Hydrological Modelling and Software Development

Team : 1

CONTENTS:

1. PROJECT STRATEGY:

- The idea of the project was to automate the pipeline of predicting the water quality index.

- The objective was to make a user interface which allows users to upload water related data of a particular location, and obtain the water quality indices at different points of the river/water body they are interested in.

- The interface must be user-friendly and should produce accurate results.

2. IMPLEMENTATION:

1. Developing a Machine Learning Model

- Given an input data file with reservoir inflow values (m3/s), rainfall (mm) and evaporation (mm).

- An inflow model is trained based on Random Forest Model.

- Steps:
1. Data Preprocessing
2. Train model(s)
3. Prediction using test-data

- Additionally if reservoir storage values are provided, then the inflow values are recomputed and save in a text file.

2. IMPLEMENTATION:

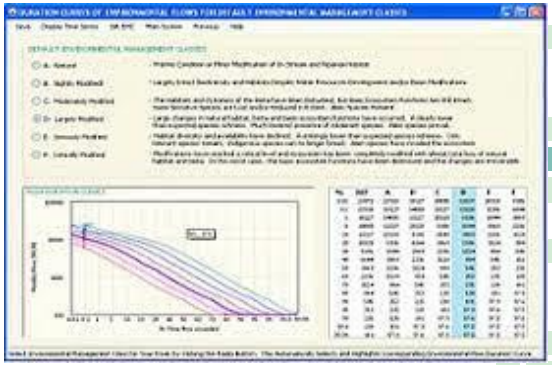
2. Predicting Environmental Class – GEFC Tool

- We take the output from the ML model and give it to the GEFC tool which then calculates the Mean Annual Runoff and Environment Class

- Used Pywinauto, pyautogui and threading to automate the working of the tool

- Used tesseract-OCR and pytesseract to read the outputs of the tool which is in the form of an image and convert it to text.

- Saved the outputs (Flow duration curves data, Mean annual runoff, Coeff of variation, etc.) in text files which can be referred by the users for further analysis



2. IMPLEMENTATION:

3. Determine Water quality parameters – Qual2k

- The output of the previous step (GEFC Tool) is a text file, which has the values of Mean Annual Runoff (MAR).

- After which, we use the MAR value and Environmental Class selected by the user, we derive the Flow Rate.

- Then, by automating mouse and keyboard controls, we input the Flow Rate into the excel file which contains the QUAL 2K parameters which is immediately followed by running Fortran.

- Finally, once the application finishes running, we save and close the excel sheet.

2. IMPLEMENTATION:

4. Determine Water Quality Index

- In the previous step, we create the updated Water Quality Parameters, which we then extract by reading the excel sheet which contains the parameters.
- We then calculate the WQI at user inputted data points by using the weights corresponding to each parameter, as shown in the table.
- The WQI values are stored in an array and outputted as a CSV file.

Parameters	Weight	Unit
DO	0.097	mg/L or Sat[1] (%)
Fecal Coliform	0.14	MPN[2]/100 mL
pH	0.051	Dimensionless
BOD_5	0.117	mg/L
Total hardness (TH)	0.059	mg/L $CaCO_3$
Ammonium (NH_4-N)	0.09	mg/L
Total Phosphate	0.087	mg/L
Nitrates (NO_3-N)	0.108	mg/L
Turbidity	0.062	NTU[3]
EC	0.096	Microseisms/cm
COD	0.093	mg/L

2. IMPLEMENTATION:

5. Visualising the Water Quality Indices

- Given the image of the location of a place, we would like to determine the water quality indices at specific points selected by the user.

- We have achieved this, by using digital image processing. The user is allowed to click the points where they want to get to know the water quality.

- Once selected, the coordinates of those points are stored and from the list of already predicted water qualities, based on the level of water quality, certain colors are assigned to each point and can be visualised on the image.

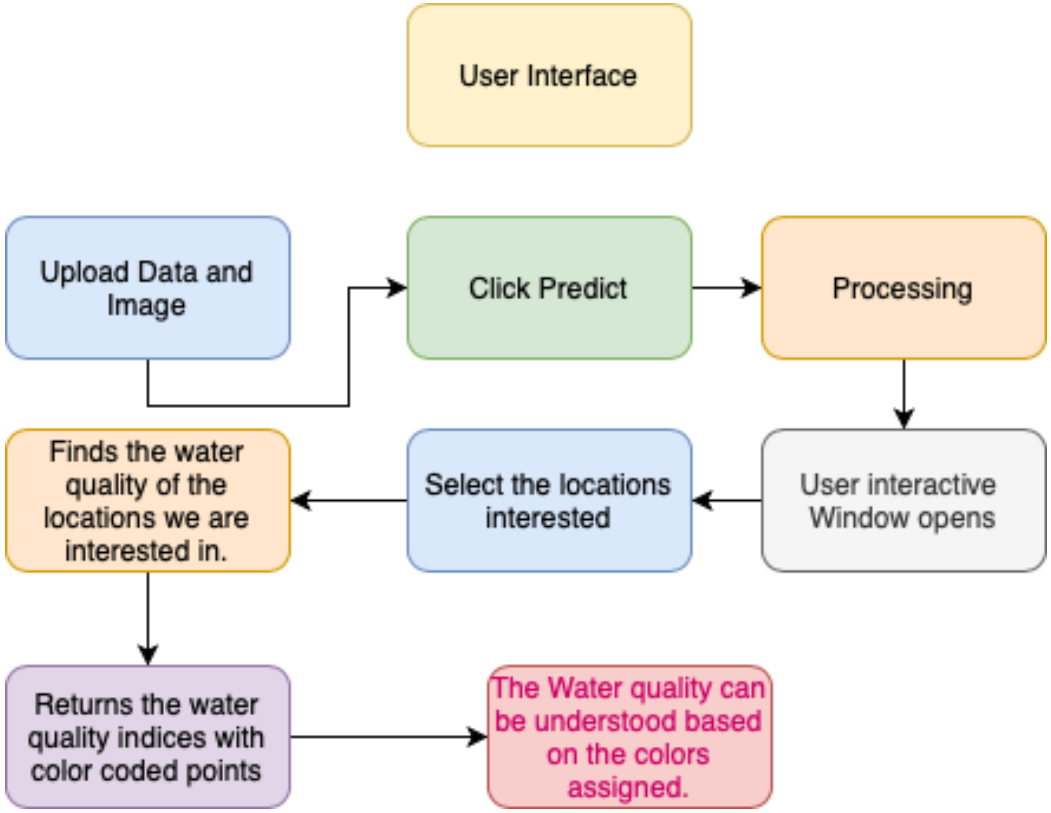
WQI Range	Class	Statement
< 45	VI	Very poor
45 – 60	V	Poor
61 – 69	IV	Fair
70 – 79	III	Good
80 - 90	II	Very good
91 – 100	I	Excellent

2. IMPLEMENTATION:

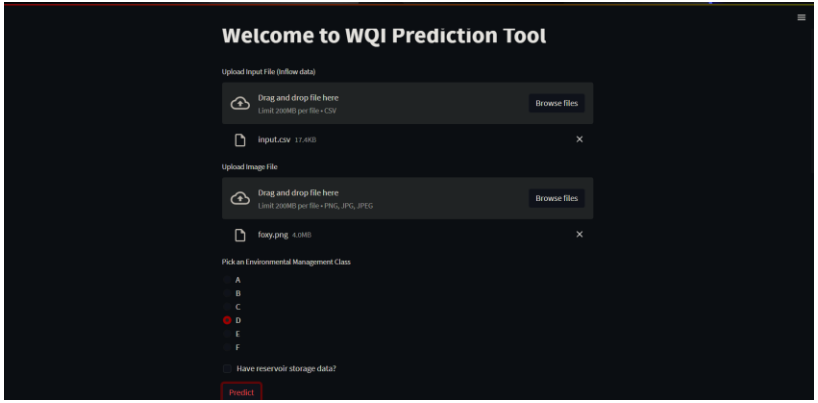
6. Streamlit

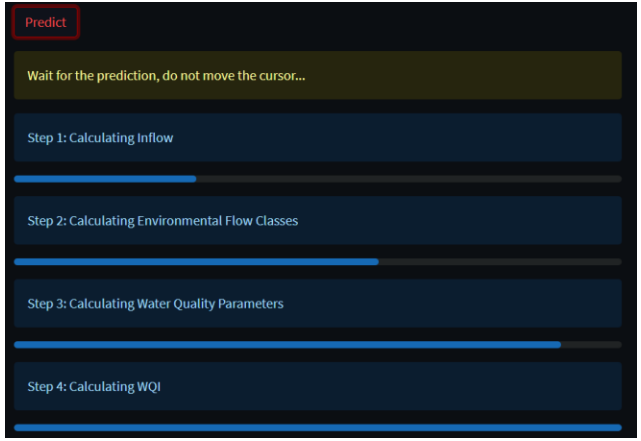
- The application's frontend is designed using streamlit
- Frontend UIs can be prepared very quickly and this also supports APIs
- This tool is ideal for creating webapps that can be deployed and hosted instantly
- Various options are configured for our purpose like file uploaders, select boxes, charts etc.

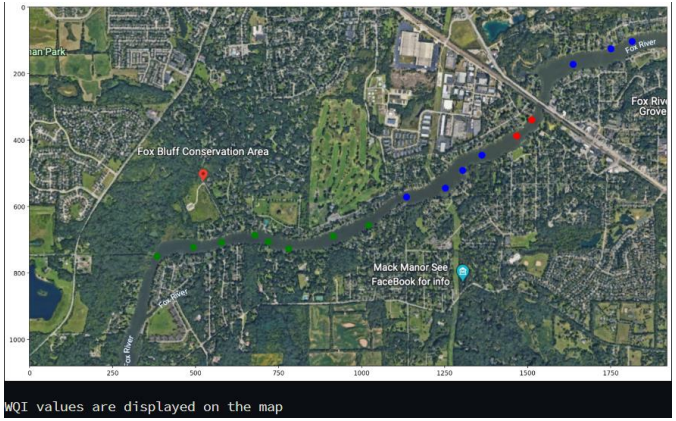
1. CODE FLOW - FLOWCHART:



1. RESULTS:







WQI values are displayed on the map

1. DRAWBACKS:

- Error logging can be improvised.
- Generate API calls instead of native applications.
- Improve precision

1. CONCLUSION:

- We can observe that we have been successful in automating the entireprocess, and giving the user a very smooth experience in determining the water quality index at different locations in an image.
- We have to note that water is extremely essential for the existence of living beings on earth, therefore, tools like these should be very carefully designed and must be giving extremely accurate values.
- The values obtained must be cross checked with various other sources before relying on them, since they can have a huge impact.

1. ACKNOWLEDGEMENT:

We would like to thank ma’am and the TA’s for supporting us throughout the course and giving us the opportunity to design this tool.

THANK YOU