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Controlling BLDC Motor using PID for single axis Drone

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INTRODUCTION

- The most widely used control algorithm in industry is proportional-integral-derivative (PID) control, which has gained widespread acceptance in industrial control. PID controllers are widely used because of their ability to function reliably under a variety of operating situations and because of their ease of use, which makes it simple for engineers to run them.

- This control strategy regulates the BLDC motor's speed by continuously adjusting the input voltage based on feedback from sensors, ensuring that the drone responds accurately to user commands and external disturbances. In this article, we explore the fundamentals of PID control for BLDC motors in drone applications, focusing on its role in stabilizing one-axis mechanisms for smooth and controlled flight.

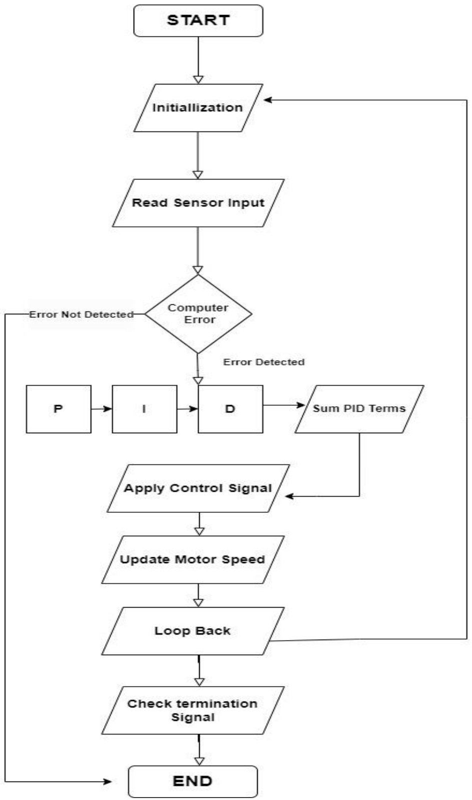
Objective and Aims

- To understand how the PID Works inside the drone.
- To interface the two BLDC motor with ESC and Two ESC with Microcontroller.
- To interface the MPU6050 with Microcontroller. The MPU6050 acts a sensor
- To assemble the above connections and gives signal to the controller to control the movement of the BLDC motor.controls the motor with the help of PID
- To Ensure stable and precise control of the BLDC motor to maintain the drone's stability during flight.

METHODOLOGY

1. **System Identification:** Understand the dynamics of your BLDC motor and the physical characteristics of your drone. This includes parameters such as motor response time, inertia of the drone, and any external disturbances like wind.
2. **Feedback from Sensor:** Determines the speed and angle using gyroscope of the BLDC motors and returns the feedback to the controller
3. **PID Tuning:** Choose appropriate PID gains (Proportional, Integral, and Derivative),it calculates the PID value based on the difference between the desired angle and the actual angle, which further adjusts the speed of the motor, to obtain balance.

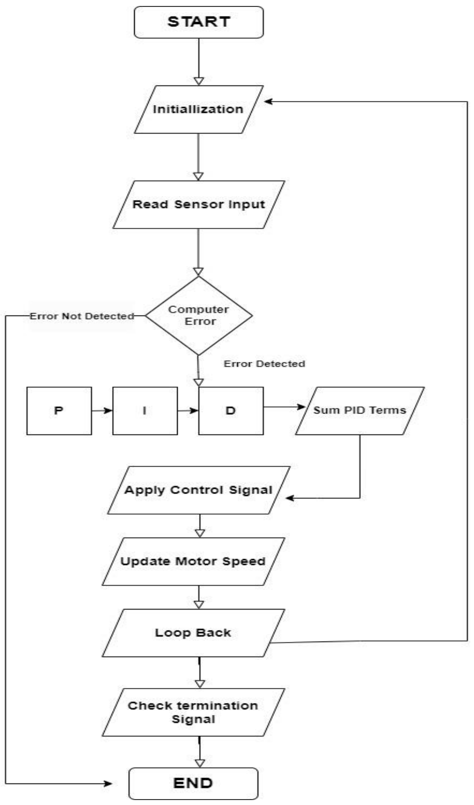
Flowchart



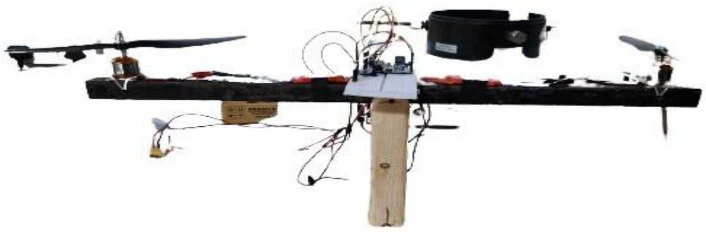
METHODOLOGY

1. **Feedback Signal Processing:** Process the feedback signal to obtain useful information about the motor's current state, such as speed or position.
2. **Controller Implementation:** Further we Implement the PID values through ESC to achieve the desired speed and angle, to maintain balance of the single axis drone.
3. **Testing and Calibration:** Test the system in a controlled environment, such as a test bench or a simulator, and calibrate the PID gains based on the performance. This may involve adjusting the gains to optimize stability, response time, and robustness to disturbances.

Flowchart



Result



1. System Identification: Understood the dynamics of BLDC motor and the drone's single axis. This includes determining the motor's response to various inputs and its transfer function.
2. Understood PID Controller Design:
   - Proportional (P) Term: A response to the current error. Adjusting its gain to control the response speed.
   - Integral (I) Term: This term integrates the error over time, helping to eliminate steady-state error. Tune it to correct any bias in the system.
   - Derivative (D) Term: This term predicts future error based on its rate of change. Use it to dampen the system's response and reduce overshoot.

Result

Conclusion & Future Scope

- This project serves as a stepping stone for further exploration of drone flight control systems and PID control applications.
- Calibrating brushless motors is essential for smooth and efficient drone operation.
- PID control is a powerful technique for regulating systems to a desired state.
- We have implemented this project on one axis to understand how PID works in Drone further for future scope we can use it for two axis i.e in drone.

Reference

- https://youtu.be/AN3yxIBAxTA?si=mKJcKmsoUCriF1KP
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- https://github.com/Rahulb2668/PID-Controller-on-BLDC-Motor/blob/master/PID_balance_arduino.ino

THANK YOU