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Agricultural Soil Mapping in a Greenhouse using a Moderate Autonomous Conditions

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Introduction

The proposed robot is built around an RGB camera for plant detection and a multispectral camera for extracting the different special bands for processing, as well as an embedded architecture that incorporates an Nvidia Jetson Nano to perform the necessary processing. To manage two parts of the algorithm, our system employs multi-sensor fusion. As a result, the proposed algorithm was built on the CPU-GPU embedded architecture. In a sequential implementation on the embedded architecture, this allows us to process each image in 1.94 seconds. To propose an optimal implementation, we used a Hardware/Software Co-Design study in our implementation [1].

Description

Autonomous systems have demonstrated significant benefits in all fields of technology. These systems range in complexity from high to low, depending on the tasks they are expected to perform. Furthermore, modern robots have undergone a massive revolution in terms of autonomous and performed tasks. More specifically, a revolution in agriculture. These robots can perform tasks ranging from simple to complex, requiring robust algorithms. These robots' successful performance necessitates multi-sensor fusion approaches that include cameras, Light Detection and Ranging, and radar. The goal of these robots in this context is to navigate agricultural fields in order to extract useful information for the production of high-quality agricultural products [2].

There are several solutions proposed for precision agriculture applications. R.P. Devanna et al. 2022 proposed a soil robot-based study for closed agricultural field monitoring. This work is based on a semi-supervised deep learning model for automatically detecting pomegranates. The robot created is a semi-trainer designed to reduce processing time when compared to the other technique created. According to the results, the proposed system received a F score of 86.42% and an IoU score of 97.94%. On the other hand, developed techniques to avoid dynamic and static osabstacles in agricultural fields [3].

Greenhouses are a strong solution for increasing plant yield. These closed greenhouses aid in the control of various crop types in order to improve plant performance. Generally, monitoring is done manually based on the farmers' experience. This results in some decision-making failures, which affect crop productivity and agricultural product yield. As a result, we will concentrate our efforts on the tomato plant. Tomatoes prefer nutrient-rich humus soil that warms up quickly. It is extremely greedy and necessitates constant fertilisation prior to installation and throughout cultivation. As a result, tomatoes require monitoring of vital signs such as water, nitrogen, and vegetation. As a result, we examined the three most commonly used monitoring indices. The indices are the normalised difference red edge index (NDRE), normalised difference red edge index (NDRE), and normalised difference red edge index (NDRE).

Because of these constraints, ground robots are very strong in terms of accuracy and flexibility of applications in open and closed fields such as greenhouses. For this research, we will concentrate on developing a platform that includes a soil robot that moves autonomously to monitor vegetation, water, nitrogen, and various applications such as counting and weed detection. It is also capable of making decisions in real time. This study aims to demonstrate the applicability and utility of our proposed algorithms. In this regard, we created the VSSAgri system (vegetation surveillance system for Precision agriculture application). The goal of this robot is to validate the monitoring algorithms proposed in this paper. The proposed prototype is based on an embedded architecture and battery-powered electrical motors. Similarly, it provides a low-cost alternative to the proposed solution.

However, if we want to build a decision system using a UAV, the weight will increase, reducing flight time. Similarly, UAVs are not adaptable when used for surveillance in enclosed greenhouses. Because of these constraints, ground robots are very strong in terms of accuracy and flexibility of applications in open and closed fields such as greenhouses. For this research, we will concentrate on developing a platform that includes a soil robot that moves autonomously to monitor vegetation, water, nitrogen, and various applications such as counting and weed detection. It is also capable of making decisions in real time. This study aims to demonstrate the applicability and utility of our proposed algorithms. In this context, we created the VSSAgri system [4,5].

Conclusion

The validation of the algorithmic approach is a critical step in testing the algorithm's dependability. We can find a variety of environmental issues that influence the algorithm's operation in real-world scenarios. The development of autonomous robots contributes to the validation and utility of the research approach. In this paper, we propose an autonomous monitoring system for crops in closed greenhouses and open fields. This system provides a map with an image of vegetation, water, and fertiliser information, as well as GPS localization. This technique will improve monitoring precision, allowing us to improve decision systems and reduce the consumption of resources required by the plant for growth. This will increase yield by reducing resource consumption.

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Conflict of Interest

There are no conflicts of interest by author.

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