Software Design

Team 7RS

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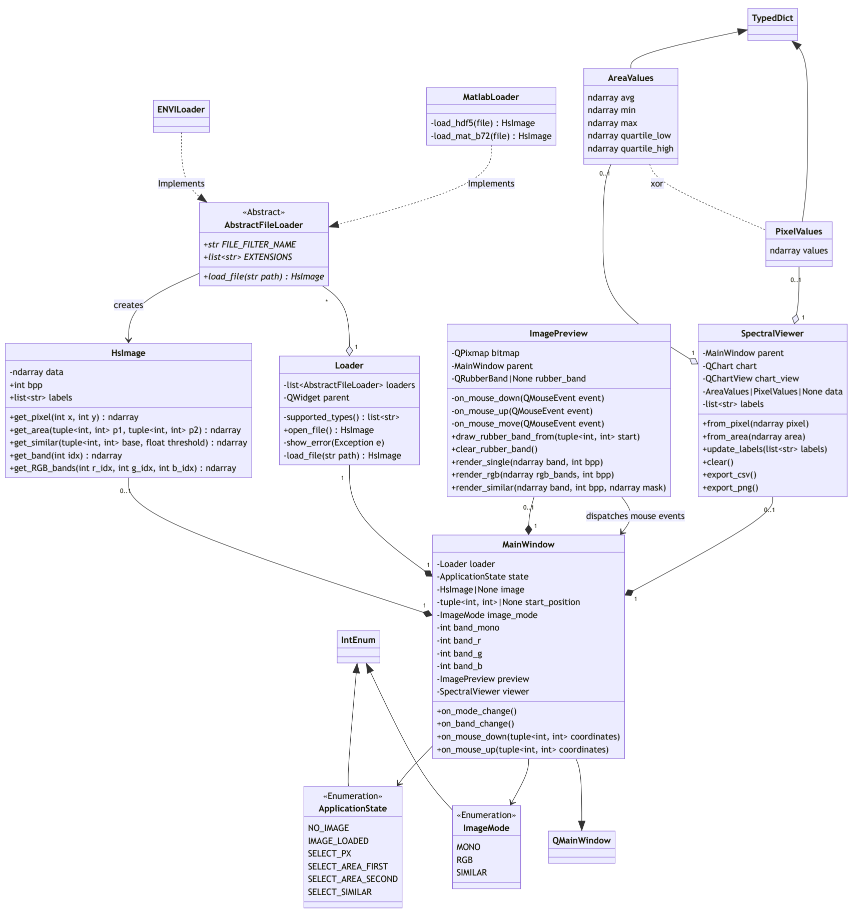
1 Classes

1.1 UML diagram



1.2 Class description

1.2.1 `MainWindow`

Derived from `QMainWindow`. Contains UI setup, most UI elements and event handlers for buttons.

Stores:

- loaded image
- state
- image mode
- selected bands
  - mono
  - red
  - green
  - blue
- tolerance for the *magic wand* functionality
- starting position of area selection

Event handlers:

- open file menu action - request loading file from `Loader`
  After the file is loaded:
  1. Save the `HsImage`
  2. Set state to `IMAGE_LOADED`
  3. Reset selected bands to default values
  4. Clear `SpectralViewer` or update it with the whole image and update its labels
  5. Clear the rubber band on `ImagePreview`
  6. Render the new image in `ImagePreview`
- mode selection - display appropriate band settings and update the preview
- band change - save the new value and update the preview
- ESC button clicked - set state to `IMAGE_LOADED` (or `NO_IMAGE`) and clear the rubber band
- select pixel/area/similar - update the state according to the clicked button

Actions triggered by `ImagePreview`:

- mouse down - ignore if not in `SELECT_AREA_FIRST` state, save `start_position`, request drawing a rubber band and change state to `SELECT_AREA_SECOND`
- mouse up - action depends on current state:
  - `SELECT_PX` - get selected pixel and update `SpectralViewer`
  - `SELECT_AREA_SECOND` - get area between `start_position` and received coordinates and update `SpectralViewer`
  - `SELECT_SIMILAR` - get similar pixels, change image mode to `SIMILAR` and update `ImagePreview`

  After any of those actions state must be restored to `IMAGE_LOADED`.

1.2.2 `Loader`

Provides an interface for loading files. Manages errors during file loading (I/O, invalid format, expectations not met, etc.). Has a list of available file loaders.

1.2.2.1 Notes for implementer

1. Use static `QFileDialog` methods - it is simpler to implement. Example:

   ```
   file_path, used_filter = QFileDialog.getOpenFileName(
       parent,
       "Open image",
       "",
       "Matlab file (*.mat);;ENVI .hdr labelled image (*.hdr);;All
       ↪  supported types (*.mat *.hdr)",
   )
   ```

2. Keep (or get as a function parameter) a reference to parent, to block the parent (main) window, while a dialog (open file, file loader *settings* or error) is open.

3. Error messages can be displayed using `QMessageBox` with static `.warning` or property-based API if informative or detailed text should be set.

1.2.3 `AbstractFileLoader`

An abstract base class for specialised file loaders. Each loader must have a getter for a friendly *category* name and a list of supported extensions. `load_file(path: str) -> HsImage` abstract method provides an universal interface for loading files.

1.2.4 `MatlabLoader`

Derived from `AbstractFileLoader`. Supports `.mat` files. If multiple three-dimensional variables are available prompt the user for selection.

1.2.4.1 Notes for implementer

1. `QInputDialog` can be used for variable selection:

   ```
   variable_names = ["data", "something", "a_name"]
   selected_var, ok = QInputDialog.getItem(
       parent,
       "Select variable",
       "Variable containing image data",
       variable_names,
       editable=False,
   )
   ```

2. For matfiles <= 7.2 use `scipy.io.loadmat`
   For 7.3 use `h5py` (a HDF5 library for Python). `h5py` is not available for Python 3.11 yet.

3. **Warning:** Some datasets have negative values instead of using unsigned integers.

1.2.5 `ENVILoader`

Derived from `AbstractFileLoader`. Supports ENVI `.hdr` labelled files. Should report compatibility with `.hdr` files, but a file with the same name, but no `.hdr` extension must exisit in the same directory.

1.2.5.1 Notes for implementer

1. ENVI files can be loaded using `GDAL`, but its installation may be tricky. Windows packages can be found here, for Linux it probably will have to be built from source.

1.2.6 `HsImage`

Stores image data:

- raw pixel data as a 3D array [height, width, bands]
- bits per pixel
- band labels

If band labels are not provided in the image file a sequence `1..=bands` should be used instead.

Must provide:

- pixel data given its coordinates
- subarray with pixels bounded by given coordinates
- a mask with pixels similar to one with given coordinates and a threshold
- a single band of the image given its index
- three bands in specified order given their indices

1.2.7 `ImagePreview`

Displays the image preview using specified mode. Proxies events to `MainWindow` after translating mouse position to pixel coordinates. Draws a `QRubberBand` when selecting an area.

Optional: Manages zoom and panning.

1.2.8 `AreaValues` and `PixelValues`

Are derived from `TypedDict` (PEP 589). Both store data displayed in `SpectralViewer` - either *aggregate values* (`AreaValues` - avg, min, max, quartiles) or a single pixel value (`PixelValue`). Their properties are vectors (1D `ndarrays`).

1.2.9 `SpectralViewer`

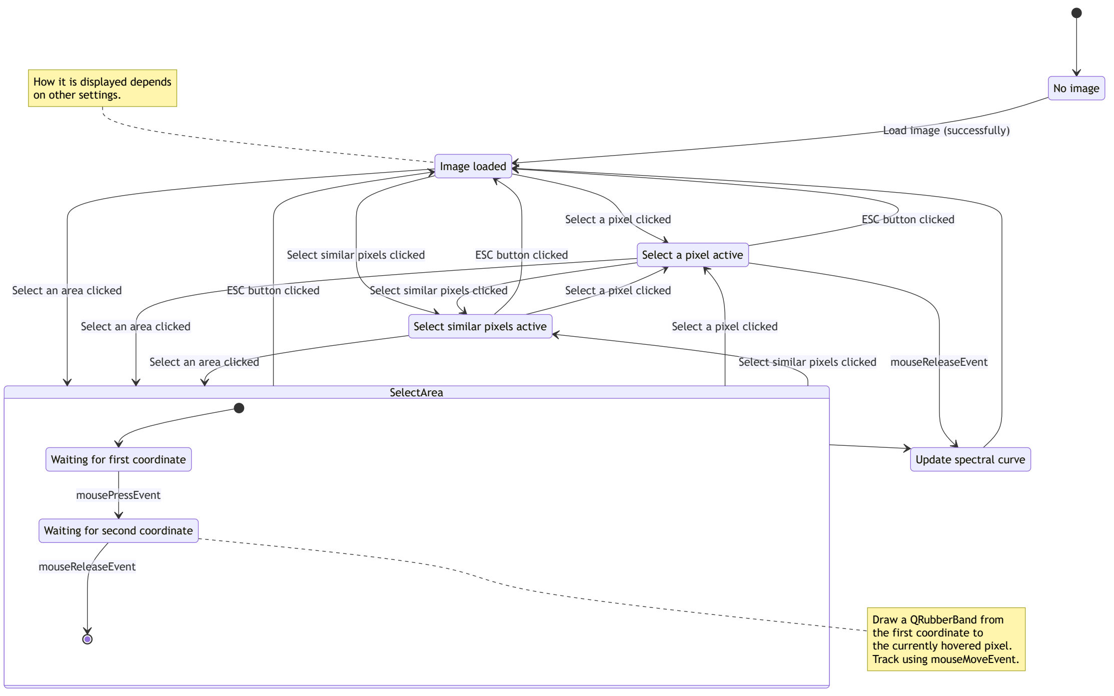
Manages the spectral curve chart. Chart is labeled using stored labels, which should be updated when a file is loaded. When created from a pixel or an area it should calculate appropriate values, store them as `PixelValues` or `AreaValues` and update the chart.
Two methods for exporting must be provided:

- exporting to CSV - simply write `PixelValues` or `AreaValues` and labels to CSV
- exporting as PNG - render the `chart` or `chart_view` to a `QPixmap` and save it

Note: If needed exporting as JPEG can also be provided just by allowing to save `QPixmap` with `jpg/jpeg` extension.

2 High level overview

2.1 State diagram


No image
Load image (successfully)
How it is displayed depends on other settings.
Image loaded
Select a pixel clicked
ESC button clicked
Select similar pixels clicked
ESC button clicked
Select a pixel active
Select an area clicked
ESC button clicked
Select similar pixels clicked
Select a pixel clicked
Select an area clicked
Select similar pixels active
Select a pixel clicked
Select an area clicked
Select similar pixels clicked
mouseReleaseEvent
SelectArea
Waiting for first coordinate
mousePressEvent
Waiting for second coordinate
mouseReleaseEvent
Update spectral curve
Draw a QRubberBand from the first coordinate to the currently hovered pixel. Track using mouseMoveEvent.

2.2 Dynamic diagrams

TODO: For each use case draw interactions between classes.