

# Harshit

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## Education

**National Institute of Technology, Kurukshetra**, *B.Tech in Electrical Engineering (CGPA 7.93/10)* **2021 - 2025**

- **Key Modules :** Basics of Programming, Modelling & Simulation, Control System, Applied Linear and Vector Algebra, Robotics, Microprocessor and MicroController, Virtual Instrumentation, Electric Vehicle, Reliability Engineering, Communications Skills in English, Ethics and Intellectual Property Rights, Business Management.

## Area of Interests

- Applied Deep Learning
- ML/LLM Operations
- Model Optimization
- Agentic AI and AI Agents
- Computer Vision
- Generative AI
- Deep Reinforcement Learning
- Multimodality AI

## Research and Internship Experience

**Research Trainee** | *Deep Learning, ComputerVision, Digital image Processing, GenAI* **Jan 2024 - Jun 2024**  
*Council of Scientific & Industrial Research–Central Scientific Instruments Organization, Chandigarh.* **ON-SITE**

- Worked on **generative models** including AE,VAE,Tranformer based AE and Diffusion model for molecules generation.
- Contibuted in a **research paper** on Navigating the Fragrance space Via Generative Models And Predicting Odors.
- Experimented with **self-/supervised** techniques for effective representaton and transfer learning.
- Worked on SOTA classification architecture **AccNet** for time–series data classification from acceleration in 3 dims.
- Implemented **YOLO** model for animal detection, recognition, and annotation classification for labeled data collection.

**Deep Learning Intern** | *Deep Learning , Audio and Digital processing , Model Optimization* **May 2024 - Jul 2024**  
*IIT Ropar - Technology & Innovation Foundation (iHub - AWaDH)* **REMOTE**

- Utilized **OpenAI API** for synthetic image gen using **DALLE3**, enhancing the dataset for classification of bees species.
- Integrated **GPT-3.5-turbo** via OpenAI API to generate structured **bee-flower relationships**, improving data diversity for model training. **[PPT]**
- Developed a Convolutional Neural Network based bioacoustic classification model architecture to classify beehive state.
- Explored different time-frequency representations of audio, experimented with different networks such as ViT, CNN.
- Improved model's accuracy by 31% & achieved **98.31%** accuracy via **data augmentation** and **hyperparam–tuning**.
- Optimized the network, reducing model size from **21.82 MB** to **1.79 MB** and accelerating inference time by **66%**, maintaining the accuracy of **97%**. **[Report]**

**Undergraduate Researcher** | *Electricity Load Forecasting using ML/DL and Hybrid Models* **Jan 2025 - May 2025**  
*National Institute of Technology, Kurukshetra - Electrical Engineering Department* **ON-SITE**

- Developed models for **short-term electricity demand forecasting** using hourly time series data and exogenous features like temperature, Weekdays/Weekend demand and holidays, under the supervision of **Dr. Ashwani Kumar**.
- Performed **EDA** (exploratory data analysis) to identify trends, seasonality, and autocorrelation patterns in load data.
- Engineered features such as lag variables, rolling statistics & calendar-based indicators to improve model input quality.
- Built and evaluated **ML** (RF, XGB, SVR, GB, DT, ARIMA), **DL models** (LSTM, GRU, CNN-LSTM, ANN) and **hybrid approaches** (ARIMA+MLP, RF+XGB+ARIMA); used **GridSearchCV** to optimize hyperparameters
- Achieved best results with **RF (MAE: 10.61, RMSE: 13.93, MAPE: 0.89)**; documented findings in a detailed **[report]**, delivered a final **[ppt]** summarizing methodology, results and key insights and shared all **[Code]** via GitHub

## Projects

**Multi-Model Voice & Text Chatbot** | **Streamlit, LLMs, Reliability** **[Source Code]**

- Built a **Streamlit-based chatbot** supporting **text and voice input** with transcription, LLM response generation, and **text-to-speech** output. **[link]**
- Integrated **OpenAI GPT-3.5-turbo**, **Groq (DeepSeek-LLaMA-70B)**, and **Gemini Pro 1.5** for **multi-model** response generation with **fallback handling**.
- Implemented **speech-to-text** using **Whisper** and **text-to-speech** using **OpenAI TTS** for full voice interaction.
- Designed a modular, **highly reliable** pipeline (Approach 2) with support for audio files, mic input, and manual text queries; compared it with a basic LLM pipeline (Approach 1 i.e. **[speech-to-speech Voice-Bot]**).
- Deployed on **Streamlit Cloud** using **secure API key management**; produced system architecture diagrams and Reliability block diagram to visualize design improvements.

## Agentic LLM for Autonomous Shopping Assistance | ReAct, Chain of tools, ReST, Multi-Agent [\[Source Code\]](#)

- Built an **Agentic LLM for shopping** with tool-augmented reasoning for multi-step product search and comparison.
- Integrated **external APIs** like Google Search, Firecrawl, and Wikipedia for **real-time knowledge retrieval**.
- Implemented **self-improvement** via adaptive reflection, black-box probing, fine-tuning, and reward ranking.
- Developed an evaluation pipeline for benchmarking and visualizing agent performance on **Webshop tasks**. [\[Video\]](#)

## Stable Diffusion | Latent Diffusion, U-Net, Variational AutoEncoder, Clip, PyTorch [\[Source Code\]](#)

- Developed SD from scratch in PyTorch, utilizing **latent diffusion** to generate images from text and image prompts.
- Implemented **U-Net architecture** for image generation and classifier-free guidance for conditional sampling.
- Leveraged **CLIP embeddings** for improved text-to-image alignment and **VAE** for compressed latent space encoding.
- Applied principles from **Denoising Diffusion Probabilistic Models (DDPM)** for progressive noise removal and image refinement. [\[Referenced implementation repository\]](#)

## Chatbot | LLaMa2( LLM ), kivyMD, HuggingFace, PyTorch [\[Source Code\]](#)

- Implemented the **LLaMA 2** architecture from scratch using **PyTorch**, incorporating advanced components like **Rotary Positional Embeddings, Grouped Query Attention (GQA), RMSNorm, SwiGLU, and KV caching**.
- **Fine-tuned** the LLaMA 2-7B-chat model on a custom dataset using **PEFT** like **LoRA and QLoRA**. [\[NoteBook\]](#)
- Built an interactive GUI using KivyMD, allowing seamless interaction with the fine-tuned model for text generation.

## MuJoCoAI | Deep Reinforcement Learning, Q-Learning [\[Source Code\]](#)

- Implemented **DQN** and **A3C** models to enhance decision-making in non-deterministic environments.
- Developed a customizable environment with Kivy for **self-driving cars** and **Lunar Lander** using **OpenAI Gym**.
- Applied **TD3** model to optimize policies in complex **MuJoCo** environments like Ant, Half-Cheetah, and Humanoid.

## Sign Language Detection | Action Recognition, ANN, LSTM [\[Source Code\]](#)

- Built a **Real-time sign language detection model**, empowered by **LSTM** layer for enhancing effectiveness.
- Extracted Holistic Key Points of palm and pose using the **Mediapipe** for training & testing action detection model.
- Developed a robust deep neural network using **Tensorflow & Keras**, utilizing a Stacked LSTM layer to effectively process and analyze the pattern from the sequences of detected holistic key points for real-time sign language decoding.

## Facial Recognition Application | CNN, Siamese Neural Network, OpenCV, KivyMD [\[Source Code\]](#)

- Built a **deep facial recognition** application for face authentication integrated into a **Kivy** application.
- Built and trained a model **CNN-based Siamese model** using **Tensorflow & Keras**, Implemented data augmentation and dropout methods to improve generalization and reduce overfitting. [\[Siamese Neural Networks paper\]](#)
- Developed a Kivy Application integrated with the DL model, achieving a perfect **precision & recall of 1** on test data.

## Technical Skills

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**Languages & Libraries:** C/ C++, Python, MATLAB/Simulink, Git, Numpy, Pandas, TensorFlow, Keras, PyTorch, Matplotlib, OpenCv, Scikit-learn, L<sup>A</sup>T<sub>E</sub>X, Langchain, HuggingFace | **Developer Tools:** Visual Studio Code, Jupyter Notebook, Google Collab, MATLAB, PyCharm, Github, Tableau | **Data Structure and Algorithms:** C++ | **Web-Development:** CSS, HTML, javascript, Bootstrap, Streamlit, KivyMD

## Achievements

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### Smart India Hackathon – Winner( Intra College ), *Team Leader & AI Developer* NIT, KKR Sep 2023

- Led a victorious team, showcasing AI development skills and strategic leadership in a nationwide hackathon.

### Extracurricular Sports & Athletics

- Represented **Haryana Cricket Association** in **U14** and **Vijay Merchant Trophy (U16)** cricket tournaments.
- Secured **third position** in **Intra-State Haryana Government U-17 cricket Tournament**.
- Competed in the **U14 State Level Basketball Tournament** representing Sirsa, Haryana.

## Technical Reports/Thesis and Papers

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### Reports/Thesis

- Beehive Classification using CNN with Bioacoustic Signal & Network Size Compression and Inference Acceleration.
- Evolution of Artificial Intelligence towards PhysicalAI. [\[report\]](#)
- Electricity Load Forecasting Using ML, DL and Hybrid models.

### Research Papers

- **Harshit**, et al. “CNN Optimization for Beehive Classification using Bioacoustic Signals.” *Manuscript in preparation*.
- **Harshit**, et al. “Comprehensive Evaluation of Different Approaches for Electricity Load/Demand Forecasting — Machine Learning, Deep Learning, and Hybrid Models.” *Under review at a peer-reviewed conference*.

## Position of Responsibility and Presentation

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### Seminar (Github) NIT, Kurukshetra

March 2025

- Delivered a **presentation** on Evolution of AI towards Physical AI to class and Associate Prof. K.K Sharma. [\[report\]](#)

### Embedded System and Robotics Club (EMR) NIT, Kurukshetra

Sep 2022 - Sep 2024

- Volunteered in workshop, educating participants on constructing and operating line following & remote-controlled bot.
- Participated in a workshop on **DIP** ( Digital Image Processing ) focusing on **OpenCV, numpy, python, And PyAutoGUI** and created a gesture control video player project.