Qt Integration

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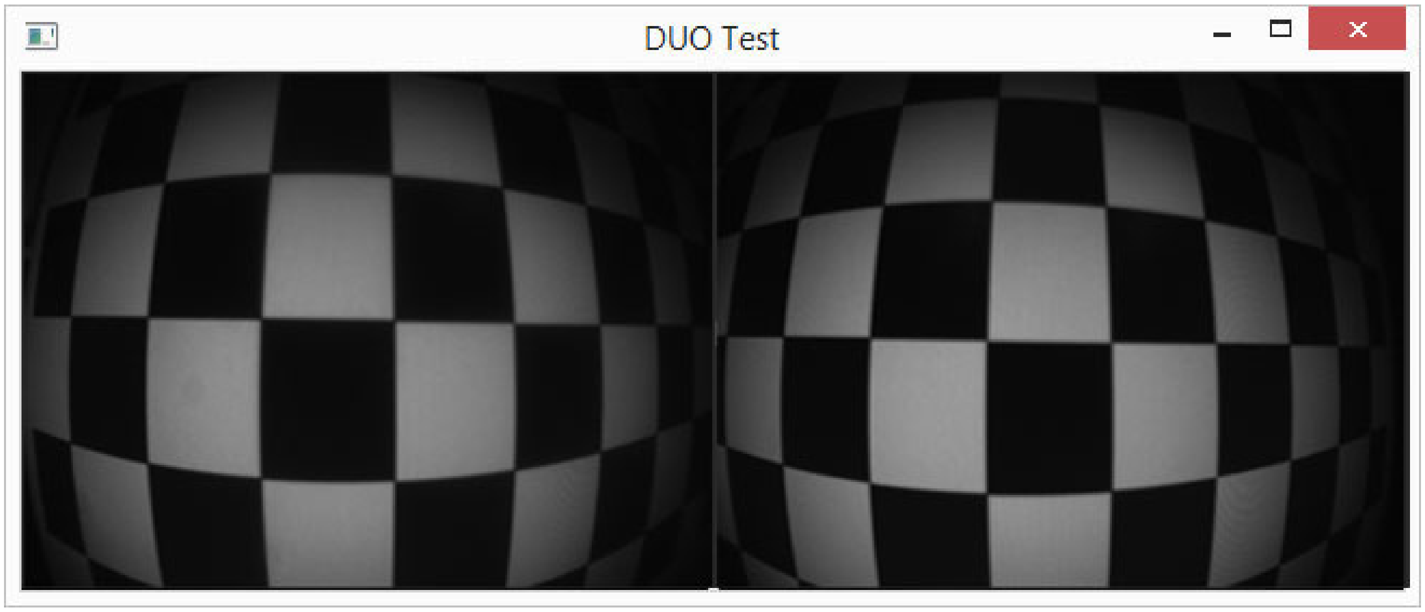
Developer Preview - This may change with updates.

Integrating DUO with Qt 5.* and OpenCV

In this article we outline how to use the DUOLib with Qt 5. We initialize the device and display the resulting frames in a standard Qt `QMainWindow` and `QWidget` classes. We use the OpenCV `Mat` structure as a helper to display the images frames using `QImage` by overriding the `paintEvent` event.



Sample Project

We provide an example project to compile an application for the usage of DUO with OpenCV and Qt.

Download Sample Project

Requirements

- Qt v5.1.1+
- OpenCV v2.4.7+
- DUOLib.lib & DUOLib dynamic library that match your compiler (VC2010/2012) and architecture (x86/x64).
- QMake/QTCreator or CMake

Building

- Place latest DUOLib.lib in the project folder. Replacing the *_stub object.
- Build the QtDUO project using Qmake or QtCreator.
- To run outside QtCreator make sure the DUOLib.dll in the target release/debug folder.

Files

- `DUOLib.h` - DUOLib include file for referencing DUO calls.
- `globals.h` - Helper functions for console output and debugging.
- `main.cpp` - Boilerplate code for initializing the MainWindow class.
- `mainwindow.cpp` - Implementation for example of how to initialize and display data.
- `mainwindow.h` - Declares variables and methods used in the implementation.
- `QtDUO.pro` - QMake project for using with QtCreator.

Implementation

In the header we do the following key steps for image display:

1. Create empty `ImageOutput` object and set its minimum size.
2. Update the pixel array using a `QMutex` to assure access.
3. Paint/Update the image by overriding with `QPaintEvent` .

Lets begin by reviewing the header class which contains the logic to display the images; `ImageObject` class which extends `QWidget` . Also note the `MainWindow` class which extends `QMainWindow` and is used for the base of the application.

mainwindow.h

```
#ifndef MAINWINDOW_H
#define MAINWINDOW_H

#include
#include "DUOLib.h"

#include
using namespace cv;

class ImageOutput : public QWidget
{
    Q_OBJECT
public:
    ImageOutput()
    {
        setMinimumSize(1, 1);
        _image = QImage(QSize(1,1), QImage::Format_RGB888);
        _image.fill(Qt::black);
    }
public Q_SLOTS:
    // Mat imag must be BGR image
    void setImage(const Mat3b &image)
    {
        QMutexLocker lock(&_mutex); // Lock to assure access
        _image = QImage(image.data, image.cols, image.rows, QImage::Format_RGB888);
        update();
    }
private:
    void paintEvent(QPaintEvent *event)
    {
        QMutexLocker lock(&_mutex);
        QPainter painter(this);
        painter.setRenderHint(QPainter::SmoothPixmapTransform, true);
        painter.drawPixmap(event->rect(), QPixmap::fromImage(_image));
    }
private:
    QImage _image;
    QMutex _mutex;
};

class MainWindow : public QMainWindow
{
    Q_OBJECT
public:
    MainWindow(QWidget *parent = 0);
    ~MainWindow();
    void closeEvent(QCloseEvent *);

private:
    static void CALLBACK newFrameCb(const PDUOFrame pFrameData, void *pUserData)
    {
        ((MainWindow *)pUserData)->onNewFrame(pFrameData);
    }
    void onNewFrame(const PDUOFrame pFrameData);

private:
    DUOInstance _duo;
    ImageOutput *_img[2];
    Mat _leftRGB, _rightRGB;
};

#endif // MAINWINDOW_H
```

Moving into the implementation where we initialize the device and emit an event which calls the `setImage` method declared in our header. Also take note of the callback `onNewFrame` which is standard method of getting updates from the device.

mainwindow.cpp

```
#include "globals.h"
#include "mainwindow.h"

MainWindow::MainWindow(QWidget *parent): QMainWindow(parent),
_duo(NULL)
{
    resize(320*2, 240);
    setWindowTitle("DUO Test");
    setGeometry(QStyle::alignedRect(Qt::LeftToRight, Qt::AlignCenter, size(),
                                    qApp->desktop()->availableGeometry()));

    QSplitter *hs = new QSplitter();
    hs->addWidget(_img[0] = new ImageOutput());
    hs->addWidget(_img[1] = new ImageOutput());
    setCentralWidget(hs);

    DUOResolutionInfo ri;
    if(EnumerateResolutions(&ri, 1, 320, 240, DUO_BIN_HORIZONTAL2 + DUO_BIN_VERTICAL2, 60))
    {
        Print("[%dx%d], [%f-%f], %f, [%d]", ri.width, ri.height, ri.minFps, ri.maxFps, ri.fps, ri.binning);

        if(OpenDUO(&_duo))
        {
            char buf[256];
            GetDUOSerialNumber(_duo, buf);       Print("Serial Number: %s", buf);
            GetDUOFirmwareVersion(_duo, buf);    Print("Firmware Version: v%s", buf);
            GetDUOFirmwareBuild(_duo, buf);      Print("Firmware Build Time: %s", buf);
            Print("Library Version: v%s", GetLibVersion());
            Print("-------------------------------------------------");

            SetDUOResolutionInfo(_duo, ri);
            uint32_t w, h;
            GetDUOFrameDimension(_duo, &w, &h);  Print("Frame Dimension: [%d, %d]", w, h);

            StartDUO(_duo, newFrameCb, this);
            SetDUOLedPWM(_duo, 30);
            SetDUOGain(_duo, 0);
            SetDUOExposure(_duo, 50);
            SetDUOVFlip(_duo, true);
        }
    }
}

MainWindow::~MainWindow()
{
    if(_duo) CloseDUO(_duo);
}

void MainWindow::closeEvent(QCloseEvent *)
{
    if(_duo) StopDUO(_duo);
}

void MainWindow::onNewFrame(const PDUOFrame pDFrame)
{
    Mat left(Size(pDFrame->width, pDFrame->height), CV_8UC1, pDFrame->leftData);
    Mat right(Size(pDFrame->width, pDFrame->height), CV_8UC1, pDFrame->rightData);
    cvtColor(left, _leftRGB, COLOR_GRAY2BGR);
    cvtColor(right, _rightRGB, COLOR_GRAY2BGR);
    Q_EMIT _img[0]->setImage(_leftRGB);
    Q_EMIT _img[1]->setImage(_rightRGB);
}
```

Brining it together we use the following QMake project to properly link against the DUOLib and OpenCV. This is provided for Windows but can with small changes target OSX or Linux.

QtDUOSample.pro

```
TARGET = QtDUO
TEMPLATE = app

QT += core gui widgets

CONFIG += console
#CONFIG -= app_bundle

DEFINES += SHOW_DEBUG_OUTPUT

HEADERS += DUOLib.h globals.h mainwindow.h
SOURCES += main.cpp mainwindow.cpp

LIBS += -L$$PWD
LIBS += -lDUOLib

# OpenCV dependency
INCLUDEPATH += C:\OpenCV\2.4.7.2\include
!contains(QMAKE_TARGET.arch, x86_64) {
    LIBS += -LC:\OpenCV\2.4.7.2\x86\vc10\lib
} else {
    LIBS += -LC:\OpenCV\2.4.7.2\x64\vc10\lib
}
LIBS += -lopencv_core247 \
        -lopencv_highgui247 \
        -lopencv_imgproc247 \
        -lopencv_features2d247 \
        -lopencv_calib3d247
```

Summary

In this example we aim to showcase a reliable method for displaying frames data using OpenCV as a helper. We provide a standard Qt ".pro" project which allows for easy compilation with the latest Qt development tooling.