HAJIM SCHOOL OF ENGINEERING & APPLIED SCIENCES
UNIVERSITY of ROCHESTER

AutoTracking + HandGesture Controlled Vehicle

Zirui Li Youjia Qian Haozhuo Liu Zijian Shang Yichuan Wang Jianxiong Li

ELECTRICAL & COMPUTER ENGINEERING
ECE
UNIVERSITY OF ROCHESTER

Glove

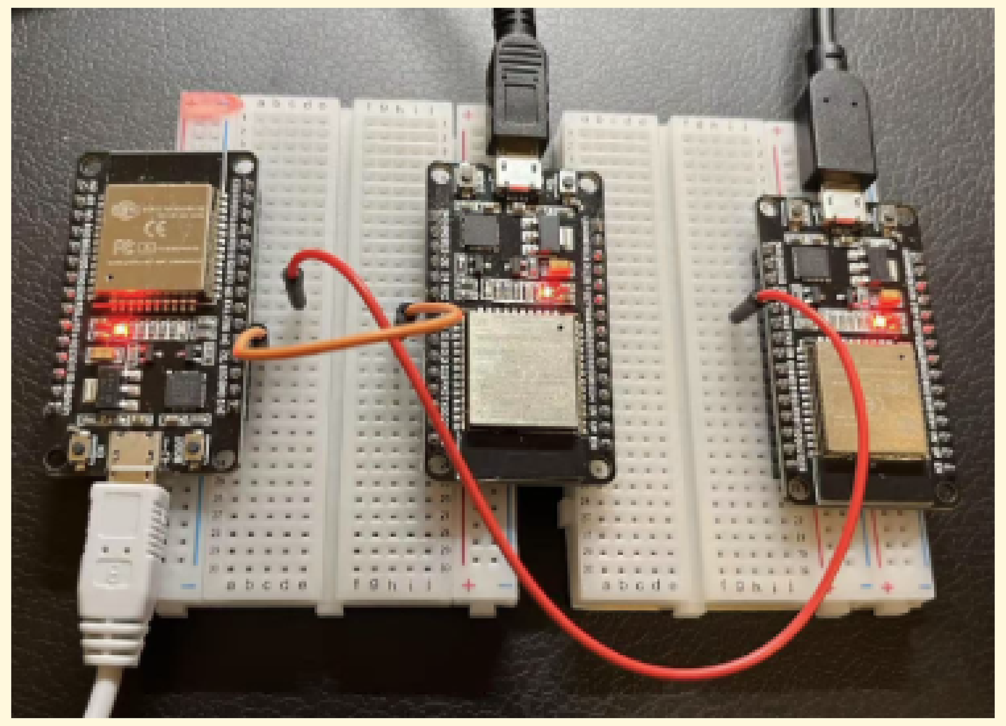
Microcontroller: STM32F403 on Nucleo-64
Sensor: MPU6050 3-axis accelerometer
Control Input:
X-axis acceleration → interpreted as linear velocity
Y-axis acceleration → interpreted as angular velocity
Function: Measures motion and vibration for directional control
Development Environment: STM32CubeIDE

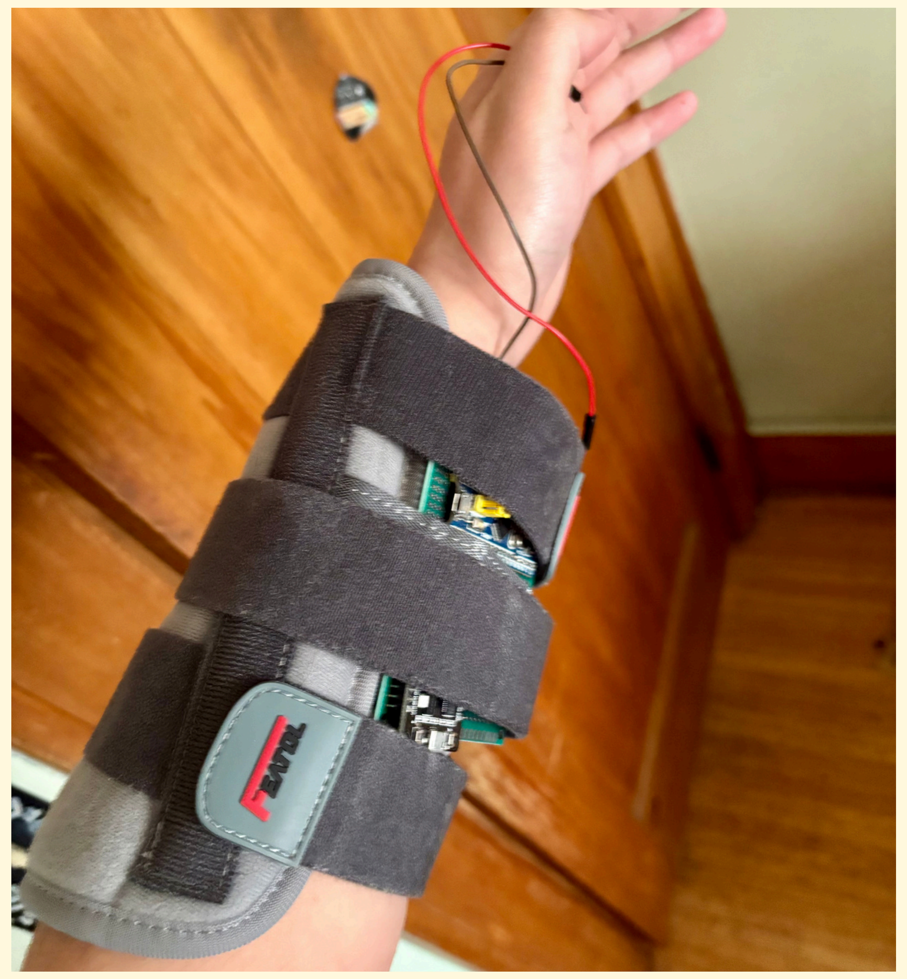
Communication

Transmit Tracking Data:

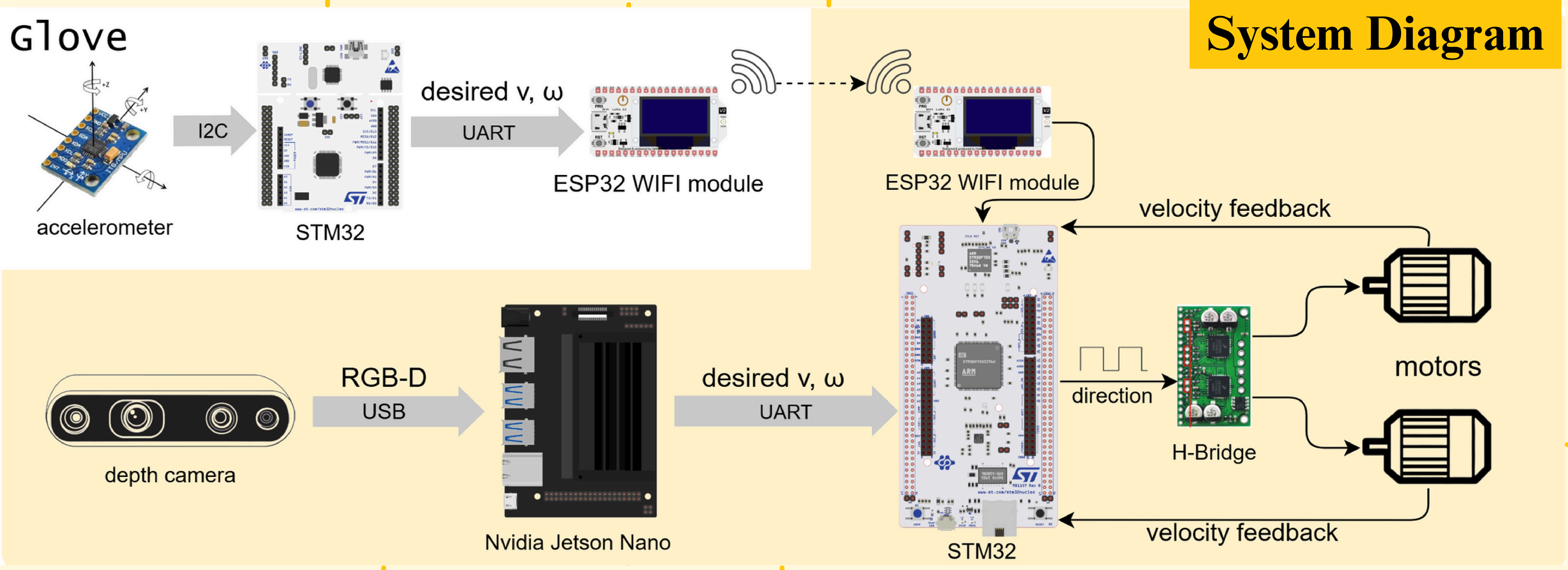
- Input: RGB-D camera data
- Output: desired v, ω → sent via UART to the STM32 on the car

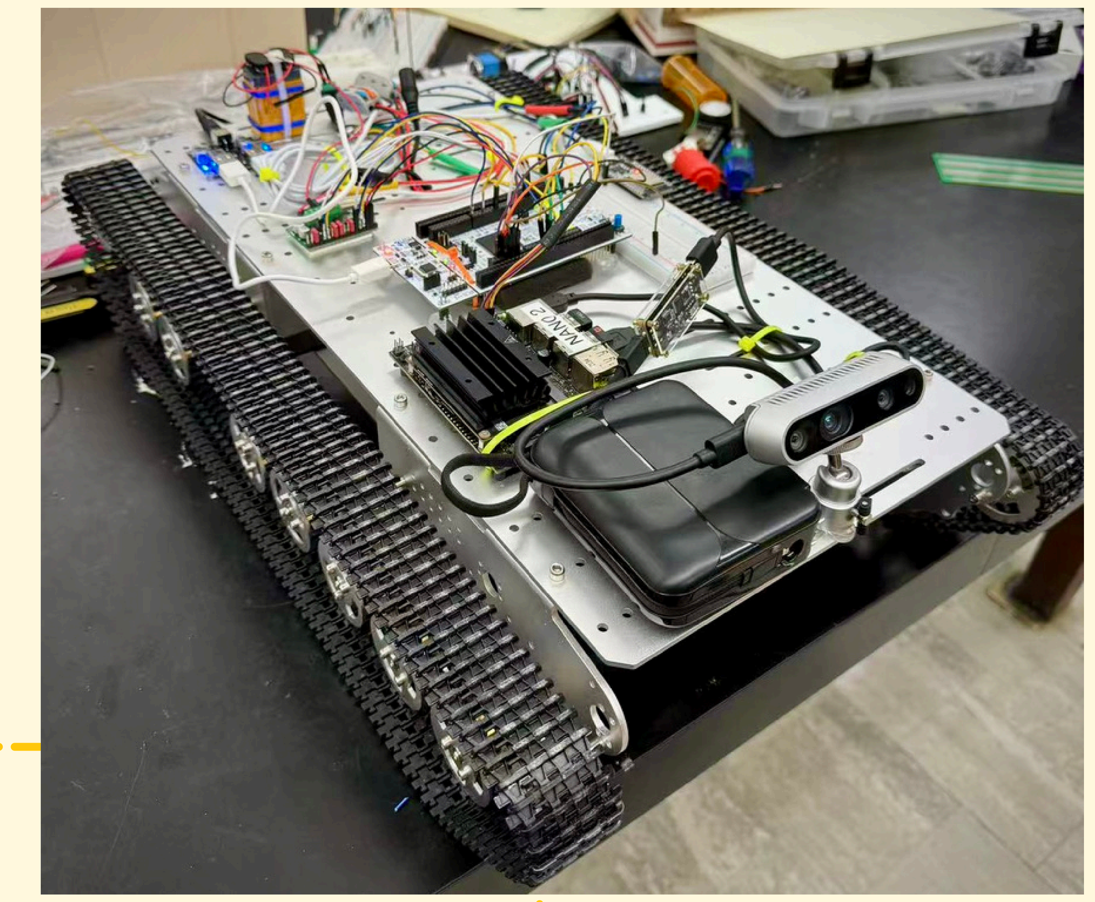
Microcontroller: ESP-WROOM-32
Two ESP32 MCUs are used as a wireless transmitter and receiver. The transmitter receives linear velocity (V) and angular velocity (W) via UART from Glove STM32 and then sends them wirelessly to the receiver using WIFI Protocol. Through UART, the receiver then forwards the data to the STM32 which controls the motors.





System Diagram



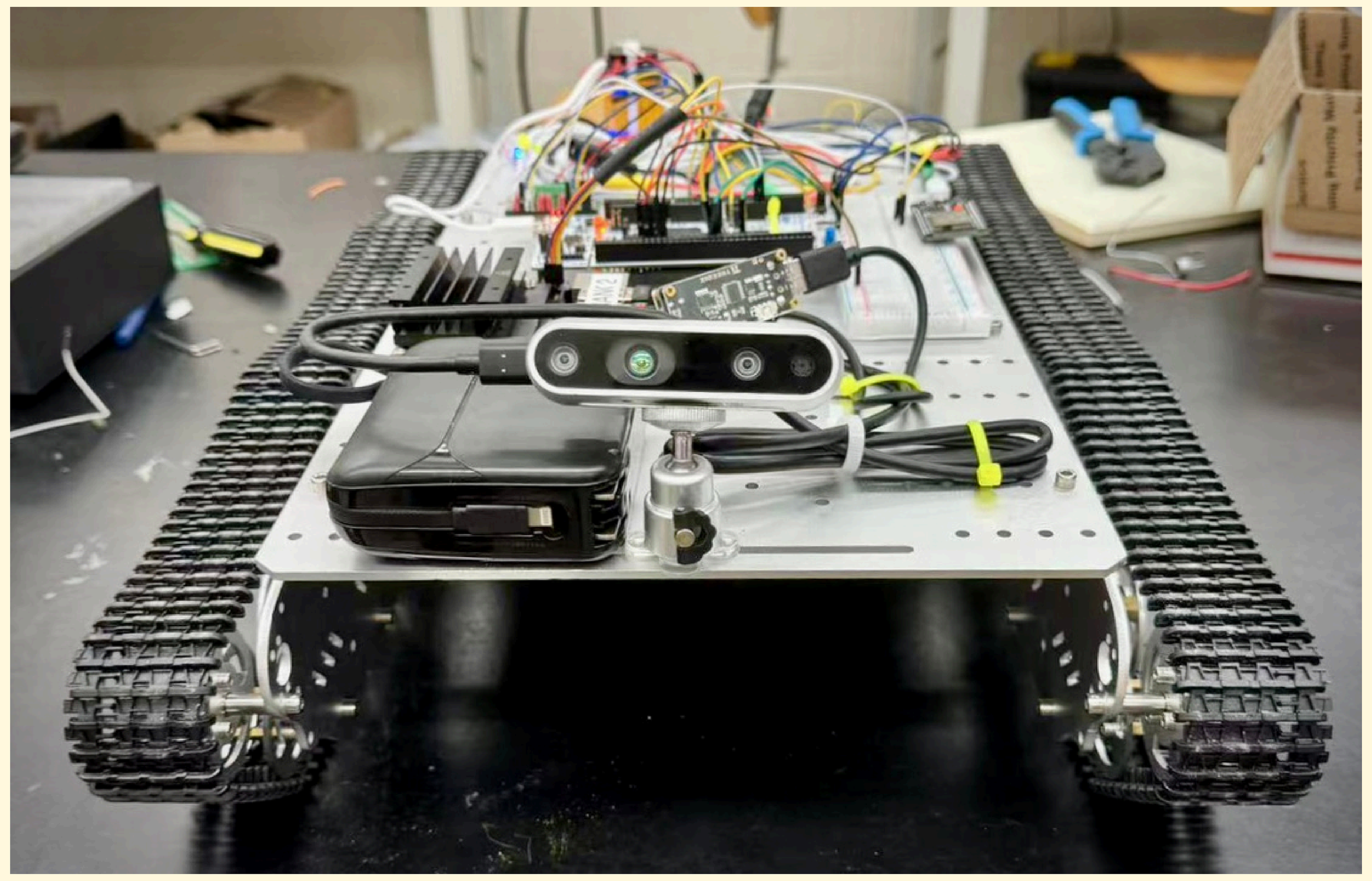


Tracking

The Jetson Nano receives real-time RGB-D input from the Intel RealSense camera and runs a custom-trained YOLOv8 model with ByteTrack multi-object tracking.

A locked target is selected based on the UR logo, and its position is continuously monitored. A PID controller adjusts the angular velocity according to the target's horizontal displacement, while linear velocity is determined based on distance data.

Smooth acceleration and safety limits are applied to ensure stable tracking behavior. If the target is lost, the system gracefully decelerates and resets tracking after a timeout.



Chassis

Motor Speed Calculation:

$$v_{\text{left}} = v_{\text{desired}} - \frac{\omega_{\text{desired}}}{\text{wheelbase}}$$

$$v_{\text{right}} = v_{\text{desired}} + \frac{\omega_{\text{desired}}}{\text{wheelbase}}$$

PID Close-Loop Control: