

# Muhammad Umair Ajmal

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## EDUCATION

**National University of Sciences and Technology (NUST)**, Islamabad, Pakistan  
2026

*Sep 2022 - June*

- Bachelor of Electrical Engineering (**CGPA: 3.14**)
- **Coursework:**
  - **AI & Computing:** Machine Learning, Computer Vision
  - **Digital & Hardware:** Computer Architecture, Digital Logic Design, Digital System Design, Microprocessors
  - **Signals & Core EE:** Signals and Systems, Communication Systems, Linear Circuit Analysis, Electromagnetic Field Theory
- **Minor Course:** Artificial Intelligence

## WORK EXPERIENCE

**Intern – FPGA Development (Verilog HDL)**

*Jun – Aug 2024*

*System on Chip Lab, SINES, NUST*

This internship focused on laboratory work for **Digital Design & Computer Architecture**. I designed and verified **digital logic modules using Verilog** and implemented them on FPGA boards. The experience improved my **logic-building skills, FPGA programming, and understanding of processor datapaths**, while highlighting my ability to **quickly learn complex concepts and work independently**.

**Research Intern – Chip Design**

*NUST Chip Design Centre (NCDC), Islamabad*

*Jun – Aug 2025*

During this internship, I worked on implementing **Vision Transformers on SoC platforms** for clinical data classification. I gained hands-on experience in **C/C++, SystemVerilog, RISC-V assembly, and digital logic design**, while contributing to the development and verification of hardware modules. The internship strengthened my knowledge in **hardware-software co-design, FPGA architecture, and AI accelerator deployment**.

## PROJECTS

**Edge-AI Accelerator: FPGA-Powered Real-Time Diagnosis and Report Generation (In Progress FYP)**

- Developing an **FPGA-based AI accelerator** for pneumonia and tuberculosis detection from chest X-ray images
- Implementing and optimizing **Vision Transformers (ViT) and CNNs** for low-latency inference
- Conducted literature review of **50+ research papers** on AI accelerators and medical imaging
- Targeting **real-time performance and efficient hardware utilization**

**SPI Protocol Integration (Verilog HDL)**

- Designed **SPI master-slave communication** in Verilog HDL
- Implemented reliable synchronization using SCK, MOSI, MISO, and SS signals
- Verified functionality using **ModelSim testbenches**

### **Real-Time Object Tracking (Computer Vision)**

- Implemented real-time object tracking using Shi–Tomasi features and Lucas–Kanade sparse optical flow.
- Generated smooth object trajectories under noise, occlusion, and illumination changes.
- Developed and tested using Python & OpenCV.

### **RV32IM 5-Stage Pipelined RISC-V Processor**

- Designed a **5-stage pipelined RV32IM RISC-V processor** (IF, ID, EX, MEM, WB).
- Implemented **hazard detection, forwarding, and pipeline control logic**.
- Verified functionality via **SystemVerilog simulation** and test programs.

### **ECG Detection & Heart Rate Monitoring System**

- Designed analog front-end including instrumentation amplifier and filters
- Detected R-wave peaks and calculated BPM in real time
- Integrated Arduino + LCD display for real-time monitoring

### **OCR Scanner (C++, OpenCV)**

- Implemented OCR pipeline using **noise reduction, thresholding, and segmentation**
- Improved text extraction accuracy from low-quality images
- Developed a simple interface for document digitization

### **Smart Home Automation System (Arduino, Embedded C)**

- Designed Bluetooth-based automation system for **fan speed and lighting control**
- Implemented temperature-based automation for energy efficiency
- Designed PCB layout and programmed system in Embedded C

## **TECHNICAL SKILLS**

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### **Programming & Hardware:**

C, C++, Embedded C, Python, Verilog HDL, SystemVerilog, Assembly, RISC-V

### **Tools & Software:**

Quartus, ModelSim, Vivado, MATLAB, Proteus, PSpice, Google Colab, TensorFlow

### **Specialized Domains:**

FPGA Design, Computer Architecture, AI Accelerators, Computer Vision, Deep Learning, Signal Processing

### **Research Skills:**

Literature Review, Technical Writing, Comparative Analysis