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PATH PLANNING FOR AN AUTONOMOUS ROVER ON LUNAR SURFACE

Abstract

Path planning for an autonomous rover on Lunar surface Hylke Merks, Idse Wiersma, Jeroen Schimmel, Jochem Sprenger, Kevin Nobel, Rayanne Jabba

In the realm of autonomous systems, the ability to accurately identify objects with minimal computational resources and under constraints such as low-resolution imagery remains a formidable challenge. This project explores the development and implementation of image processing techniques designed to identify objects using images of 320x320 pixel resolution. The image processing is performed on the simple yet effective Raspberry Pi platform. We have designed a method that not only navigates the limitations imposed by the low-resolution images but also ensure high degree of accuracy for object detection, to ensure collision avoidance. The concept of our approach is the integration of a lightweight convolutional neural network tailored for the constraints of edge computing devices. By optimizing the YOLO (You Only Look Once) algorithm, specifically the YOLOv8(nano) variant, for low resolution input, we have managed to achieve real-time object recognition capabilities without the need for high-end computing resources. This optimalization includes evaluation of model parameters, resolutions settings, pruning, performance tradeoffs, ensuring an optimal balance between speed and accuracy. Our project underscores the potential of low-resolution image processing in applications where high-resolution image handling are impractical due to power, size, and temperature constraints. Considering the short duration of the project the significant advancement in object detection accuracy compared to existing systems/techniques, making it particularly relevant for deployment in remote sensing, autonomous navigation and surveillance applications where operational conditions are challenging. The successful implementation of this project on a Raspberry Pi showcases the viability of deploying advanced image processing algorithms on low-cost, low-power hardware platforms. It opens new possibilities for deployment of autonomous systems capable of operating effectively in environments where the available processing power is compromised. Our findings contribute valuable insights into the field of image processing and object recognition, highlighting the importance of algorithmic efficiency and optimalization in the area of edge computing. We show via simulations and on-field experiments the performance of our proposed solution, and propose future directions for work.