Project Documentation-

Group 11

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Scope –

The scope of the proposed project encompasses the development of an AI-driven platform that enables users to upload images for the identification of plastic bag pollutants through a batch processing system. By integrating an intuitive interface with a 'Upload' feature, users—from environmental researchers to volunteer cleanup crews—can submit various forms of imagery, such as satellite data or high-resolution photographs taken during fieldwork. The platform is designed to aggregate the uploads and execute the detection algorithm at the end of each day, thus optimizing computational resources and minimizing operational costs. The result is a set of processed images, each with accurately placed bounding boxes highlighting the presence of plastic bags. This daily, consolidated approach not only streamlines the detection process but also aligns with the urgent need for cost-effective and scalable solutions in environmental monitoring and cleanup initiatives.

Domain of the project –

The project operates within the environmental conservation and technology domain, with a particular focus on marine and terrestrial ecosystems. It is designed to address the pervasive issue of plastic bag pollution, leveraging the capabilities of artificial intelligence and machine learning for object detection. By developing a system that can accurately identify and locate plastic bags in diverse environments, from bustling urban landscapes to the vast expanses of the ocean, the project aims to facilitate targeted clean-up efforts, thus contributing to waste reduction, wildlife protection, and the overall health of our planet's ecosystems. The technology developed will serve multiple stakeholders including environmental agencies, conservationists, policymakers, and the wider community, all of whom are invested in combating the detrimental effects of plastic waste on the natural world.

Tools - AWS Sagemaker, AWS S3, AWS Lambda, AWS EventBridge (for CRON jobs), AWS IAM, AWS Sagemaker EFS

Data sources for the project –

We intend to use open images dataset from Google.
https://storage.googleapis.com/openimages/web/visualizer/index.html?type=detection&set=train&c=%2Fm%2F05gqfk
we have filtered the dataset based on detection and plastic bags as a use case.

Problem we are trying to address -

The project addresses the critical environmental problem of plastic bag pollution, which poses a grave threat to marine life, disrupts ecosystems, and contributes to the larger global crisis of plastic waste. Traditional methods for detecting and collecting these pollutants are inadequate, often missing small or submerged plastic bags that can cause significant harm. The opportunity lies in harnessing cutting-edge AI and machine learning techniques to create a sophisticated object detection system capable of identifying plastic bags in complex and variable environments. By improving detection, the project facilitates more effective and efficient clean-up operations, directly contributing to the mitigation of pollution, the protection of wildlife, and the promotion of ecological sustainability.

KPIs –

Establishing flexible Key Performance Indicators (KPIs) is essential for effectively tracking and adapting the effectiveness of an AI-driven platform aimed at identifying plastic bag pollutants. Key metrics might include the accuracy and reliability of the detection algorithm, particularly the precision in identifying pollutants correctly. The efficiency of the system, both in terms of processing time and its scalability to accommodate various types of data, is also crucial. The user experience, as reflected in stakeholder feedback, and the tangible environmental impact, such as the measurable reduction in pollution, are significant considerations. Additionally, operational aspects like cost-effectiveness and system reliability should not be overlooked. As the project progresses, these KPIs should be revisited and modified as necessary to ensure they continue to align with evolving objectives, technological advancements, and the changing dynamics of environmental conservation.

Paper 1 –

Title - Machine learning for aquatic plastic litter detection, classification and quantification (APLASTIC-Q)

Citation - Wolf, Mattis, et al. "Machine learning for aquatic plastic litter detection, classification and quantification (APLASTIC-Q)." *Environmental Research Letters* 15.11 (2020): 114042.

Literature Review –
The APLASTIC-Q system represents a pivotal development in the detection and quantification of plastic litter in aquatic environments, employing advanced machine learning techniques. Utilizing

high-resolution aerial imagery, this system incorporates a two-component machine learning framework, consisting of a Plastic Litter Detector (PLD-CNN) and a Plastic Litter Quantifier (PLQ-CNN). Achieving an accuracy of 83% in distinguishing between different environmental elements, including plastic litter, the APLASTIC-Q system is adept at categorizing and quantifying a variety of plastic waste types, such as water bottles, Styrofoam, and large carry bags. This approach of using high spatial resolution imagery (~0.002 m pixel−1) is a significant stride in enhancing precision in environmental monitoring. The system's capability for quasi-quantification, which involves automated counting with allowances for aggregated litter, offers a detailed assessment of pollution levels. This technology presents a promising avenue for supporting decision-making processes among policymakers and stakeholders, paving the way for more effective environmental conservation strategies.

Paper 2 –

Title - Autonomous trash collector based on object detection using deep neural network

Citation - Hossain, Shamima, et al. "Autonomous trash collector based on object detection using deep neural network." *TENCON 2019-2019 IEEE Region 10 Conference (TENCON)*. IEEE, 2019.

Literature Review –
The development of an autonomous mobile trash collector, as outlined in the abstract, showcases an innovative application of deep learning algorithms in environmental conservation. This system integrates an ultrasonic sonar sensor with a camera module, managed by a Raspberry Pi, to differentiate between trash and non-trash items with high accuracy. The design of this low-cost, autonomous robot includes a trash-container attachment, enabling it to collect a wide range of waste materials. The implementation of deep learning for trash detection is not only efficient but also economical, addressing the pressing challenge of improper waste disposal and the accumulation of non-biodegradable products. The robot's ability to autonomously navigate and classify various types of trash presents a significant step forward in waste management technology. This autonomous system highlights the potential for using advanced technology to tackle environmental issues, demonstrating a practical approach to reducing the ever-growing problem of trash accumulation in urban and natural environments.