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1 Introduction

This is a manual for the installation and use of software for creating a digital 'impression' of a scene from a photograph. The application is ideally suited for landscape features rather than portraiture. It is also possible to delineate the regions with borders of various types, to display the borders separately, and to number them according to the colours used. The program is a Windows application, for creating attractive images from an image.

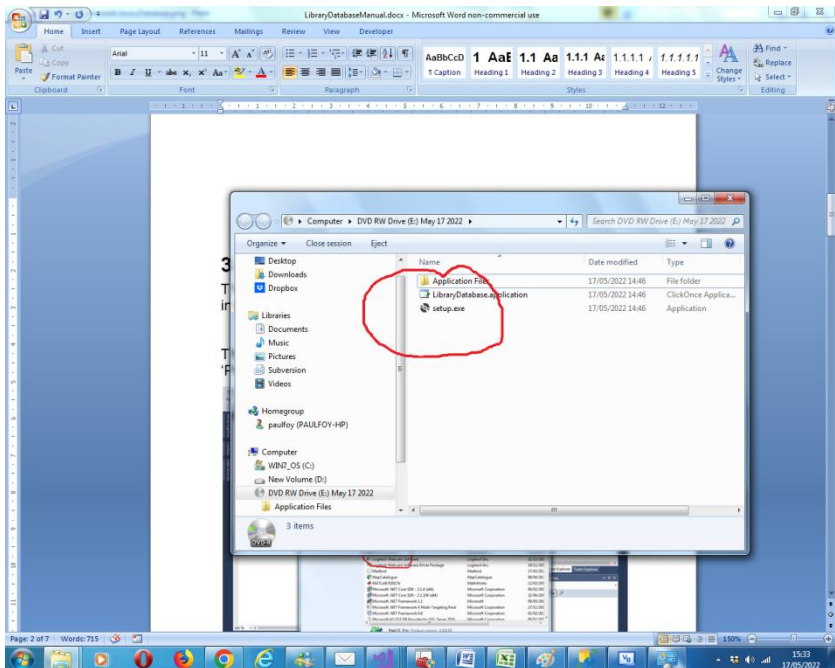
The general procedure is to load a .jpg or .bmp file, convert it to 30 colours or less (and to amalgamate regions at the same time), simplify the resulting image in some way and then create the delineated regions (or just the borders and numbers).

2 Pre-requisites.

- [1] A PC running Windows 7 or above.
- [2]
- [3] A USB stick or optical drive containing the program setup files, together with this manual (available online).

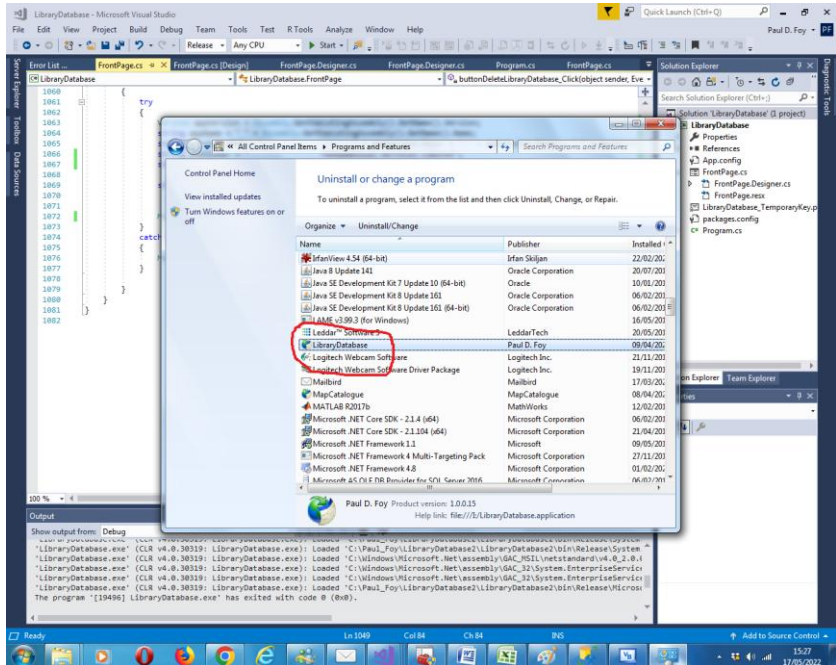
3 Installation/Removal

The program is installed by inserting the supplied stick or disc into the PC and running the 'setup.exe' program on it.

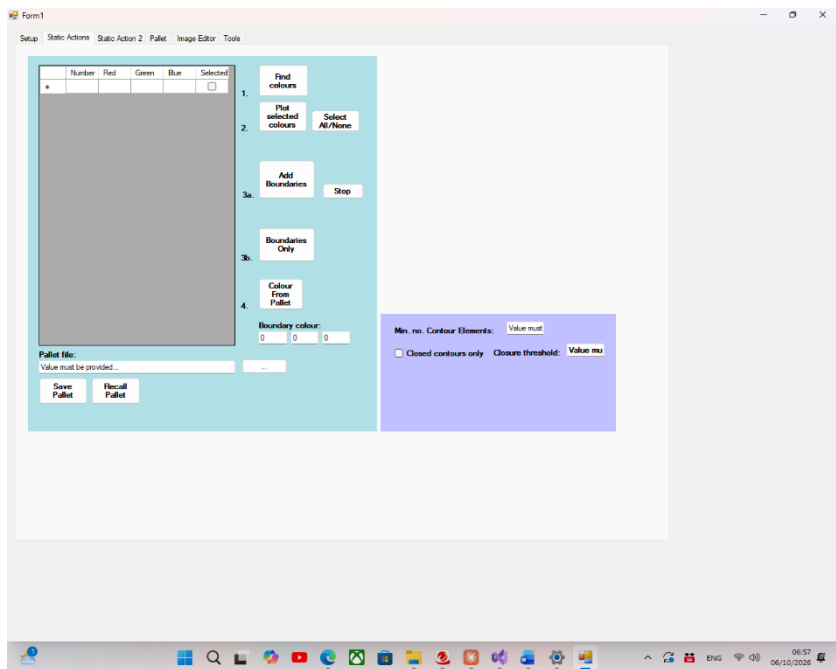


The program can be removed from the PC, by using the 'Program & Features' menu from within Control Panel.

The program is robust to erroneous parameter input, but not completely fool proof.



3.2 Static Actions



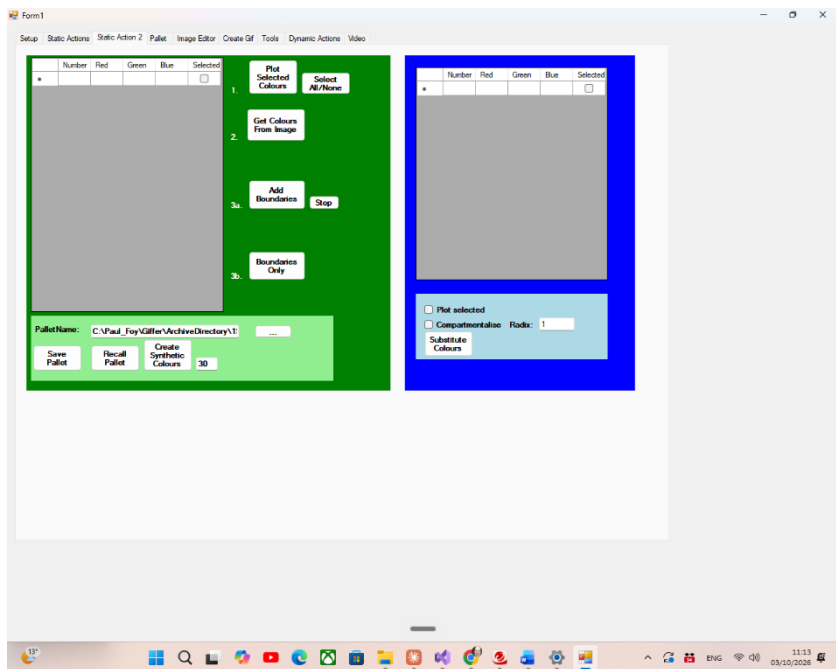
This tab permits plotting regions of colour and the boundaries of regions of colour from the loaded input file.

Left panel: **Find colours** lists the colours of the image into the adjacent Flex Grid. The following buttons can be used only after the colours of the image have been found. **Plot selected colours** plot those colours selected only. **Select All/None** selects or de-selects all the colours. **Add Boundaries** adds the boundaries of each region to the image. **Boundaries Only** plots just the boundaries. The boundary colour is supplied via the **Boundary colour** text boxes. The colours in the Flex Grid may be amended manually and then these colours can be drawn, in the same location as the amended colour, using the **Colour From Pallet** button. The default is black.

The **Pallet file** can be saved or recalled into or from a supplied.txt file using the buttons **Save Pallet** and **Recall Pallet** respectively.

Lower right panel: There is a small amount of control of the contours displayed: The checkbox **Closed contours only** ensures only closed contours (boundaries) are plotted. **Closure threshold** is the closure tolerance in pixels. **Min. no. Contour Elements** prescribe the minimum number of points before a contour will be displayed.

3.3 Static Actions 2



This tab also permits plotting of regions of colour and the boundaries of the regions of colour from the loaded input file. It does things in a different way to the previous tab.

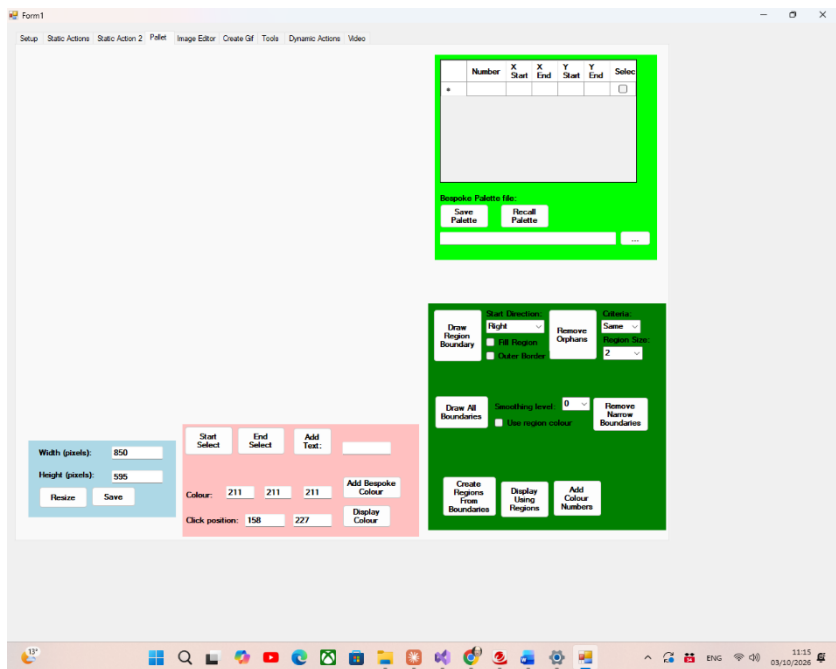
- [4] A palette of colours is loaded into the Flex grids (load this into the **Pallet Name** textbox or generate it synthetically using the **Create Synthetic Colours** button). Information on generating the pallet of colours from the image is given in the 'Pallet' section. The **Radix** (a number above 2) can be set and the **Compartmentalise** checkbox set. An image is then created with precisely the number of colours selected in the Flex Grid with blocks of colours of size **Radix**. A least squares fitting approach is used to select colours in the Flex grid from those in the original

- image. All colours may be selected (or de-selected) at once using the **Select All/None** button.
- [5] By selecting the checkbox **Plot selected** at the same time the pixel set in the image is from the colour selected in the right-hand Flex-grid but using the index number calculated by the fitting algorithm using the colours in the left-hand Flex-grid. When this checkbox is selected the number of colours selected in the left-hand and right-hand Flex grids must be the same.
 - [6] The button **Get Colours From Image** is used to populate the Flex grids with the colours of the image in the Pallet.
 - [7] (a) The boundaries of the selected colours can, in addition, be drawn by using the **Add Boundaries** button. The method used is either from one based purely on the image in the Pallet tab, or from the boundaries as delineated in the Pallet tab (or recalled from archive). This is as selected in the combobox **Boundary method**. As the former process may take some time the calculation can be aborted by using the **Stop** button. If **Apply smoothing** is set the boundaries are smoothed from their native rectilinear state. With radix set to 1 (or equivalently not set) the boundaries will be the natural state of the image.
 - [8] (b) The boundaries only are drawn by using the **Boundaries Only** button.
 - [9] The colour of the boundary is set using the three **Boundary Colour** text boxes.
 - [10]
 - [11] In each of cases (a) and (b) the boundary colour is selected in the Pallet tab selected below.
 - [12]
 - [13]

The colours (and their order) in the Flex Grid may be saved in a provided Pallet file (which can be selected) and then recalled using the **Save Pallet** and **Recall Pallet** buttons respectively.

- [14] The **Substitute Colours** button may be used to substitute colour(s) present in the image from those selected in the left-hand Flex grid with the corresponding colour in the right-hand Flex grid.

3.4 Pallet



3.4.1 Lower left panels

This tab contains a picture box control for receiving the created image. This tab is the heart of the processing of Painting Using Numbers. As well as being the Painting Using Numbers engine it also functions as a primitive photo editor if desired. The image may be resized with a new or original size by using the **Width (pixels)**, **Height (pixels)** text boxes and **Resize** button. The image is saved with the **Save** button.

As mentioned in the Static Images2 section representative colours of the image may be created directly in the Flex grids there by hitting **Start Select** and then clicking on a colour in the

image. The process of adding colours ends when **End Select** is hit.

Notwithstanding by clicking on the image the click position (in pixels) is set adjacent to **Click position**. This is useful for filling in the coordinates of the flex grid. Picture box coordinates are from the top left corner. X is positive to the left, and Y is positive downwards. Using the colour provided, and by clicking then drawing the cursor around on the picture box to form a closed curve and then clicking in the closed curve a bespoke area of colour may be created. Clicking **Add Bespoke Colour** colours the regions of the image provided in the top right Flex grid with the colour present. The button **Display Colour** displays the **Colour** at the pixel given by **Click position**.

When working in this drawing mode capacity it is important to ensure the width and height of the picture box correspond to width and height of the underlying image (otherwise there is a mismatch between image position and screen position). This is achieved automatically when loading the raw .jpg file. Only subsequent changes in size will change this feature.

Double clicking anywhere in the picture box image shows the RGB values of the underlying colour in the three **Colour** text boxes.

Use the **Add Text** button to add the text of the adjacent text box (in the colour of **Colour**) to the image.

At any time the image can be saved by using **Save** button in the lower left panel. It can be re-sized using the Resize button. The Save function saves everything displayed on the (pictureBox) control to a file. In particular, the size of the labels (i.e. numbers) will be that of the font used on the control (screen). Also if the size on the control (on screen) is different to the size of the original image there will be a loss of resolution AND the number of colours is not guaranteed to be the same as that of

the control. If the size on screen is the same as that of the original image the number of colours will be preserved.

3.4.2 Image Processing for Painting Using Numbers

There are broadly three stages for preparing a canvas for painting using numbers, as depicted in the lower right panel.

[15] Top row. The image of blocks of pixels is generally too complex to produce outlines of the coloured regions and must be simplified. The button Remove Orphans removes isolated blocks (depending upon their size, as selected via the upper combo box). A size greater than 2 can only be selected when the boundaries (and outer boundaries) of the pixel blocks have been de-linedated with the **Draw All Boundaries** button. When the Criteria 'Same' is selected the pixel block is only removed if the outer boundary to the pixel block is composed of a single colour, different to the pixel block colour. In this case the pixel block is re-coloured with this colour. When the criteria 'Different' is selected the pixel block is removed if each pixel of the outer boundary is a different colour to the pixel block (they do not all need to be the same colour). In this case the pixel block is coloured with the most common colour of the outer boundary.

The button **Draw Region Boundary** is used to draw the boundary of a region. The user clicks on this button and then clicks on the image. The border is drawn around the region. To cancel this functionality click on this button again. The boundary of the region is drawn in colour **Colour**. If **Fill Region** is selected the region is coloured in, also with this colour. If **Outer Border** is selected the outer border of the region is drawn, in black.

- [16] Middle row. The **Draw All Boundaries** button is used to populate the image loaded into the picture box with all the regions' (delineated with respect to colour) boundaries. The colour for each boundary is that present in **Colour**, unless the **Use region colour** checkbox is selected. This will result in a rectilinear polygon around each region whose lengths are given by **Radix**, in the previous tab. It is possible to create smoother borders for each region by selecting **Apply smoothing** (otherwise the default rectilinear) is used). This routine can take a long time to complete (completion being indicated by the appearance of a message box). Once the regions, delineated by boundaries, are created, it is possible to remove those of width and height less than **Region Size** or having minimum width and size less than 2 by using the **Remove Narrow Boundaries** button. Again this function takes some time to complete, completion being indicated by a message.

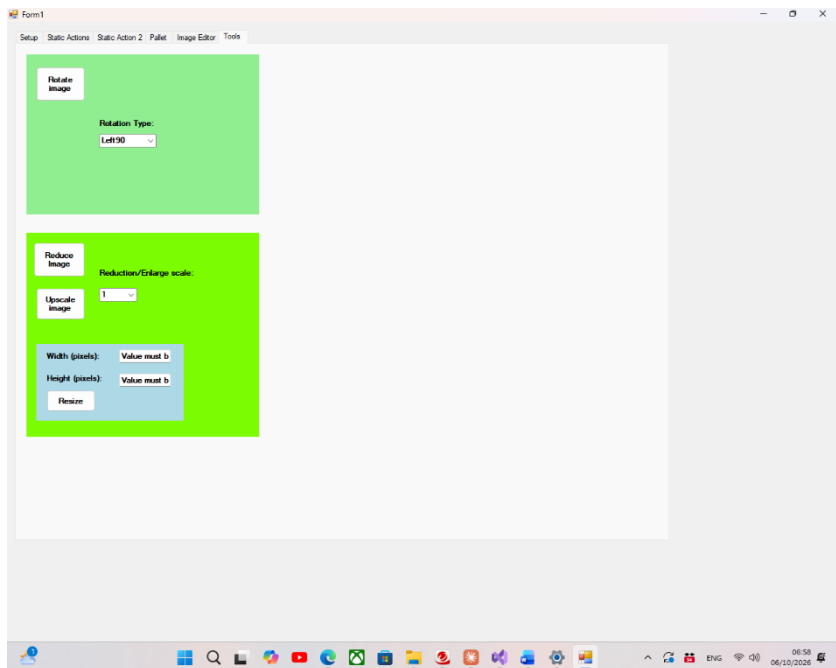
Because both actions of drawing boundaries and removing small/narrow boundaries may take some time these actions can be stopped, at any time, by using the **Stop** button.

- [17] Bottom row. This row of buttons is used to re-display the image after processing by the buttons on the first two rows. The **Display Using Regions** button displays the coloured regions without their enumerated boundaries. If **Apply smoothing** has been set, then because a smooth curve is constructed for each region independently, there may be small gaps if the regions are plotted via this button. In this case it is necessary to use the button **Create Regions From Boundaries**, to re-create the regions, before using **Display Using Regions**.

The **Add Colour Numbers** button adds numbers to each coloured region according to the colours present in the **Static**

Actions 2 flex grid. Similarly the **Add Region Number** labels the clicked upon region a number according to its colour.

3.5 Tools



The original image loaded may be rotated according to **Rotation Type** using the button **Rotate image**.

The bottom left-hand panel is used to reduce or increase the dimensions of the original input file. The scaling factor is two to the power of the value selected in the combo box. Thus if 2 is selected the image is reduced (or enlarged) by a factor of four

in each dimension. The original colours of the image are preserved.

Using the **Resize** button an image can be re-sized to the desired **Width** and **Height** in pixels. The nature of this resize (which works with a limited number of colours) is that the colours of the image are preserved exactly (i.e. no new ones are introduced).

The right-hand panel is used to archive the delineated boundaries for quick recall (sometime necessary because the Draw All Boundaries button can take some time). The root name used for the files archived is as provided in the **Archive name** textbox. **Save Archive** creates the archive and **Recall Archive** recalls it.

4 Example Workflow

- [18] Select the working directory and then load the reference image or application into the application. The artwork can be saved at any stage of the following process.
- [19] Using the 'Pallet' tab populate the Flex grids of the 'Static Action 2' tab with representative colours of the image (say up to 30). Save this pallet in a file for recall later.
- [20] Working in the Static Action 2 tab: Select all these representative colours. Set the Radix, check Compartmentalise and then create an image of compartmentalised and segregated regions using the Plot Selected Colours (1.). This is the image to be worked with in the Pallet tab.
- [21] Working in the Pallet tab: It's usually better to simplify the region by removing orphan blocks of pixels. (top layer).
- [22] Create the boundaries, remove larger orphan blocks of pixels, display the regions, remove regions of a desired size (middle layer). Repeat until a desired image is achieved.

If a 'painting by numbers' template is desired continue with the following steps:

- [23] Working in the Static Action 2 tab: Get the colours from the image of coloured regions in the pallet.
- [24] Create the boundaries only (3b). The pallet is now populated with the image of the boundaries.
- [25] Working in the Pallet tab: Add the numbers of the colours (from the list in the previous tab's Flex grids).

These images can be saved at any stage, in various file formats. You can resume working from them at various stages. Note to preserve the precise number of colours (important for

this application) use the .bmp or .png filetypes. Delineated regions can be save for recall later in the Tools tab.

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October 2026