# Hassan Rasheed

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## Education

**Gift University** **Gujranwala, Pakistan**
*Bachelor of Science in Data Science, GPA: 3.3/4.0* *Dec 2022 – July 2026*

Coursework:Machine Learning, Deep Learning, Artificial Intelligence, Computer Vision, Data Mining, Operating Systems, Programming Fundamentals, Data Structures & Algorithms, Analysis of Algorithms, Database Management System, Linear Algebra, Probability and Statistics, Advanced Statistics, Big Data Analytics

## Technical Skills

**Languages**: Python, R, C++, Java, SQL, JavaScript

**ML/DL Frameworks**: TensorFlow, PyTorch, Keras, Scikit-learn, XGBoost, OpenCV, MediaPipe

**Data Science**: Pandas, NumPy, Matplotlib, Seaborn, Plotly

**Tools & Platforms**: Git/GitHub, Docker, Jupyter, Google Colab, Streamlit, Flask, Tableau, Power BI

**Databases**: MySQL, PostgreSQL, MongoDB

**Web Technologies**: JavaScript, PHP, HTML

## Research Experience & Skills

**Research Areas**: Machine Learning, Deep Learning, Foundation Models, Knowledge Distillation, Multi-Modal Learning, Medical Imaging, Computer Vision, Time-Series Analysis, Ensemble Methods, Real-Time Systems

**Technical Strengths**: Machine Learning Algorithm Development, Deep Learning Architecture Design, Model Optimization & Hyperparameter Tuning, Transfer Learning & Fine-Tuning, Ensemble Methods, Feature Engineering, Real-Time Video Processing, Statistical Analysis

**Soft Skills**: Independent Research, Technical Writing, Problem Solving, Algorithm Design, Code Documentation, Collaborative Development

## Research & Projects

Deep Learning & Foundation Models

**Advanced Research Project**
***Foundation Model-Enhanced COVID-19 Detection*** *July 2025 – Sep 2025*

- Developed novel knowledge distillation framework using foundation models (BiomedCLIP, DINOv2, OpenAI CLIP) for COVID-19 detection from chest X-ray images, achieving 99.3% teacher accuracy
- Engineered two-stage architecture with lightweight student model (297x parameter reduction) maintaining 96.4% accuracy through multi-level knowledge distillation (hard loss, soft loss, feature alignment)
- Implemented medical-optimized efficient blocks with SE attention mechanisms and depthwise separable convolutions for pathological pattern recognition
- Achieved 5-6MB deployable model with 20x inference speedup (45ms), enabling real-time mobile deployment

**Medical Imaging – BRATS 2020**
***Brain Tumor Segmentation*** *Jun 2025 – July 2025*

- Developed Attention U-Net architecture for precise multi-class tumor segmentation (ET, TC, WT) achieving Dice score 0.993
- Applied advanced preprocessing: CLAHE, normalization, ROI extraction; custom loss combining Dice coefficient and Binary Cross-Entropy
- Implemented efficient data handling pipeline with .npy format for scalable clinical deployment

## Hybrid Machine Learning & Ensemble Methods

**Environmental AI**

***CO Emission & Fuel Consumption Prediction*** *April 2025 – June 2025*

- Developed hybrid DL/ML system combining Feature Transformer (TensorFlow/Keras) with XGBoost for dual prediction of vehicle CO emissions (g/km) and fuel consumption (L/100 km)
- Designed meta-classifier ensemble approach using XGBoost as final decision layer, achieving superior generalization over individual models
- Engineered comprehensive preprocessing: StandardScaler, categorical encoding, feature engineering for engine specifications

**Healthcare ML**

***AI-Powered Heart Disease Prediction System*** *April 2025 – May 2025*

- Developed comprehensive cardiac risk assessment combining ensemble ML (Random Forest, Logistic Regression, XGBoost) with OCR technology for automated medical report analysis
- Achieved 95%+ accuracy on Cleveland Heart Disease dataset (303 patients, 13 parameters) validated via 5-fold cross-validation
- Integrated Tesseract OCR with OpenCV preprocessing and regex extraction for automated medical report analysis
- Built production Streamlit application with real-time prediction (<100ms), interactive Plotly visualizations, automated PDF reports via ReportLab
- Designed medical-grade UI with professional dark theme, color-coded risk indicators, and personalized health recommendations

## Computer Vision & Multi-Object Tracking

**Intelligent Transportation**

***Red Light Violation Detection System*** *Oct 2024 – Dec 2024*

- Developed automated traffic violation detection using YOLOv12 + ByteTrack (ECCV 2022) for multi-object tracking in video streams
- Implemented HSV color space analysis with CLAHE on V channel and morphological operations for robust traffic light state classification
- Engineered geometric line-crossing algorithms with ByteTrack's two-stage association framework (high/low confidence detections) maintaining consistent object IDs through occlusions
- Built interactive ROI definition interface with brightness-weighted pixel voting and automated violation recording

**Workplace Safety**

***AI-Powered Construction Safety Monitoring*** *Aug 2024 – Oct 2024*

- Developed real-time YOLOv8 web application for PPE violation detection (10 categories) on construction sites
- Applied transfer learning on custom safety dataset; built full-stack Flask application with bilingual audio feedback (English/Arabic)
- Engineered automated compliance system with visual annotation, dynamic label scaling, audio alerts via gTTS/pyttsx3

**Security & Surveillance**

***Real-Time Weapon Detection System*** *May 2024 – Jul 2024*

- Developed AI-powered surveillance system using YOLO/SSD-MobileNet for firearm and knife detection in real-time video
- Engineered end-to-end pipeline: video preprocessing, frame extraction, detection, alert generation
- Applied transfer learning on custom weapon dataset with annotated bounding boxes for CCTV deployment

**Insurance Technology**

***AutoClaimVision: Vehicle Damage Assessment*** *Feb 2025 – Mar 2025*

- Developed CNN-based model (ResNet/EfficientNet) for automated vehicle damage classification achieving 88% accuracy
- Engineered end-to-end pipeline with data augmentation reducing manual inspection time by 50%
- Deployed via Flask API for real-time severity assessment with IoU and F1-score evaluation

## Image Processing & Augmented Reality

**Image Segmentation & AR**

***OpenCV Invisibility Cloak*** *Jan 2025 – Feb 2025*

- Developed real-time augmented reality application using color detection and segmentation in HSV color space
- Implemented background subtraction with morphological operations (opening, dilation) for noise reduction and mask refinement
- Engineered frame replacement algorithm using bitwise operations to blend foreground and background, creating invisibility effect
- Applied dynamic HSV thresholding for robust color detection under varying illumination conditions

## Human Pose & Gesture Recognition

### Human-Computer Interaction

***Real-Time Hand Gesture Recognition System*** *Sep 2024 – Nov 2024*

- Developed dual-mode system combining MediaPipe Hand Landmark Detection (21 3D landmarks) with 468-point face mesh visualization
- Implemented 7 gesture classifications (Fist, Open Palm, Thumbs Up/Down, Index, Peace, Rock) achieving 95%+ accuracy
- Engineered configurable detection algorithms with real-time performance (30+ FPS), multi-hand support, modular architecture
- Applied MediaPipe Pose estimation for face landmark tracking with complete facial feature detection

### Driver Safety

***Real-Time Drowsiness Detection System*** *Jun 2024 – Aug 2024*

- Built computer vision system using dlib's 68-point facial landmark predictor and Eye Aspect Ratio (EAR) algorithm
- Developed multi-stage pipeline: Haar Cascade detection, landmark extraction, frame-based monitoring distinguishing blinks from drowsiness
- Implemented real-time audio alerts with extensive testing under varied lighting and head positions

### Fitness Technology

***Push-Up Detection & Form Analysis*** *Apr 2024 – Jun 2024*

- Developed MediaPipe Pose-based system for automated push-up counting via elbow angle analysis
- Implemented state machine logic with noise-filtering for accurate rep counting and real-time form feedback
- Built webcam application with fullscreen optimization and automated AVI recording

### Touchless Interfaces

***Gesture-Based Grocery Basket System*** *Feb 2024 – Apr 2024*

- Developed touchless shopping application using MediaPipe hand tracking (21 3D landmarks per hand)
- Engineered gesture recognition with custom logic for finger counting, pinch gestures, palm movements
- Built interactive UI for virtual shopping with gesture-controlled browsing, cart management, checkout

## AI-Powered Analytics & Automation

### Data Science Automation

***AutoStatAgent: Multi-Agent EDA Platform*** *Jul 2024 – Sep 2024*

- Built multi-agent system with 7 specialized agents for automated exploratory data analysis
- Integrated Groq LLM API (Llama3-8b-8192) for AI-powered question generation and statistical interpretation
- Implemented comprehensive statistical analysis: correlation (Pearson, Spearman), hypothesis testing (t-tests, ANOVA, chi-square)
- Developed intelligent visualization engine with LaTeX-based PDF report generation; Streamlit interface supporting CSV/Excel/JSON

### Business Analytics

***Customer Churn Prediction*** *Nov 2023 – Jan 2024*

- Built ensemble ML models (Logistic Regression, Random Forest, XGBoost) achieving 92% accuracy, 0.85 ROC-AUC
- Performed comprehensive preprocessing: missing value handling, feature engineering, encoding, normalization
- Deployed via Flask API for real-time churn prediction with cross-validation and hyperparameter tuning

## Industrial IoT & Predictive Maintenance

### Signal Processing

***Motor Fault Classification via MCSA*** *Dec 2023 – Feb 2024*

- Developed comprehensive ML pipeline for 14-class induction motor fault classification using Motor Current Signature Analysis
- Processed high-frequency time-series data (39 datasets, 100,000+ samples at 10 kHz) under varied loads (100W, 200W, 300W)
- Classified bearing faults (0.7-1.7mm severity) and broken rotor bar faults through current signature analysis
- Implemented manual K-NN from scratch; compared with Logistic Regression, Naïve Bayes, SVM using PCA dimensionality reduction
- Evaluated via Hold-out and 10-fold Cross Validation with metrics: Accuracy, Recall, Precision, Sensitivity, Specificity, F1

### Additional Projects

**Geospatial AI**

***Satellite Image Recognition*** *May 2023 – Jul 2023*

CNN-based land classification with GPS metadata integration, transfer learning using ResNet/EfficientNet for multi-class detection of water bodies, deserts, forests, and urban areas

**Recommender Systems**

***Music & Movie Recommendation Systems*** *Mar 2023 – May 2023*

Collaborative filtering (neighborhood-based, matrix factorization), content-based filtering with TF-IDF and cosine similarity, NLP for metadata analysis

## Certifications & Achievements

**Coursera**: Machine Learning Specialization (Supervised/Unsupervised Learning, Deep Learning)

**Coursera**: Introduction to Deep Learning with Keras (Neural Networks, Regularization)

**Hackathons**: Participated in 10+ international hackathons demonstrating problem-solving and rapid prototyping skills

**Harvard**: Puzzle Competition – Solved 9/9 puzzles (Outstanding analytical & critical thinking)

**UC Berkeley**: Coding Competition Certificate

**Meta**: Hacker Cup Coding Competition Certificates (2 certifications)