Hisham Khalil

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Education

- **PhD, Mechanical and Mechatronics Engineering** — Ontario, Canada
  University of Waterloo - Supervisor: Prof. Yue Hu — Jan. 2024 - Present
- **BEng, Mechanical Precision Engineering** — Kuala Lumpur, Malaysia
  Universiti Teknologi Malaysia (UTM) — Jan. 2019 - Mar. 2023
  - **Grade:** 3.96/4.0
  - **Relevant Coursework:** Dynamics, C++ Programming, Differential Equations, Probability and Statistics, Numerical Methods, Robotics, Sensor and Actuator Systems, Mechatronics, Modeling and Simulation
  - **Thesis Title:** Detection of Patient's Fragility Based on Posture and Slight Body Motion - Grade: A+
- **Exchange Student, Mechanical Systems Engineering** — Tokyo, Japan
  Tokyo University of Agriculture and Technology (TUAT) — Sep. 2020 - Feb. 2021
  - **Grade:** 3.9/4.0
  - **Relevant Coursework:** Control Engineering, Mechanics of Machines and Vibration, Pattern Recognition and Machine Learning, Human Body Dynamics

Research Interests

Physical Human-Robot Interaction • Collaborative and Assistive Robotics • Human State and Motion Analysis • Applied Machine Learning in Robotics • Learning-Based Control

Research Experience

- **Graduate Research Student** — Tokyo, Japan
  GV Lab, The University of Tokyo - Supervisor: Prof. Gentiane Venture — Apr. 2023 - Sep. 2023
  - Developed a heterogeneous graph to represent human physical state during human-robot interactions.
  - Implemented a variational graph auto-encoder using PyTorch Geometric to extract latent embeddings from the human state representation highlighting human perceptions towards collaborative robots.
  - Assisted in developing a deep reinforcement learning framework for adaptivity of social robotic objects.
- **Undergraduate Researcher** — Kuala Lumpur, Malaysia
  Center for Artificial Intelligence and Robotics, UTM - Supervisor: Dr. Uswah Khairuddin — Oct. 2021 - Mar. 2023
  - Constructed a human gait dataset of 2 million points from captured motion videos using data augmentation.
  - Applied LSTM networks using PyTorch to diagnose ataxic patients from gait sequences with 99.8% accuracy.
  - Worked on machine learning projects for 2 professors for their research on river conditions in Malaysia.
- **Research Intern** — Tokyo, Japan
  GV Lab, TUAT - Supervisor: Prof. Gentiane Venture — Oct. 2020 - Feb. 2021
  - Reproduced human motion from videos using MediaPipe Pose for imitation by Pepper humanoid robot.
  - Wrote Python scripts for computing joint kinematics and controlling the robot using NAOqi framework.
  - Discussed and analyzed with professors and graduate students 10+ research papers related to control of space robotics, roboethics, human-centered design, and soft actuators as part of GV Lab Robotics Reading Club.

Publications

Conference Papers

- P. Osorio, **H. Khalil**, S. Capy, and G. Venture, "Cultivating Expressivity and Communication in Robotic Objects: An Exploration into Adaptive Human-Robot Interaction," *International Conference on Social Robotics (ICSR)*, 2023, pp. 1-14.
- **H. Khalil**, A. M. S. E. Saad, and U. Khairuddin, "Diagnosis of Cerebellar Ataxia Based on Gait Analysis Using Human Pose Estimation: A Deep Learning Approach," *IEEE-EMBS Conference on Biomedical Engineering and Sciences (IECBES)*, 2022, pp. 201-206.
- **H. Khalil**, E. Coronado, and G. Venture, "Human Motion Retargeting to Pepper Humanoid Robot from Uncalibrated Videos Using Human Pose Estimation," *IEEE International Conference on Robot & Human Interactive Communication (RO-MAN)*, 2021, pp. 1145-1152.

Datasets

- **H. Khalil**, A. M. S. E. Saad, and U. Khairuddin, "Dataset for Gait Analysis of Cerebellar Ataxic Patients and Healthy Adults Using MediaPipe Pose," *Mendeley Data*, V1, 2023.

Scholarly Activities

- **Reviewer for Journals and Conferences**
  - ACM Transactions on Human-Robot Interaction
  - International Conference on Robotics and Automation (ICRA)
- **Workshop Organizer**
  - Towards Collaborative Partners: Design, Shared Control, and Robot Learning for Physical Human-Robot Interaction, ICRA 2024

Grants and Awards

- **International Doctoral Student Award, University of Waterloo** Jan. 2024
- **Graduate Research Studentship, University of Waterloo** Jan. 2024
- **Best Student Award, Malaysia-Japan International Institute of Technology** Nov. 2023
  - **Criteria:** Best student in the Bachelor of Mechanical Precision Engineering program for 2023 cohort
  - **Selection:** 1 out of 70 students
- **Finalist at IEEE RO-MAN 2023 Robot Design Competition** Aug. 2023
  - **Project:** Can a Robotic Object Express Moods in Long-Distance Relationships?
- **Dean's Award, Universiti Teknologi Malaysia** Mar. 2023
  - **Criteria:** Final CGPA of 3.67 and above
- **The Japanese Chamber of Trade & Industry, Malaysia Research Grant** Nov. 2021 - Nov. 2022
  - **Scheme:** JACTIM Research Proposal Competition 2021
  - **Project:** Detection and Classification of Cerebellar Ataxic Gait from Videos Based on Human Pose Estimation
  - **Research Fund:** MYR 12,500
  - **Competition:** Awarded among the best 4 proposals from 7 submissions (only undergraduate student awardee)
- **Dean's List, Universiti Teknologi Malaysia** Jan. 2019 - Mar. 2023
  - **Criteria:** High academic achievement for each semester (GPA of 3.67 and above)
  - **Awards:** Semesters 1-8 (all semesters)

Industrial Experience

- **NSW Automation Inc.** Penang, Malaysia
  Mechanical Design Engineering Intern Aug. 2022 - Oct. 2022
  - Designed 4 prototypes of PCB magazines for semiconductor fluid dispensing machines using PTC Creo.
  - Increased machine assembly efficiency by optimizing pneumatic actuator and pressure sensor manifold designs.
  - Produced detailed documentations to production for assembling and testing volumetric pump service stations.
  - Established alliance with Intel by servicing 5 semiconductor testing chips for R&D purposes.

Projects

Major Projects

- **Waste Cooking Oil Collector Machine (Capstone Project)** Advanced Precision Lab, MJIIT
  Project Lead/Electronics Engineer - Supervisor: Dr. Ahmad Muhsin Ithnin Mar. 2021 - Feb. 2022
  - Designed oil pumping and storage systems and conducted CFD and stress analysis using SolidWorks.
  - Assembled and programmed automated oil collection, measurement, and filtering systems based on Arduino.
  - Assisted in the component fabrication using CNC machining and welding and tested the actuated mechanisms.
  - Led a 26-student team of engineering and marketing units and pitched the product to industry panelists.

Minor Projects

- **Investigation of River Trash Conditions Using Machine Learning (Contract Project)** Mar. 2023
  - Identified the trash amount in rivers from 200+ images with 94% accuracy using MobileNetV2 and Keras.
  - Utilized CNN to determine the motion of trash-collecting excavators from image sequences with 91% accuracy.
- **Machine Vision-Based Classification of River Stream Flow Direction (Contract Project)** Dec. 2022
  - Produced binary masks on 1000+ images of upstream, downstream, and changing river currents.
  - Constructed U-Net architecture in PyTorch for semantic segmentation to increase model accuracy by 15%.

- Trained a CNN model to classify flow direction with 88% accuracy on 300+ test images.
- Extracted river camera capturing timestamps from the images into a dataset using Tesseract OCR engine.

- **Cartesian Control and Motion Planning of 7-DoF KUKA LWR Robot (Course Project)** Apr. 2021
  - Numerically computed the Jacobian pseudo-inverse to achieve null-space control on the ROS simulated robot.
  - Implemented Rapidly-Exploring Random Trees path planning on the manipulator's end-effector using MoveIt.
- **Human Activity Recognition from IMU Motion Data (Course Project)** Jan. 2021
  - Developed a feedforward neural network in Keras to identify squats, abduction, and hip and knee flexion exercises from body accelerations, angular velocities, and magnetic field measurements with 97% accuracy.
  - Experimented PCA and k-NN algorithms to observe model performance changes.

Skills

- **Programming** Python • C++ • MATLAB • LaTeX
- **Frameworks** PyTorch • Keras • Scikit-Learn • ROS • OpenCV • MediaPipe • OpenPose
- **Platforms** Linux • Arduino • Raspberry Pi • Choregraphe • NAOqi • PLC • LTspice • OpenModelica
- **Mechanical** SolidWorks • AutoCAD • Fusion 360 • PTC Creo • 3D Printing • CNC Machining
- **Research** Academic Writing • Data Analysis and Visualization
- **Languages** English (Fluent: TOEFL 110/120) • Arabic (Native) • Japanese, French, and Malay (Beginner)

Courses and Certifications

- **MITx 6.86x Machine Learning with Python: From Linear Models to Deep Learning** Aug. 2022
  Massachusetts Institute of Technology - edX
- **Neural Networks and Deep Learning** Apr. 2022
  DeepLearning.AI - Coursera
- **Human-Robot Interaction Professional Certificate** Mar. 2022
  University of Canterbury - edX
- **CSMM.103x Robotics** May 2021
  Columbia University - edX

Invited Talks

Senpai-Kouhai (Senior-Junior) University Experience Talk Nov. 2021
- Gave an engagement talk organized by Mechanical Precision Engineering Student Society on my academic and extra-curricular experiences at MJIIT attended by all students and faculty members.

Let's Talk About Outbound Mobility Oct. 2021
- Presented to students my experiences as an exchange student in Japan and how to apply to Japanese universities organized by International Student Society of Egypt at Universiti Teknologi Malaysia.

Extra-Curricular Activities

President of Mechanical Precision Engineering Student Society Oct. 2020 - Oct. 2021
- Managed a committee of 25 executives and officers to organize academic, social, and recreational events and conduct technical workshops for 200+ students in the department.

- **Intensive Japanese Language Program at Sun Asterisk Inc., Japan** Dec. 2020 - Oct. 2021
  Trained on Japanese language and interviews for job hunting in Japanese industries.

Co-Founder of Ideas Platform Jun. 2019 - Present
- Established an online podcast and YouTube platform to provide students and youth with ideas on work and educational concepts, self-improvement, and learning methods, impacting 2000+ people.