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Muhammad Umar

Robotics Engineer

Skills

Languages	Python, C, C++, JavaScript, TypeScript, HTML, CSS, Java, MySQL
Frameworks	ROS, ROS2, OpenCV, PCL, VTK, Qt5, OpenVino, TensorRT, Tensorflow, PyTorch, NumPy
Others	Gazebo, RViz, Git, Docker, , MATLAB, Google Cloud, Linux, VS Code

Technical Experience

Full Stack Robotics Engineer **Aug 2023 — Present**

Paltech Robotics *Kempten, Germany*

- Develop MVP of an autonomous weed removal robot by implementing perception, navigation and localization algorithms. (ROS2, C++, Python)
- Calibrate different sensors such as camera, IMU, RTK GPS etc. and fuse them for localization. (OpenCV)
- Integrate Deep Learning models in ROS2 for weed detection and estimate plant position in world frame. (PyTorch, TensorRT)
- Implement state machine for robot mission planning to detect the weed, extract it and navigate to waypoints.
- Onboard the software team to Test Driven Development (TDD) and write unit and integration tests in ROS2. (unittest, pytest, launch_test).
- Integrate new features such as system checks (hardware connected, sensors working etc.), GRBL to servo motor and test in outdoor fields. (CAN bus, Arduino).

Master's Thesis Student - Robotics and Automation Team **Feb 2023 — May 2023**

Eurecat Technology Center *Cerdanyola del Valles, Spain*

- Thesis topic: **Vision Based Reactive Navigation for Agricultural Robotics Operations**.
- Used Deep Learning **Detectron2** module to detect tree trunks and estimated their position by color to depth image correspondence. (PyTorch)
- Develop the simulation in ROS2 dockerized environment and implement detection algorithm.
- Optimized Keypoint Detection using **OpenVino** and **TensorRT**, and improved FPS from 8 to 25. (OpenVino, TensorRT)
- Implemented **Pure Pursuit** algorithm to safely navigate agriculture fields.

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. (ROS)
- 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.

Software Developer **Jun 2019 — Aug 2021**

Educative Inc. *Lahore, Pakistan*

- Developed and maintained features as a **Full Stack Web Developer** in **React, Redux, NextJS, JavaScript, NodeJS, 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.
- Worked extensively in migrating Educative's frontend from create-react-app to NextJS and hosted tech-talks to onboard the development team to NextJS.
- Revamped Educative's editor experience by integrating a modern WYSIWYG editor using slateJS.
- Developed a MVP of auto-save functionality in Educative's content such as Blogs, Courses, Answers etc.

Education

M.Sc. Erasmus Joint Master in Intelligent Field Robotic Systems (IFRoS) **Sept 2021 — July 2023**

Eötvös Loránd University, Budapest, Hungary Grade: 5.0/5.0

Universitat de Girona, Spain Grade: 9.3/10.0

Autonomous Systems, Machine Learning, Probabilistic Robotics, Robot Manipulation, Multiview Geometry with 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
Electives: Database Systems, Computer Architecture, Operating Systems, Introduction to Robotics, Data Structures, Machine Learning

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*

- Extended A* algorithm for non-holonomic vehicles by incorporating vehicle dynamics using 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 image and upsampling filters. Also made a 3D visualizer with slider using **VTK** and **QT5**. *Link*
- Implemented **Iterative Closest Point (ICP)** and **Trimmed ICP (TrICP)** 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.

Deep Learning Projects

- Using **PyTorch and Transfer Learning**, trained an image classifier on fruits-360 dataset with VGG16 *Colab Link*
- Fine-tuned **Mask R-CNN** on custom dataset (sunflowers) for segmentation. *Colab Link*
- Implemented **encoder** and fine-tuned encoder-decoder on COCO image captioning dataset. *Colab Link*

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.

Languages

English	C2	Spanish	A1	Urdu	C2