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Mobile Robot Localization Performance with Integrated Multi-Sensor Fusion and UWB Technology

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***Abstract*— This study integrates IMU, odometry, and UWB positioning to enhance robot position estimation. An Extended Kalman Filter improves position accuracy, and an algorithm fuses sensor data with UWB information. Simulation results in ROS-Gazebo show enhanced position estimation compared to using UWB alone, enabling its utilization in shipyard welding. Future work involves implementing the algorithm on actual robots for navigation in shipyards.**

Keywords—Localization, UWB system, Sensor fusion

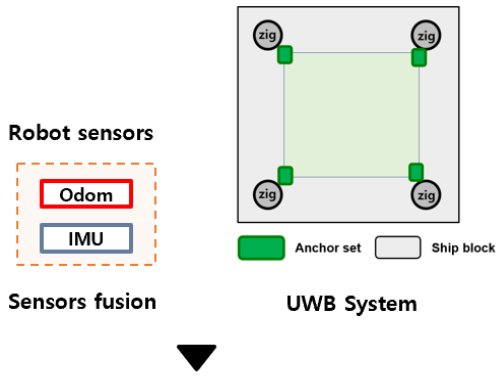
I. INTRODUCTION

In shipbuilding, welding operations on the underside of ship blocks are essential, yet automation is imperative due to the cumulative fatigue experienced by workers from welding postures. Autonomous driving technology for mobile robot platforms is a crucial element for welding automation. However, obtaining GPS information or Land Marks for robot localization is challenging when large blocks are positioned overhead. To address this challenge, this study investigates enhancing the accuracy of robot position estimation by integrating IMU sensors and odometry information, as well as combining UWB positioning technology to improve the accuracy of robot position estimation [1, 2].

II. METHOD

To improve the accuracy of position estimation in the global coordinate system of the workspace, an Extended Kalman Filter (EKF) was applied to IMU sensors and the robot's odometry information. Additionally, an algorithm was proposed to fuse the position estimated by the robot's own sensors with the position information provided by the UWB positioning system to enhance the accuracy of the robot's position estimation. The robot kinematics considered modified UWB-based position estimation results were transformed to the global coordinate system of the workspace to guide the robot through the designated welding operation area. Through the application of the proposed algorithm in the ROS-Gazebo environment, it was observed that the robot's position estimation results were improved compared to using the UWB system alone.

(a) Ship block



(b) System configuration

Figure 1. Integrated Multi-Sensor Fusion and UWB Technology

III. CONCLUSION

In this study, a method for improving the accuracy of robot position estimation in challenging environment was proposed. An algorithm was developed to enhance the accuracy of UWB-based positioning systems, enabling their utilization in welding operations on ship block undersides. The feasibility of this algorithm was verified through ROS simulations. Future research will involve implementing the proposed algorithm on actual robots for navigation in shipyard environments.

REFERENCES

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