User Interfaces Coursework 3 : A Qt-based Desktop Application for Viewing Water Pollutant Levels in Different Geographical Areas

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Abstract: The objective of the project is to develop a Qt-based desktop application that visualises UK/EU water quality data, with an emphasis on accessibility, internationalisation, and clear data presentation. The application is essentially about viewing water pollution levels, what pollutants make up these levels, and if they meet the UK/EU requirements.

Overview

The project will be delivered in three, partially concurrent parts:

- ❖ Implementation of Application : The Qt desktop application
- ❖ Final Report : A six-page report detailing the process, findings, feedback and final product
- ❖ Videos : Three videos of each implementation cycles, and a short final product video

As well as this, the app's design will be user friendly to a variety of audiences, but specifically:

- ♦ Enviromental Researchers ~ accessing data and looking for trends
- ♦ Policymakers ~ Viewing summary dashboards to make informed decisions
- ♦ General Public ~ Quickly interpret pollutant levels without needing in-depth analysis

Requirements

The main purpose of the application is simplifying the process for users to explore, evaluate and identify geographic patterns of water pollution levels with respect to UK/EU standards. This makes the main functionality of the application the accuracy, and the utility of it methods of data visualisation, with respect to the UK/EU regulation. Principly the application provides visualisation for a broader understanding of the data, in a geographical context, alongside providing the data for reference.

This makes the application have four principle functional requirements:

→ **Data Visualisation** : Graphs and filters should be applicable to the data, allowing the user to compare geographical locations with respect to their water levels, or say, list all of the areas which are below the UK/EU threshold.

- ❑ Use intuitive visualisations, such as time-series and bar charts, to present pollutant levels over time, and compare pollutant levels across difference geographical locations.
- ❑ Implement a traffic-light colour scheme to indicate whether pollutant levels fall within, safe, thresholding or exceeded limits, with respect to regulation.

→ **Compliance with UK/EU regulation** : Data should be presented and formatted such that it highlights its relevance to the UK/EU thresholds i.e. Green, the level of pollutants present in the water are well below UK/EU standards; Amber, the levels are nearing the threshold; Red, the levels are above UK/EU standards.

- ❑ Clearly display whether pollutant levels are within UK/EU safety standards.
- ❑ Allow users to filter data by pollutant type, location or compliance.

→ **Interactive Map** : (optional) Coloured coded markers to be placed on the geographical locations themselves, on a map, as an alternate way of representing the data.

- ❑ Create a map to highlight geographic hotspots with colour-coded markers.

→ **Accessibility** : Meet basic standards for colour contrasts, screen-reading, and keyboard navigation. This also includes the il8n options for input of other languages, since this project is supposed to be for an international audience.

- ❑ Ensure an accessible experience that meets basic accessibility standards
- ❑ Include internationalisation options to make the app accessible to non-English speakers.

This will be achieved throughout six principal pages, being:

❑ **Pollutant Overview Page**

- **Search Function**: Include a search bar to help people locate pollutants by name.
- **Visualisation**: Use time-series or bar charts to show pollutant trends over time.
- **Compliance Indicators**: Colour-code pollutant levels (e.g., green for safe, amber for caution, red for exceeding safe levels).
- **Pop-Ups**: Provide additional information on pollutant risks, compliance status, and safety thresholds when people hover or click on data points.

❑ **Persistent Organic Pollutants (POPs) Page**

- **Data Trends**: Use line charts or similar visualisations to show POP levels at various sampling points over time.
- **Rollover Pop-Ups**: Include additional information on health risks, monitoring importance, and safety levels.
- **Compliance Colour-Coding**: Show compliance with UK/EU safety levels using colour-coded indicators.

❑ **Environmental Litter Indicators Page**

- **Litter Comparisons**: Provide comparisons of litter levels across different locations and water body types, using bar or pie charts.
- **Compliance Indicators**: Show adherence to EU Bathing Water standards regarding litter presence.
- **Interactive Elements**: Allow people to filter by location or type of litter to explore trends.

❑ **Fluorinated Compounds Page**

- **Map or Time-Series Visualisation**: Show distribution of fluorinated compounds across sites, using either a map view with colour-coded markers or time-series charts.
- **Compliance Indicators**: Use traffic-light colours to indicate levels relative to safety thresholds (e.g., 0.1 µg/L for PFAS).

- **Rollover Pop-Ups**: Provide contextual information on PFAS persistence and health/environmental implications.

❑ **Compliance Dashboard**
- **Summary Cards**: Display compliance status for each pollutant with a quick colour-coded indicator.
- **Filters**: Allow people to filter by location, pollutant, or compliance status to see which areas require attention.
- **Pop-Up Details**: Include summaries for non-compliant sites, explaining possible causes or historical data trends.

❑ **Geographical Hotspots Page** (Optional for Advanced Implementation)
- **Interactive Map**: Use **QtLocation** to display sampling points, with colour-coded markers based on pollutant levels.
- **Rollover Information**: Show details for each hotspot, such as pollutant type, recent levels, and compliance status.
- **Filters**: Allow filtering by specific pollutant or geographic region to focus on areas of interest.

The primary library to be used throughout the project is of course **Qt**, with specific utilisation of the **QtCharts** for data visualisation, such as line, bar and pie charts. This library also supports comparisons.

The other primary library is the **CSV Parser**, which is already provided in the started code.

There's also a series of alternate approved libraries that can be used:

- QtLocation & QtPositioning
- QtSQL
- QtMultimedia
- QtWebView

For responsiveness, Qt layout managers such as **QVBoxLayout, QHBoxLayout** or **QGridLayou**t, should be used to make a responsive and adaptable layout. Keep in mind colour contrast, as well as keyboard navigation, and good tag discipline. The whole app should also be touch-screen accessible.

The language support and internationalisation requirements, are not such that you translate the entire program into other languages, but that you make it easy for future adaptations to include them. Ensure that all of the strings you output are translatable, the app responds appropriately if the locale changes, and optionally some translations in a language of choice to so show internationalisation. The focus is to allow for the support of translatability, rather than doing it yourself.

The design concept for this coursework is a card-based design layout, where the application is split over different cards, rather than crowding them onto one, as well as including roll-over pop-ups, when a user hovers over a link or tab.

As a minimum, the project should express:

❑ A working dashboard, basic data visualisations for each page, and preliminary compliance indicators, as well as a fully implemented backend, for most of the features.

- ❑ Partial or Prototyped features, especially if the focus is on UI and interaction, documenting these elements in the final report.
- ❑ Transparent documentation about any challenges, limitations and incomplete features, along with the decisions behind them, outlining what would be needed for full implementation. Honesty and professionalism will be credited.

Dataset

The dataset follows the typical CSV structure, with helpful headings in the first row indicating what each field is. EU/UK compliance can easily be deduced from the dataset from the field **"sample.isComplianceSample",** which is simply a Boolean statement declaring if the sample is compliant, with its location be contained in the penultimate and final columns as **"sample.samplingPoint.easting, sample.samplingPoint.Northing",** as well as the common name for the location under **"sample.samplingPoint.label".** It's essential to note that the primary key, per say, for the data is not the actual location, but the determinant, so for instance the first location, Malham Tarn, has about **813** entries, each being a description of the potential contaminants. All these entries are essentially identical apart from this, other than perhaps a different timestamp:

- determinand.label (chemical symbol)
- determinand.definition (chemical name)
- determinand.notation (integer, probably represents element)
- resultQualifier.notation (Sometimes blank, mostly "(symbol for less than)")
- result (float representation of concentration)
- codedResultInterpretation.interpretation (entire column blank)
- determinand.unit.label (units of result/concentration)

Index	Rubric	% – In Marks
1	**Prototype Quality**	**20% - 17 marks**
a	Stability & Functionality • Assess the application's overall stability, responsiveness, and freedom from crashes or bugs	3
b	Completeness • Evaluate whether the application meets all required features, including dashboard functionality, pollutant pages, and basic accessibility.	3
c	UI & Responsiveness • Review the overall design, layout consistency, and responsiveness of the UI, ensuring it adapts smoothly across desktop and tablet screens.	5
d	Improvements & Creativity • Award marks for creativity and thoughtful improvements made throughout iterations, based on feedback and testing	6
2	**Documentation & Report**	**30% - 29 marks**
a	Structure & Clarity • Assess the report's overall organisation, coherence, and flow. The report should clearly explain each design choice, feedback, and iteration outcome.	4
b	Arguments & Supporting Information • Evaluate the strength of arguments made in the report, with evidence supporting design and implementation decisions.	6
c	Scoping Analysis & Scenario • Review the quality of the project's scoping and scenario analysis, ensuring the project's focus aligns with monitoring context.	8
d	Application of UI/UX Theory • Look for references to relevant UI/UX theories and design principles, applied to design decision and iteration improvements.	6
e	Use of Prototyping Technique • Assess the variety and appropriateness of prototypes methods used throughout development, and how these methods informed design choices.	5

3	**Iterations & Evaluations**	**20% – 19 marks**
a	Ethics Compliance • Ensure ethics documentation is complete, including participant consent forms and anonymized feedback data, following ethical standards.	3
b	Documented Iterative Cycles • Check that the project includes at least three documented iterations, with iterative improvements across each cycle.	1
c	Evaluation Techniques • Review the evaluation methods used (e.g., heuristic, walkthroughs) and their relevance to the project's design.	4
d	Evaluation Reasoning • Ensure clear reasoning behind each evaluation method and design choice, detailing why specific techniques were chosen.	2
e	Feedback Integration • Award marks based on the extent to which customer feedback was incorporated, with clear documentation of implemented and deprioritized feedback.	6
f	Evidence of Evaluation • Assess the quality and clarity of evaluation evidence, including tables, anonymized images, and summarized feedback data.	3
4	**Video Submissions**	**20% - 18 marks**
a	Iteration Videos • Evaluate the submission of three iteration videos, showcasing development progression, feedback, and adjustments.	3
b	Showcase Video • Ensure submission of a final showcase video demonstrating the app's main features and accessibility.	1
c	Video Length Compliance • Check that all videos meet the required lengths (iterations: 45s-1m20s; showcase 1m20s-1m45s).	4
d	Clarity & Evolution	2

	• Review the quality, clarity, and accessibility of each video. Videos should be understandable on first viewing, with accessible features like subtitles where possible.	
e	Process & Evolution • Award marks for evidence of development process and iterative evolution across videos, highlighting major improvements and design choices.	6
f	Audience Appropriate Showcase • Assess the showcase video for its suitability for a general (non-technical) audience, effectively highlighting key features and usability reports	2
6	**Module Participation**	**10%**
Total	**100%**	**83 marks**