**Interrupt-Driven Odometry using Hall Effect Sensors on STM32 Nucleo-H563ZI**

**Objective**

The goal of this project was to design and implement an odometry system using four Hall effect sensors (one per wheel) on an STM32 Nucleo-H563ZI microcontroller. The system counts encoder pulses, converts them into wheel distances, and computes the robot’s position (x, y, θ) and velocities (v, w). A Kalman filter was applied for smoothing noisy measurements.

**Challenges Faced**

* Noisy Hall sensors: Holding the magnet near the sensor caused multiple false triggers. This was solved with debouncing and state filtering.
* Manual testing: Due to unavailability of real wheel encoders, a manual magnet was used for generating pulses, which required fine-tuning debounce times.
* Interrupt vs Sampling: Polling with stable sampling was more reliable for manual tests, but the final version uses interrupts to satisfy assignment requirements.
* STM32 Arduino IDE support: Needed correct mapping of digitalPinToInterrupt() for Nucleo pins.

**Results**

* Reliable pulse counting from 4 Hall sensors.
* Correct odometry tracking (x, y, θ) with smooth Kalman estimates.
* Linear and angular velocities computed at 50 Hz update rate.
* All assignment requirements fully satisfied.