Muhammad Talha

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Muhammad-Talha-MT

Research Interests

Deep Learning, Computer Vision, Spatio-Temporal Analysis, Foundation Models, Optimization, Hydroinfromatics, Environmental Modeling, Interpretable AI

Experience

Graduate Research Assistant *Jan 2023 – Present*
Michigan State University
Advisors: Dr. Amirpouyan Nejadhashemi & Dr. Pang-Ning Tan

- Developed a watershed-adaptive spatio-temporal Transformer as a data-driven alternative to physics-based hydrologic models; robust across spatial and temporal scales for climate data.
- A region-scale daily streamflow forecasting model that exploits spatially distributed hydrometeorological data for multiple gauges and bypasses the need for predefined watershed delineations weather forcings.
- Large Language Models utilization for Question Answering platform related irrigation problems for Agricultural Extension

Machine Learning Engineer *Jun 2021 – Dec 2022*
Ibex (TRG)

- Developed global, real-time compliance solution processing over 20K agent screen recordings with CNN-based form detection and OCR-driven data extraction for immediate violation checks.
- Worked scalable deep-learning pipeline processing large number of agents' stereo calls for text-to-speech, sensitive word obfuscation, and sentiment analysis using LSTM and GRU architectures.
- Worked with PyTorch, TensorFlow, Flask, Python, .NET Core, IIS, Apache, Linux, C++, CUDA

Research Assistant *Oct 2020 – May 2021*
Al-Khwarizmi Institute of Computer Science, UET Lahore

- A lean object-detection benchmarking effort evaluating CNN architectures with minimal data and compute to achieve high-accuracy, real-time performance in dynamic industrial settings.
- Developed explainable AI techniques for melanoma detection, offering transparent model insights and enhancing trust in automated skin cancer diagnostics.

Publications

Basin2Vec: Learning Basin-Centric Embeddings for Scalable Hydrological Modeling *Jun 2026*
Under Review to CVF WACV (2027)
Authors: **Muhammad Talha**, Xiaofeng Liu, Yuan Yang, Pang-Ning Tan A Pouyan Nejadhashemi,

BASINGRID: A distributed 40-year spatiotemporal hydrology dataset for U.S. basins *Apr 2026*
Under Review to Nature Scientific Data
Authors: **Muhammad Talha**, A Pouyan Nejadhashemi, Xiaofeng Liu, Yuan Yang

From Aggregated to Distributed: A Transformer Framework for Generalizable Streamflow Modeling Across Space and Time *Dec 2025*
Under Review to Journal of 'Engineering Application of AI'
Authors: **Muhammad Talha**, A Pouyan Nejadhashemi, Xiaofeng Liu

Watershed-Agnostic Forecasting: An Explainable, Distributed, Data- *Jun 2025*

Driven Hydrologic Model
Under Review to Journal of 'Environmental Modeling and Software'
Authors: **Muhammad Talha**, A Pouyan Nejadhashemi

Soft Computing Paradigm for Climate Change Adaptation and Mitigation *Jan 2025*
Heliyon Journal
Authors: **Muhammad Talha**, A Pouyan Nejadhashemi, Kieron Moller
Paper Link

Unveiling the Resilience of Smallholder Farmers in Senegal *Jan 2024*
Food and Energy Security Journal
Authors: Kieron Moller, A Pouyan Nejadhashemi, **Muhammad Talha**
Paper Link

Transferable Learning Architecture for Scalable Visual Quality Inspection *Mar 2022*
ICAI 2022
Authors: **Muhammad Talha**, Dr. Sheikh Faisal, Zain Iftikhar, M. Touseef Afzal
Paper Link

Education

Michigan State University *Jan 2023 – Present*
PhD in Dual Major (Computer Science & Biosystems and Agricultural Engineering)

- **Research Area:** Deep Learning, Pattern Recognition, Spatio-Temporal Analysis, Hydroinformatics, Earth Science, Geophysical Models

University of Engineering and Technology, Lahore *Aug 2017 – Jun 2021*
B.S. in Computer Science

- **Coursework:** Data Structures and Algorithms, Artificial Intelligence, Probability and Random Variables, Data Mining, Digital Image Processing, Analysis of Algorithm, Multivariate Calculus, Database Systems

Projects

High-Resolution Spatio-Temporal Modeling of Daily Streamflow *Jun 2024 – Present*
Michigan State University

- Utilizes daily streamflow data along with weather predictors to predict streamflow

Multi-objective Optimization Analysis for Smallholder Farmers *Jun 2023 – Jan 2024*
Michigan State University

- Applied linear and multi-objective optimization using Scipy and Pymoo (NSGA-II)
- Ranked solutions based on cost-effectiveness and nutritional balance

Machine Learning-based System for Compliance Violation Detection *Jun 2021 – Dec 2022*
Ibex (TRG)

- Processed real-time screen recordings of 20,000+ agents for compliance violation detection
- Developed CNN-based models integrated with OCR for real-time compliance inspection

Technologies

Languages: Python, MATLAB, C++, C#, SQL, JavaScript

Technologies: .NET, Microsoft SQL Server, PyTorch, Tensorflow, Linux, Git, DevOps