Image Composition Example

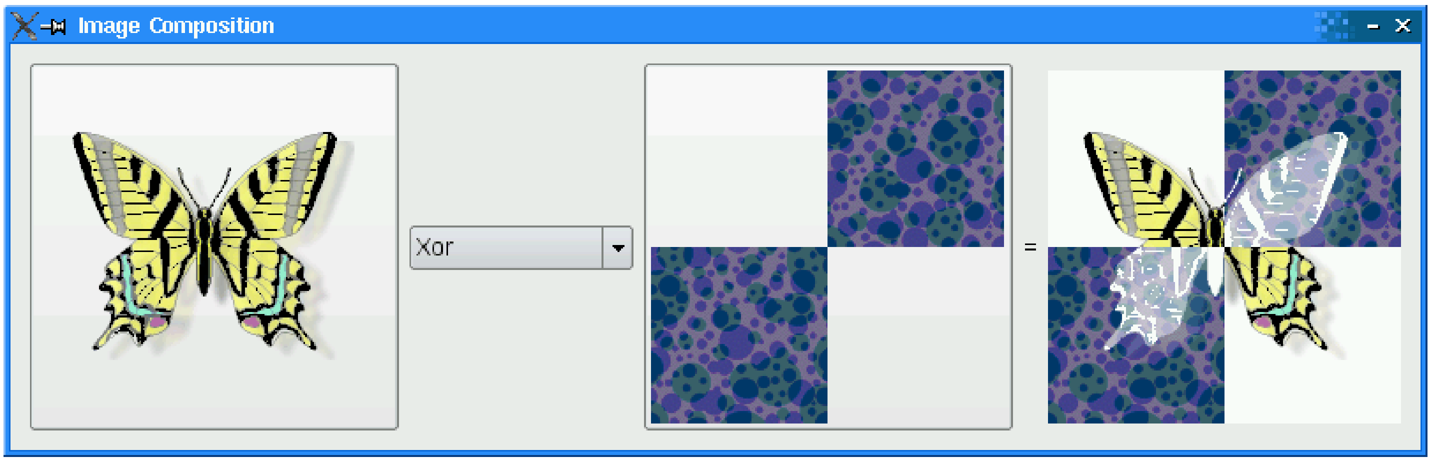
Files:

- painting/imagecomposition/imagecomposer.cpp
- painting/imagecomposition/imagecomposer.h
- painting/imagecomposition/main.cpp
- painting/imagecomposition/imagecomposition.pro
- painting/imagecomposition/imagecomposition.qrc

Images:

- painting/imagecomposition/images/background.png
- painting/imagecomposition/images/blackrectangle.png
- painting/imagecomposition/images/butterfly.png
- painting/imagecomposition/images/checker.png

The Image Composition example lets the user combine images together using any composition mode supported by QPainter, described in detail in Composition Modes.



Setting Up The Resource File

The Image Composition example requires two source images, *butterfly.png* and *checker.png* that are embedded within *imagecomposition.qrc*. The file contains the following code:

```
<!DOCTYPE RCC><RCC version="1.0">
<qresource>
    <file>images/butterfly.png</file>
    <file>images/checker.png</file>
</qresource>
</RCC>
```

For more information on resource files, see The Qt Resource System.

ImageComposer Class Definition

The `ImageComposer` class is a subclass of QWidget that implements three private slots, `chooseSource()`, `chooseDestination()`, and `recalculateResult()`.

```
class ImageComposer : public QWidget
{
    Q_OBJECT

public:
    ImageComposer();

private slots:
    void chooseSource();
    void chooseDestination();
    void recalculateResult();
```

In addition, `ImageComposer` consists of five private functions, `addOp()`, `chooseImage()`, `loadImage()`, `currentMode()`, and `imagePos()`, as well as private instances of QToolButton, QComboBox, QLabel, and QImage.

```
private:
    void addOp(QPainter::CompositionMode mode, const QString &name);
    void chooseImage(const QString &title, QImage *image, QToolButton *button);
    void loadImage(const QString &fileName, QImage *image, QToolButton *button);
    QPainter::CompositionMode currentMode() const;
    QPoint imagePos(const QImage &image) const;

    QToolButton *sourceButton;
    QToolButton *destinationButton;
    QComboBox *operatorComboBox;
    QLabel *equalLabel;
    QLabel *resultLabel;

    QImage sourceImage;
    QImage destinationImage;
    QImage resultImage;
};
```

ImageComposer Class Implementation

We declare a QSize object, `resultSize`, as a static constant with width and height equal to 200.

```
static const QSize resultSize(200, 200);
```

Within the constructor, we instantiate a QToolButton object, `sourceButton` and set its iconSize property to `resultSize`. The `operatorComboBox` is instantiated and then populated using the `addOp()` function. This function accepts a QPainter::CompositionMode, *mode*, and a QString, *name*, representing the name of the composition mode.

```
ImageComposer::ImageComposer()
{
    sourceButton = new QToolButton;
    sourceButton->setIconSize(resultSize);

    operatorComboBox = new QComboBox;
    addOp(QPainter::CompositionMode_SourceOver, tr("SourceOver"));
    addOp(QPainter::CompositionMode_DestinationOver, tr("DestinationOver"));
    addOp(QPainter::CompositionMode_Clear, tr("Clear"));
    addOp(QPainter::CompositionMode_Source, tr("Source"));
    addOp(QPainter::CompositionMode_Destination, tr("Destination"));
    addOp(QPainter::CompositionMode_SourceIn, tr("SourceIn"));
    addOp(QPainter::CompositionMode_DestinationIn, tr("DestinationIn"));
    addOp(QPainter::CompositionMode_SourceOut, tr("SourceOut"));
    addOp(QPainter::CompositionMode_DestinationOut, tr("DestinationOut"));
    addOp(QPainter::CompositionMode_SourceAtop, tr("SourceAtop"));
    addOp(QPainter::CompositionMode_DestinationAtop, tr("DestinationAtop"));
    addOp(QPainter::CompositionMode_Xor, tr("Xor"));
    addOp(QPainter::CompositionMode_Plus, tr("Plus"));
    addOp(QPainter::CompositionMode_Multiply, tr("Multiply"));
    addOp(QPainter::CompositionMode_Screen, tr("Screen"));
    addOp(QPainter::CompositionMode_Overlay, tr("Overlay"));
    addOp(QPainter::CompositionMode_Darken, tr("Darken"));
    addOp(QPainter::CompositionMode_Lighten, tr("Lighten"));
    addOp(QPainter::CompositionMode_ColorDodge, tr("ColorDodge"));
    addOp(QPainter::CompositionMode_ColorBurn, tr("ColorBurn"));
    addOp(QPainter::CompositionMode_HardLight, tr("HardLight"));
    addOp(QPainter::CompositionMode_SoftLight, tr("SoftLight"));
    addOp(QPainter::CompositionMode_Difference, tr("Difference"));
    addOp(QPainter::CompositionMode_Exclusion, tr("Exclusion"));
```

The `destinationButton` is instantiated and its iconSize property is set to `resultSize` as well. The QLabels `equalLabel` and `resultLabel` are created and `resultLabel`'s minimumWidth is set.

```
    destinationButton = new QToolButton;
    destinationButton->setIconSize(resultSize);
```

```
     equalLabel = new QLabel(tr("="));

     resultLabel = new QLabel;
     resultLabel->setMinimumWidth(resultSize.width());
```

We connect the following signals to their corresponding slots:

- `sourceButton`'s clicked() signal is connected to `chooseSource()`,
- `operatorComboBox`'s activated() signal is connected to `recalculateResult()`, and
- `destinationButton`'s clicked() signal is connected to `chooseDestination()`.

```
     connect(sourceButton, SIGNAL(clicked()), this, SLOT(chooseSource()));
     connect(operatorComboBox, SIGNAL(activated(int)),
             this, SLOT(recalculateResult()));
     connect(destinationButton, SIGNAL(clicked()),
             this, SLOT(chooseDestination()));
```

A QGridLayout, `mainLayout`, is used to place all the widgets. Note that `mainLayout`'s sizeConstraint property is set to QLayout::SetFixedSize, which means that `ImageComposer`'s size cannot be resized at all.

```
     QGridLayout *mainLayout = new QGridLayout;
     mainLayout->addWidget(sourceButton, 0, 0, 3, 1);
     mainLayout->addWidget(operatorComboBox, 1, 1);
     mainLayout->addWidget(destinationButton, 0, 2, 3, 1);
     mainLayout->addWidget(equalLabel, 1, 3);
     mainLayout->addWidget(resultLabel, 0, 4, 3, 1);
     mainLayout->setSizeConstraint(QLayout::SetFixedSize);
     setLayout(mainLayout);
```

We create a QImage, `resultImage`, and we invoke `loadImage()` twice to load both the image files in our *imagecomposition.qrc* file. Then, we set the windowTitle property to "Image Composition".

```
     resultImage = QImage(resultSize, QImage::Format_ARGB32_Premultiplied);

     loadImage(":/images/butterfly.png", &sourceImage, sourceButton);
     loadImage(":/images/checker.png", &destinationImage, destinationButton);

     setWindowTitle(tr("Image Composition"));
 }
```

The `chooseSource()` and `chooseDestination()` functions are convenience functions that invoke `chooseImage()` with specific parameters.

```
 void ImageComposer::chooseSource()
 {
     chooseImage(tr("Choose Source Image"), &sourceImage, sourceButton);
 }

 void ImageComposer::chooseDestination()
 {
     chooseImage(tr("Choose Destination Image"), &destinationImage,
                 destinationButton);
 }
```

The `chooseImage()` function loads an image of the user's choice, depending on the *title*, *image*, and *button*.

```
 void ImageComposer::chooseImage(const QString &title, QImage *image,
                                 QToolButton *button)
 {
     QString fileName = QFileDialog::getOpenFileName(this, title);
     if (!fileName.isEmpty())
         loadImage(fileName, image, button);
 }
```

The `recalculateResult()` function is used to calculate amd display the result of combining the two images together with the user's choice of composition mode.

```
 void ImageComposer::recalculateResult()
 {
     QPainter::CompositionMode mode = currentMode();

     QPainter painter(&resultImage);
     painter.setCompositionMode(QPainter::CompositionMode_Source);
     painter.fillRect(resultImage.rect(), Qt::transparent);
     painter.setCompositionMode(QPainter::CompositionMode_SourceOver);
     painter.drawImage(0, 0, destinationImage);
     painter.setCompositionMode(mode);
     painter.drawImage(0, 0, sourceImage);
     painter.setCompositionMode(QPainter::CompositionMode_DestinationOver);
     painter.fillRect(resultImage.rect(), Qt::white);
     painter.end();

     resultLabel->setPixmap(QPixmap::fromImage(resultImage));
 }
```

The `addOp()` function adds an item to the `operatorComboBox` using QComboBox's addItem function. This function accepts a QPainter::CompositionMode, *mode*, and a QString, *name*. The rectangle is filled with Qt::Transparent and both the `sourceImage` and `destinationImage` are painted, before displaying it on `resultLabel`.

```
void ImageComposer::addOp(QPainter::CompositionMode mode, const QString &name)
{
    operatorComboBox->addItem(name, mode);
}
```

The `loadImage()` function paints a transparent background using fillRect() and draws `image` in a centralized position using drawImage(). This `image` is then set as the `button`'s icon.

```
void ImageComposer::loadImage(const QString &fileName, QImage *image,
                              QToolButton *button)
{
    image->load(fileName);

    QImage fixedImage(resultSize, QImage::Format_ARGB32_Premultiplied);
    QPainter painter(&fixedImage);
    painter.setCompositionMode(QPainter::CompositionMode_Source);
    painter.fillRect(fixedImage.rect(), Qt::transparent);
    painter.setCompositionMode(QPainter::CompositionMode_SourceOver);
    painter.drawImage(imagePos(*image), *image);
    painter.end();
    button->setIcon(QPixmap::fromImage(fixedImage));

    *image = fixedImage;

    recalculateResult();
}
```

The `currentMode()` function returns the composition mode currently selected in `operatorComboBox`.

```
QPainter::CompositionMode ImageComposer::currentMode() const
{
    return (QPainter::CompositionMode)
           operatorComboBox->itemData(operatorComboBox->currentIndex()).toInt();
}
```

We use the `imagePos()` function to ensure that images loaded onto the QToolButton objects, `sourceButton` and `destinationButton`, are centralized.

```
QPoint ImageComposer::imagePos(const QImage &image) const
{
    return QPoint((resultSize.width() - image.width()) / 2,
                  (resultSize.height() - image.height()) / 2);
}
```

The `main()` Function

The `main()` function instantiates QApplication and `ImageComposer` and invokes its show() function.

```
int main(int argc, char *argv[])
{
    Q_INIT_RESOURCE(imagecomposition);

    QApplication app(argc, argv);
    ImageComposer composer;
    composer.show();
    return app.exec();
}
```