case-study-Wwwzff

Case Chosen: OpenCV

Technology and Platform used for development

a). What coding languages are used? Do you think the same languages would be used if the project was started today? What languages would you use for the project if starting it today?

OpenCV(Open source computer vision), coded in C++, is an open source library originally developed by Intel and is initially released in 2000. For my opinion, if I'd started these functions today I'd like to chose python for its convenience when dealing with image datas. Since Python is not a strong type as C++ or Java, it has more flexibility especially calling build-in data structures like list or dictionary, which is obvious easier comparing to map/vector in C++, which also means time saving when coding basic library functions. Besides, taking python's popularity to programmers into account, a python based project means more references and more mature help/suggestions from third party.

b). What build system is used (e.g. Bazel, CMake, Meson)? What build tools / environment are needed to build (e.g. does it require Visual Studio or just GCC or ?)

CMake's used when building the whole system. Although all algorithms are implemented in C++, OpenCV's actually supporting other languanges like Python(OpenCV-Python) and Java(OpenCV.js). Take python for example, according to their tutorial, an automatic wrapper script in modules/python/src2 wraps C functions automatically and thus there's no need to rewrite whole code in python at all. See How OpenCV-Python Bindings Works.
C++ and Python version are both built using simple GCC compiler. For the java version, a compiler called Emscripten's taking the job. There's also another library called Binaryen needed for compiling to webassembly. See Build OpenCV.js.

c). What frameworks / libraries are used in the project? At least one of these projects don't use any external libraries or explicit threading, yet is noted for being the fastest in its category--in that case, what intrinsic language techniques is it using to get this speed.

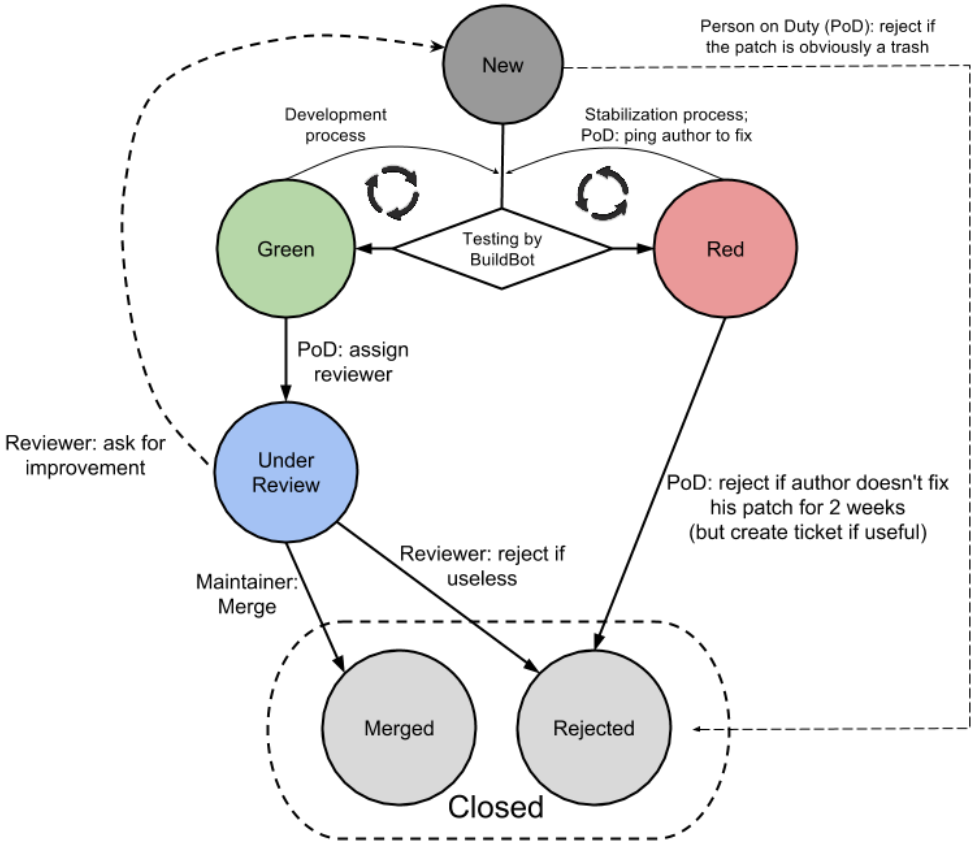
Since OpenCV's a huge open source program sponsored by many companies and programmers, quite a lot of third party libraries are used in this case. For details see the table below. * Content marked as red are libraries used for acceleration and optimizing the program.

Lib/Frame	Description
Carontene	Low-level library for optimizing CPU routines that are useful for CV algorithms
Cpufeatures	Detect the target CPU family and optional features it supports
Ffmpeg	A powerful video processing library that we're familiar with
Opencl	A framework for writing programs that execute across heterogeneous platforms
Vulkan	A cross-platform 3D graphics and computing API targeting realtime 3D apps
Ippicv	A subset of functions for image processing and CV built by Intel
Ittnotify	A Intel library for generating and controlling trace data during execution
LibJasPer	A collection of software for coding and manipulation of images
Libjpeg-turbo	A JPEG image codec that use specific instructions to accelerate JPEG compression and decompression on x86, x86-64, ARM and PowerPC systems
Libjpeg	C software for JPEG image encoding, decoding and transcoding
Libpng	C software for PNG image encoding, decoding and transcoding
Libtiff	Library for Tag Image File Format
Libwebp	Library to encode and decode images in WebP format.
Openexr	A high dynamic-range (HDR) image file format developed by Industrial Light & Magic

Openvx	An open API for cross platform acceleration of CV apps.
Protobuf	Google's language-neutral, platform-neutral, extensible mechanism for serializing structured data
Quirc	A QR decoder library
Tbb	Threading building blocks, for writing parallel C++ programs
zlib	A general purpose data compression library

Testing

a). How are they ensuring the testing is meaningful? Do they have code coverage metrics for example?



P1.1 Diagram for CI platform

Test cases are available under each module's directory, which seems to be offered by both developer & from public pull requests. The graph above shows how the CI platform worked and click the image for the source site.

b). What CI platform(s) are they using (e.g. Travis-CI, AppVeyor)?

OpenCV uses a platform called buildbot, and real-time pull-request infos can be found here.

c). What computing platform combinations are tested on their CI? E.g. Windows 10, Cygwin, Linux, Mac, GCC, Clang

Quite a bunch of platforms are tested on CI which is really amazing. See the table for details.

Platform	Sub-Version
Linux	X64
	X64(Debug)
	OpenCL
	Linux32
	AVX2
Win64	Standard
	OpenCL
	MSVS2017
	MSVS2017 OpenCL
Mac	Standard
	OpenCL
Win32	
ARM	V7
	V8

Custom
Docs
iOS
Android armeabi-v7a

Software Architecture

a). How would you add / edit functionality if you wanted to? How would one use this project from external projects, or is it only usable as a standalone program?

Using github's pull-requests function with their CI platform can easily take the job. The only thing you need is to optimize/add/edit parts in project and make a pull request. After checked by CI it will be merged into master branch by someone with authorization to merge.

OpenCV can also be easily used from external projects. For instance you can do *include <opencv2>* in C++ projects, or *import cv2* after *pip install python-opencv* for a python project.

b). What parts of the software are asynchronous (if any)?

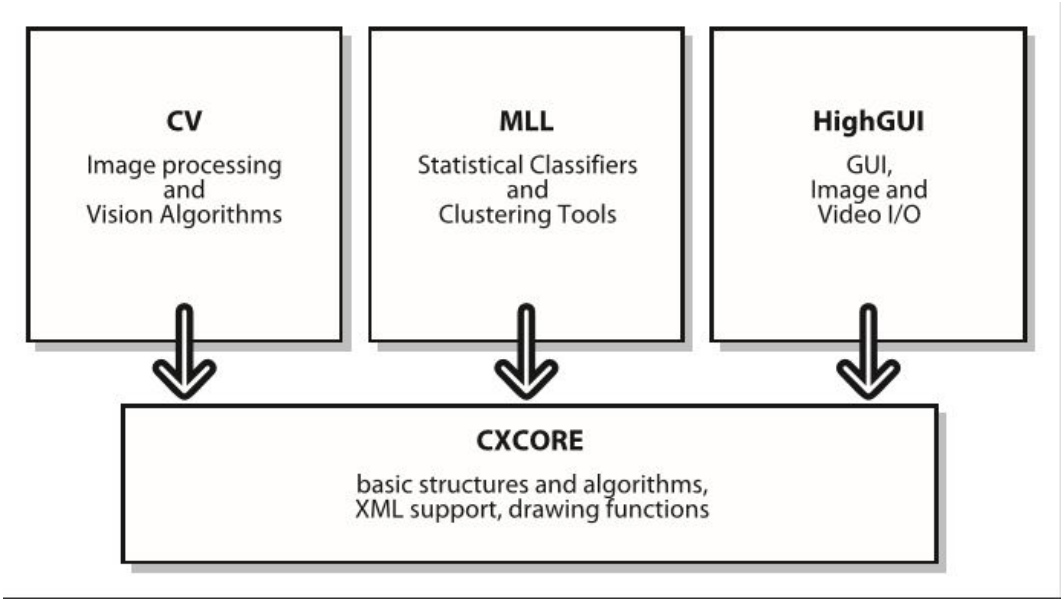
Seems there's no asynchronous part in OpenCV, while a bunch of solutions are available to use OpenCV's functions asynchronously. OpenCV4NodeJS is an expanded NodeJS library of openCV and offers a series of asynchronous APIs, such as imreadAsync, bgrToGrayAsync and etc.

c). Please make diagrams as appropriate for your explanation

See P1.1

d). How are separation of concerns and information hiding handled?

The basic concept of Separation of Concerns (SOC) is to eliminate interference of inner components in a system, and each section address to a separate concern. For instance, the CXcore in OpenCV is separated as different functions and algorithms, which offers basic operations for image processing, and is especially easy for testing and editing.



P1.2 Basic Structure for OpenCV

e,f).What architectural patterns are used? Does the project lean more towards object oriented or functional components?

OpenCV is a MVP (Minimum Viable Product) and learns more on functional components . Although this pattern increases costs if the product fails, it also cuts down costs at the very beginning of the whole project.

Defects

a).Does the issue require an architecture change, or is it just adding a new function or?

https://github.com/opencv/opencv/pull/11748/files:

This request add an exception handler to VideoCapture function, which will throw an exception when input video not exist in appointed directory.

https://github.com/opencv/opencv/pull/11880:

This one add additional functions when put parameter -1 in cv.2VideoCapture(index), which will use default camera for the running system.