# Hassan Shahzad

London, UK ✉ hshahxr@gmail.com ☎ +447918800632 🔗 https://hassan-xr.com

in Hassan Shahzad ⚙ TheHassanShahzad

MEng Robotics student at UCL with hands-on experience developing autonomous mobile robots using ROS2, Nav2, and SLAM. Specialized in building complete navigation stacks from hardware integration to high-level AI control. Proven track record of delivering working robotic systems through industry placement and personal research projects.

## Experience

### ROS2 Robotics Engineer                                    *January 2024 — Present*

Industry Placement - Autonomous Agricultural Robots

- Developed ROS2 Humble autonomous navigation with Nav2, AMCL, and SLAM Toolbox for agricultural robots
- Built high-fidelity Gazebo simulations with accurate sensor models and physics for field testing
- Implemented URDF pipeline for automated 3D robot model generation from CAD files
- Created microROS bridge for real-time sensor data processing and motor control

## Projects

### A24 - Autonomous SLAM Research Platform                   *Present — Present*

- 2-year development of modular AMR with complete ROS2 Nav2 stack and SLAM Toolbox integration
- Implemented RP-LiDAR A1 360° scanning with custom mounting for precise 2D mapping
- Developed microROS firmware for ESP32 enabling efficient ROS2-microcontroller communication
- Achieved successful sim2real transfer from Gazebo simulation to hardware deployment

### OpenBase2 - Low-Cost Autonomous Navigation                *Present — Present*

- Built £240 AMR using repurposed hoverboard motors demonstrating cost-effective robotics
- Implemented RTAB-Map SLAM with Intel D415 depth camera for 3D mapping and localization
- Developed ESP32 microROS nodes for distributed motor control and sensor processing
- Integrated WebRTC for remote teleoperation and real-time video streaming

### BiStable - Self-Balancing Robot                           *Present — Present*

- Developed 2-wheeled balancing robot with complete ROS2 architecture in 2-week UCL project
- Implemented dual-core ESP32 processing: Core 1 for PID balance, Core 2 for motor control
- Created PyBullet simulation for PID tuning achieving stable balance with MPU6050 IMU
- Integrated MediaPipe hand tracking for gesture-based robot control
- Succesfully tuned the FreRTOS tasks to handle velcotity control for stepper motors while still enabling microROS comunication

### Nav2 Agent - Natural Language Robot Control               *Present — Present*

- Pioneered LLM-controlled navigation enabling commands like 'Go to kitchen' in simulation
- Built LangChain-ROS2 bridge for AI-driven path planning and obstacle avoidance
- Developed semantic mapping system translating natural language to navigation goals
- Demonstrated feasibility of conversational interfaces for robot control

### radioROS - Universal Wireless Controller                  *Present — Present*

- Designed custom PCB with ESP32-S3 for universal ROS2 robot control
- Implemented hardware interrupt-based PWM processing for real-time control
- Developed ROS2 driver package with Twist message publishing for robot velocity control

## Education

| **University College London (UCL)** | *September 2023 — June 2027* |
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*MEng (Integrated Master's) in Robotics and AI*

- Autonomous Robotics & Control
- SLAM & Computer Vision
- Embedded Systems & Real-time Programming
- Multi-robot Systems & Navigation

## Certificates

| **ROS2 for Beginners - Level 1 & 2** | *March 2024* |
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*Udemy - Edouard Renard*

| **ROS2 Nav2 Stack - SLAM and Navigation** | *May 2024* |
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*Udemy - Edouard Renard*

| **Deep Learning Prerequisites: The Numpy Stack** | *February 2024* |
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*Udemy - Lazy Programmer Inc.*

| **Deep Learning and Neural Networks in Python** | *April 2024* |
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*Udemy - Lazy Programmer Inc.*

## Skills

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| **ROS2 & Navigation:** | ROS2 Humble, Nav2 Stack, SLAM Toolbox, AMCL, microROS, Gazebo, ros2_control, MoveIt2 |
| **SLAM & Mapping:** | RTAB-Map, Gmapping, 2D/3D SLAM, Occupancy Grids, Sensor Fusion |
| **Hardware Integration:** | LiDAR, Depth Cameras, IMUs, Motor Control, ESP32, Raspberry Pi, Jetson Nano |
| **Programming:** | Python, C++, URDF/XACRO, Docker, Git, PyBullet, MujoCo |
| **AI Integration:** | LangChain, Computer Vision, MediaPipe, LLM Tool Calling, n8n |
| **Protocols:** | BLE5, UDP, MQTT, CAN, WebRTC, PWM, ESP-NOW |

## Interests

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| **Research Areas:** | Autonomous Navigation, Multi-robot SLAM, Human-Robot Interaction, Field Robotics, Augmented Rality, Low Latency Tele-operation |