

# Richard Djarbeng

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## PERSONAL STATEMENT

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I am a research-oriented graduate with a Master's in Electrical and Computer Engineering from Carnegie Mellon University (CMU), completed in May 2024. My academic journey has built a strong foundation in Wireless Networks, computer vision and machine learning with a particular focus on their applications in autonomous systems.

My technical proficiency spans multiple programming languages, including Python, JavaScript, Java, and C++, enabling me to tackle diverse challenges in software engineering. I've honed my skills in machine learning frameworks such as fastai and PyTorch, with a special emphasis on Convolutional Neural Networks (CNNs). My expertise in computer vision extends to semantic segmentation and object detection, skills that are crucial for advanced autonomous driving systems. Through my tenure as a research assistant and teaching assistant, I've deepened my capabilities in data analysis and applied machine learning.

## EDUCATION

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- **MSc Electrical Computer Engineering — Carnegie Mellon University** July 2022 - May 2024  
*Courses: Introduction to Deep Learning, Computer Vision, Internet of Things, Autonomous Driving, Data Analytics, Data structures and Algorithms, Introduction to Information Security, Cognitive Robotics, Wireless Networks*
- **BSc Computer Engineering — University of Ghana** November 2021  
*Electives: Software Engineering and Computer Graphics*

## EXPERIENCE

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- **Research Associate — Carnegie Mellon University** July 2024 - Present
  - **Environmental Sensor Development:** Responsible for the design and development of low-cost sensor nodes for measuring temperature, humidity, wind speed and environmental parameters with the aim of building open datasets for Africa.
  - **Data Storage and Visualization:** Collaborate with the project's principal investigators and external researchers to design a data storage and management framework, ensuring the collected environmental data is stored securely and made accessible to project stakeholders.
  - **Sensor Testing and Calibration:** Participate in the testing and calibration of the sensor nodes using machine learning techniques to improve the accuracy and reliability of the low-cost sensors.
  - **Air Quality Data Analysis and Visualization:** Analyze air quality data from US Embassy sources in Kigali and other cities via Airnow, creating visualizations leveraging archived datasets for enhanced environmental insights.
  - **Academic Paper Preparation:** Collaborate with the research team to prepare and publish academic papers documenting the project's findings and methodologies.
- **Research Assistant — Carnegie Mellon University** January 2024 - May 2024
  - **Interdisciplinary Research:** Working with the CMU mechanical engineering department and Center for Atmospheric Particle Studies(CAPS to research alternative ways of predicting biomass pollutants in the air using a combination of sensor data from aethalometers and mathematic models for the absorption rate of different wavelengths of particulate matter pollutants.
  - **Air Quality Prediction:** Improving existing low-cost means of predicting black carbon pollutants using RGB pictures of filters to be able to distinguish pollution from wood from fossil fuels.
  - **Data Analysis and Experimentation:** Conducting data analysis with datasets collected for more than 2 years and verifying experiments to measure black carbon pollutants.
- **Teaching Assistant — Carnegie Mellon University** August 2023 - December 2023
  - **Teaching and Mentoring:** Conducting recitations for the Internet of Things (IoT) focused on setting up IoT systems with a web API using JavaScript and NodeJs on the Raspberry Pi.

- **Academic Support:** Assisting students in understanding concepts in circuit design, programming embedded systems, REST, HTTP, and wireless connectivity (2G, 3G).

## ● Graduate Intern — AfriqAir- Kigali Collaborative Research Center May 2023 – August 2023

- **System Design:** Designed system specifications and architecture for an IOT wireless data logging unit.
- **Prototype Development:** Built a prototype IOT system to automate the diagnostic and data collection process from the Thermofisher TEOM™ air quality system. Built with Python and C++ for Raspberry Pi and Arduino.
- **Web Dashboard Development:** Developed a web dashboard using ReactJs for visualization and interpretation of air quality data.

## ● Intern — Sorphise GH Ltd (Ghana) July 2020 – January 2021

- **Web Application Development:** Web application development and deployment using JavaScript, PHP, React (GatsbyJS), Netlify NetlifyCMS
- **Task Management** Used task management software to track project timelines, define requirements, build mock-ups for client feedback, and communicate with managers about challenges.
- **Scalable Static Site Architecture:** Implemented a scalable static site architecture by decoupling code from content, utilizing Netlify CMS to manage site content and GitHub repositories for code management. This separation of concerns enabled faster website development with continuous integration (CD), increased project efficiency, and allowed for more projects to be completed within a given timeframe. By keeping code and content separate, we were able to streamline our workflow to use the benefits of static site generation.
- **Site Deployment and Management:** Deployed sites on Netlify site-hosting, configured the Netlify content management system (CMS), to integrate with site content, fixed DNS errors and checked status; performance and errors, on deployed websites.
- **DNS Configuration:** Configured DNS settings and domain names/URLs for custom-hosted websites, enabling secure HTTPS connections and ensuring seamless redirects from HTTP to HTTPS.
- **Cloud-Based CMS Migration:** Pushed for migration of developed websites to a cloud-based Content Management System (CMS) via GitHub enabling seamless continuous deployment (CD) and automated website updates. This integration allowed changes to website content to trigger automatic rebuilds and deployments, eliminating the need for manual intervention by administrators or developers and less manual effort.
- **Custom CMS Development:** Worked on Content Management System (CMS) for website administrators which separated website content from code. This allowed website administrators to update content such as posts; title, body and images for websites without changing the web application code.
- **In-House CMS Development:** Made changes to in-house CMS application using PHP, AJAX, JavaScript for websites not using cloud CMS.

## SKILLS

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- **Web Development:** React.js, Node.js, PHP Express.js, RESTful APIs, WebSockets, Ruby
- **Cloud & Machine Learning:** Google Cloud (Computer vision, Vertex AI, BigQuery), fastai, pytorch, model deployment (Hugging face)
- **Languages:** JavaScript (ES6+), Python, Java, C++, Dart(Flutter)
- **Tools & Practices:** Git, Test-Driven Development
- **Others:** PWAs, Performance Optimization, IoT (Raspberry Pi), Satellite Image Processing

## LEADERSHIP EXPERIENCE

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- **Club President** Internet of Things (IoT) club Carnegie Mellon University Africa
  - Led a team of 6 committee members to organize campus events enhancing student knowledge of IoT and embedded systems, fostering a culture of innovation and technological exploration.
  - Orchestrated field trips to Zipline, a company pioneering autonomous drone delivery of medical supplies to remote areas of Rwanda, providing students with real-world exposure to cutting-edge IoT applications in humanitarian technology.
  - Served as a technical advisor for student projects, offering expertise in data collection, GPS integration, and various microcontrollers, thereby supporting practical application of IoT concepts.

## PROJECTS

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- **Background Removal and Image Segmentation on Hugging Face** Aug 2024
  - *Skills used: Deep learning · Python · Computer vision · Gradio · Rembg*
  - Deployed a machine learning model for background removal leveraging the ‘rembg’ library.
  - Deployed the model into a production-ready Gradio interface, enabling users to upload and process images directly through an intuitive web-based platform.
  - Allowed users to select different models and add image processing features, such as post processing the mask, returning only the images mask correction, focusing on optimizing performance and usability for various image types.
- **Predicting Loan Risk with AutoML on Google Cloud Vertex AI** May 2024
  - *Skills: Google Cloud AutoML · Machine Learning · APIs · Google BigQuery*
  - Developed a machine learning model to predict loan default risk using Google Cloud Vertex AI’s AutoML.
  - Engineered features from tabular data, optimized model training with compute budgets and early stopping.
  - Evaluated model using precision/recall curves, ROC curves, and Explainable AI for feature importance.
  - Deployed model endpoints and integrated with Shared ML Service, showcasing end-to-end ML lifecycle management.
- **Detection and Identification of Manipulated Facial Images using Deep Learning** Sep 2023 - Dec 2023
  - *Skills used: Deep learning · Python · Computer vision*
  - Developed a robust system using deep learning techniques to detect and identify manipulated facial images using RESNET-50, focusing on software like Face swap, deepfakes, and Face2Face.
  - Utilized a Block-based Convolutional Neural Network (CNN) and a ResNet34 model to achieve high accuracy in classifying manipulated images extracted from videos.
- **Countdown Progressive Web Application (PWA)** Dec 2021
  - *Skills: JavaScript · Git/Github · PWAs · User-Centered Design · Continuous Development (CI/CD)*
  - Developed a feature-rich countdown PWA using just HTML, CSS and JavaScript with offline support and caching of resources using service workers.
  - Led user-centered design process, prioritizing features based on user feedback (90+ pull requests, many resolved github issues, multiple iterations).
  - Implemented responsive design, dark/light modes, user data persistence, and social media sharing.
- **Transmission Corridor Monitoring using Satellite Imagery** Sep 2020 - Aug 2021
  - *Skills: Python · Satellite Image Processing · Geospatial Information Systems*
  - Developed a web application system for GRIDCo/ECG in Ghana to monitor transmission corridors using satellite imagery and deployed as a Google cloud application.
  - Applied image processing and geospatial analysis to detect and alert on potential hazards or encroachments.
  - Showcased ability to work with big data (satellite imagery) and domain-specific challenges.
- **IoT Security System** Nov 2022 - Dec 2022
  - *Skills: Node.js · Raspberry Pi · WebSockets · Real-time Systems*
  - Engineered an IoT security system using Raspberry Pi, sensors, and Node.js for real-time monitoring.
  - Implemented a WebSocket-based server for instant alerts and data visualization.
  - Demonstrated skills in embedded systems, real-time data processing, and IoT security.