

Muhammad Talha

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PROFILE

Machine learning and HCI researcher working across NLP, computer vision, and AR/VR interaction; creator of [AR-CAD](#), an augmented-reality CAD system for Meta Quest 3. Recent work includes machine-learning extension of Bloom's Taxonomy, NLP analysis of think-aloud protocols, EEG signal processing for cognitive-load evaluation, and LLM-powered document intelligence.

Experienced in NLP/ML pipelines, computer-vision workflows, LLM and RAG application development, Unity/C# development for Meta Quest (Meta XR) and SteamVR, 3D interaction and spatial modeling, UX research and usability testing, qualitative/quantitative study design, and product-oriented research translation.

EDUCATION

University of Alberta

Edmonton, Canada

M.Sc. in Engineering Management (Thesis-Based) | GPA: 3.8/4.0

Jan. 2024 – Apr. 2026

- **Thesis:** *How Interaction Modality Shapes Design Cognition: Evaluating Augmented Reality CAD Through Behavioral, Cognitive-Process, and Neurophysiological Evidence* (defended Apr. 2026; convocation Nov. 2026).
- **Coursework:** Applied Machine Learning and AI; ML for Procedural Content Generation; Wearable Devices, IoT, and ML Data Analysis; Intellectual Property and New Technology Commercialization; Ergonomics and Work Design.
- **Supervisors:** [Dr. Ahmed Jawad Qureshi](#) and [Dr. Sehrish Javed](#).

Lahore University of Management Sciences (LUMS)

Lahore, Pakistan

B.S. in Computer Science

Sep. 2019 – Jun. 2023

- **Coursework:** Object-Oriented Programming, Data Structures, Algorithms, Operating Systems, Software Engineering, Machine Learning, Artificial Intelligence, Human-Computer Interaction, Topics in Design and HCI, Computer Graphics, Databases, Network Security, and ICT for Development.

PUBLICATIONS AND PREPRINTS

- M. Talha, A. Mohiuddin, S. Javed, and A. J. Qureshi, “[Lowering Barriers to CAD Adoption: A Comparative Study of AR-CAD and a Traditional CAD Tool](#),” ASME IDETC/CIE, 2025.
- M. Talha, J. Shi, and A. J. Qureshi, “[Extending the Cognitive Domain of Bloom's Taxonomy using Machine Learning](#),” Research Square preprint, 2026; submitted to *Discover Education*.

RESEARCH EXPERIENCE

Machine Learning Engineer & Research Assistant

Dec. 2023 – Present

ADaMS Lab, University of Alberta

Edmonton, Canada

- Designed and developed [AR-CAD](#), a standalone augmented-reality CAD system for Meta Quest 3 using Unity, C#, and the Meta XR stack, supporting primitive modeling, object manipulation, scene composition, STL export, and in-environment concept evaluation.
- Led a within-subject comparative study of AR-CAD and a traditional CAD tool with **20 participants**, showing AR-CAD raised task completion from **77.5% to 97.5%** with no time penalty and reduced mental demand for novice users; published at ASME IDETC/CIE 2025.
- Co-invented AR-CAD, earning **Report of Invention approval** from the University of Alberta Technology Transfer Office, and positioned it as both a research platform and translational product concept for CAD accessibility and design education.
- Built [Python NLP/ML pipelines](#) (Whisper ASR, spaCy, NLTK, sentence-transformers, scikit-learn) that auto-coded 15,000+ words of time-aligned think-aloud audio from 38 CAD sessions into **1,800+ Bloom-coded verb occurrences**, replacing manual protocol coding.
- Developed a **YOLOv8-based computer-vision system for Durabuilt** that detects doors, windows, assembly tools, and their components on the production line to estimate build progress and feed worker-efficiency metrics into monitoring dashboards.
- Developed machine-learning workflows for wire arc additive manufacturing (WAAM) that classify deposited alloys (e.g., Inconel 625 vs. 17-4 PH stainless steel) from emission spectra and process data at **97% test accuracy**, detect material interfaces, and identify WAAM process phases.

- Engineered a 10-stage **EEG signal-processing pipeline** in MNE-Python, spanning FIR band-pass and notch filtering, ICA-based ocular and muscle artifact removal, re-referencing, adaptive per-channel signal-quality weighting, and Welch spectral estimation, to reconstruct clean cognitive-load spectra from 32-channel recordings during Meta Quest 3 AR interaction; pilot presented at the Alberta BME Conference.
- Collaborated with cross-functional teams across engineering design, neuroscience, HCI, manufacturing, and commercialization to translate research prototypes such as AR-CAD, the Durabuilt detection system, and WAAM monitoring workflows into user-evaluated, product-oriented systems.

Research Assistant

Nov. 2021 – May 2023

CHISEL, LUMS

Lahore, Pakistan

- Designed and evaluated five health-tech, VR, and assistive research prototypes (**AssistTH**, RehabVR, **Meditare**, Rawaan, and **VR awareness training**), combining Unity-based VR development with interviews, surveys, and usability testing.
- Built user flows, wireframes, prototypes, and research documentation for telehealth, rehabilitation, mental well-being, dyslexia support, and immersive training applications, and implemented the corresponding Unity VR environments with custom interaction scripting.
- Contributed literature review, intervention ideation, and evaluation-driven refinement to a virtual-reality environmental-enrichment intervention for older adults with mild cognitive impairment and mild dementia.
- Quality-tested **Rawaan**, an Urdu-based remedial therapy tool for dyslexia, validating product flows, auditing audio assets, and reporting implementation issues before release.
- Screened more than 45 papers for inclusion in a systematic review of assistive technology for older adults in low- and middle-income countries.

TEACHING EXPERIENCE

Teaching Assistant and Course Support

Sep. 2024 – Apr. 2026

University of Alberta

Edmonton, Canada

- Delivered teaching, assessment, and technical support for **ENGM 680: Applied Machine Learning and AI**, a graduate applied machine learning course.
- Served as a Teaching Assistant for **MEC E 590: Statistics and Data Management for Engineers**, supporting course delivery, assessment, and student learning in applied statistical methods and data handling.
- Graded assessments and provided instructional support for **MEC E 300: Mechanical Measurements** and **MEC E 390: Numerical Methods**.
- Delivered guest lectures for **MEC E 265** on how interaction modality shapes the design process and the emerging role of AI in engineering design.

Head Teaching Assistant

Jan. 2023 – May 2023

LUMS

Lahore, Pakistan

- Led teaching assistant operations for **CS 331: Introduction to Artificial Intelligence**, managing course logistics, grading, and supervision of other TAs for assignments, quizzes, and exams.
- Managed two sections of **CS 200: Introduction to Programming** with approximately 130 students each, organizing labs, assignments, quizzes, exams, and weekly tutorials and office hours.
- Served as TA for **CS 100: Computational Problem Solving**, managing labs, quizzes, and tutorials for a class of approximately 60 students.

INNOVATION AND COMMERCIALIZATION

Entrepreneurial Lead, AR-CAD

Sep. 2026 – Dec. 2026

Technology Readiness Level-Up (TRL) Program, Labs4 (Mitacs-supported)

NAIT, Edmonton (Hybrid)

- Accepted into Labs4's Mitacs-supported Technology Readiness Level-Up program, receiving **CAD \$15,000** in mentorship and project-development support to raise AR-CAD's technology readiness level.
- Preparing AR-CAD for testing in industry environments, with the goal of a sellable, revenue-generating product by program completion.

Founder, AR-CAD

Mar. 2026 – Present

Innovation, Creativity and Entrepreneurship (ICE) Engineering Incubator, University of Alberta

Edmonton, Canada

- Advancing AR-CAD from a research prototype toward a technology venture through the incubator's structured mentorship and commercialization support.
- Refining customer segments, value proposition, product positioning, technical roadmap, and go-to-market direction for an immersive CAD platform focused on improving CAD accessibility and design education.

- Building on prior Lab2Market customer discovery, Mitacs commercialization work, and University of Alberta Report of Invention approval to strengthen the startup pathway for AR-CAD.

Entrepreneurial Lead, AR-CAD Validation

Sep. 2025 – Dec. 2025

Lab2Market Validate / Mitacs Business Strategy Internship

Canada

- Led customer discovery for **AR-CAD**, conducting more than **100 interviews** that validated problem-solution fit and identified design engineers in R&D settings at additive-manufacturing firms as the primary target users.
- Secured **CAD \$10,000** in Mitacs funding to advance the product and customer discovery, and developed market positioning and value propositions from interview evidence to support a path from academic prototype toward higher technology readiness.

Customer Discovery

Jan. 2025 – Mar. 2025

Lab2Market Discover

Canada

- Explored user segments, industry pain points, and adoption barriers relevant to immersive CAD workflows, design education, and product commercialization.

PROFESSIONAL EXPERIENCE

Co-Founder & AI Engineer

Jan. 2026 – Present

WarpShift

Remote

- Ship a **RAG-based legal research assistant** with custom deployments for **22 paying law-firm clients** (20 in Ontario, 2 in Australia), answering legal questions directly from firm documents instead of keyword search across case files.
- Benchmark multiple LLMs against each other for every pipeline role (retrieval, reasoning, extraction), selecting the best performer per task on accuracy, citation-precision, and hallucination-rate evaluations; every answer is grounded in retrieved source documents, keeping responses traceable in high-stakes legal work.
- Automate real-estate document closings and client reception using LLM extraction pipelines, text-to-SQL generation, and voice AI agents, converting document-heavy workflows into deployed software.

Instructor

Aug. 2023 – Oct. 2023

Knowledge Streams

Lahore, Pakistan

- Trained two cohorts of 30 to 40 industry-referred trainees each in Python, data science, programming fundamentals, and MERN stack development, with many graduates subsequently placed into professional software roles.
- Designed hands-on coding labs and project-based sessions covering full-stack development, data analysis, debugging, Git workflows, and software-development practices.

Associate UX Analyst

Apr. 2023 – Jun. 2023

CureMD Inc.

New York, United States

- Improved UX for **US healthcare products** including the CureMD EHR, Nightingale, and patient/provider portals by analyzing clinical workflows, identifying usability issues, and recommending product-focused interface improvements.
- Collaborated remotely with product, design, engineering, and QA teams across the US, India, and Pakistan to refine workflows, improve task clarity, and support patient/provider-facing digital experiences.

Freelance Software Developer and UI/UX Designer

Feb. 2020 – Jun. 2023

Fiverr / Upwork / Private Clients

Remote

- Designed, developed, tested, and deployed digital products including tutoring platforms, social-media-style web applications, portfolio and research/product websites, landing pages, and mobile app concepts for independent and client-based projects.
- Built front-end and full-stack applications using HTML/CSS, JavaScript, React, Node.js, Express.js, SQL, MongoDB, Firebase, Git/GitHub, Netlify, Heroku, and form/email integrations.
- Translated client requirements and user needs into user flows, information architecture, wireframes, interactive prototypes, responsive layouts, and implementation-ready interface designs.
- Created and improved UI/UX designs using Figma, usability feedback, heuristic review, accessibility-aware design, responsive design principles, and iterative redesign for web and mobile interfaces.
- Developed application features such as posting workflows, dashboard-style interfaces, admin/content-management flows, database-backed functionality, landing-page sections, and deployment-ready project pages.
- Managed projects end-to-end, from concept and requirements gathering through UX planning, interface design, development, and testing to deployment, alongside ongoing client-facing communication.

Content Writer

Apr. 2019 – Jun. 2020

Private Client

Remote

- Wrote, edited, and optimized articles, web content, blog posts, product descriptions, and marketing copy for digital platforms with a focus on clarity, search visibility, and audience engagement.
- Conducted keyword research, competitor/content analysis, topic research, and content planning to create SEO-friendly outlines, headings, metadata, and structured web copy.
- Applied on-page SEO practices including keyword placement, title optimization, meta descriptions, internal-linking suggestions, readability improvement, and content formatting for better discoverability.
- Produced content across technical, educational, business, software, and general-interest topics while adapting tone, structure, and terminology for different audiences and client requirements.
- Revised drafts for grammar, technical accuracy, readability, search intent, keyword relevance, and publication quality while incorporating client/editor feedback under deadlines.

PROFESSIONAL DEVELOPMENT

Participant, AI Career Accelerator Program

Mar. 2026 – Present

Alberta Machine Intelligence Institute (Amii)

Edmonton, Canada

- Participating in Amii's AI Career Accelerator, strengthening industry readiness across applied machine learning, data science, AI product development, technical communication, and employer-facing project presentation through structured industry engagement and networking.

CERTIFICATIONS

AI Career Exploration Badge , Alberta Machine Intelligence Institute (Amii)	Jul. 2026
Lab2Market Discover National Cohort (Winter 2025) , Lab2Market	May 2025
Introduction to User Experience Design , Coursera	Jun. 2023
Introduction to UI Design , Coursera	Jun. 2023
Visual Elements of User Interface Design , Coursera	Jun. 2023
Technology Entrepreneurship: Lab to Market , edX	Oct. 2021

PROJECTS

AR-CAD: Augmented-Reality Computer-Aided Design

Jan. 2024 – Present

- Developed an immersive CAD workflow for early-stage concept modeling, spatial validation, and export in mixed reality using Unity, Meta Quest 3, and the Meta XR stack.
- Implemented interactions for primitive creation, object manipulation, scene composition, and free-form modeling, with STL export for downstream design tools.
- Validated the system in a **20-participant** comparative study (**97.5% vs. 77.5%** task completion with no time penalty) published at ASME IDETC/CIE 2025, and used it as the platform for EEG and Bloom-coded think-aloud studies with novice and experienced users.
- Co-invented the system (University of Alberta **Report of Invention**, approved by the Technology Transfer Office) and positioned it as both a research platform and translational product concept for broader CAD accessibility and design education.

Bloom-Coded Think-Aloud Transcript Analysis for Design Cognition

Jan. 2026 – Apr. 2026

- Developed a pipeline for analyzing time-aligned think-aloud transcripts from a comparative AR-CAD and traditional CAD study to characterize how interaction modality shapes expressed design cognition.
- Processed participant verbal protocols with an NLP pipeline covering Whisper ASR transcription, transcript cleaning and alignment, time-bin segmentation, POS tagging and lemmatization for verb extraction, WordNet validation, and multi-label Bloom classification with normalized-progress mapping across task sessions.
- Generated participant-level and group-level cognitive-process trajectories across all six Bloom domains: Knowledge, Comprehension, Application, Analysis, Synthesis, and Evaluation.
- Found that AR-CAD elicited nearly **2×** the Bloom-coded cognitive activity of traditional CAD (**1,191 vs. 628** coded verbs), with significantly higher Knowledge and Comprehension activity (Wilcoxon signed-rank with Holm correction, $r = 0.75$ and 0.84), triangulated against SUS, NASA-TLX, completion, and interview evidence.
- Produced visual analytics including per-bin cognitive activity plots, participant-level micro-histograms, normalized progress trajectories, and summary exports for thesis figures and manuscript preparation.

Bloom Taxonomy Extension using Machine Learning

May 2025 – Dec. 2025

- Built a **multi-stage NLP pipeline** (Stanza POS tagging and lemmatization, WordNet sense validation, Sentence-BERT/MPNet embeddings, one-vs-rest multi-label classification, empirical CDF score calibration, threshold-based acceptance) that extended Bloom's cognitive-domain verb inventory from **358 core verbs to 1,506 newly classified engineering verbs**, mined from a curated corpus of 7 textbooks and 170 papers.

- Devised a taxonomy-aware structural criterion for model selection on unlabeled data, preserving Bloom's ordinal structure on the extended set (Spearman $\rho = 0.90$, $p < 0.05$); validated against expert judgment, reaching **76.7%** ambiguity-aware coverage of expert-endorsed domains with 8 expert raters.
- Applied the resulting model to research workflows for automated coding of think-aloud verbalizations in design studies.
- Created the extended Bloom verb resource used as the classification backbone for later think-aloud transcript analysis in design-cognition research.

EEG-Based Comparative Study of Cognitive Load in CAD

May 2025 – Apr. 2026

- Designed a within-subject study comparing AR-CAD and a traditional CAD tool using **32-channel EEG (Emotiv FLEX 2)** recorded concurrently with Meta Quest 3 interaction, with synchronized keystroke event markers and structured eyes-closed, eyes-open, and in-HMD baselines (ethics protocol Pro00152781).
- Built a **10-stage MNE-Python signal-processing pipeline**: zero-phase FIR band-pass and 60 Hz notch filtering, bad-channel rejection, ICA-based ocular/muscle artifact removal, average re-referencing, marker-based epoching with edge trimming, amplitude artifact rejection, dB baseline normalization, and Welch spectral estimation across five scalp ROIs.
- Implemented an adaptive per-channel signal-quality weighting scheme that down-weights noisy epochs when reconstructing regional power spectra, and designed an **ML-assisted artifact-removal** stage (ASR, ICLabel, iCanClean) using Meta Quest 3 IMU signals as motion references for high-throughput cleaning in the full study.
- Validated signal integrity via alpha-blocking checks and discovered elevated occipital alpha under Quest 3 passthrough, a methodological confound that motivated HMD-specific baselines for AR-EEG; pilot presented at the Alberta BME Conference.

Procurement Document Intelligence: Natural-Language Querying of Government RFPs

Jul. 2026

- Built a two-stage system that converts government procurement PDFs into a structured SQLite database and answers plain-English questions as validated, read-only SQL, deployed as a self-seeding Streamlit app with a [live public demo](#).
- Benchmarked three OCR engines (Tesseract, EasyOCR, PaddleOCR) against born-digital ground-truth text, selecting Tesseract (**0.093** character error rate, 1,391 chars/sec) and showing that model-reported confidence inversely tracked accuracy, which motivated a design that validates extracted *values* rather than engine self-confidence.
- Combined a heuristic parser with an **LLM extraction overlay** to pull fields from bilingual English/French RFP forms where values trail two-language labels, with silent fallback so uploads never fail; normalized and validated every value (ISO-8601 dates, fiscal year, monetary coercion, recomputed line totals) using hard-error versus soft-warning gating.
- Engineered a **RAG text-to-SQL engine** (ChromaDB schema embeddings with grounded prompting) behind a three-gate safety layer (`sqlparse` token guard, `EXPLAIN` compile-check, and a read-only connection with row caps), plus an error-driven self-correction loop and always-visible generated SQL for auditability.
- Abstracted three LLM providers (Anthropic native; Gemini and Groq via OpenAI-compatible endpoints) behind one client with key auto-detection, bring-your-own-key, and rate-limit fallback; added trust features that refuse unanswerable questions and annotate rows silently dropped by nullable foreign-key joins in plain language.
- Made the full stack run offline with zero API keys via a deterministic rule-based stub, covered by **156 passing tests**, and hardened it against path traversal, rate-limit storms, and shared-key abuse.

Generating Consistent Game Sprites from Multi-Style Dataset

Sep. 2024 – Dec. 2024

- Co-authored a study on automating pixel-art sprite generation by combining Pokémon and Tiny Hero datasets to address data scarcity in style-specific generative models.
- Implemented and fine-tuned a diffusion model with a residual U-Net architecture and sinusoidal time embeddings that won on both styles, achieving **FID 32.70** (Pokémon) and **67.19** (Tiny Hero) versus 47.16/69.85 for the best β -VAE baselines, plus the best Pokémon reconstruction quality (SSIM 0.86).
- Evaluated GM-VAE, β -VAE, and diffusion models with 1,500 reconstruction test samples and 1,000 generated samples per style, using t-SNE, latent-space interpolation, MSE/SSIM, and FID.

Machine Learning for Scoliosis Curve Prediction

Jan. 2024 – Apr. 2024

- Built a machine learning pipeline to predict scoliosis curve progression (classification) and Cobb angle (regression) from clinical and radiographic features.
- Performed data preprocessing, feature engineering, label encoding, and exploratory data analysis on a clinical scoliosis dataset of 211 patient records.
- Benchmarked **10 classification and 10 regression models** for curve-progression classification and Cobb-angle regression, with ensemble methods (Random Forest, AdaBoost) delivering the strongest validated performance across both tasks.

Ergonomic Enhancement of a Manufacturing Workplace

Jan. 2024 – Apr. 2024

- Conducted ergonomic assessment of workstations at Qualitest Canada, a welding engineering facility, to identify musculoskeletal disorder risks in tasks involving pushing, pulling, lifting, grinding, and cutting.
- Collected posture data using video recording and OpenPose-based joint coordinate extraction, then applied Rapid Entire Body Assessment (REBA) to calculate risk scores.
- Identified high-risk tasks and proposed targeted ergonomic interventions to reduce injury risk and improve worker safety and productivity.

SageWatch: Assistive Smartwatch for the Elderly

Jan. 2024 – Apr. 2024

- Designed an assistive smartwatch system for elderly health monitoring with vitals tracking, fall detection, BLE-based location tracking, and emergency calling.
- Specified hardware architecture including sensor selection, BLE SoC (BlueNRG-132), NFC wireless charging, power management, and a TFT display, with a total BOM cost of \$64.23.
- Designed the software stack using FreeRTOS, LVGL for the UI, MQTT for cloud communication, and AES-128 encryption, with estimated battery life of approximately 3.7 days on a 700 mAh cell.
- Created UI mockups for the watch face, elderly companion app, and caretaker monitoring app.

Air Quality Prediction in Beijing: Deep Learning for Time-Series Forecasting

Jan. 2024 – Apr. 2024

- Forecast hourly pollutant concentrations and the Air Quality Health Index (AQHI) from multi-station Beijing air-quality data, engineering cyclic sine/cosine datetime encodings, season and holiday calendar features, and outlier interpolation.
- Benchmarked seven classical regressors (Linear, Lasso, backward elimination, PCA regression, Random Forest, XGBoost, SVR) against RNN, LSTM, BiLSTM, and GRU networks, tuning each with grid search under blocked cross-validation to prevent temporal leakage.
- Selected an RNN with a 3-hour lookback and 1-hour prediction horizon (Adam optimizer, early stopping) as the best model, reaching **RMSE 0.536, MAE 0.302, and $R^2 = 0.947$** on held-out test data, versus RMSE 0.541 for the best classical regressor.

Applied Machine Learning and Data Science

Jan. 2024 – Apr. 2024

- Completed applied ML projects spanning data processing, classical ML, ML pipelines, computer vision, large language models, and retrieval-augmented generation.
- **Data Processing and Visualization:** Cleaned, explored, and visualized Edmonton property tax assessment data using pandas, handling missing values, feature distributions, and geospatial patterns.
- **Classical ML:** Trained and evaluated decision trees, random forests, KNN, logistic regression, and naive Bayes classifiers on cardiovascular disease and other datasets, including hyperparameter tuning and cross-validation.
- **ML Pipelines:** Built end-to-end scikit-learn pipelines with feature engineering, scaling, encoding, and model comparison for property value prediction.
- **Computer Vision:** Developed image classification and object detection workflows using CNNs, including training on Fashion-MNIST, custom datasets, and video-based detection tasks.
- **LLMs and RAG:** Fine-tuned BERT for sentiment analysis on IMDB reviews and built a Retrieval-Augmented Generation pipeline integrating document retrieval with transformer-based language models.
- **Markov-Chain Procedural Content Generation:** Implemented a Markov-chain-based procedural content generation workflow for game-level modeling.

Ehsaas: Mental Health of Pregnant Women in Pakistan

Feb. 2023 – May 2023

- Investigated mental health challenges among pregnant women in Pakistan, including postpartum depression and the perceived role of mental health and pregnancy-related applications.
- Conducted semi-structured interviews and surveys, reviewed literature on mental-health approaches in the UK and India, and analyzed qualitative data using Atlas.ti and affinity mapping.
- Designed a complete Figma prototype informed by user research and an audit of existing pregnancy and mental-health applications.

RehabVR: Virtual Reality for Rehabilitation

Feb. 2023 – May 2023

- Designed and developed a VR rehabilitation concept in collaboration with the Pakistan Society for the Rehabilitation of the Disabled, supporting cognitive and exercise-based recovery for patients with neurological conditions such as stroke.
- Visited hospitals and engaged with patients and medical professionals to identify rehabilitation pain points, practical constraints, and interaction needs.
- Designed research-informed interfaces and activity flows in Unity for virtual rehabilitation environments intended to facilitate exercise performance in calming settings.

Meditare: Virtual Reality for Well-Being

Jun. 2022 – May 2023

- Designed and developed VR environments for mental well-being and breathing-based relaxation, informed by prior user research, contextual inquiry, and literature on calming experiences.
- Implemented immersive environments in Unity and SteamVR, including interactive elements, environmental effects, reflections, shadows, materials, shaders, and 3D environment details intended to support a peaceful experience.
- Conducted pilot testing to identify user-experience issues and iterated on the environments and interaction flow based on participant feedback.

Virtual Reality for Sexual Harassment Awareness

Feb. 2022 – May 2022

- Designed and implemented a VR awareness and training experience based on recurrent campus harassment scenarios while considering user comfort and trauma-sensitive presentation choices.
- Analyzed the problem through user research, storytelling, and narrative-therapy-oriented exploration to understand overlooked forms of harassment and the contexts in which they occur.
- Conducted evaluation using pre- and post-questionnaires, user testing, and comparative testing between 2D and 3D versions to examine differences in perceived impact.

AssistTH: Telehealth Mobile Application

Sep. 2021 – Feb. 2022

- Conducted contextual inquiry, interviews, and surveys in healthcare settings to design a telehealth mobile application connecting patients and physicians while considering constraints in access and resource availability.
- Developed sketches, scenarios, storyboards, and low-, medium-, and high-fidelity prototypes based on user needs and feasibility considerations.
- Refined the solution through low-fidelity testing, iterative redesign, pilot testing, usability testing, and high-fidelity prototyping in Figma.

Samsara: A Fight to Survive Game

Oct. 2022 – Jan. 2023

- Developed a Unity-based 3D single-player game in which the player collects coins and health points, defeats enemies, and progresses through the environment.
- Created 3D assets in Blender, built the environment in Unity, scripted core gameplay, and prototyped an early VR version for a more immersive experience.

Language Detection Classifier

Dec. 2021 – Feb. 2022

- Built a language detection classifier using machine learning methods and a dataset of more than 700 recordings spanning English, Urdu, Spanish, Punjabi, and other languages.
- Tested logistic regression, KNN, decision trees, and random forests, achieving roughly 70% overall accuracy and about 90% for English and Urdu.

Full-Stack Web Applications

2021 – 2023

- **Insta-clone:** Designed a web-based Instagram clone as a full-stack project with follow requests, posting workflows, and admin-level content management backed by SQL.
- **Choka (tutoring platform):** Designed, developed, tested, and deployed a tutoring platform connecting students, tutors, and administrators using a user-centered design process, surveys, Figma prototypes, SQL-backed workflows, and Selenium-based automated testing.
- **Forest Health Calculator:** Collaborated with NCRA and WWF on a forest health assessment project using tree imagery and computer-vision-oriented workflows; redesigned the mobile app experience for field users such as forest rangers.

Systems, Networking, and Security Projects

2020 – 2023

- **Chat Application:** Built a multi-client chat application with file-sharing support, implementing custom reliability mechanisms on top of UDP sockets.
- **Link-State Routing:** Implemented and tested a link-state routing algorithm for correct packet forwarding across a simulated network.
- **Distance-Vector Routing:** Implemented and tested a distance-vector routing algorithm for distributed route updates and packet forwarding across a network.
- **Fault Tolerant Server:** Built a fault-tolerant server using a distributed hash table for load distribution with service continuity during server failures.
- **Web Security Exploits:** Built proof-of-concept [clickjacking](#) and [SQL-injection](#) demonstrations for a network-security course, illustrating common web attack vectors in a controlled environment.
- **Environment Control System:** Designed a digital system for household environment management using sensors, logic gates, and digital circuit design in Proteus.

Embedded Systems: Line Following Robot

Sep. 2019 – Jan. 2020

- Designed a line-following robot with IR sensors for collision avoidance and Bluetooth-based mobile control for manual interaction.

TECHNICAL SKILLS

Programming and Software Engineering: Python, C#, C/C++, Java, JavaScript, TypeScript, SQL, Bash, object-oriented programming, data structures, algorithms, debugging, software testing, Git, GitHub, GitKraken, Visual Studio, VS Code

Web, Full-Stack, and Deployment: HTML5, CSS3, React, Node.js, Express.js, REST APIs, MERN stack, Ruby on Rails, MongoDB, Firebase, MySQL, PostgreSQL, SQLite, Streamlit, Netlify, Heroku, WordPress, responsive design, Selenium

AI, Machine Learning, NLP, and Data Science: Scikit-learn, PyTorch, deep learning (CNNs, LSTMs/GRUs, Transformers), Hugging Face Transformers, diffusion models, XGBoost, YOLOv8, OpenCV, Pandas, NumPy, SciPy, Statsmodels, Matplotlib, Jupyter Notebook, MATLAB, spaCy, NLTK, Stanza, WordNet, POS tagging, lemmatization, multi-label text classification, sentence-transformers, Whisper ASR, BERT, RAG, ChromaDB, vector search, LLM APIs (Anthropic/Gemini/Groq), prompt engineering, text-to-SQL, OCR (Tesseract), classification, regression, clustering, time-series forecasting, model evaluation, feature engineering, data visualization

XR, Game Development, CAD, and Computer Graphics: Unity, C#, Meta Quest 3, Meta XR SDK, SteamVR, AR/VR interaction design, 3D interaction, raycasting, shaders/materials, lighting, reflections, spatial modeling, primitive modeling, STL export, Blender, procedural content generation, game mechanics, mixed-reality prototyping

UX, Product Design, and Research Methods: Figma, Adobe XD, Adobe Photoshop, Mural, user research, usability testing, interviews, surveys, contextual inquiry, affinity mapping, thematic analysis, think-aloud protocols, mixed-methods research, within-subjects experimental design, statistical analysis (Wilcoxon signed-rank, Spearman correlation, Holm correction), SUS, NASA-TLX, Atlas.ti, wireframing, prototyping, user flows, product documentation

Signal Processing, EEG, Embedded Systems, and IoT: EEG signal processing, MNE-Python, ICA artifact removal, FIR filtering, Welch spectral estimation, Emotiv hardware, spectral bandpower, baseline normalization, ROI analysis, event markers, sensor data processing, BLE, MQTT, FreeRTOS, LVGL, Proteus, Arduino-style prototyping, digital logic, wearable/IoT system design

Writing, Communication, and Commercialization: Technical writing, content writing, SEO-oriented writing, website copy, project documentation, research communication, grant/proposal writing, customer discovery, market validation, product positioning, pitch development, stakeholder communication

Languages: English, Urdu, Punjabi, Hindi, French

LEADERSHIP, SERVICE, AND COMMUNITY INVOLVEMENT

Technical Committee Chair , CIRP CAT 2026, University of Alberta	Apr. 2026 – Jun. 2026
Technical Committee Chair , PAMM Conference, University of Alberta	Jul. 2025 – Aug. 2025
realme Pakistan Campus Ambassador for LUMS	Mar. 2021 – May 2023
Assistant Director Marketing , INDEX – Design & Innovation Society, LUMS	Sep. 2022 – Apr. 2023
Director Marketing & Event Head , LUMS Students Mathematics Society	Dec. 2020 – May 2022
Assistant Director Events , LUMS Religious Society (LRS)	Sep. 2020 – May 2022
Director Events , Your Buddy Community (YBC)	Sep. 2020 – May 2021
Coach , Summer Coaching Session, National Outreach Program (NOP), LUMS	Jul. 2022 – Aug. 2022
School Head , Project Bunyaad, LUMS Community Service Society (LCSS)	Aug. 2021 – Sep. 2021
Event Head , LUMS Literary Society (LLS)	Dec. 2019 – Feb. 2020
Volunteer : LUMS Open Day (Dec. 2020), LUMS Career Fair (Mar. 2020), SIGMA IV by LSMS (Jan. 2020)	