Smarthub Sensor Data Calculation Equations

Auto-generated

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Sensor Data Decoding

Raw sensor data is decoded into acceleration and gyroscope arrays as follows:

$$\text{accel}_i = \frac{\text{data}[2i+2] + 256 \times \text{data}[2i+3]}{1000}$$

$$\text{gyro}_i = \frac{\text{data}[2i+10] + 256 \times \text{data}[2i+11]}{100}$$

Sign bits are used to determine the sign of each value.

Velocity Calculation

Velocity at each time step is calculated as:

$$\text{v}_r = \text{rot}_r[i] \times \frac{d}{2} \times \text{IN\_TO\_M}$$

$$\text{v}_l = \text{rot}_l[i] \times \frac{d}{2} \times \text{IN\_TO\_M}$$

$$\text{velocity}[i] = \frac{\text{v}_r + \text{v}_l}{2}$$

where d is the wheel diameter in inches, and IN_TO_M is the conversion factor from inches to meters.

Displacement Calculation

Displacement at each time step is:

$$\Delta x_r = \frac{\text{rot}_l[i] + \text{rot}_r[i]}{2} \times (t_{i+1} - t_i)$$

$$\Delta x_m = \Delta x_r \times \frac{d \times \text{IN\_TO\_M}}{2}$$

$$\text{displacement}[i+1] = \Delta x_m + \text{displacement}[i]$$

Heading Calculation

Heading (in degrees) at each time step is:

$$\omega = \frac{(\text{rot}_r[i] - \text{rot}_l[i]) \times d \times \text{IN\_TO\_M}/2}{\text{wheelDistance} \times \text{IN\_TO\_M}}$$

$$\Delta t = t_{i+1} - t_i$$

$$\Delta h = \omega \times \Delta t$$

$$\Delta h_{deg} = \Delta h \times \frac{180}{\pi}$$

$$\text{heading}[i+1] = \Delta h_{deg} + \text{heading}[i]$$

Trajectory Calculation

Trajectory (x, y) over time is:

$$\Delta t = t_{i+1} - t_i$$
$$\theta = \text{heading}[i] \times \frac{\pi}{180}$$
$$\Delta x = \text{velocity}[i] \times \cos(\theta) \times \Delta t$$
$$\Delta y = \text{velocity}[i] \times \sin(\theta) \times \Delta t$$
$$\text{x}[i+1] = \text{x}[i] + \Delta x$$
$$\text{y}[i+1] = \text{y}[i] + \Delta y$$