# Toufiq Musah

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## Summary

A biomedical researcher and engineer with multidisciplinary experience in technology driven healthcare solutions, deep learning, and digital health. Focus on global health, translational medicine, and artificial intelligence. Proven ability to lead impactful research and project initiatives, with a strong commitment to bridging the gap between technology and accessible healthcare solutions.

## Education

**Kwame Nkrumah University of Science and Technology (KNUST)** Jan 2021 – Nov 2024
***BSc. Biomedical Engineering*** *- First Class Honors*

- **Relevant Courses:** Research Methods, Biomechanics, Medical Imaging, Probability and Statistics, Linear Algebra, Calculus, C Programming, Biomaterials, Bioinstrumentation, Biosignal Processing and Analysis, Basic Mechanics

## Professional Experience

**Research Assistant, Engineering Research** *Kumasi, Ghana* Oct 2024 – Present
***Kumasi Centre for Collaborative Research in Tropical Medicine (KCCR)***

- Research in Digital Health and Artificial Intelligence in the Global Health & Infectious Diseases (GHID) Group.
- Developing generative AI tools for the assistive management of diseases and Clinical Decision Support Systems.

**Research Assistant, Machine Learning Intern** *Kumasi, Ghana* Oct 2023 – Feb 2024
***Responsible Artificial Intelligence Lab (RAIL)***

- Conducted extensive research across multiple domains of machine learning/deep learning, including Generative Adversarial Networks (GANs) and Machine Learning Applications in Biomedical Engineering.
- Built Generative Models for CT denoising and upscaling (SRGAN), and CT-MRI synthesis (CycleGAN).

**Engineering Intern** *Kumasi, Ghana* Sept 2021 – Nov 2021
***Sesi Technologies Limited***

- Built User-Interface components to assist in the digitization of agricultural tools.
- Designed and implemented a custom computer mouse, sourcing components, utilizing CAD & 3D printing.

**Biomedical Engineering Intern** *Accra, Ghana* Dec 2022 – Jan 2023
***37 Military Hospital***

- Assisted in routine maintenance checks on various medical equipment including autoclaves and surgery lightening equipment.
- Supported quality control processes through testing and evaluations, ensuring medical devices met organizational and regulatory standards.

**Teaching Assistant & Private Tutoring** *Accra, Ghana* Aug 2019 – Feb 2022

- Aided in the curation of a teaching curriculum to improve the classroom learning experience.
- Tutored students one-on-one in various subjects including; Science, Physics, Chemistry, Mathematics.

## Research and Academic Work

*Conference Papers*

**Automated Segmentation of Ischemic Stroke Lesions in Non-Contrast Computed Tomography Images for Enhanced Treatment and Prognosis**
Authors: **Toufiq Musah**, Prince Ebenezer Adjei, Kojo Obed Otoo
Accepted at: MICCAI Meets Africa Workshop - Paper, Oral Presentation
ArXiv preprint: https://arxiv.org/abs/2411.09402

- **Transformer and ConvNet: An Approach for Advanced Brain Tumor Segmentation in Sub-Saharan Africa**

Authors: Toufiq Musah, et al.
Under review by: MICCAI BraTS Challenge
*Poster Presentations*

- **An Explainable Artificial Intelligence Framework for Clinical Decision Support Systems in Stroke Triaging**
  Authors: **Toufiq Musah**, Tracy Birago Boamah, Mathew Akakpo, Prince Ebenezer Adjei
  Accepted at: Ghana Digital Innovation Week - Poster Presentation
- **Explainable Classification of Ischemic And Hemorrhagic Strokes Using Non-contrast Computed Tomography Scans**
  Authors: **Toufiq Musah**, Tracy Birago Boamah, Mathew Akakpo, Adjei Prince Ebenezer
  *Abstracts & Talks*
- **An Explainable Artificial Intelligence Framework for Clinical Decision Support Systems**
  Authors: **Toufiq Musah**, Tracy Birago Boamah, Mathew Akakpo, Adjei Prince Ebenezer
  Presented at: Biomedical Engineering Symposium, KNUST and VRIJE Universiteit Brussel - Oral Presentation
- **Sleep Apnea detection Using machine learning in low-resource compute devices and SpO2 Sensors**
  Authors: Toufiq Musah
  Accepted at: University of Ghana, School of Engineering Sciences Conference - Abstract, Oral Presentation
  Book of Abstracts

## Relevant Projects

**Brain Tumor Segmentation Using Deep Learning**

Developed and implemented advanced algorithms for segmenting brain tumors from multi-modal MRI scans as part of the Sprint AI Training for African Medical Imaging Knowledge Translation programme. The project focused on addressing the unique challenges facing the Sub-Saharan African region including limited data availability.

**Super Resolution and Denoising of Computed Tomography Scans**

A generative model for producing high resolution head CT scans from low resolution variants, to minimize effective patient radiation dose in CT diagnosis radiology procedures.

**Ocular Disease Detection using Deep Learning**

Developing an open-source suite of efficient CNN models for automated diagnosis of major eye conditions (glaucoma, diabetic retinopathy, AMD, cataracts) using fundus images. Achieved >90% accuracy while optimizing for minimal computational requirements. Incorporated explainable AI techniques to ensure models used the right features in disease detection, enhancing interpretability and trust in the system.

**Data Augmentation via Deep Convolutional GAN**

Implemented a deep convolutional generative adversarial network (DCGAN) to synthetically generate additional medical image data for self-supervised pre-training, enabling effective data augmentation and facilitating robust fine-tuning of computer vision models.

**Geospatial Data Visualization Pipeline**

Built a pipeline that accepts and augments data from the Ghana Statistical Service StatsBank, to easily create Geospatial and Exploratory Data Analysis (EDA) plots for research and policy purposes.

**Prosthetic Leg Design**

Led a team of students in designing an affordable, safe and efficient 3D above knee prosthetic leg, applying Finite Element Analysis (FEA) in validating the final design.

**Remote Patient Monitoring Telemetry System**

Engineered an IoT-based health vitals monitoring solution using the MAX30102 sensor and Arduino Nano RP2040. Implemented a cloud dashboard for real-time tracking of vital signs, enhancing remote patient care capabilities.

## Awards and Acknowledgments

- Best Oral Presentation Award - MICCAI Meets Africa Workshop, 2024
- Best Poster Presentation Award - Ghana Data Science Summit, IndabaX, 2024
- MICCAI Meets Africa Travel Award, 2024
- Academic Excellence Awardee – Provost List 2021, 2022, 2023
- MasterCard Health Entrepreneurship Grant
- Ghana Statistical Service, Data Science Hackathon – First Runner Up
- Engineering Maker's Fair Competition – First Runner Up
- Trade and Technology Committee – Chairperson

## Volunteering

**Course Facilitator, Women in Engineering - SheCodes Club**
Teaching Python programming and introductory machine learning classes for the Women in Engineering Society, creating an inclusive learning environment to help members gain critical tech skills and build their confidence in STEM.

**Student Lead, ARM(E3)NGAGE Club**
Spearheading the ARM student club focused on microcontroller programming, IoT, and embedded machine learning. Guided teams in developing innovative hands-on projects while organizing outreach workshops at local high schools to inspire interest in emerging technologies.

**Volunteer, IndabaX, Ghana Data Science Summit**
Contributing to the organization of IndabaX GDSS by curating engaging content that raised awareness and sparked interest in the transformative potential of data science.

**Club President, Biomedical Engineering Hands-On Club**
Led a club that brought biomedical engineering concepts to life through immersive, hands-on projects, nurturing members' practical skills and passion for innovation.

**Mentor, Student Mentor Program**
Guiding peers through academic and personal challenges, fostering a support system that empowers their growth and success.

## Blog Posts, Tutorials

**Introduction to TorchIO for 3D MRI Processing: Preprocessing Transforms** - Blog Post

**How to Make an Image Classification Model: Is it a Pie?** - Blog Post

**End-to-End Deep Learning Tutorial for Image Classification: Pneumonia Detection** - Colab Notebook

## Skills

**Languages:** C/C++, Python, LaTeX, MATLAB

**Libraries:** PyTorch, TensorFlow, Keras, Scikit-Learn, Pandas, LangChain

**Software:** Solidworks, Fusion 360, ANSYS FEA, Unity Game Engine, KiCAD, Electronics Prototyping