

# Visual Perception Coursework

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## User Manual

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**This software is developed as a part of course work for Visual Perception Module of Masters In Computer Vision Program of Centre Universitaire Condorcet, Université de Bourgogne, France. This software is free and open source.**

# Table of Contents

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## Contents

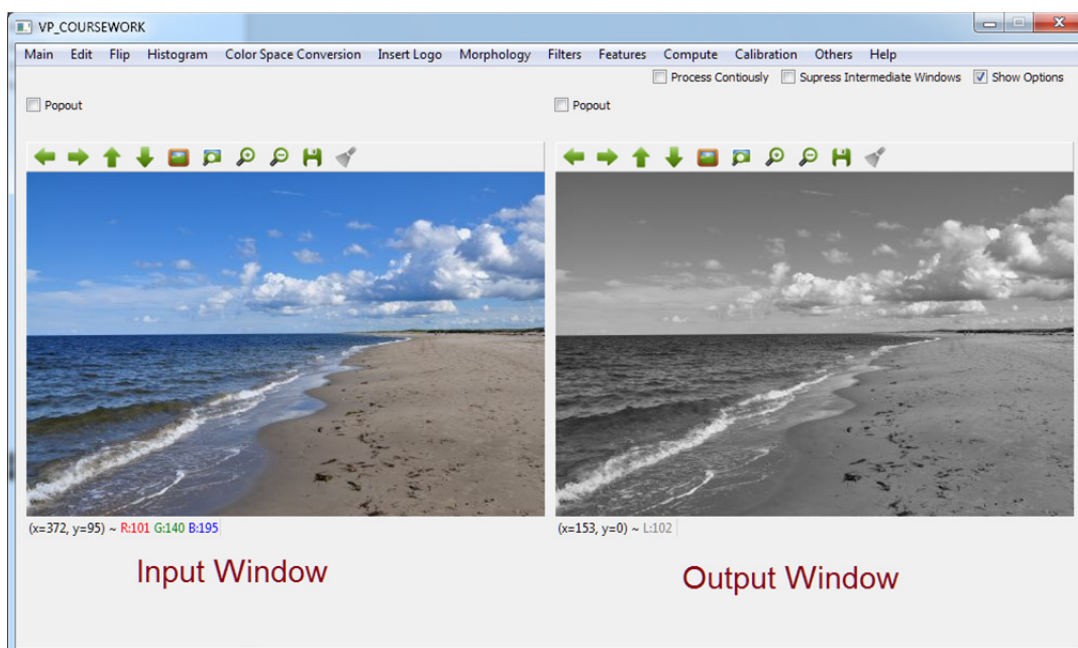
Main Window.....	2
I) Checkboxes .....	2
a) Popout.....	2
b) Process Continuously .....	2
c) Suppress Intermediate Windows .....	3
d) Show Options.....	3
II) MainMenu .....	3
a) Main .....	3
b) Edit .....	3
c) Flip .....	4
d) Histogram .....	4
e) Color Space Conversion .....	4
f) Insert Logo .....	4
g) Morphology.....	5
h) Filters .....	5
i) Features .....	6
j) Compute .....	7
k) Calibration .....	7
l) Others .....	8
Appendix .....	9
Links .....	10
About .....	10
Checkerboard.....	10

# VP COURSEWORK

This is the user manual for VP\_COURSEWORK. This software uses open source computer vision libraries (OpenCV) and open source UI framework QT. Some important computer vision algorithms are implemented with user options. The operation of the software is simple. Open Image / video / webcam and start performing the operations.

## Main Window

This is main GUI of the software. It consists of input and output windows, main menus and check boxes as shown below:



## I) Checkboxes

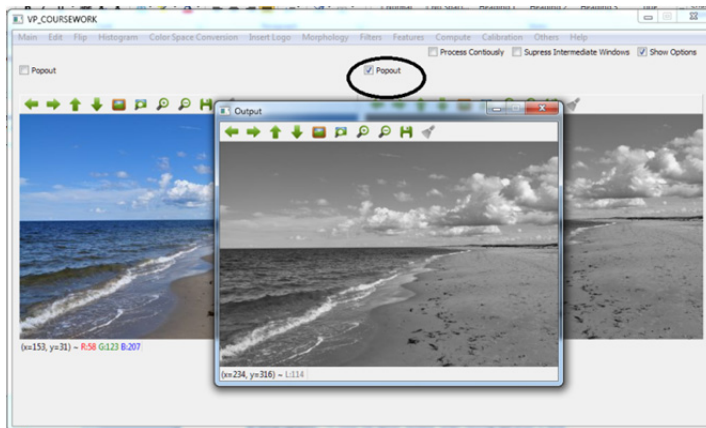
### a) Popout:

- When checked, pops out the display window to see image in different scale.

### b) Process Continuously

- For simultaneous operations.
- If unchecked, only the current selected operation is applied to the input. If checked, the operations are applied simultaneously in the order of selection.

**For Video and Webcam:** - when checked, the operations which are being performed are ticked. If the checked operation is not wanted any more, just click that operation which will uncheck it.



### c) Suppress Intermediate Windows

- When checked, suppresses the intermediate windows shown during processing.
- Especially useful when processing videos

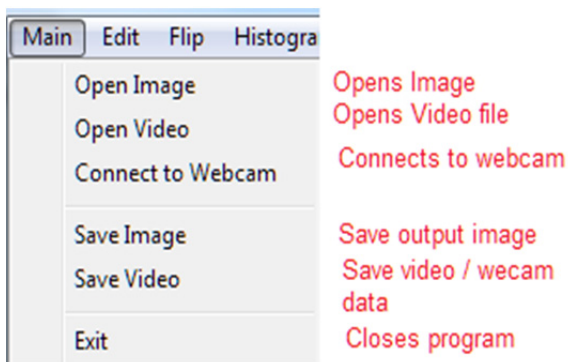
### d) Show Options

- To show the option window when resizing operation is done.

## II) MainMenu

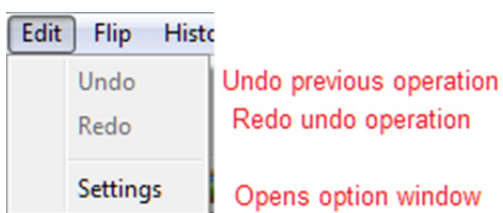
### a) Main

- For opening Image/Video/Webcam and save output.

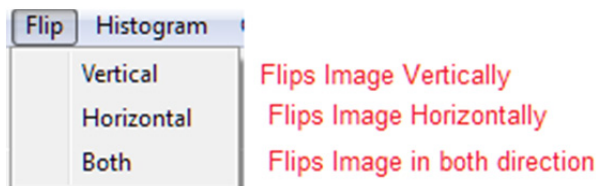


- The webcam selected on OPTIONS window is connected
- To save video file, first open video/webcam and then click save. The video will be saved as the processing is done.
- For webcam <filename>\_org is used to save video from webcam
- Saved video file may not be available to other applications until program is closed

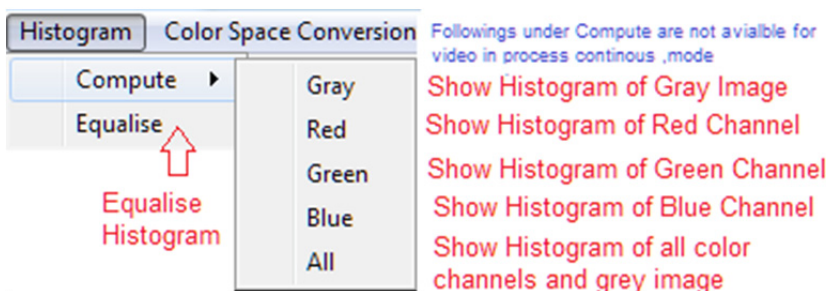
### b) Edit



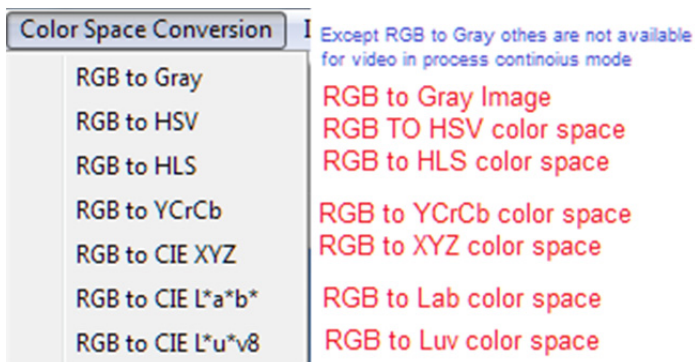
### c) Flip



### d) Histogram

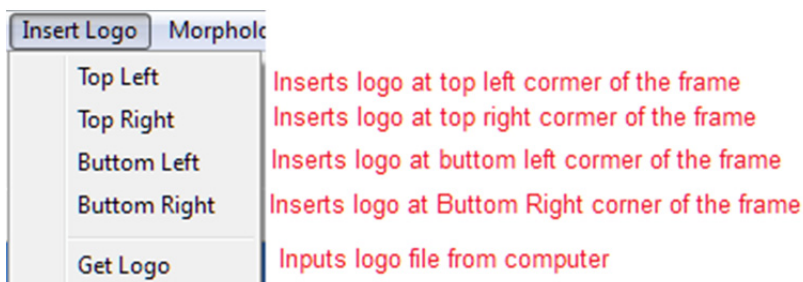


### e) Color Space Conversion



### f) Insert Logo

- Inserts Logo.
- Before inserting logo, make sure logo is in bmp format and small enough to fit in the frame.
- Before applying logo, first get logo from Insert Logo -> Get Logo.



## g) Morphology

Morphology	Filters	Featu
Dilate		Performs Morphology
Erode		Dilation
Open		Erosion
Close		Opeaning
Morphology Gradient		Closing
Top Hat		Gradient
Black Hat		Top Hat
		Black hat

## Options

Resize	Morphology	Filter	Edge	Hough	Features	Camera	Others
Erosion		Dilation					
No of Iterations	1	No of Iterations	1	Nunmer of iterations for Erision and dilation			
<input type="radio"/> OpenCV Default	<input checked="" type="radio"/> Custom	<input type="radio"/> OpenCV Default	<input checked="" type="radio"/> Custom	OpenCv custom or Defaults			
Structuring Element for Erosion		Structuring Element for Dilation		Structuring Element Recatngle, cross or disc			
<input checked="" type="radio"/> Rectangle	<input type="radio"/> Ellipse	<input type="radio"/> Cross	<input checked="" type="radio"/> Rectangle	<input type="radio"/> Ellipse	<input type="radio"/> Cross		
Kernel Size(2n+1)	1	Kernel Size(2n+1)	1	Kernel size of 2n+1 ,n is entered value			
For Morphology Open,Close,Grdient,Top hat and Black Hat							
<input type="radio"/> OpenCV Default		<input checked="" type="radio"/> Custom					
Structuring Element		<input checked="" type="radio"/> Rectangle		<input type="radio"/> Ellipse	<input type="radio"/> Cross	Kernel Size(2n+1) 1	

## h) Filters

- Performs filtering operation in images
- Before Performing Edge detection Gaussian filter is recommended.
- For webcam data, it is recommended to use median filter to video stream at first.
- Options for custom filter are in *Others* tab.
- Options for Edge filter is in Edge tab.

Filters	Features	Compute	Calibration
Blur		Blurs Image	
Sharpen		Sharpen Image	
Edge		Sobel Edge	
Median		Laplacian edge	
Bilateral		Canny Edge	
Gaussian			
Custom Filter		User Defined filter in options	

Medain Filter  
Bilateral Filter  
Gaussian Filter

## Options

Resize	Morphology	Filter	Edge	Hough	Features	Camera	Others
Mean Filter Size		3	Median Filter Size		3	Size of filters	
Gaussian FilterSize		3	Bilateral Filter Size		3		
SigmaX		1.00	SigmaColor		10.00	For Bilateral filters	
SigmaY		1.00	SigmaSpace		10.00		
Threshold		100	<div> <div>Sigma for Gaussian Filters</div> <div>Threshold Value for binarisation</div> </div>				

Resize	Morphology	Filter	Edge	Hough	Features	Camera	Others
<b>Sobel</b> <input type="radio"/> Sobel Vertical <input type="radio"/> Sobel Horizontal <input checked="" type="radio"/> Sobel Both							
Offset		0	Kernel Size		3	Scale	
Laplace		0	Kernel Size		3	Scale	
Canny		<input checked="" type="radio"/> L1 norm <input type="radio"/> L2 norm	Upper threshold		10	Lower threshold	
		0	Kernel Size		3		

Sobel's filter direction  
 Offset Value to be added  
 Scale the edges  
 Kernel Size  
 which distance to be used for canny  
 Upper and Lower Threshold for Canny

## i) Features

- Hough transform, Contours Extraction and Shape Descriptors works better with binary images or images after edge detection

Features	Compute	Calibration	Others	Help
Hough Transform	<div> <div>Line</div> <div>Circle</div> </div>			
Contours	<div> <div>Line</div> <div>Circle</div> </div>			
Shape Descriptors	<div> <div>Harris</div> </div>			
Corners	<div> <div>Extract</div> </div>			
FAST	<div> <div>Match</div> </div>			
SURF	<div> <div>Match</div> </div>			
SIFT	<div> <div>Match</div> </div>			
Get Second Image for Matching				
Get Second Image for Matching using SIFT/SURF				
<div> <div>Performs Convex Hull Operation</div> <div>Convex Hull</div> <div>Draw bounding box in detected shapes</div> <div>Bounding Box</div> <div>Enclose detected shape by rectangle</div> <div>Rotated Rectangle</div> <div>Enclose detected shape by circle /ellipse of minimum area</div> <div>Min Enclosing Circle</div> <div>Min Enclosing Ellipse</div> <div>Find moment of detected shape</div> <div>Moments</div> </div>				

Extracts Countours  
 Detects Hough Line  
 Detects Hough Circle  
 Extracts Harris Corners  
 Extracts FAST/SURF/SIFT features  
 Matches features of two images using SURF/SIFT features  
 Performs Convex Hull Operation  
 Draw bounding box in detected shapes  
 Enclose detected shape by rectangle  
 Enclose detected shape by circle /ellipse of minimum area  
 Find moment of detected shape



## Options

Resize	Morphology	Filter	Edge	Hough	Features	Camera	Others
<b>Lines</b> <input type="radio"/> Normal Hough transform <input checked="" type="radio"/> Probabilistic Hough Transform							
rho: 1    angle in degrees: 1.00    threshold: 50							
min line length: 0    min line gap: 0							
<b>Circles</b> image:accumulator resolution: 2.00    min distance: 100    min radius: 0    max radius: 0							
Max Canny Threshold: 75    Accumulator threshold: 50							

Use Normal or Probabilistic Hough transform of lines  
Probabilistic detects better lines

radius, angle and threshold used for Normal Hough transform

Parameters for Probabilistic Hough Transform

min length of line

minimum gap between two lines or circles

minimum and maximum limit of radius to be detected

Resize	Morphology	Filter	Edge	Hough	Features	Camera	Others
<b>Harris Corner</b> Block Size: 2    Aperture Size for Sobel: 3    Threshold: 100    Harris detector free parameter: 0.010							
<input type="checkbox"/> Apply Non maximal suppression							
FAST Threshold: 40    SURF Threshold: 2500							
Matches to show: -1							

Harris Corner detector

min hessian

number of best matches to show  
-1 means all matches

## j) Compute

- The left image is assumed to be opened from *Main -> Open Image*
- The images can be taken from Webcam using *Get Left and Right Images from WebCam*
- *Fundamental* and Homography matrix are shown in GUI similar to calibration matrix as shown in Appendix.
- After Fundamental matrix calculation, epipolar lines are drawn in image as shown in Appendix

Compute	Calibration	Others	Help
Fundamental Matrix			
Homography			
Get Right Image			
Get Left and Right Images from WebCam			

7 Point method  
8 Point method  
RANSAC

Computes Fundamental Matrix using 7 point, 8 Point and RANSAC

Finds Homography between two views

Get right image for homography and fundamental matrix

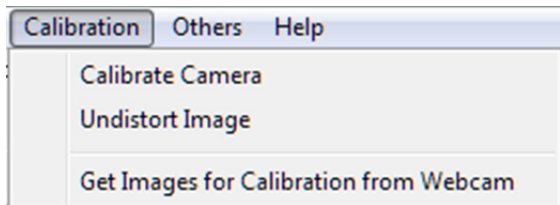
Get Image from webcam. Follow instructions above output image window

## k) Calibration

- Works only for checker board images.

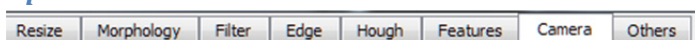


- Images should be in a folder
- Images can be taken from webcam using Get Images for Calibration from *Webcam*. After taking images *Calibrate Camera* should be run.
- Calibration matrix is saved in text file of calibration folder as ***calibrationmatrix.txt***
- For Un-distort Image, image should be opened from *Main* menu.
- Calibration matrix is also shown in GUI. Refer to Appendix for this



Calibrate camera from the checker board images stored in a folder  
Undistorts image using calibration results  
Get images from webcam for calibration

### Options



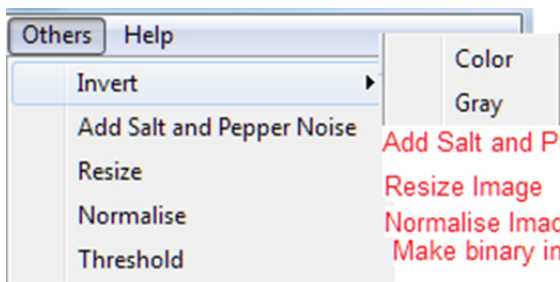
Connect to Camera 0 Camera ID .. default is 0.. used when there are multiple web cam attached to computer

Board Size for Calibration 6 X 4

Board Size of calibration pattern

### 1) Others

- For miscellaneous operations like adding noise, binarization, normalization, inverting and resizing.
- The options for Thresholding (Binarization) is under *Filter* tab



Make neagative of image

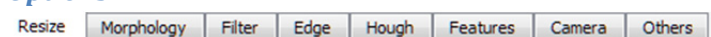
Add Salt and Pepper Noise

Resize Image

Normalise Image

Make binary image

### Options



☒ Pixels  
☐ 640 x 480  
☐ 800 x 600  
☐ 1024 x 768  
☐ Custom : Scale to 1280 X 800  
☐ 854 x 480  
☐ 1366 x 768  
☐ 1920 x 1080

resizes by pixel size  
preserves aspect  
ratio

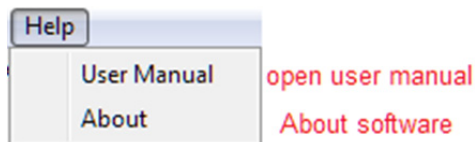
☐ Percentage  
100.0

resize by percentage

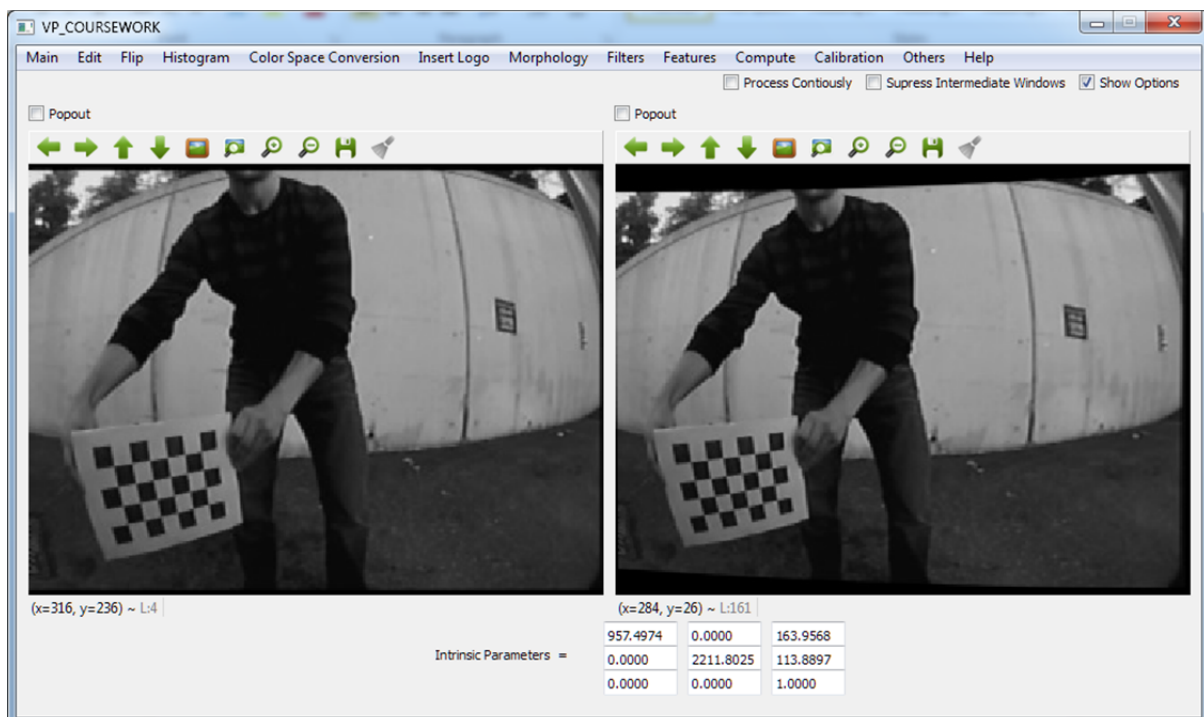
- Resize Options is shown each time the resize operation is called. To disable it uncheck *show options* checkbox.



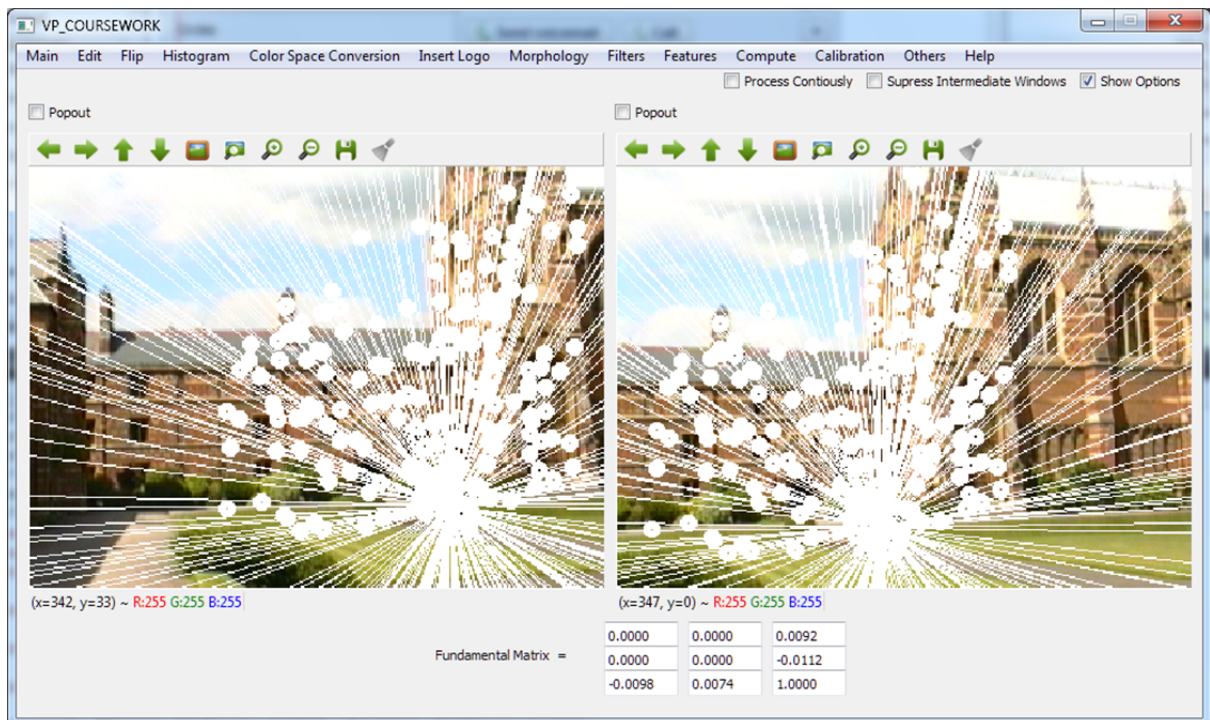
### m) Help



## Appendix



- Output of camera calibration. The last image taken during calibration is undistorted and shown. The matrix is shown below the windows.



- Fundamental matrix calculation and epipolar lines are shown

## Links

1. <http://opencv.willowgarage.com/wiki/>
2. <http://docs.opencv.org/>
3. <http://qt.nokia.com/products/>
4. <http://doc.qt.nokia.com/sdk-1.2/index.html>
5. OpenCV 2 Computer Vision Application Programming Cookbook by Robert Laganière  
<http://www.packtpub.com/opencv-2-computer-vision-application-programming-cookbook/book>
6. <http://code.google.com/p/vibot6-mscv3-se/>
7. <http://code.google.com/p/qt-opencv-multithreaded/>

## About

This software is available as free and open source as described by GNU General Public License v3.

## Checkerboard

