SIMRAN SAHA

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RESEARCH INTERESTS

My research is driven by a profound interest in mental health, focusing on understanding the complexities of mental illnesses such as depression, anxiety, and beyond. At the heart of my work is a commitment to uncovering the cognitive behaviors and neural mechanisms that contribute to these conditions, aiming to uncover how they manifest differently across individuals. With a keen eye on the contributing factors behind various mental health disorders, my goal is to lay the groundwork for developing innovative interventions.

Central to my approach is the design and development of assistive technologies tailored to support individuals dealing with mental health challenges. This includes conceptualizing tools and resources, such as applications or devices, that can provide real-time support and intervention. My aim is to translate theoretical research into practical solutions that can make a tangible difference in people's lives, particularly for those with cognitive impairments or those in need of support in acute care and hospice settings.

Beyond the technical aspects of creating wearable devices or software applications, my work emphasizes the importance of accessibility, user-friendliness, and the integration of these solutions into daily life. This approach is underpinned by a broader engagement with fields such as Human-Computer Interaction (HCI) and Human-Centered Artificial Intelligence, which, while not the main-focus, significantly enhance my primary mission by providing a multidisciplinary perspective on how technology can best serve mental health needs.

In essence, my research seeks to bridge the gap between mental health challenges and technological innovation, offering new pathways for intervention and support. By focusing on the needs of individuals affected by mental illnesses and designing interventions that are both effective and accessible, I aspire to contribute meaningful advancements in the field of mental health.

EDUCATION

The University of California, Riverside, *California*   *Sep 2021-Mar 2023*
Master of Science - Computer Engineering
Relevant Courses: Artificial Intelligence, Design and Analysis of Algorithms, Adv. Software Testing and Analysis, Data Mining Techniques, Database Management Systems, Information Retrieval and Web Search, Spatial Computing, Natural Language Processing

Institute of Engineering & Management, **Kolkata**, *India*   *Aug 2016- Jul 2020*
Bachelor of Technology in Information Technology

SKILLS

Programming Skills: Python, Java, Matlab, JavaScript, R
Data Analysis and Machine learning libraries: scikit-learn, stats model, pandas, TensorFlow, SAS
Database, Query, and Streaming: SQL, dbt, Apache Kafka
Data Visualization libraries: matplotlib, seaborn, Tableau
Web Development frameworks: Flask, Django
Operating Systems and Platform: Linux, AWS
Neuroscience and EEG tools: BIDS, EEGLab, Psych toolbox, real-time decoded toolbox, PsychoPy
Version Control: GitHub

RESEARCH / WORK EXPERIENCE

Lab Manager- *Memory and Aging Lab, The University of Texas at Austin, Texas*   *Jul 2023- Present*
- **EEG Data Analysis and Innovation:** Employed MATLAB, EEGLAB, and Python for advanced preprocessing and analysis of EEG data, including the development of custom scripts for robust spectrogram generation. Leveraged innovative techniques for signal quality enhancement and artifact removal, ensuring high fidelity in data analysis.
- **Machine Learning and Neural Network Development:** Spearheaded the design and implementation of sophisticated Convolutional Neural Networks (CNNs) for the classification of EEG data. This work has not only enabled precise sleep stage identification during EEG recordings but also facilitated the extraction of intricate features crucial for understanding sleep's impact on memory and cognitive functions.
- **Sleep Monitoring System Development:** Played a pivotal role in the creation and validation of a state-of-the-art, wearable sleep monitoring system. This system, characterized by its skin-friendly electrodes and seamless integration with mobile devices, represents a leap forward in at-home sleep studies, offering unparalleled comfort and data accuracy.
- **Cognitive and Sleep Study Coordination:** Actively engaged in the recruitment and coordination of study participants, overseeing the comprehensive administration of cognitive assessments and the collection of EEG data using cutting-edge BrainVision equipment. This role involved meticulous planning and execution of study protocols to ensure participant compliance and data integrity.
- **Lab Operations and Team Leadership:** Directed the day-to-day operations of the psychology lab with a focus on maintaining the highest standards of equipment functionality, supply management, and safety compliance. Fostered a collaborative and ethical research environment through effective project support, data management, and team training. Implemented budgetary controls and ensured thorough documentation and regulatory adherence, contributing significantly to the lab's research output and reputation.

Research Assistant- *University of California Riverside, CA*   *May 2023- Jun 2023*
- **Threat Generalization Research**: The project examines the degree to which experiencing a fear-inducing event paired with one outgroup member evokes a similar fear response to other individuals of the same group.
- **Analyzing Data**: Output data management, cleaning, and used BIDS for analyzing the data

Teaching Assistant- *University of California Riverside, CA*   *Mar 2022 – Mar 2023*

- **GitHub for Software Development:** Mentored and guided more than 150 students in utilizing GitHub for software development. Worked with tools such as Valgrind, Continuous Integration, and Design Labs to augment their learning—guided students in improving the project design, translating into developing high-quality projects.

PUBLICATIONS

- Roy A, Singh P, Saha S, Sen A, Ray M, Deb Majumder S, Dutta S, Chowdhuri S, Mundhra R. Design of a Multi-Control Objective Rescue Mechanical Ventilation System (Linshomator). Front Med Technol. 2020 Nov 17;2:575964. doi: 10.3389/fmedt.2020.575964. PMID: 35047880; PMCID: PMC8757753.
- Majumder, Samarpan & Saha, Simran & Das, Ankit. (2021). Testing the feasibility of geothermal heat sinks with concentrated solar power for effective municipal wastewater disinfection: A Pilot Study. Water-Energy Nexus. 4. 10.1016/j.wen.2021.11.003.

RESEARCH PROJECTS

Developing Advanced Wearable Sleep Monitoring Systems for Cognitive and Memory Studies - Ongoing research *Jul 2023-Current*

- Spearheaded the development and validation of a cutting-edge, ultra-thin wearable sleep monitoring system, integrating soft substrate and epidermal electronics for at-home sleep studies. This system features skin-conformable, wireless dry electrodes for EEG, EOG, and EMG recording, ensuring user comfort and data reliability over multiple nights.
- Employed a convolutional neural network (CNN) for automated sleep staging, leveraging multitaper spectrogram images from EEG and EOG channels. This approach allowed for efficient sleep architecture analysis, overcoming the limitations of manual scoring in terms of time and subjectivity.
- Conducted comprehensive analysis of sleep data to explore ethnoracial differences in sleep architecture and its associations with memory performance and decline. This involved innovative use of time-frequency principal component analysis (TF-PCA) to reduce data dimensionality and identify predictors of memory change.
- Utilized hierarchical and mediated regression models to investigate the impact of sleep microarchitecture on episodic memory, examining factors such as spindle density, slow oscillation-spindle coupling, and their variability. This analysis extended to assess the influence of psychosocial and lifestyle factors on these sleep-memory relationships.
- This research contributes significantly to understanding the complex interplay between sleep architecture, cognitive performance, and memory decline, with a particular focus on ethnoracial disparities. It leverages state-of-the-art technology and analytical methods to provide novel insights into sleep's role in cognitive aging and memory health.

Cancer Detection using PanSeer blood test and Linear Discriminant Classifier, 4-5 years prior (Python, Machine Learning algorithm, Scikit-learn, Data Preprocessing, PCA, Cross-validation) - Masters project   *Mar 2022*

- Potential to revolutionize cancer detection and treatment by enabling early diagnosis and saving lives.
- Achieved almost an accuracy of 77% in detecting cancer by analyzing blood biomarkers.
- Identified 10 significant biomarkers related to cancer from a dataset of 1,000 blood samples.

Visual Language Modeling on Statistical Datasets (Python, Natural Language Processing) - Seminar Project   *Mar 2022*

- Explored transfer learning of fine-tuned model for Chart Question Answering task.
- Evaluated model on grey scaled images from Plot QA dataset.
- Found better performance on colored images, according to study findings.

AI Chatbot (Python, Transformer model, gTTS, Tensorflow)- Artificial Intelligence Project   *Dec 2021*

- Programmed and designed a chat server with Python, NLP model, and gTTS.
- Added intelligence to the chatbot through Artificial Intelligence models, providing a striking performance turnaround and chat accuracy of 70-75%.
- Analyzed 1500+ responses to a consumer survey to evaluate what future features can be added to the Chatbot.

Testing the feasibility of geothermal heat sinks with concentrated solar power for effective municipal wastewater disinfection: A Pilot Study (Automation, C++, Sensor programming, Arduino) - Published in the Water-Energy Nexus, Elsevier Journal *Nov 2021*

- Developed an ingenious technique that coalesces concentrated solar power and geothermal heat sinks to harness freshwater.
- Used an open-source electronics platform, Arduino, to design an automated solar radiation technique to treat seawater.
- This resulted in a significant 50-60% reduction in carbon footprint while generating clean water with a purity level of approximately 75%.

Design of Low-Cost Multi-Control Objective Rescue Mechanical Ventilation System- Linshomator (Python, ML algorithm, Automation, Mobile App Development) - Frontiers in the Medical Technology section of Pharmaceutical Innovation.   *Nov 2020*

- Redesigned the conventional ventilation system into an affordable, mechanical ventilation system with a built-in mobile application to monitor essential medical parameters.
- Used machine learning algorithms to optimize the different ventilation parameters, achieving a 10% lower error rate than traditional ventilation systems.
- Validated the system with input from 6 medical professionals across the globe, ensuring the highest standards of safety, efficacy, and ease of use.
- Successfully tested in clinical trials on 100 patients and received FDA approval for emergency use during the COVID-19 pandemic, the system has the potential to provide life-saving support for critically ill patients in resource-limited settings.

ACADEMIC AWARDS

- Secured the Second Spot in the IAMAI challenge organized by UNICEF, India.
- Awarded Director's Award for Overall Student Performance, issued by Institute of Engineering & Management, Kolkata.
- Secured First Position in the Social Enterprise Challenge 2019, awarded by Azim Premji University.
- Emerged as a Finalist at the Carbon Footprint Challenge (CFC) 2019, hosted by Bühler Group.
- Gold medalist in the World Invention Innovation Contest 2019, South Korea, issued by the International Federation of Inventors' Association.
- Recognized by NSSWM for the "Best Paper" award at NSSWM 2019- Pre-Event of 9th ICON 2019.