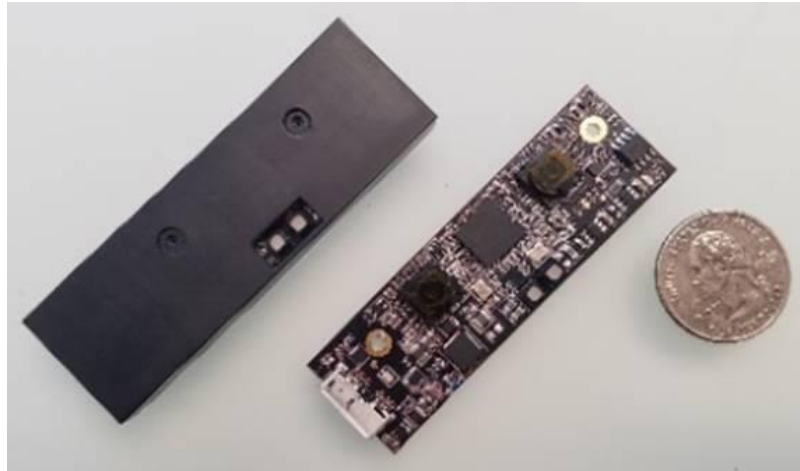


Mocha

Stereo vision module with patterned IR illumination and depth engine

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Product Description

Mocha is a stereo vision module with 2 IR sensitive color cameras, a patterned IR illumination to assist with depth map computation, and a depth computation ASIC on-board.

Mocha comes pre-calibrated for optimal stereo. The module comes in a metal housing for optimal mechanical ruggedness and thermal management.

Mocha provides flexibility over range from 15cm up to 3m.

Mocha utilizes Heptagon's proprietary patterned IR projector for texture projection to enable fast and efficient stereo matching and depth map generation.

The dedicated depth engine enables fast and efficient computation of depth map out of the stereo camera pair.

Features

- Robust active stereo, powered by Heptagon's unique IR pattern projector
- Pre-calibrated stereo module
- Depth engine for fast and power efficient depth map generation
- USB3.0 connector

Applications

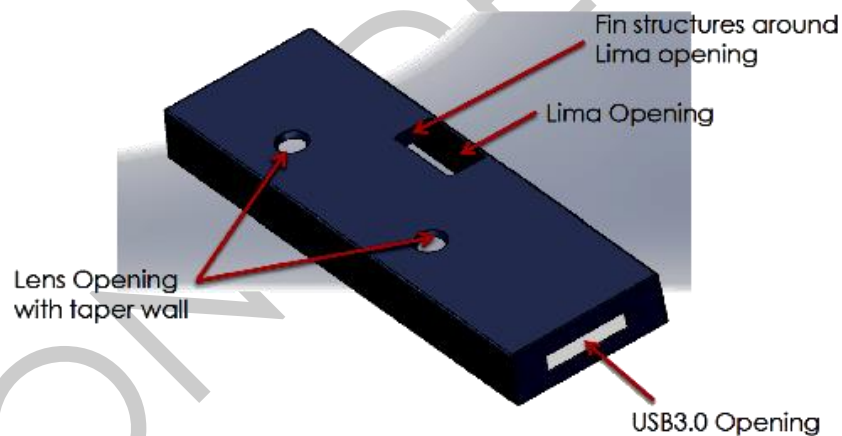
- Mobile devices
 - Enhanced photography
 - Gesture recognition
- Virtual reality & augmented reality platforms
 - Gesture recognition
 - Obstacle recognition
 - SLAM
- 3D camera modules for PCs, tablets, and laptops
 - Background removal
 - 3D scanning
- Smart home devices with 3D vision
 - Surveillance
 - Human tracking
- Robots & drones
 - 3D vision
 - SLAM, obstacle recognition
- Health & medical
- Automotive

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Specifications

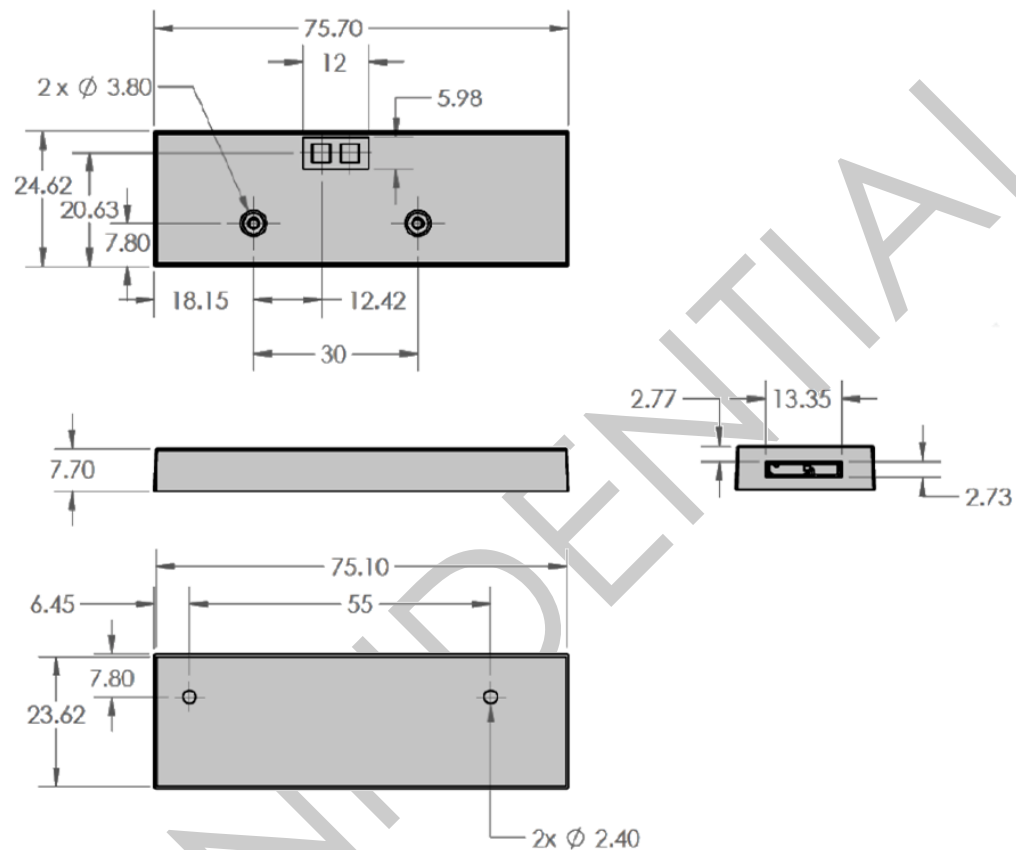
Component	Parameter	Specification
Stereo camera	Number of pixels	1.2MP
	Frame rate	30fps
	Pixel size	3µm
	Diagonal field of view	71.5 degrees
IR pattern projector	Wavelength	850nm ±10nm
	Number of features	>10,000
	Peak output power	2x250mW
Stereo performance	Baseline	30mm
	Range	15cm-3m
	Depth accuracy	Refer to Appendix I
	Depth map frame rate	30fps
	Power consumption	550-1100mA (depending on illumination level)
	Latency	5-10ms

Housing Overall dimensions
Length: 75.70mm
Width: 24.62mm
Height: 7.70mm



Drawings

Stereo camera board housing



Connectors

Mocha provides USB 3.0 connectivity. It can be connected to any system that supports USB3.0 and had its drivers installed.

Power Consumption

Mocha consumes from 550mA-1100mA depending on the brightness level of IR illuminators. Please refer to Illuminator datasheets for the illuminator power consumption.

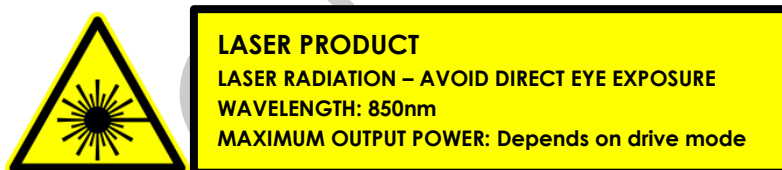
RoHS & REACH Compliance

The IR pattern projector module is compliant with the European RoHS Directive 2002/95/EC (Restriction of the Use of Certain Hazardous Substances in Electrical and Electronic Equipment) and REACH (Registration, Authorization and Restriction of Chemicals, European Union Regulation (EC) 1907/2006).

Safety Advice

Depending on the operational use of the device, the modules can emit highly concentrated non visible infrared light which can be hazardous to the human eyes. Products incorporating these modules may have to follow the safety precautions described by IEC 60825-1 and IEC 62471.

The LIMA illuminator is a laser product capable of high power infrared emission. Refer to the relevant safety regulations for protection during handling and operation.



User Guide

Mocha Testing

Hardware Components:

1. 1x 3D Camera Module (for use with USB 3.0 cable)

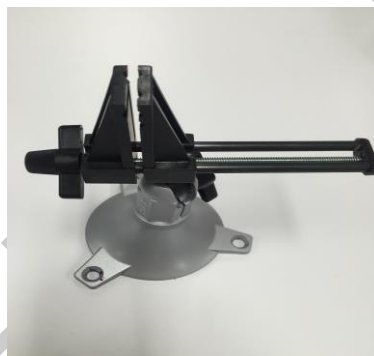


Front view



Right Side view (USB socket)

2. Stand Holder



3. 2 x Boxes(non-reflective material surface, white color preferred)



4. Meter Measurement



Software Preparation

General Introduction: The system is cross-platform developed and eventually will run on Windows, Android, Linux and OSX. However, the current testing user manual is based on windows application. Please ask for latest software before moving down.

Environment Requirement

The testing needs to be done in indoor environment with as little sunshine or infrared light as possible.

[Setup]

General Description: Use stand holder to hold Mocha. Two target object(non-reflective white boxes preferred) need to be set stand in front of camera within field of view. One is 50cm away and the other is 100cm away from the frontal surface of the boxes to Mocha itself. Please refer to the pictures as setup scene.



Picture 1



Picture 2



Picture 3

PC: Windows 7/Windows 10

[SW Testing Guide]

General Description: In general to pass the testing, based on the testing images, Dual Limas need to be confirmed to work well and calibration should be fine for **all three resolutions(wide angle FOV 640x360, VGA 640x480, QVGA 320x240)**. A special dual-lima pattern could be observed if dual Limas work well, disparity map should be clean and depth be accurate(error 3% for 50cm target and 6% for 100cm target) if calibration is done well. Please refer to the testing procedure as below:

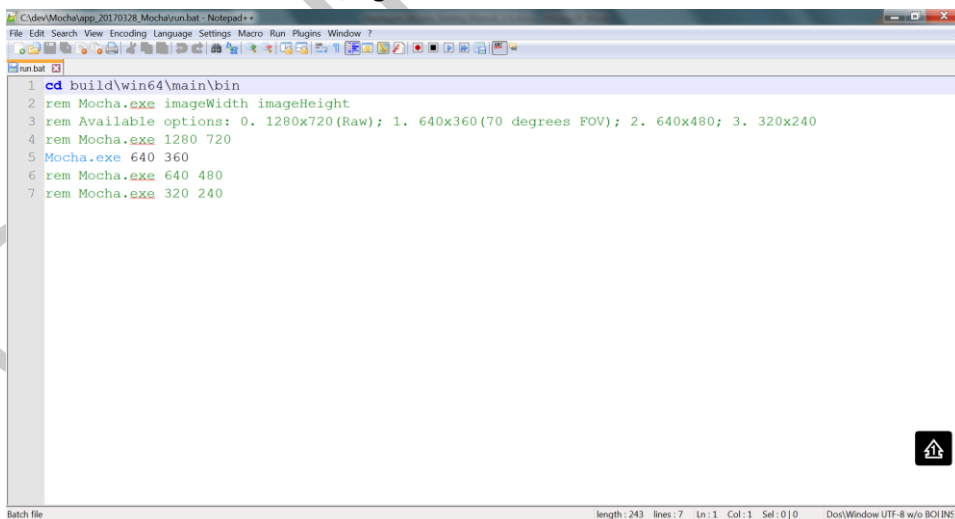
1. Extract the software (folder name “app_timestamp_mocha(_xxx)”) onto the PC running Windows 7 or later
2. Connect the Mocha module via the USB cable that is provided
3. Open the extracted folder which includes two folders, named “build” and “resource”, and one batch file named “run.bat”.
4. Prepare a form to record testing result. The empty sample testing form is showed below:

20170521: Target Customers

Module No./Resolution	640x360(70 FOV)		VGA		QVGA	
	50(cm)	100(cm)	50(cm)	100(cm)	50(cm)	100(cm)

Empty Sample Testing Form

5. Once the cable is connected, right click and **Edit** run.bat with default editor.



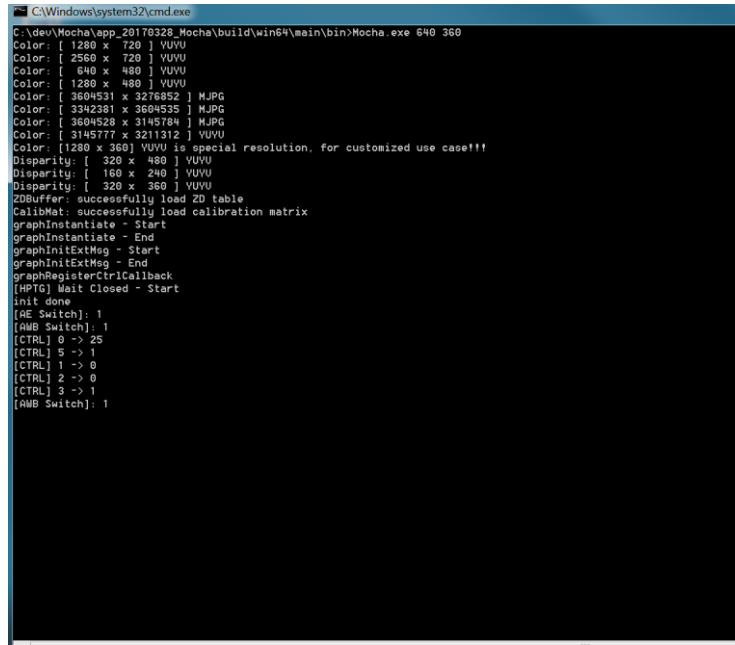
```

1 cd build\win64\main\bin
2 rem Mocha.exe imageWidth imageHeight
3 rem Available options: 0. 1280x720 (Raw); 1. 640x360 (70 degrees FOV); 2. 640x480; 3. 320x240
4 rem Mocha.exe 1280 720
5 Mocha.exe 640 360
6 rem Mocha.exe 640 480
7 rem Mocha.exe 320 240
  
```

By default, **resolution for wide angle field of view 640x360** will be selected as default.

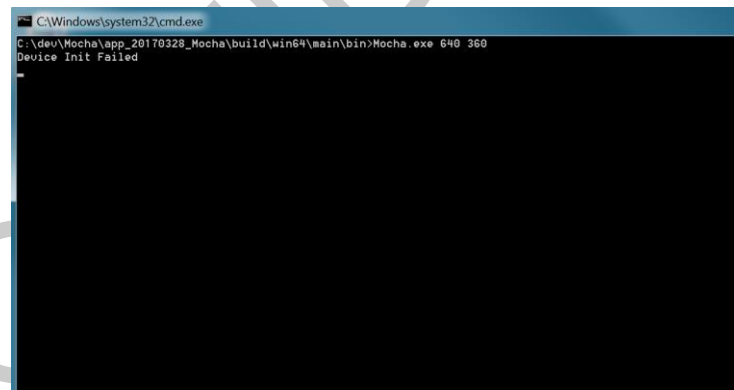
Double click on the “run.bat” file. A Dos window will pop up as shown below.

It takes a few seconds to run the app on the Windows platform. If the Dos window shows the same as the screenshot below, then everything the module is ready for operation



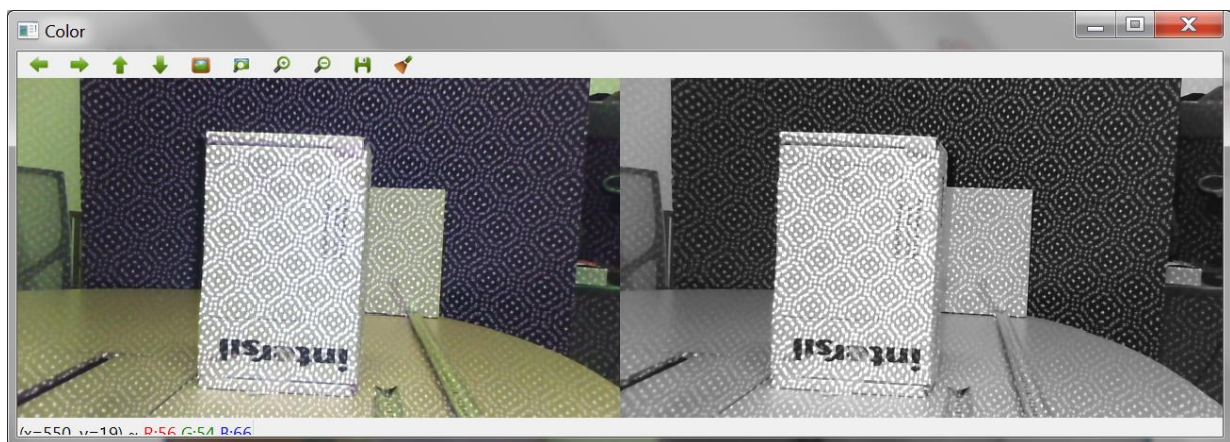
```
C:\Windows\system32\cmd.exe
C:\dev\Mocha\app_20170328_Mocha\build\win64\main\bin\Mocha.exe 640 360
Color: [ 1280 x 720 ] VUVU
Color: [ 2560 x 720 ] VUVU
Color: [ 640 x 480 ] VUVU
Color: [ 1280 x 480 ] VUVU
Color: [ 3604531 x 3276852 ] MJPG
Color: [ 3294281 x 3604535 ] MJPG
Color: [ 3604528 x 3145784 ] MJPG
Color: [ 3145777 x 3211312 ] VUVU
Color: [1280 x 360] VUVU is special resolution, for customized use case!!!
Disparity: [ 320 x 480 ] VUVU
Disparity: [ 160 x 240 ] VUVU
Disparity: [ 320 x 360 ] VUVU
ZDBuffer: successfully load ZD table
CalibMat: successfully load calibration matrix
graphInstantiate - Start
graphInstantiate - End
graphInitExtMsg - Start
graphInitExtMsg - End
graphRegisterCtrlCallback
[HPG] Wait Closed - Start
init done
[RE Switch]: 1
[AMB Switch]: 1
[CTRL] 0 -> 25
[CTRL] 5 -> 1
[CTRL] 1 -> 0
[CTRL] 2 -> 0
[CTRL] 3 -> 1
[AMB Switch]: 1
```

6. If the module is not connected or the USB connection is not good, then the following screenshot will appear.



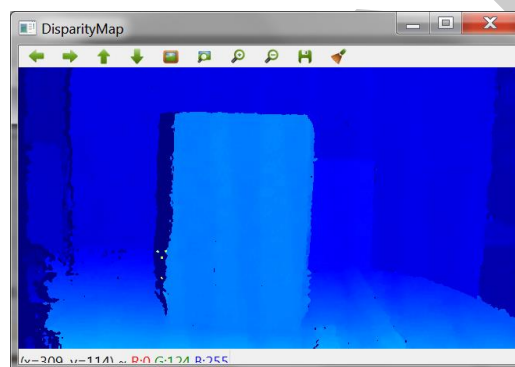
```
C:\Windows\system32\cmd.exe
C:\dev\Mocha\app_20170328_Mocha\build\win64\main\bin\Mocha.exe 640 360
Device Init Failed
```

7. In that case close the DOS window, unplug module and plug it in again. Try running the BAT file again.
8. Upon successful start of the setup, Displayed on the screen are the color image, rectified grey-level images, disparity map, and depth map which is 16bits based grey-level image.
9. Check Dual-Lima Pattern: The dots pattern showed below is based on dual-lima pattern. If pattern is different from this, probably one or both of dual limas are not functional properly.



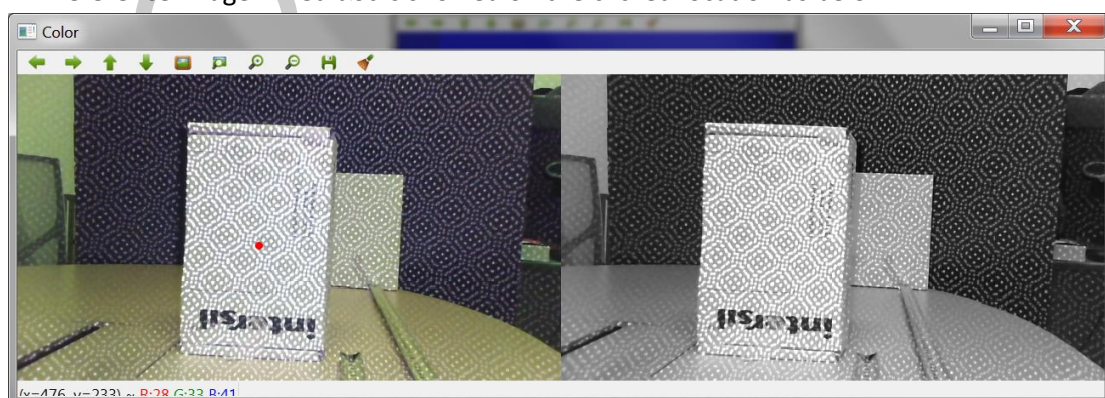
Pair of Rectified Images

10. Check Disparity Map Quality: The shown disparity map should be clean as below to indicate that calibration is not done or off. If a noisy disparity is seen, a recalibration for this resolution is needed to operate again.

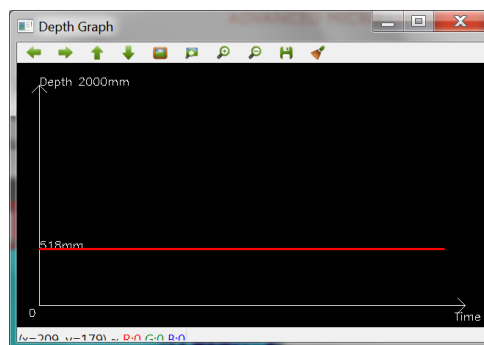


Disparity Map

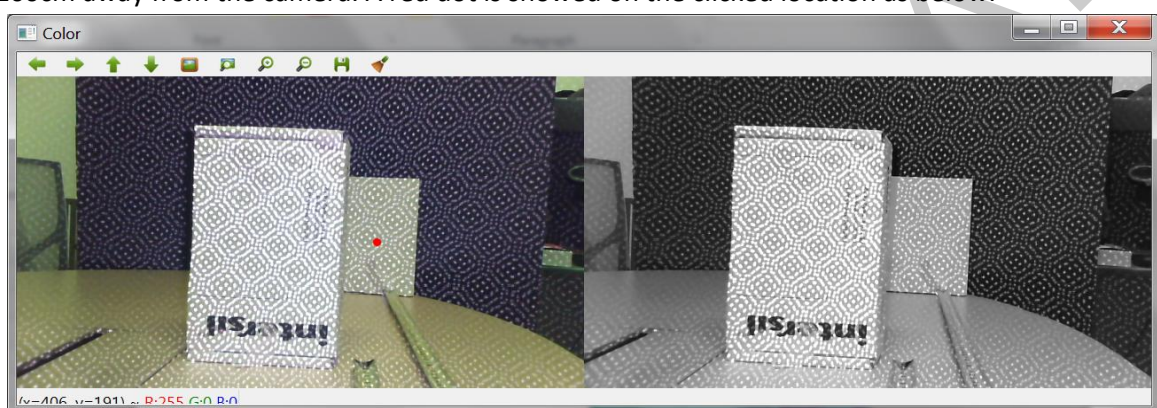
11. Check Depth Map Accuracy: Left click on first target box, which is 50cm away from camera on reference image. A red dot is showed on the clicked location as below:



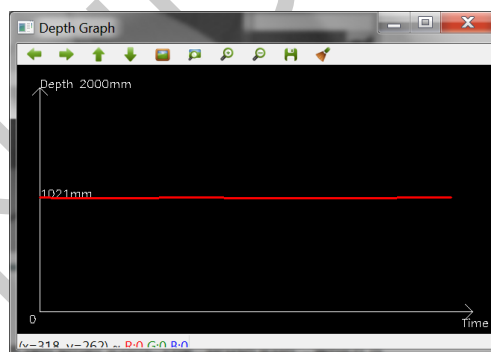
In the meanwhile, a new graph called "Depth Graph" is popped up accordingly.



The distance in graph showed is in millimeter domain. Note down this number in the testing form and go ahead to look for the second target. Similarly, left click on the second target, which is 100cm away from the camera. A red dot is showed on the clicked location as below:



And "Depth Graph" is as below:



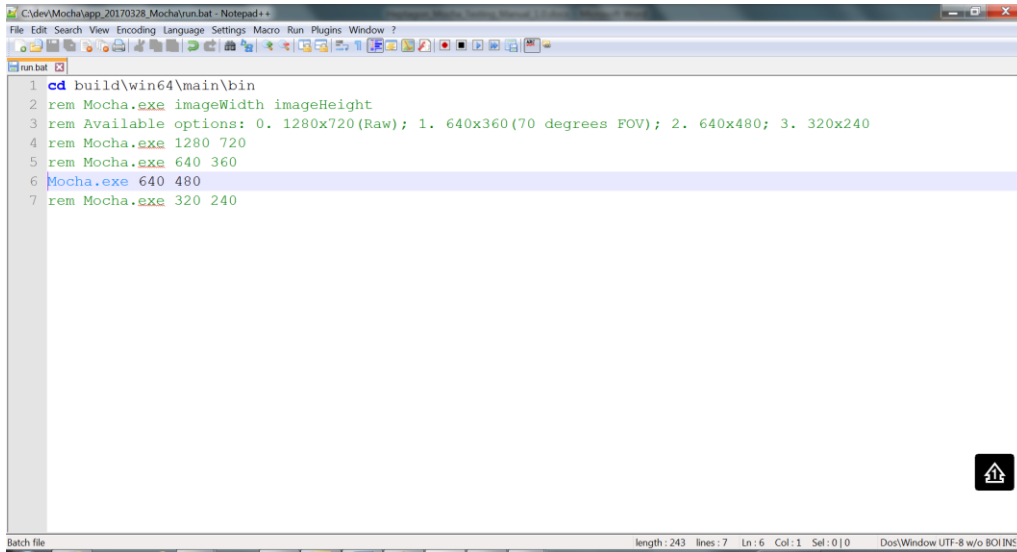
Note down this measurement number in the testing form. After the testing for this resolution, the testing form should be like shown below:

20170521: Target Customers

Module No./Resolution	640x360(70 FOV)		VGA		QVGA	
	50(cm)	100(cm)	50(cm)	100(cm)	50(cm)	100(cm)
B5-123	51.8	102.1				

Sample Testing Form

12. Change resolution option in run.bat file as shown below, repeat step 4 – 10.



```
1 cd build\win64\main\bin
2 rem Mocha.exe imageWidth imageHeight
3 rem Available options: 0. 1280x720 (Raw); 1. 640x360 (70 degrees FOV); 2. 640x480; 3. 320x240
4 rem Mocha.exe 1280 720
5 rem Mocha.exe 640 360
6 Mocha.exe 640 480
7 rem Mocha.exe 320 240
```

Batch file length: 243 lines: 7 Ln: 6 Col: 1 Sel: 010 DosWindow UTF-8 w/o BOM

Revision History

Version	By	Date	Notes
1.0	William Liu	05/21/2017	Preliminary version

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