

Computer Vision

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Informatii generale

- Pagina web a cursului (in curs de completare)
 - <http://inf.ucv.ro/~cstoean/courses/cv/>
- Nota
 - Se obtine in urma prezentarii unui proiect insotit de un referat.
 - Teme de proiect vor fi enuntate pe parcursul cursului si cuprind:
 - in principal, procesari de imagini
 - dar si extrageri de informatii din imagini (masuratori, calcule etc) folosind sau nu invatare automata

Bibliografie 1/2

- Robert Laganière, OpenCV 2 Computer Vision Application Programming Cookbook, Packt Publishing, Birmingham, UK, 2011.
- Gary R. Bradski, Vadim Pisarevsky, Jean-Yves Bouguet, Open Source Computer Vision Library, Springer, 1st ed. 2006.
- Gady Agam, Introduction to programming with OpenCV, Illinois Institute of Technology, 2006,
<http://www.cs.iit.edu/~agam/cs512/lect-notes/opencv-intro/opencv-intro.html>

Bibliografie 2/2

- D.A. Forsyth, Jean Ponce, Computer Vision - A Modern Approach (2nd Edition), Jean Ponce, 2011.
- Gary Bradski and Adrian Kaehler, Learning OpenCV: Computer Vision with the OpenCV Library, O'Reilly Media, 2008.

<http://www.cse.iitk.ac.in/users/vision/dipakmj/papers/OReilly%20Learning%20OpenCV.pdf> .

- Peter Corke, Robotics, Vision & Control, Springer 2011.

Continutul cursului

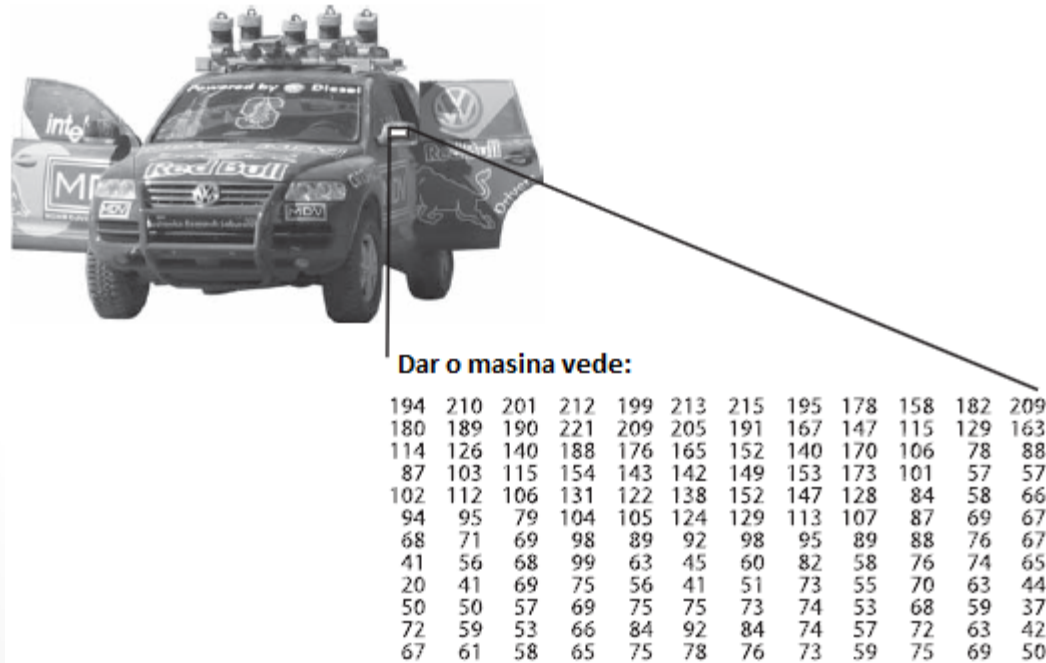
- Computer Vision cu OpenCV
- Încărcarea, afisarea si salvarea imaginilor
 - Crearea unei aplicatii GUI folosind QT pentru procesare de imagini
- Accesarea valorilor pentru pixeli din cadrul unei imagini
- Definirea de regiuni de interes in imagini
- Procesare de imagini cu clase
- Histograma unei imagini
- Detectarea continutului unei imagini folosind histograma
- Transformarea imaginilor cu operatii morfologice
- Extragerea de linii, contururi si componente
- Detectarea de puncte de interes
- Procesarea de secvente video

Ce este Computer Vision?

- Transformarea datelor de la o camera foto sau video intr-o reprezentare noua sau chiar in decizii.
 - Camera poate fi montata pe o masina
 - Un laser poate indica faptul ca te apropii mai aproape de 1 metru de un obiect
- Aceste observatii se fac in general simplu, intruitiv de catre om.

Ce este Computer Vision?

- Este banal pentru un om sa identifice o masina intr-o poza
 - S-a focusat in imagine doar pe acea regiune
 - A vazut deja suficiente masini anterior ca sa aiba o reprezentare clara asupra lor



De ce Computer Vision?

- Imagini (si filme) sunt pretutindeni
- Aplicatii utile care sa extraga informatii din imagini:
 - Identificarea automata a numarului de la masina
 - Identificarea feței
 - Identificarea unor regiuni de interes intr-o imagine
 - Procesarea filmelor
- Exista deja multe soft-uri care face astfel de procesari.
 - Dar cand avem nevoie sa procesam zeci, sute sau chiar mii de imagini/filme, este esential sa ne cream propria aplicatie care sa realizeze aceste lucruri.

OpenCV

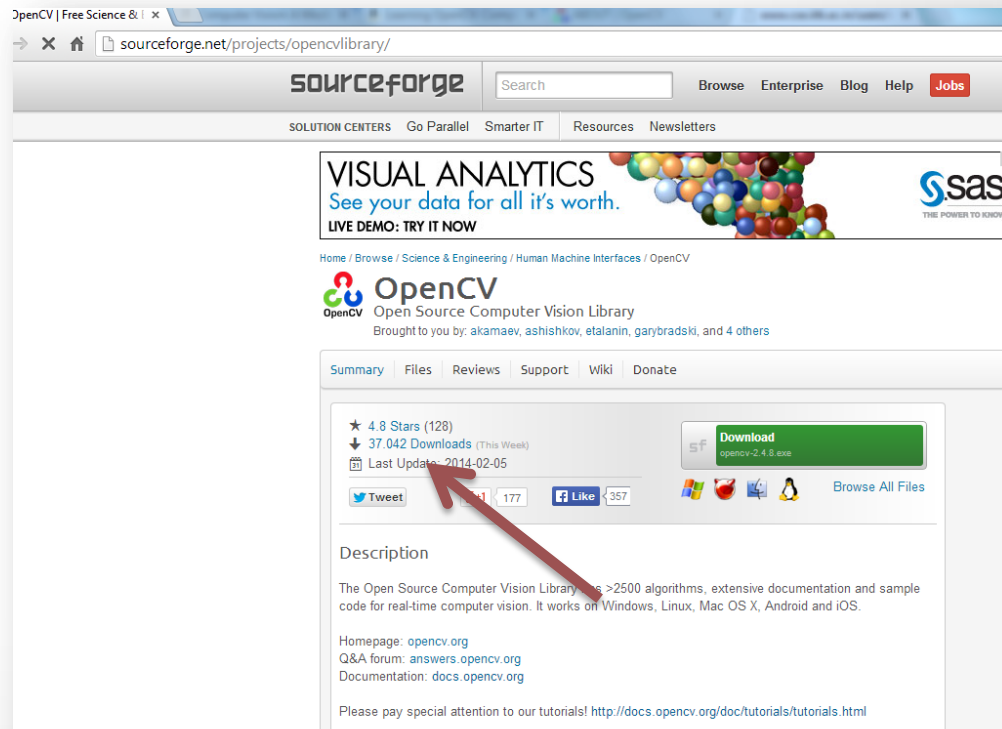
- Reprezinta o librerie gratuita (Open) pentru dezvoltare si cercetarea in Computer Vision
 - <http://sourceforge.net/projects/opencvlibrary/>
- Contine peste 2500 de algoritmi
- Functioneaza sub Windows, Linux, Android, Mac OS.
- Sunt dezvoltate interfete pentru alte limbaje precum: C++, C, Java, Python, Matlab.
- Oferă infrastructura pentru Computer Vision pentru a construi rapid aplicatii sofisticate
- Cursul ne va ajuta sa alegem ce algoritm sa utilizam pentru scopul avut si in ce moment

OpenCV

- Are peste 7 mil de descarcari
- Printre utilizatori se numara si companii mari precum Google, Yahoo, Microsoft, Intel, IBM, Sony etc.
- Printre algoritmi continuti sunt unii dedicati pentru:
 - Recunoasterea feței
 - Identificarea de obiecte
 - Urmărirea obiectelor in miscare
 - Gasirea de imagini similare intr-o baza de date cu imagini
 - Eliminarea ochilor rosii din poze
 - Urmărirea ochilor in miscare
- Functioneaza sub diferite medii de dezvoltare integrate (IDE) pentru C++.

Descarcarea OpenCV

- **Presupunem instalat deja Visual Studio 2010**
 - Gratuit prin contul personal de la DreamSpark
<http://e5.onthehub.com/d.ashx?s=bc81baqimt>
- Cea mai recenta versiune de OpenCV se descarca de la <http://sourceforge.net/projects/opencvlibrary/>
- Arhiva se extrage intr-un folder, de exemplu in D:\OpenCV2



OpenCV | Free Science & ...

sourceforge.net/projects/opencvlibrary/

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OpenCV
Open Source Computer Vision Library
Brought to you by: akamaev, ashishkov, etalain, garybradski, and 4 others

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★ 4.8 Stars (128)
↓ 37,042 Downloads (This Week)
Last Update: 2014-02-05

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opencv-2.4.8.exe

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Description

The Open Source Computer Vision Library has >2500 algorithms, extensive documentation and sample code for real-time computer vision. It works on Windows, Linux, Mac OS X, Android and iOS.

Homepage: opencv.org
Q&A forum: answers.opencv.org
Documentation: docs.opencv.org

Please pay special attention to our tutorials! <http://docs.opencv.org/doc/tutorials/tutorials.html>

Instalarea OpenCV

- Dupa descarcare, biblioteca se instaleaza
- Pentru aceasta, descarcati CMake (open-source)



The image shows a screenshot of the CMake website homepage. The browser's address bar displays "www.cmake.org". The website features a green header with the CMake logo (a 3D pyramid) and the text "CMake". Navigation links for "PROJECT", "RESOURCES", "HELP", and "OPEN SOURCE" are visible. A search bar is located in the top right corner. The main content area includes a welcome message, a "News" section, and a prominent announcement for "CMake 2.8.12 Now Available for Download" with a "Download Now" button and a 3D pyramid graphic.

CMake - Cross Platform v x
www.cmake.org

Kitware Search

CMake

PROJECT RESOURCES HELP OPEN SOURCE

Welcome to **CMake**, the cross-platform, open-source build system. CMake is a family of tools designed to build, test and package software. CMake is used to control the software compilation process using simple platform and compiler independent configuration files. CMake generates native makefiles and workspaces that can be used in the compiler environment of your choice.

CMake was created by Kitware in response to the need for a powerful, cross-platform build environment for open-source projects such as ITK and VTK. In addition to leading the development of this popular tool, Kitware also offers commercial consulting, support and training to help your organization effectively use CMake and the entire Kitware quality software process.

News [More News >](#)

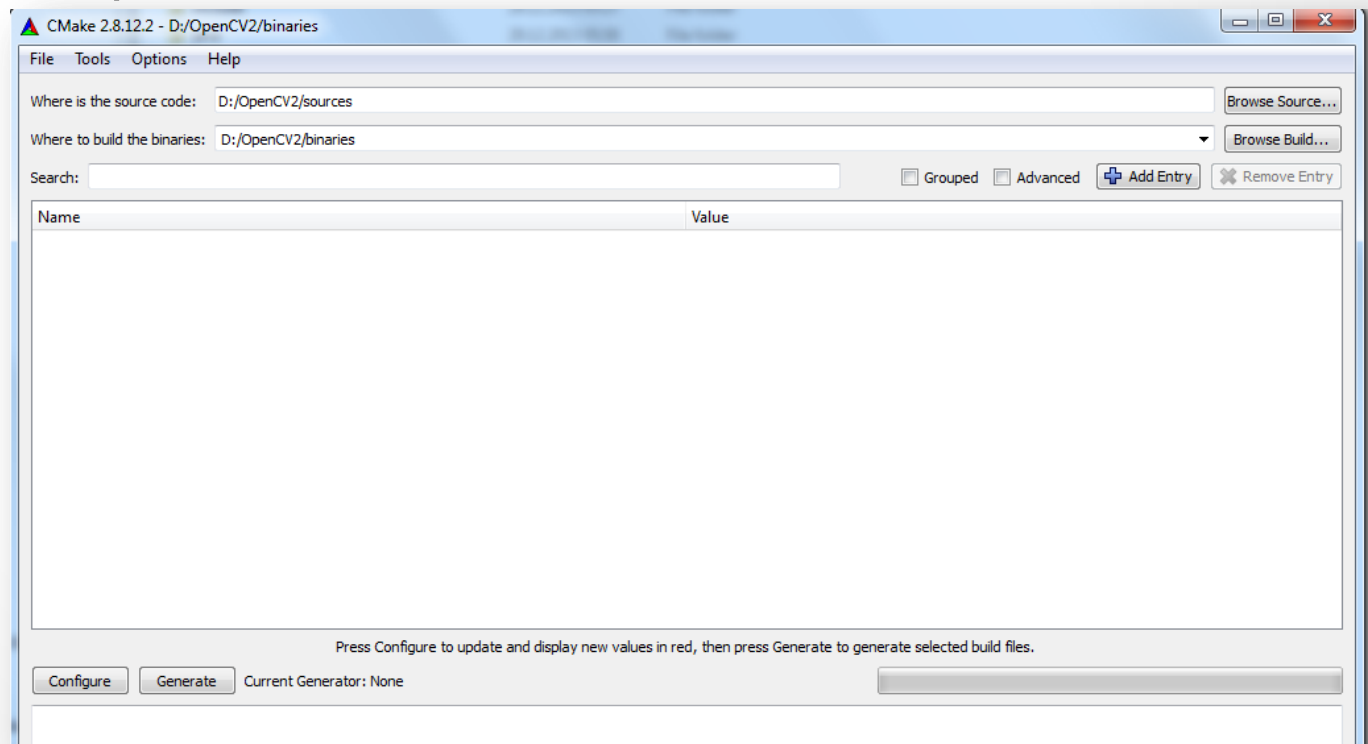
CMake 2.8.12 Now Available for Download

Download Now >

Instalarea OpenCV

- Dupa descarcare, biblioteca se instaleaza
- Pentru aceasta, descarcati si instalati CMake (open-source)

- Se pun:
 - Calea catre sursa
 - Calea catre biblioteca compilata
- Configure
 - Se alege Visual Studio 10
- Generate



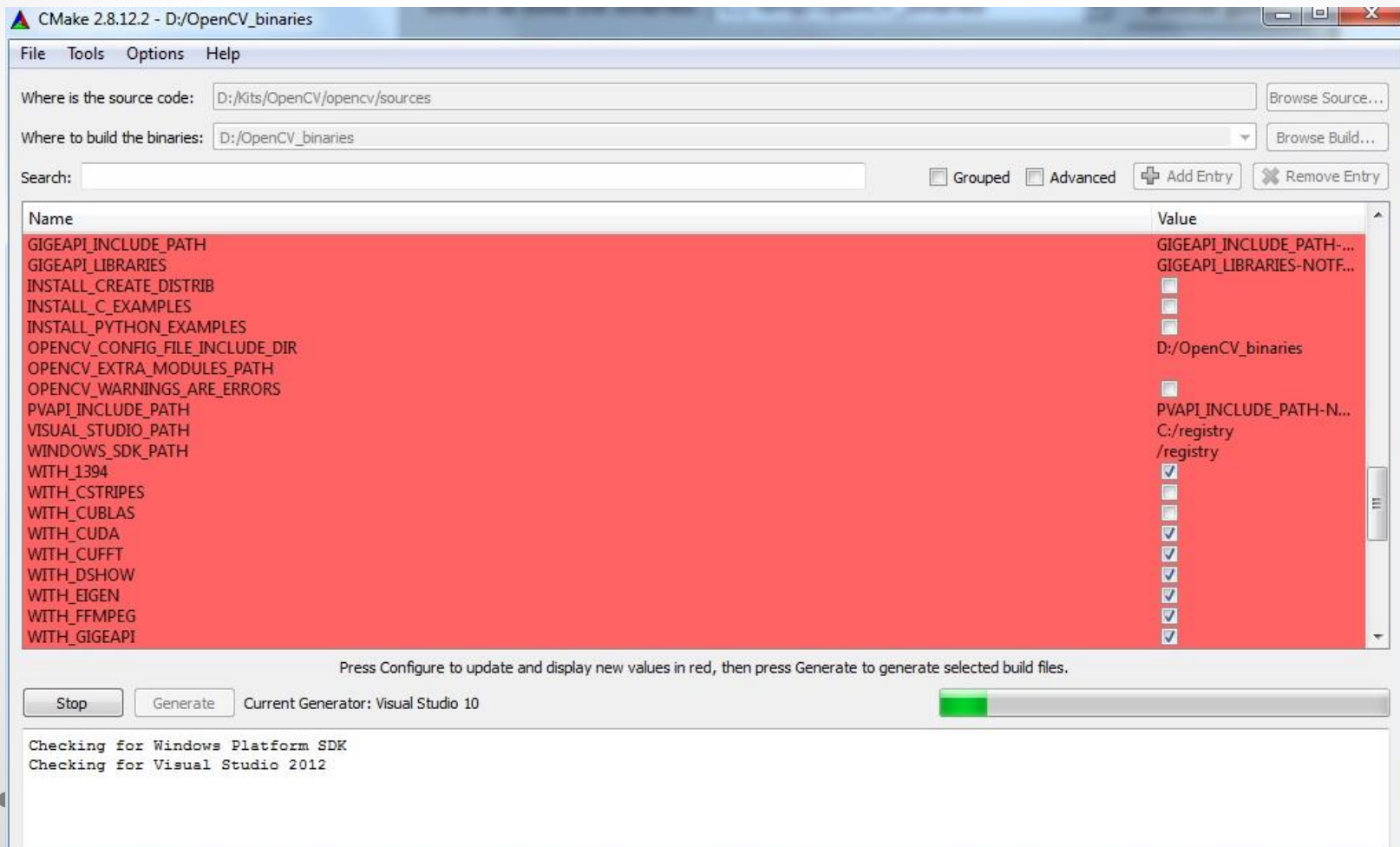
Instalarea OpenCV

- Se obtine o fereastră ca mai jos.
- Apasam din nou **Configure**.



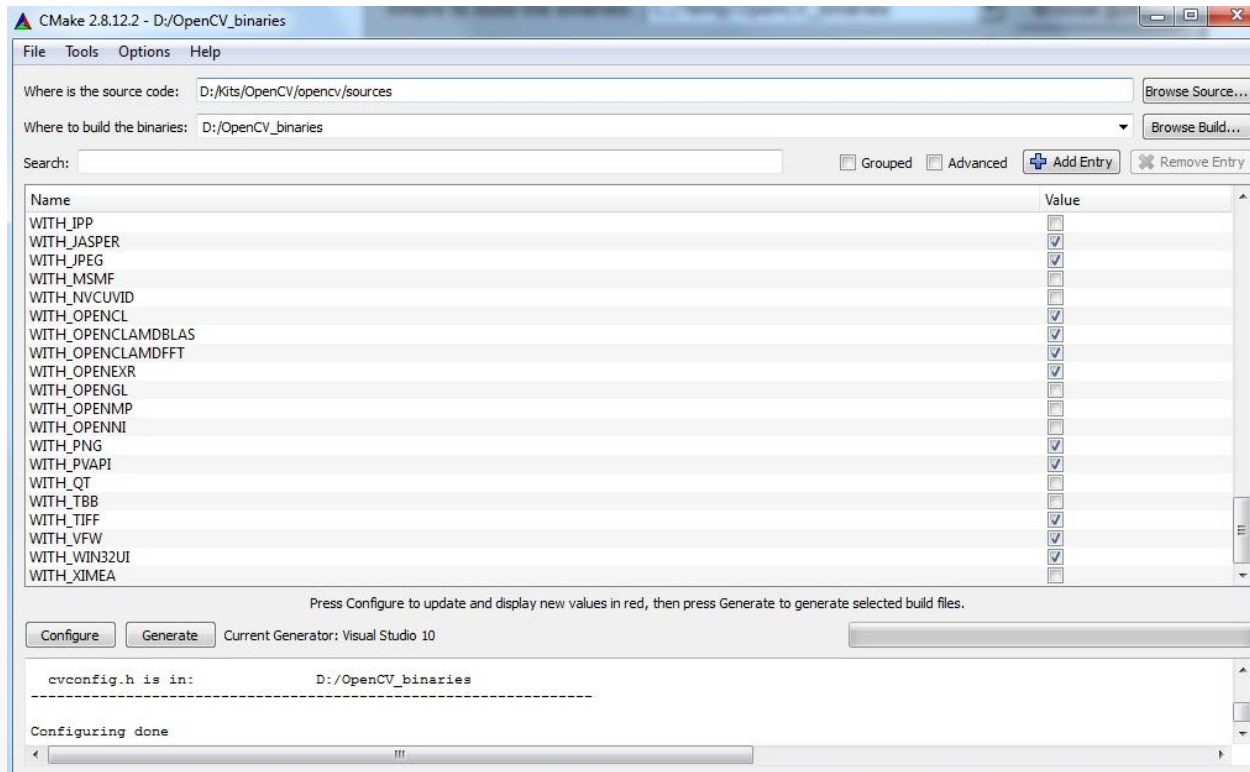
Instalarea OpenCV

- Dupa ce a fost apasat din nou **Configure**



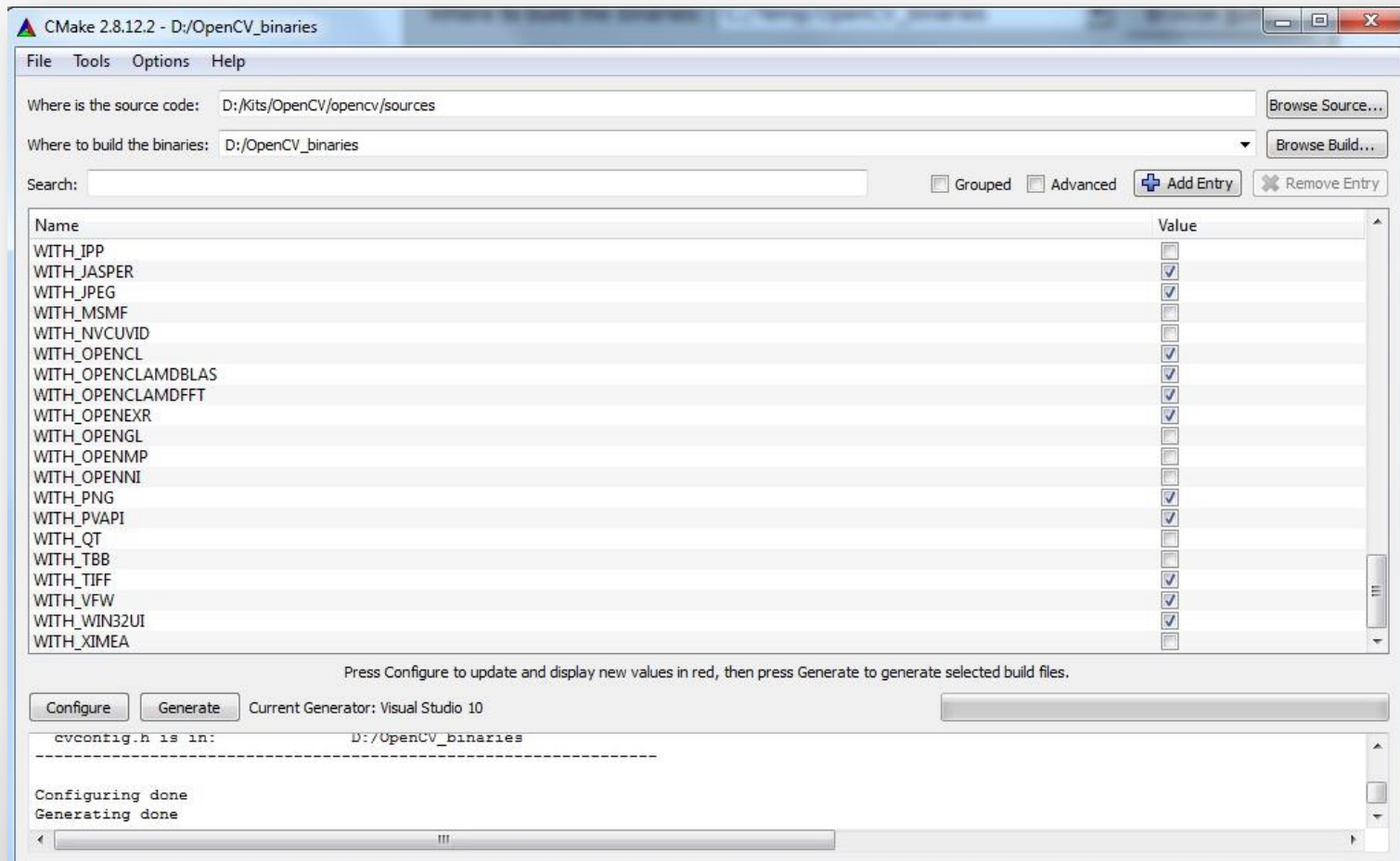
Instalarea OpenCV

- Configurarea este gata. Acum apasam din nou **Generate**



Instalarea OpenCV

- Gata si generarea

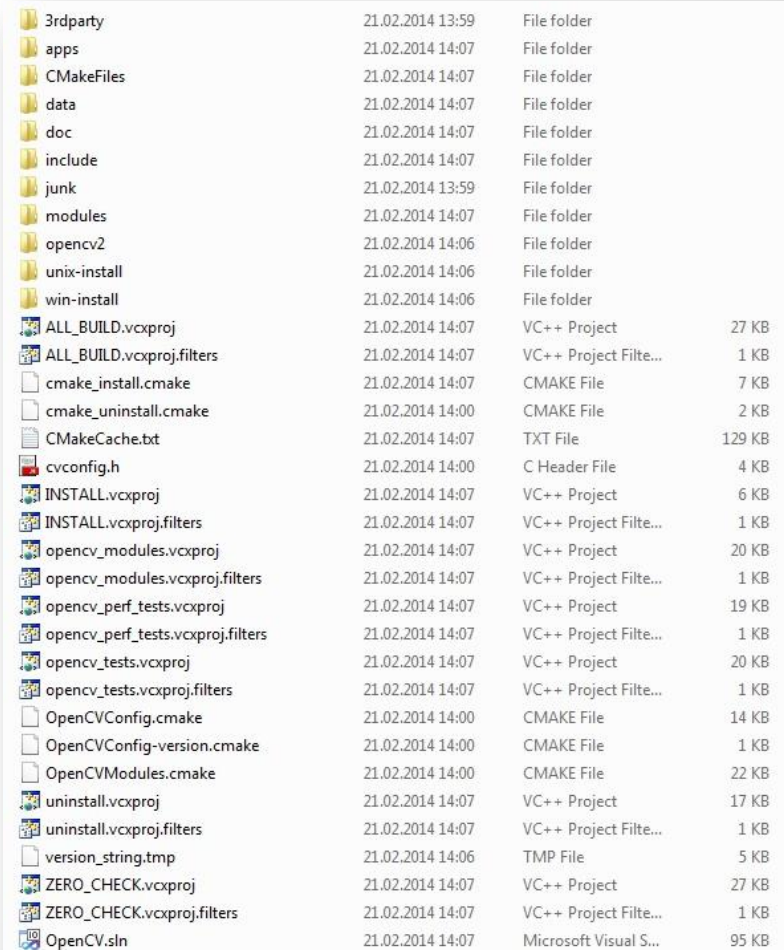


Instalarea OpenCV

- Verificam folderul in care am trimis libraria

- Dam dublu-click pe OpenCV.sln (solutia creata) pentru a o deschide in Microsoft Studio 2010

- Dam Build Solution
 - Dureaza peste 5 minute

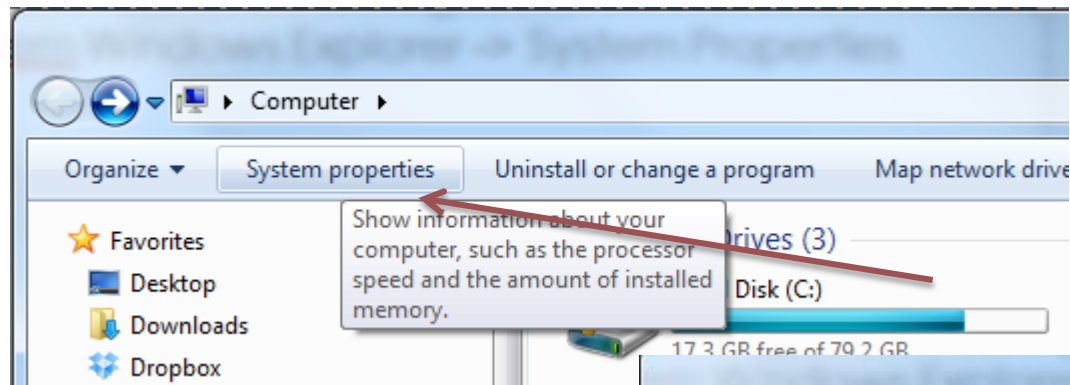


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apps	21.02.2014 14:07	File folder	
CMakeFiles	21.02.2014 14:07	File folder	
data	21.02.2014 14:07	File folder	
doc	21.02.2014 14:07	File folder	
include	21.02.2014 14:07	File folder	
junk	21.02.2014 13:59	File folder	
modules	21.02.2014 14:07	File folder	
opencv2	21.02.2014 14:06	File folder	
unix-install	21.02.2014 14:06	File folder	
win-install	21.02.2014 14:06	File folder	
ALL_BUILD.vcxproj	21.02.2014 14:07	VC++ Project	27 KB
ALL_BUILD.vcxproj.filters	21.02.2014 14:07	VC++ Project Filte...	1 KB
cmake_install.cmake	21.02.2014 14:07	CMAKE File	7 KB
cmake_uninstall.cmake	21.02.2014 14:00	CMAKE File	2 KB
CMakeCache.txt	21.02.2014 14:07	TXT File	129 KB
cvconfig.h	21.02.2014 14:00	C Header File	4 KB
INSTALL.vcxproj	21.02.2014 14:07	VC++ Project	6 KB
INSTALL.vcxproj.filters	21.02.2014 14:07	VC++ Project Filte...	1 KB
opencv_modules.vcxproj	21.02.2014 14:07	VC++ Project	20 KB
opencv_modules.vcxproj.filters	21.02.2014 14:07	VC++ Project Filte...	1 KB
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opencv_perf_tests.vcxproj.filters	21.02.2014 14:07	VC++ Project Filte...	1 KB
opencv_tests.vcxproj	21.02.2014 14:07	VC++ Project	20 KB
opencv_tests.vcxproj.filters	21.02.2014 14:07	VC++ Project Filte...	1 KB
OpenCVConfig.cmake	21.02.2014 14:00	CMAKE File	14 KB
OpenCVConfig-version.cmake	21.02.2014 14:00	CMAKE File	1 KB
OpenCVModules.cmake	21.02.2014 14:00	CMAKE File	22 KB
uninstall.vcxproj	21.02.2014 14:07	VC++ Project	17 KB
uninstall.vcxproj.filters	21.02.2014 14:07	VC++ Project Filte...	1 KB
version_string.tmp	21.02.2014 14:06	TMP File	5 KB
ZERO_CHECK.vcxproj	21.02.2014 14:07	VC++ Project	27 KB
ZERO_CHECK.vcxproj.filters	21.02.2014 14:07	VC++ Project Filte...	1 KB
OpenCV.sln	21.02.2014 14:07	Microsoft Visual S...	95 KB

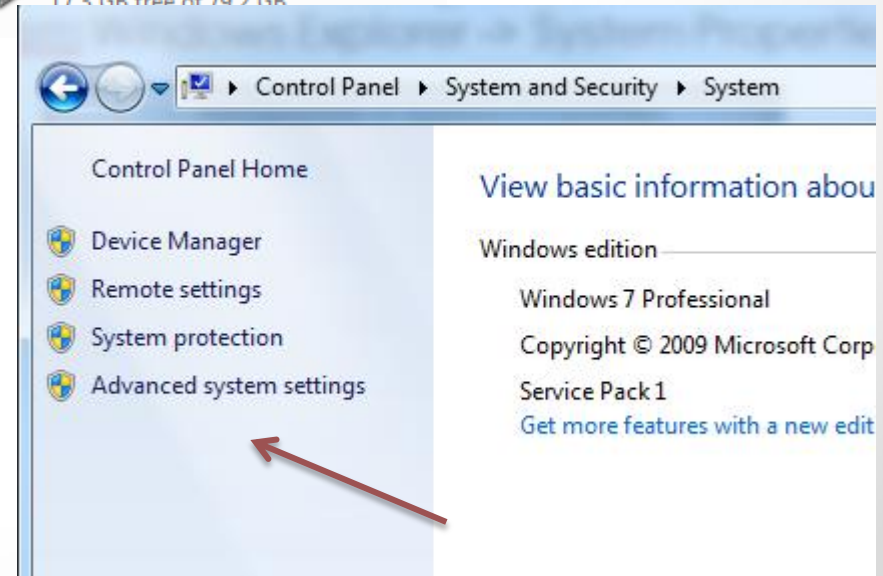
Instalarea OpenCV

Setare variabile de mediu

- Alegem Windows Explorer -> System Properties



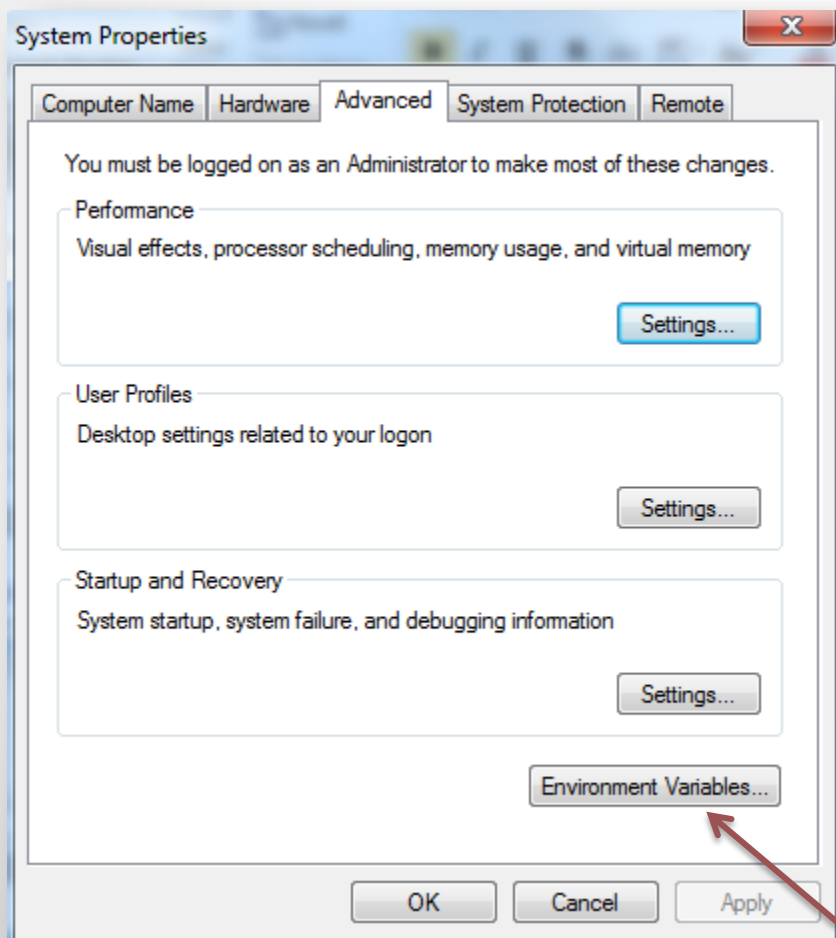
- Apoi **Advanced system settings**



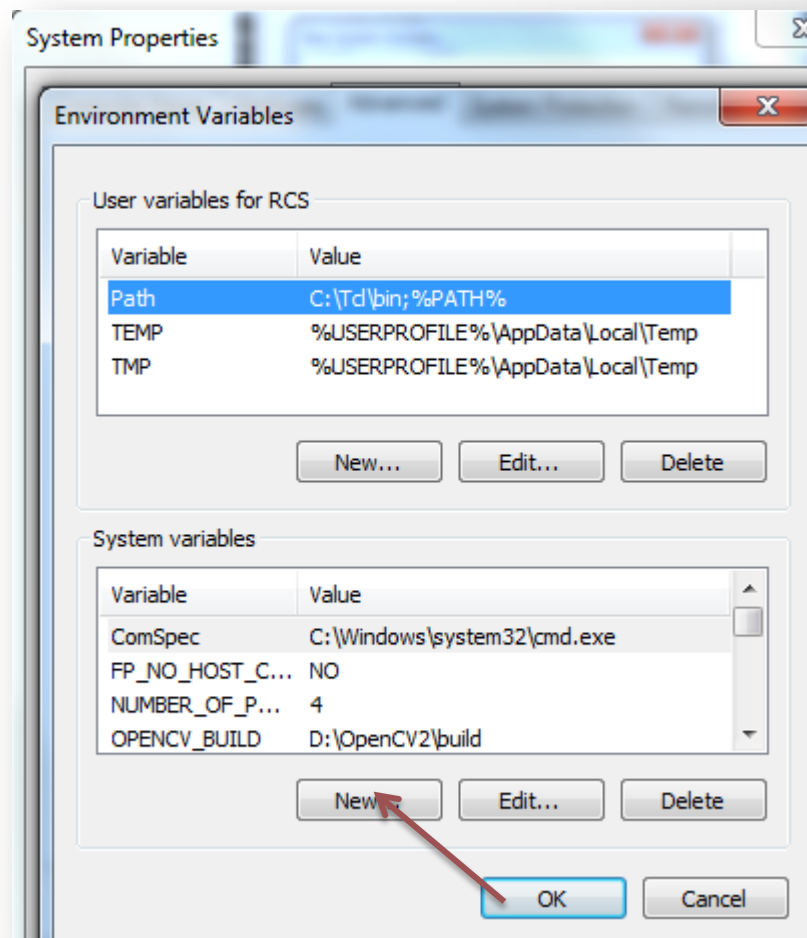
Instalarea OpenCV

Setare variabile de mediu

- Environment Variables



- Cream o variabila de sistem

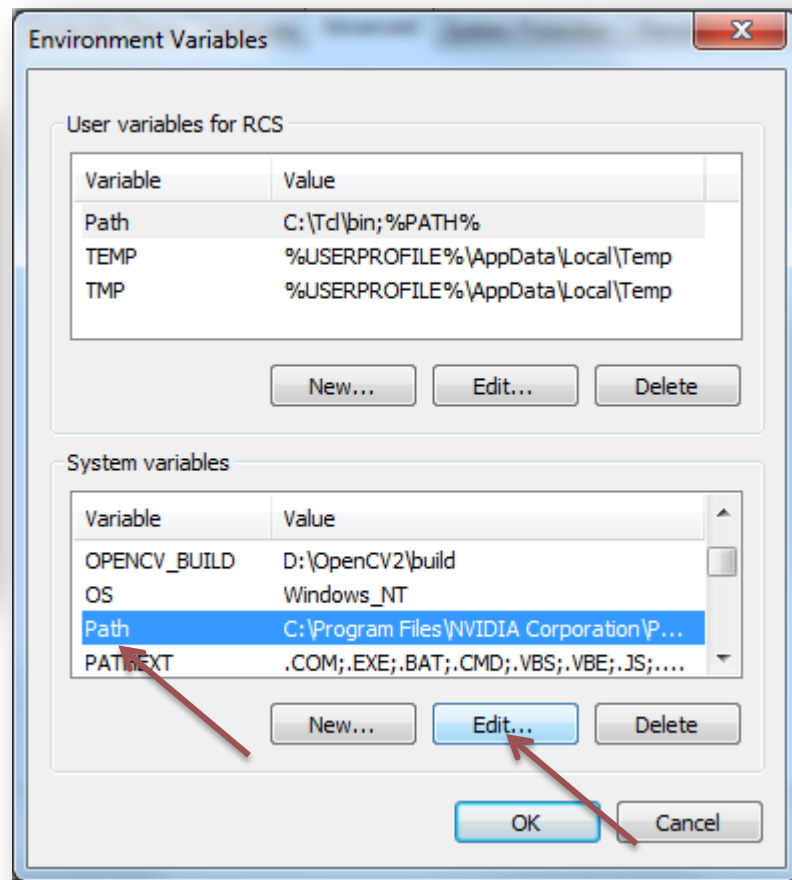
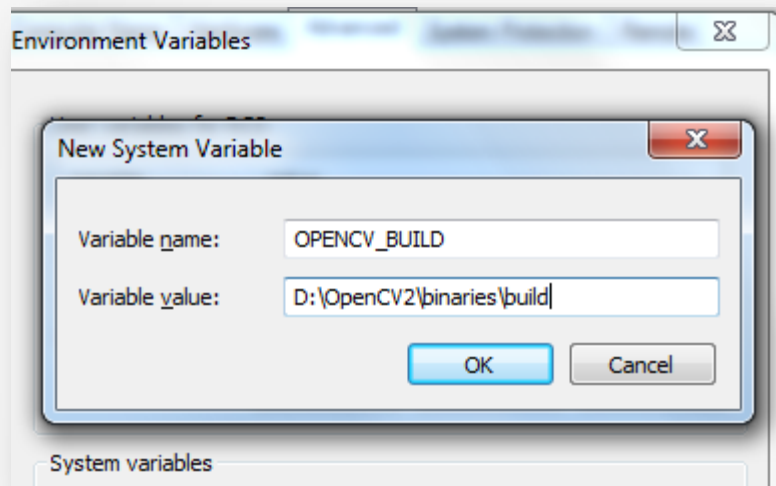


Instalarea OpenCV

Setare variabile de mediu

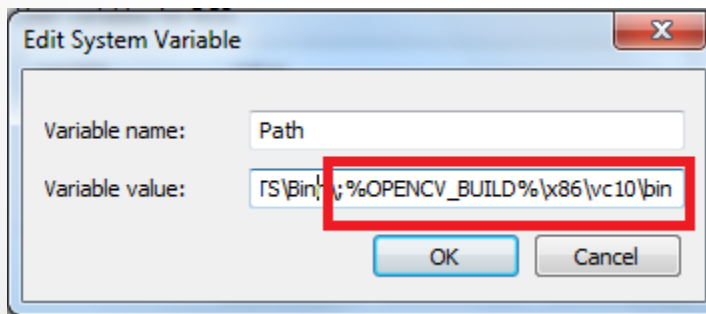
- Environment Variables

1



2

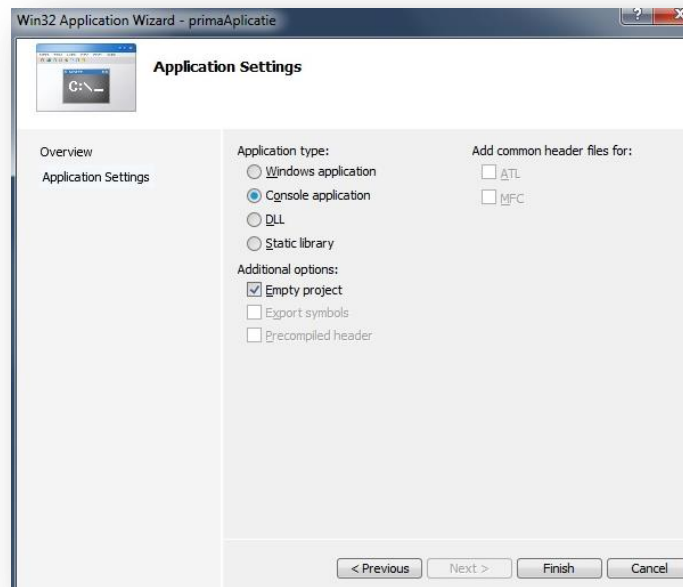
3



Daca sistemul este pe 64 de biti, se alege folderul x64 in loc de x86.

Proiect OpenCV folosind Visual Studio 10

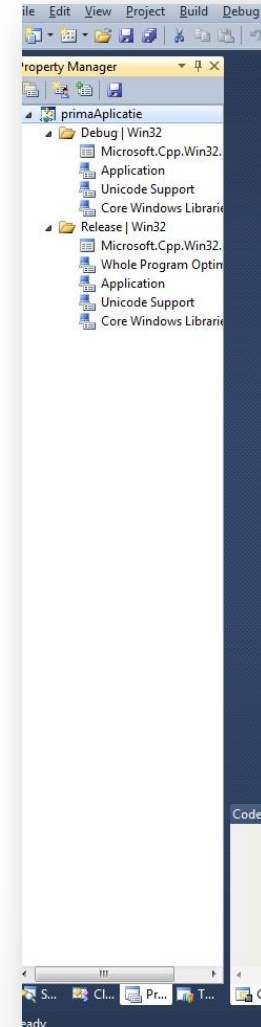
- Cream un proiect de tip **Console Application**, **Empty project**, fara precompiled header.



- In continuare, trebuie sa specificam unde se gasesc librariile OpenCV.

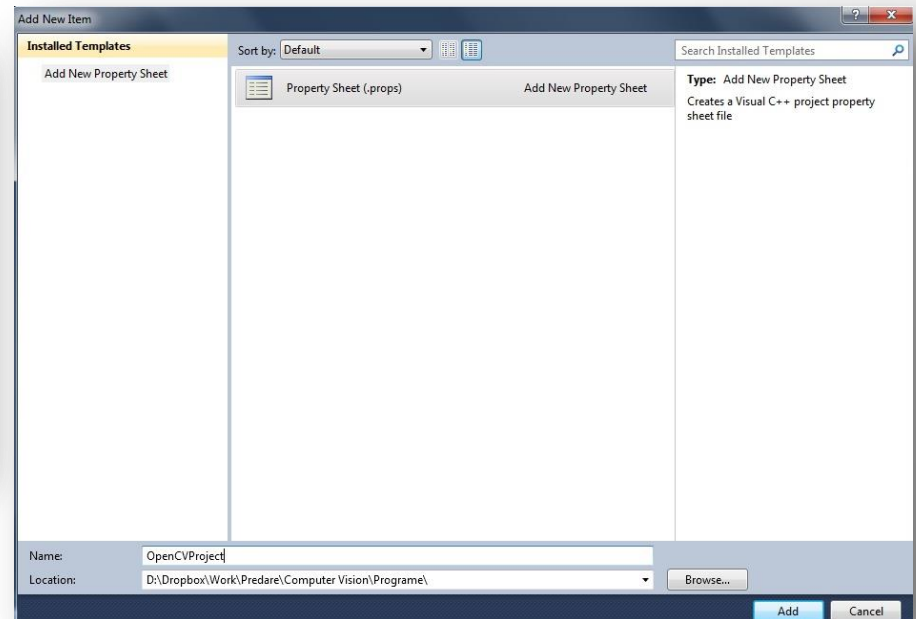
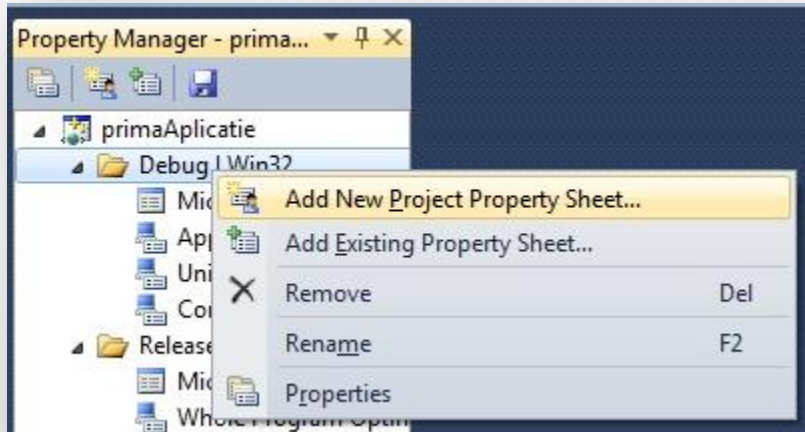
Proiect OpenCV folosind Visual Studio 10

- Cea mai buna optiune pentru a specifica unde se gasesc librariile OpenCV este sa cream un **Property Sheet** pe care sa il putem utiliza si in alte proiecte.
- Pentru aceasta, mergem la Property Manager.
 - Avem de adaugat cate unul pentru **Debug** si **Release**.



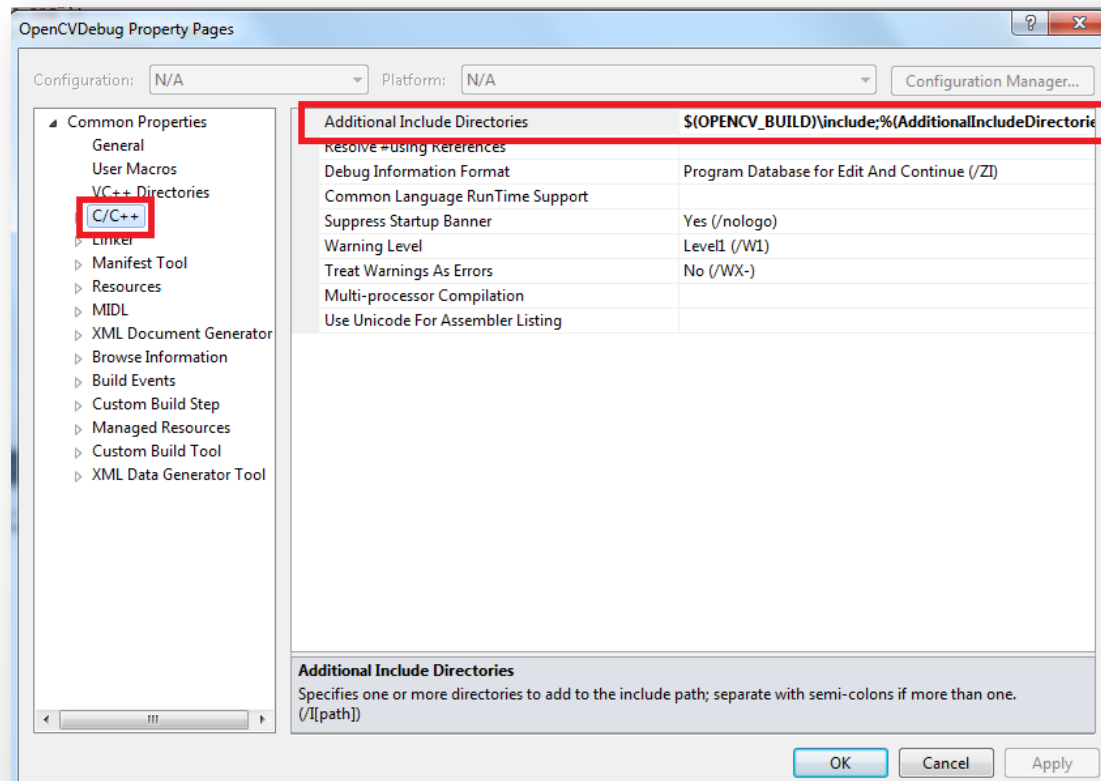
Property Sheet

- Click-dreapta pe Debug si selectam **Add New Property Sheet...**
- In fereastra care se deschide ii punem un nume, de exemplu **OpenCVDebug**, apoi **Add**.



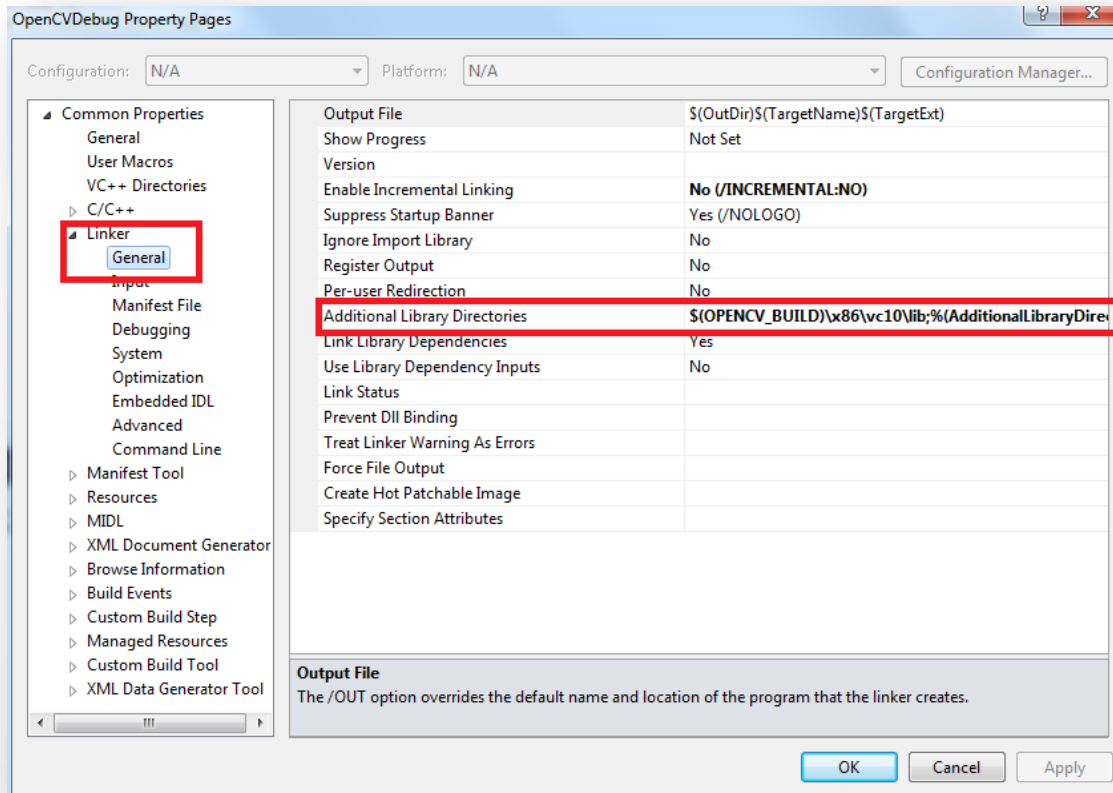
Property Sheet

- Dublu-click pe noul property sheet creat, **OpenCVDebug**.
- La **C/C++**, alegem **Additional Include Directories**, apasam **Edit** si in fereastra deschisa adaugam **\$(OPENCV_BUILD)\include**
 - Astfel furnizam calea catre bibliotecile din OpenCV pe care le vom utiliza



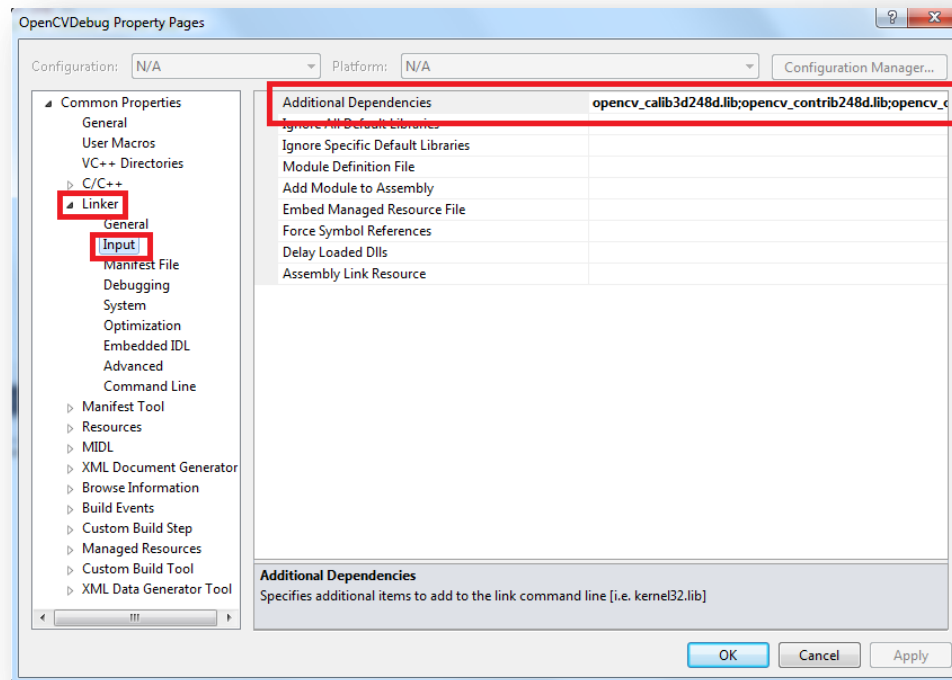
Property Sheet

- Mergem apoi la **Linker** -> **General** -> **Additional Library Directories**, apasam **Edit...** si introducem **\$(OPENCV_BUILD)\x86\vc10\lib**.
 - Din nou, daca avem SO pe 64 de biti alegem folderul **x64**.



Property Sheet

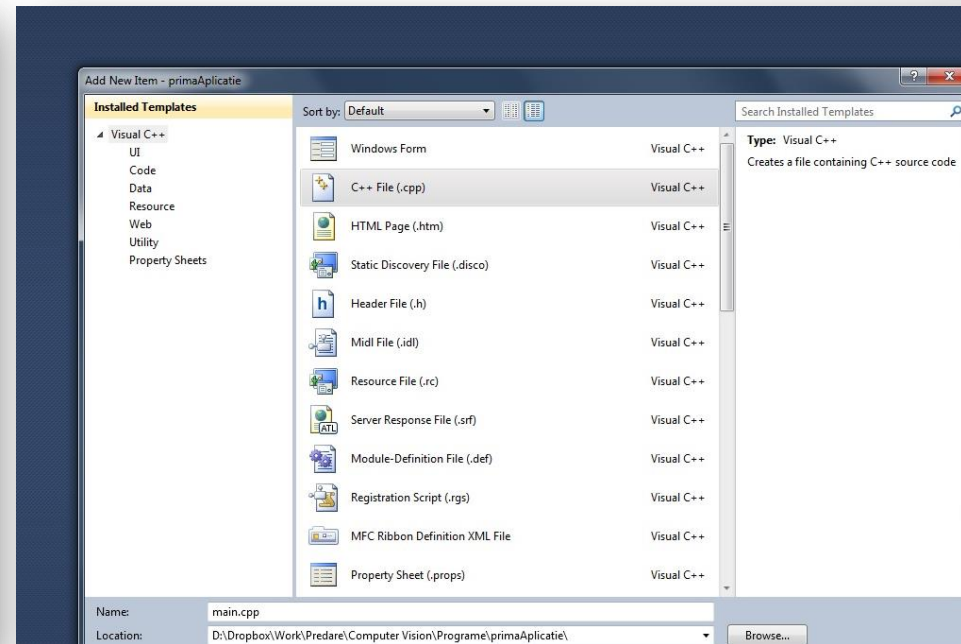
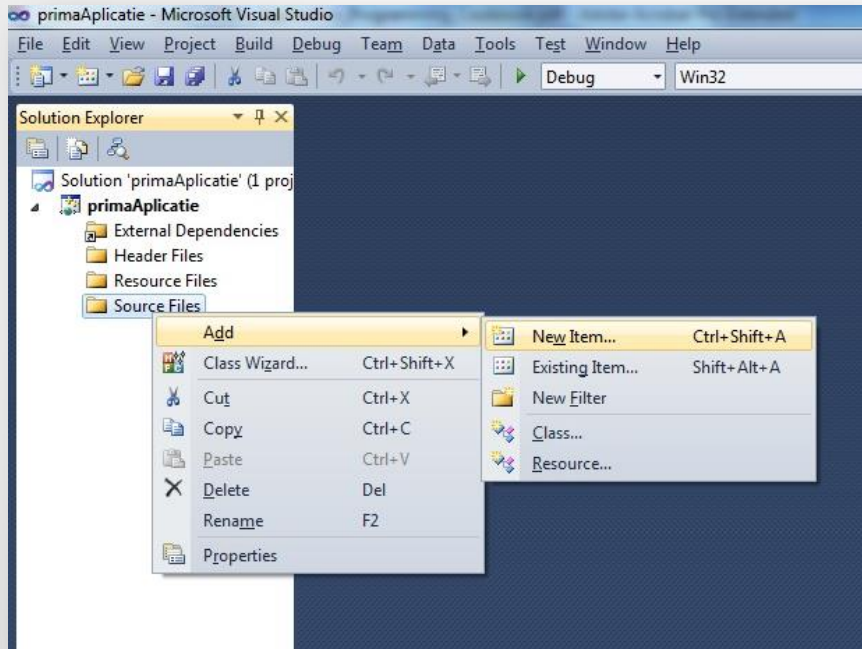
- Tot la **Linker**, **Input** si **Additional Dependencies**, **Edit**.
- Adaugam in fereastra care se deschide:
 - opencv_calib3d248d.lib
 - opencv_contrib248d.lib
 - opencv_core248d.lib
 - opencv_features2d248d.lib
 - opencv_flann248d.lib
 - opencv_gpu248d.lib
 - opencv_highgui248d.lib
 - opencv_imgproc248d.lib
 - opencv_legacy248d.lib
 - opencv_ml248d.lib
 - opencv_nonfree248d.lib
 - opencv_objdetect248d.lib
 - opencv_photo248d.lib
 - opencv_stitching248d.lib
 - opencv_ts248d.lib
 - opencv_video248d.lib
 - opencv_videostab248d.lib
- 248 vine de la versiunea OpenCV. Daca aveti o versiune diferita, schimbati valorile.



Property Sheet

- Caracterul d de la finalul librariilor de pe slide-ul anterior vine de la **debug**.
- Cum am facut pentru Debug va trebui sa facem si pentru varianta de Release.
 - **Add New Property Sheet** cu numele **OpenCVRelease**
 - **C/C++ -> Additional Include Directories**
 - **Linker -> General -> Additional Library Directories**
 - **Linker -> Input -> Additional Dependencies**
 - opencv_calib3d248.lib
 - opencv_contrib248.lib
 - opencv_core248.lib
 - ...
 - Toate fara d-ul de la final

Proiect OpenCV folosind Visual Studio 10



Build si Run

- Daca nu merge si nu identificati o eroare de sintaxa, trebuie reluati pasii anteriori. 😊

```
main.cpp X
(Global Scope)
#include <iostream>
#include <opencv2/core/core.hpp>
#include <opencv2/highgui/highgui.hpp>

using namespace std;
using namespace cv;

int main()
{
    //citim o imagine
    Mat poza = imread("D:/poza.jpg");

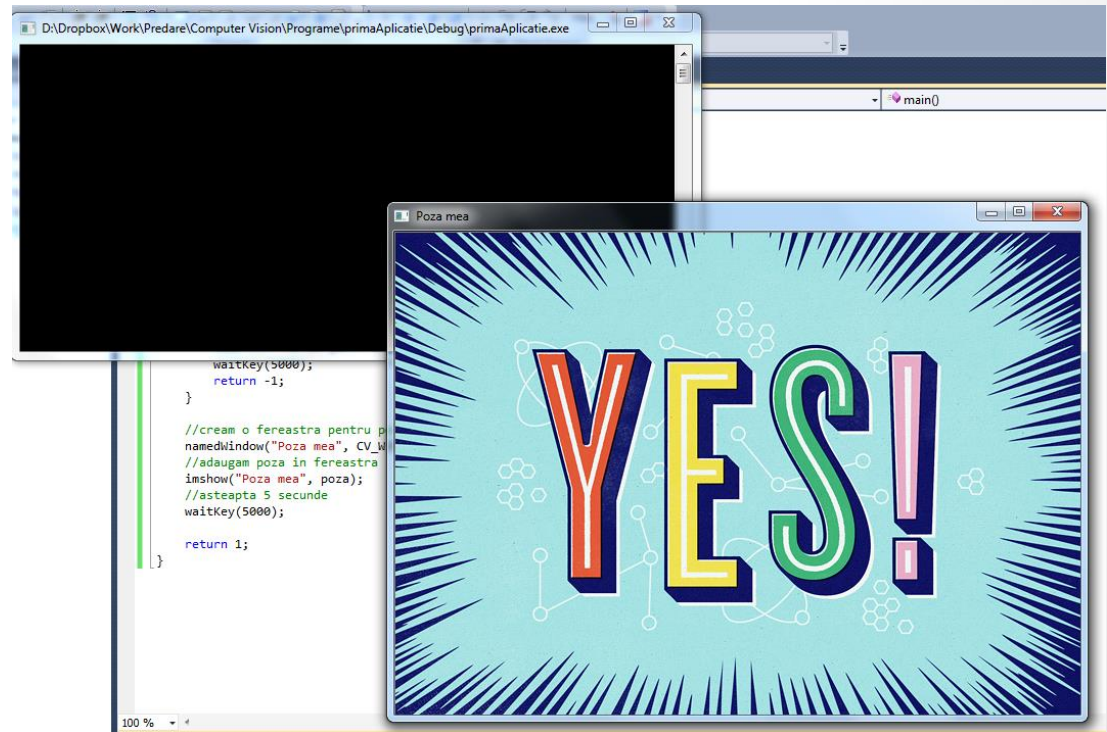
    if(! poza.data ) // Verific daca citirea este valida
    {
        cout << "Nu am gasit poza" << endl ;
        waitKey(5000);
        return -1;
    }

    //cream o fereastră pentru poza cu numele "Poza mea"
    namedWindow("Poza mea", CV_WINDOW_AUTOSIZE);
    //adaugam poza in fereastră
    imshow("Poza mea", poza);
    //asteapta 5 secunde
    waitKey(5000);

    return 1;
}
```

Ce face programul

- Afiseaza o poza

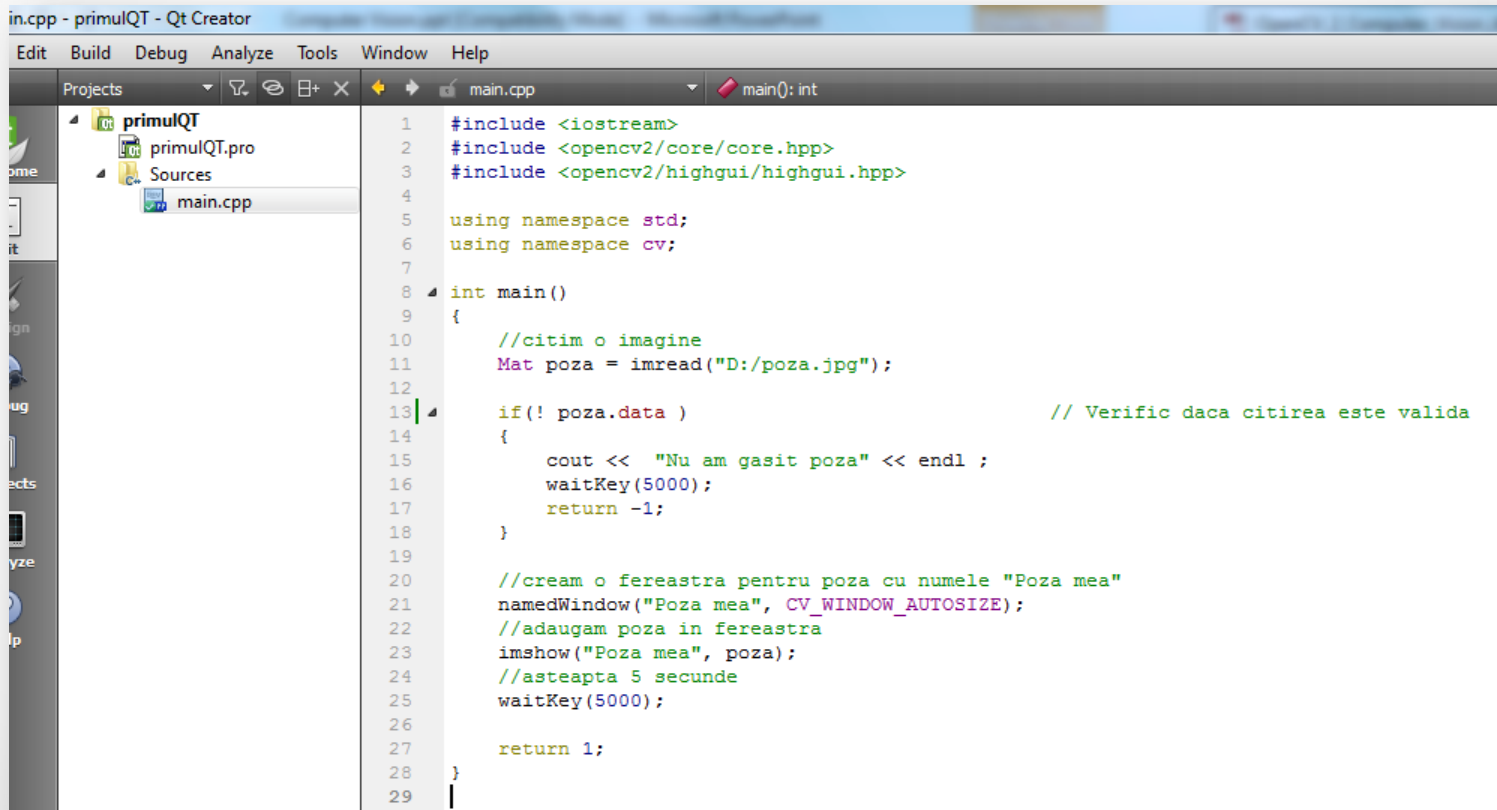


Proiect OpenCV folosind QT

- QT se descarca de la
<http://qt-project.org/downloads>
- Dezvoltat de compania norvegiana Trolltech si cumparat de Nokia in 2008.
- Open source
- Cross-platform

Proiect OpenCV folosind QT

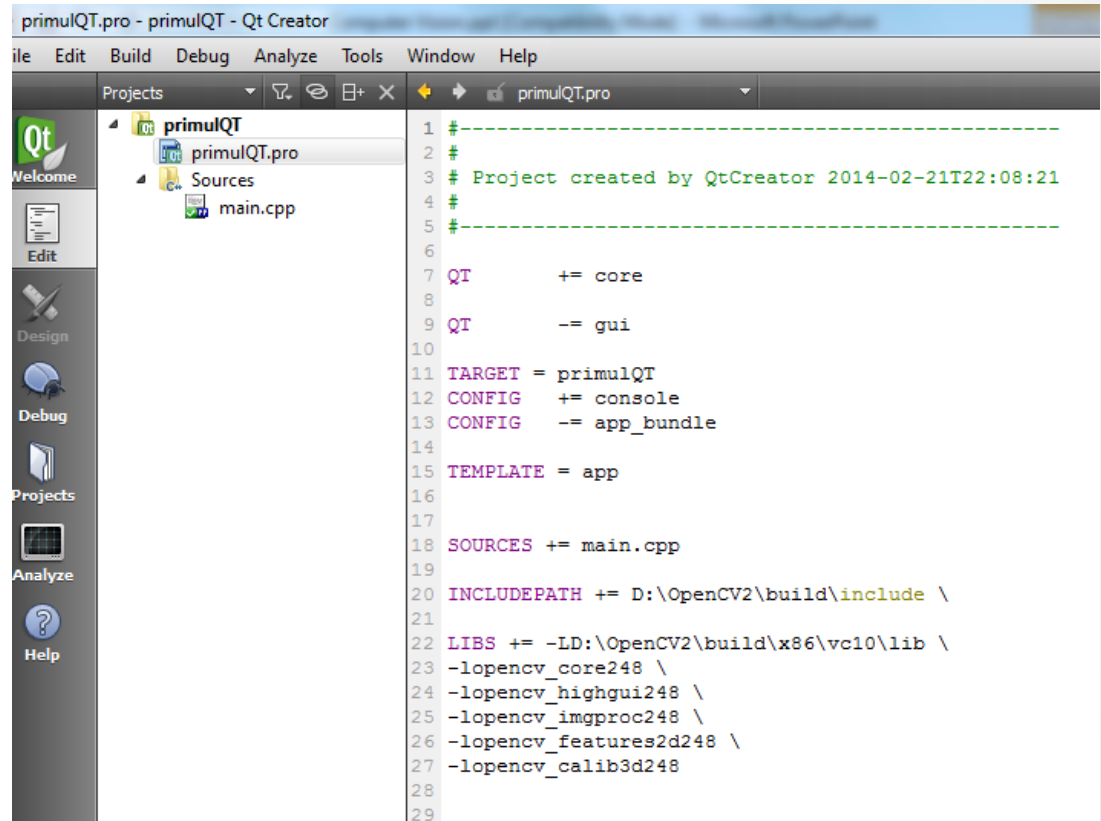
- Cream un proiect de tip **Console Application**.



```
1 #include <iostream>
2 #include <opencv2/core/core.hpp>
3 #include <opencv2/highgui/highgui.hpp>
4
5 using namespace std;
6 using namespace cv;
7
8 int main()
9 {
10     //citim o imagine
11     Mat poza = imread("D:/poza.jpg");
12
13     if(! poza.data ) // Verific daca citirea este valida
14     {
15         cout << "Nu am gasit poza" << endl ;
16         waitKey(5000);
17         return -1;
18     }
19
20     //cream o fereastră pentru poza cu numele "Poza mea"
21     namedWindow("Poza mea", CV_WINDOW_AUTOSIZE);
22     //adaugam poza in fereastră
23     imshow("Poza mea", poza);
24     //asteapta 5 secunde
25     waitKey(5000);
26
27     return 1;
28 }
29
```

Proiect OpenCV folosind QT

- In fisierul .pro se specifica calea catre folderul **include** si catre librarii.
- Nu este nevoie de setari aditionale.



The screenshot shows the Qt Creator interface with the 'primulQT.pro' file open. The left sidebar shows the project structure with 'primulQT' and 'Sources' folders, and 'main.cpp' file. The main editor displays the following .pro file content:

```
1 #-----
2 #
3 # Project created by QtCreator 2014-02-21T22:08:21
4 #
5 #-----
6
7 QT      += core
8
9 QT      -= gui
10
11 TARGET = primulQT
12 CONFIG += console
13 CONFIG -= app_bundle
14
15 TEMPLATE = app
16
17
18 SOURCES += main.cpp
19
20 INCLUDEPATH += D:\OpenCV2\build\include \
21
22 LIBS += -LD:\OpenCV2\build\x86\vc10\lib \
23 -lopencv_core248 \
24 -lopencv_highgui248 \
25 -lopencv_imgproc248 \
26 -lopencv_features2d248 \
27 -lopencv_calib3d248
28
29
```

Proiect OpenCV folosind QT

