



Automatically Guided Chassis Using AI, UWB and GPS

Ing. Kryštof Vacek

Supervisor: Ing. Pavel Kubalík, Ph.D.

Czech Technical University in Prague
Faculty of Information Technology

Motivation and Objectives

Commercial mobile robots with autonomous tracking are often expensive or tied to a single navigation method. The aim was to create an affordable and modular platform that can be adapted to different robotic applications.

Main objectives:

- design and manufacture a four-wheel chassis,
- track a selected person using machine vision,
- provide UWB and GPS as alternative navigation methods,
- support remote control and live telemetry,
- keep the system modular and reproducible.

Navigation Methods

Machine Vision

YOLO11 inference runs on the Raspberry Pi AI HAT. The selected person is tracked in the image and the camera and chassis are steered to keep the target centred.

Ultra-Wideband

Two calibrated UWB anchors estimate the target distance and relative direction. Dedicated Arduino Nano controllers handle timing-sensitive communication.

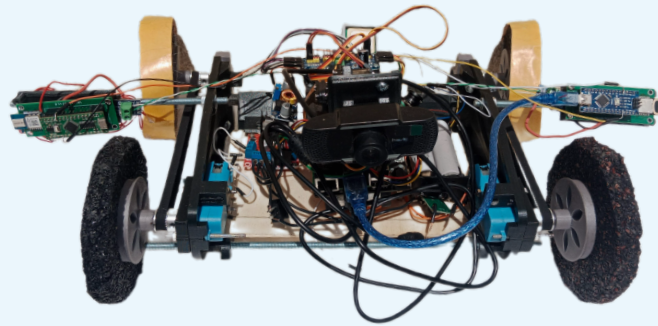
GPS + Magnetometer

GPS enables navigation towards fixed coordinates in open areas, while the magnetometer provides an approximate heading for steering.

Combined operation

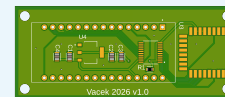
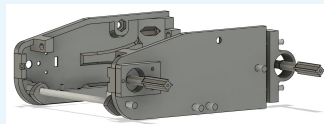
The methods complement each other: vision provides immediate target tracking, UWB supplies a backup distance and angle estimate, and GPS supports outdoor point-to-point navigation.

Implemented Prototype



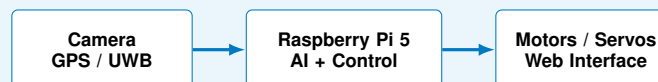
Differential-steering prototype with a pan-tilt camera, UWB anchors, GPS and Raspberry Pi 5.

Hardware Design



The chassis combines 3D-printed functional parts with a plywood base. A belt drive transfers power from one motor to both wheels on each side. Custom PCBs reduce wiring length and improve the stability of the DW1000 UWB modules. RS-485 connects the two UWB controllers across the chassis.

System Architecture



Control Software and Interface



The Python control application integrates Hailo inference, tracking, motor and servo control, UWB serial data, GPS navigation and a Flask-based web interface. Independent threads share synchronized state and a safety watchdog stops the chassis if the remote connection is lost.

Experimental Results

- **25–30 FPS** object-detection pipeline,
- approximately **10 cm** UWB distance error after calibration,
- up to approximately **30 cm** combined UWB deviation,
- magnetometer deviation up to approximately **20°**,
- more than **2 hours** of battery-powered operation,
- all three navigation modes verified in practical tests.

Conclusion and Future Work

The project demonstrates a functional, affordable and extensible platform combining three navigation methods. Its modular design supports replacement of sensors, vision models and control algorithms.

Future work includes stronger motors, wheel odometry, sensor fusion and lower-latency video transport instead of MJPEG.