kyndryl

REVA UNIVERSITY
Bengaluru, India

Hackathon on Plastic-Free Rivers

With Artificial Intelligence

Towards Sustainability

SAVE THE RIVERS

#PlasticFreeWithKyndryl #RACEREVAforSDG14

Hackathon on Plastic-Free Rivers with Artificial Intelligence

Let's create a ripple effect of change by harnessing the power of AI to protect our water bodies. Participate in this exciting AI Hackathon challenge and help us positively impact the environment. The goal of this Hackathon is to create new technologies, policies, and strategies to reduce plastic waste and create healthier and more sustainable rivers and oceans.

The Dataset

The dataset for this challenge is extracted from the images of plastic and water weeds taken by drones across the river Saigon[1]. The images contain large patches of water weeds (hyacinths), plastic, and other floating debris. The participants must build an end-to-end solution to help the local authorities to know the plastic density to decide on planning, cleaning schedules, and resources. The challenge is to detect and classify the plastics in the dataset and propose a viable and architecturally sound AI solution. The models must be capable of identifying and estimating plastic waste in the images, with the goal of helping the local authorities to take timely action in cleaning up and thus reducing the negative impact of plastic pollution on the environment and human health.

The Problem Statement

Develop a reliable and efficient AI-based object detection model using drone images to detect plastic waste in rivers and demonstrate a feasible solution/system architecture for implementation, ultimately reducing the negative impact of plastic pollution on the environment and human health.

Phase I: Model Building

i. Label the images for plastic. Accurate labelling is part of the Hackathon challenge[2].
ii. AI-based object detection and counting of plastic in images.
iii. Geotagging of the plastic and providing the URL link.
iv. Submit the result.

Phase II: Prototype Submission

i. Demonstrate and deploy a feasible solution with system architecture for implementation. Show tech stack, dashboards, and downstream actions which trigger a set of events for the detection and estimation of plastic.
ii. Submit a prototype or an MVP as a working model. A demonstrable version is preferred.

[1] *Source: Schreyers, Louise; Bui, Khiet; Emmerik, van, Tim (2022): Drone images over the Saigon river – Hyacinth & Plastic patches. 4TU.ResearchData. Dataset. https://doi.org/10.4121/21648152.v1
[2] You may use any open tools for labelling like Labelimg/CVAT.

Optional: Think out of the box – Open Innovation Challenge

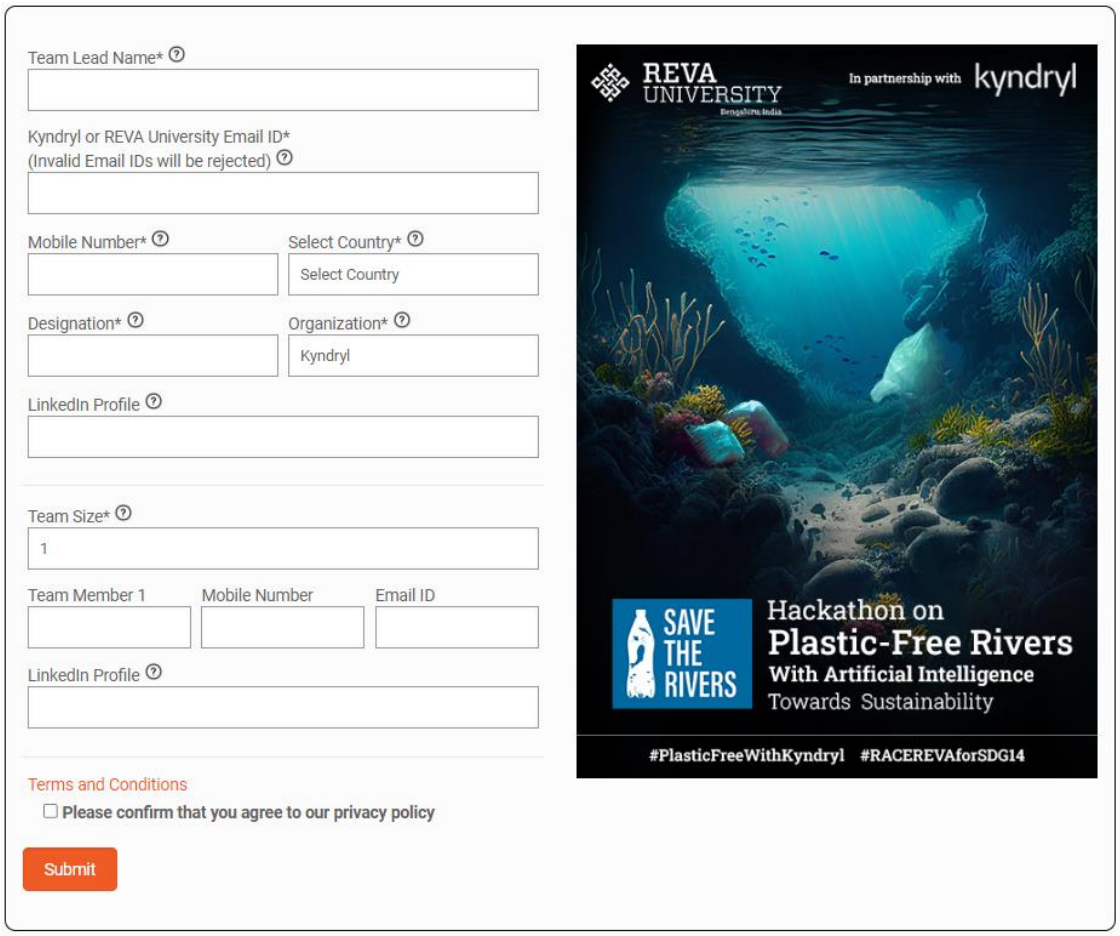
The hackathon has an open innovation entry with a special jury award.

i. Build a spatiotemporal model capturing the metadata available in the images, including Latitude and Longitude, to detect moving and stationary plastic.
ii. You may annotate and detect the weeds and other debris in the images.
iii. You may use state-of-the-art algorithms to build efficient solutions to detect and curb the plastic menace, which can help local authorities to take intelligent actions. Build a solution to identify the severity of the menace and develop an early intervention and warning system.

Participation Process: Registration

Click on the website link below to register. You can participate individually or in teams of a maximum of four members (One member or multiple members).

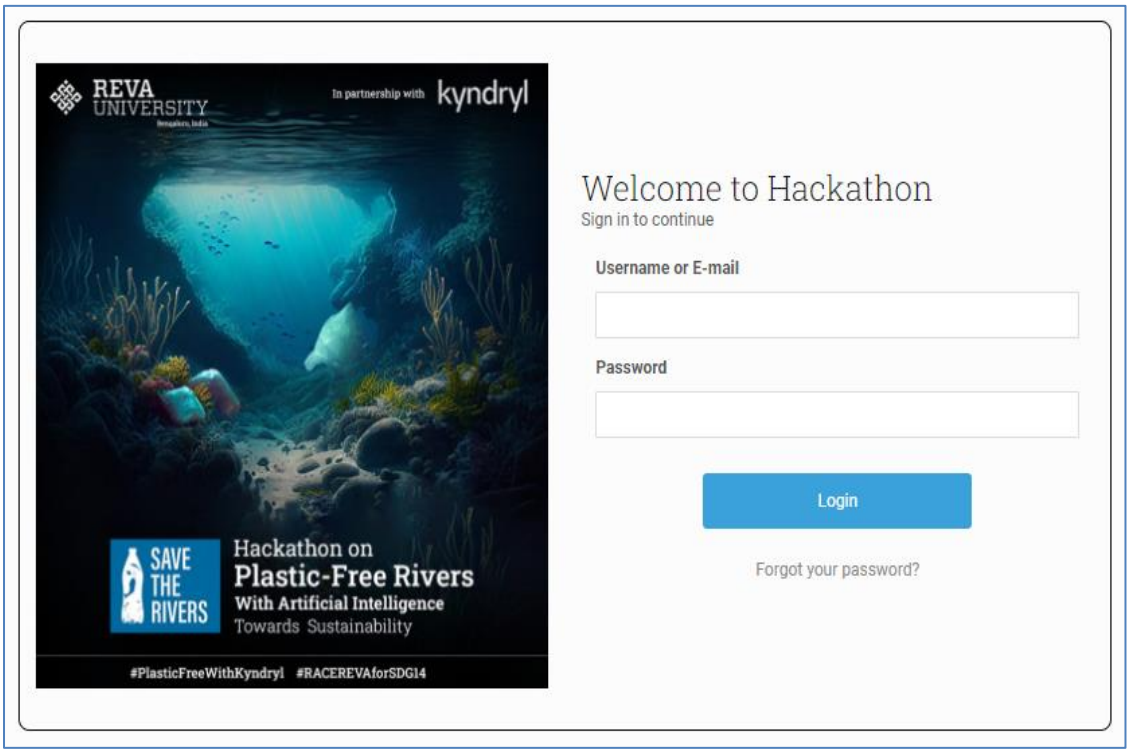
https://race.reva.edu.in/hackathon-on-building-plastic-free-rivers



1. After registration, complete the email verification and authentication.
2. You will receive a *team name* unique to your team through your registered email.

2. Login

Once you are registered, you must log in with your credentials. You may log in with your registered email id on the team's name as a username.



After verification, log in to the webpage to learn more about the challenges.

Dataset Information

- Dataset Folder Name: AI Hackathon Kyndryl_REVA University Dataset
- Dataset Type: Color Images
- Image Format: JPG
- Image Size: 3992x2992 pixels
- Image Resolution: 240 dpi
- Longitude, latitude, and altitude information is available in the metadata.

Download the Dataset

You can directly download the folder from the website, which contains the data in three folders:

1. Train (70 images)
2. Test (30 images)
3. Predict (10 images)

Download Instructions and Submission Templates

1. README (this document) with detailed instructions
2. Model results - Submission formats
3. Slide Deck for Phase I – PPT Template
4. Slide Deck for Phase II – PPT Template

Phase I: Model Building

Object Detection for Plastic Waste Identification - Background

Object detection is a powerful technique that utilises Deep Learning (DL) and Convolutional Neural Networks (CNN) to identify different types of objects quickly and accurately in real time. When applied to the problem of plastic waste identification, object detection can play a crucial role in identifying and quantifying plastic waste in each area.

Recent advancements in object detection have led to the development of models specifically designed for plastic debris detection. These models can be trained to detect plastic waste in challenging or inaccessible areas, such as waterways or riverbeds. By leveraging object detection models, researchers and environmentalists can gain a more comprehensive understanding of the extent of plastic pollution, allowing more targeted and effective solutions to be implemented.

Moreover, these models are constantly improving in accuracy and speed, with the latest versions of object detection models providing even more unified frameworks for training models to perform object detection, instance segmentation, and image classification tasks. By leveraging these advancements in object detection technology, we can make significant progress in the fight against plastic pollution.
Note: Counting plastic in the given images can be calculated/predicted from the labelled images.

Prerequisites

- Participants must have experience with object detection models and frameworks, such as YOLO, TensorFlow Object Detection API, or OpenCV.
- Participants must have a good understanding of image processing techniques and deep learning algorithms.
- Participants must demonstrate their ability to implement and fine-tune object detection models for real-world applications.
- Participants must be familiar with data annotation and cleaning techniques.
- Participants should have experience in programming languages such as Python.
- Participants must be able to work collaboratively in teams and communicate effectively.
- Participants must be able to submit a detailed report, codes, and relevant files and present their solutions on the day of the hackathon.
- Participants should have a strong passion for creating innovative solutions to tackle the global plastic waste problem.

Guidelines for Building an Object Detection

- Participants must label the data on their local system before training it. You may annotate the images using an annotation tool such as labelimg or CVAT.
- Train, test, and predict datasets are provided, and it is important to use the training set exclusively for training the model, while the test set should be used for testing the model. Use the 'predict' dataset to validate your results.
- Organize your object detection algorithm's folder structure, including folders for training, testing, and any data configuration files that may be necessary.
- Clean coding practices, including proper inline comments, must be followed.
- The code should effectively detect plastic waste and provide its geolocation as a URL link.
- The model's mean average precision, commonly referred to as mAP, needs to be a minimum of 65%.

Phase I: Submission Guidelines Upload Model and Results

One can make a maximum of two submissions. The latest submission will be considered. Submission must include a zip folder containing,

1. Share the ONNX format of the final working code. This is a mandatory submission format.
2. A working code with folder structure zipped, with associated comments and dependencies. Preferable format is .py (Python 3.8) with .config file executed in a Python virtual environment.
3. A Slide Deck with concept note, approach, model, and solution architecture (A deck template is available in the zip folder).
4. A demonstration video explaining the solution (not more than 2 minutes).
5. The resulting file must be a CSV file (Predict) containing the following fields. The fields cover all the given tasks.
6. All submissions must be genuine; any plagiarised code/content will lead to disqualification.

Note: You may create a Google Drive/Drop Box and store all the artifacts and share the link with AIHackathon@race.reva.edu.in. The same must be submitted on the Hackathon website through your login page.

Predict Data Set (Submit as .CSV)

IMG_ID	PRED_LAB	ACTUAL_CT	PRED_CT	CT_Error	% Error	mAP_Train	mAP_Test	GEO_Tag_URL

i. IMG_ID: Image ID as given in the Predict Dataset
ii. PRED_LAB: Plastic Yes or No as per the image
iii. ACTUAL_CT: Actual count of the number of plastics in the given image
iv. PRED_CT: Predicted count of the number of plastics in the given image (based on the number of plastic objects detected in the given image)
v. CT_Error: Mean Absolute Error

vi. % Error: Calculate % Error (CT_Error / ACTUAL_CT)
vii. mAP_Train: Mean average precision of train data.
viii. mAP_Test: Mean average precision of test data.
ix. GEO_Tag_URL: URL of the location of the image. This must be added programmatically.

Predict Data Set (.CSV: A Sample file)

IMG_ID	PRED_LAB	ACTUAL_CT	PRED_CT	CT_Error	% Error	mAP_Train	mAP_Test	GEO_Tag_URL
DJI_0001	Yes	21	12	9	0.428	0.55	0.52	10°53'44.9"N 106°41'43.2"E - Google Maps
DJI_0002	Yes	23	4	19	0.826	0.55	0.52	10°53'45.5"N 106°41'38.1"E - Google Maps
DJI_0003	Yes	12	3	9	0.75	0.55	0.52	10°53'45.2"N 106°41'36.8"E - Google Maps

Phase I Scoring

The submissions are evaluated on technical and non-technical criteria as below.

Non-technical Criteria

1. Replicable –The solutions must be easily replicable by the evaluation team.
2. Clarity – The architecture and the solution presented must be clear and comprehensive.
3. Impact – A solution that provides actionable solutions to control the plastic menace in scale is appreciated.

Technical Criteria

1. Evaluation metric: Mean Average Precision (mAP) confidence interval for the validation data set.
2. Code quality – Codes must be well-commented and clear.
3. Optimization – The code must be efficient, use the least possible memory or disk space, and minimize resources like GPU and network bandwidth.

Evaluation Metrics: The model results will be evaluated using an automated Python script.

1. Plastic detection: mAP (Mean Average Precision)
2. Count of the plastic: MAE (Mean Absolute Error)
3. The combined score will be based on the normalized average (relative score).

Note: Additional points will be earned based on the slide deck and video submitted.

Presentation Requirements

- Team Profiles
- Solution Summary
- Effectiveness of the model in detecting plastic and providing geolocation as output
- Accuracy and mean average precision (mAP) of the detection model.
- Provide detailed steps on how the model will be used in real time.
- Business value and impact of the model
- Provide information on any other solutions you have considered.
- Comparison with other existing models

- Challenges and drawbacks of the current model

A slide template (Phase I) is available on the website to download. You may edit/modify and submit the final deck. The submission of the slide deck is mandatory.

Scoring the Final Model

1. The ONNX format submitted by you and your team will be executed on the validation data set (a new set of images). The evaluation team will also run the codebase for clarity, efficiency, and originality.
2. The final scoring of the model will be calculated on the validation data set. The validation data set will be released after the competition on our website.

IMG_ID	PRED_LAB	ACTUAL_CT	PRED_CT	CT_Error	% Error	mAP_Train	mAP_Test	GEO_Tag_URL

Phase I: Results

A leaderboard with the top 50 winners will be published based on the final score below.

- Combined Score on Code quality, Model Results (70%),
- Slide Deck with Proposed solution (20%), and,
- A video explaining the solution (10%).

Phase II Prototype Submission

The 50 shortlisted entries must submit a **working prototype** with the final solution, including a refined and more efficient working code and a working prototype with a solution architecture. **A demonstrable version of the final prototype is preferred.**

You must submit a more refined PowerPoint presentation with a demo link and 2-3 minutes of video demonstration. The slide deck template for Phase II is available on the website.
Note: You may create a Google Drive/Drop Box and store all the artifacts and share the link with AIHackathon@race.reva.edu.in. The same must be submitted on the Hackathon website through your login page.

Phase III: Mentorship and Grand Finale

The final ten shortlisted entries will work with industry mentors to fine-tune their submissions and presentations before the grand finale. Week-long support with one/two meetups with a respective mentor will be scheduled. The schedule and the meetup (online) will be managed by RACE, REVA University team.

Grand Finale

The grand finale will be held at the REVA University campus in Bangalore. The final 10 teams will present their work to the jury panel. For those who are presenting online, a link will be provided. The top 10 presenters will receive exciting, branded swags, and the top three will receive cash prizes during the final awards ceremony.

Channels for Support and Communication

For all communications and queries, a **Discord channel** is available on the website. A direct phone number and email id are also provided. Do connect with us for any support required.

Let the hackathon begin! Good luck to all participants!