MOHAMMAD GHUFRAN

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EDUCATION

UNIVERSITY OF ARIZONA
Master of Engineering in Robotics and Automation, GPA: 3.6/4.0

Tucson, Arizona, USA
Aug 2022 - Aug 2024

ALIGARH MUSLIM UNIVERSITY
Bachelor of Technology in Mechanical Engineering

India
Aug 2018 - May 2022

TECHNICAL SKILLS

Programming: Python, C++, C, HTML, JavaScript, CSS, MATLAB, Python Scripting, Robot Operating System (ROS), Reinforcement Learning, Machine Learning
Software: SOLIDWORKS, Fusion 360, AutoCAD, DS Abaqus, ANSYS, Adobe Creative Cloud, ROS
Tools & Skills: CAD Modelling, Data Analysis, 3D-Printing, Casting, Soldering, Lathes

ACADEMIC EXPERIENCE

UNIVERSITY OF ARIZONA
Research Assistant

Tucson, Arizona, USA
Aug 2023 - Aug 2024

- Engineered a heterogeneous robot coordination system with **quadcopters, hexacopter,** and **quadruped,** leveraging **Python, C++,** and **MATLAB** within the **Robot Operating System (ROS)**, and employing external positioning to enhance system capabilities and operational efficiency indoors.
- Optimized a deformable **UAV's design** using **SolidWorks** and **Fusion 360,** achieving a **25%** weight reduction and **35%** size reduction while integrating sensor data and **Vicon positioning** through **custom ROS packages,** markedly improving navigational precision.
- Participated in **NSF I-Corps** program to evaluate the market for deformable UAVs**,** conducting **50** detailed customer interviews in **42** days, employing **data analysis** to uncover critical industry needs, directly informing targeted development of deformable UAVs for agriculture, mining, and emergency response applications.
- Developed an integrated robotic dog and UAV system, applying **Fused Deposition Modeling (FDM)** and **Stereolithography (SLA) 3D printing techniques** with **BambuLabs X1 Carbon** and **FormLabs 3+ printers,** and **CAD modeling** in **SolidWorks** and **Fusion 360,** setting a new standard in robotic collaboration.

UNIVERSITY OF ARIZONA
Teaching Assistant

Tucson, Arizona, USA
Aug 2023 - May 2024

- Leveraged **MATLAB** and **programming** expertise to enhance AME301 and AME209 courses, boosting student proficiency via **targeted one-on-one sessions** and **practical lab exercises,** leading to significant improvements in **programming understanding,** efficiency, and **problem-solving** among undergraduates.
- Designed innovative **programming exercises** for AME209, utilizing **MATLAB** to cultivate **programming skills** and **debugging capabilities** in aerospace and mechanical applications, significantly enhancing **problem-solving abilities** and **programming habits** in a cohort of **59** students.
- Streamlined learning and assessment process in **Engineering Analysis (AME301)** by elevating **student comprehension** of complex topics and ensuring accurate proficiency evaluation.

UNIVERSITY OF ARIZONA
Student Researcher

Tucson, Arizona, USA
Nov 2022 - June 2023

- Optimized drone designs using **SOLIDWORKS** and **comprehensive design, modeling, and prototyping techniques,** reducing size by **40%** and weight by **25%,** without compromising performance.
- Developed and executed an efficient pathfinding solution by implementing the **Astar algorithm** in **Python,** which enhanced drone navigation performance in varied environments, and verified through experimental trials with **crazyflies** to ensure theoretical and practical alignment

PROJECTS

Object Detection on FLIR Dataset.

- Developed a **convolutional neural network (CNN) using TensorFlow** for vehicle and pedestrian detection in thermal images from the FLIR Thermal Dataset from **scratch**. Implemented data preprocessing, bounding box regression, and a custom loss function. Proposed model improvement strategies include data augmentation, hyperparameter optimization, and architecture refinements.

Heterogeneous Robots Coordination, University of Arizona

Aug 2023 - Aug 2024

- Developed **3D CAD modeling** and **prototyping skills** with **Solidworks, FDM, and SLA printing** to construct six quadcopters, and a hexacopter, modifying frames to integrate **Raspberry Pi Zero** and **Nvidia Jetson Nano**, which enhanced structural integrity and durability.
- Implemented dynamic control with **ROS2** and **Python**, adjusting quadcopter and hexacopter positions in real-time based on the robotic dog's location, achieving synchronized movements and deformity adjustments, which elevated operational efficiency and system interoperability in a complex robotic ecosystem.

Reconfigurable UAV, University of Arizona

Nov 2022 - Aug 2024

- Leveraged **SOLIDWORKS** for design optimization, reducing UAV size by **30%** and weight by **25%** through iterative **CAD** and **3D printing processes,** including a **custom base plate** for **Raspberry Pi 4B,** enhancing structural integrity and performance efficiency of the UAV model.
- Engineered a **ROS2 package** in **Python** integrated with **MATLAB-generated waypoints** and a Vicon system for precise external positioning, optimizing flight control and reliability
- Carried out a quad-UAVs system conversion from quad to coaxial quad frame conversion without compromising on size or weight, achieving a **30%** thrust increase in subsequent iterations.

One-Dimensional Ultrasound Guidance via Q-Learning

Mar 2023 - May 2023

- Engineered an interactive system using **C programming** for **PIC16F690** and **MATLAB** for **Q-Learning,** assembling components on a breadboard to develop a **machine learning model** that interprets user behavior from ultrasonic signals, achieving guidance in the least number of steps to the goal state within **50** iterations, signifying enhanced system learning efficiency and user interaction.

Stem Curriculum Recommender using the K-Means Algorithm

Mar 2023 - May 2023

- Developed an **unsupervised machine learning model** with **K-Means Clustering** and **TF-IDF vectorization techniques** in **Python,** successfully **clustering K-12** educational resources into distinct categories based on content similarity, achieving **95%** accuracy in topic clustering, significantly contributing to UN's Sustainable Development Goal 4 for Quality Education by aligning educational content with curriculum requirements.

Development of Sanitization Drone (Final Year Project | Best Project Award)

Aug 2021 - Apr 2022

- Utilized **advanced CAD modeling, simulation** with **Solidworks, and Ansys** and **3D printing techniques** to design an aerodynamic sanitization drone, achieving a factor of safety greater than 10, validated by wind tunnel testing for stability and optimal performance, which won the **Best Project Award,** demonstrating a creative, efficient, and effective resolution to **complex design challenges,** marking a significant milestone in drone innovation for **public health applications**

INTERNSHIP

ENGINEERING & ENVIRONMENTAL SOLUTIONS PVT LTD.
Intern - Drone Development

India
Jun 2022 - Jul 2022

- Engineered and optimized agriculture **drone technology** utilizing **Python scripting** and **Robot Operating System (ROS),** achieving a **60%** reduction in fertilizer usage by integrating IFFCO's nano urea, directly decreasing agricultural costs and enhancing sustainability in farming practices.
- Collaborated with **cross-functional teams** to design and draft a DGCA-compliant user and maintenance manual employing **advanced report writing** and **testing techniques,** which played a pivotal role in securing product approval by detailing comprehensive safety, operation, and maintenance protocols.

RESEARCH PAPER

- M. Ghufran, S. Tetakayala, and H. Rastgoftar, "Motion Planning for Quadruped Teams: An Experimental Evaluation Using a Dynamic Fluid Flow Model," 2024 18th International Conference on Control, Automation, Robotics and Vision (ICARCV), 2024, Accepted for Publication
- M. Ghufran, S. Tetakayala, A. Mathias, J. Hughes and H. Rastgoftar, "Quadcopter Team Configurable Motion Guided by a Quadruped," 2024 18th International Conference on Control, Automation, Robotics and Vision (ICARCV), 2024, Accepted for Publication
- H. Uppaluru, M. Ghufran and H. Rastgoftar, "Fluid Flow Modeling and Experimental Evaluation of Unscrewed Aerial System Coordination," 2024 International Conference on Unmanned Aircraft Systems (ICUAS), Chania - Crete, Greece, 2024
- H. Uppaluru, M. Ghufran, A. E. Asslouj and H. Rastgoftar, "Drones Practicing Mechanics," 2023 International Conference on Unmanned Aircraft Systems (ICUAS), Warsaw, Poland, 2023