

# Anubhav Elhence

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I am a Ph.D. candidate at BITS Pilani, working under the ASEAN India Collaborative Project funded by SERB DST, with a focus on enabling drone-driven smart cities through real-time computer vision, secure communication, and data fusion for drones. As the Lab In-charge of the IoT Tinker Lab, I mentor over 20 students and manage an 80 lakhs INR funding. I have co-instructed courses in IoT, Hardware Software Co-design, and Microprocessor Programming and Interfacing, emphasizing practical hands-on learning using industry-standard tools. My expertise is in designing system architectures for embedded AI, IoT, and Blockchain projects, coupled with extensive R&D experience in robots, drones, and cloud technologies, underscores my dedication to innovation and impactful solutions. My passion for teaching drives me to inspire and equip the next generation of engineers with the skills and knowledge they need to succeed.

## EDUCATION

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### BITS Pilani

Pilani, RJ, India

*Full Time PhD*

*Jan 2022 – Finishing in Jan/Feb 2025*

My PhD is under the ASEAN India Collaborative Project funded by SERB DST, a collaborative initiative between Prof Vinay Chamola (PI), BITS Pilani, India, Prof Biplab Sikdar (Co-PI), National University of Singapore, and Prof Huynh Thi Thanh Binh, Hanoi University of Science and Technology, Vietnam. **My PhD topic is “Enabling Drone Driven Smart Cities: Real-time computer vision, Secure Communication, and Data Fusion for Drones.”**

### BITS Pilani

Pilani, RJ, India

*B.E. in Electronics and Instrumentation; GPA: 9.20/10.00*

*Aug 2015 – May 2020*

*M.Sc.(Hons) in Physics; GPA: 9.20/10.00*

*Aug 2015 – May 2020*

**Relevant coursework in Electronics:** Computer Architecture, Embedded System Design, Microprocessor Programming and Interfacing, Hardware Software Codesign, Deep Learning

**Relevant coursework in Physics:** Quantum Physics, Quantum Computing, Classical Mechanics, Statistical Mechanics, Nuclear Physics

## EXPERIENCE

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### LaTrobe University

Melbourne, Australia

*Australia-India Research Fellowship*

*May 2023 – Aug 2023*

- Successfully implemented a novel authentication scheme to enhance secure communication between UAVs and ground stations as well as between UAVs.
- Collaborated closely with experts at the Cisco LaTrobe Centre for AI and IoT, leveraging cutting-edge AI and IoT technologies.
- Conducted extensive research and development to ensure the robustness and reliability of the authentication scheme in various operational scenarios.

### National University of Singapore (NUS)

Singapore

*Research Internship at CISCO-NUS Corporate Lab*

*Jun 2022 – Sep 2023*

- Contributed to the development of a blockchain and machine learning-based framework aimed at optimizing health insurance industry operations, reducing costs, and improving efficiency.
- Implemented AI-driven solutions for secure and cost-effective minor medical teleconsultation, enhancing accessibility and patient outcomes.
- Published two research papers detailing the methodologies and results of the project, which were well-received in the academic and professional communities.

### BITS Pilani

Pilani, India

*PhD Scholar under the ASEAN India Collaborative Project*

*Feb 2022 – Ongoing*

- Actively involved in high-impact research aimed at integrating drone technology into smart city infrastructures.
- Mentored over 20 students closely, guiding them on both study-oriented and lab-oriented projects.
- Co-instructed lectures and lab sessions in courses such as Internet of Things, Hardware Software Co-design, and Microprocessor Programming and Interfacing.
- Collaborated with international experts from the National University of Singapore and Hanoi University of Science and Technology.

- Managed the IoT Tinker Lab, overseeing projects and ensuring effective use of the allocated 80 lakhs INR funding.

## Advanced Micro Devices, Inc. (AMD)

Hyderabad

Design Engineer

Jul 2020 – Feb 2022

- Responsible for coding test benches for verifying the RTL of IPs related to high frame-rate video processing, real-time signal processing, high bandwidth IO, low latency control, and other hardware-accelerated algorithm IPs.
- Played a key role in developing an internal tool to automate the regression testing process, which featured a GUI along with analysis and reporting capabilities.
- Worked extensively on the DPU IP, a programmable engine dedicated to convolutional neural networks. The DPU IP includes a register configure module, data controller module, and convolution computing module with a specialized instruction set for efficient operation across various convolutional neural networks including VGG, ResNet, GoogLeNet, YOLO, SSD, MobileNet, and FPN.
- Integrated the DPU IP with DDR memory based on the provided architectural diagrams, ensuring optimal performance for deep learning applications.

## SKILLS

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**Machine Learning:** Deep Learning, Neural Networks, Model Optimization, Convolutional Neural Networks

**Embedded Systems:** FPGA, Microcontrollers, Real-Time Systems, System Verilog, System C modelling,

**IoT Systems:** Sensor Networks, IoT Protocols, Edge Computing, IoT Security, Wireless Communication

**Nvidia CUDA and DPU:** Parallel Computing, GPU Acceleration, Deep Learning Processor Unit, CUDA Programming, TensorRT

**Programming Languages:** Python, C++, Java, Verilog, GoLang

**System Architecture Design:** System Design, Communication Flows, Hardware-Software Co-design, System Integration, Scalability

**Blockchain Technology:** Smart Contracts, Blockchain for IoT, Decentralized Applications, Cryptography, Consensus Algorithms

## PUBLICATIONS

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**Sparse Attention Optimized RoBERTa Acceleration on FPGA for Low-Power Edge AI Applications**

Arti Jha, Anubhav Elhence, Vinay Chamola *IEEE Transactions on Consumer Electronics*. (January 2025)

**HARP-UNet: A Hardware-Accelerated TinyML Framework for Pothole Segmentation and Road Quality Assessment using UAVs**

Anubhav Elhence, Harshil Jeswani, Vinay Chamola *IEEE Transactions on Intelligent Transportation Systems*. (December 2024)

**Voronoi-Based Collaborative Target Tracking with Drone Swarms: Edge Prediction and Data Fusion for Enhanced Efficiency**

Anubhav Elhence, Tejas Sriganesh, Vinay Chamola *IEEE Transactions on Vehicular Technologies*. (November 2024)

**HardSecUAV: A Hardware-Based Mutual Authentication Protocol Using Physical Unclonable Functions**

Anubhav Elhence, Vinay Chamola *Science Direct Journal of Computers and Electrical Engineering*. (November 2024)

**FPGA-Accelerated YOLOX with Enhanced Attention Mechanisms for Real-Time Wildfire Detection on UAVs:**

Anubhav Elhence, Anubhav Panda, Vinay Chamola *IEEE Transactions on Instrumentation and Measurement*. (November 2024)

**A Blockchain and ML-Based Framework for Fast and Cost-Effective Health Insurance Industry Operations:**

Anubhav Elhence, Adit Goyal, Vinay Chamola, Biplab Sikdar *IEEE Transactions on Computational Social Systems*. (2023)

**Enabling Cost-Effective and Secure Minor Medical Teleconsultation using Artificial Intelligence and Blockchain:**

Anubhav Elhence, Varun Kohli, Vinay Chamola, Biplab Sikdar *IEEE Internet of Things Journal*. (Aug 2022)

**A Blockchain and Machine Learning based Framework for Efficient Health Insurance Management:**

Meghna Raj, Shashank Gupta, Anubhav Elhence, and Vinay Chamola, Tanya Garg, Mohammed Atiquzzaman, Dusit Niyato **SenSys '21: The 19th ACM Conference on Embedded Networked Sensor Systems**. (Dec 2021)

**Machine Learning on FPGA for Robust Si3N4-gate ISFET pH Sensor in Industrial IoT Applications:**

Soumendu Sinha, Nishad Sahu, Rishabh Bhardwaj, and Aditya Mehta, Hitesh Ahuja, Satyam Srivastava, Anubhav Elhence, Vinay Chamola **IEEE Transactions on Industry Applications**. (Sep 2021)

**A survey on the role of Internet of Things for adopting and promoting Agriculture 4.0:**

Adit Goyal, Anubhav Elhence, Vinay Chamola, and Biplab Sikdar **Journal of Network and Computer Applications**. (Aug 2021)

**Electromagnetic Radiation Due to Cellular, Wi-Fi and Bluetooth Technologies: How Safe Are We?:**

Naren, Anubhav Elhence, Vinay Chamola, and Mohsen Guizani **IEEE Access**. (2020)

## AWARDS & ACHIEVEMENTS

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**Australia India Research Fellow 2023:** Awarded the prestigious Australia India Research Fellowship 2023 by the Australia Dept of Education, including a \$10,000 grant, recognizing top 30 PhD research scholars across India for short-term research in Australia. (May 2023)

**BITS-Postman API Global Hackathon 3rd Edition Winner:** First Place Winner, BITS Pilani Postman API Hackathon 3.0 – Developed "Feathered Friends: an End-to-End Bird Detection System", awarded cash prize (Oct 2023)

**KVPY Scholar, IISc Bangalore:** Awarded the prestigious KVPY Scholarship by IISc Bangalore and the Dept of Science and Technology, India, recognizing brilliant students pursuing a career in scientific research. (Apr 2016)

**Xilinx Innovator Award:** Awarded for developing an internal tool to automate the regression testing process, which featured a GUI along with analysis and reporting capabilities. (Aug 2021)

**Sakura Science Scholarship:** Awarded the prestigious Sakura Science Scholarship by the Japanese Science and Technology Agency, recognizing top students for fostering groundbreaking collaborative research between India and Japan. (Jun 2018)

**Student Delegate for Nobel Laureates Convention, Vibrant Gujarat Global Summit:** Selected as student delegate for participating in Nobel Laureates Convention and was awarded third prize for presenting innovative solution for Brain Computer Interfacing using Spatio-Generative Matrix based Reinforcement Learning. (Mar 2016)

## PROJECTS

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### Quantized and Optimized NLP Models Deployment on Edge AI Devices (2024)

- Developed and deployed quantized and optimized natural language generation models on resource-constrained edge AI devices, ensuring efficient memory utilization and reduced latency.
- Implemented script unification and Romanization techniques to minimize tokenization complexity and improve cross-lingual transfer for low-resource Indian languages.
- Leveraged perplexity filtering to enhance synthetic data quality, enabling the fine-tuning of compact, efficient models for on-device inference.
- Optimized model inference using low-rank adaptation (LoRA) and knowledge distillation, achieving state-of-the-art performance with reduced parameter counts suitable for edge deployment.
- Designed an ONNX-based model compilation workflow for seamless integration with FPGA-based accelerators, ensuring low-latency language processing tasks.
- Demonstrated successful deployment on Xilinx Zynq UltraScale+ MPSoC with a DPU IP, achieving real-time language generation with minimal resource overhead.

### High-Performance Deep Learning Pipeline on Zynq Ultrascale+ with DPU IP Optimization (2024)

- Developed an end-to-end deep learning video processing pipeline on Zynq 7000 and Zynq Ultrascale+ platforms, leveraging the DPU (Deep Learning Processing Unit) IP to accelerate AI inference.
- Optimized the YOLO object detection model by integrating CBAM (Convolutional Block Attention Module) to enhance model accuracy, achieving real-time performance with a 30 FPS video feed at 1080p from a MIPI camera.
- Implemented a complete FPGA-based pipeline using Vitis HLS for preprocessing tasks such as resizing and denoising, enhancing image quality before feeding into the AI models.
- Designed an ONNX-based model compilation workflow, enabling seamless deployment of multiple machine learning models on FPGAs with a 4-core AXI-enabled DPU architecture.

- Integrated video encoding through the Video Codec Unit (VCU) and directed processed video output to the HDMI interface for high-quality display.
- Achieved significant performance improvements by offloading post-processing tasks such as resizing, denoising, and encoding to specialized hardware IPs, ensuring low latency and high throughput.

### **Design and Development of Multi-Functional Drone Ecosystem (2023)**

- Developed an advanced multi-functional UAV platform for autonomous operations in smart city environments.
- Engineered a flight controller compliant with the Pixhawk open hardware standard, running the PX4 flight stack combined with nVidia Jetson Xavier NX for powerful onboard processing.
- Implemented the Kria KV260 board to enable real-time AI inferencing using sophisticated computer vision algorithms, optimizing performance in few-shot learning scenarios.
- Integrated SLAM (Simultaneous Localization and Mapping) capabilities to enhance autonomous navigation and environmental awareness.
- Designed modular payloads to support various applications, including aerial imaging, delivery, and environmental monitoring.

### **Domain-Specific Sovereign Blockchain for Mobility Usecase (2022)**

- Developed a secure and high-performance blockchain platform tailored for mobility applications, ensuring data integrity and privacy.
- Implemented geo-location tracking, querying, and verification features to enhance mobility management.
- Supported high transaction speeds and throughput, coupled with low transaction costs, to optimize performance.
- Enabled secure Vehicle-to-Everything (V2X) communication and data sharing between roaming and stationary entities.
- Leveraged a combination of Blockchain, AI, IoT, and 5G technologies to create an innovative and efficient mobility ecosystem.

### **Design of Privacy-Enhanced Self-Sovereign Decentralized Data Marketplace (2022)**

- Designed a decentralized data marketplace that ensures secure and private data exchange using Decentralized Identifiers (DIDs).
- Developed a platform that facilitates self-sovereign data management and exchange, enhancing user privacy and control.
- Implemented advanced cryptographic techniques to secure data transactions and protect against unauthorized access.
- Created a user-friendly interface to simplify the process of data exchange and ensure seamless interaction.
- Conducted extensive testing and validation to ensure the robustness and reliability of the platform in various scenarios.

## **COURSES TAUGHT**

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### **Hardware Software Codesign (EEE G616) | [Course Page](#)**

BITS Pilani

*Co Instructor*

*Fall Semester 2023, 2022*

- Delivered 20 lectures to approximately 60 students enrolled in the M.Tech program for Embedded Systems and Microelectronics.
- Emphasized practical, hands-on learning with a particular focus on accelerating machine learning models through hardware-software co-design approaches, utilizing Kria KV260 boards and Nvidia Jetson.
- Facilitated student placements in top-tier companies by teaching industry-leading tools and software, including AMD Vivado, AMD Vitis HLS, AMD Vitis AI, and Nvidia TensorRT and CUDA programming.

### **Internet of Things (EEE F414) | [Course Page](#)**

BITS Pilani

*Head TA and Lab Incharge*

*Fall Semester 2023, 2022*

- Created comprehensive lab tutorial videos utilizing Raspberry Pi, Flask, Arduino, and Node MCU to facilitate practical learning.
- Instructed students on MQTT protocol, Websockets, and other relevant IoT networking concepts through practical demonstrations and hands-on activities.
- Managed and coordinated lab sessions, ensuring students had access to necessary resources and support for their projects.
- Developed and implemented lab exercises that integrated real-world IoT applications, enhancing students' understanding and skills.

## Microprocessor Programming and Interfacing (CS F211) | [Youtube](#)

BITS Pilani

Lab Incharge / Tutorial Instructor / Guest Lecturer

Spring Semester 2024, 2023, 2022

- Produced comprehensive tutorial videos on 8086 programming using the Intel instruction set architecture, covering various topics in microprocessor programming.
- The course was attended by 600 students at the Pilani campus and received highly positive feedback for the lab sessions, significantly enhancing students' understanding. Students from the Goa and Hyderabad campuses also utilized the videos for their learning.
- Authored the lab manual for the course, providing clear and detailed instructions for lab exercises.
- Conducted tutorial sessions and doubt-solving sessions, offering additional support and guidance to students.
- Delivered guest lectures on Memory Interfacing and the Protected Mode of operation, providing in-depth knowledge on these advanced topics.

## Computer Architecture (CS F212) | [Youtube](#)

BITS Pilani

Lab Incharge

Spring Semester 2023

- Created comprehensive tutorial videos on Verilog programming and its applications in Computer Architecture.
- Delivered guest lectures on advanced topics such as Memory Interfacing and implementing state machines using Verilog.

## Digital Design (EEE F212)

BITS Pilani

Tutorial Instructor

Fall Semester 2023

- Instructed tutorial sections for approximately 70 students, focusing on foundational and advanced topics in digital design.
- Covered important topics including K-Maps, combinational and sequential circuits, flip-flops, and latches, ensuring a solid understanding of digital logic design.
- Introduced FPGA technology to second-year students, providing them with early exposure to industry-relevant hardware design and development tools.

## CERTIFICATES

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**Embedded Computing for IoT Systems**

Mar 2022

IEEE

**Deep Learning Nanodegree**

Nov 2021

Udacity

**Blockchain Developer**

Jun 2020

Dapp University

**FPGA Design for Embedded Systems**

Aug 2021

Coursera

**Nvidia Deep Learning Institute Certificate**

Jan 2022

Nvidia

**IoT Security**

May 2021

edX

**Machine Learning Specialization**

Sep 2020

Coursera

## SPECIAL MENTIONS AND HOBBIES

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**YouTube Channel - AIoTBlocks** | [Youtube](#) : I run a monetized YouTube channel named AIoTBlocks, where I post content about tech topics, especially related to AI and IoT. I am adept at creating engaging online content and have built a significant audience.

**GATE 2021:** Qualified the GATE exam with an All India Rank of 621 in the Electronics and Communication paper.

**Medium Articles:** I regularly write articles on Medium, discussing various topics related to embedded AI, computer architecture, and other tech subjects, sharing my knowledge and insights with a broader audience.

**Instagram Content Creator:** I am a content creator with over 30K followers on Instagram, where I post about my lifestyle and hobbies connecting with a vibrant community of enthusiasts.

**Hobbies:** In my free time, I enjoy piloting drones, photography, playing basketball, swimming, and staying fit. I also have a passion for singing and dancing, which I pursue as enjoyable hobbies.

## REFERENCES

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References available upon request.