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Advancements and Challenges in Mobile Robot Navigation: A Comprehensive Review of Algorithms and Potential for Self-Learning Approaches

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Abstract
Mobile robot navigation has been a very popular topic of practice among researchers since a while. With the goal of enhancing the autonomy in mobile robot navigation, numerous algorithms (traditional AI-based, swarm intelligence-based, self-learning-based) have been built and implemented independently, and also in blended manners. Nevertheless, the problem of efficient autonomous robot navigation persists in multiple degrees due to the limitation of these algorithms. The lack of knowledge on the implemented techniques and their shortcomings act as a hindrance to further development on this topic. This is why an extensive study on the previously implemented algorithms, their applicability, their weaknesses as well as their potential needs to be conducted in order to assess how to improve mobile robot navigation performance. In this review paper, a comprehensive review of mobile robot navigation algorithms has been conducted. The findings suggest that, even though the self-learning algorithms require huge amounts of training data and have the possibility of learning erroneous behavior, they possess huge potential to overcome challenges rarely addressed by the other traditional algorithms. The findings also insinuate that in the domain of machine learning-based algorithms, integration of knowledge representation with a neuro-symbolic approach has the capacity to improve the accuracy and performance of self-robot navigation training by a significant margin. © The Author(s) 2024.

Author Keywords
Advancement; Challenges; Mobile robot; Navigation; Self-learning

Index Keywords
Adversarial machine learning, Contrastive Learning, Federated learning, Knowledge representation, Microrobots, Mobile robots, Robot learning, Self-supervised learning, Swarm intelligence; Advancement, Autonomous robot navigation, Challenge, Further development, Learning approach, Mobile Robot Navigation, Navigation performance, Potential needs, Review papers, Self-learning

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