

ABHIJITH CHEPPALLIMURIYIL BIJUKUMAR

✉ abhijithcb88@gmail.com ☎ +91 6282338895  linkedin.com/in/abhijithcb  0009-0002-1601-0249
 github.com/Abhijith-CB

EDUCATION

Bachelor of Technology In Electronics and Communication Engineering, Amrita Vishwa Vidyapeetham - Current CGPA : 8.89/10

2021 – 2025 | Amritapuri, India

RESEARCH EXPERIENCE

Student Researcher, Amrita Mind and Brain Center

2024 – 2025 | Amritapuri, India

- Designed and built a modular human gait data acquisition system utilizing ESP32 microcontrollers, various sensors, and Type-C USB interfaces, enabling precise detection and differentiation of swing and stance phases during gait cycles.
- Conducted in-depth research on cerebellum-inspired neuron models, focusing on their implementation using Verilog HDL for hardware-level simulation and testing.
- Developed a neural network-based system comprising an encoder, decoder, and a robotic arm, enabling real-time motor control and task automation.

Mitacs GRI Research Student, e-minds - University of Windsor

2024 | Windsor, Canada

- Conducted research on Organic Electrochemical Transistors (OETs), MEMS-based capacitive micromachined ultrasonic transducers, and novel piezoelectric-based ultrasonic transducers.
- Managed fabrication and characterization experiments using advanced tools such as impedance analyzers, parameter analyzers, probe stations, and the Keithley 2636B SMU.
- Developed experimental methodologies for statistically processing raw data and presented detailed comparative analyses using methods such as ANOVA and Tukey's HSD.
- Tested piezoelectric-based ultrasonic transducers using high-precision equipment such as the SIA-7 for conducting ultrasonic analysis.
- Collaborated effectively with graduate students, quickly adapting to the lab environment while demonstrating technical proficiency, a strong work ethic, initiative, teamwork, and problem-solving skills.

Hardware Security Researcher, Redantio Solutions Pvt Ltd

2023 | Amritapuri, India

- Designed and built custom SDR components, including LNAs, filters, DC blocks, and high-frequency circuit boards. Applied RF design principles for enhanced signal reception and minimal interference.
- Worked with NI B204-mini SDR, HackRF, and multiple LoRa transmitters for real-time RF signal analysis. Integrated urban RF noise generation for performance testing in challenging environments.
- Synchronized five RTL-SDRs using a GPSDO for precise time and frequency alignment. Ensured reliable multi-device communication through hardware-level synchronization.
- Collaborated with SDR manufacturers and developers for advanced hardware insights. Gained practical experience in custom SDR design through expert mentorship.
- Used GNU Radio and SDR++ for real-time signal demodulation, decoding, and analysis. Developed efficient signal processing pipelines for robust LoRa detection and data collection.

PUBLICATIONS

Cross-channel Configured Organic Field-Effect Transistors with Enhanced Transconductance, *IEEE Transactions on Electron Devices*, (Under Review, Submitted: November 2024) 2024

- **Fabrication:** The OFET devices were fabricated on p-doped silicon wafers with a dry thermal oxide dielectric layer. Diketopyrrolopyrrole-thiophene (DPP-T) was used as the organic semiconductor polymer, applied through spin-coating, followed by gold electrode deposition using PVD.
- **Experimental Characterization and Performance Results:** Devices were characterized using a Keithley 2636B SMU and an EverBeing Probe Station. Electrical measurements involved varying gate and drain voltages to obtain output and transfer characteristics. Key improvements included an 8.17x higher drain current, a 5.48x increase in transconductance, a 1.51x higher ON-OFF current ratio, and a 1.91x reduction in hysteresis. The design efficiently utilized chip area while providing stable electrical performance.

Detecting, Demodulating & Decoding LoRa, *International Conference on Computing and Networking Technology* (10.1109/ICCCNT61001.2024.10725687) 2024

- **Model Development:** Created deep learning models (ResNet, InceptionV3, EfficientNet) for LoRa signal classification using spectrograms.
- **Data Collection:** Used an NI B204-mini SDR with a custom LNA and four different LoRa transmitters, while generating urban RF noise using two Great Scott HackRF devices.
- **Real-Time Analysis:** Implemented real-time analysis using the B204-mini SDR with 16 MHz bandwidth, employing GNU Radio tools for demodulation and decoding.
- **Results:** Achieved over 94% accuracy with high precision, recall, and F1-scores, enabling robust LoRa detection and protocol understanding.

PROJECTS

Cerebellum-Inspired Neural Network for Robotic Arm Control 2025

- Modeled a neural network consisting of 10 neurons in Verilog. These neurons are connected in a network that collectively outputs a signal, which is then encoded. A decoder was designed on the ATmega232p to control a six-degree-of-freedom robotic arm.
- The input is provided from electrodes connected to the biceps and triceps, and spikes are extracted to activate the neurons. Moreover, this project ultimately aims to develop neural prosthetics.

Human GAIT Analysis System 2025

- Designed and prototyped a low-cost wearable system based on the ESP-32 and a set of four accelerometers, four gyroscopes, two rotary encoders, and a pair of force sensors.
- The system is used for human gait analysis to aid patients with limb loss in controlling robotic prosthetics and to assist individuals with Parkinson's disease in walking normally. The project aims to enable motion prediction for enhanced mobility and rehabilitation support.

IOT Irrigation Automation 2024

- Automated 200 acres of agricultural land by integrating 287 ESP-8285-based solenoid valves and eight electric water pumps into a central server.
- Used software-defined networking (SDN) to connect all nodes to a central server, with an instance of the server deployed on a local Raspberry Pi.

PrecisionWave 2024

- Developed an Arduino-based GPS-disciplined oscillator (GPSDO) to enhance the accuracy and stability of RTL-SDR receivers.
- Designed a circuit integrating a GPSDO and an ATmega328p microcontroller to generate a 10 MHz synchronized clock signal when locked to a GPS satellite. This external clock source enabled precise synchronization of multiple RTL-SDRs across different locations, ensuring accurate, time-aligned RF data collection.

- Improved SDR performance for precise signal localization and analysis.

Wireless Forensics toolkit

2024

- Developed the SDR-to-computer interface for real-time LoRa signal detection and demodulation.
- Demodulation of the intercepted signal was achieved using tools like GNU Radio and by applying various signal processing techniques such as Fast Fourier Transform, wavelet transform, whitening, de-whitening, interleaving, de-interleaving, and frame decoding.

IC3 Shield

2023

- Developed a challenge board for the IC3 Global Cybersecurity Event on Altium Designer, featuring the ESP-32 S3 and an E-ink display, integrating various Capture the Flag (CTF) challenges.
- Designed the driver circuit for the E-ink display and handled the power management of the circuit board.

PIKey Pro

2023

- Built a custom mechanical keyboard using a Raspberry Pi Pico with added macro support.
- Designed the PCB on Altium Designer with a 68-key keyboard matrix. It also featured a 1" OLED screen for displaying verbose output from the Pico and other applications.

Cracker 85

2023

- Designed the PCB on KiCAD and developed an enhanced keychain using an ATtiny85 and an OLED screen with a couple of buttons.
- It is a trinket featuring a clock and mini-games.

Raptor (USB Samurai)

2023

- Developed a remote OTA HID injection attack tool exploiting USB Samurai vulnerabilities in Logitech dongles.
- Integrated a Nordic nRF52840 for pairing and coupled an RP2040 MCU board with a GSM SIM700 module running MicroPython for remote server connectivity.
- Enabled attacker-controlled shell access via TCP through the Logitech dongle.

Verilog based ALU

2022

- Designed an ALU using Verilog HDL and implemented its functionality on a Xilinx Artix-7 FPGA, utilizing expertise in digital logic and FPGA development.

Remote Patient Monitoring System

2022

- Developed an ESP32-based system consisting of a pulse oximeter and blood pressure monitor in C++ to monitor patient vitals and log data to a remote server.

SEMINAR

A Comprehensive Study on RF Signals and ML,

2024

Guide: Dr. Gayathri R. Prabhu

- Presented our review research work titled "A Comprehensive Study on RF Signals and Machine Learning" at Amrita School of Engineering, Amritapuri Campus. The presentation emphasized ML-based techniques for various RF signal operations.
- Engaged in discussions on advanced topics in machine learning and signal processing.
- Focused primarily on applications such as decoding, detection, classification, and augmentation of RF signals.

COMMUNITY OUTREACH PROGRAMS

Amritavarsham'70

2023

- Led a team of eight members at Amritavarsham'70 as part of the cleanup drive team.
- Ensured proper waste segregation and management in and around the event venue.

Live-in-Labs®

2024

- Designed and implemented a fiber-optic network to provide internet access in Wavanje, a rural village near Mumbai, by addressing infrastructure and connectivity challenges.
- Connected over 590 homes to the internet and distributed digital devices, enhancing communication and access to educational and digital resources for the community.
- Conducted awareness sessions for men and women on tuberculosis, menstrual hygiene, nutrition, education, and social services provided by the government.

Student Social Responsibility (SSR)

2024

- Created and conducted three study sessions on electrical engineering topics such as circuit theory and electronic devices for peers needing additional support.
- Taught fundamental principles of electronic circuit design and trained them in simulating circuits using Proteus simulation software.

Deep Dive into Hardware Hacking

2023

- Delivered presentations on firmware analysis and PCB reverse engineering as the lead of Team biOs.
- Showcased practical techniques for hardware system analysis and reverse engineering to students.
- Guided first-year undergraduates in prototyping and Arduino basics.

CO-CURRICULAR PURSUITS

Team Lead & Mentor, Hardware Development Team,

2022 – Present | Amritapuri, India

Team biOs – Cyber Security Research Group

- Led a team of students in designing and prototyping innovative embedded systems, fostering collaborative problem-solving and project management skills.
- Developed functional prototypes using single-board computers (SBCs).
- Focused on signal processing and analysis for advanced cybersecurity applications.

Challenge Author & Design Engineer, IC3 Global Cybersecurity Event

2023 | California, USA

- Contributed to circuit board design by designing the display driver circuit and power management circuit.
- Designed the PCB on Altium Designer, assembled the components, and tested the circuits.
- Developed a hardware reversing challenge focused on sequential logic and custom communication protocols for the event.

Sports

2018 | Idukki, India

- Played basketball in inter-high school tournaments.
- Participated in cycling events for charity and blood donation drives.

AWARDS

Mitacs Globalink Graduate Fellowship

2024

- Eligible for the Mitacs Globalink Graduate Fellowship, a \$11,000 scholarship to pursue graduate studies in Canada. Also received an opportunity to become a Mitacs Globalink Ambassador.

Global Nominee & Galactic Impact Award,

2023

NASA Space Apps Challenge

- Awarded for the application presentation **Hydrocrate** at the NASA Space Apps Challenge and selected as a global nominee from over 5,500 submissions.

National Finalist, Kavach 2023

2023

- Represented Amrita and Kerala at the national level and won runner-up in India's Best Cybersecurity Hackathon, hosted by the Ministry of Education, India.

- Awarded for the application presentation **Atlantis** at the NASA Space Apps Challenge.

INTERESTS

- MEMS and Nanotechnology
- Embedded System Design
- Network Engineering
- Computer Architecture
- VLSI Design
- Electrical Engineering

PROGRAMMING SKILLS

C | C++ | Python | MATLAB | Verilog HDL | BASIC

SOFTWARE SKILLS

ANSYS HFSS | COMSOL Multiphysics | AutoCAD | Proteus | Altium Designer | Fusion 360 | LT Spice | ModelSim