Madhur Kumar Rana

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Portfolio and live demos: madhur0770.github.io

Profile

Software engineer and M.Tech student in Artificial Intelligence and Data Science at MNNIT Allahabad. I build full-stack web applications and machine-learning systems and ship them with automated tests, continuous integration and public demos. My current research is automatic glaucoma detection from retina photographs. I am looking for software engineering, AI/ML and data science roles.

Education

Motilal Nehru National Institute of Technology (MNNIT) Allahabad — Prayagraj, India
M.Tech. in Artificial Intelligence and Data Science, CPI 8.4 — *2025 – Present*

KIET Group of Institutions (AKTU) — Ghaziabad, India
B.Tech. in Information Technology, Aggregate 76.8% — *2024*

Hoerner College — Lucknow, India
ISC (Class XII) 79.33%, ICSE (Class X) 81.16% — *2019, 2017*

Technical Skills

Languages: Python, TypeScript, JavaScript, SQL, HTML, CSS
Web and Backend: FastAPI, Next.js, SQLModel, REST APIs, WebSockets, JWT authentication
AI and Machine Learning: PyTorch, scikit-learn, OpenCV, Ultralytics YOLO, Deep Learning, Computer Vision, Retrieval-Augmented Generation (RAG), Model Context Protocol (MCP), Neo4j and knowledge graphs
Data Science: scikit-learn, cross-validation, probability calibration, ROC and AUC, DeLong test, segmentation metrics (Dice)
Tools and Practices: Git, GitHub Actions (CI), Docker, pytest, Playwright, Data Structures and Algorithms

Projects

Signal Clone: Real-Time Messaging Application [Demo] [GitHub]
Next.js, TypeScript, FastAPI, SQLModel, WebSockets, JWT, Playwright
- Built a Signal-style messenger with real-time one-to-one and group chat, delivery and read receipts, typing indicators, reactions, replies, attachments, disappearing messages, blocking and dark mode.
- Implemented real-time delivery with native WebSockets and a server-side connection manager that broadcasts events to conversation members; the client reconnects automatically and updates a single Zustand store.
- Designed an 8-table SQLModel schema (including per-recipient message status and reactions) and JWT authentication backed by a sessions table, so the same session check protects REST and WebSocket access.
- Tested the REST API, WebSocket events, uploads, message expiry and database migrations with pytest, the UI with Vitest and the full app with Playwright; GitHub Actions runs lint, tests and the production build. Frontend on Vercel, API on Render.

BrowserPilot: Natural-Language Browser Agent [Page] [GitHub]
Python, Model Context Protocol, Playwright, Streamlit, Ollama
- Built a Streamlit app where an LLM (OpenAI or a local Ollama model) plans and carries out browser tasks by calling Playwright MCP tools, and returns a markdown report.
- Added guardrails that reject loopback, private and cloud-metadata targets before the agent starts, and treat page content as untrusted data.
- Pinned the Playwright MCP version, tested the tool layer end to end without an LLM, and documented a live check with a local model, including its limits.

SprintPilot: Approval-Gated Sprint Planning for Jira [Page] [GitHub]
PowerShell, Jira, Model Context Protocol, GitHub Actions
- Built nine Agile workflows (scope shaping, backlog triage, owner recommendation, load balancing, risk detection, stand-up brief, retrospective notes and others) as prompt templates with a tested PowerShell runner for Windows PowerShell 5.1 and 7.
- Enforced safe defaults: runs are dry by default, changes need an explicit flag, assignee changes need a named approver checked before the agent starts, and applied runs are written to an audit log.
- Included an offline demo on fictional data that needs no Jira, network or account, with CI checking its output.

YOLO Object Detection Studio [Demo] [GitHub]
Python, Ultralytics YOLO, OpenCV, Streamlit, Docker
- Built an app that detects and counts objects in images, video and a live camera, with region-of-interest counting, object tracking for unique counts, class filtering and CSV export.
- Supports general-purpose YOLO models: COCO (80 classes) and Open Images v7 (600 classes) in four sizes, with adjustable confidence and region of interest.
- Separated peak-per-frame counts, total detections and unique tracks for video. Added 40 tests, CI on Windows and Linux with a real-model job, and a Docker image; deployed on Streamlit Community Cloud.

GraphCite: Knowledge-Graph Question Answering with Verified Citations [Page] [GitHub]
Python, Neo4j, Streamlit, LLM APIs

- Built multi-hop question answering over a Neo4j knowledge graph: the model must quote the sentence behind every entity and relation, unsupported extractions are dropped, and relations keep their source sentence.
- Verified each answer sentence for a citation, valid evidence numbers and word-level support in the cited sentence, and flagged the rest. Documented that the check is lexical and what it cannot catch.
- Added a demo mode that runs without a model or database, unit tests and CI, and ran the pipeline end to end on a local Ollama model.

Experience

MNNIT Allahabad: M.Tech Research, Glaucoma Detection with Deep Learning [Demo] [GitHub]
Ongoing *2026 – Present*

- Built a multi-stage system for fundus photographs: U-Net localises and segments the optic disc and cup, a PPA model finds atrophy, the cup-to-disc ratio and rim widths are measured, and a ResNet-50 with heat maps feeds a calibrated glaucoma probability and an image-quality warning.
- Trained on about 2,600 photos from public datasets (RIGA, Chaksu, PAPILA; PALM for atrophy) with patient-wise splits. Disc and cup Dice 0.978 and 0.904; cup-to-disc ratio error 0.031 (classical baseline 0.178); AUC 0.877 on 411 clinically diagnosed eyes (baseline 0.602).
- On 191 eyes graded by six ophthalmologists, out-of-fold accuracy against their consensus is 92.7% (best single doctor 91.1%).
- Evaluated with leave-one-dataset-out testing, blur, darkening, compression and noise tests, 5-fold cross-validation, DeLong tests and calibration.
- Exported the models to ONNX and shipped a browser-only demo and a command-line tool. Two manuscripts are in preparation.

KIET Group of Institutions Ghaziabad, India
Departmental Intern *Aug. 2021 – July 2023*

- Built internal web tools and Python automation scripts (HTML, CSS) for departmental reporting.
- Worked with departmental teams on solutions that reduced manual data processing time by 30%.

Publication, Achievements and Certifications

- **IEEE publication:** Co-authored "Financial Fraud Detection and Comparison Using Different Machine Learning Techniques" (IEEE Xplore, 2024).
- **GATE qualified** (CS/DA), leading to admission to MNNIT Allahabad.
- **InnoTech 2022:** 1st position in the annual technical fest of KIET Group of Institutions.
- **TATA Imagination Challenge:** cleared Round 2 of the national-level innovation challenge.
- **Certifications:** Artificial Intelligence (Infosys Springboard); Front End Development (Great Learning).
- **Athletics:** national-level sprinter.