Mustafa Shaikh

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Robotics and deep learning practitioner with hands on experience in object tracking, control, reinforcement learning, 2D/3D computer vision, and LLMs. I have 5 years of industry experience working closely with business stakeholders. I can dive deep into the details and have led projects end-to-end, from identifying a problem and designing a solution, to implementation and delivery.

EDUCATION

M.S. Electrical and Computer Engineering — San Diego, CA | 2022 - 2024
University of California, San Diego
Specialization: Robotics and Intelligent Systems

B.A.Sc. Engineering Science — Toronto, ON | 2013 - 2017
University of Toronto

WORK EXPERIENCE

RESEARCH ENGINEER | Salk Institute for Biological Studies — San Diego, CA | 2024 -

Key Skills: PyTorch, Lightning, multiple object tracking, deep learning, transformers, ResNet, rotary embeddings, segmentation, bipartite matching, ffmpeg, multi-view geometry, camera calibration, triangulation

Multiple Object Tracking: https://dreem.sleap.ai/0.2.0/

- Co-developed a transformer-based **multiple object tracker** for video data, achieving **>95%** accuracy
- Created a **pretrained model** for microscopy videos that beats state of the art by **>8%**
- **Optimized inference** code to reduce **GPU memory** and **runtime** by **40%** with only 5% decrease in accuracy
- Developed a **metrics pipeline** to enable fast model evaluation and development

3D multi-view pose estimation:

- Developed simple GUI to enable users to register 3D pose keypoints to global frame and render output

GRADUATE RESEARCHER | Existential Robotics Lab, UC San Diego — San Diego, CA | 2023 - 2024

Key Skills: Model predictive control, control barrier functions (CBF), casADi, CVX, Extended Kalman Filter, RRT*, collision avoidance, ROS, Jackal robot, LiDAR, HectorSLAM

Project website: https://existentialrobotics.org/VisibilityControl

- Implemented a **model predictive controller** with **control barrier** constraints for a robot to track a target
- Implemented **Extended Kalman Filter** to estimate target's state from camera detections
- Demonstrated **>95% tracking** in **real world experiments** with a Jackal robot

SR. DATA SCIENTIST | Walmart Canada — Toronto, ON | 2019 - 2022

Key Skills: Natural Language Processing - Spacy, Named Entity Recognition, BERT, human-in-the-loop systems, AutoML, PySpark, SQL, MLOps, Python, Pandas, Numpy, Google Cloud Platform, Airflow

Project lead - Automated Attribute Assignment (2021-2022)
Goal: Improve search quality for customers by automatically populating product data for 3rd party sellers

- Developed **named entity recognition pipeline** to learn **context-aware** features from product descriptions; led to **>$1MM CAD revenue increase** annually by populating features for over 500,000 items

- Recognized need for **high quality custom annotated data**; pitched, acquired and integrated a **human-in-the-loop** annotation tool (Prodigy) with active labelling
- **Coordinated Jr. Data Scientist**, and guided the implementation of an **asynchronous orchestration layer**
- Worked closely with business stakeholders to guide problem framing, roadmap, execution and production support

Other Projects (Apr. 2019 to Jun. 2021)

- Developed and deployed **hierarchical model factory** to categorize 3rd party vendor items on walmart.ca; increased **categorization rate from 90% to 97%** which increased product views for previously 'unfindable' items
- Lead developer for **grocery substitutions recommendation** engine; **300bps improvement in customer satisfaction**
- Created and maintained **fulfillment centre forecast** to optimize labour; **>90%** accuracy up from 75% led to **$1MM CAD annual labour savings**

SR. DATA ANALYST | Shoppers Drug Mart — Toronto, ON | 2017 - 2019

Key Skills: Data engineering, systems engineering, performance metrics, worfklow improvements

- Developed **ETL pipeline** and a large SQL application that **transforms event triggers** into key pharmacy **workflow metrics** such as customer wait times, rework rates and labour heatmaps, to enable store performance reporting
- Used metrics to create business cases and guided rollout of **$1MM CAD in workflow improvements**

PROJECTS

Key Skills: Extended Kalman Filter (EKF), Particle Filter, IMU, LiDAR, encoder, scan matching, intrinsics, sensor fusion, odometry, disparity, occupancy grid mapping, SIFT, point cloud registration, PyTorch, C++, smart pointers, design patterns, STL, LLM finetuning, workflows, Mujoco, reinforcement learning, Gymnasium, PPO, A2C

- Trained a **reinforcement learning** based controller for **autonomous 3D navigation** of a quadrotor in a custom simulated Mujoco environment. Integrating **obstacle avoidance** using differentiable QP.
- Created an **LLM workflow** with **finetuned Llama 3.2 1B Instruct** that retrieves research papers from Arxiv based on user chat queries. Integrated with Cursor using **Model Context Protocol**
- Implemented **visual-inertial SLAM** for mapping and localizing a car using an Extended Kalman Filter with **IMU** and **stereo camera** data
- (C++) Implemented basic **string library** with underlying buffer manager. **Achieved 25% lower memory usage than C++ std::string** for common string operations: append, replace, insert, erase, search
- (C++) Created a general purpose **compressing archive tool** with add, extract, retrieve capability

PUBLICATIONS

[1] Minnan Zhou*, **Mustafa Shaikh***, Vatsalya Chaubey*, Patrick Haggerty, Shumon Koga, Dimitra Panagou, Nikolay Atanasov, **"Control Strategies for Pursuit-Evasion Under Occlusion Using Visibility and Safety Barrier Functions"** accepted at *IEEE International Conference on Robotics and Automation (ICRA)*, 2025. Available: https://arxiv.org/abs/2411.01321