Jonathan Flores Monroy

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Summary

AI Developer with experience designing, implementing, and optimizing artificial intelligence solutions using Python and modern machine learning and deep learning techniques.

Strong background in developing end-to-end AI applications, including data processing, model training and evaluation, and integration of AI models into real systems through APIs.

Experience working with Computer Vision, Natural Language Processing, and Transformer-based models, focusing on building practical, scalable, and efficient AI solutions for real-world use cases.

Education

Instituto Politécnico Nacional (IPN) *Mexico City, Mexico*
PhD Candidate in Communications and Electronics Engineering *Feb 2023 – June 2027*
PhD program focused on applied artificial intelligence, deep learning, and intelligent systems with emphasis on real-time and deployable AI solutions.

- Thesis: TransLowNet — Online Modular Framework for Abnormal Human Action Detection and Multiclass Classification in Video Surveillance
- Research focus: applied AI, computer vision, video understanding, and real-time AI systems
- Development of modular and lightweight AI architectures for real-world deployment

The University of Electro-Communications (UEC) *Tokyo, Japan*
Research Student in Computer Science and Intelligent Systems *Sept 2023 – Sept 2024*
International research stay focused on applied deep learning and computer vision for efficient and real-time AI systems.

- Advanced deep learning and computer vision applied to real-world systems
- Focus on efficient AI models and edge deployment
- Collaboration in international and multicultural research environments

Instituto Politécnico Nacional (IPN) *Mexico City, Mexico*
Master of Science in Microelectronics Engineering *Oct 2020 – Aug 2022*
Graduate program focused on applied machine learning, embedded systems, and intelligent perception.

- Thesis: SOMN_IA — Portable Device for Real-Time Driver Drowsiness and Distraction Detection
- Applied machine learning and computer vision for real-time embedded systems
- End-to-end development from data acquisition to model deployment

Experience

AI Developer *Mexico City, Mexico*
Instituto Politécnico Nacional (IPN) *Jan 2020 – present*
Development of applied artificial intelligence solutions focused on computer vision, deep learning, and real-time AI systems, bridging research and practical deployment.

- Designed and implemented end-to-end AI solutions for video analysis, anomaly detection, and multi-class classification using Python and deep learning frameworks.
- Developed data processing and training pipelines including preprocessing, annotation, model training, evaluation, and inference.
- Built and optimized deep learning models for real-time and edge deployment, prioritizing efficiency, modularity, and scalability.
- Integrated computer vision and NLP models, including Transformer-based architectures, into functional AI systems.
- Performed model optimization, hyperparameter tuning, and performance evaluation to improve accuracy and inference speed.
- Collaborated with multidisciplinary teams using Agile workflows, contributing to system design and technical documentation.

Software Developer (QA Automation & API Validation) *Mexico City, Mexico*
Solera *Aug 2022 – Jan 2023*
Backend-oriented software development role focused on API validation, automation, and system reliability within an Agile environment.

- Developed automated testing workflows for backend services and REST APIs using Python-based tools.
- Validated API integrations, data integrity, and system behavior through manual and automated testing.
- Collaborated closely with development teams to identify issues and improve backend stability and performance.
- Worked within Agile/Scrum teams using Jira for task tracking and sprint planning.

Technical Lead & Graduate Mentor *Mexico City, Mexico*
Signal Processing Laboratory — IPN *Jan 2020 – present*
Technical leadership role supporting AI development projects and mentoring graduate students in applied artificial intelligence.

- Provided technical guidance on AI model design, implementation, and optimization for computer vision and machine learning projects.
- Supported troubleshooting, workflow optimization, and architectural decisions for AI systems.
- Assisted in translating research ideas into functional and reusable AI components.
- Contributed to technical documentation and knowledge sharing within the laboratory.

Projects

TransLowNet *Mexico City, Mexico*
Jan 2023 – present

Modular and low-power AI system for online detection, classification, and localization of abnormal human actions in video streams, designed for real-time deployment on edge devices.

- Designed an end-to-end online video analysis pipeline for abnormal human action detection and multi-class classification in surveillance scenarios.
- Implemented a modular architecture composed of a spatiotemporal feature extractor (X3D-S), an anomaly detector (C2FPL-based), and a multi-class classifier operating at clip level.
- Developed real-time inference workflows using non-overlapping video clips and streaming-based processing, enabling progressive decision-making without full video access.
- Optimized the system for edge deployment, achieving up to 283.49 FPS (without I/O) and 27.42 FPS (with I/O) on a Jetson Orin NX (8 GB, 20 W).
- Achieved 80.0% AUC for anomaly detection and 59.02% classification accuracy on human-centered abnormal actions using the UCF-Crime dataset.
- Reduced computational cost to 2.84 GFLOPs using lightweight X3D-S backbone, enabling efficient deployment in resource-constrained environments.
- Implemented weakly supervised learning strategies using video-level labels and adapted pseudo-labeling techniques for clip-level anomaly scoring.
- Evaluated and benchmarked multiple backbone architectures (X3D-S, X3D-M, UniFormer-S, I3D) to balance accuracy, efficiency, and real-time performance.
- Trained and validated models on real-world surveillance data, demonstrating robustness to occlusions, illumination changes, and crowded environments.

SOMN_IA *Mexico City, Mexico*
Jan 2020 – Aug 2022

Portable and real-time AI system for detecting driver drowsiness and distraction using computer vision and lightweight deep learning models, designed for deployment in resource-constrained embedded environments.

- Designed and implemented an end-to-end real-time computer vision pipeline for driver monitoring, operating directly on a portable embedded device.
- Developed a shallow CNN (S-CNN) optimized for low computational cost, achieving 95.77% classification accuracy with only ~340k trainable parameters.
- Implemented face detection using MediaPipe, optimized for mobile and embedded deployment with low latency.
- Designed temporal decision logic to distinguish real drowsiness from normal blinking and short-term distractions using consecutive-frame analysis.
- Implemented isolated prediction error correction mechanisms to improve robustness under illumination changes and sensor noise.
- Built a multi-stage alerting system integrating visual, audio, GUI-based, and SMS notifications for critical safety scenarios.
- Integrated the system with vehicle power using a buck-type DC-DC converter, enabling universal installation across different vehicles.
- Constructed and curated a custom training dataset (4,800 labeled face images) based on the NTHU-DDD dataset for three driver states.
- Achieved stable real-time operation (~21 FPS) on portable hardware with limited memory and computational resources.
- Validated the system under real driving conditions, demonstrating robustness to lighting variation, head pose changes, and sensor placement.

Intelligent Anti-Theft System for Motorcycles *Mexico City, Mexico*
Embedded and IoT-based security system for motorcycles that prevents theft by automatically disabling the engine and braking system when unauthorized separation between rider and vehicle is detected. *Jan 2018 – June 2019*

- Designed a dual-device embedded system integrating a helmet-mounted module and a motorcycle-mounted control unit.
- Implemented distance-based logic between helmet and vehicle to automatically shut down the engine and lock the front mechanical brake.
- Developed microcontroller firmware including communication protocols, control logic, and safety mechanisms.
- Integrated GPS-based real-time vehicle localization and GSM communication to send alerts and location data to the user's mobile phone.
- Implemented remote blocking capabilities, allowing the system to be activated or locked via phone communication in theft scenarios.
- Developed a user data management module storing vehicle and owner information (ID, plates, serial number, vehicle characteristics) for rapid incident reporting.
- Designed power management strategies for low energy consumption, including manual system activation via hardware switch.
- Built a practical and deployable prototype focused on real-world theft scenarios and user safety.

Publications

An Online Modular Framework for Anomaly Detection and Multiclass Classification in Video Surveillance Aug 2025
Modular and efficient framework for online video anomaly detection and multi-class classification, designed for real-time deployment on edge devices under limited computational resources.
Jonathan Flores-Monroy, Gibran Benitez-Garcia, Mariko Nakano-Miyatake, Hiroki Takahashi
(Applied Sciences (MDPI))

Ownership Authentication and Integrity Verification of Digital Images Using Generative Models and Custom Signature July 2024
Image ownership authentication framework using generative models and custom digital signatures to ensure integrity and authenticity.
Jonathan Flores-Monroy, Manuel Cedillo-Hernandez, Mariko Nakano-Miyatake, Hector Perez-Meana
(47th International Conference on Telecommunications and Signal Processing (TSP), IEEE)

Voice Gender Recognition Under Unconstrained Environments Using Fine-Tuned CNNs June 2024
CNN-based voice gender recognition system designed to operate under noisy and unconstrained acoustic environments.
Jorge Jorrin-Coz, Mariko Nakano, *Jonathan Flores-Monroy*, Hector Perez-Meana
(New Trends in Intelligent Software Methodologies, Tools and Techniques (IOS Press))

Face Expression Recognition using Recurrent Neural Networks July 2023
Facial expression recognition approach using recurrent neural networks to model temporal dynamics in facial features.
Marcos Sanchez-Ruiz, *Jonathan Flores-Monroy*, Mariko Nakano-Miyatake, Enrique Escamilla-Hernandez, Hector Perez-Meana
(46th International Conference on Telecommunications and Signal Processing (TSP), IEEE)

SOMN_IA: Portable and Universal Device for Real-Time Detection of Driver's Drowsiness and Distraction Levels Aug 2022

Portable embedded system combining computer vision and lightweight CNNs for real-time driver drowsiness and distraction detection in real driving conditions.

Jonathan Flores-Monroy, Mariko Nakano-Miyatake, Enrique Escamilla-Hernandez, Gabriel Sanchez-Perez, Hector Perez-Meana

10.3390/electronics11162558 (Electronics (MDPI))

Skills

Programming Languages: Python (Advanced), C/C++, Bash, MATLAB

AI & Machine Learning: Machine Learning, Deep Learning, Supervised and Weakly Supervised Learning, Model Training and Evaluation, Hyperparameter Tuning

Computer Vision: Video Analysis, Action Recognition, Anomaly Detection, Face Analysis, Feature Extraction, Spatiotemporal Modeling

NLP & Multimodal AI: Natural Language Processing (NLP), Transformer-based Models, Multimodal Learning, Semantic Feature Integration

Frameworks & Libraries: PyTorch, TensorFlow, scikit-learn, OpenCV, HuggingFace Transformers, PyTorchVideo, Ultralytics YOLO

Edge AI & Real-Time Systems: Real-Time Inference, Edge AI Deployment, Model Optimization, Low-Power AI, Embedded AI Systems

Data & Pipelines: Data Preprocessing, Dataset Construction and Annotation, Feature Engineering, End-to-End AI Pipelines

Hardware & Embedded Systems: NVIDIA Jetson (Orin NX), GPU Acceleration (CUDA), Microcontrollers, Sensor Integration

Software Engineering & Tools: Git, Linux, REST APIs, Jupyter, Agile/Scrum, Jira

Evaluation & Metrics: AUC, Accuracy, FPS, GFLOPs, Latency, Model Benchmarking

Patents

1. Sistema Portátil para Detección de Somnolencia y Distracción en Conductores Usando Inteligencia Artificial (MX/a/2022/015919)

Invited Talks

4. Detección y clasificación de acciones humanas anómalas para videovigilancia en dispositivos de borde — CONCAPAN - El Salvador (2025)
3. TransLowNET: IA Embebida para Detección de Violencia en Transporte Público. — TalenLand - Mexico (2025)
2. TransLowSecurNet: Optimization of a Low-Cost AI Model to Improve Safety in Public Transportation in Mexico — Mini Conference JUSST - Japan (2024)
1. Ownership Authentication and Integrity Verification of Digital Images Using Generative Models and Custom Signature — TSP - Czechoslovakia (2024)