Project Plan
Product-based Capstone Project

Problem Statement

Water is a fundamental need for all living things, but pollution in rivers, lakes, and seas is now an increasingly pressing problem. This pollution not only impacts the ecosystem, but also affects human health, the quality of natural resources, and hinders sustainable development. Current water quality assessment methods generally require a manual sampling process, which must then be tested in a laboratory. This process is often time-consuming, expensive, and not always easily accessible, especially for communities living in areas with limited facilities and budgets. This condition results in delays in detecting water pollution problems, potentially endangering the lives and health of local communities.

Research Question

- How effective is the model in classifying different levels of water quality based on images taken from polluted water images?
- What are the most significant visual features, such as color and turbidity, that contribute to accurate identification of water quality through image recognition technology?
- How do users respond to the water management suggestions provided by the application, and do these suggestions have an impact on reducing pollution levels in the field?
- Does providing a scan history help users monitor changes in water quality effectively?

Team ID : C242-PR587

Team Member :

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Final Selected Themes:

Sustainable Futures: Nurturing harmony between humanity and the environment

Title of the Project:

WaterEye: Water Quality Scanner App

Executive Summary/Abstract:

In many areas, water quality is often neglected and polluted by various sources, such as household, industrial, and agricultural waste. This pollution can have serious impacts on human health, the environment, and ecosystems. Unfortunately, many parties such as farmers, environmental managers, and the general public still have difficulty identifying water quality problems and finding solutions.

This project aims to develop an application that can scan and analyze water quality through images, providing accurate information and appropriate improvement suggestions. By utilizing technologies such as image recognition or smart sensors, we hope that this application can help users, especially farmers and environmental managers, to quickly find out the condition of the water and how to overcome it, so that negative impacts on health and the environment can be minimized.

This research will answer several key questions, such as how effective the AI model is in analyzing water quality, what visual features are most important in the analysis, and how this application can affect the way people manage water quality in the field. Our goal is to create a solution that can really help solve water quality problems directly and sustainably.

We feel the need to address this issue urgently because of its large impact and the potential for positive change. We believe this application will be a practical and educational tool for farmers, environmental managers and the wider community, while supporting more environmentally friendly and sustainable water management.

How did your team come up with this project?

Our team started this project after recognizing the widespread problem of water pollution in rivers, lakes, ponds, and coastal areas. This pollution poses a serious threat to ecosystems and public health, especially in areas with limited resources. We wanted to address the challenges of water quality monitoring in areas that do not have access to traditional testing methods. By leveraging AI and image recognition technology, we aim to create an affordable and accessible solution to assess water quality based on visual indicators such as

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color, turbidity, and the presence of debris. This project aligns with our passion for leveraging technology to address critical environmental challenges and support healthier communities.

Project Scope & Deliverables:

Project Scope

- Water Quality Classification with Management Information:
  The app will provide predictions and classifications of water quality based on images uploaded by the user. In addition to classification and prediction, it will offer information on appropriate water management techniques for each identified water quality type.
- Water Quality Comparison:
  The app will include a feature to compare water quality by analyzing past scan history with the latest scan, allowing users to track changes in water quality over time.

Project Deliverables

No	Task	Person Responsibilities	Timeline
1	Collecting and cleaning data	ML	9-15 Nov
2	Create models for image classification and	ML	16-27 Nov
3	Training and testing models	ML	28 Nov- 4 Des
4	Optimization and deployment models	ML	5-12 Des
5	Cloud Create API Spec	CC	9-10 Nov
6	Create API Spec	CC	11-15 Nov
7	API Development	CC	16-30 Nov
8	Set Up Cloud	CC	1-4 Des

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9	Full Testing	CC	5-11 Des
10	UI/UX Design	MD	9-15 Nov
11	Implement User Interface	MD	16-29 Nov
12	Features Integration and Testing	MD	30 Nov - 6 Des
13	Mobile App Optimization	MD	7-13 Des

Project Schedule:

No	Activity	November																				December												
		9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	1	2	3	4	5	6	7	8	9	10	11	12	13
Machine Learning																																				
1	Collecting and cleaning data																																			
2	Create models for image classification and recommendation system																																			
3	Training and testing models																																			
4	Optimization and deployment models																																			
Cloud Computing																																				
1	Cloud Architecting																																			
2	Create API Spec																																			
3	API Development																																			
4	Set Up Cloud																																			
5	Full Testing																																			
Mobile Development																																				

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1	UI/UX Design																															
2	Implement User Interface																															
3	Features Integration and Testing																															
4	Mobile App Optimization																															

Based on your team's knowledge, what tools/IDE/Library and resources that your team will use to solve the problem?

Mobile Development	Cloud Computing	Machine Learning
Android Studio	Compute Engine, Cloud Firestore, Cloud Storage, VPC Network	Google Collabs, JupyterNotebook
Figma	Visual Studio Code	Tensorflow
Retrofit	Postman	NumPy
CameraX	Nodemon, Express, Dotenv	Pandas
	Swagger API	Kaggle
	@google-cloud/firestore, @google-cloud/storage	OpenCV
		Scikit-learn
		Matplotlib and Seaborn

Based on your knowledge and explorations, what will your team need support for?

- Machine Learning Assistance: Guidance to improve the accuracy of our models for water quality prediction, especially in effectively processing visual features such as color and turbidity from images.
- Environmental Expertise: Insights into water quality indicators and pollution impacts to help align our projects with real-world environmental standards and ensure relevance in addressing pollution challenges.

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Based on your knowledge and explorations, tell us the Machine Learning Part of your Capstone!

For our capstone project, we trained a TensorFlow based model to classify various types of water conditions using image recognition. We applied transfer learning with a fine tuned CNN to capture key visual features, such as color and texture, that distinguish each waste type. For deployment, we integrated TensorFlow.js, making the model accessible as a web application for ease of use in the field.

Based on your knowledge and explorations, tell us the Mobile Development Part of your capstone?

Development begins with preparation for visual asset needs, followed by prototyping in Figma to design and visualize the application's interface. The resulting design will be developed into an Android application using Java or Kotlin. The application connects to the backend via Retrofit, which allows for API communication to send user assessment data and receive analysis results and learning recommendations.

Based on your knowledge and explorations, tell us the Cloud/Web/Frontend/Backend Part of your capstone?

We plan to create API Spec using Swagger and built using Expess.js. We plan to use Compute Engine to create a web server and also a place to train models. We will utilize Cloud Storage to store static images and also saved models, while Firestore will be the main database to manage user data. In addition, for the frontend, we use mobile devices and intuitive interface designs created by Mobile Development.

Based on your team's planning, is there any identifiable potential Risk or Issue related to your project?

- Based on our research, there is no specific annotated dataset for water quality prediction based on color and turbidity from images, so we may need to research and also create our own dataset during the development of the project.
- Limited funding for model training and processing in the cloud: Due to budget constraints, we may need to optimize the cost of model training and processing in the cloud.
- Fear of taking a long time to train the machine learning model to achieve the desired accuracy target, because the data used is quite large.

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Any other notes/remarks we should consider on your team's application

Our app not only aims to provide air quality assessments, but also provides steps that users can take, such as pollution prevention recommendations and safe air usage guidelines. In addition, the app will also compare historical air quality with recent photos, allowing users to aggregate changes in air quality over time. We also focus on easy-to-use design so that it is accessible to individuals and communities, even in remote areas.