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The advancement of vehicle navigation technology demands accurate localization methods, even without GPS support or full autonomy. This research focuses on the design and implementation of a localization system based on wheel encoders and an Inertial Measurement Unit (IMU) for a miniature vehicle platform. The system is designed to estimate position and orientation in real-time through sensor data fusion, thereby reducing the limitations of each individual sensor, such as IMU drift and wheel slip.

The methodology involves the integration of hardware and software for sensor data processing. The wheel encoders provide information on travel distance and velocity, while the IMU supplies acceleration, angular velocity, and vehicle orientation data. These data are processed using an ESP8266 microcontroller and a Jetson AGX Xavier mini-computer. Tests were conducted on straight and figure-eight tracks to evaluate the accuracy of the position estimation.

The experimental results show that the localization system can estimate the position with an accuracy of up to 99.7%. In a straight-line test over a 10-meter track, the difference between manual measurement and odometry results was only about 0.02 meters (0.3%), while in the figure-eight track test, the system remained stable in following the movement pattern with deviations within the centimeter range. These findings confirm that integrating the IMU and wheel encoders produces a precise and reliable localization system, even without GPS support.

Keywords: Position Estimation, Vehicle Localization, Wheel Encoder, IMU, Odometry