Anandarup **Mukherjee**

SENIOR RESEARCH FELLOW · PH. D. SCHOLAR

Smart Wireless Applications and Networking (SWAN) Lab., Department of Computer Science and Engineering, Indian Institute of Technology Kharagpur, W. Bengal, India 721302

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Education

Indian Institute of Technology Kharagpur (IIT-KGP)   *West Bengal, India*

PH.D. IN COMPUTER SCIENCE AND ENGINEERING   *Jan. 2015 - PRESENT*

- Research domain: Internet of Things for Constrained Networks
- Thesis: "Offloading in Networked UAVs and UAV Swarms"
- Supervisors: Prof. Sudip MISRA, Prof. Narendra Singh RAGHUWANSHI
- Obtained 92% marks in coursework and 81% in Ph.D. comprehensive exam (top 5% in the CSE department)

West Bengal University of Technology (UTech)   *West Bengal, India*

M.TECH. IN ELECTRONICS AND COMMUNICATIONS ENGINEERING   *July. 2010 - May 2012*

- Specialization on Microelectronics and VLSI Design
- Thesis: "Detection of Arrhythmia using Wavelet Transforms, PCA and Neural Networks"
- Supervisor: Prof. Kamal Kanti GHOSH
- Obtained a GPA of 9.38/10 (top 2 in the ECE department)

West Bengal University of Technology (UTech)   *West Bengal, India*

B.TECH. IN ELECTRONICS AND COMMUNICATIONS ENGINEERING   *July. 2006 - May 2010*

- Final year project on "PC controlled Robotic Arm with Authentication Control"
- Advisor: Mr. Avishankar ROY
- Obtained a GPA of 8.2/10 (top 10% in the ECE department)

Research Interests

Internet of Things	Offloading, Low-power sensing, Acoustic sensing, Collaboration, Scheduling, Network optimization
UAV Networks	Communications, Controls, Swarms, Data Offload, Processing offload, Imaging, Machine learning
Underwater Networks	Modem development, PHY and MAC layer protocols, Signalling
Deep Learning	LSTM, CNN, GAN, MLP
Networked Robots	Agricultural robots, UAV swarms, UAV-UGV collaboration

Skills

Programming	Python, Matlab, C, Embedded C, Arduino, LaTeX
Web	HTML, PERL, PHP, Javascript
Libraries	Numpy, Scipy, Pandas, Keras, OpenCV, Matplotlib
Environments	Linux, Windows, OSX
Languages	English, Hindi, Bengali

Research Experience

Sensordrops Networks Pvt. Ltd.   *IIT Kharagpur, India*

CO-FOUNDER & DIRECTOR   *Aug. 2018 - Present*

- Responsible for the design and development of patentable technological ideas in the domains of networking and communication for Nokia's "Invent with Nokia" initiative, with which Sensordrops Networks Pvt. Ltd. has signed a contract.
- Responsible for the design and development of mesh-based IoT remote temperature monitoring network. Led a 4-person team from Sensordrops Networks for the development and manufacture of this product and its visualization app. for TCS INNOVATION LAB, KOLKATA, INDIA.
- Responsible for all technical and commercial aspects of the development of partial discharge sensing solutions for monitoring of electrical sub-stations and installations of CESC, KOLKATA.
- Responsible for all technical and commercial aspects of the development of Epione: IoT-based Ubiquitous Healthcare monitoring kit, and machine health monitoring in manufacturing industries.

Ministry of Electronics and Information Technology, Govt. of India

IIT Kharagpur, India

SENIOR RESEARCH FELLOW

Sep 2018 - Present

- Project: Development of Digital Mine Using IoT
- Responsible for conceptualizing and implementing algorithms, methods and hardware for underground coal mine safety and worker safety.

UGC-UKIERI

IIT Kharagpur,India

SENIOR RESEARCH STAFF

Aug 2017 - Present

- Project: Joint Indo-UK Project on Safe and Usable IoT Ecosystem
- Responsible for conceptualizing and implementing algorithms, methods and hardware for acquisition and encryption of healthcare data, and finally releasing it on an IoT Blockchain.

Indian Council for Agricultural Research, Govt. of India

IIT Kharagpur, India

SENIOR RESEARCH FELLOW

Oct 2017 - Jan 2018

- Project: Development of Precision Robotic Planter
- Responsible for conceptualizing and implementing algorithms, methods and hardware for agricultural robotic planter. The planter has to autonomously navigate a given plot of land and plant seedlings at pre-defined intervals.

ITRA, Department of Electronics and Information Technology

IIT Kharagpur, India

SENIOR RESEARCH FELLOW

Oct 2014 - Jul 2017

- Project: Increasing water use efficiency through experimental sensor networks
- Provided technical know-how, implementation and support for deployment and analysis of data gathered from wireless sensor networks, deployed for in-field monitoring of agricultural data. Developed and implemented an IoT- Cloud based infrastructure for integrating and automated analysis of the incoming field data. Designed various smartphone apps and sensor nodes for low-cost field parameter monitoring.

Defence Scientific Information & Documentation Center

DRDO, India

SUMMER RESEARCH INTERN

May 2009- July 2009

- Applied various data-mining and visualization techniques for analyzing interdependence between various users and their field of research. The data analyzed was acquired from the DRDO central library, which had information about various scientists and their book issue records. This work culminated in the publication of a magazine article and a research paper.

Department of Computer Science & Engineering

IIT Kharagpur, India

RESEARCH INTERN

Jan 2009- Feb 2009

- Interned under Prof. Pabitra Mitra (CSE).
- Implemented various image processing technologies to perform segmentation and thresholding of satellite images, for detection of aircraft in the satellite images.

Eastern Regional Testing Labs. (ERTL)- EAST, Govt. of India

Kolkata, India

INTERN

Dec. 2008

- Interned at Center for Electronics Test Engineering (CETE) , Kolkata
- Learned about various Intel based micro-controllers and micro-processors. Implemented the technologies learned to design an automated traffic light controller using Atmel 89c51 based micro-processor.

Teaching Experience

National Programme on Technology Enhanced Learning (NPTEL)

IIT Kharagpur, India

GRADUATE TEACHING ASSISTANT

Jul 2017- Present

- Course: Introduction to Internet of Things
- Responsible for assisting in the development of course material, evaluation questions, and regularly addressing students' technical queries on the online forum.

National Programme on Technology Enhanced Learning (NPTEL)

IIT Kharagpur, India

COURSE TRAINER

Mar. 2017

- Course: Introduction to Internet of Things
- Responsible for demonstrating various hardware and software-based IoT projects for course video lectures of weeks 5, 6, and 7.

Dept. of Computer Science & Engineering

IIT Kharagpur, India

GRADUATE TEACHING ASSISTANT

Aug 2016- Present

- Responsible for assisting in taking theory, as well as laboratory sessions along with evaluations for courses ranging from "Programming and Datastructures" to "Architecting solutions for the Internet of Things".

University of Engineering & Management

Jaipur, India

HEAD OF DEAPRTMENT (ACTING)

Jan 2013- Oct 2014

- Dept. of Electronics & Communication Engineering
- Responsible for liasioning between the department and various levels of university management. Organized multiple workshops, outreach programmes, and technical exhibitions. Responsible for management of department's workings.

University of Engineering & Management

Jaipur, India

ASSISTANT PROFESSOR

Jun 2012- Oct 2014

- Dept. of Electronics & Communication Engineering
- Responsible for teaching as well as administrative assignments. The teaching assignments spanned over theory as well as practical classes. Administrative tasks involved the assignment of acting Head of Department for a period of 2 years from 2013-2015. Oversaw and implemented the setting up and planning of over 7 laboratories, as well as student welfare activities such as workshops, internships and industrial visits.

Institute of Engineering & Management

Kolkata, India

LECTURER

Aug 2011- May 2012

- Dept. of Information Technology
- Responsible for theory as well as practical assignments. Additional responsibilities included mentoring students and organizing an international conference at the institute, as the *Assistant Organizing Secretary*, in Jan 2012.

Honors & Awards

INTERNATIONAL

2019	**Top Downloaded Article 2017-2018**, Interdisciplinary Reviews - Data Mining and Knowledge Discovery	*Wiley*
2015	**Special Mention**, IEEE PULSE	*EMBS PULSE*

DOMESTIC

2019	**Young Achiever Award**, Institute of Scholars (InSc)	*Bangalore, India*
2018	**Dr. Amulya K. N. Reddy Award**, Hari-om Ashram Prerit Society	*New Delhi, India*
2018	**Gold Medallist**, The Internet of Things Quiz Contest, Dept. of IT & Electronics, Govt. of West Bengal	*Kolkata, India*
2018	**Socially Relevant Innovation**, Gandhian Young Technology Innovation Award by the PRESIDENT OF INDIA	*New Delhi, India*
2016	**Finalist**, 2nd Runner up, Inovation Challenge, Johnson Controls	*IIT Kharagpur, India*
2016	**Finalist**, 1ST Runner up, Prototype Demo., IBM	*IIT Kharagpur, India*
2015	**Head (Membership Development)**, IEEE Student Branch	*IIT Kharagpur, India*

Media Mentions

2018	**Gandhian Young Technology Innovation Award**, The Telegraph, SRISTI	*Print Media*
2017	**AmbuSens - Ambulatory Monitoring System**, Economic Times, Hindustan Times, Indian Express, Times of India, Firstpost	*Print Media*
2017	**BHIM - Autonomous Drone**, The Hindu, LinkedIn, Times of India, India Today	*Print Media*

Talks

KEYNOTE TALK

2020	**Phantom Networks: An Intangible Communication Paradigm**, Indo-UK (UGC-UKIERI) Workshop on IoT and Security	*Loughborough University, U.K.*

INVITED TALKS

2019	**Covert Networked Surveillance Systems and Soldier-as-a-System**, SRIC-NSCS Workshop on Future Research COllaborations on Defence Security Applications	*IIT Kharagpur*
2019	**Development of an End-to-End IoT-based Architecture for real deployments**, SGRIP-sponsored Short Term Course on Selected Topics in Modern Wireless Networks and IoT	*IIT Kharagpur*
2018	**Evolution and Need for IoT: Microcontrollers to Complex System of Systems**, TEQIP III-sponsored Short Term Course on Internet of Things: Theory and Applications	*IIT Kharagpur*
2018	**Safety and Privacy in IoT Healthcare**, Indo-UK (UGC-UKIERI) Workshop on IoT Security	*City, University of London, U.K.*
2017	**Architecting IoT-enabled UAV Networks and Networked UAV Swarms**, Indo-UK (UGC-UKIERI) Workshop on IoT Security	*Loughborough University, U.K.*
2017	**Designing Autonomous UAVs**, DeITy-Media Lab. Asia - ITRA Water Evaluation Workshop	*IIT Kharagpur, India*

Travel Grants

INTERNATIONAL

2020	**IEEE INFOCOM 2020**, Agency: ACM India	*Beijing, China*
2020	**Loughborough University**, Agency: UGC-UKIERI	*London, U.K.*
2018	**IEEE WCNC 2018**, Agency: IIT Kharagpur	*Barcelona, Spain*
2018	**City, University of London**, Agency: UGC-UKIERI	*London, U.K.*
2017	**Loughborough University**, Agency: UGC-UKIERI	*London, U.K.*

DOMESTIC

2019	**Central Institute of Mining and Forestry Research (CIMFR)**, Agency: MeitY	*Dhanbad, India.*
2017	**Indo-UK joint project workshop on Internet of Things**, Agency: UGC-UKIERI	*Bhubaneshwar, India*
2016	**ITRA-Water Evaluation Workshop, KIIT University**, Agency: DeITy, Media lab Asia	*Bhubaneshwar, India*
2015	**Microsoft-ACM Academic Research Summit**, Agency: ACM	*Pune, India*
2016	**ITRA-Water FeedbackWorkshop, IIT Bombay**, Agency: DeITy, Media lab Asia	*Mumbai, India*
2015	**ITRA-Water Evaluation Workshop, University of Hyderabad**, Agency: DeITy, Media lab Asia	*Hyderabad, India*
2015	**ITRA-Water Feedback Workshop, IISc. Bangalore**, Agency: DeITy, Media lab Asia	*Bengalore, India*

Professional Affiliations

IEEE *IIT Kharagpur, India*

GRADUATE STUDENT MEMBER *2015 - PRESENT*

- IEEE Communications Society (ComSoc)
- IEEE Computer Society
- IEEE Young Professionals Society

ACM *IIT Kharagpur, India*

GRADUATE STUDENT MEMBER *2015 - PRESENT*

Academic Referee Service

- IEEE ACCESS
- IEEE Wireless Communication Letters
- IEEE Systems Journal
- IEEE Transactions on Sustainable Computing
- IEEE Journal on Selected Areas in Communication
- IEEE Transactions on Vehicular Technology
- IEEE Transactions on Mobile Computing
- Telecommunication Systems, Springer
- Photonic Network Communications, Springer
- Fractals, Elsevier
- Pervasive and Mobile Computing, Elsevier
- Computers and Electronics in Agriculture, Elsevier
- Security and Communication Networks, Wiley
- International Journal of Communication Systems, Wiley
- International Journal of Communication Networks and Distributed Systems, Inderscience
- Journal of Visualized Experiments, JoVE

Books

B2. S. Misra, **A. Mukherjee**, A. Roy, "Introduction to Industrial Internet of Things and Industry 4.0", CRC Press, USA (Forthcoming)

B1. S. Misra, **A. Mukherjee**, A. Roy, "Introduction to IoT", Cambridge University Press, UK (In Press)

Articles

A4. **A.Mukherjee**, S. Goswami, "Visualizing Graphs using PAJEK", PC Quest, Enterprise Solutions, Nov. 2010.

A3. **A. Mukherjee**, "Creating VB Macros in MS Word", PC Quest, Developer, Dec. 2010.

A2. **A. Mukherjee**, "Folder Manipulator in VB 6.0", Electronics for You, ISSN No. : 0013- 516x, Sep. 2011.

A1. N.Pathak, **A. Mukherjee**, "NANOENGINEER- A Virtual Nanotechnology Lab", PC Quest, Hands On, Apr. 2013

Journals

J19. S. Misra, A. Roy, C. Roy, **A. Mukherjee**, "RACE: Dynamic Radio Protocol Selection for Energy-Constrained Wearable IoT Healthcare", IEEE Journal of Selected Areas in Communications (JSAC), *Special issue on Internet of Things for in-home health monitoring*, accepted- Apr. 2020. (IF=7.172)   Link-TBA

J18. N. Pathak, **A. Mukherjee**, S. Misra, "AerialBlocks: Blockchain-Enabled UAV Virtualization for Industrial IoT", IEEE Internet of Things Magazine, Special Issue on Blockchain-Enabled IIoT, IEEE (copyright transferred), Mar. 2020.   Link-TBA

J17. N. Pathak, S. Misra, **A. Mukherjee**, A. Roy, A. Zomaya "UAV Virtualization for Enabling Heterogeneous and Persistent UAV-as-a-Service", Transactions on Vehicular Technology, IEEE (copyright transferred), Mar. 2020. (IF=5.339)   Link-TBA

J16. **A. Mukherjee**, S. Misra, V.S.P.Chandra, N. S. Raghuwanshi, "ECoR: Energy-Aware Collaborative Routing for Task Offload in Sustainable UAV Swarms", Transactions on Sustainable Computing, IEEE (Early access), Feb. 2020. (IF=2.456)   Link

J15. D. Bhattacharya, S. Misra, N. Pathak, **A. Mukherjee**, "IDeA: IoT-Based Autonomous Aerial Demarcation and Path-planning for Precision Agriculture", Transactions on IoT, ACM (copyright transferred), Jan. 2020.   Link-TBA

J14. S. Misra, **A. Mukherjee**, "Phantom Networks: The Intangible Shoot-and-Scoot Communication Paradigm For Future Militaries", *IEEE Communications Magazine*, Feb. 2020. (IF=10.356)   Link

J13. **A. Mukherjee**, S. Misra, A. Sukrutha, N. S. Raghuwanshi "Distributed Aerial Processing for IoT-Based Edge UAV Swarms in Smart Farming", Computer Networks (SI), Elsevier, Published- Nov. 2019, DOI: https://doi.org/10.1016/j.comnet.2019.107038. (IF=3.03)   Link

J12. **A. Mukherjee**, S. Misra, N. S. Raghuwanshi, "A Survey of Unmanned Aerial Sensing Solutions in Precision Agriculture", JNCA, Elsevier, pp.102461, Oct 2019 DOI: 10.1016/j.jnca.2019. 102461 (IF=5.273) Link

J11. **A. Mukherjee**, S. Misra, A. Atrish, "MiND: Mind Networked Device Architecture for Attention-Gated Ambient Assisted Living Systems", *IEEE Systems Journal*, Accepted- Mar 2019. (IF=4.463)   Link

J10. **A. Mukherjee**, S. Misra, V. S. P. Chandra, M. Obaidat, "Resource-Optimized Multi-Armed Bandit Based Offload Path Selection in Edge UAV Swarms", *IEEE IoT Journal (Special Issue on Advanced Computational Technologies in Mobile Edge Computing for Internet of Things)*, Nov. 2018. (IF=9.515)   Link

J9. **A. Mukherjee**, S. Misra, N. S. Raghuwanshi, S. Mitra, "Blind Entity Identification for Agricultural IoT Deployments", *IEEE IoT Journal*, vol.6, no. 2, pp. 3156–3163, Accepted- Oct 2018. (IF=9.515)   Link

J8. S. Misra, **A. Mukherjee**, A. Roy, "Knowledge Discovery for Enabling Smart Internet-of-Things: A Survey", *Wiley Interdisciplinary Reviews: Data Mining and Knowledge Discovery*, 8.6 (2018): e1276. (IF=2.541)
Link

J7. S. Misra, S. Goswami, C. Taneja, **A. Mukherjee**, Mohammad Obaidat, "A PKI Adapted Model for Secure Information Dissemination in Industrial Control and Automation 6LoWPANs", *IEEE ACCESS*, vol.3, no., pp.875,889, 2015, DOI: 10.1109/ACCESS.2015.2445817. (IF=4.095)
Link

J6. S Goswami, S Misra, C Taneja, **A. Mukherjee**, "Design and Implementation Analysis of a Public Key Infrastructure- enabled Security Framework for Zigbee Sensor Network", *International Journal of Communication Systems (IJCS)*, Int. J. Commun. Syst. (2014), Published online in Wiley Online Library (wileyonlinelibrary.com). DOI: 10.1002/dac.2893, Nov 2014.
Link

J5. U. N. Thakur, S. Saha, **A. Mukherjee**, "A Proposed Architecture for Residue Number System based 1D 5/3 Discrete Wavelet Transform using Filter Bank and Lifting Scheme." *International Journal of Computer Applications*, Vol. 90, No.14, 2014.

J4. **A. Mukherjee**, N. Pathak, A. Roy, "Heart Murmur Detection using Fractal Analysis of Phonocardiograph Signals." *International Journal of Computer Applications*, Vol. 88, No.12, 2014.

J3. A. Roy, **A. Mukherjee**, "An Analysis of the Viability of using Katz Algorithm in differentiating Normal Heart Sounds from Cardiac Murmurs." *American Journal of Electronics & Communication*, Vol. 1, No.2, pp. 32-36, 2014.

J2. **A. Mukherjee**, S. Chatterjee, K. Chatpadhyay, K. K. Ghosh, "A comparative study on the accuracy of ecg detection for arrhythmia by different wavelet families." *IEMIJMT*, Vol. 2, No.1, pp. 93-98, 2012.

J1. S. Goswami, **A. Mukherjee**, A. Gupta, M. Kharbanda, P. Soni. "Visualization of Relationship among Library Users based on Circulation Data". *Defence Scientific Information and Documentation Centre Journal of Library and Information Technology (DJLIT)*, Vol. 30, No. 2, ISSN No. : 0974-0643. March 2010.
Link

Conferences

C13. N. Pathak, **A. Mukherjee**, S. Misra, "Reconfigurable Wearables for an Interoperable Healthcare IoT Framework", IEEE INFOCOM 2020 (*selected for oral presentation*), Jul 2020, Toronto, Canada. Link-TBA

C12. S. Misra, P. Deb, N. Pathak, **A. Mukherjee**, "Blockchain-Enabled SDN for Securing Fog-Based Resource-Constrained IoT", IEEE INFOCOM 2020 Workshop (BlockSecSDN: Block- chain for Secure Software defined Networking in Smart Communities), (*selected for oral presentation*), Jul 2020, Toronto, Canada. Link-TBA

C11. P. Deb, **A. Mukherjee**, S. Misra, A. Jamalipour "SkopEdge: A Traffic-Aware Edge-Based Auscultation Sound Monitor", (*selected for oral presentation*), IEEE ICC 2020, Jun 2020, Dublin, Ireland. Link-TBA

C10. S. Misra, **A. Mukherjee**, A. Rehman, N. S. Raghuwanshi, "ROSE: Random Opportunistic and Selective Exploration for Cooperative Edge Swarm of UAVs", IEEE COMSNET 2020, Bengaluru, Jan 2020, India. Link

C9. **A. Mukherjee**, S. Misra, N. Daw, D. Paul, "Fog-Based Visual Gesture Control and External Stabilization for micro-UAVs", IEEE Wireless Communications and Networking Conference (WCNC), Marrakkeh, Morocco, Apr. 2019. Link

C8. **A. Mukherjee**, N. Pathak, S. Misra, S. Mitra, "Predictive Intra-Edge Packet-Source Mapping in Agricultural Internet of Things", IEEE Workshop on Communication, Computing, and Networking in Cyber Physical Systems, IEEE Globecomm 2018, Abu Dhabi, Dec. 2018. Link

C7. **A. Mukherjee**, S. Misra, N. S. Raghuwanshi, "SPA: A Sense-Predict-Actuate TDMA Latency Reduction Scheme in Networked Quadrotors", IEEE Wireless Communications and Networking Conference (WCNC), Apr. 2018, Barcelona, Spain. Link

C6. **A. Mukherjee**, S. Misra, P. Khandelwal, "R2D2: Rotating-turret 2D-scanning and Dead-reckoning for Remotely Operated Rovers over Resource Constrained Network Systems", IEEE International Conference on Advanced Networks and Telecommuncations Systems (ANTS), Dec. 2017, Bhubaneshwar, India.   Link

C5. **A. Mukherjee**, S. Misra, P. Mangrulkar, Muttukrishnan Rajarajan, and Yogachandran Rahulamathavan, "SmartARM: A Smartphone-based Group Activity Recognition and Monitoring Scheme for Military Applications", IEEE International Conference on Advanced Networks and Telecommuncations Systems (ANTS), Dec. 2017, Bhubaneshwar, India   Link

C4. S. Misra, **A. Mukherjee**, D. Pal, S. Dalal, "u-OCEAN: An Underwater Omnidirectional Communication Environment using Acoustic Sensor Nodes", IEEE International Conference on Advanced Networks and Telecommuncations Systems (ANTS), Dec. 2017, Bhubaneshwar, India   Link

C3. S Goswami, S Misra, C Taneja, **A. Mukherjee**, "Securing Intra-communication in 6LoWPAN: A PKI Integrated Scheme", IEEE International Conference on Advanced Networks and Telecommuncations Systems (ANTS), 2014, vol., no., pp.1,5, 14-17 Dec. 2014, doi: 10.1109/ANTS.2014.7057265.   Link

C2. **A. Mukherjee**, K. K. Ghosh, "A Noise Independent Approach to QRS- Complex Detection Using CWT", International Conference on Informatics, Electronics and Vision (ICIEV'13). Dhaka, Bangladesh. 18- 19 May 2013(Digital Object Identifier: 10.1109/ICIEV.2013.6572722), p. 1-5, 2013.   Link

C1. **A. Mukherjee**, K. K. Ghosh. "An Efficient Wavelet Analysis for ECG Signal Processing", International Conference on Informatics, Electronics and Vision (ICIEV'12). Dhaka, Bangladesh. 18- 19 May 2012, IEEE Xplore (Digital Object Identifier: 10.1109/ICIEV.2012.6317 419), p. 411-415, 2012.   Link