Smart Parking System Using Heuristic Optimization For Autonomous Transportation Robots In Agriculture

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Summary

This work develops a heuristic assignment technique called Smart Parking. Smart Parking is used for allocating parking spaces to autonomous transportation robots that assist fruit pickers working in such farms. The Smart Parking algorithm developed is put to test in a simulation software. It is also integrated with a robot controller called RASberry, which is a cutting-edge research project for running an entirely automated strawberry farm. The robots utilised for autonomous transportation in the RASberry project and the real-world trials in this study are Thorvald by Saga Robotics. To monitor and evaluate the effectiveness of Smart Parking, a number of real-world tests are carried out using the RASberry-Thorvald system. Smart Parking performs better than Standard Parking in terms of mechanical conservation and task completion time, as shown by graphical trend lines and statistical tests.

Introduction

The number of robots a human can control at once, along with the robotic system's performance of the necessary sensory-motor coordination on the ground, will help motivate the coexistence of human supervisors and robot agents in such a paradigm [1]. This paper aims to facilitate and optimise the use of autonomous transportation robots that operate in a parallel aisle or poly-tunnel environment. A typical commercial berry farm is spread across quite a few hectares and has over hundreds of rows and tens of pickers operating on a daily basis [2]. The importance of this contribution is due to the huge scale of area at which commercial horticulture and berry farms operate.

Context and Problem Statement

This problem statement is fundamentally a dynamic assignment problem where a number of robots must be instantly assigned to a variety of jobs.

The highlights of this research are as follows:

- Creating a heuristic algorithm (Smart Parking) to dynamically assign parking places to a multi-robot system changing with the transient locations of fruit pickers.
- Integrating the RASberry controller with Smart Parking and testing the system in a real-world setting.
- Comparing the performance of Smart Parking versus Standard Parking, which involves employing fixed, unchanging parking places using a simulation software.

Sub-Heading/References

[1] C Duckett, T., Pearson, S., Blackmore, S., Grieve, B., Chen, W., Cielniak, G., Cleaversmith, J., Dai, J., Davis, S., Fox, C. & Others Agricultural robotics: the future of robotic agriculture. ArXiv Preprint ArXiv:1806.06762. (2018)

[2] Cheshire, L. Dyson Farming extends UK strawberry season. Fruitnet. (2021,3), https://www.fruitnet.com/fresh-produce-journal/dyson-farming-extends- uk-strawberry-season/

Collaborators

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Methodology

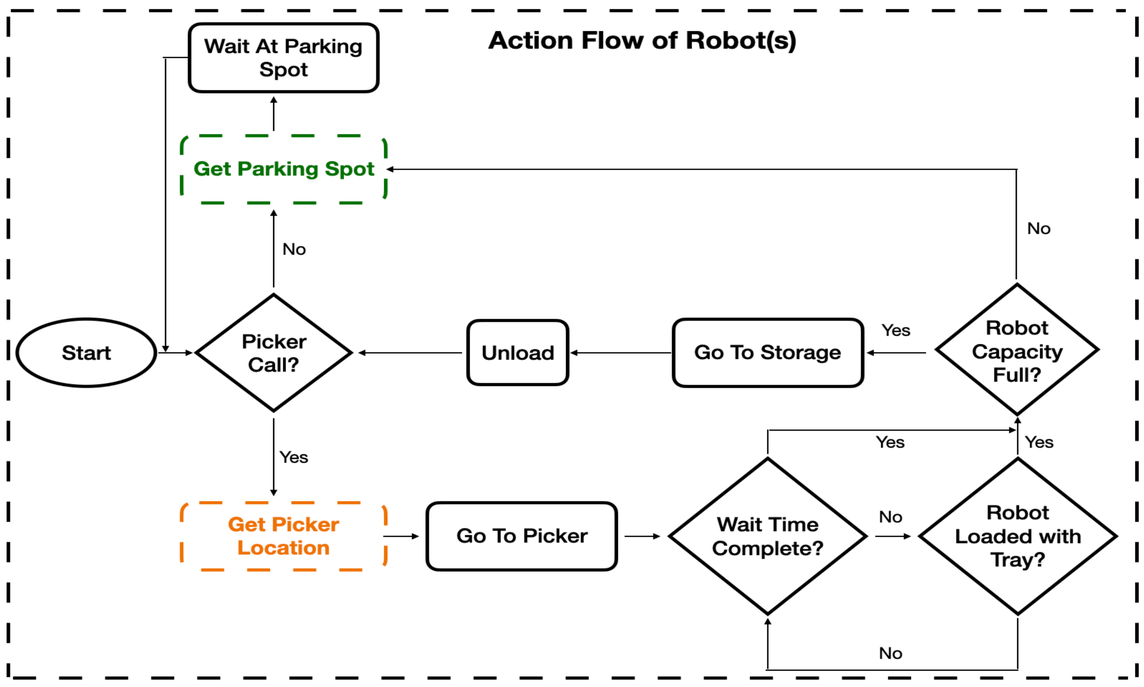

Fig 1: Action Flow Diagram of the Robot(s)

Experiments

Fig 2: Images from the real world experiments

Smart Parking Algorithm is integrated with the RASberry-Throvald controller and the performance is tested out at a strawberry farm with actual human pickers for some scenarios. More test scenarios are implemented and studied using a simulation software of the same built using Python.

Results and Conclusion

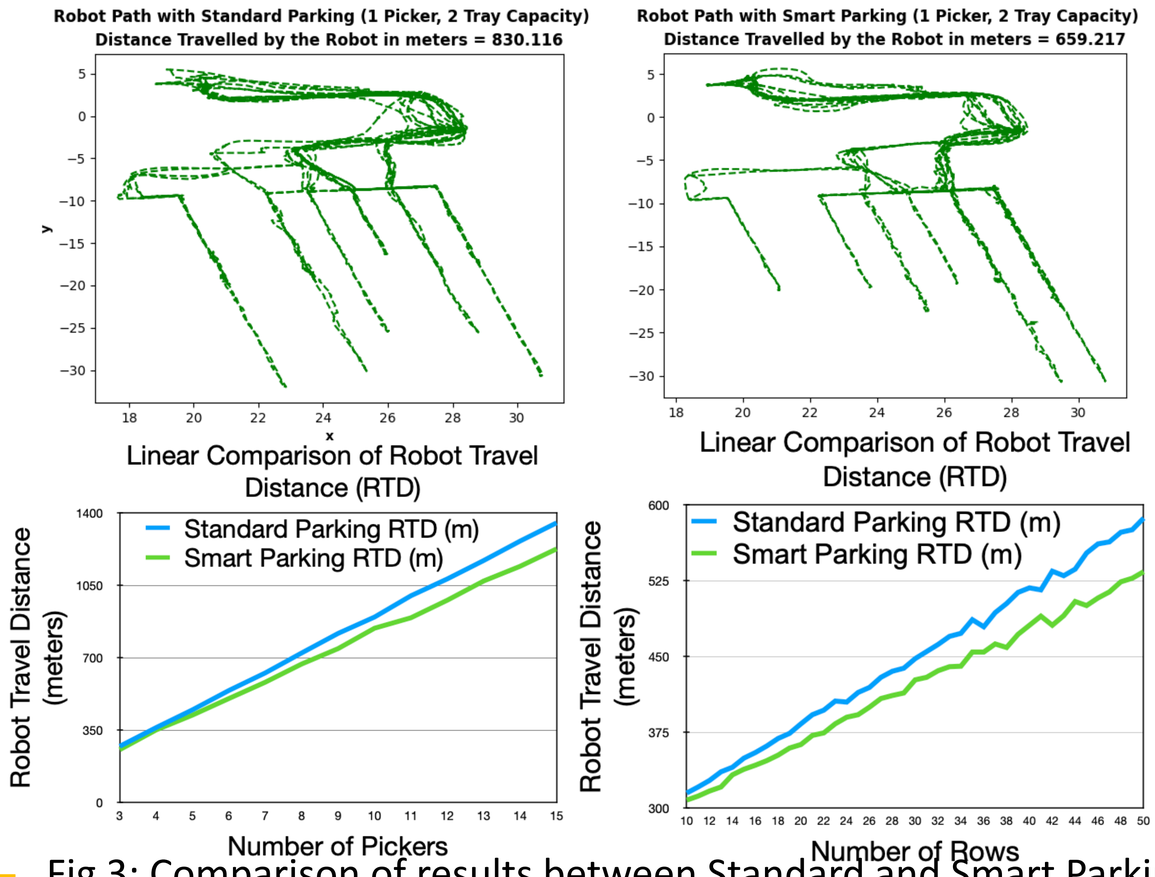

Fig 3: Comparison of results between Standard and Smart Parking

There is approximately 12% decrease of robot travel distance while using Smart Parking thereby causing conservation of mechanical and power consumption of Robot Resources.