EMBEDDED SYSTEMS WORKSHOP (EC3.202,MONSOON 2023)

PID CONTROL OF DC MOTOR

Team 33

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August 2023

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1 Motivation

We use PID control for motors to address challenges such as load variations, mechanical inefficiencies, voltage fluctuations, inaccurate sensors, and environmental factors that can lead to deviations from the desired RPM. By combining proportional, integral, and derivative components, PID control helps quickly respond to error changes, eliminate steady-state errors, and dampen oscillations, ensuring precise and stable motor speed regulation under varying conditions.

The project aims to provide a hands-on demonstration of feedback control principles using a DC motor controlled by an Arduino. By showcasing various feedback control laws, the project offers a practical understanding of how systems can automatically adjust their behavior to achieve desired outcomes.

2 Implementation of the project

The implementation of the project involves setting up a DC motor controlled by an ESP32, along with an RPM sensor attached to the motor shaft. The RPM sensor will detect the RPM and convey it to ESP32, which will perform PID calculations to calculate the error, and give feedback to the motor, to correct the error and minimize the difference between the desired RPM and obtained RPM. Data analysis will be done to identify optimum values to perform PID, and IoT will be implemented to visualize the same.

3 Components Required

- DC motor
- Motor driver IC
- Encoders (to sense the RPM of the motor)
- Wheels
- ESP32
- Transistor
- Resistors
- Connecting Wires and Jumper wired
- Breadboard

4 Data Analysis

- Defining performance criteria and setpoints of the system, calculating PID values for different situations and different expected RPMs.
- Observing Expected speed vs. Obtained speed
- Tweaking the values of proportional, integral, and derivative used, depending on the analyzed data to find the optimum values

5 Task Timeline

Getting a basic layout and approach to the project by mid-September, Designing the circuit, and implementing simple PID within 2-3 weeks of receiving components. Conducting Data analysis and improving PID values, to optimize motor control in the next 2 weeks. Setting up IoT for the project, plotting real-time graphs for various parameters, and allowing user to control expected RPM before final submission

6 Summary

The project highlights why one needs to use PID control for motors, the project will apply feedback control principles to showcase the ability of systems to automatically adjust their behaviors to read desired outcomes, we will study outcomes for various scenarios and build IoT based UI to observe the same.