PROJECT MACHINE LEARNING

Team 4:

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Machine Learning

Problem description:

In many cities, urban parks suffer from litter contamination due to improper littering by visitors and inefficient waste management systems. Cleanup workers cannot cover the entire park efficiently, and trash cans are often overflowing, resulting in an unhealthy, unhealthy, and aesthetically unpleasing environment. This problem is exacerbated during special events and on weekends, when the influx of visitors is high.

Proposal:

To address the problem of waste pollution in urban parks, we propose the implementation of an Autonomous Waste Collection Robot (RRRA). The RRRA will be equipped with advanced technology for waste identification, collection and sorting, as well as autonomous navigation and safe interaction with the environment and park visitors.

The project is divided into three different learning approaches: supervised learning, unsupervised learning and reinforcement learning. More on each of these approaches is elaborated here:

- **Supervised Learning:**

Objective: The goal of supervised learning is to train the RRRA to classify objects as "waste" or "non-waste" based on the images captured in the park.

Data: There are labeled images of different objects found in the park. Some of these objects are waste (plastic bottles, cans, papers) and others are not (stones, leaves, branches).

Application

A classification model will be implemented, such as, for example, a convolutional neural network, which upon receiving a new image can determine whether the object in the image is a residue or not. This allows the RRRA to correctly identify the objects to be collected.

- **Non-Supervised learning:**

Objective: The unsupervised learning approach focuses on segmenting different areas of the park according to waste accumulation.

Data: Data is available on the location of waste previously collected in the park.

Application

A clustering model will be used, such as the K-means algorithm, which when receiving a set of images can assign them to different groups according to their similarity. This allows the RRA to identify the areas most affected by contamination and prioritize their cleanup.

- Reinforcement learning:

Objetives:

Objective 1: In reinforcement learning, it is to allow the RRRA to optimally navigate the park, finding efficient routes in each segmented area.

Objective 2: The second objective is to improve the robot's ability to collect waste and avoid obstacles during its work.

Data

Data 1: A reinforcement learning model that considers all routes in simulation, considering distances, will be used to find the most efficient way to move through the park, i.e., to find the optimal route for RRRA work.

Data 2: The RRRA will receive rewards or penalties based on their actions. For example, he will receive a positive reward for picking up a waste and a penalty for bumping into a bench or tree.

Application

Reinforcement learning techniques and evolutionary algorithms, such as Deep Q Networks or Proximal Policy Optimization, will be used for the robot to learn a navigation policy that allows it to move through the park efficiently, collecting waste, avoiding obstacles and optimizing its energy use.

Together, these approaches will enable RRRA to effectively address the problem of waste pollution in urban parks, improving the cleanliness, efficiency and aesthetics of these public spaces, and promoting a healthier environment for visitors. In addition, the project also has the potential to serve as an example of how technology and machine learning can contribute to solving environmental problems in urban settings.

-Success Metrics

Key metrics for evaluating project success will include:

Collection Efficiency: Measured by the amount of waste collected in relation to the total identified.

Operating Time: Time that the RRRA can operate effectively before needing maintenance or recharging.

Safety: Incidence of errors or accidents during operation.