Afzal Hossain

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PROFESSIONAL SUMMARY

- Ph.D. Candidate in Electrical and Computer Engineering with research experience in cybersecurity, biometric security, and AI-driven threat detection. Expertise in designing, optimizing, and implementing machine learning and deep learning models for secure authentication, presentation attack detection, and adversarial defense in cybersecurity applications.
- Proven track record of securing external research funding through competitive grants, including NSF-funded projects under CITeR, demonstrating strong grant-writing and proposal development skills.
- Experienced educator committed to excellence in cybersecurity education. Successfully designed and taught courses in various instructional modalities, including face-to-face, online, and hybrid formats. Served as a Course Instructor and Graduate Teaching Assistant, mentoring students through assignments, hands-on projects, and applied research.
- Dedicated to interdisciplinary collaboration and academic service. Actively engaged in peer-reviewed research, student mentorship, professional development programs to advance cybersecurity education and research at the university level.

EDUCATIONAL QUALIFICATION

- **Ph.D.** in **Electrical and Computer Engineering**, **Clarkson University,** Potsdam, NY, USA (*final semester)*
  Current CGPA: **3.75/4.00**
- **Bachelor of Science** in **Computer Science and Engineering**, Eastern University, Bangladesh
  CGPA: **3.93/4.00**

RESEARCH AND PROFESSIONAL EXPERIENCE

- Graduate Research Assistance at **Bio-Signal Analysis Laboratory – Electrical and Computer Engineering Department, *Clarkson University***, *Potsdam, New York*

  - ***Deep Learning Approach for Ear Recognition and Longitudinal Evaluation in Children:*** *(published paper in BIOSIG)*
    - Segment the ear from a profile face using Mask R-CNN, detect contours in the mask, compute bounding boxes for each, and crop the ear using these coordinates
    - Apply an ensemble method that combines VGG, and MobileNet to extract features from the ear
    - Conduct noise reduction, then utilize PCA or UMAP for optimal feature extraction, and evaluate the performance
  - ***Face Liveness Detection Competition (LivDet-Face) – 2024:*** *(published paper in IJCB)*
    - Evaluate advancements in Presentation Attack Detection (PAD) for face biometrics, focusing on identifying and preventing attacks using advanced techniques and a diverse dataset of facial images and videos
    - Introduce innovative attack types, such as 2D and 3D projections, flexible 3D silicon masks, and bobblehead models, providing a realistic and challenging test environment for PAD algorithms
    - Test and analyze 16 algorithms in image and video categories, with top entries achieving industry-leading accuracy
    - Identify key detection challenges with 2D projections and print attacks, underscoring the need for robust algorithms and diverse training datasets for future improvements in PAD systems
  - ***Development of Novel 3D Face Masks for Assessment of Face Recognition Systems:*** *(published paper in BIOSIG)*
    - Introduce novel Presentation Attack Instrument (PAI) species to the Livdet-Face 2021 dataset, facilitating the testing of presentation attack detection algorithms on face biometric systems
    - Develop seven innovative PAIs, including a bobblehead, various 3D masks (white filament, white resin, and high-quality variations, with some featuring image projection), and a mannequin head with image projection
    - Conduct comparative analysis of all PAIs using three face biometric PAD (Presentation Attack Detection) algorithms
  - ***A Comprehensive Evaluation of Iris Segmentation on Benchmarking Datasets:*** *(published paper in Sensors)*
    - Development of three U-Net and U-Net++ based iris segmentation models with cross-dataset accuracy above 90%.
    - Creation of a composite iris dataset (>45k samples) and 1k manually annotated ground truth masks, including occlusions like eyelashes and eyeglasses.
    - Introduction of a GUI-based manual segmentation toolkit, facilitating accurate annotations for training and evaluation.
    - The paper sets new benchmarks for robust and generalizable iris segmentation and provides open-source resources to encourage further research.
  - ***Post-Mortem Human Iris Segmentation Analysis with Deep Learning:*** *(paper under review in IEEE Access)*
    - Research pretrained deep learning models as core architectures for SegNet and DeepLabv3+ in semantic segmentation of post-mortem iris images.
    - Validate approaches across multiple databases, including Warsaw-BioBase-PostMortem-Iris, ensuring broad applicability.
    - Enhance post-mortem iris segmentation accuracy using a MobileNet and DeepLabv3+ combination, optimizing the model for potential mobile device applications.

- **Teach my advisor's classes at Clarkson University while she is away for research-related travels, mentoring and supporting students with their course projects.**

- Graduate Teaching and Research Assistance at **Computer Science Department, *New Mexico State University***, *Las Cruces, New Mexico*

  - As a Summer Course Instructor, I developed and led Python Programming courses with a focus on interactive learning and practical use.
  - Served as a Graduate Teaching Assistant for a C++ course, I refined my teaching skills, guided students through assignments, and conducted problem-solving sessions.
  - ***Prediction using Non-edge Sampling:***
    - Apply Laplacian Eigenmaps on benchmark datasets to get the Eigenvectors and Eigenvalues, converting the graph of the dataset into a Line graph and get the Adjacency, Degree, and Laplacian matrices
    - Implement dimensionality reduction, normalized the dataset and apply the Multi-Layer Perceptron for data classification

- Internship at **Azoncode, Dhaka, Bangladesh**

  - Contributed to a government initiative aimed at organizing and consolidating information pertaining to public officials into a structured format, as part of my internship responsibilities.

PROJECTS

- ***Hardware Information-based Anomaly Detection to Prevent Cyber-Attacks:***
  - Implement the K-LEB tool as a real-time anomaly detection system
  - Apply Meltdown and Spectre for cache side-channel attacks
  - Gather low-level hardware information from different hardware events like Branch Instruction Retired, Branch Misses Retired, Last Level Cache References, Last Level Cache Misses, and Number of Instructions Retired
  - Evaluate a range of Machine Learning models, such as Multi-Layer Perceptrons, Decision Trees, Autoencoders, and LSTMs, to determine their compatibility with this framework
- ***Taxi Trip Data Analysis in New York City using AWS:***
  - Store raw trip datasets in Amazon S3, ensuring secure and scalable data management
  - Use Amazon EC2 to handle data preprocessing and transformation
  - Utilize Amazon EMR to perform complex data querying and analytical tasks using big data frameworks like Hadoop and Spark
  - Analyze data focusing on identifying peak demand times and locations, understanding fare structures, and evaluating the impact of external factors on taxi usage
  - Offer actionable insights to enhance taxi services and urban mobility in New York City
- ***Bitcoin Price Prediction and Data Visualization:***
  - Collect Bitcoin stock prices from Google Finance and Yahoo Finance; analyze data plotting various data visualizations including candlestick charts, violin plots, pie charts, box plots, scatter plots, line graphs, and area graphs
  - Employ Facebook Prophet for time series forecasting of Bitcoin prices
  - Apply Random Forest Classifier machine learning algorithm to assess the accuracy of price predictions

AWARDED GRANTS

- As the lead author and principal investigator, I submitted proposals and secured two grants funding from NSF funded CITeR
  - 'Performance Benchmark: Ear-only vs. Ear+Face Fusion Biometrics for Adults and Children' (Project #23S-08CB)
  - 'Development of Patterned and Clear Contact Lens Detection in Iris Recognition' (Project #24S-11C-G)

TECHNICAL SKILLS

- **Programing Languages:** Python, Matlab, C++
- **Machine Learning:** TensorFlow, PyTorch, Scikit-Learn, Keras
- **Statistical Modeling & AI:** Regression, Classification, Predictive Analytics
- **Course Work:** Cryptography, Introduction to Biometrics, Advanced Topics in Biometrics, Information Security and Cyber Law, Applied Machine Learning, Deep Learning, Computer Vision, Graph Data Mining, Big Data Processing and Cloud Services, Introduction to Big data Architecture

SYNERGISTIC EXPERIENCES

- Awarded as the Best Poster Presenter in the Engineering/Modeling/Material Science category at Clarkson University's Research and Project Showcase (RAPS)
- President (Current) and Former Secretary, Bangladeshi Students' Association at Clarkson University (BSACU)
- Received the Vice Chancellor's Honor Award and Dean's Honor Award for academic excellence at Eastern University (EU)
- Programming Contest trainer for beginner level students at EU
- Organized National Informatics Olympiad and Math Olympiad as a president of Eastern University Computing Club (EUCC)
- Engaged in 'Theater and Life' workshop and played a pivotal role in organizing the Annual Drama Festival at Bangladesh Public Library's theater as a key committee member of the Eastern University Drama & Theater Forum (EUDTF)