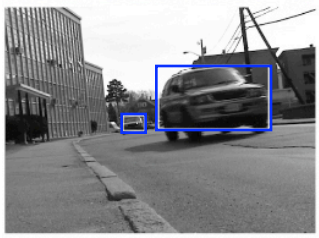
Robot Vision @ UMass Lowell

UMass Lowell Robotics Lab
Department of Computer Science
http://www.cs.uml.edu/robots



Phission: A Vision Software Development Kit

To interact well with the world and people in the world, robots must be able to effectively sense the areas around them. Human vision allows us to quickly identify objects in the world and plan our activities. Interpretation of camera images is a difficult task for a computer, yet machine vision is integral to designing good robot systems.

To facilitate the development of robot systems in the UMass Lowell Robotics Lab, the Phission software development kit has been developed as a backbone. Phission provides a robot developer with a means for getting images from a camera, processing the images, and returning information to the robot control program. Phission includes a set of standard vision algorithms and can be easily modified to include additional algorithms.

In our lab, Phission is used in all vision-related research. It has been used to detect oncoming cars for a street crossing robot, to find objects in a robot scavenger hunt, and to overlay thermal images on video for victim detection in urban search and rescue. Phission is also being used in the development of visual navigation for our robot wheelchair system and improved interaction with an assistive robot arm.

UMass Lowell Robotics Lab
The Robotics Lab was founded by Dr. Holly Yanco in 2001. Research focuses on human-robot interaction (HRI), which includes interface design, robot autonomy, computer vision, and evaluation methods. Application domains include assistive technology (AT) and urban search and rescue (USAR). The Robotics Lab also has an active community partnerships program, working with K-12 students.

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Phission Computer Vision Library

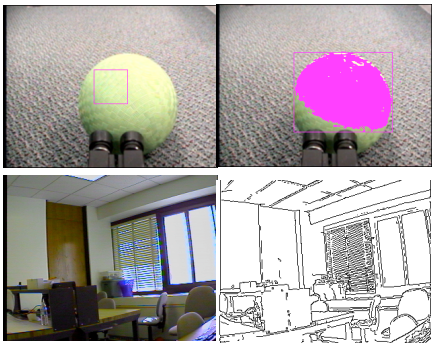
Phission is a concurrent cross-platform, multiple language vision system software development kit (SDK). The SDK constructs a processing sub-system for computer vision applications. Phission abstracts low-level image capture and display primitives, which allows researchers to focus on their primary work.

Using Phission, our ATRV-JR robot found the yellow beach ball at the AAAI-05 Scavenger Hunt competition. Phission can be used for object recognition and tracking, as well as image segmentation.

Few well developed computer vision tools provide for automatic continuous processing of live video. Phission was designed to supply this capability and allow integration with those existing vision libraries. Phission has been used with the Stanford Small Vision System, Intel's OpenCV library, Southern Illinois' CVIPTools, and the Java Media Framework. (See sidebar below for further information on library support.) It natively supports Linux, Windows (Cygwin and Visual Studio 2005), and Analog Devices' Blackfin BF-537 microprocessor. Phission has been used in Python, Java, and C/C++ applications. It can also be extended to provide bindings for any language supported by SWIG.

Phission has four structural layers. The Framework layer is the top layer and includes classes to capture, filter, process pipelines, and display images. A system class is included to allow easy startup and shutdown of the capture, pipeline, display, and generic threads. The capture, pipeline, and display components are linked using get-input and set-output methods.

The Image Toolkit Layer contains an image class and a group of standard C functions and structures. The Data-Flow Toolkit Layer provides thread-safe data synchronization and flow between threads directed by the Framework Layer. The System Toolkit Layer is the bottom layer and provides the portable interfaces for threads, mutexes, reader/writer locks, condition variables, semaphores, network sockets, time and error functions, and the standard integer types.



Phission provides some standard vision algorithms. Blob detection (top) and Canny edge detection (bottom) can be run at over 30 frames per second on commodity computer hardware.

Phission provides some standard image processing algorithms including blob segmentation, region histogram, blur, motion, and edge detection. These algorithms are coded in C/C++. Current applications include object recognition and tracking for mobile robots, as well as image segmentation. Phission is used in all vision-related research in the UMass Lowell Robotics Lab.

http://phission.org

Further Reading: Phission's Supported Libraries and Platforms

Stanford Research Institute's Small Vision System (SVS) - http://www.videredesign.com/small_vision_system.htm

Intel Open Source Computer Vision Library (OpenCV) - http://www.intel.com/technology/computing/opencv/index.htm

Southern Illinois University Computer Vision and Image Processing Tools (CVIPTools) - http://www.ee.siue.edu/CVIPtools/

Sun Microsystems Java Media Framework API (JMF) - http://java.sun.com/products/java-media/jmf/

Simplified Wrapper and Interface Generator (SWIG) - http://www.swig.org/

Red Hat Cygwin Product for Windows - http://www.cygwin.com/

Microsoft Visual Studio 2005 Developer Platform - http://msdn2.microsoft.com/en-us/vstudio/default.aspx

Analog Devices Blackfin Embedded Processor - http://www.analog.com/processors/blackfin/

Analog Devices Visual DSP++ Developer Platform - http://www.analog.com/en/epHSProd/0,2542,VISUALDSPBF,00.html

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