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Muhammad Umar

Robotics Engineer

Technical Experience

Robotics and Automation Intern — **July 2022 — September 2022**
Eurecat Technology Center — *Cerdanyola del Valles, Spain*

- Used **RTSP** in **ROS** to video stream camera feed and **MQTT** for robot's status information.
- Communicated between sprayer system and robot using **CAN** in **ROS**. **LiDAR** was used for volume estimation.
- Estimated elevator location using Aruco markers and developed a **PID controller** to safely dock/undock the robot inside the elevator.

Robotics Research Intern — **June 2022 — July 2022**
ViCOROB - Computer Vision and Robotics Center — *Girona, Spain*

- Segmented live video feed from a camera to detect the center of the LUMA optical modem using **OpenCV** in **ROS**. And developed a motion controller for the Reach Alpha Pan&Tilt Arm to follow the light source.

Software Developer — **Jun 2019 — Aug 2021**
Educative Inc. — *Lahore, Pakistan*

- Developed and maintained features as a **Full Stack Web Developer** in **React, Redux, Next.js, JavaScript, Node.js, Typescript, Python, NDB,** and **Google Cloud Platform**.
- Researched and implemented techniques such as server-side rendering, image & font optimizations, etc., to improve lighthouse score from 67 to 99.

Education

M.Sc. Erasmus Mundus Joint Master in Intelligent Field Robotic Systems (IFRoS) — **Sept 2021 — June 2023**
Eötvös Loránd University, Budapest, Hungary — *Grade: 5.0/5.0*
Universitat de Girona, Spain — *Grade: 9.3/10.0*
Specialization in Autonomous Systems and Self-Driving Vehicles — *Curriculum*

B.Sc. Electrical Engineering with Honors (Computer Science Minor) — **Oct 2015 — Aug 2019**
University of Engineering and Technology, Lahore, Pakistan — *CGPA: 3.772/4.0*

Projects

Package Delivery Robot using AgileX Scout Robot — ***Project Link***

- Created **Gazebo simulation** for the newly arrived scout-mini robots at ELTE, Budapest.
- Implemented Navigation module using **IMU, GPS, Laser Odometry and robot odometry** for package delivery application.
- Integrated **road-segmentation** using OpenCV in ROS for future works.

Frontier-Based Exploration using Hybrid-A* Planner — ***Video Link***

- Implemented **frontier-based exploration** and **Hybrid-A*** algorithm from scratch using **ROS and python**.
- Extended the traditional A* algorithm for non-holonomic vehicles by incorporating vehicle dynamics inspired by Reeds-Shepp curves.

EKF-SLAM using corner features

- Implemented **EKF-SLAM** from scratch by detecting corners of a room using a **360°** **LiDAR** in an unknown environment.

Sensor Fusion Projects

- Implemented stereo matching techniques and 3D displays using **Point Cloud Library (PCL)**. — *Link*
- Implemented different image and upsampling filters. Also made a 3D display GUI using **VTK** and **QT**. — *Link*
- Implemented **Iterative Closest Point (ICP)** and **Trimmed ICP (TrICP)** algorithm for point cloud reconstruction. — *Link*

Object Recognition using PyTorch in ROS

- Implemented object detection using **transfer learning** on **COCO dataset** and analyzed its performance using Voxel51. The inference detector was later integrated in **ROS** for pick and place robot application.

TRACK-E: Smartphone's IMU-Based Human Following Robot (Final Year Project) — ***Project Link***

- Designed a robot capable of tracking and following a person through the **IMU sensors** of a smartphone.
- Used raw data of **accelerometer** & **magnetometer**, transferred over **UDP**, for distance and heading measurement.
- Implemented **tilt-compensation** and **dual PID controller** in a Raspberry Pi to follow the person using the sensor data.

Skills

Languages & Frameworks	ROS, Python, C/C++, OpenCV, PCL, VTK, Qt5, JavaScript, Typescript, CSS/HTML, React, Next.js
Others	Gazebo, RViz, MATLAB, Git, Docker, Tensorflow, PyTorch, Keras, Scikit-learn, Matplotlib

Accomplishments

- Gold Medal by Government of Pakistan for obtaining highest marks in Intermediate (11/12th grade) Lahore Board, 2015.
- Awarded fully funded Erasmus Mundus Master's Scholarship in Intelligent Field Robotics.