Group 17 - ADIOS

Littering in urban areas poses a serious threat across the globe, with direct consequences on human health and climate change. Litter pieces such as soda cans or plastic bags left in the environment destroy nature by, for example, polluting water or contaminating soil. Moreover, animals consume these non-digestible pieces. Once they are washed away into the ocean, both land animals and fish ingest plastic pieces. Not only does this destroy the biodiversity, but toxic microplastics make their entrance in the human food chain as well. In light of these problems, there is a need for a rapid and flexible litter cleanup system.

Mission Objective

Autonomous Integrated Drones Operational cleaning System (ADIOS) aims to clean up litter in a fast and energy-efficient way. As drones have a high accessibility, they can cover hard-to-reach in a practical manner. Using Artificial Intelligence (AI) allows for image detection and contributes to the automation of this system. The drones carry a pick-up mechanism for either small or big litter pieces. After being deployed in an urban area, they fly at a height to avoid low obstacles, such as fences, poles and small trees, towards litter in the shortest but safest distance possible. After being picked up, the litter is disposed at the ground station in containers. The ground station then serves as a check point that allows for docking as well as communication and control of the drones. Ultimately, the system is completely reliant on renewable energy sources, making it a sustainable cleaning solution without adding to carbon emissions. Next to designing ADIOS, a prototype is built. Due to the novelty of the concept, a prototype will demonstrate that the system could work in reality. Moreover, it will ensure that the design trade-offs made in the process are feasible; the prototype will operate as a validation method.

System Design

The ADIOS is a system that can be installed inside a van or a trailer. Within the installable system, monitoring and control of the drones are carried out. The communication links for both video transmission and Control and Non-Payload Communications (CNPC) are based on cellular communication, namely 5G. To ensure the safety of both the public and animals, the drones employ sensors as well as cameras in combination with a sophisticated AI model called Yolov8n. With the use of data sets of images of trash, it can detect litter pieces, while recognizing people as well. Furthermore, the drones emit ultrasonic frequencies to deter animals, avoiding any potential collisions and interference. Interchangeable pick-up mechanisms are used depending on the size of the litter; for small objects, brushes are used, whereas larger pieces are picked up by a claw system. With the use of 16000 mAh Lithium-Polymer batteries, the drones can fly up to 25 minutes on a full charge. Additionally, each drone is equipped with six motors for redundancy. A pair of flexible wheels is used to land close to the litter, approach it and perform the pick-up. A preliminary lay-lout is shown in Figure These design options are to be integrated into a final configuration. In parallel to this, an accurate simulation of the operations is created to analyse the system performance and have a clear vision of how ADIOS would function. Ultimately, the established prototype will carry out the demonstration of picking-up litter, to validate the design and finalize the project with a proof-of-concept.