

RANCANG BANGUN ROBOT *TRAINING* PELONTAR BOLA PINGPONG BERBASIS MIKROKONTROLER

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Abstrak

Penelitian ini bertujuan untuk merancang dan membangun robot *training* pelontar bola pingpong berbasis mikrokontroler ESP32 yang dapat dikendalikan secara nirkabel menggunakan *joystick* melalui komunikasi *Bluetooth*. Sistem memiliki dua mode operasi, yaitu manual dan otomatis dengan empat tingkat latihan, serta dilengkapi *encoder* untuk membaca kecepatan motor (RPM) dan sensor *infrared* untuk menghitung jumlah bola. Metode penelitian meliputi perancangan, implementasi perangkat keras dan perangkat lunak, serta pengujian kinerja alat yang mencakup kecepatan motor, respon kendali, akurasi sensor, jarak dan kecepatan pelontaran, serta konektivitas *Bluetooth*. Hasil pengujian menunjukkan motor mampu mencapai ± 4900 RPM. Kecepatan bola pada 3000 RPM sebesar 5,31 m/s (jarak-tinggi) dan 5,62 m/s (waktu), pada 4000 RPM sebesar 6,42 m/s dan 6,50 m/s, serta pada 4900 RPM sebesar 8,12 m/s dan 8,23 m/s, dengan selisih terkecil pada 4000 RPM. Jarak pelontaran berkisar 1,3–2 meter. Sistem *Bluetooth* memiliki waktu respon sekitar 1 detik, waktu koneksi rata-rata 2,21 detik (sistem) dan 3,26 detik (*stopwatch*), serta jangkauan efektif hingga 7 meter. Sensor *infrared* memiliki akurasi 98,5%. Dengan demikian, robot pelontar bola pingpong yang dirancang mampu berfungsi sebagai alat bantu latihan yang fleksibel dan interaktif. Namun, masih diperlukan pengembangan lebih lanjut untuk meningkatkan kestabilan sistem dan konsistensi pelontaran.

Kata kunci: Pelontar Bola Pingpong, ESP32, *Joystick*, *Bluetooth*.

DESIGN AND CONSTRUCTION OF A MICROCONTROLLER-BASED PING PONG BALL LAUNCHER TRAINING ROBOT

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Abstract

This study aims to design and build a ping pong ball launcher training robot based on the ESP32 microcontroller that can be controlled wirelessly using a joystick via Bluetooth communication. The system has two operating modes manual and automatic with four training levels, and is equipped with an encoder to measure motor speed (RPM) and an infrared sensor to count the number of balls. The research methods include design, hardware and software implementation, and performance testing of the device, covering motor speed, control response, sensor accuracy, launch distance and speed, and Bluetooth connectivity. Test results show that the motor can reach ± 4900 RPM. The ball speed at 3000 RPM was 5.31 m/s (distance-height) and 5.62 m/s (time), at 4000 RPM were 6.42 m/s and 6.50 m/s, and at 4900 RPM were 8.12 m/s and 8.23 m/s, with the smallest difference observed at 4000 RPM. The launch distance ranges from 1.3 to 2 meters. The Bluetooth system has a response time of approximately 1 second, an average connection time of 2.21 seconds (system) and 3.26 seconds (stopwatch), and an effective range of up to 7 meters. The infrared sensor has an accuracy of 98.5%. Thus, the designed ping-pong ball launcher robot is capable of functioning as a flexible and interactive training aid. However, further development is still needed to improve system stability and launch consistency.

Keywords: Ping Pong Ball Launcher, ESP32, Joystick, Bluetooth.