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Performance Analysis of Autonomous Mobile Robot Navigation Using ArUco Markers

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Recent efforts have been ongoing to utilize mobile robots for safety management at construction sites. Autonomous driving is essential to address crucial challenges in introducing mobile robots to construction sites. In this study, to apply mobile robots to construction sites with high variability, we propose a method that enhances the usefulness and accuracy of robot navigation by utilizing Aruco markers in conjunction with the conventional Gmapping. To compare the performance of autonomous driving using the proposed method and Gmapping-based navigation, we aim to compare the stability of the proposed method with that of the conventional method by autonomously driving in the same space using the map created based on Gmapping, as shown in Figure 1. Fundamentally, the position of the mobile robot is estimated using odometry values, which serve as the basis for autonomous driving. Additionally, in this study, we intend to enhance the stability of autonomous driving by utilizing the relative coordinates between Aruco markers and the mobile robot as additional topic values. For comparison between autonomous driving using only Gmapping and using the proposed method, tracking was conducted by driving through a narrow and long corridor in a corridor-shaped building from the same position. As depicted in Figures 2, 3. autonomous driving utilizing the proposed method demonstrated stability when transitioning from the corridor to different spaces. Based on this, we anticipate that stable autonomous driving is achievable in construction sites with variability. Conventional autonomous driving relies on the odometry values of the mobile robot, which can lead to critical issues such as slippage or collisions with walls, where the wheels may rotate but the actual body does not move. However, experiments conducted by combining Aruco markers with Gmapping to compensate for this revealed that the position of the mobile robot could be determined by utilizing both the wheel rotation values and additional topic values obtained from the relative coordinates between Aruco markers and the mobile robot. Therefore, we believe that by providing greater stability, the proposed method can enable autonomous driving with higher stability at construction sites, even in the presence of map changes.

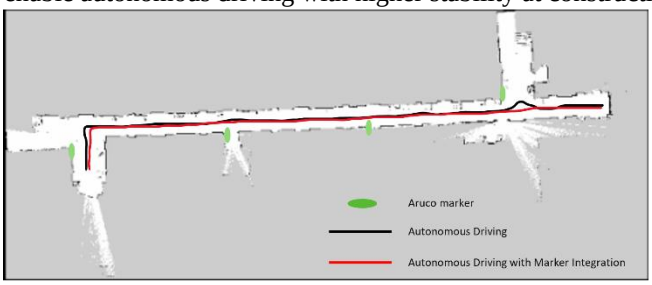

Figure 1. Autonomous Driving Comparison


Figure 2. Intersection of hallways(1)

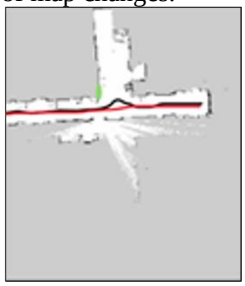
Figure 3. Intersection of hallways(2)

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