Stabilization and Control of an Inverted Pendulum System Using a Microcontroller and Voice Control

Nuno Santos[3,5], **António Anjos**[4], **José Lourenço da Saúde**[3] **and Mouhaydine Tlemçani**[1,2,5]

[1]*Department of Mechatronics Engineering, University of Évora, Portugal*
[2]*Instrumentation and Control Laboratory, Institute of Earth Sciences, Portugal*
[3]*Chair Aerospace and Technology Sciences, Portugal*
[4]*NOVA LINCS, University of Évora, Portugal*
[5]*ICT–Earthsciences Institute, University of Évora, Portugal*

Corresponding/Presenting author: nuno.santos@uevora.pt

Talk Abstract

Balancing an inverted pendulum is a challenging task and a classic problem in control theory [1],[2],[3]. Such a system is characterized by its unstability and nonlinearity that requires precise instrumentation and control algorithms [4]. In this work, we present the design and implementation of a stabilized inverted pendulum system using an ESP32 embedded system, a MPU6050 gyroscope, and a PID controller. The MPU6050 gyroscope is used to measure the tilt angle of the pendulum, providing feedback to the control system. The PID gains (Kp, Ki, and Kd) are tuned using a trial and error approach, taking into account factors such as rise time, settling time, overshoot, and steady-state error. The ESP32 embedded system is chosen as the main controller due to its powerful processing capabilities, built-in Wi-Fi and Bluetooth connectivity, and support for various peripherals. The performance of the stabilized inverted pendulum system is evaluated based on its ability to maintain the pendulum's upright position under various conditions, such as external disturbances and changes in the pendulum's parameters. The integration of voice control adds a unique and user-friendly aspect to the system, allowing for intuitive interaction and control of the inverted pendulum.

Keywords: Self-Balancing Robot, Control Theory, Microcontrollers, PID Controller.

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