# Shumit Saha

## Personal Data

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**Web-Links:** Linked-In, Google Scholar

## Current Appointments

**Assistant Professor** (Tenure Track), Department of Biomedical Data Science, School of Applied Computational Sciences, Meharry Medical College, USA

## Education

**Ph.D. in Biomedical Engineering** 2016-2020
University of Toronto, Canada

- Thesis Title: Acoustic assessment of pharyngeal airway dimension and its application in sleep apnea
- Supervisor: Prof. Azadeh Yadollahi
- CGPA: 4.00 out of 4.00 (100%)

**M.Sc. in Biomedical Engineering** 2014-2016
University of Manitoba, Canada

- Thesis Title: Snoring sounds analysis for the assessment of the upper airway anatomy and fluid accumulation in the neck during sleep
- Supervisor: Prof. Zahra Moussavi
- CGPA: 4.03 out of 4.50 (89.56%)

**B.Sc. in Electronics and Communication Engineering** 2008-2012
Khulna University of Engineering and Technology (KUET), Bangladesh

- Thesis Title: Designing a digital system for detection of the dicrotic notch in the carotid pulse signal using Verilog-HDL
- Supervisor: Prof. S. M. Rabiul Islam
- CGPA: 3.83 out of 4.00 (86.40%) [1st in the Department]
- Awarded University Gold Medal for Academic Excellence

## Employment History

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|---|---|
| 12/2023- Present | **Assistant Professor (Tenure Track),** Department of Biomedical Data Science, School of Applied Computational Sciences, Meharry Medical College |
| 09/2022- Present | **Assistant Professor (Status-Only),** Institute of Health Policy, Management and Evaluation (IHPME), Dalla Lana School of Public Health, University of Toronto |
| 02/2022- 11/2023 | **Senior Scientific Associate,** Centre for Digital Therapeutics, University Health Network |
| 02/2021- 01/2022 | **Postdoctoral Researcher,** Centre for Global eHealth Innovation, University Health Network |
| 09/2020- 04/2021 | **Professor (Part-time),** School of Electronics & Mechanical Engineering and Technology, Seneca College, Canada |
| 09/2012- 09/2014 | **Lecturer,** Department of Electronics and Communication Engineering, Khulna University of Engineering & Technology (KUET), Khulna, Bangladesh |

# Publications

## Peer-Reviewed Journals:

**Published/Accepted/In-Press:** (Trainees who I have supervised are underlined, *Represents Corresponding Author)

1. F. Sarker, R. Ripan, M. Chowdhury, AKMN Islam, M. Rahman, S. Islam, **S. Saha***, K. A. Mamun "Prevalence and Risk Factors of Stroke in Rural Bangladesh: A Population-Based Study on 1.3 million people", JMIR Public Health and Surveillance, In Press (IF: 8.25) [Co-Senior Author]
2. **S. Saha**, A. Rattansingh, K. Viswanathan, A. Saha, N. Montazeri, R. Martino, A. Yadollahi, "Influence of obstructive sleep apnea on upper airway dimension during vowel articulation: A pilot observation using ultrasonography and acoustic analysis", (Scientific Reports, Accepted with Revision) (IF: 4.99)
3. K. Pfisterer, R. Lohani, E. Janes, D. Ng, D. Wang, D. Bryant-Lukosius, R. Rendon, A. Berlin, J. Bender, I. Brown, A. Feifer, G. Gotto, **S. Saha**, J. Cafazzo, Q. Pham, "An actionable expert-system algorithm to support nurse-led cancer survivorship care: Algorithm development study", JMIR Cancer, 2023;9:e44332 (IF: 2.80)
4. N. Montazeri, **S. Saha**, B. Gavrilovic, K. Zhu, B. Taati, H. Alshaer, A. Yadollahi, "Sleep Apnea Severity based on Estimated Tidal Volume and Snoring Features from Tracheal Signals", Journal of Sleep Research, 2022, 31 (2), e13490. (IF: 5.29)
5. Z. Morsada, M. M. Hossain, M. T. Islam, M. A. Mobin, **S. Saha***, "Recent progress in biodegradable and bioresorbable materials: From passive implants to active electronics", Applied Materials Today, 2021, Volume 25, 101257 (IF: 8.86)
6. X. Cao, T. D. Bradley, S. Bhatawadekar, **S. Saha**, S. M. Tarlo, M. B. Stanbrook, M. Inman, K. Rana, R. Dandurand, A. Yadollahi, "Effect of simulated obstructive sleep apnea on thoracic fluid volume and lower airways resistance in asthmatic subjects", American Journal of Respiratory and Critical Care Medicine, 2021, 203(7), 908–910 (IF: 30.52)
7. Z. A. Nazi, F. R. Mashrur, M. A. Islam, **S. Saha***, "Fibro-CoSANet: Pulmonary Fibrosis Prognosis Prediction using a Convolutional Self Attention Network", Physics in Medicine and Biology, 2021, 66 (22) (IF: 4.17)
8. M. Hasan, M. Jawad, K. N. I. Hasan, S. B. Partha, M. A. Masba, **S. Saha**, M.A. Moni, "COVID-19 identification from volumetric chest CT scans using a progressively resized 3D-CNN incorporating segmentation, augmentation, and class-rebalancing", Informatics in Medicine Unlocked, 2021, Volume 26, 100709 (IF: 3.37)
9. F. R. Mashrur, A. D. Roy, A. P. Chhoan, S. Sarker, A. Saha, S. N. Hasan, **S. Saha***, "Impact of demographic, environmental, socioeconomic, and government intervention on the spreading of COVID-19", Clinical Epidemiology and Global Health, 100811, 2021 (IF: 1.6).
10. N. Montazeri, M. Kabir, **S. Saha**, B. Gavrilovic, K. Zhu, B. Taati, H. Alshaer, A. Yadollahi, "Relative tidal volume and respiratory airflow estimation using tracheal sound and movement during sleep", Journal of Sleep Research, 2021, e13279. (IF: 5.29)
11. N. Montazeri, M. Kabir, **S. Saha**, K. Zhu, B. Gavrilovic, H. Alshaer, B. Taati, A. Yadollahi, "Automatic respiratory phase identification using tracheal sounds and movements during sleep", Annals of Biomedical Engineering, 2021, 1-13 (IF: 4.21)
12. **S. Saha**, M. Kabir, N. Montazeri, M. Hafezi, B. Gavrilovic, K. Zhu, H. Alshaer, A. Yadollahi, "Portable diagnosis of sleep apnea with the validation of individual event detection", Sleep Medicine, 69C (2020) pp. 51-57 (IF: 4.84)
13. **S. Saha**, A. Rattansingh, K. Viswanathan, A. Saha, R. Martino, A. Yadollahi, "Ultrasonographic measurement of pharyngeal airway dimension and its relationship with obesity and sleep-disordered breathing", Ultrasound in Medicine & Biology, 46(11), 2998-3007, 2020 (IF: 3.69)

14. N. Montazeri, S. Akbarian, M. Hafezi, **S. Saha**, K. Zhu, H. Alshaer, B. Taati, A. Yadollahi, "Sleep/wakefulness detection using the tracheal sound and movement", Nature and Science of Sleep, 12, 1009-1021, 2020 (IF: 5.34)
15. M. Hafezi, N. Montazeri, **S. Saha**, K. Zhu, B. Gavrilovic, A. Yadollahi, B. Taati, "Sleep apnea severity estimation from tracheal movements using a deep learning model", IEEE Access, vol. 8, pp. 22641-22649, 2020. (IF: 3.36)
16. **S. Saha**, Z. Moussavi, P. Hadi, T.D. Bradley, A. Yadollahi, "Effects of fluid accumulation in the neck on features of snoring sounds", Journal of Clinical Sleep Medicine, 2018;14(10):1653–1660. (IF: 4.32)
17. **S. Saha**, T.D. Bradley, M. Taheri, Z. Moussavi, A. Yadollahi, "A subject-specific acoustic model of the upper airway for snoring sounds generation", Scientific Reports, 2016; 6: 25730. (IF: 4.99)
18. S.M.R. Islam, **S. Saha**, M.I. Khan, "FPGA based digital system for detection of dicrotic notch in the carotid pulse signal", International Journal of Information and Communication Technology Research [ISSN 2223 - 4985], Vol. 2, No. 12, pp. 872 – 880

**Manuscripts Under Review:** (Trainees who I have supervised are underlined)

19. K. Pfisterer, **S. Saha**, Y. Fossat, M. Grossman, A. Wong, A. Yadollahi, B. Wang, A. Garg, L. Dinu, D. Kale, C. Leppin, M. Oldham, M. Taylor, I. Connell, C. Garnett, Q. Pham, "Responsible artificial intelligence in clinical decision support systems requires good science: Lessons learned from an international roundtable discussion", (Submitted to Journal of Medical Internet Research)
20. **S. Saha**, N. Montazeri, A. Yadollahi, "Distinguishing central and obstructive respiratory events during sleep through breathing sounds utilizing transfer learning on deep convolutional networks", (Submitted to Sleep)
21. **S. Saha**, K. Viswanathan, A. Saha, A. Yadollahi, "Feasibility of acoustic features of vowel sounds in estimating the upper airway cross-sectional area during wakefulness", (Submitted to Speech Communication)
22. **S. Saha**, H. Ross, C. Wang, J. Vishram, C. Manlhiot, B. Wang, J. Cafazzo, "Detection of Heart Failure Decompensation: Enhancing the Performance of an Expert System using Machine Learning and Electronic Health Record (EHR) data", (Submitted to PLOS-Digital Health)

## Conference Proceedings:

1. **S. Saha**, K. Viswanathan, N. Montazeri, A. Yadollahi, "Relationship between vowel sound features and pharyngeal airway cross-sectional area during normal breathing", 42nd Annual International Conferences of the IEEE Engineering in Medicine and Biology Society (EMBS), Montreal, Canada, 2020 (Oral presentation)
2. N. Montazeri, **S. Saha**, B. Gavrilovic, A Yadollahi, "Removing of snoring segments from tracheal breathing sounds using a wavelet-based algorithm", 42nd Annual International Conferences of the IEEE Engineering in Medicine and Biology Society (EMBS), Montreal, Canada, 2020 (Oral presentation)
3. M. Shokrollahi, **S. Saha**, P. Hadi, F. Rubzicz, A. Yadollahi, "Snoring sound classification from respiratory signal", in Proc. of 38th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBS 2016), Orlando, USA, 2016.
4. **S. Saha**, M. Taheri, Z. Moussavi, A. Yadollahi, "Effects of changing in the neck circumference during sleep on snoring sound characteristics", in Proc. of 37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society (EMBS 2015), Milan, Italy, 2015.
5. **S. Saha**, "Fuzzy logic analysis of physiological data for hypovolemia class level detection," in Proc. of 3rd International Conference on Informatics, Electronics & Vision (ICIEV 2014), Dhaka,

Bangladesh, 2014.

6. **S. Saha**, M. Jahiruzzaman, C. Saha, R. Hosen, A. Mahmud, "FPGA Implementation of Modified Type-C PID Control System", in Proc. of 2nd International Conference on Electrical Engineering and Information Communication Technology (ICEEICT 2015), Dhaka, Bangladesh, 2015.
7. M. Jahiruzzaman, A.B.M.A. Hossain, **S. Saha**, "Implementation of 2D Torus Automorphisms for Image Encryption on FPGA," in Proc. of 2nd International Conference on Electrical Engineering and Information Communication Technology (ICEEICT 2015), Dhaka, Bangladesh, 2015.
8. M. Jahiruzzaman, **S. Saha**, A.K. Hawlader, "Dynamically Reconfigurable Parallel Architecture Implementation of 2D Convolution for Image Processing over FPGA", in Proc. of 2nd International Conference on Electrical Engineering and Information Communication Technology (ICEEICT 2015), Dhaka, Bangladesh, 2015.
9. **S. Saha**, K.H. Uddin, M.S. Islam, M. Jahiruzzaman, A.B.M.A. Hossain, "Implementation of Simplified Normalized Cut Graph Partitioning Algorithm on FPGA for Image Segmentation", in Proc. 8th International Conference on Software, Knowledge, Information Management and Applications (SKIMA 2014), Dhaka, Bangladesh, 2014.
10. **S. Saha**, R. Islam, H. Rahman, M. Hassan, A.B.M.A. Hossain, "Design and Implementation of Block Cipher in Hummingbird Algorithm over FPGA", in Proc. 5th IEEE International Conference on Computing, Communication and Networking Technologies (ICCCNT 2014), Hefei, China, 2014.
11. **S. Saha**, N. Alam, R.K. Mondal, "Design and Implementation of FlexRAy Protocol with BIST Capability over FPGA", in Proc. 5th IEEE International Conference on Computing, Communication and Networking Technologies (ICCCNT 2014), Hefei, China, 2014.
12. **S. Saha**, M. Hossain, N. Alam, R.K. Mondal, "Fuzzy Logic Analysis of Knitted Fabrics Spirality", in Proc. 5th IEEE International Conference on Computing, Communication and Networking Technologies (ICCCNT 2014), Hefei, China, 2014.
13. **S. Saha**, S. K. Saha, I.S. Iqbal, A.K. Kundu, M.T.H. Khan, S.K. Pramanik, "Designing of an Air Conditioning System using Fuzzy Logic with Advantage of Energy Saving", in Proc. 2014 3rd International Conference on Informatics, Electronics & Vision (ICIEV), Dhaka, Bangladesh, 2014.
14. **S. Saha**, M.A. Rahman, A. Thakur, "Design and Implementation of SPI Bus Protocol with Built-In-Self-Test Capability over FPGA", in Proc. 1st IEEE International Conference on Electrical Engineering and Information Technology (ICEEICT 2014), Dhaka, Bangladesh, 2014.
15. **S. Saha**, N. Sarker, A. Hira, "Design & implementation of a low-cost blood glucose meter with high accuracy", in Proc. 1st IEEE International Conference on Electrical Engineering and Information Technology (ICEEICT 2014), Dhaka, Bangladesh, 2014.
16. **S. Saha**, M.A. Rahman, A. Thakur, "Design and implementation of a BIST embedded inter-integrated circuit bus protocol over FPGA", in Proc. 1st IEEE International Conference on Electrical Information and Communication Technology (EICT), Dhaka, Bangladesh, 2014
17. **S. Saha**, M.A. Rahman, A. Thakur, "Design and Implementation of a BIST Embedded High Speed RS-422 Utilized UART over FPGA", in Proc.4th IEEE International Conference on Computing, Communication and Networking Technologies (ICCCNT 2013), Tiruchengode, India, 2013.
18. S.M.R. Islam, R. Sarker, **S. Saha**, A.F.M.N. Uddin, "Design of a programmable digital IIR filter based on FPGA", in Proc. 1st IEEE/OSA/IAPR International Conference on Informatics, Electronics & Vision (ICIEV), pp. 716 – 721, Dhaka, Bangladesh, 2012

## Conference Presentations [Abstract Only]:

1. C. Licskai, J. Cafazzo, M. Ferrone, D. Ng, A. Hussey, Q. Pham, C. Ranot, P. Mastoridis, **S. Saha,** K. Mezzi, "Addressing asthma management gaps with a respiratory digital ecosystem: A preliminary analysis", ERS International Congress, Milan, Italy, 2023 (Oral presentation)
2. **S. Saha,** A. Rattansingh, K. Viswanathan, A. Saha, R. Martino, A. Yadollahi, "Utility of ultrasonography in the assessment of the pharyngeal airway", ERS International Congress, Vienna, Austria, 2020 (Oral presentation)
3. **S. Saha,** M. Kabir, N. Montazeri, B. Gavrilovic, K. Zhu, H. Alshaer, A. Yadollahi, "Sleep apnea diagnosis using tracheal respiratory sounds and movement", World Sleep Congress, Vancouver, Canada, 2019
4. **S. Saha,** G. Gruenspan, M. Kabir, M. Montazeri, M. Hafezi, T. Meisami, A. Yadollahi, "Investigation of the relationship between snoring sounds features and response to the mandibular advancement devices", World Sleep Congress, Vancouver, Canada, 2019
5. M. Kabir, B. Gavrilovic, **S. Saha,** K. Zhu, A. Yadollahi, "Automatic estimation of heart rate from heart sounds during sleep", World Sleep Congress, Vancouver, Canada, 2019
6. M. Kabir, B. Gavrilovic, **S. Saha,** K. Zhu, A. Yadollahi, "Increases in the intensity of heart sounds at the termination of respiratory events are positively correlated with the magnitude of hypoxia", World Sleep Congress, Vancouver, Canada, 2019
7. X. Cao, T. D. Bradley, **S. Saha,** S. M. Tarlo, M. B. Stanbrook, M. Inman, A. Yadollahi, "Influence of simulated obstructive sleep apnea on thoracic fluid volume and airways resistance in asthmatic and healthy subjects", World Sleep Congress, Vancouver, Canada, 2019
8. N. Montazeri, M. Kabir, K. Zhu, **S. Saha,** B. Gavrilovic, B. Taati, H. Alshaer, A. Yadollahi, "Estimation of Respiratory Signals using Tracheal Sound and Movement", European Respiratory Society International Congress, Madrid, Spain, 2019
9. **S.Saha,** M. Kabir, N. Montazeri, B. Gavrilovic, K. Zhu, A. Yadollahi, H. Alshaer, "Apnea-hypopnea index (AHI) estimation using breathing Sounds, accelerometer and pulse oximeter", ERJ Open Research 2019 5: P63, ERS/ESRS Sleep and Breathing Conference, Marseille, France, 2019.
10. M. Kabir, B. Gavrilovic, **S. Saha,** K. Zhu, and A. Yadollahi, "Increases in heart sound intensity following respiratory events are positively correlated with drops in oxygen saturation during the events", American Thoracic Society, San Diego, USA, 2018.
11. G. Gruenspan, **S. Saha**, T. Meisami, and A. Yadollahi, "Investigating CT imaging of the pharyngeal airway as a predictor of the effectiveness of maxillomandibular advancement to treat sleep apnea", Chest, 152 (4), A1087, Toronto, Canada, 2017.
12. **S. Saha**, Z. Moussavi, P. Hadi, T. D. Bradley, A. Yadollahi, "Investigating the effects of pharyngeal tissue content on snoring sounds features", American Thoracic Society, 2017: A2610, Washington DC, USA.
13. M. Shokrollahi, **S. Saha**, M. Taheri, Z. Moussavi, A. Yadollahi, "Development and validation of an acoustic model of the upper airway for snore sound generation", American Thoracic Society, 2016: A5978, San Francisco, USA.
14. **S. Saha**, M. Taheri, Z. Moussavi, A. Yadollahi, "Effects of changing in the neck fluid volume, neck circumference and upper airway during sleep on snoring sound characteristics", World Congress on Medical Physics and Biomedical Engineering (Oral Presentation), Toronto, Canada, 2015.

## Research Funding

### Grants awarded as Principal or Co-Principal Investigator:
### Total funding: CAD **$699,500**

1. Topic: Development of Smart-Ring and Medly Interface for Continuous, Remote, Vasomodulation Monitoring
    - Grantor: TBEP Translation Team Grant Competition, Translational Biology & Engineering Program, University of Toronto
    - Amount and Duration: $100,000 from May. 2023-March. 2025
    - My role in grant application: **Co-Principal Investigator** (leading machine learning model development)
2. Topic: Improving Accessibility: The Development of Voice Biomarkers for Non-Invasive Blood Glucose and BNP Monitoring
    - Grantor: TRANSFORM-HF, 2023 Collaboration Starter Grant
    - Amount and Duration: $17,500 from May. 2023- April. 2024
    - My role in grant application: **Principal Investigator**
3. Topic: Continuous Vasomodulation Monitoring by Smart Ring
    - Grantor: Ted Rogers Centre for Heart Research Innovation Fund, 2023 Seed Grant Competition
    - Amount and Duration: $100,000 from May 2023 – April. 2024
    - My role in grant application: **Co-Principal Investigator** (leading the machine learning model development)
4. Topic: Accessible Blood Pressure Estimation with Earbuds
    - Grantor: TRANSFORM-HF, 2022 Seed Grant
    - Amount and Duration: $70,000 from Feb. 2023-April. 2024
    - My role in grant application: **Co-Principal Investigator** (leading the acoustic signal processing and machine learning model development)
5. Topic: Building an Automated Titration Model on the Optimization of Guideline-Directed Medical Therapy for Patients with Heart Failure
    - Grantor: AMS Healthcare, 2022 Fellowship on Compassion and Artificial Intelligence
    - Amount and Duration: $75,000 from Sep. 2022-Aug. 2023
    - My role in grant application: **Principal Investigator**
6. Topic: Optimizing the Interface of an Automated Medication Model for Patients with Heart Failure
    - Grantor: HF outcomes program, Ted Rogers Centre for Heart Research, Canada
    - Amount and Duration: $10,000 from April. 2023-Sep.2023
    - My role in grant application: **Principal Investigator**
7. Topic: Using Natural Language Processing (NLP) to Create a Shared Vocabulary of Standard Medical Terminologies on Functional Seizures utilizing Electronic Patient Records (EPR)
    - Grantor: 2022-23 Turing-Manchester Sandpit project awards (International Award)
    - Amount and Duration: $16,500 from Nov. 2022-Mar. 2023
    - My role in grant application: **Co-Principal Investigator** (co-leading the statistical analysis and machine learning support)
8. Topic: Machine learning approaches to Identify Patterns and Predict Treatment Outcomes for Patients with Epilepsy using Electronic Health Records
    - Grantor: 2022-23 Turing-Manchester Sandpit project awards (International Award)
    - Amount and Duration: $16,500 from Nov. 2022-Mar. 2023
    - My role in grant application: **Co-Principal Investigator** (co-leading the statistical analysis and machine learning support)

9. Topic: Investing the Impact of a Fixed-dose Single Inhaler Combination Therapy on COPD symptoms, Quality of Life, and Exacerbations
    - Grantor: AstraZeneca (Industry Grant)
    - Amount and Duration: $267,000 from Aug. 2022-Aug. 2026
    - My role in grant application: **Co-Principal Investigator** (leading the statistical analysis and machine learning support)
10. Topic: Identifying Potential Barrier of the Automatic Titration of the Guideline Directed Medical Therapy for Patients with Heart Failure
    - Grantor: TRANSFORM-HF, 2022 Collaboration Starter Grant
    - Amount and Duration: $10,000 from April. 2022- April. 2023
    - My role in grant application: **Principal Investigator**
11. Topic: Speech Production Analysis to Estimate Heart Failure Decompensation
    - Grantor: TRANSFORM-HF, 2022 Collaboration Starter Grant
    - Amount and Duration: $9,000 from April. 2022-April. 2023
    - My role in grant application: **Co-Principal Investigator** (leading the statistical analysis and machine learning support)
12. Topic: Estimation of Cardiogenic Shock Occurrence Utilizing Machine Learning Approaches
    - Grantor: HF outcomes program, Ted Rogers Centre for Heart Research, Canada
    - Amount and Duration: $8,000 from April. 2022-Sep. 2022
    - My role in grant application: **Co-Principal Investigator** (leading the statistical analysis and machine learning support)

## Grants awarded as Co-Investigator, Co-Applicant or Collaborator: Total funding: CAD **$865,000**

13. Topic: AutoWATChmAN: Development of an Advanced Decision Support Engine for the Automation of Cancer Care
    - Grantor: 2022 MSH-UHN AMO Innovation Fund
    - Amount and Duration: $200,000 from May. 2023-April. 2025
    - My role in grant application: **Co-Investigator**: I helped in conceptualizing the machine learning support
14. Topic: AI Noise Suppression for Interventional MRI
    - Grantor: INOVAIT (Federal Strategic Innovation Fund) Pilot Fund
    - Amount and Duration: $125,000 from Mar. 2023-June. 2024
    - My role in grant application: **Co-Investigator**: I helped in conceptualizing the machine learning support
15. Topic: The Value of Real-World Data and Evidence for Digital Therapeutics
    - Grantor: The Strategic Challenge Fund, University College London & University of Toronto - Joint Call for Collaborative Projects
    - Amount and Duration: $40,000 from Jan. 2023-Jan. 2024
    - My role in grant application: **Co-Applicant**: I conceptualized the value of ethical and equitable machine learning in healthcare in the proposal.
16. Topic: Development and Applications of a Novel Acoustic Model for Respiratory System
    - Grantor: Natural Sciences and Engineering Research Council (NSERC) - Discovery Grant
    - Amount and Duration: $200,000 from Jan. 2016-Dec. 2021
    - My role in grant application: **Collaborator**: I helped in conceptualizing the project, writing, and revising the proposal
17. Topic: Developing and Validating a Wearable Device to Assess Respiratory Disorders During Sleep
    - Grantor: Ontario Center of Excellence (OCE) - Voucher for Innovation and Productivity (VIP-II)

- Amount and Duration: $300,000 from Aug. 2016- Jul. 2018
- My role in grant application: **Collaborator**: I helped in conceptualizing the project, writing, and revising the proposal

## Patents and IP Disclosure

1. A. Yadollahi, F. Rudzicz, and **S. Saha**, "Acoustic upper airway assessment system, method, and model with sleep apnea assessment system and method" US10506969B2, CA2931662C. 2019.
2. J. Cafazzo, H. Ross, **S. Saha**, and B. Wang, "System, method, and model to improve mobile phone-based remote monitoring system for heart failure management" (IP Disclosed and patent under preparation).
3. J. Cafazzo, H. Ross, **S. Saha**, and M. McDonald, "System, method, and model to implement Guideline Directed Medical Therapy in a mobile phone-based remote monitoring system for heart failure patients" (IP Disclosed and patent under preparation).

## Research Experience

**Senior Scientific Associate** 2022-2023
Centre for Digital Therapeutics, Toronto General Hospital Research Institute, University Health Network, Toronto, Canada

- Leading the statistical programming and machine learning support, including analyzing model databases, visualizing data, and managing clinical study reports
- Leading the programming deliverable for regulatory submissions, including specification and delivery of overview databases and response to regulatory questions
- Leading the development of artificial intelligence-based systems to enhance better chronic disease management
- Conceptualizing and writing collaborative grants for future research projects
- Supervising clinical trials, including randomized control trials to measure the effectiveness of digital health technologies, and qualitative study trials to understand barriers to implementing digital health interventions
- Conducting database searches and systematic literature reviews, and extracting, appraising, and analyzing performance data for chronic disease management
- Mentoring students on biostatistics, biomedical engineering, and machine learning

**Post-Doctoral Researcher** 2021-2022
Centre for Global eHealth Innovation, Toronto General Hospital Research Institute, University Health Network, Toronto, Canada

- Implemented machine learning algorithm to predict the decompensated episodes of heart failure
- Performed statistical analysis to investigate the effectiveness of medical records in heart failure management
- Mentored 1 PhD student in study design
- Supported participant screening, enrollment, and data collection for a research trial

**Doctoral Researcher** 2016-2020
SleepdB, KITE-Toronto Rehabilitation Institute, University Health Network, Toronto, Canada

- Implemented innovative acoustic techniques based on advanced signal processing algorithms and machine learning models for the diagnosis of sleep disorders
- Employed TensorFlow and PyTorch libraries to develop deep learning algorithms for classifying the types of sleep disorders using acoustic data

- Implemented advanced signal processing and machine learning models for speech-based diagnosis of sleep disorders
- Utilized R for statistical analysis and data visualization in big data sets for the diagnosis of respiratory disorders
- Conducted several human research trials and collected clinical data
- Demonstrated proficiency in programming languages including R, Python, and MATLAB and in the Python Data Analytics package consisting of Pandas, Numpy, Scipy, Sklearn, and Matplotlib
- Contributed to $1M funding for the PI through 8 peer-reviewed high impact factor journals and 10+ conferences
- Taught and mentored 7 undergraduate and 2 graduate students in statistics, biomedical engineering, and machine learning
- Gained expertise through working with physicians and program directors of the world's number one rehabilitation research center

**MSc Researcher** 2014-2016

Biomedical Instrumentation & Signal Analysis Lab, Winnipeg, Manitoba and Sleep Science Team, Toronto Rehabilitation Institute-University Health Network, Toronto, Canada

- Developed and validated an electrical equivalent upper airway model for snoring sounds generation using MATLAB
- Implemented statistical analysis using SPSS and R
- Implemented advanced acoustic signal processing algorithms in MATLAB
- Published 2 peer-reviewed journals and 1 US Patent

**Lab Supervisor** 2012-2014

Digital System Design & Signal Processing Laboratory, Khulna University of Engineering and Technology, Bangladesh

- Designed and implemented digital systems for biomedical applications and image processing using Field-programmable gate array (FPGA), Microcontroller, and Arduino
- Supervised 2 undergraduate theses and 10 capstone projects
- Published 13 papers in IEEE conferences

## Teaching Experience

**Guest Lecturer** 10/2023

Institute of Biomedical Engineering, University of Toronto, Canada

Course title:

BME1580H: Application of digital technologies for chronic cardio-respiratory conditions

- Gave a lecture on "Digital Therapeutics in Management of Heart Failure"

**Part-time Professor** 09/2020-04/2021

School of Electronics & Mechanical Engineering and Technology, Seneca College, Canada

Courses taught:

DGS266: Digital Electronics and Introduction to PLC

DGS255: Digital Systems

- Conducted tutorials and laboratory
- Set up examination papers
- Evaluated student examination papers

**Graduate Teaching Assistant** 01/2017-09/2020
University of Toronto, Canada
Courses taught:
ECE110: Electrical Fundamentals - 6 times as both tutorial and laboratory TA
ECE241: Digital Systems
CSC108: Introduction to Computer Programming
- Served 3 times as a tutorial and 5 times as a laboratory teaching assistant
- Evaluated 400+ student examination papers
- Mentored students in course projects based on Python
- Invigilated the examinations

**Lecturer** 09/2012-09/2014
Department of Electronics and Communication Engineering,
Khulna University of Engineering & Technology, Khulna, Bangladesh
Courses taught:
ECE4227: Biomedical Engineering
ECE4229: Digital Image Processing
ECE4101: VLSI Design
ECE4103: Mobile Communications
ECE3209: Microprocessors and Microcomputers
ECE3203: Digital Signal Processing
ECE3109: Numerical Analysis
ECE2103: Digital Electronics & Logic Circuits
ECE1209: Analog Electronics-1
ECE3215: Communication Engineering
- Conducted lectures and weekly lab practicum for more than 300 students
- Created and administered examinations
- Developed new course curriculum for the Dept. of Biomedical Engineering
- Revised course curriculum and graduation requirements
- Supervised and co-supervised 10+ capstone projects

## Research Supervision

### Graduate Student Projects:

1. **Natasha Rozario**; Masters in Health Informatics, IHPME, University of Toronto, Development of speech based technologies to monitor heart failure instability, Practicum Supervisor — 05/2023
2. **Rachelle Karuse**; Masters in Public Health, Investigating the feasibility of blood reports in predicting the hospitalization of heart failure patients. [Co-Supervisor (with Drs. H. Ross and J. Cafazzo)] — 09/2022
3. **Godfrey Zziwa**; MD Fellow, Predicting the mortality of heart failure patients who are in a controlled tele-monitoring program utilizing machine learning. [Co-Supervisor (with Drs. H. Ross and J. Cafazzo)] — 09/2022

### Co-OP and Intern Student Projects:

4. **Shaghayegh Chavoshian**; IBME, University of Toronto (Summer Co-OP), Evaluating the interfaces of the automatic medication management model for patients with heart failure — 05/2023
5. **Sabrina Hirani**; Computer Science, University of Toronto (Summer Co-OP), Implementation of Large Language Models in heart failure management — 05/2023

6. **Derek Liu**; Masters in Health Administration, University of Toronto (Intern), Reviewing Health Canada regulation and understanding the barriers of implementing automatic medication management model 01/2023
7. **David Leung**; Engineering Science, University of Toronto (Summer Co-OP), Prediction of cardiogenic shock occurrence of heart failure patients utilizing machine learning approaches. [Co-Supervisor (with Dr. B. Phyllis)] 04/2022
8. **Claire Thompson**; ECE, University of Waterloo (Summer Co-OP), Software development of the automatic medication management model for heart failure patients 04/2022

## Undergraduate Student Projects:

9. **Fazle Rabbi Mashrur**; BME, KUET, Pulmonary Fibrosis decline prediction from CT imaging (Published a paper in Physics in Medicine & Biology) 11/2020
10. **Zabir Al Nazi**; BME, KUET, Pulmonary Fibrosis decline prediction from CT imaging (Published a paper in Physics in Medicine & Biology) 11/2020
11. **Zinnat Morsada**; BME, KUET, Review on Bioelectronics materials (Published a paper in Applied Materials Today). [Co-Supervisor (with Dr. M. Hossain)] 08/2020
12. **M. Tauhidul Islam**; BME, KUET, Review on Bioelectronics materials (Published a paper in Applied Materials Today). [Co-Supervisor (with Dr. M. Hossain)] 08/2020
13. **M. Ahsanul Mobin**; BME, KUET, Review on Bioelectronics materials (Published a paper in Applied Materials Today). [Co-Supervisor (with Dr. M. Hossain)] 08/2020
14. **Sumit Sarker**; BME, KUET, Covid-19 risk factor identification (Published a paper in Clinical Epidemiology and Global Health) 04/2020
15. **Amit Dutta Roy**; BME, KUET, Covid-19 risk factor identification (Published a paper in Clinical Epidemiology and Global Health) 04/2020
16. **Anisha Prasub Choann**; BME, KUET, Covid-19 risk factor identification (Published a paper in Clinical Epidemiology and Global Health) 04/2020
17. **M. Tasnim Jawad**; EEE, KUET, Covid-19 prediction from volumetric CT imaging (Published a paper in Informatics in Medicine Unlocked). [Co-Supervisor (with Dr. Moni and Mr. M. Hasan)] 03/2020
18. **Kazi Nasim Imtiaz Hasan**; EEE, KUET, Covid-19 prediction from volumetric CT imaging (Published a paper in Informatics in Medicine Unlocked). [Co-Supervisor (with Dr. Moni and Mr. M. Hasan)] 03/2020
19. **Sajal Basak Partha**; EEE, KUET, Covid-19 prediction from volumetric CT imaging (Published a paper in Informatics in Medicine Unlocked). [Co-Supervisor (with Dr. Moni and Mr. M. Hasan)] 03/2020
20. **Safera Zainab**; ECE, University of Toronto (capstone student), Diagnosis of sleep apnea utilizing computer vision. [Co-Supervisor (with Dr. Yadollahi)] 07/2020
21. **Samara Jalal**; ECE, University of Toronto (capstone student), Diagnosis of sleep apnea utilizing computer vision. [Co-Supervisor (with Dr. Yadollahi)] 07/2020
22. **Jackie Midroni**; ECE, University of Toronto (capstone student), Diagnosis of sleep apnea utilizing computer vision. [Co-Supervisor (with Dr. Yadollahi)] 07/2020
23. **Anisa Poddar**; ECE, University of Toronto (capstone student), Diagnosis of sleep apnea utilizing computer vision. [Co-Supervisor (with Dr. Yadollahi)] 07/2020
24. **Shiqi Hu**; ECE, University of Toronto (capstone student), Automatic detection of wheezing sounds in patients with asthma during sleep. [Co-Supervisor (with Dr. Yadollahi)] 04/2018
25. **Jiayu Carl**; ECE, University of Toronto (capstone student), Automatic detection of wheezing sounds in patients with asthma during sleep. [Co-Supervisor (with Dr. Yadollahi)] 04/2018

26. **He Zhang**; ECE, University of Toronto (capstone student), Automatic detection of wheezing sounds in patients with asthma during sleep. [Co-Supervisor (with Dr. Yadollahi)] 04/2018
27. **Kazi Hasan Uddin**; ECE, KUET, FPGA implementation of a modified normalized cut algorithm for detection of malaria parasites in blood smear images. 02/2014
28. **M. Sajidul Islam**; ECE, KUET, FPGA implementation of a modified normalized cut algorithm for detection of malaria parasites in blood smear images. 02/2014
29. **M. Jahiruzzaman**; ECE, KUET, FPGA implementation of Image Processing and Control Algorithms (Published 4 IEEE Proceedings). 02/2014
30. **Takdir Azim**; ECE, KUET, EEG pattern recognition for controlling an automated wheelchair. 02/2014
31. **Shanto Rahman**; ECE, KUET, EEG pattern recognition for controlling an automated wheelchair. 02/2014
32. **Amit Thakur**; ECE, KUET, Built-in self-test embedded integrated circuit implementation using FPGA (Published 3 IEEE Proceedings). 02/2013
33. **M. Ashiqur Rahman**; ECE, KUET, Built-in self-test embedded integrated circuit implementation using FPGA (Published 3 IEEE Proceedings). 02/2013

### Contract Employees Supervision:

34. **Kamilla Kopec-Harding**; Research Software Engineer-University of Manchester, Developing machine learning model to predict the pattern of seizure in patients with epilepsy using electronic health records. [Co-Supervisor (with Dr. Lai, Lu, Mashuk)] 01/2023
35. **Sharon Mukhi**; Healthcare Human Factor Specialist-UHN, Patient and clinician facing interfaces development of the automatic medication management model for heart failure patients 05/2022
36. **Rubayat Ahmed Hridhee**; Research Engineer-CMED Health, Investigating the effectiveness of implementing mHealth interventions in Rural Bangladesh. [Co-Supervisor (with Dr. Mamun)] 08/2021
36. **Rony Chowdhury Ripan**; Research Engineer-CMED Health, Investigating the prevalence of stroke in Rural Bangladesh. [Co-Supervisor (with Dr. Mamun)] 08/2021

### Thesis Committees:

1. **Kenneth Christofferson**, Department of Computer Science, University of Toronto, Accessible Acoustic Sensors to Monitor Cardiac Hemodynamics; PhD committee member
2. **Behrad Taghibeyglou**, Institute of Biomedical Engineering, University of Toronto, Sleep Apnea Diagnosis in people experiencing homelessness; PhD committee member
3. **Delaram Sadatamin**, Institute of Biomedical Engineering, University of Toronto, Developing and Validating a Textile-Based Wearable to Monitor Sleep Apnea in Persons with Heart Failure; PhD qualification external examiner

### Ph.D./M.Sc. Examination Chair:

1. **Richard Walker**; M.Sc. Oral Defense, Institute of Health Policy, Management and Evaluation (IHPME), University of Toronto 08/2023
2. **Zixuan Peng**; Ph.D. Qualification Defense, Institute of Health Policy, Management and Evaluation (IHPME), University of Toronto 10/2022

## HONOURS AND AWARDS

2021-2022 Barnett Family Fellowship in Computational Data Analysis [$60,000], University Health Network, Canada

| | |
|---|---|
| 2016-2020 | Connaught International Scholarships for Doctoral Students [$140,000], University of Toronto, Canada |
| 2020 | Doctoral Completion Award [$10,000], University of Toronto, Canada |
| 2020 | Mitacs Research Training Award [$6,000], Mitacs, Canada |
| 2019 | School of Graduate Studies Travel Award [$530], University of Toronto, Canada |
| 2019 | Office of Research Trainee Travel Award [$500], University Health Network, Canada |
| 2019 | Best Minute Presentation Award [$200], Toronto Rehabilitation Institute, Toronto, Canada |
| 2018 | Technovation Award [$1,000], Toronto Rehabilitation Institute, Toronto, Canada |
| 2018 | Runner-up in Best Poster Presentation Award at IBBME Research Day [$250], IBBME, University of Toronto, Canada |
| 2016 | Team Excellence Award [$1,000], Toronto Rehabilitation Institute, Toronto, Canada |
| 2016 | Wildcat Rotation Scholarship, IBBME, University of Toronto, Canada [Rejected due to holding Connaught] |
| 2014-2016 | Manitoba Graduate Scholarship (MGS) [$30,000/2 years], Province of Manitoba, Canada |
| 2014 | University of Manitoba Graduate Fellowship (UMGF), University of Manitoba, Canada [Migrated to MGS] |
| 2014-2015 | International Graduate Student Entrance Scholarships (IGSES) [$4,000], University of Manitoba, Canada |
| 2015 | Faculty of Graduate Studies (FGS) Travel Award [$1,000], FGS, University of Manitoba, Canada |
| 2015 | University of Manitoba Graduate Student Association (UMGSA) Conference Travel Award [$750], UMGSA, University of Manitoba, Canada |
| 2015 | Faculty of Engineering Travel Award [$500], Faculty of Engineering, University of Manitoba, Canada |
| 2012 | University Gold Medal (Awarded to the student with the highest academic standing in the department), Khulna University of Engineering & Technology, Bangladesh |
| 2010-2012 | Dean's List Award(Awarded to students with honor's mark in an academic year), Khulna University of Engineering & Technology, Bangladesh |
| 2008-2012 | University Grant Commission Scholarship (Awarded to the student with high academic standing), Ministry of Education, Bangladesh |

## Outreach & Professional Development

### Invited Talks

1. "Enlightening Panel discussion: Navigating the Path to a Professorship Position", Invited Panelist, IEEE EMBS Seminar Series, IEEE Toronto Section, KITE, University Health Network, June 20, 2023.
2. "Digital Health Interventions Utilizing Artificial Intelligence in Chronic Disease Management", Invited Talk, Department of Electrical & Computer Engineering, University of Arizona, Tucson, USA, April 10, 2023.
3. "Utilization of Data Science and Machine Learning in Chronic Disease Management", Invited Talk, School of Applied Computational Sciences, Meharry Medical College, Tennessee, USA, March 07, 2023.

4. “Wearable and Mobile Health Technologies to Better Manage Sleep Apnea”, Invited Speaker Series, Sleep Science Team, Harvard Medical School, Boston, USA, January 10, 2023.
5. “Detection of Heart Failure Decompensation: Enhancing the Performance of an Expert System using Machine Learning and Electronic Health Record (EHR) data”, Invited Speaker, Mind the Gap: Enabling AI Deployment in Health, Vector Institute, Toronto, Canada, November 18, 2022.
6. “Mobile Health Technologies in Chronic Disease Management”, Invited Speaker, Electronics & Communication Engineering, Khulna University of Engineering & Technology, Bangladesh, October 29, 2022.
7. “Digital Health Intervention with Artificial Intelligence to Better Manage Chronic Diseases”, Seminar Series of AIMS Lab, United International University, Bangladesh, October 22, 2022.
8. “Handling Unstructured Data: Acoustic Signal”, Seminar Series on Digital Health and Data Analytics, Mitchener Institute, University Health Network, Toronto, Canada, September 28, 2021.

## Leadership Activities

01/2023 **Member of Graduate Admission Committee of Masters in Health Informatics Program**
Institute of Health Policy, Management & Evaluation, University of Toronto, Canada
Evaluated and interviewed students for admission and scholarships

12/2022 **Member of the Syllabus and Course Outline Update Committee of the Masters in Health Informatics Program**
Institute of Health Policy, Management & Evaluation, University of Toronto, Canada
Participated in the syllabus modernization

09/2016-12/2020 **SleepdB Lab Representative**
Biomedical Engineering Student Association, University of Toronto, Canada
Represented the lab news and updates to the association

02/2018-12/2020 **Lab Meeting and Journal Club Organizer**
Sleep Science Team, Toronto Rehabilitation Institute, Canada
Organized the weekly lab meeting and journal club
Scheduled the presenters, invited outside speakers

04/2013 **Member of Organizing Committee of the 1st International Conference on Electrical Information and Communication Technology (EICT-2013)**
Khulna University of Engineering and Technology, Bangladesh
Participated in managing the session chairs, reviewer assignments, reviewer score accumulation, paper decision-making, and setting up the presentations

## Grants and Fellowships Reviewer

1. **Mitacs Accelerate Program**, Mitacs, Canada

## Journal Editorial Activities

1. **Editorial Board Member**, Scientific Reports-Nature Publishing Group (IF: 4.996)
2. **Guest Editor**, Special Issue in Emerging Nanomaterials and Nanotechnologies for Biomedical Applications, Bioengineering-MDPI (IF: 5.046)

## Peer-Review Activities

- **Reviewer in Journals:**
  - Scientific Reports- Nature Publishing Group (1 Review)
  - IEEE Journal of Biomedical and Health Informatics (JBHI)- IEEE (1 Review)
  - Annals of the American Thoracic Society (1 Review)
  - PLOS Digital Health- PLOS (2 Reviews)
  - Journal of Clinical Sleep Medicine-American Academy of Sleep Medicine (3 Reviews)
  - Sensors-MDPI (5 Reviews)
  - Pattern Recognition Letters-Elsevier (2 Reviews)
  - Frontiers in Psychiatry - Frontiers (1 Review)
  - Healthcare-MDPI (2 Reviews)
  - Respiratory Care-American Association for Respiratory Care (2 Reviews)
  - Cognitive Computing-Springer (1 Review)
  - Computers in Biology and Medicine-Elsevier (1 Review)
  - Journal of Materials Science- Springer (1 Review)
  - Methods and Protocols-MDPI (1 Review)
- **Reviewer in International and Domestic Conferences:**
  - International IEEE Conference on Electrical Information and Communication Technology (EICT), Bangladesh
  - International IEEE Conference on Trends in Computational and Cognitive Engineering (TCCE), Bangladesh
  - International IEEE Conference on Computer and Information Technology (ICCIT), Bangladesh
  - University of Toronto – IBME Research day, Canada

## Professional Association Memberships

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|---|---|
| 2023-Present | Healthcare Information and Management Systems Society (HIMSS), Individual Organizational Affiliate |
| 2023-Present | The Toronto Initiative for Diversity and Excellence (TIDE), Member |
| 2022-Present | School of Graduate Studies, University of Toronto, Associate Faculty Member |
| 2022-Present | Centre for Analytics and Artificial Intelligence Engineering, Faculty Affiliate |
| 2021-Present | Temerty Centre for AI in Medicine, University of Toronto, Member |
| 2021-Present | Data Science Institute (DSI), University of Toronto, Member |
| 2018-Present | AGE-WELL NCE., Canada, High-Quality Professional |
| 2019-2020 | World Sleep Society, Graduate Student Member |
| 2016-2018 | American Thoracic Society, Trainee Member |
| 2014-2020 | Institute of Electrical and Electronics Engineers (IEEE), Student Member |
| 2014-2017 | IEEE Engineering in Medicine and Biology Society, Graduate Student Member |
| 2012-Present | Institute of Engineer, Bangladesh (IEB), Associate Member |

## Certifications

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|---|---|
| 2021 | **ISO13485-Quality Maintenance System (QMS)**- Product Development Training |
| 2021 | **ISO13485-Quality Maintenance System (QMS)**- Risk Management Training |
| 2021 | **Deep Learning Specialization**, deeplearning.ai |
| 2020 | **Tri-Council Policy Statement: Ethical Conduct for Research Involving Humans, Course on Research Ethics (TCPS 2: CORE)**, Panel of Research Ethics, Canada Federal Research |