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SYNOPSIS ON

SMOOTH SLOPE CONTROLLER

Using PID Control system for Precise Inclination control

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INTRODUCTION

Drones/quadcopters are becoming increasingly popular for various applications such as aerial photography, surveillance, and delivery services. However, maintaining stability and control of these unmanned aerial vehicles (UAVs) can be challenging, especially in changing environments.

One of the critical parameters affecting the stability and control of UAVs is the inclination angle or slope. Even a slight deviation from the horizontal plane can lead to instability and loss of control, which can result in crashes and damage to the UAV. Traditional methods for controlling the inclination angle of UAVs involve manual adjustment or the use of basic control systems that may not be precise enough to handle external disturbances. The proposed smooth slope controller using a PID control system aims to address these limitations and provide a more accurate and stable solution for controlling the inclination angle.

The PID control system is a widely used method for controlling various processes and systems, including UAVs. It uses feedback to adjust the control input based on the error between the desired output and the actual output. The Proportional, Integral, and Derivative terms of the control system work together to minimize the error and maintain stability.

The smooth slope controller can have applications in various fields, including aerial photography, agriculture, search and rescue, and inspection services. It can also be used in other industries where precise inclination control is required, such as construction and mining.

ORIGIN OF THE RESEARCH PROBLEM

The traditional method of controlling the slope or inclination of a drone/quadcopter is through manual control or using basic control systems such as proportional control systems. These methods are not precise enough to achieve stable and predictable flight, leading to unstable and unpredictable behavior. This research aims to modify the traditional method by using a PID control system to achieve precise and smooth inclination control.

The traditional control methods for controlling the slope of UAVs are not suitable for outdoor environments where external disturbances such as wind and turbulence can cause significant changes in the inclination angle. These disturbances can lead to unstable flight and poor control of the UAV. The use of a PID control system for inclination control has been studied extensively in literature, and several researchers have proposed different algorithms and methods for implementation.

However, there is still a need for a robust and reliable controller that can handle external disturbances and provide precise control of the inclination angle. This research is motivated by the need for a more precise and stable method of controlling the inclination angle of UAVs, which can be used in a wide range of applications such as aerial photography, surveillance, and delivery services.

The use of PID control systems has been successful in various applications, including industrial processes, robotics, and automotive systems. However, implementing a PID control system for UAVs requires specific considerations, such as the weight and size of the UAV, the dynamics of the system, and the external disturbances that may affect the performance of the controller. The research aims to overcome the limitations of traditional control methods and develop a smooth slope controller that can provide stable and predictable flight of UAVs in outdoor environments. This controller can be applied in various fields, including agriculture, inspection services, and search and rescue operations.

- **INTERDISCIPLINARY RELEVANCE**

The smooth slope controller is an interdisciplinary project that combines knowledge and expertise from both mechanical and electrical engineering fields. The mechanical engineering aspects of the project involve the design and construction of the UAV and its mechanical components, while the electrical engineering aspects involve the design and implementation of the PID control system.

The project has relevance in the aerospace industry, where precise control of the inclination angle is critical for stable and safe flight of UAVs. The smooth slope controller can be used to improve the performance of UAVs in various applications such as surveillance, inspection, and cargo delivery.

The project has relevance in the robotics industry, where inclination control is essential for the stability and mobility of robots. The smooth slope controller can be used to improve the performance of robots in various applications such as manufacturing, warehouse operations, and hazardous environment exploration.

- **REVIEW OF RESEARCH AND DEVELOPMENT IN THE SUBJECT**

Previous research has focused on using various algorithms and control systems for drone/quadcopter control. However, the PID control system is a widely used and effective control system for precise control of such systems. The literature review should also include information on the most recent and relevant research in the field and how the proposed project is different and innovative. Recent research has shown that using machine learning algorithms in combination with PID control can lead to even more precise and robust control of drones and quadcopters.

Some researchers have investigated the use of fuzzy logic control in place of PID control, but this approach has not yet been widely adopted in the industry.

One challenge in drone and quadcopter control is dealing with external disturbances such as wind and turbulence. Some researchers have proposed using adaptive control systems to account for these disturbances. The proposed project is innovative because it focuses on controlling the slope or inclination of the drone/quadcopter with respect to the ground, which is a less explored area of research compared to controlling other aspects such as altitude and position.

- **CURRENT SYSTEM AND ITS LIMITATIONS**

The current methods used for controlling the slope of a drone/quadcopter are not accurate enough to achieve precise control, leading to instability and unpredictable behavior The current methods for controlling the slope of a drone/quadcopter typically rely on measuring the pitch angle using an accelerometer or gyroscope, and then adjusting the motor speeds to maintain a desired pitch angle.

However, these sensors are not always accurate and can be affected by external factors such as vibrations, which can lead to errors in the pitch angle measurement. Another limitation of the current system is that it does not take into account external disturbances such as wind and turbulence, which can cause the drone/quadcopter to tilt and lose control.

The current system also does not account for changes in the center of mass of the drone/quadcopter, which can occur due to payload changes or battery depletion, leading to further inaccuracies in the control of the slope. In addition, the current methods do not provide a way to correct for errors in the control of the slope, leading to instability and unpredictable behavior.

Overall, the limitations of the current system highlight the need for a more precise and robust control system, such as the proposed PID controller for controlling the slope of the drone/quadcopter.

- **OBJECTIVE**

1. The objective of the project is to design and implement a smooth slope controller using a PID control system for precise inclination control of a drone/quadcopter.

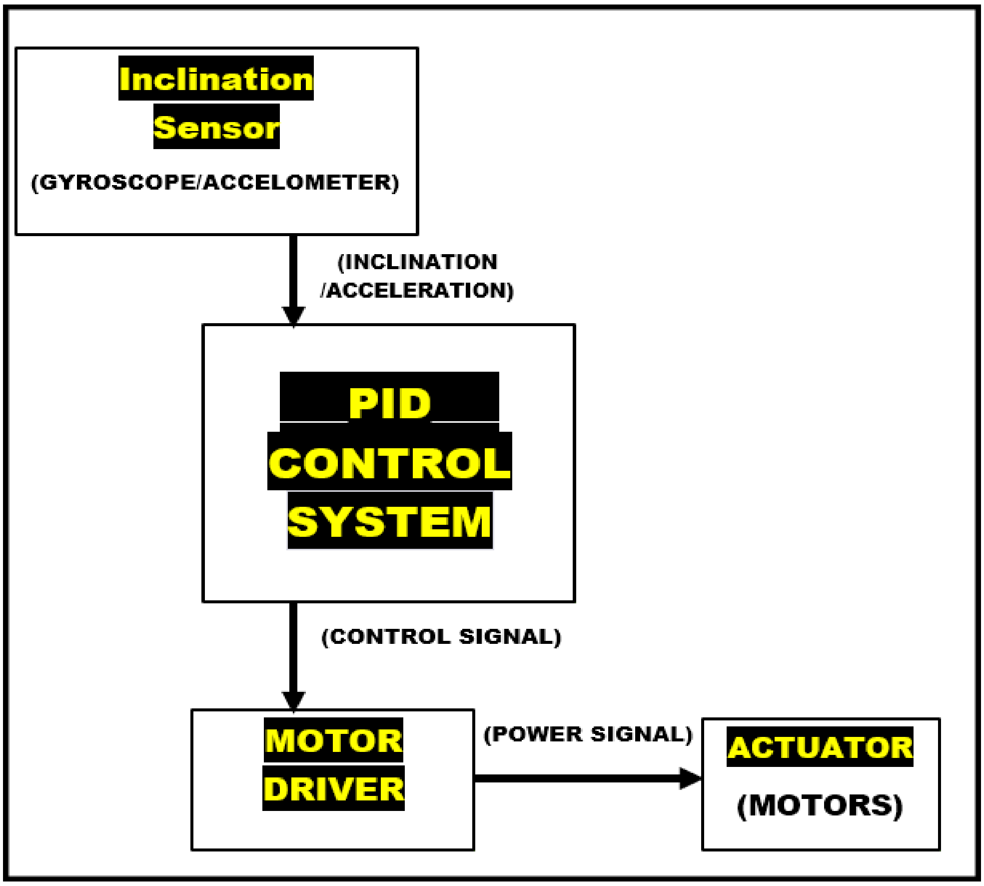
2. The project aims to provide a more accurate and robust control system for controlling the slope of a drone/quadcopter, which will improve its stability and reliability.

3. The project aims to implement the PID control system on a physical drone/quadcopter and demonstrate its effectiveness in achieving precise control of the slope.

- **METHODOLOGY**

The mpu(accelometer gyrometer) senses the g and the inclination Angle of the axis this data is sent using i2c to the microcontroller where it is processed and actual error of inclination is calculated and sent to the PID algorithm where it is compensated by providing desired inputs to the actuators(BLDC)

- **BLOCK DIRAGRAM**



- **WORKING**

The gyroscope/accelometere measures the inclination/ acceleration of the drone, which is sent to the PID control system. The PID control system then computes a control signal based on the difference between the desired inclination angle (zero degrees) and the measured angle. The control signal is then sent to the motor driver, which provides power to the motors to adjust the inclination angle of the drone

Inclination Sensor: This block represents the sensor that measures the inclination angle of the drone with respect to the ground. The sensor used can be an accelerometer, gyroscope, or a combination of both.

PID Controller: This block represents the PID controller used to regulate the inclination angle of the drone. The PID controller receives the inclination angle signal from the inclination sensor and generates an error signal by comparing it with the desired angle of 0 degrees. The PID controller then calculates the appropriate correction signal to be sent to the actuator.

Actuator: This block represents the motor or servo that adjusts the inclination angle of the drone. The actuator receives the correction signal generated by the PID controller and adjusts the inclination angle of the drone accordingly.

Microcontroller: This block represents the microcontroller that interfaces with the inclination sensor, PID controller, and actuator. The microcontroller receives the inclination angle signal from the sensor and processes it using the PID controller algorithm. It then sends the correction signal to the actuator to adjust the inclination angle of the drone.

Overall, this block diagram represents a closed-loop control system that regulates the inclination angle of the drone to a desired set point using a PID controller. The system continuously measures the inclination angle using the sensor, calculates the error signal using the PID controller, and sends the correction signal to the actuator to adjust the drone's inclination angle.

- **COMPONENTS -**

Microcontroller

BLDC (Brush less DC) motor

Propellers

ESC (electronic speed controllers)

MPU 6050 gyroscope and accelerometer

LIPO (lithium polymer) battery

Prototype structure

- **FINANCIAL ASSISTANCE REQUIRED**

All overall tentative cost of the project is around 8000Rs Financial assistance is required for purchasing the necessary hardware components such as sensors, motors, and electronic control systems, as well as for the fabrication and testing of the prototype. The project can be funded through college grants or by seeking external funding from investors or funders who are interested in the field of drone/quadcopter technology. The financial assistance is essential for the successful completion of the project