ABSTRAK

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Program Studi	:	Teknik Elektro
Judul	:	Implementasi Metode *Artificial Potential Field* dan *PID* Kontrol Pada *Mobile Robot Omni Wheels.*

Penelitian ini membahas implementasi metode *Artificial Potential Field* (APF) dan *PID* kontrol pada *mobile* robot *omni-wheel* untuk navigasi menuju target serta menghindari rintangan (*obstacle avoidance*) secara *real-time*. Robot *omni-wheel* memiliki kemampuan gerak holonomik, namun memerlukan sistem kontrol yang presisi agar dapat bergerak secara akurat. Metode APF digunakan untuk menentukan arah gerak berdasarkan gaya tarik dan tolak, sedangkan PID kontrol mengatur kecepatan motor berdasarkan umpan balik *encoder*. Sistem diimplementasikan menggunakan mikrokontroler ESP32, sensor ultrasonik, dan *rotary encoder*. Hasil pengujian menunjukkan bahwa integrasi APF dan PID meningkatkan kinerja sistem dibandingkan APF murni. Rata-rata *error* posisi pada APF murni berada pada rentang 2,33%–4,62%, sedangkan pada APF dan PID menurun menjadi 1,27%–2,74%. Dari sisi waktu tempuh, sistem juga menunjukkan peningkatan performa, di mana waktu menuju target (1,5; 0) berkurang dari 4,67 detik menjadi 3,54 detik, serta pada kondisi kompleks dengan rintangan dari 16,59 detik menjadi 9,08 detik. Dengan demikian, integrasi APF dan PID terbukti mampu meningkatkan akurasi dan efisiensi navigasi *mobile* robot *omni-wheel*.

Kata Kunci: *Artificial Potential Field* (APF), PID Kontrol, *Mobile* Robot, *Omni Wheel*, *Obstacle Avoidance*.

ABSTRACT

Name	:	Fizar Maulana
Study Program	:	Electrical Engineering
Judul	:	Implementation of Artificial Potential Field Method and PID Control for an Omni-Wheel Mobile Robot

This study presents the implementation of the Artificial Potential Field (APF) method and PID control on an omni-wheel mobile robot for real-time target navigation and obstacle avoidance. Omni-wheel robots offer holonomic motion capabilities, however, precise control is required to ensure accurate movement. The APF method is utilized to generate motion direction based on attractive and repulsive forces, while the PID controller regulates motor speed using encoder feedback. The system is implemented using an ESP32 microcontroller, ultrasonic sensors, and rotary encoders. Experimental results show that the integration of APF and PID improves system performance compared to the standalone APF method. The average position error of the APF method ranges from 2.33%–4.62%, while the integrated APF–PID approach reduces it to 1.27%–2.74%. In terms of travel time, performance is also enhanced, where the time to reach the target (1.5, 0) decreases from 4.67 seconds to 3.54 seconds, and under complex conditions with obstacles, it is reduced from 16.59 seconds to 9.08 seconds. Therefore, the integration of APF and PID control is proven to improve the accuracy and efficiency of omni-wheel mobile robot navigation.

Keywords: Artificial Potential Field (APF), PID Control, Mobile Robot, Omni Wheel, Obstacle Avoidance.