Build a 30$ laser Scanner

by **Sardau** on April 2, 2015

Table of Contents

Intro: Build a 30$ laser Scanner

This instructable will guide you to build a 3D scanner for less than 30$.

No you didn't misread, 30$. Event 12$ if you already have a usb webcam.

After seeing the price of the commercial scanner, they limitations, i've decided to build my own as a intelectual challenge. It as to be cheaper, every body with a 3D printer must be able to build one.

Here is the result.

The Scanner is a Laser scanner, comparable (if not better) to the M****bot digitizer, or other professional scanner, but for less than 20 times the price. and have twice the number of lasers.

The principe of the "Sardauscan" is "keep it simple", "keep it low kost", "keep it evolutive" and do a "complete solution"

The Sardauscan scanner is totaly open source and open Hardware.

The software is writen in C sharp. and all the source are available. He is not limited to any hardware, you can write plugins for your own hardware. Easely.... realy.

The software allow you to scan , smooth, build meshes and export to variuous format.

How a 3D Laser scanner work ?

The principe of a 3d laser scanner is simple.

You take a picture of the object with all laser off. then you light one laser on and you retake a picture.

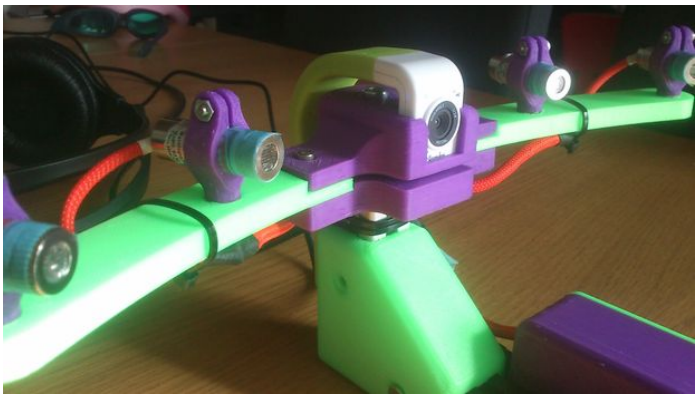
You make a "difference" of the 2 images, it give you the laser trace: a profile of the object.

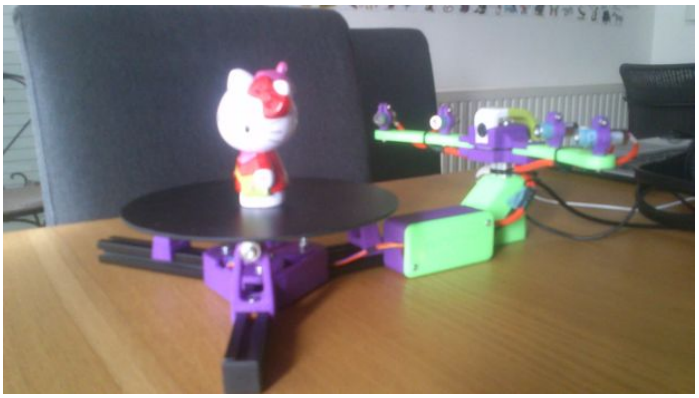
Knowing the camera position and the laser position, with some geometry, you can compute the 3D coordinates of all these trace pixels.

You do it for all the lasers, you turn the table

you do it until the table has made a full revolution.

there you are, with a "pointcloud" representing your object.





Step 1: What do you need ? and how much ?

Here is the list of all the parts you need to build the scanner.

Bunch of M3 (16 and 20 mm)

Bunch of M4 (12 ans 20 mm)

1x Arduino nano (chinese copy, 4$) http://www.befr.ebay.be/itm/NEW-Nano-V3-0-ATmega3...

1x chinese Stepper Motor and controler (5$) http://www.befr.ebay.be/itm/NEW-Nano-V3-0-ATmega3...

1-4x Line laser (2.5$ piece) http://www.befr.ebay.be/itm/NEW-Nano-V3-0-ATmega3...

1x Hercule HD twist (15$) http://www.befr.ebay.be/itm/NEW-Nano-V3-0-ATmega3...

20x20 profile (can be printed : there are plainy stl on the net)

optionnal 3x 4mm roller (0.3$ piece) (624 bearings)

Total 26.5$ (1 laser) to 35$ (4 lasers)

Concerning the 2020 lenghts, it is not realy important. the only constraint is to have the camera to see all the table.

For exemple here are the lenghts i've use for my build :

2x 140mm

1x 120mm

1x 250mm

What to print. ?

All the STL are located on thingiverse :

http://www.thingiverse.com/thing:702470

1 x arm_left.stl

1x box.stl

1x box_door.stl

1x box_arduino_clamp.stl

1x arm_right.stl

1x CORNER.stl

1x MOTOR_MOUNT.stl

1 to 4 x laser_holder.stl

1X Camera_HOLDER_LOWER_PART.stl

1x Camera_HOLDER_UPPER_PART.stl

1x center_axe_MINIMAL.stl OR 1x table_AXLE.stl OPTIONAL

3x roller_baseV2.stl

you can print 12x M4_tslot_nut.stl if you use 20x20 profile and you don't have any

Remarks :

The 2020 profiles are only for the ease of use. you can use whatever you whant, wood, metal etc.

If you whant to use another camera, you only need to redo the "'Camera_HOLDER_UPPER_PART" to match your camera.

The bearings are optional, it is only necessary if you whant to scan "heavy" object or if you cant get your table flat.

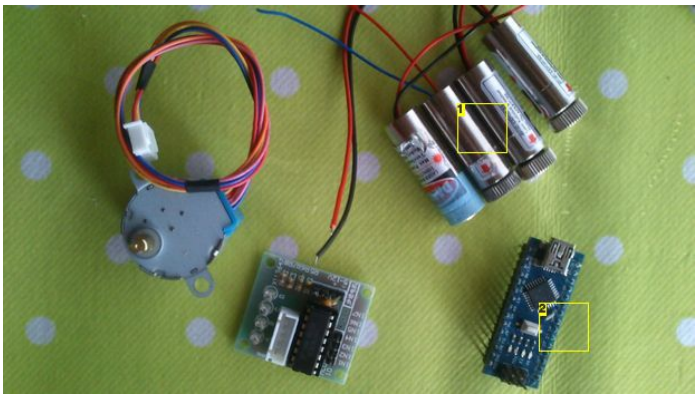
"Keep the build simple"

The build is realy simple, just look at the pictures.

put the motor at the center, put the 3 profiles around, screw them. Put the corner, screw, put the arms, screw ....

there is a hole for each screw, you can't get it wrong.

For the wiring, refere to the diagram . no problem there.



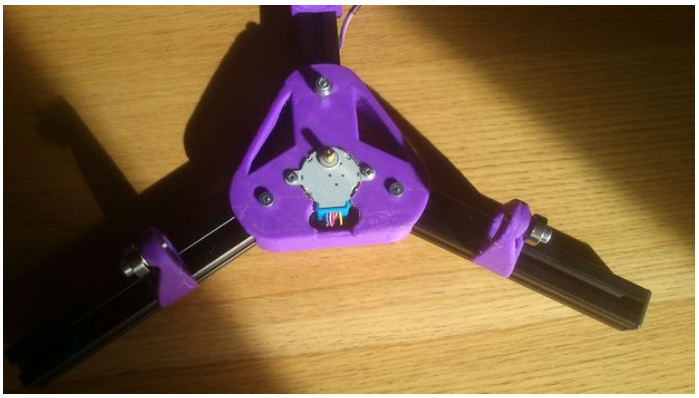


Image Notes
1. Line lasers
2. Arduino Nano

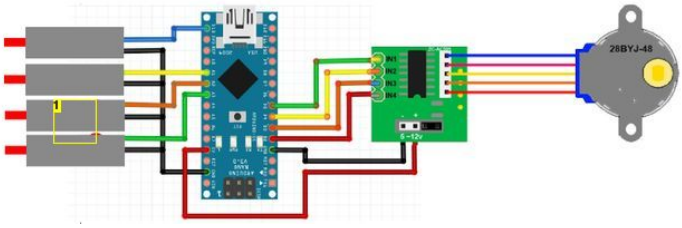


Image Notes
1. lasers

Step 2: And now what ?

At this point, all you need to complete the hardware part is to upload the firmware.

To upload the firmware, you need the arduino ide or another sketch editor.

The firmware is available on the Sardauscan github :

https://github.com/Sardau/Sardauscan

You must edit the configuration.h to match your wiring.

The firmware is a normal arduino sketch, but be aware that you must install the accellstepper library in arduino to compile the firmware
https://github.com/adafruit/AccelStepper

Just upload it like any other arduino sketch.

now that your hardware is complete, test it !

Connect to your arduino with the arduino ide (or other).

type "sardauscan" , the arduino must respond "yes".

Try the stepper : type "T R 100" , your table must turn from 100 steps.

Try the laser : type "L 0 1" for Laser first (0) to on (1). the first laser must go on.

If something didn't work, verify your wiring and that your configuration.h correspond.

Step 3: Software and Calibration

No you need the install the Sardauscan Software.

Go to github and download the last binary version.

Extract it in a directory on your computer and launch the exe file.

On the main interface, you must have 3 red icons. one for the table, one for the lasers and one for the camera.

Just click on them to connect the corresponding hardware.

If you use the standard sardaukan firmware the table and the laser are link.

Now that you have your hardware ready, that your software know the hardware.

It is time for the tricky part, the Calibration.

The calibration take 3 steps.

a manual calibration, the build dimention and the correction.

The better the calibration, the better the result will be.

To calibrate click the target icon.

and on the "manual" button.

First of all, move your camera so that the vertical line in the preview window cross exactly the center of the table.

now click on the center of the table in the preview window . the lines will help you to align the calibration object.

place the calibration object (stl on thingiverse) on the table. flat face in fron on the camera (help you with the horizontal line).

now click on the first laser icon on top to light the first laser. align the laser line to the vertical line on the preview window.

Do it for all your lasers.

the Manual calibration is finished.

Now click the "build dimention" button and enter your build dimention.

As the calibration is never perfect, and exponentialy difficult to the number of laser, the "correction" will help you to correct the previous errors.

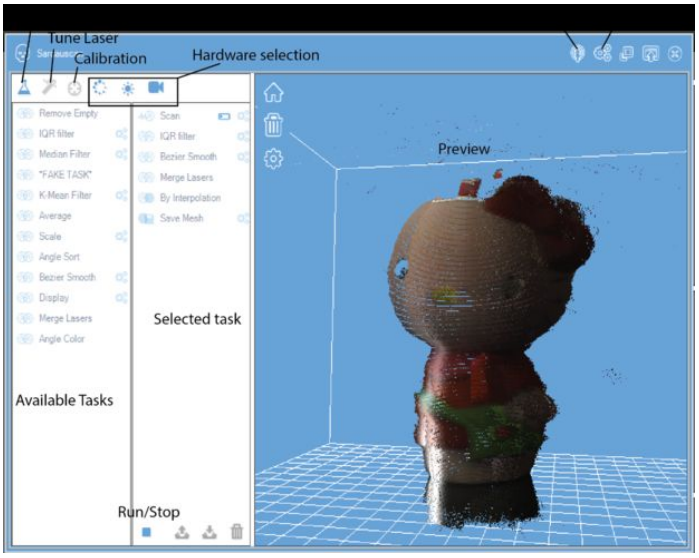
place your calibration object on the center of the table and click "quick scan".

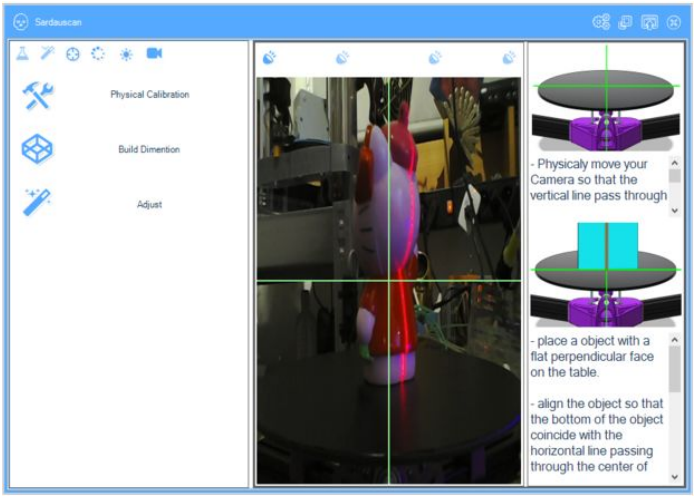
when the scan is finished, you will see a top view of you scan. each color coresponf to a laser.

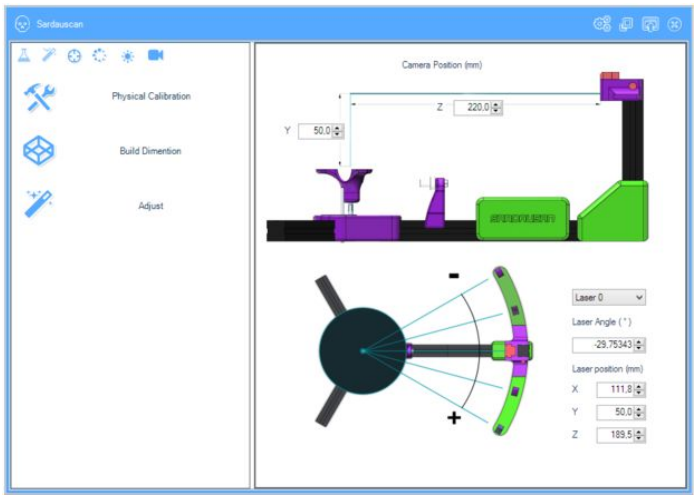
the game here is to superpose as best as possible the laser scan relative to each other.

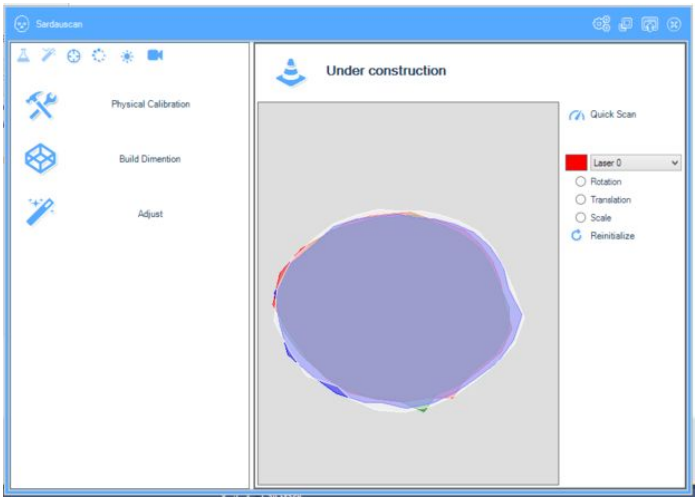
Select a laser in the combobox, you can rotate (left mouse button) scale (middle) and pan (right) the laser scan.

All is aligned, congratulation your calibration is done.









Step 4: WTF is this for a interface ?

To be evolutive, the software is articulated around task and process.

When you open the programm, you see at the left a list of available task.

To do something in the program, you drag the task to the right list and hit play icon on the bottom.

Here is a non exhaustive take.

Scan => scan a object

"Grab pictures" => take pictures around the objects to use is a photogametry program.

"Filter IQR" => do a IRQ filter to remove noise in datas

"Filter Median" => do a median filter to remove noise from the datas.

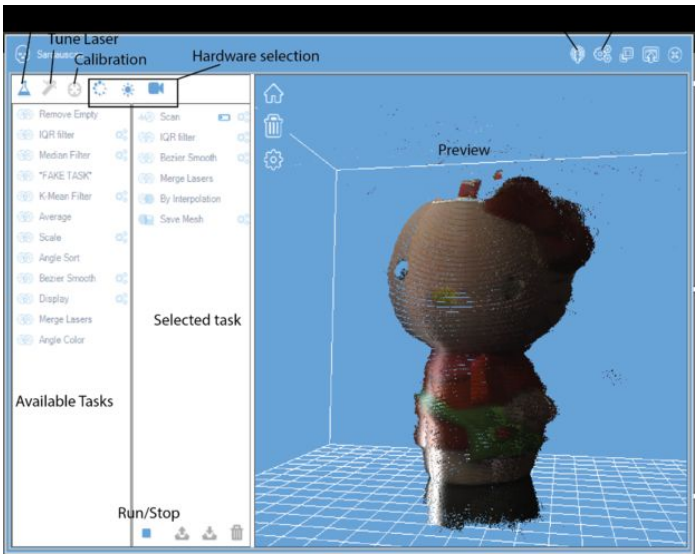
"Angle" => merge laser scan by angle (smooth the scan, and filter noise)

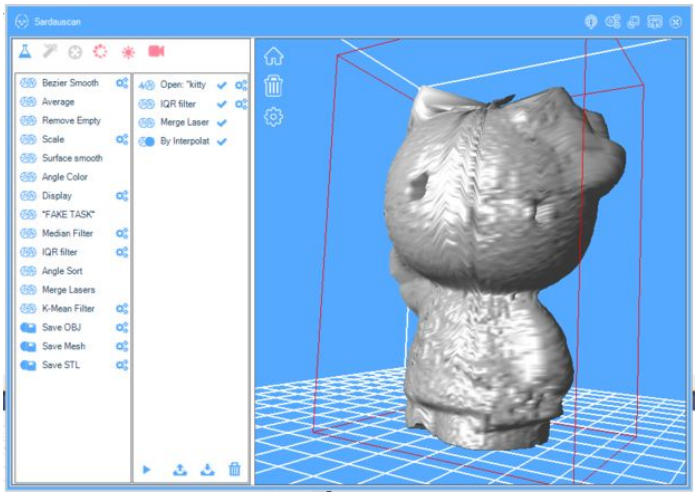
"Besier" => Smooth the datas with besier curve

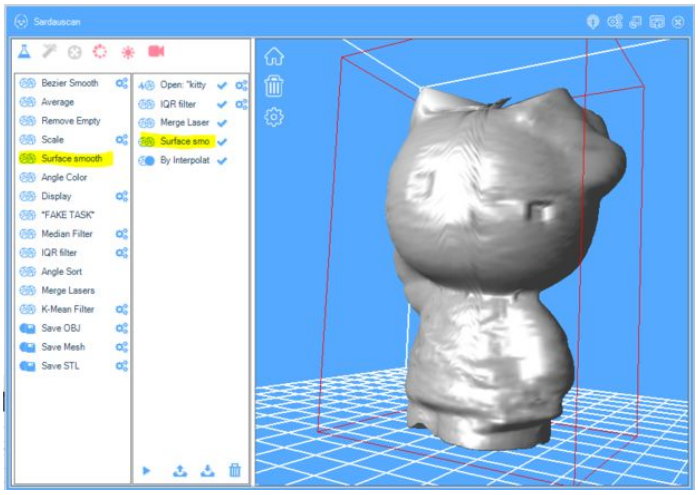
"Surface" => smooth the datas with a laplace surface smooth

"Save ply" => save a ply file to use with meshlab or another pointcloud software.

"Save STL" => guest what ? :)







Step 5: Developper Corner : Evolution ? Own hardware ? plugins ?

As i said, the Software is not link to the sardauscan build. The software is made to be evolutive.

You can do almost whatever you want via plugins.

You have a magical alorithm?

Do a plugin for it !

You have a custom image acquisition hardware ?

Do a plugin !

You want to use your own hardware firmware for the table or the laser ?

Do a plugin !

You can look at the github repository, there are some plugins samples. it is realy simple to code.

To use the plugin, just copy then in the "plugin" subdirectory.

Happy scanning !

Related Instructables

WhiteScanner3D Mark 2 video (video) by wezyap

Sense Scanner Holder for MacBook Pro by Aminimal

Sardauscan sub-30$ Opensource 3d laser scanner by Sardau

WhiteScanner3D slideshow (Photos) by wezyap

EASY Kinect 3D Scanner! (video) by toddie123

DIY Digital Caliper Micrometer Comparator by iectyx3c

Comments

2 comments **Add Comment**

Bongmaster says:
u missed the word 'scanner' in the title ;)

Apr 2, 2015. 12:01 PM **REPLY**

Sardau says:
thx ;)

Apr 2, 2015. 12:15 PM **REPLY**