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**Report: Overview of the Integrated Embedded System Code of Drone Maneuvering**

This report provides an overview of the integrated embedded system code designed to simulate drone control system. This prototype may serve as a baseline/foundation as to how computer operating systems in high-flight aircraft may operate at the very minimum. The system includes features such as sensor fusion with a Kalman filter, adaptive PID control, dynamic path planning with obstacle avoidance, predictive maintenance, safety monitoring, multi-agent coordination, and enhanced communication protocols. The code is structured to manage tasks efficiently within an rtos framework.

The system is composed of several key components, each responsible for specific tasks within the overall architecture:

* **RTOS with Priority Scheduling**: Manages the execution of various tasks based on their priority levels, ensuring that critical tasks are processed before less critical ones.
* **Sensor Fusion**: Integrates data from multiple sensors (GPS and accelerometer) using a Kalman filter to provide an accurate estimation of the drone's state.
* **Adaptive PID Control**: Utilizes a PID controller that dynamically adjusts its parameters based on real-time feedback to maintain stability and control of the drone.
* *Dynamic Path Planning with A and RRT*\*: Implements path planning algorithms to navigate the drone through an environment while avoiding dynamic obstacles.
* **Predictive Maintenance**: Monitors sensor data to predict potential failures, allowing the system to take preemptive actions to prevent breakdowns.
* **Safety System**: Continuously checks for failures in sensors and actuators, switching to backup systems if necessary to ensure continued operation.
* **Multi-Agent Coordination**: Simulates the communication and coordination between multiple drones, enabling them to work together towards a common goal.
* **Enhanced Communication Protocol**: Handles commands and telemetry data, allowing for efficient communication between the drone and a control system.

**RTOS with Priority Scheduling**

The RTOS is responsible for managing and scheduling tasks based on their priority. Tasks are executed in a loop, with higher-priority tasks being processed first. This ensures that critical operations, such as safety checks, are performed in a timely manner.

**Sensor Fusion with Kalman Filter**

The sensor fusion module combines GPS and accelerometer data to produce an accurate state estimate. The Kalman filter is used to smooth the data and reduce noise, providing reliable inputs for the control system. C:\Users\antho\source\repos

**Adaptive PID Control**

The adaptive PID controller adjusts its parameters (proportional, integral, and derivative gains) in real-time based on the error between the desired and actual state. This allows the system to maintain control even as conditions change.

*Dynamic Path Planning with A and RRT*\*

The path planning module uses the A\* algorithm to find the shortest path to the goal while avoiding obstacles. The dynamic obstacle avoidance feature ensures that the drone can navigate through environments with moving obstacles.

**Predictive Maintenance**

This module collects sensor data and analyzes it to predict potential failures. If an anomaly is detected, the system can take preventive action, such as switching to backup components or alerting the operator.

**Safety System**

The safety system monitors the health of sensors and actuators, triggering backups if failures are detected. This ensures that the drone can continue to operate safely even in the event of a component failure.

**Multi-Agent Coordination**

This component allows multiple drones to communicate and coordinate their actions. The drones share information about their positions and goals, enabling them to work together effectively.

**Enhanced Communication Protocol**

The communication protocol handles the transmission of commands and telemetry data. It processes commands such as "MOVE" and "STOP" and sends appropriate responses, allowing the drone to be controlled remotely.