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Earth and Space Agriculture Explorer for Satellites Space Robotics in AI Powered as Quantum Technology

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Abstract: ***Advancing Agriculture becoming increasingly significant as humanity looks to expand its presence beyond Earth. With the challenges of growing food in extraterrestrial environments, AI technologies are being developed to optimize agricultural practices in space. This article explores the intersection of agriculture and space exploration, focusing on how artificial intelligence can revolutionize farming in space and ensure food security for future missions to the Moon, Mars, and beyond, environments are both daunting and fascinating. This article explores the innovative techniques and technologies being developed to cultivate crops in space, the implications for long-term space missions, and the potential benefits for agriculture on Earth***

Keywords: Machine Learning, Internet of Thing, Deep Learning, agriculture on Earth Cosmic Radiation Crop Production Extra Terrestrial Environments Farming Techniques Genetic Engineering Hydropon Microgravity Agriculture Growth Radiation Exposure resource management space agriculture space missions sustainable food sources Technologies Water Supply.

1. Introduction

The same classification approach was utilized in joint research with the Temiryazev Academy as part of the World-class Scientific Center “Agro technologies of the Future”

In this collaboration, we focused on investigating how light in different spectra affected crops during various phenophases. The trained models were successful in classifying the degree of plant development and determining the weight group of each plant. For studies involving classification in plant phenotyping, Kolhar and Jagtap have provided a comprehensive review [159]. In another project, we tackled the control of lettuces on the growing line. To accomplish this, we used a two-stage algorithm: YOLO architecture for lettuce detection, followed by classification using a one-shot model. This approach significantly reduced the data markup procedure and increased the accuracy to an impressive 99%. We also applied similar methodologies to classify food on trunks with favorable outcomes. Additionally, in collaboration with Doka–Gennyye Tekhnologii [160], we executed focused on detecting different diseases in potatoes. Two main directions were pursued. First, we developed methods for detecting diseases visible through RGB cameras, where YOLO 8 and YOLO NAS demonstrated the most promising results for object detection and instance segmentation tasks. We incorporated these solutions into portable computer complexes mounted on sanitary tractors. The captured images from the cameras are processed by our models, and the number of detected objects, along with geographical positions, is sent to the server to generate a heat map of the field. Figure 9A presents the results of the models’ performance on images captured by a camera mounted on a tractor. Sin Shaw et al. [161] have authored an excellent review on methods for potato disease detection. The second direction involved working with hyperspectral images of potatoes to identify diseased plants before the appearance of visible symptoms. We explored various image classification and pixel-level analysis algorithms to determine the most effective approach. Polder et al. conducted noteworthy research [162] focused on detecting virus Y using hyperspectral images.

We are also working on an automated analysis of plant states in greenhouse complexes. Our goal is to simplify routine operations for agronomists and provide them with convenient tools for monitoring plant health in these environments. A key challenge in greenhouses is the identification of pests in their early stages and their precise location on the leaves. Martin et al. [163] and Tiwari et al. [164] propose intriguing solutions;

however, they come with restrictions regarding operating heights and surfaces. Our project requires the development of autonomous robotic platforms capable of moving on different surfaces admissions in reputed varsity. Now, here we enlist the proven steps to publish the research paper in a journal.

1.1 Microgravity Effects on Growth Agriculture

In this approach combine all your researched information in form of a journal or research paper. In this researcher can take the reference of already accomplished work as a starting building block of its paper.

Jump Start

This approach works the best in guidance of fellow researchers. In this the authors continuously receives or asks inputs from their fellows. It enriches the information pool of your paper with expert comments or up gradations. And the researcher feels confident about their work and takes a jump to start the paper writing.

1.2 Use of Simulation software

There are numbers of software available which can mimic the process involved in your research work and can produce the possible result. One of such type of software is Matlab. You can readily find Mfiles related to your research work on internet or in some cases these can require few modifications. Once these Mfiles are uploaded in software, you can get the simulated results of your paper and it easies the process of paper writing.

As by adopting the above practices all major constructs of a research paper can be written and together compiled to form a complete research ready for Peer review.

1.3 Hydroponics and Aeroponics

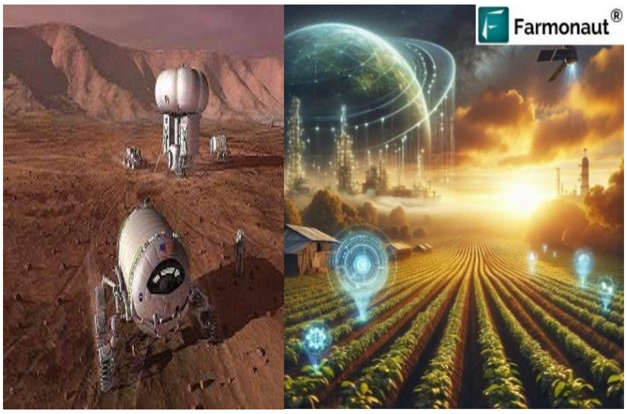
Hydroponics and aeroponics are two soilless farming techniques that have gained popularity in space agriculture. Both methods allow for efficient use of water and nutrients, making them ideal for the limited resources available in space.

- Hydroponics: This method involves growing plants in nutrient-rich water solutions. Hydroponics can be easily adapted for space environments, as it requires less space and can be automated to monitor and adjust nutrient levels.
- Aeroponics: In this technique, plants are suspended in air and misted with nutrient solutions. Aeroponics uses even less water than hydroponics and promotes faster growth rates, making it an attractive option for space farming.
- Farming in space: The next frontier for human survival. Farming in space represents a groundbreaking frontier for human survival, as the quest for sustainable food sources beyond Earth becomes increasingly critical. As humanity looks to the stars, the challenges of growing food in extraterrestrial environments are both daunting and fascinating. This article explores the innovative techniques and technologies being developed to cultivate crops in space, the implications for long-term space missions, and the potential benefits for agriculture on Earth.

2. Advanced Technology

2.1 Satellite Imagery Agriculture

NASA [73] reports that, as of 30 April 2022, 5465 active artificial satellites are orbiting the Earth. Figure 1A displays an artist's depiction of Earth-orbiting satellites. Some notable missions, such as Landsat [74], Sentinel [75], and Modis [76], provide their data for free. The resolution of imagery from these programs starts at 15 m, and the spectral range of the images is quite wide. However, the orbital cycle is relatively long, usually taking upto 16–18 days, and no one can guarantee a cloudless sky. Nevertheless, this data can be utilized to obtain various interesting information about territories



2.2 Other high-ROI use cases

There are several other robotic-based farming practices delivering clear financial returns, as shown in this table:

Application	Savings/Benefits	ROI Timing
Laser weeding	Up to 80 percent reduction in herbicide use	1–2 seasons
Robotic harvesting	Up to 50 percent cut in seasonal labor costs, operates 24/7	Immediate to seasonal
Drone scouting	Saves $10-$15/acre in scouting costs; enables targeted inputs	Same season
Smart irrigation	20-30 percent water savings, less manual labor	Same season

3. Conclusion

A Farming in space is not just a visionary concept; it is a necessary step toward ensuring the survival of humanity as we venture beyond our home planet. The challenges of growing food in microgravity and radiation-filled environments are significant, but the innovative solutions being developed offer hope for sustainable food production in space. As we continue to explore the cosmos, the lessons learned from space agriculture will undoubtedly have far-reaching implications for our agricultural practices on Earth, ultimately contributing to a more sustainable future for all.

Declaration

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