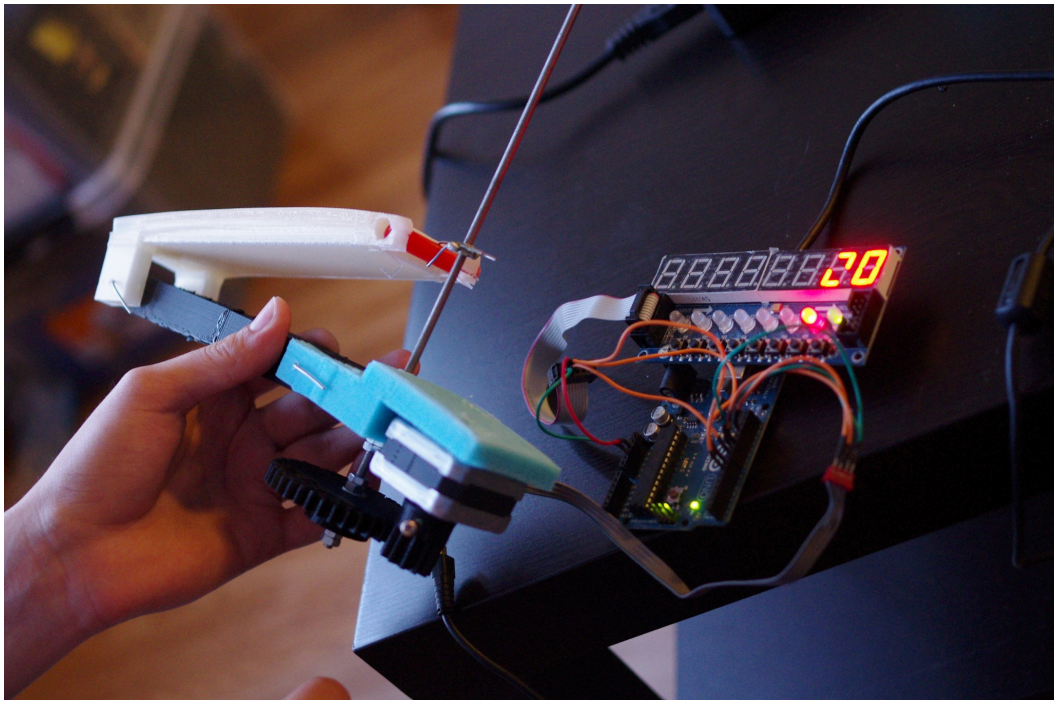
Arduino is programmed with C++ programming language. The IDE that comes with the arduino drivers is very basic in features and is unsuitable for real programmers so we downloaded an arduino programming plugin for Netbeans IDE. Netbeans was already familiar to both of us so once we managed to setup it for arduino programming it made writing the final code much easier. The program we wrote for arduino allows us to increase and decrese the speed of the stepper motor as well as change the rotation direction. There's also a button for stopping the motor. A display connected to arduino shows the current speed of the motor and changes to rotation direction.

State of the project

The course has finished, but the mount is not completely ready yet. Mechanical construction is ready and tested, but electronics are still lacking because of the fried stepper controllers. Software for the microcontroller is ready. We have uploaded a video demonstrating the mount and the state of the project in youtube http://www.youtube.com/watch?v=7MEBemAZFiw&feature=youtu.be and demonstrated the project on the last meeting onf the course. Now that the course is over we plan to improve the design and repair the electronics.



Mount undergoing an extension test



Mount at the end of the project

Planned improvements

We plan to add the Stepper motor driver, which will make moving heavy objects(camera) possible. We are also planning on printing a camera adapter to change the orientation of the camera mount.

What we learned

This project was a great learning experience about designing and building a physical thing, especially about using 3d-printing for prototyping something relatively big. We also learned things about designing and about simplifying things.

People we would like to thank

We would like to thank all the course personnel, this was probably the best “Aalto” -course we have taken, it was a lot of fun and some really nice food for thought.

We would also like to thank Aalto ADDLAB, especially Meng Wang and Sergei Chekurov for letting us use the printers and helping us with them.