UMass Amherst

3D Scanner MDR

Team 8

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PDR Recap : What's All In One 3D Scanner

What's our motivation ?

- to build a fully automatic, affordable and PC-free 3D scanner

Who is it for?

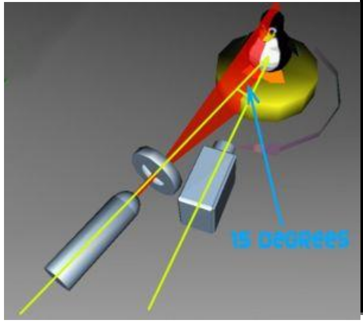
- anyone who desire to buy a user friendly 3D scanner. Designed to smooth into your workspace.

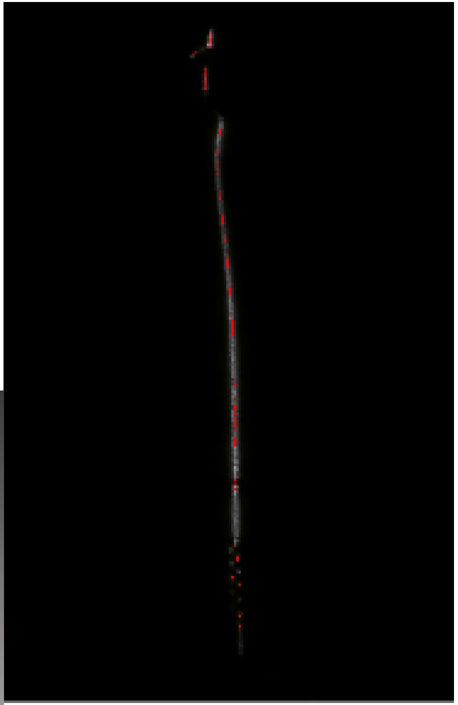
What does it do?

- uses a Raspberry Pi to do imaging, user interface, the math and to control the A4988 stepper driver board and lasers
- Input: physical object; Output: STL file

PDR Recap: How it works

- pictures is taken with ON and OFF
- then compare between the two images
- a laser trace is obtained
- by knowing the position of the camera, system can drive the 3D model by using the 3D triangulation to generate a point cloud for each location where the laser hits the model.

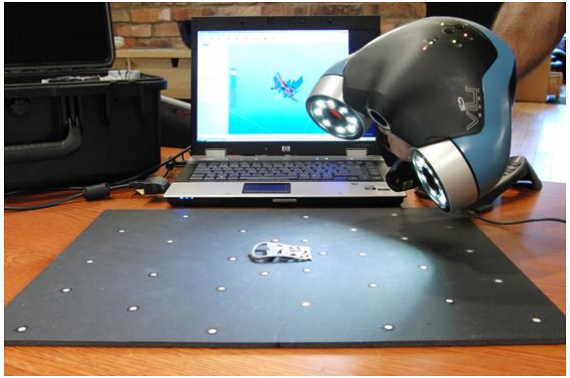




source: http://www.soliforum.com/

Significance and Social Impact

- Currently no stand alone scanner
- Must be wired to computer
- In need of some other device to run



Significance and Social Impact

Time Saving

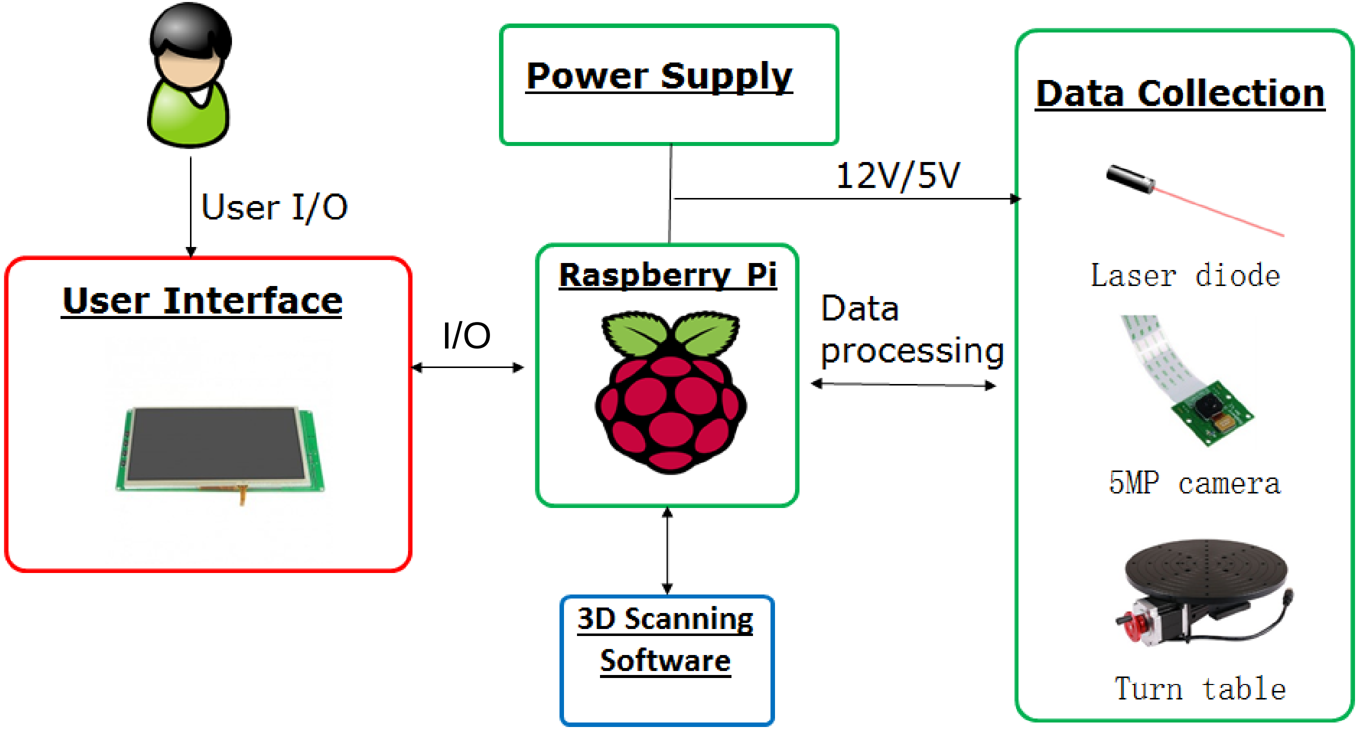
- people are busy
- scanning is a process that takes time, let alone the time it takes to set up scanners.

Significance and Social Impact

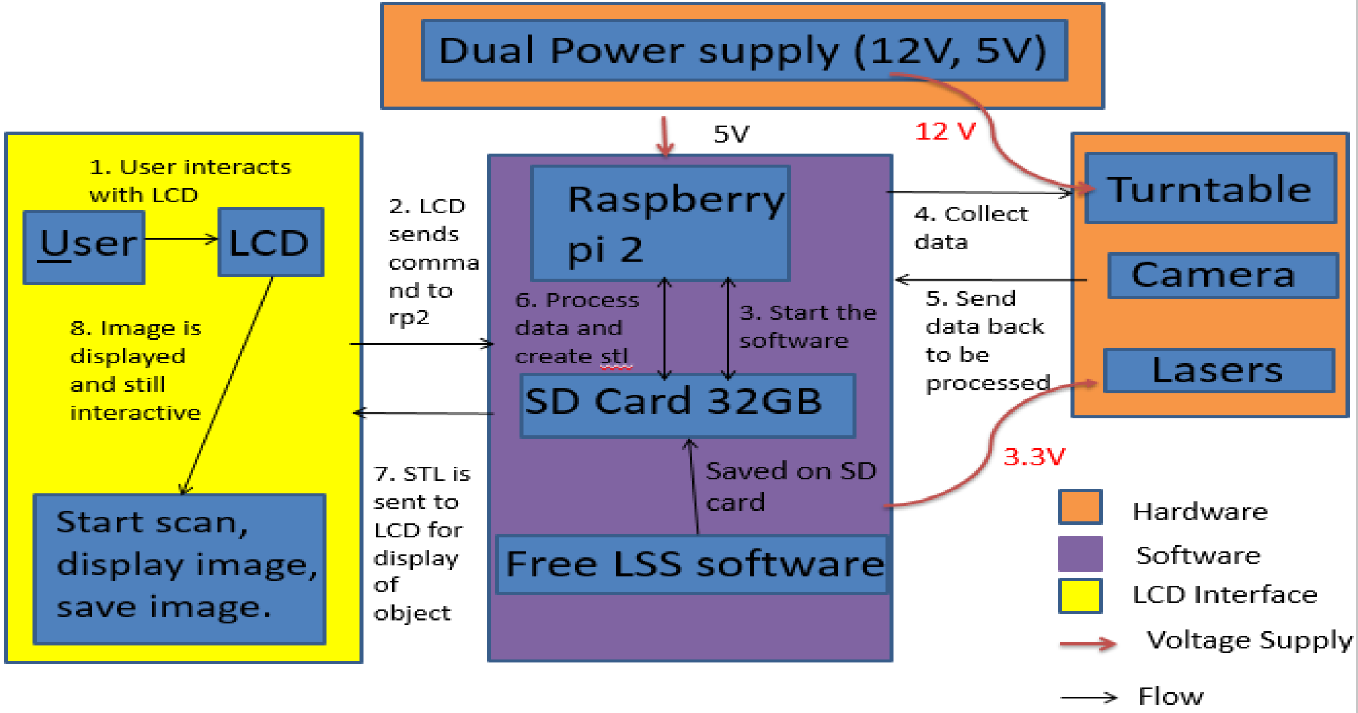
No Room, No problem

- People can now place the scanner anywhere they want.
- No longer needs to be in a room with multiple outlets.
- Can be placed anywhere that is aesthetically appeasing
- No need to rearrange the setup of your home
- Convenient

Previous Block Diagram



Updated Block diagram


Dual Power supply (12V, 5V)
5V
12 V
1. User interacts with LCD
User
LCD
8. Image is displayed and still interactive
Start scan, display image, save image.
2. LCD sends command to rp2
7. STL is sent to LCD for display of object
Raspberry pi 2
6. Process data and create stl
3. Start the software
SD Card 32GB
Saved on SD card
Free LSS software
4. Collect data
5. Send data back to be processed
Turntable
Camera
Lasers
3.3V
Hardware
Software
LCD Interface
Voltage Supply
Flow

System requirement

- Able to take object as input and produce an stl (STereo Lithography) file of that object.
- It must scan objects that fit in the base of the turn table (4" in diameter) and up to a foot in height.
- Produce an accurate model of the input object, (without paying attention to minor details)

System Requirements

How accurate is “accurate”

- Model should be within +/- 2 millimeters of accuracy in terms of size. (~0.08 inches)
- In terms of area +/- 8mm^3

System Requirements

Time requirements

- Able to do a scan within 15 minutes of turning on the system

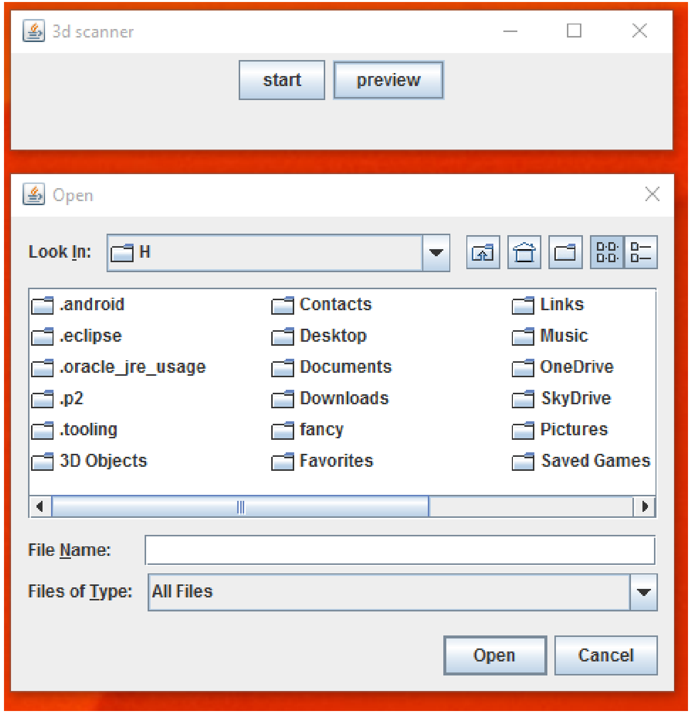
Interface requirements:

- User friendly, able to be operated by people with 0 experience working with RP, terminals, or linux based systems

What we thought

-We thought freelss does not have GUI

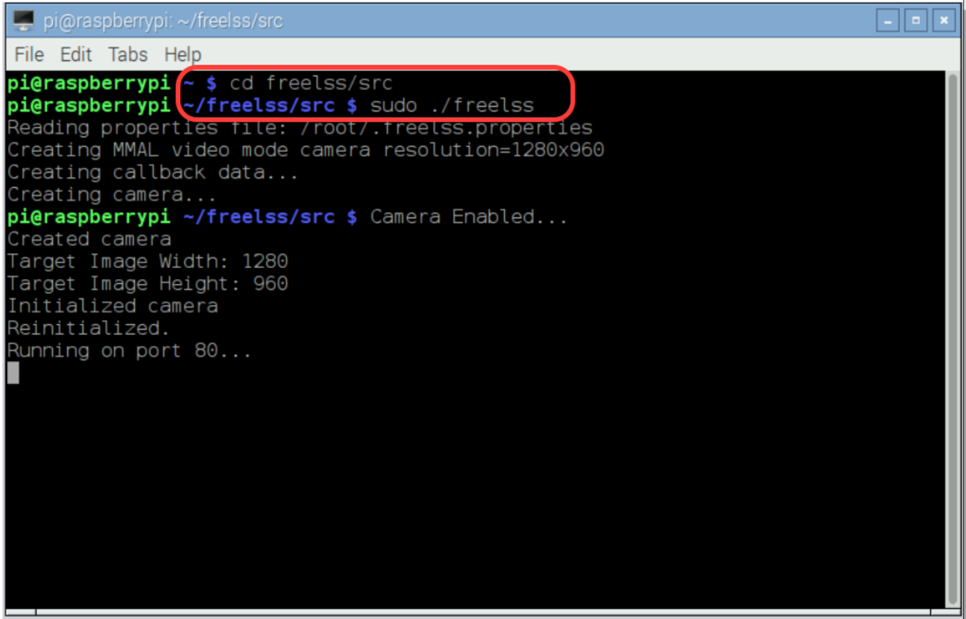
-User interface on freelss is too small on a 7 inches touchscreen



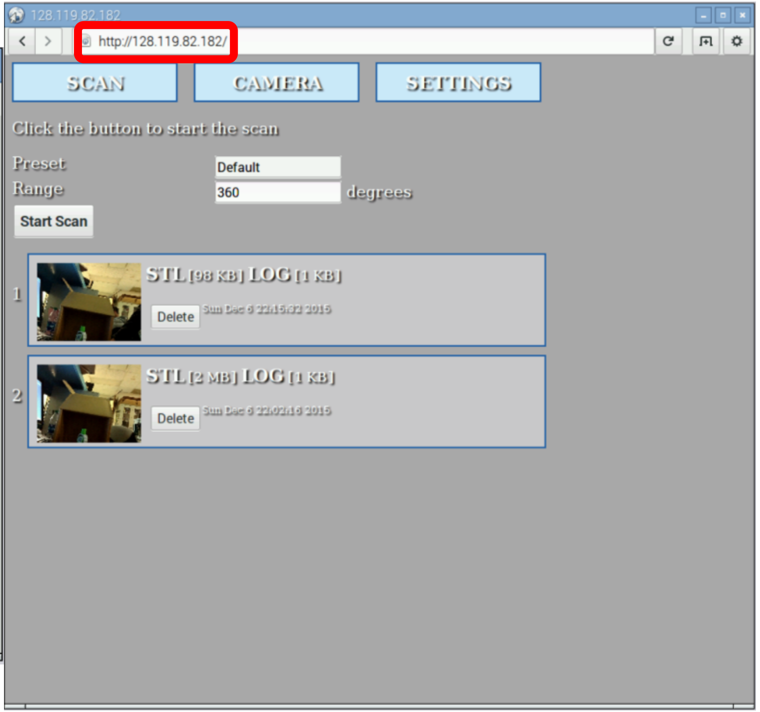
Look In: H

Files of Type: All Files

Freelss so far



```
pi@raspberrypi ~ $ cd freelss/src
pi@raspberrypi ~/freelss/src $ sudo ./freelss
Reading properties file: /root/.freelss.properties
Creating MMAL video mode camera resolution=1280x960
Creating callback data...
Creating camera...
pi@raspberrypi ~/freelss/src $ Camera Enabled...
Created camera
Target Image Width: 1280
Target Image Height: 960
Initialized camera
Reinitialized.
Running on port 80...
```



Click the button to start the scan

Preset Default

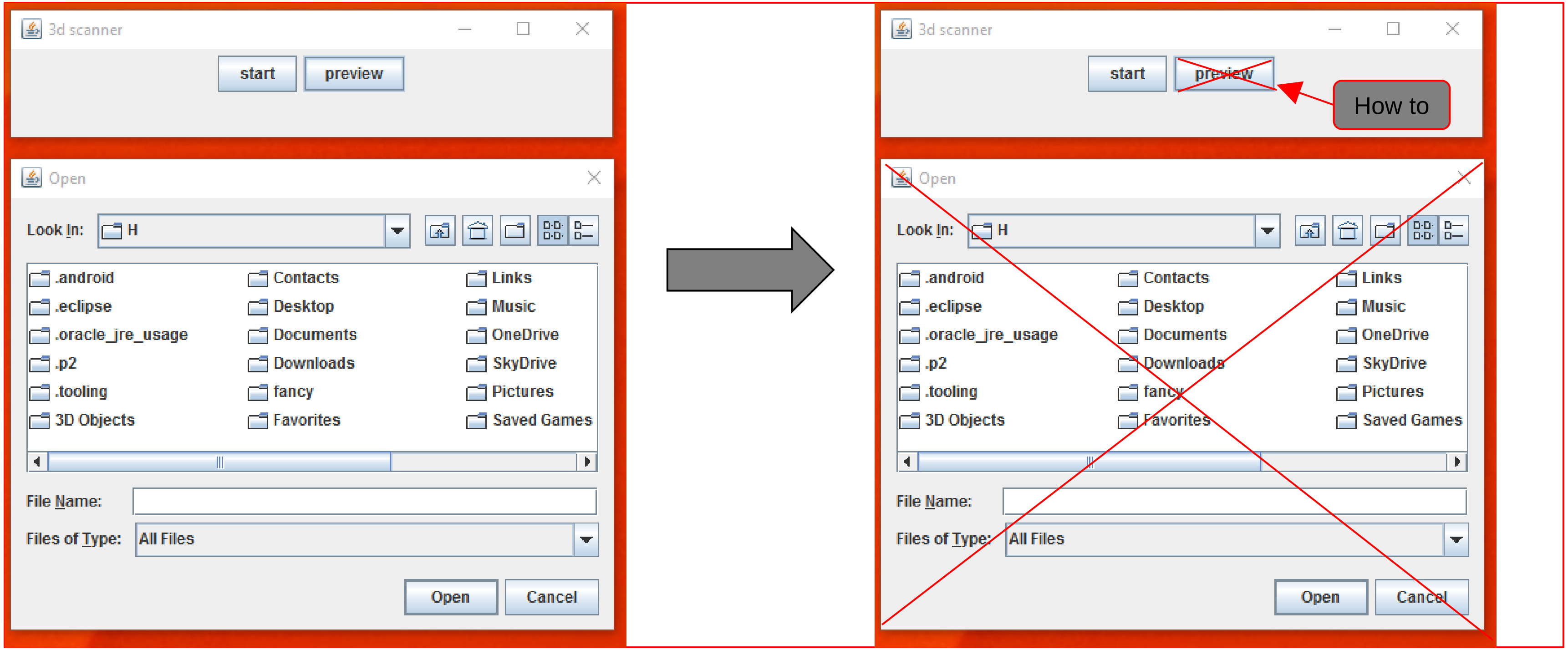
Range 360 degrees

Start Scan

1 STL [98 KB] LOG [1 KB]
Delete Sun Dec 6 22:15:32 2015

2 STL [2 MB] LOG [1 KB]
Delete Sun Dec 6 22:02:16 2015

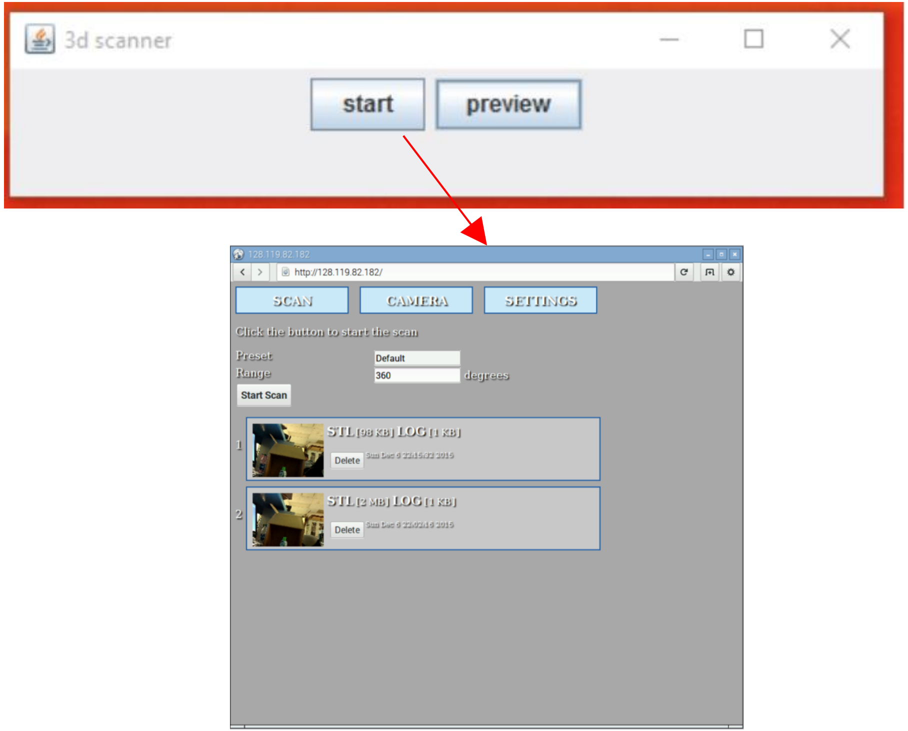
User Interface



“Start” button

-Open terminal and input command automatically

-Directly brings user to Freelss



http://128.119.82.182/

Click the button to start the scan

Preset Default

Range 360 degrees

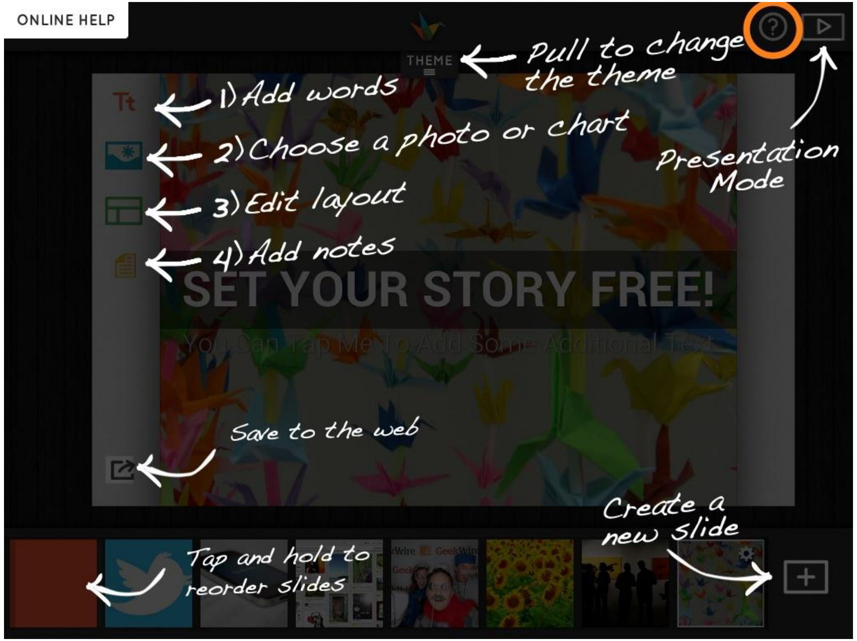
1 STL [98 KB] LOG [1 KB] Sun Dec 6 22:15:32 2015

2 STL [2 MB] LOG [1 KB] Sun Dec 6 22:02:16 2015

“How to” button

- -Briefly explain what is going to happened

- -Explanation on different tabs on Freelss interface



Pull to change the theme

1) Add words

2) Choose a photo or chart

3) Edit layout

4) Add notes

Presentation Mode

Save to the web

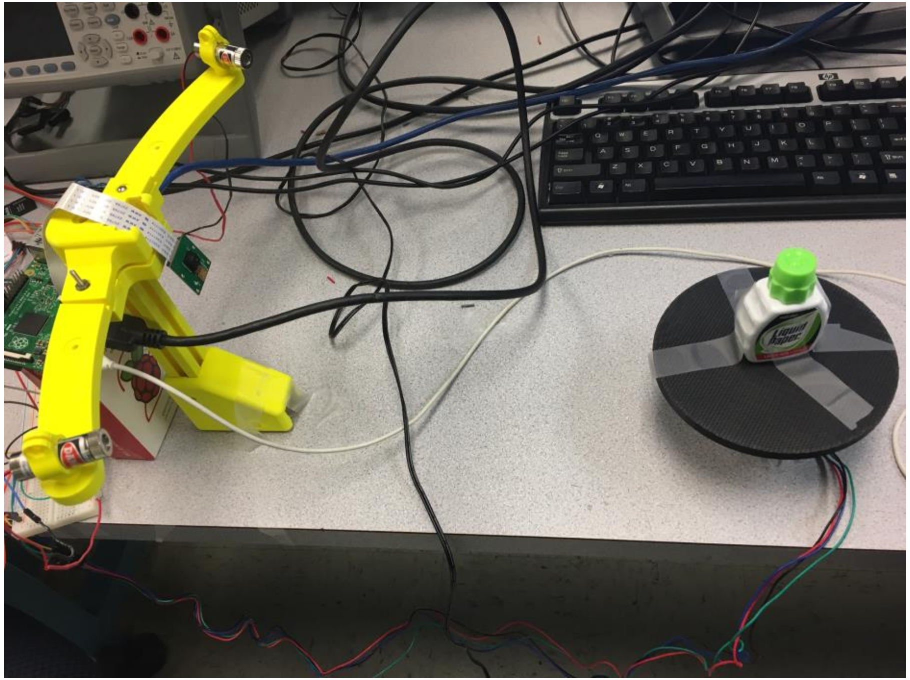
Create a new slide

Tap and hold to reorder slides

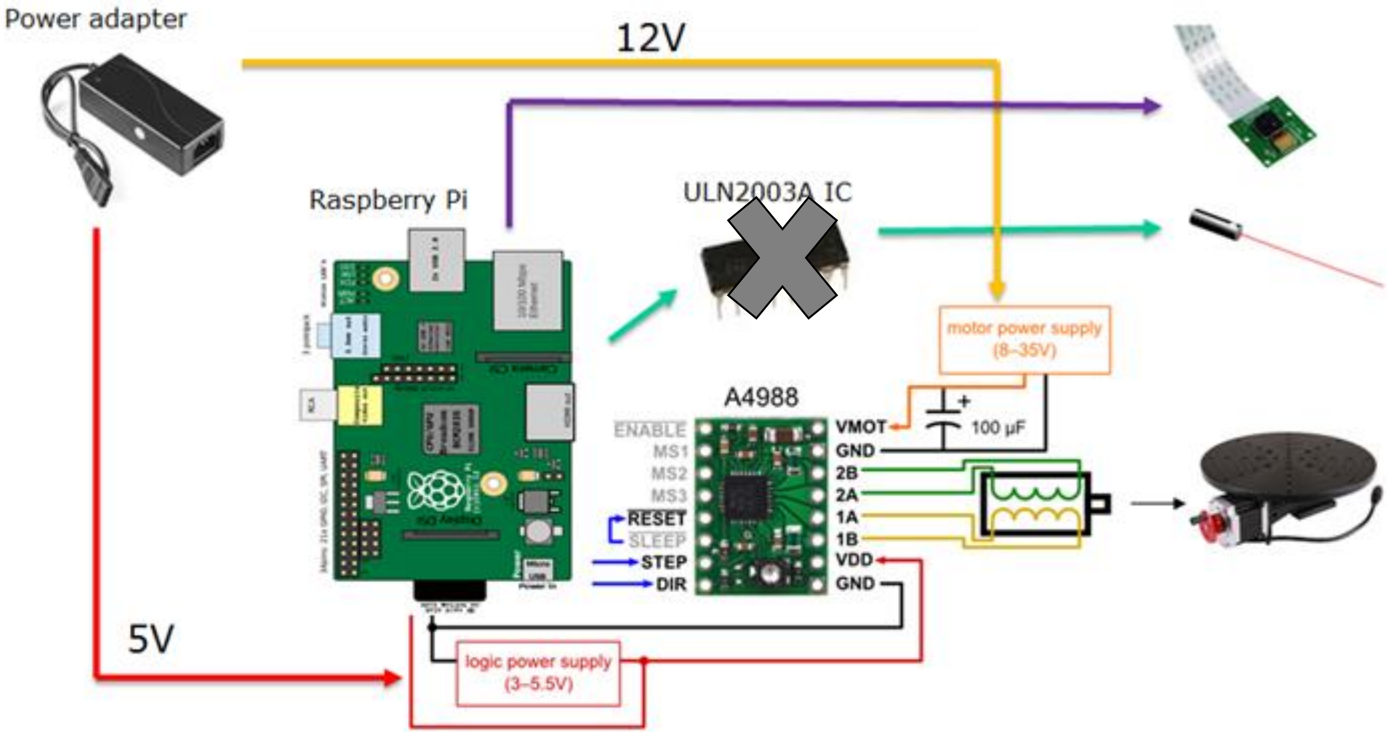
Calibration

-Measuring required data(i.e distances between lasers, camera and scanned object)

-most vital part throughout whole project



Hardware Flow Chart

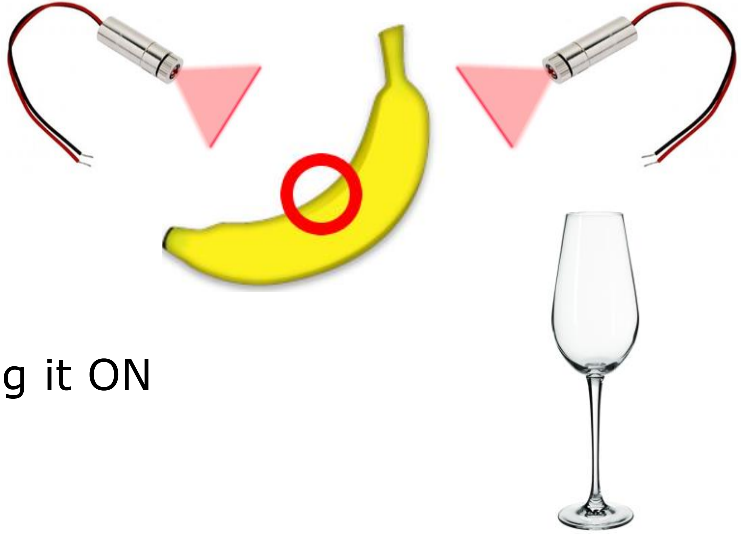


Optics Sensor

- One vs. Two lasers
  - Able choose one or two lasers for a scan
  - not increases the quality
  - but reduce the number of “gaps”
  - calibrate before use

- further questions
  - other colors?
  - ambient light ?

- **Accomplished:**
  Able to use python code to control it by turning it ON and off as the rate we defined.



Bipolar Stepper Motor

Implementation:

- Stepper motor and driver
- 200 steps/rev (1.8 degrees)
- 12V, 350mA
- Holding torque: 3.2kg-cm(44 oz-in)

Accomplished:

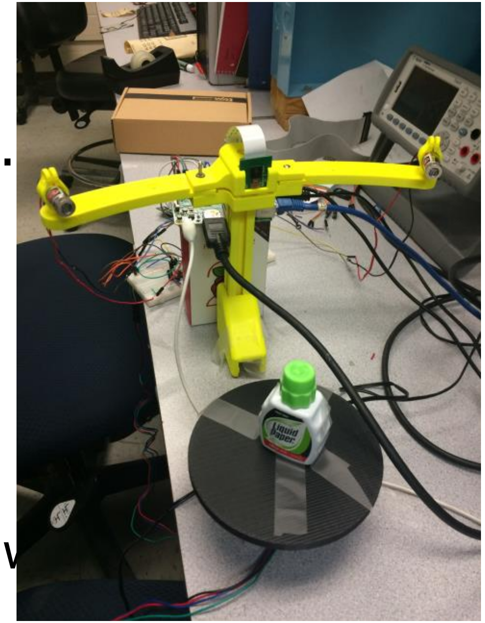
Program raspberry pi 2 microprocessor to send real time serial data to control stepper motor and control the number of revolutions in python

Camera

- Resolution:

  5 Megapixel(2592 X 1944) takes about 55 mins.
  1.9Megapixel(1600 X 1200) takes about 10 mins.
  1.2Megapixel (1280 X 960) takes about 8 mins.
  0.3 Megapixel (640x480) takes about 3 mins.
- Size : 2MB- 100MB

- **Accomplished:**
  - Build physical skins to hold components.
  - Able to program in python for the laser and table w same time while the camera is ON



MDR Deliverables

- Purchase part and prototype of hardware working on breadboard
- GUI interface which can connected to the hardware
- Demonstrate data collection from sensors and as well as ability of basic communication
- A prototype 3D laser scanner which able to roughly output stl file of scanning objects

- Siyan - Reliable power supply which able to power raspberry Pi, turntable, camera and laser
- Vangjel - Software data processing and able to output stl file from the input data collection
- Chenkai - Create GUI on LCD to display connectivity between GUI and raspberry pi

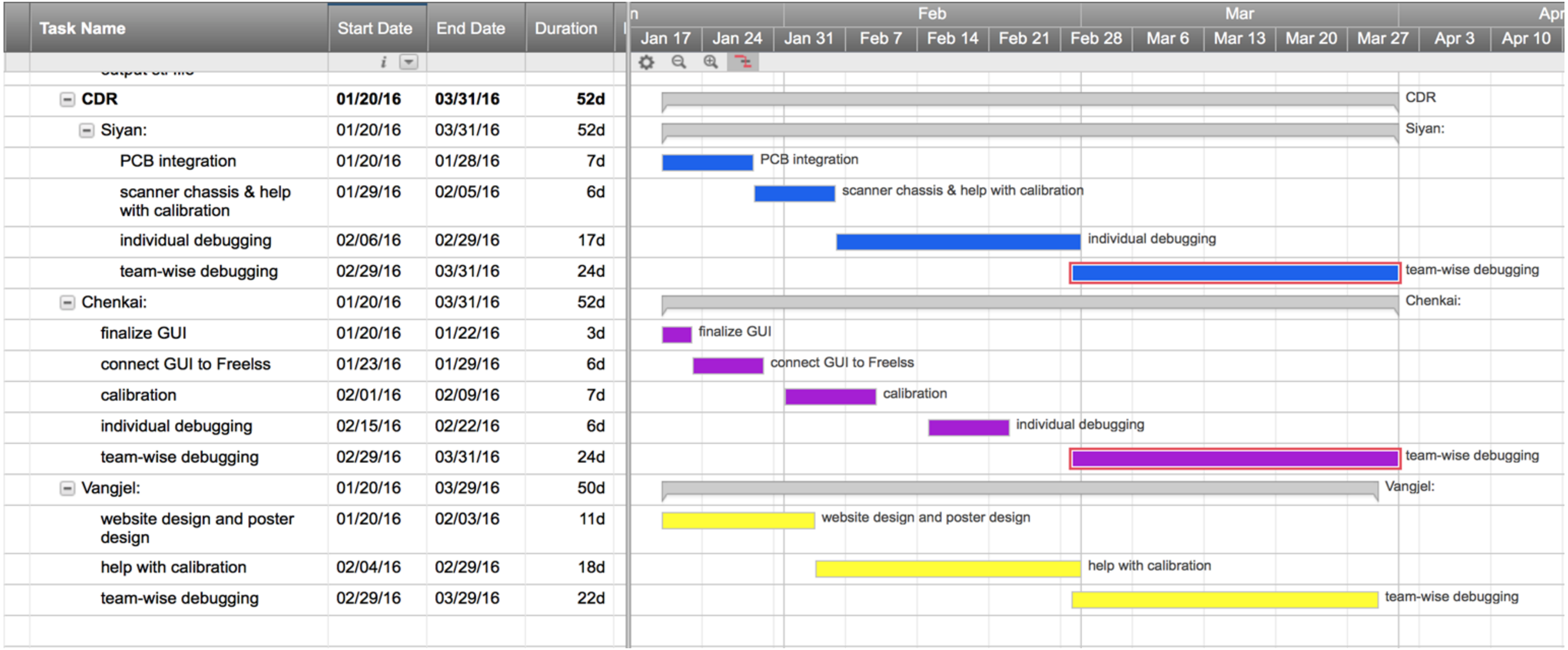
What we did

Siyan: building all the necessary hardware, layout skin and helping to figure GPIO pin layout

Chenkai: Drawing basic user interface outline and figuring out GPIO pin layout

Vangjel: Go through and compile Freelss software

Scheduling and important dates



Task Name	Start Date	End Date	Duration
⊟ **CDR**	**01/20/16**	**03/31/16**	**52d**
⊟ Siyan:	01/20/16	03/31/16	52d
PCB integration	01/20/16	01/28/16	7d
scanner chassis & help with calibration	01/29/16	02/05/16	6d
individual debugging	02/06/16	02/29/16	17d
team-wise debugging	02/29/16	03/31/16	24d
⊟ Chenkai:	01/20/16	03/31/16	52d
finalize GUI	01/20/16	01/22/16	3d
connect GUI to Freelss	01/23/16	01/29/16	6d
calibration	02/01/16	02/09/16	7d
individual debugging	02/15/16	02/22/16	6d
team-wise debugging	02/29/16	03/31/16	24d
⊟ Vangjel:	01/20/16	03/29/16	50d
website design and poster design	01/20/16	02/03/16	11d
help with calibration	02/04/16	02/29/16	18d
team-wise debugging	02/29/16	03/29/16	22d

CDR Deliverables

-"Accurate" printed out object

(Model should be within +/- 2 millimeters of accuracy in terms of size. (~0.08 inches)

(In terms of area +/- 8mm^3)

- An user interface on LCD panel
- Nicely organized PCB

Thank you

Demo.
-video?
-live demo?