OpenCV 개요 및 설치

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학습 내용

- OpenCV Library Introduction
- Installing OpenCV Library (Visual Studio 2010)
- Loading, displaying and saving images
- 주요 자료구조

OpenCV Library Introduction

- open computer vision and machine learning software library
  - developed by Intel, supported by Willow Garage and Itseez
  - WebSite : http://opencv.org (http://docs.opencv.org)
- History
  - Intel Research Project (1999)
  - v1.0 (2006) → Stable Release v2.4.2 (2012. 7. 4)
- Support OS : Windows, Linux, Mac, Android, iOS
- Interface : C, C++, Python, JAVA(Android only)
- License : open source BSD License
  - free for both academic & commercial use
- IPP(MMX, SSE), TBB, GPU(CUDA) support

Non-free functionality module

- SIFT : Scale-Invariant Feature Transform
  - David G. Lowe, **Distinctive Image Features from Scale-Invariant Keypoints**, IJCV, 60(2), 2004
  - OpenCV Implementation : Rob Hess
- SURF : Speeded Up Robust Features
  - Herbert Bay, Andreas Ess, Tinne Tuytelaars and Luc Van Gool, **SURF: Speeded Up Robust Features**, CVIU, Vol. 110, No. 3, pp. 346-359, 2008
  - OpenCV Implementation : Liu Liu

OpenCV 1.x – C Interface

OpenCV 2.x – C++ Interface

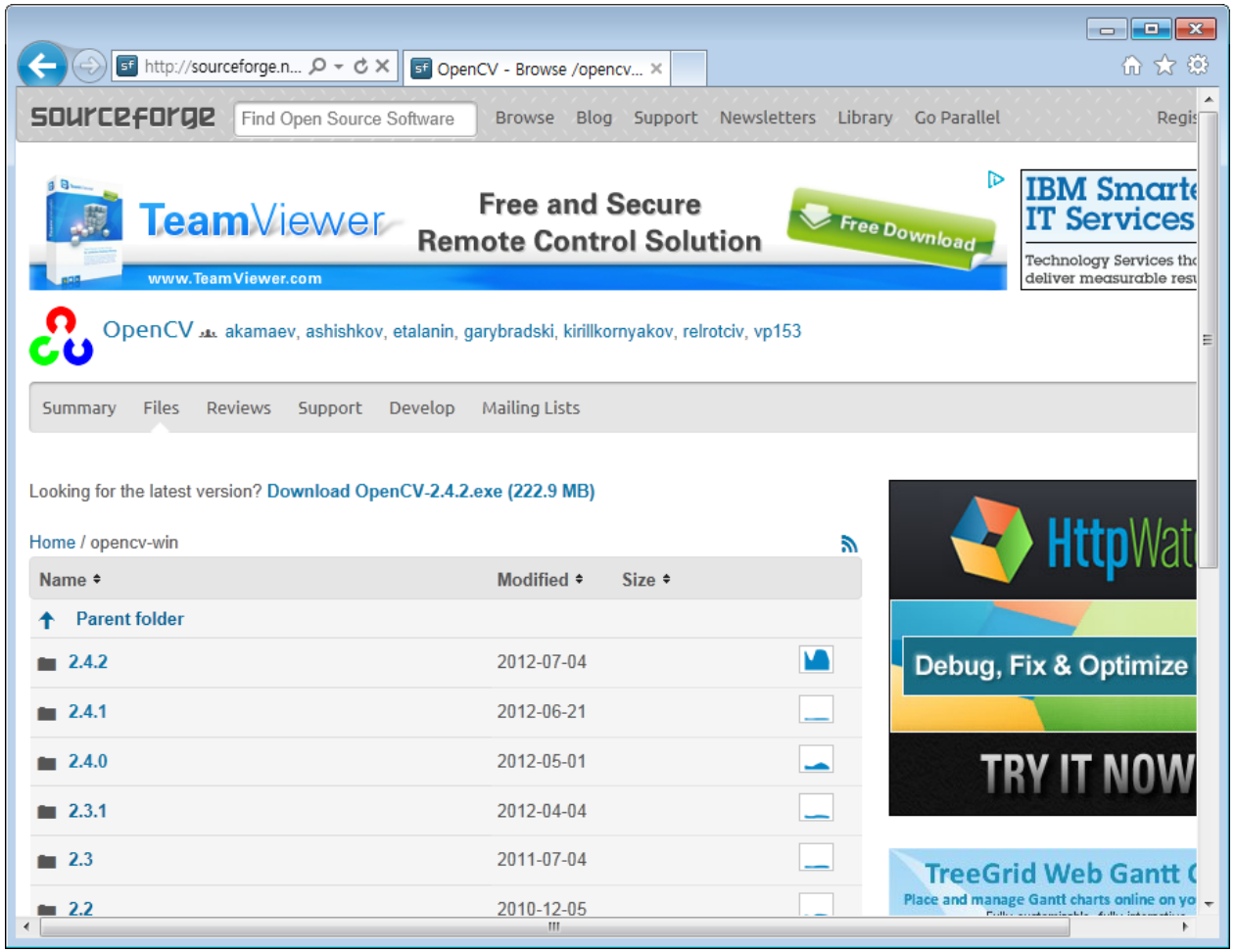
Module	Function
core	The Core Functionality
imgproc	Image Processing
highgui	High-level GUI and Media I/O
video	Video Analysis
calib3d	Camera Calibration and 3D Reconstruction
features2d	2D Features Framework
objdetect	Object Detection
ml	Machine Learning
flann	Clustering and Search in Multi-Dimensional Spaces
gpu	GPU-accelerated Computer Vision
photo	Computational Photography
stitching	Images Stitching
nonfree	Non-free functionality
contrib	Contributed / Experimental Stuff
legacy	Deprecated Stuff

C:¥opencv¥samples¥cpp

C:¥opencv¥samples¥cpp¥tutorial_code

Installing OpenCV Library

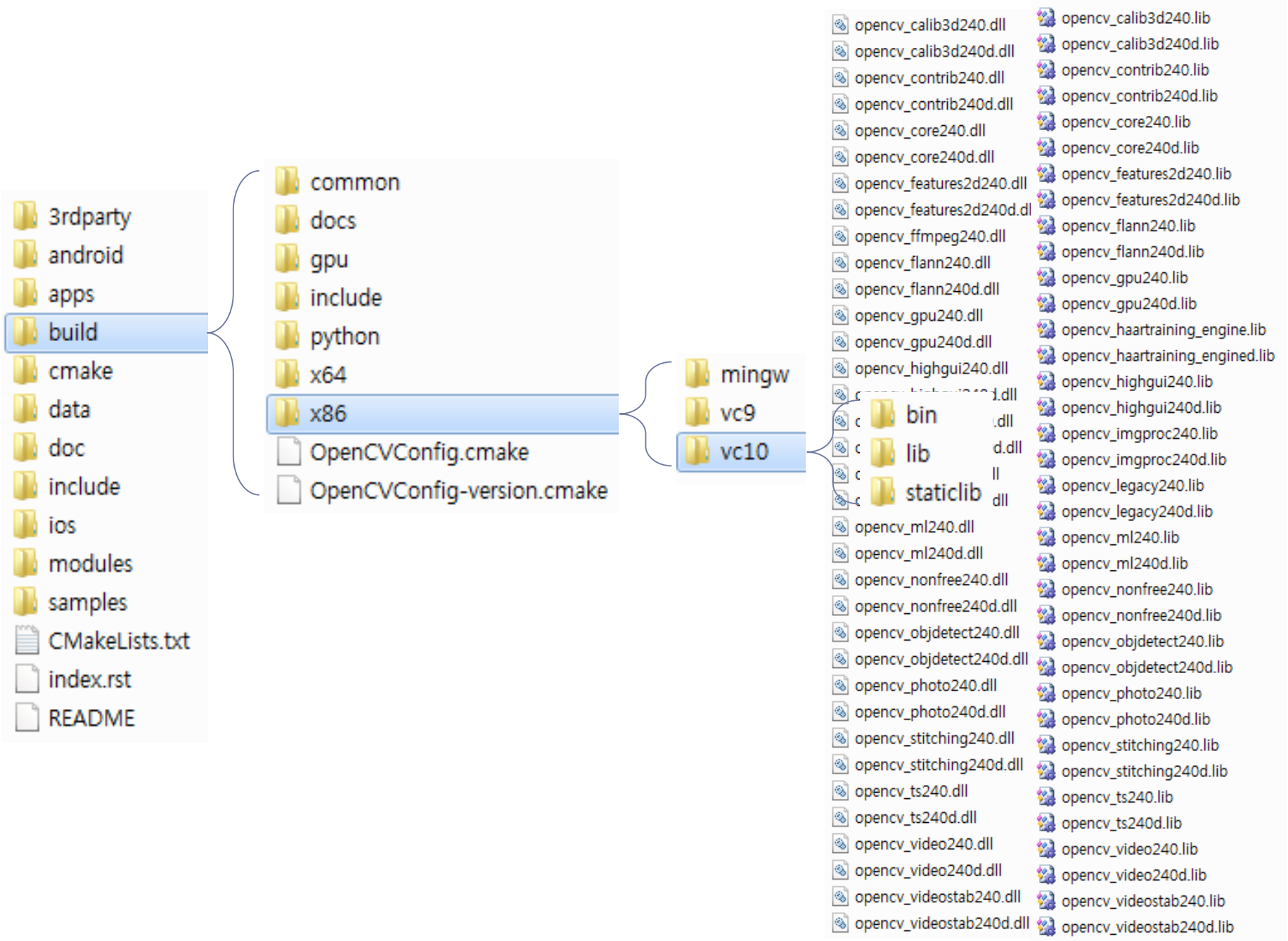
http://sourceforge.net/projects/opencvlibrary/files/opencv-win/



파일 구성

C:¥OpenCV에 압축 해제

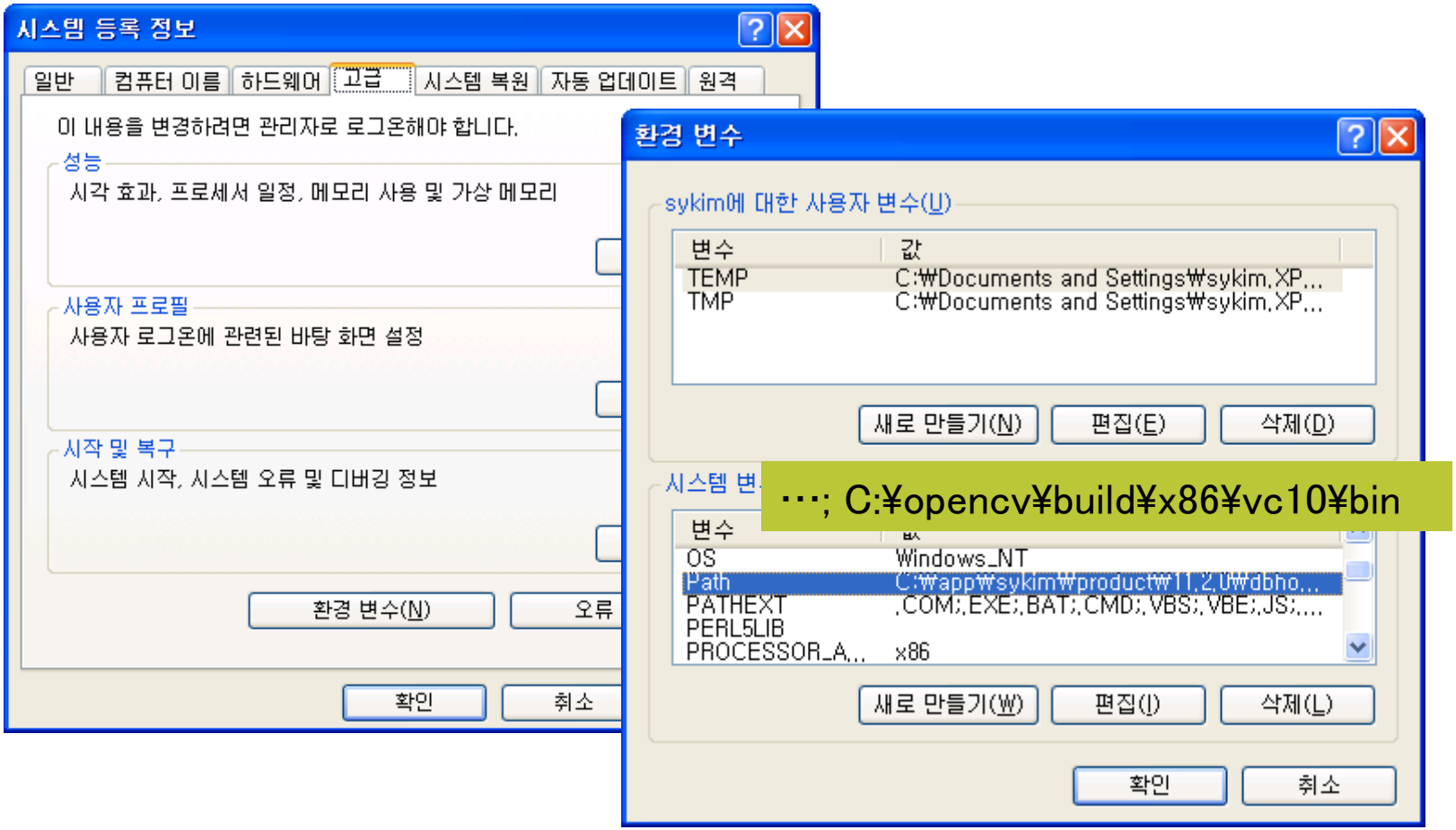
3rdparty	Third Party Code : OpenCV 라이브러리에서 사용하는 라이브러리 (JPEG, ffmpeg, TBB 등)
android	Android용 OpenCV
apps	응용 프로그램 코드
build	플랫폼으로 이미 빌드된 파일
cmake	CMake 설정파일
data	XML 학습 데이터
doc	OpenCV 문서들 : 사용자 가이드, 참조 문서, 튜토리얼, 로고 등
include	include 헤더파일
ios	iOS(MAC) 관련파일
modules	OpenCV 모듈별 소스코드
samples	OpenCV 예제 코드


3rdparty
android
apps
build
cmake
data
doc
include
ios
modules
samples
CMakeLists.txt
index.rst
README
common
docs
gpu
include
python
x64
x86
OpenCVConfig.cmake
OpenCVConfig-version.cmake
mingw
vc9
vc10
bin
lib
staticlib
opencv_calib3d240.dll
opencv_calib3d240d.dll
opencv_contrib240.dll
opencv_contrib240d.dll
opencv_core240.dll
opencv_core240d.dll
opencv_features2d240.dll
opencv_features2d240d.dl
opencv_ffmpeg240.dll
opencv_flann240.dll
opencv_flann240d.dll
opencv_gpu240.dll
opencv_gpu240d.dll
opencv_highgui240.dll
opencv_ml240.dll
opencv_ml240d.dll
opencv_nonfree240.dll
opencv_nonfree240d.dll
opencv_objdetect240.dll
opencv_objdetect240d.dll
opencv_photo240.dll
opencv_photo240d.dll
opencv_stitching240.dll
opencv_stitching240d.dll
opencv_ts240.dll
opencv_ts240d.dll
opencv_video240.dll
opencv_video240d.dll
opencv_videostab240.dll
opencv_videostab240d.dll
opencv_calib3d240.lib
opencv_calib3d240d.lib
opencv_contrib240.lib
opencv_contrib240d.lib
opencv_core240.lib
opencv_core240d.lib
opencv_features2d240.lib
opencv_features2d240d.lib
opencv_flann240.lib
opencv_flann240d.lib
opencv_gpu240.lib
opencv_gpu240d.lib
opencv_haartraining_engine.lib
opencv_haartraining_engined.lib
opencv_highgui240.lib
opencv_highgui240d.lib
opencv_imgproc240.lib
opencv_imgproc240d.lib
opencv_legacy240.lib
opencv_legacy240d.lib
opencv_ml240.lib
opencv_ml240d.lib
opencv_nonfree240.lib
opencv_nonfree240d.lib
opencv_objdetect240.lib
opencv_objdetect240d.lib
opencv_photo240.lib
opencv_photo240d.lib
opencv_stitching240.lib
opencv_stitching240d.lib
opencv_ts240.lib
opencv_ts240d.lib
opencv_video240.lib
opencv_video240d.lib
opencv_videostab240.lib
opencv_videostab240d.lib

path 설정

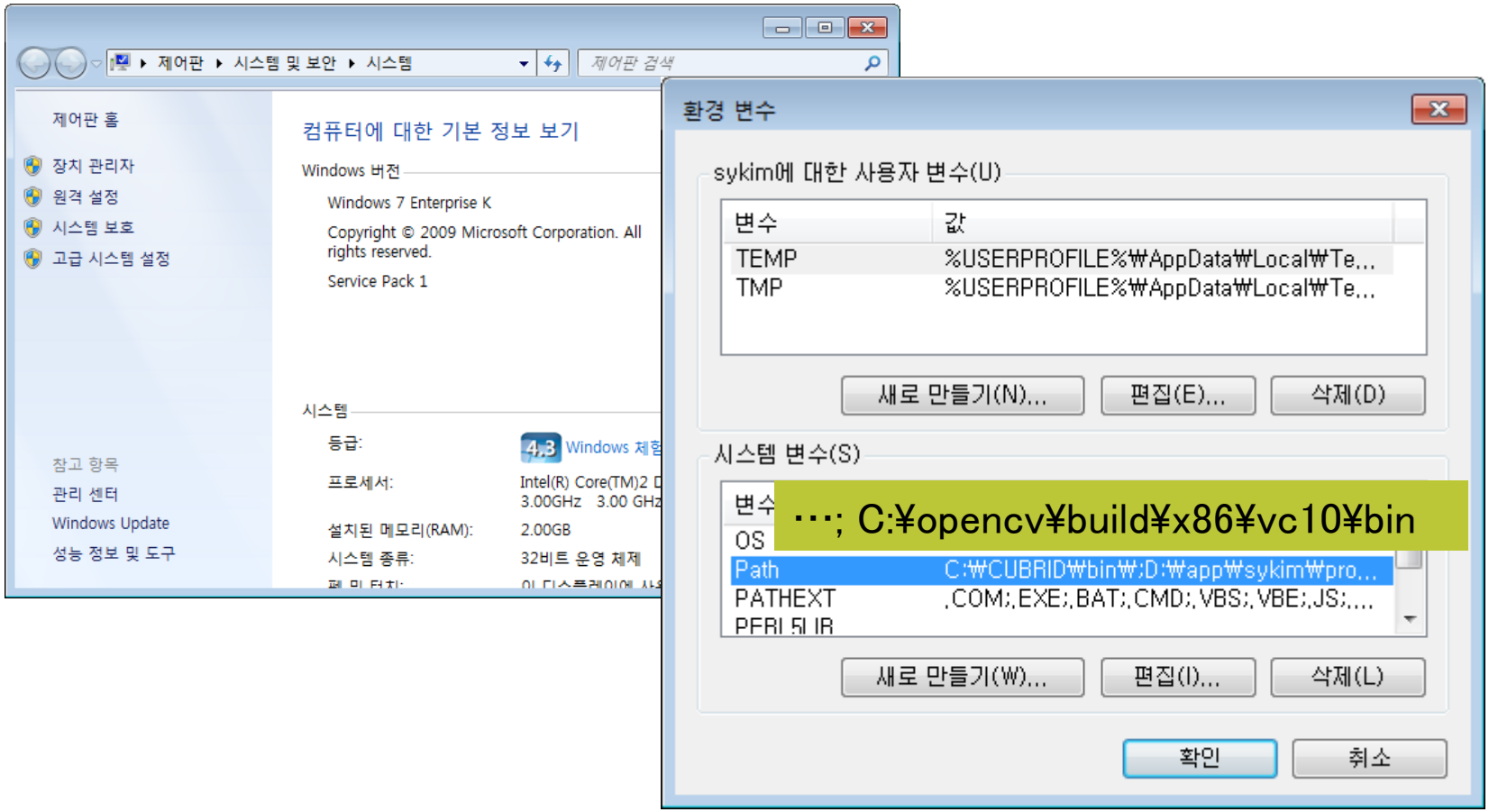
Windows XP

시작 | 내 컴퓨터 | 속성 | 고급 | 환경 변수 | Path



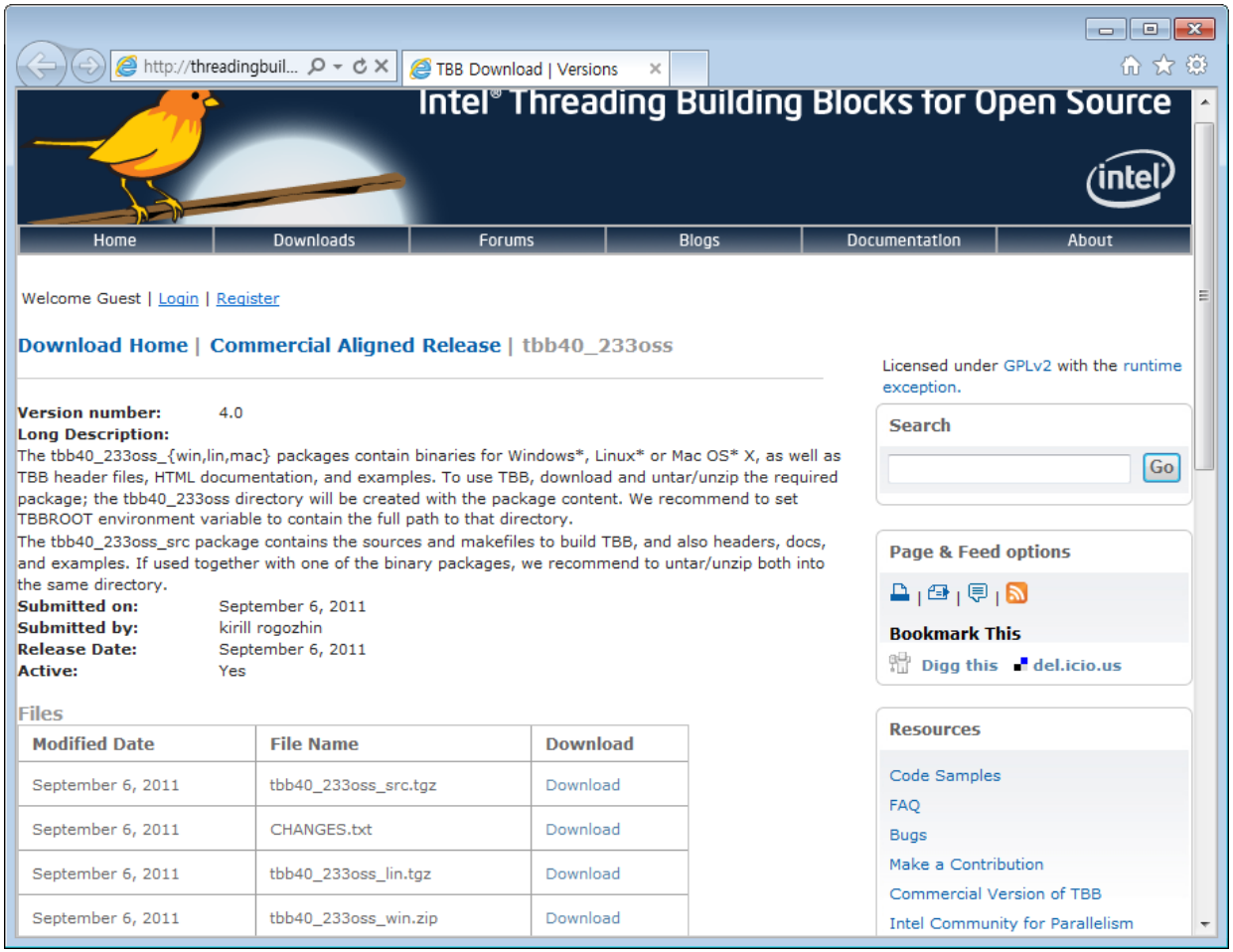
Windows 7

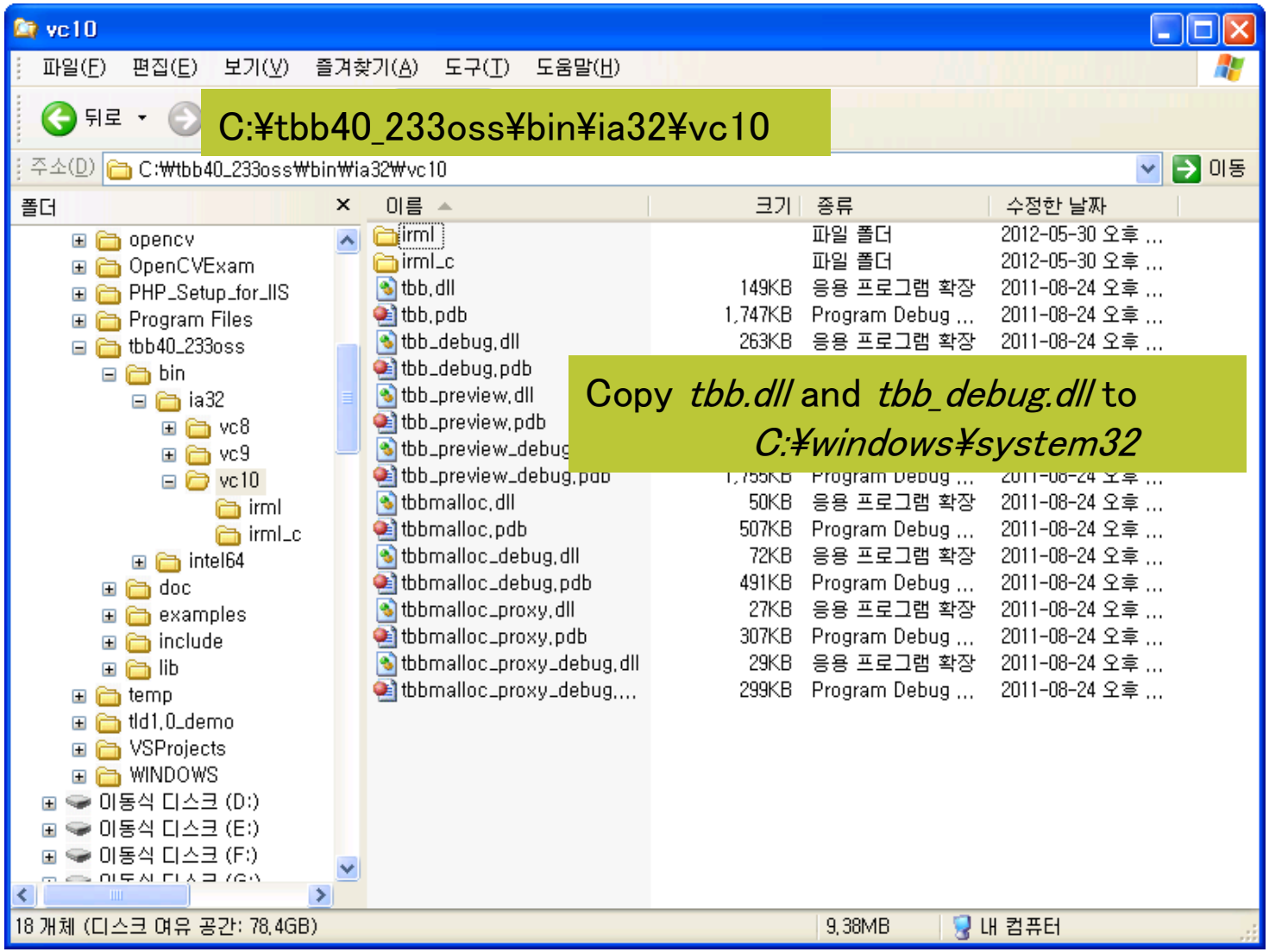
시작 | 컴퓨터 | 속성 | 고급 시스템 설정 | 고급 | 환경 변수 | Path



tbb download

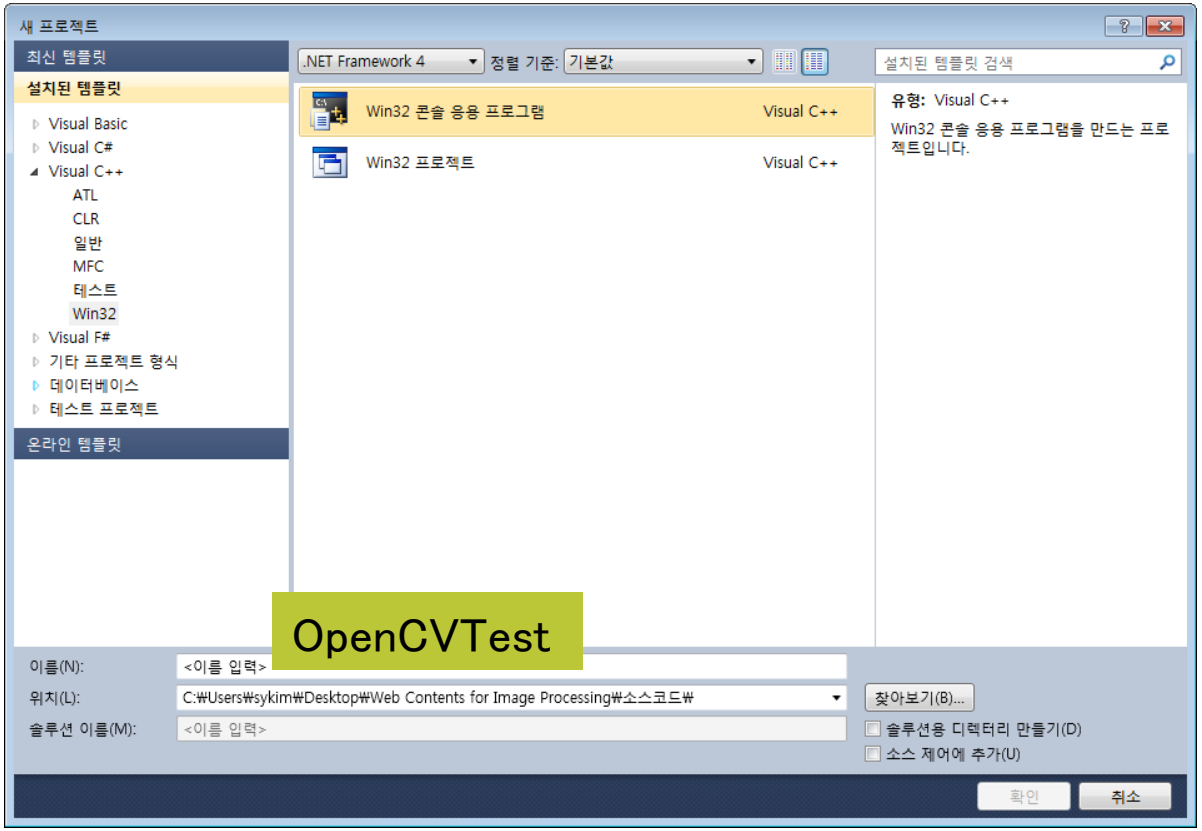
http://threadingbuildingblocks.org/ver.php?fid=174




vc10
파일(F) 편집(E) 보기(V) 즐겨찾기(A) 도구(T) 도움말(H)
뒤로
C:¥tbb40_233oss¥bin¥ia32¥vc10
주소(D) C:₩tbb40_233oss₩bin₩ia32₩vc10
이동
폴더
opencv
OpenCVExam
PHP_Setup_for_IIS
Program Files
tbb40_233oss
bin
ia32
vc8
vc9
vc10
irml
irml_c
intel64
doc
examples
include
lib
temp
tld1.0_demo
VSProjects
WINDOWS
이동식 디스크 (D:)
이동식 디스크 (E:)
이동식 디스크 (F:)
이름 크기 종류 수정한 날짜
irml 파일 폴더 2012-05-30 오후 ...
irml_c 파일 폴더 2012-05-30 오후 ...
tbb.dll 149KB 응용 프로그램 확장 2011-08-24 오후 ...
tbb.pdb 1,747KB Program Debug ... 2011-08-24 오후 ...
tbb_debug.dll 263KB 응용 프로그램 확장 2011-08-24 오후 ...
tbb_debug.pdb
tbb_preview.dll
tbb_preview.pdb
tbb_preview_debug
tbb_preview_debug.pdb
tbbmalloc.dll 50KB 응용 프로그램 확장 2011-08-24 오후 ...
tbbmalloc.pdb 507KB Program Debug ... 2011-08-24 오후 ...
tbbmalloc_debug.dll 72KB 응용 프로그램 확장 2011-08-24 오후 ...
tbbmalloc_debug.pdb 491KB Program Debug ... 2011-08-24 오후 ...
tbbmalloc_proxy.dll 27KB 응용 프로그램 확장 2011-08-24 오후 ...
tbbmalloc_proxy.pdb 307KB Program Debug ... 2011-08-24 오후 ...
tbbmalloc_proxy_debug.dll 29KB 응용 프로그램 확장 2011-08-24 오후 ...
tbbmalloc_proxy_debug.... 299KB Program Debug ... 2011-08-24 오후 ...
Copy tbb.dll and tbb_debug.dll to
C:¥windows¥system32
18 개체 (디스크 여유 공간: 78.4GB)
9.38MB
내 컴퓨터

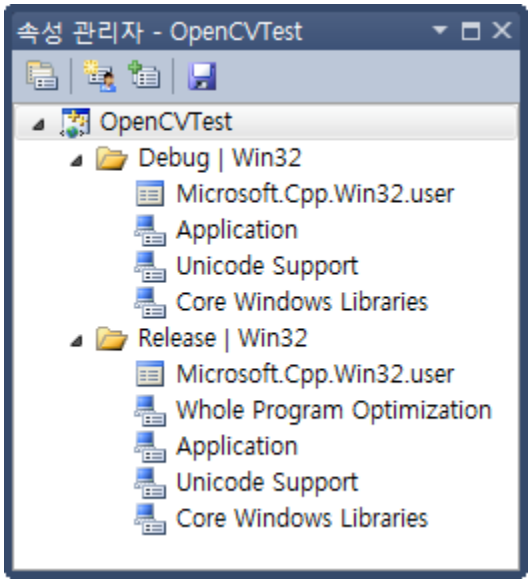
Loading, displaying and saving images

파일|새로 만들기|프로젝트... File|New Project|Project...

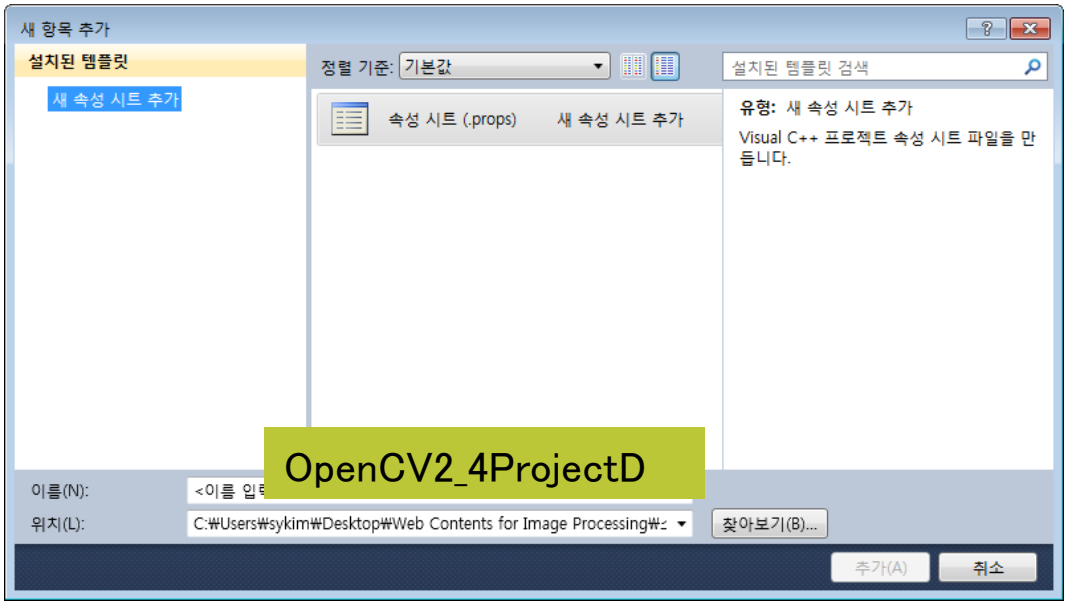


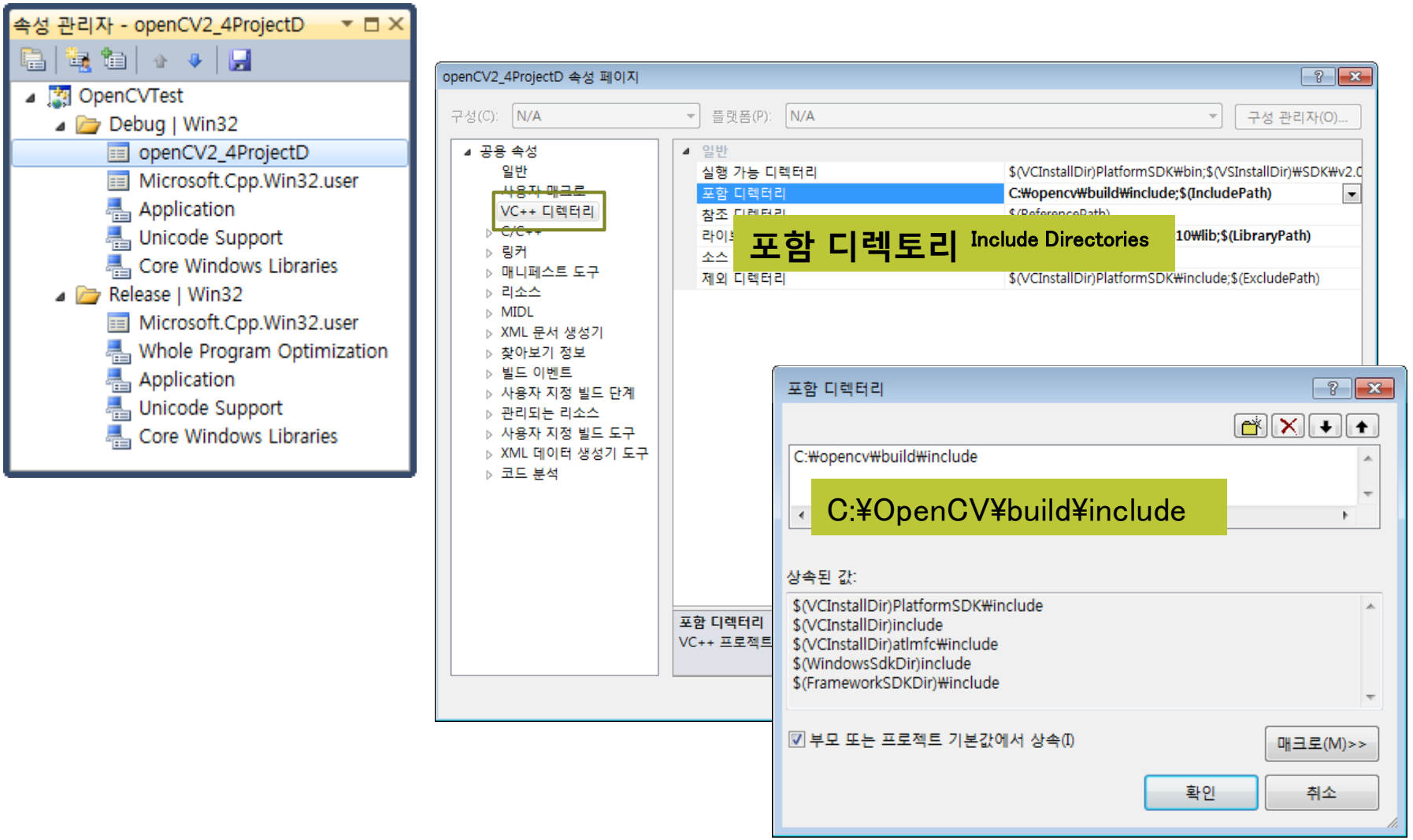
콘솔 응용 프로그램 | 빈 프로젝트 Console Application | Empty Project

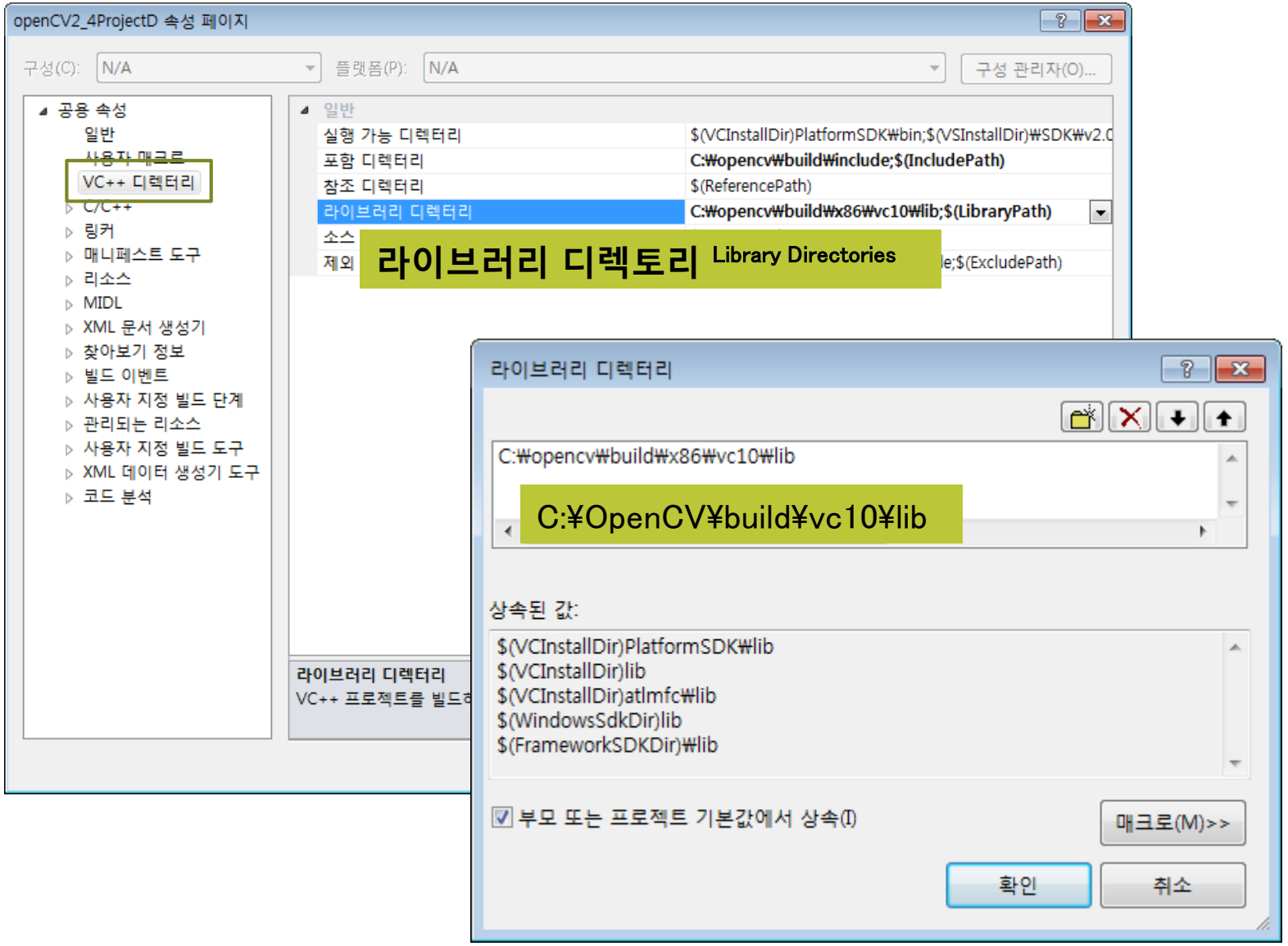
보기| 속성 관리자 View|Property Manager

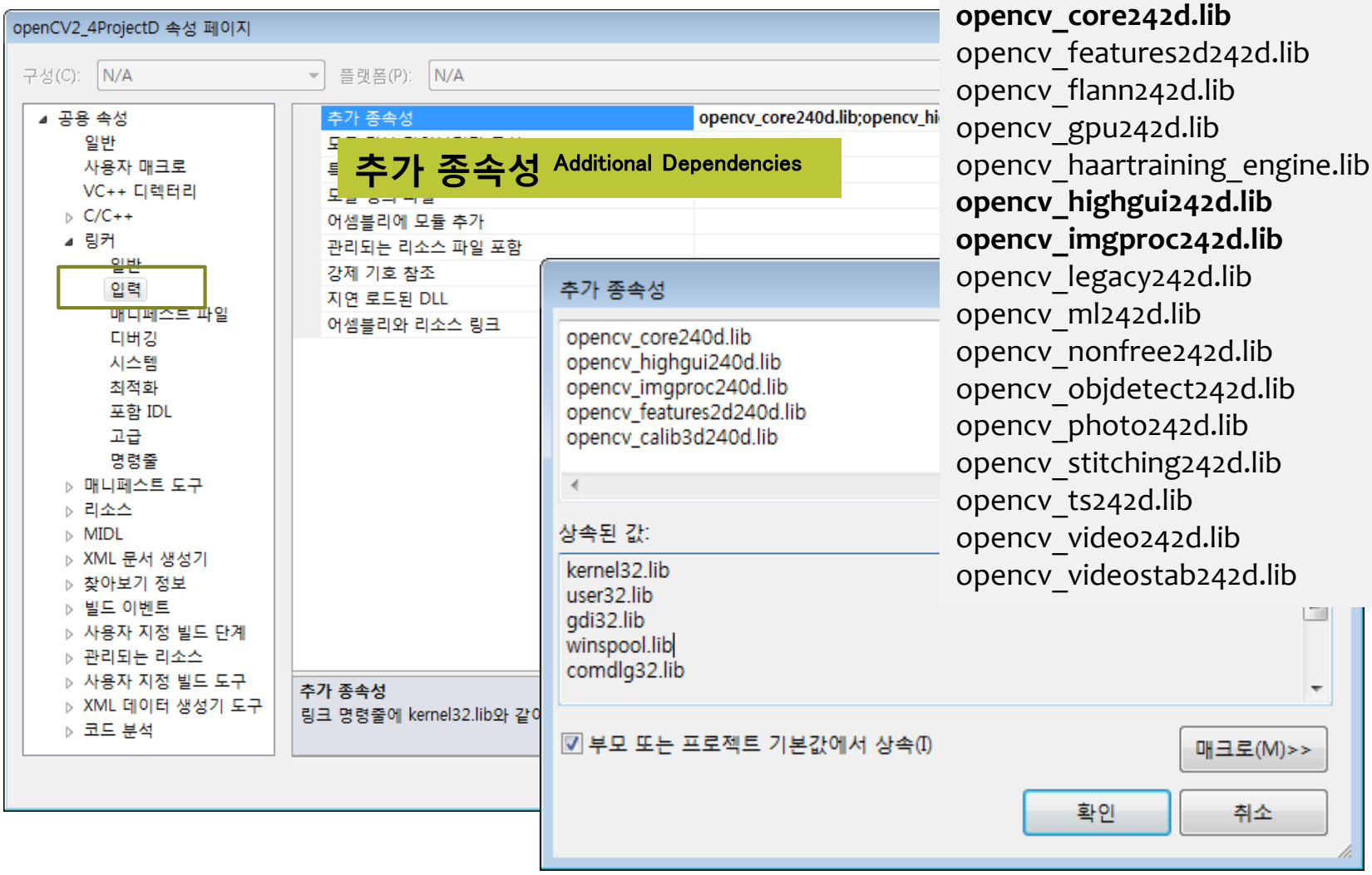


1. Right-clicking on **Debug | Win32**
2. 새 프로젝트 속성 시트 추가 Add New Project Property Sheet



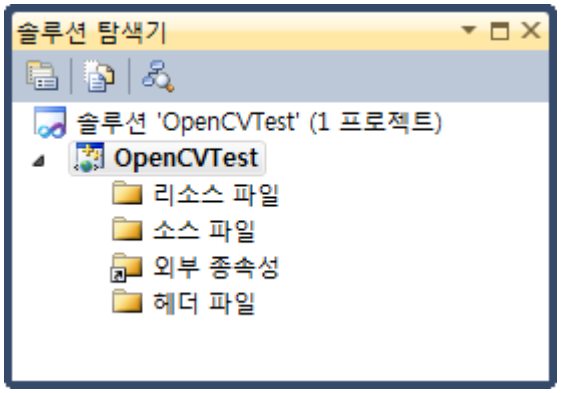

속성 관리자 - openCV2_4ProjectD
OpenCVTest
Debug | Win32
openCV2_4ProjectD
Microsoft.Cpp.Win32.user
Application
Unicode Support
Core Windows Libraries
Release | Win32
Microsoft.Cpp.Win32.user
Whole Program Optimization
Application
Unicode Support
Core Windows Libraries
openCV2_4ProjectD 속성 페이지
구성(C): N/A
플랫폼(P): N/A
구성 관리자(O)...
공용 속성
일반
사용자 매크로
VC++ 디렉터리
C/C++
링커
매니페스트 도구
리소스
MIDL
XML 문서 생성기
찾아보기 정보
빌드 이벤트
사용자 지정 빌드 단계
관리되는 리소스
사용자 지정 빌드 도구
XML 데이터 생성기 도구
코드 분석
일반
실행 가능 디렉터리
포함 디렉터리
참조 디렉터리
라이브러리
소스
제외 디렉터리
$(VCInstallDir)PlatformSDK₩bin;$(VSInstallDir)₩SDK₩v2.0
C:₩opencv₩build₩include;$(IncludePath)
10₩lib;$(LibraryPath)
$(VCInstallDir)PlatformSDK₩include;$(ExcludePath)
포함 디렉터리
Include Directories
포함 디렉터리
VC++ 프로젝트
C:₩opencv₩build₩include
C:¥OpenCV¥build¥include
상속된 값:
$(VCInstallDir)PlatformSDK₩include
$(VCInstallDir)include
$(VCInstallDir)atlmfc₩include
$(WindowsSdkDir)include
$(FrameworkSDKDir)₩include
부모 또는 프로젝트 기본값에서 상속(I)
매크로(M)>>
확인
취소


openCV2_4ProjectD 속성 페이지
구성(C): N/A
플랫폼(P): N/A
구성 관리자(O)...
공용 속성
일반
사용자 매크로
VC++ 디렉터리
C/C++
링커
매니페스트 도구
리소스
MIDL
XML 문서 생성기
찾아보기 정보
빌드 이벤트
사용자 지정 빌드 단계
관리되는 리소스
사용자 지정 빌드 도구
XML 데이터 생성기 도구
코드 분석
일반
실행 가능 디렉터리
$(VCInstallDir)PlatformSDK₩bin;$(VSInstallDir)₩SDK₩v2.0
포함 디렉터리
C:₩opencv₩build₩include;$(IncludePath)
참조 디렉터리
$(ReferencePath)
라이브러리 디렉터리
C:₩opencv₩build₩x86₩vc10₩lib;$(LibraryPath)
소스
제외
$(ExcludePath)
라이브러리 디렉터리
VC++ 프로젝트를 빌드
라이브러리 디렉토리 Library Directories
라이브러리 디렉터리
C:₩opencv₩build₩x86₩vc10₩lib
C:¥OpenCV¥build¥vc10¥lib
상속된 값:
$(VCInstallDir)PlatformSDK₩lib
$(VCInstallDir)lib
$(VCInstallDir)atlmfc₩lib
$(WindowsSdkDir)lib
$(FrameworkSDKDir)₩lib
부모 또는 프로젝트 기본값에서 상속(I)
매크로(M)>>
확인
취소

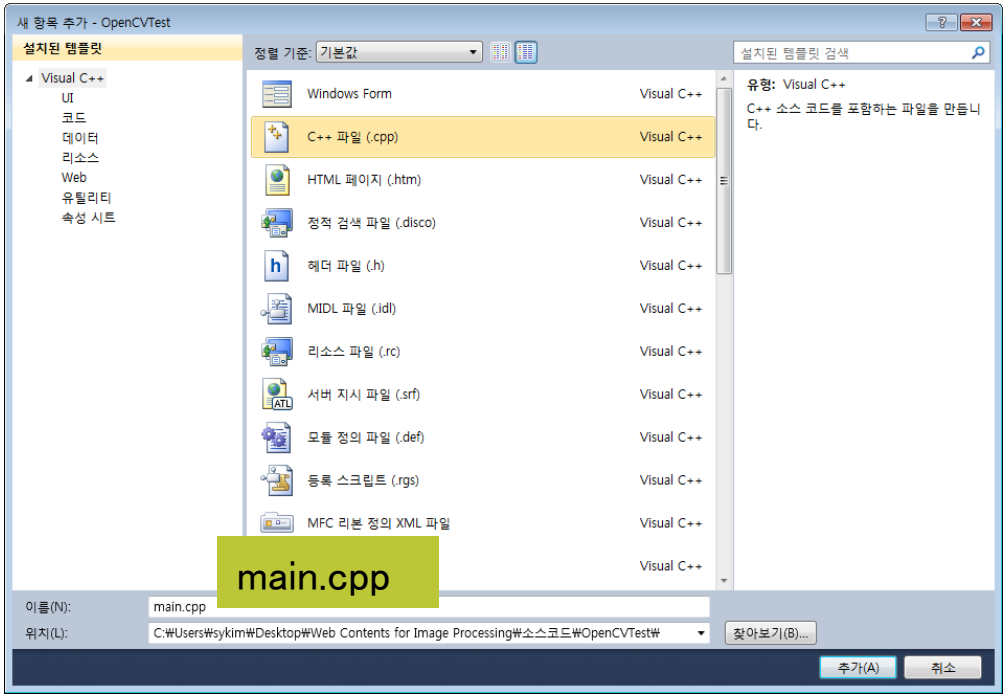


opencv_calib3d242d.lib
opencv_contrib242d.lib
opencv_core242d.lib
opencv_features2d242d.lib
opencv_flann242d.lib
opencv_gpu242d.lib
opencv_haartraining_engine.lib
opencv_highgui242d.lib
opencv_imgproc242d.lib
opencv_legacy242d.lib
opencv_ml242d.lib
opencv_nonfree242d.lib
opencv_objdetect242d.lib
opencv_photo242d.lib
opencv_stitching242d.lib
opencv_ts242d.lib
opencv_video242d.lib
opencv_videostab242d.lib

보기| 솔루션 탐색기 View|Solution Explorer



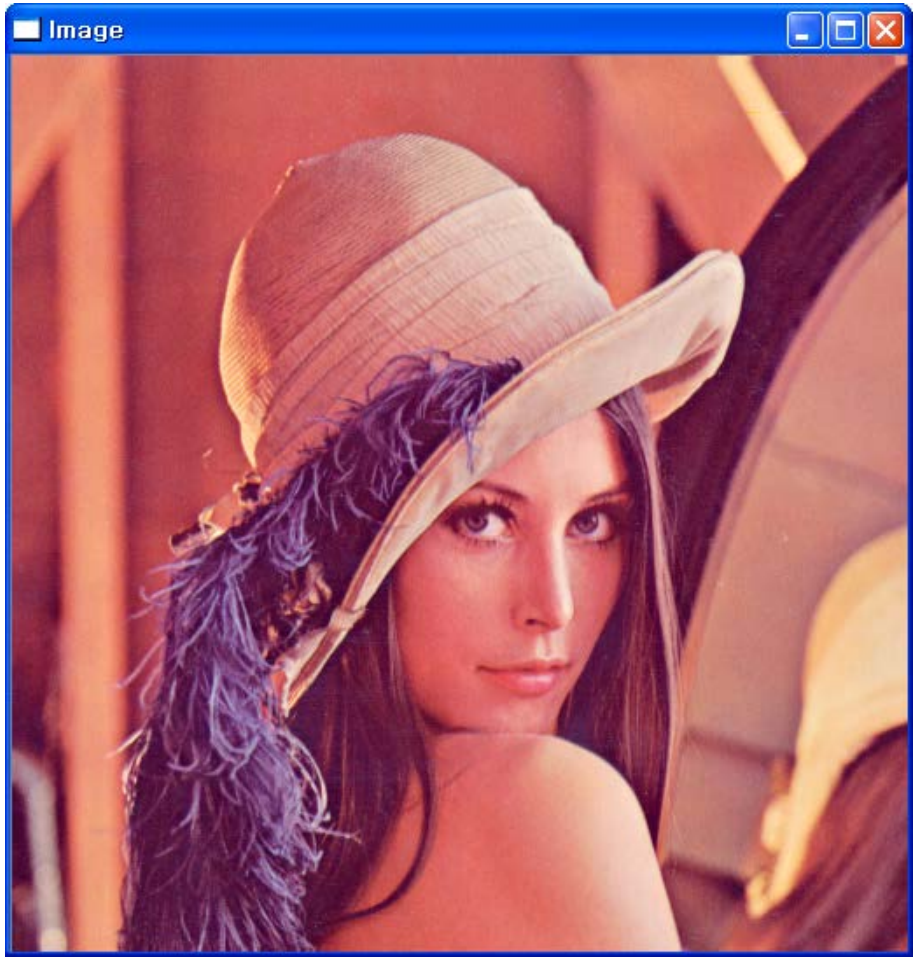
1. Right-clicking on **소스파일** Source Files
2. **추가|새 항목...** Add New Item...



```
#include "opencv/cv.h"
#include "opencv/highgui.h"

int main(void)
{
    IplImage* pImage = cvLoadImage( "lena.png", -1 );
    if(pImage == NULL) return -1;

    cvNamedWindow( "Image", 1 );
    cvShowImage( "Image", pImage );

    cvWaitKey( 0 );

    cvDestroyWindow( "Image" );
    cvReleaseImage( &pImage );

    return 0;
}
```

```
#include "opencv/cv.h"
#include "opencv/highgui.h"

int main(void){
    IplImage* pImage = cvLoadImage( "lena.jpg", -1 );
    if(pImage == NULL) return -1;

    int param[3];
    param[0] = CV_IMWRITE_JPEG_QUALITY;
    param[1] = 95;
    param[2] = 0;
    cvSaveImage( "result.jpg", pImage, param );

    cvReleaseImage( &pImage );

    return 0;
}
```

CV_IMWRITE_JPEG_QUALITY: 0 to 100 (better quality)
CV_IMWRITE_PNG_COMPRESSION: 0 to 9 (smaller size)
CV_IMWRITE_PXM_BINARY: 0 or 1



Image

```
#include "opencv2/core/core.hpp"
#include "opencv2/highgui/highgui.hpp"

using namespace cv;

int main(void) {
    Mat image = imread( "lena.jpg", -1 );
    if(image.data == NULL) return -1;

    namedWindow( "Image" );
    imshow( "Image", image );

    waitKey( 0 );

    return 0;
}
```

```
#include "opencv2/core/core.hpp"
#include "opencv2/highgui/highgui.hpp"

using namespace cv;

int main(void) {
    Mat image = imread( "lena.jpg", -1 );
    if(image.data == NULL) return -1;

    vector<int> params;
    params.push_back( CV_IMWRITE_JPEG_QUALITY );
    params.push_back( 95 );
    imwrite( "result.jpg", image, params );

    return 0;
}
```

CV_IMWRITE_JPEG_QUALITY: 0 to 100 (better quality)
CV_IMWRITE_PNG_COMPRESSION: 0 to 9 (smaller size)
CV_IMWRITE_PXM_BINARY: 0 or 1

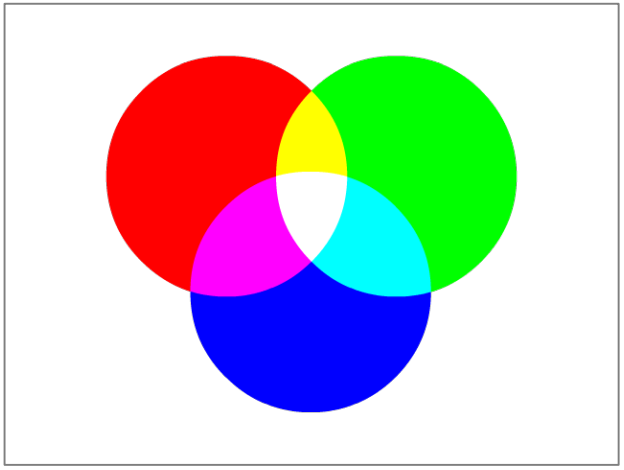
주요 자료구조

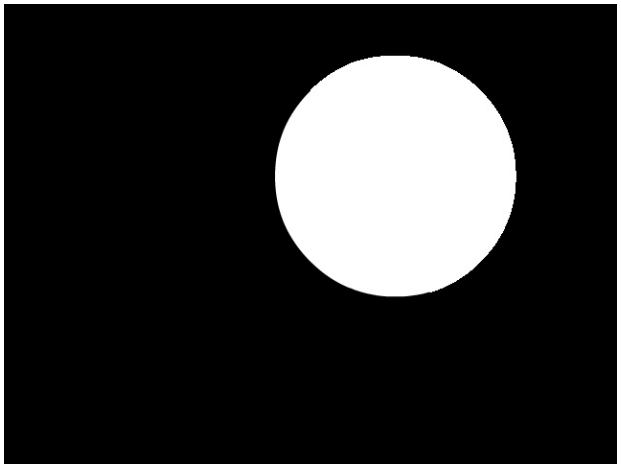
```
typedef struct _IplImage
{
    int  nSize;         /* sizeof(IplImage) */
    int  ID;            /* version (=0)*/
    int  nChannels;     /* Most of OpenCV functions support 1,2,3 or 4 channels */
    int  depth;         /* pixel depth in bits */
    int  dataOrder;     /* 0 - interleaved color channels,
                           1 - separate color channels */
    int  origin;        /* 0 - top-left origin,
                           1 - bottom-left origin (Windows bitmaps style) */
    int  align;         /* Alignment of image rows (4 or 8).
                           OpenCV ignores it and uses widthStep instead */
    int  width;         /* image width in pixels */
    int  height;        /* image height in pixels */
    struct _IplROI *roi;/* image ROI */
    int  imageSize;     /* image data size in bytes
                           (=image->height*image->widthStep
                           in case of interleaved data)*/
    char *imageData;    /* pointer to aligned image data */
    int  widthStep;     /* size of aligned image row in bytes */
    char *imageDataOrigin; /* pointer to a very origin of image data
                              (not necessarily aligned) -
                              it is needed for correct image deallocation */
} IplImage;
```

```
class CV_EXPORTS Mat
{
public:
    // ... a lot of methods ...
    ...

    /*! includes several bit-fields:
         - the magic signature
         - continuity flag
         - depth
         - number of channels
     */
    int flags;
    //! the array dimensionality, >= 2
    int dims;
    //! the number of rows and columns
    int rows, cols;
    //! pointer to the data
    uchar* data;

    //! pointer to the reference counter;
    // when array points to user-allocated data, the pointer is NULL
    int* refcount;

    // other members
    ...
};
```

Exercise

칼라 영상을 불러와서 split() 함수를 이용하여 영상을 빨강, 녹색, 파랑 채널(평면)로 분리하여 녹색 영상만을 화면에 출력하시오.





```
#include "opencv2/core/core.hpp"
#include "opencv2/highgui/highgui.hpp"
using namespace cv;

int main(void) {
   Mat image = imread( "color.png", -1 );
   if(image.data == NULL) return -1;

   vector<Mat> mv;
   split( image, mv );

   namedWindow( "Image" );
   imshow( "Image", mv[1] );

   waitKey( 0 );

   return 0;
}
```

요약

- OpenCV Library
  - open computer vision and machine learning software library
- Installing OpenCV Library (Visual Studio 2010)
- Loading, displaying and saving images
- 주요 자료구조
  - IplImage, Mat

Reference

- R. Laganière, **OpenCV2 Computer Vision: Application Programming Cookbook,** PACKT Publishing, 2011
- G. Bradski and A. Kaebler, **Learning OpenCV: Computer Vision with the OpenCV Library**, O'REILLY, 2008
- 정성환, 이문호, **오픈소스 OpenCV를 이용한 컴퓨터 비전 실무 프로그래밍**, 홍릉과학출판사, 2007