

# Dr Sandhya Aneja

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*Wireless Networks, Internet of Things, Deep Learning,  
Natural Language Processing*

## Employment

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- **Visiting Scholar in Computer Science**
  - *Purdue University, United States* *1st July – 15 Aug 2019, June 2022 – till date*  
Subjects: Cyber Security, Quantum Computing & Machine Learning
  
- **Assistant Professor in Faculty of Integrated Technologies**
  - *Universiti Brunei Darussalam, Brunei Darussalam* *2016 –2022*  
Subjects: Mobile and Wireless Networks
    1. Alumni coordinator 2017-2019, Faculty of Integrated Technologies
    2. Research seminar coordinator 2019-2020, Faculty of Integrated Technologies
    3. Research Associate 2017-2021, Institute of Applied Data Analytics
  
- **Assistant Professor Institute of Information and Communication**
  - *Delhi University, India* *2010–2016*  
Subjects: Algorithms and Data Structures
    1. Library committee member
    2. Graduate admissions committee member
    3. Faculty research committee member

## Education

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### Academic Qualifications.....

- **Ph.D. Computer Science** **Feb 2012**
  - *Delhi University, India* *2004–2012*  
Title: Handling attacks on routing protocols in ad hoc networks
  
- **M.Tech. Computer Applications** *2001–2002*
  - *Indian Institute of Technology, Delhi, India*
  
- **M.Sc. Mathematics** *1995–1997*
  - *M. D. University, Rohtak, India*  
Awarded Gold Medal

- **B.Sc. Physics, Chemistry, Mathematics**  
*M. D. University, Rohtak, India* 1992–1995

## Awards and Fellowships

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- **Brunei ICT (BICTA) award** **June 2016**  
*InfoComFederation, Brunei* 2016  
 Title: OffAT—Chat in Airplane Mode
- **UBD IBM Center** **Universiti Brunei Darussalam**  
*Research Fellow, High Performance Computing* Apr 2013 – Apr 2015
- **Graduate Aptitude Test of Engineering (GATE) scholarship**  
*IIT Delhi, India* 2001

## Other Technical Skills

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- **MPI, OpenMP**  
*Research Fellow- High Performance Computing, Universiti Brunei Darussalam* 2013-2015
- **Network Simulator (NS-2)**  
*Learned during PhD- Delhi University* 2006-2012
- **Network Simulator- Delay Tolerant Network Simulator (DTN-1, DTN-2)**  
*Worked with PhD Students at Delhi University* 2012-2017

## Research Projects completed based on Deep Learning

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### Neural Network Models for Internet of Things.....

We solved problem of IoT device identification for the 5-6 publicly available datasets (Uluagac, 2014) by training Convolution Neural Network (CNN). The convolution neural networks are the universal function approximation which learn abstract, highlevel, non-linear representation of training data. We also generated two datasets.

1. **Packet-level and IEEE 802.11 MAC frame-level network traffic traces data of the D-Link IoT devices:** The data collection experiment was conducted in the Network Systems and Signal Processing laboratory at Universiti Brunei Darussalam. All the required devices, like as IoT devices, computer, smartphone, laptop, USB Ethernet adapter, and USB WiFi adapter, were configured to capture and store network traffic traces of the IoT devices in the laboratory. All these IoT devices were from the same manufacture (D-Link) with different categories, such as camera, home-hub, door-window sensor, and smart-plug.
2. **Inter Arrival Time (IAT) Dataset (Image signature):** The 100 GB pcap files of GTID dataset were converted to 2 GB MATLAB files of IAT time (Uluagac, 2014). The MATLAB files were restored to compatible HDF5 data format in Python, every 1000 packets IAT was converted to one jpg image using the Python matplotlib library resulting in 36 GB jpg images. This IAT dataset (as image) consists of 137,300 images from the isolated network of 14 devices and a total of 608,864 images from the campus network of 44 devices including active DFP (34,898 images) and passive DFP (573,966 images) signatures. This IAT dataset is publicly available on the DOI

link: <https://dx.doi.org/10.21227/d9e4-wm90>. The size of each protocol traffic signature trained over the dataset is in the range of 2 GB to 6 GB.

Project was run under my Supervision with one undergraduate student, one PhD student and two colleagues.

### **Neural Machine Translation model for University Email Application.....**

In this project, the bilingual emails were collected at the University for communication over a period of three years whose size was small in comparison with state-of-the-art-dataset e.g. WMT-18 (English → German). An application-based corpus populated with regional vocabulary, human translations and corresponding translations of the email content from Google Translate was prepared for developing the neural machine translation model. We wanted to show that these types of models are required in comparison to commercial general translators e.g. Google translator. Therefore, a RNN based Gated Recurrent Unit with attention decoder model was used for the University Email application, which predicted the next word conditioned on the previous context words.

Project was run under my Supervision with one undergraduate student and one colleague.

## **Research Projects completed based on High Performance Computing**

### **Flood Simulator.....**

At UBD | IBM Centre, Universiti Brunei darussalam. One of the interesting project was to develop Flood model using LIDAR 1m data, integrated with 1.5km weather output of WRF model for Brunei in collaboration with IBM Austin, IBM Brazil and IBM India. I tested some modules developed by team using MPI for mpic++ compiler and suggested corrections which were accepted and included when project was admitted for production.

## **Patents**

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1. Sandhya Aneja; Nagender Aneja; Mohamad Iskandar Petra, "[Instant Messaging for Mobile Device with Offline and online mode](#)," US 10,834,035, Nov 10, 2020 (Granted)
2. Nagender Aneja and Sandhya Aneja, "[Anti-fraud computer implemented method for financial card transaction](#)," US 2015/0339657, Nov 26, 2015 (Published)

## **Research Publications**

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### **2022.....**

1. Sandhya Aneja, Nagender Aneja, Bharat Bhargava, and Rajarshi Roy Chowdhury "[Device Fingerprinting using Deep Convolutional Neural Networks](#)", Int. J. of Communication Networks and Distributed Systems, Volume 28, Issue 2, 2022
2. Sandhya Aneja, Melanie Ang Xuan En, Nagender Aneja "[Collaborative adversary nodes learning on the logs of IoT devices in an IoT network](#)", 2022 14th International Conference on COMmunication Systems & NETworkS (COMSNETS)

3. Sandhya Aneja, Nagender Aneja, Pg Emeroylariffion Abas, Abdul Ghani Naim, "[Transfer learning for cancer diagnosis in histopathological images](#)", IJES International Journal of Artificial Intelligence (IJ-AI)
4. Sandhya Aneja, Nagender Aneja, Pg Emeroylariffion Abas, Abdul Ghani Naim, "[Defense against Adversarial Attacks on Deep Convolutional Neural Networks through non-local Denoising](#)", IJES International Journal of Artificial Intelligence (IJ-AI)
5. Sandhya Aneja, Nagender Aneja, Ponnurangam Kumaraguru, Predictive Linguistic Cues for Fake News: A Societal AI Problem", IJES International Journal of Artificial Intelligence (IJ-AI) (in press)
6. AI-enabled emerging learning architecture and framework over B5G/6G Internet of Things Network", (in preparation)

## 2021

1. Rajarshi Roy Chowdhury, Sandhya Aneja, Nagender Aneja, Pg Emeroylariffion Abas, "[Packet-level and IEEE 802.11 MAC frame-level network traffic traces data of the D-Link IoT devices](#)", Data in Brief, Volume 37, Aug 2021, 107208, ISSN 2352-3409
2. Preeti Nagrath, Sandhya Aneja, and G. N. Purohit, "[Taxonomy of reputation-based defending mechanisms against types of attacks in delay tolerant networks](#)", International Journal of Security and Networks, ISSN: 1747-8405, eISSN: 1747-8413, Vol.16, No.2 pages 77-91, Published: Aug 2021
3. Aneja N., Aneja S. (2021), "[Detecting Fake News with Machine Learning](#)", Conference Proceedings of ICDLAIR2019. ICDLAIR 2019. Lecture Notes in Networks and Systems, vol 175. Springer, Cham.

## 2020

4. Rajarshi Roy Chowdhury, Sandhya Aneja, Nagender Aneja, and Emeroylariffion Abas, "[Network Traffic Analysis based IoT Device Identification](#)", In Proceedings of the 2020 the 4th International Conference on Big Data and Internet of Things (BDIOT 2020). Association for Computing Machinery, New York, NY, USA, 79–89
5. Sandhya Aneja, Siti Nur Afikah Bte Abdul Mazid, Nagender Aneja, "[Neural Machine Translation model for University Email Application](#)" International Conference on Natural Language Processing (ICNLP 2020), July 11-13, 2020

## 2019

6. Sandhya Aneja, Preeti Nagrath, and G. N. Purohit, "[Energy efficient reputation mechanism for defending different types of flooding attack](#)", Wireless Networks, ISSN: 10220038, eISSN: 15728196, Pages: 3933-3951, Published: 1 October 2019
7. Nagender Aneja, Sandhya Aneja, "[Transfer Learning using CNN for Handwritten Devanagari Character Recognition](#)", Presented in First IEEE International Conference on Advances in Information Technology, 24th - 27th July 2019, Chikkamagaluru, Karnataka, India, (Best Paper Award)
8. Sandhya Aneja, Preeti Nagrath, and G. N. Purohit, "[Attacks in Delay Tolerant Networks: Classification and Analysis](#)", 2019 11th International Conference on Communication Systems &

Networks (COMSNETS), ISSN: 2155-2509, eISSN: 2155-2487, Pages: 489-491, Published: 7 July 2019

## 2018

9. Sandhya Aneja, Nagender Aneja, Md Shohidul Islam, "[IoT Device Fingerprint using Deep Learning](#)", International Conference on Internet of Things and Intelligence System (IoTaIS 2018), Bali, Indonesia, 2018

## 2017

10. Noman Shahid, Sandhya Aneja, "[Internet of Things: Vision, Application Areas and Research Challenges](#)", International conference on I-SMAC (IoT in Social, Mobile, Analytics and Cloud) Pages: 583-587, ISBN: 978-1-5090-3244-0, eISBN: 978-1-5090-3243-3, 10-11 Feb, 2017.
11. Shivika Arora, Preeti Nagrath, Sandhya Aneja "[Secure Encryption Protocol for ad hoc networks](#)", 2017 8th International Conference on Computing, Communication and Networking Technologies (ICCCNT), Pages: 1-7, July 2017
12. Sandhya Aneja, Nagender Aneja "[Security and Privacy: Challenges and Defending Solutions for NoSQL Data Stores](#)", NoSQLDatabase for Storage and Retrieval of Data in Cloud, 237-250., Taylor & Francis Group, CRC Press 2017, Print ISBN: 978-1-4987-8436-8, eBook ISBN: 978-1-4987-8437-5 [Book Chapter]

## 2016

13. Rahul Johari, Neelima Gupta, and Sandhya Aneja, "[Experimental Evaluation of Routing Schemes for Intermittently Connected Wireless Mobile Networks](#)", Wireless Personal Communications, ISSN: 09296212, eISSN: 1572834X, Pages: 897-921, Published: 1 April 2016
14. Preeti Nagrath, Sandhya Aneja, Neelima Gupta, and Sanjay Madria, "[Protocols for mitigating blackhole attacks in delay tolerant networks](#)", Wireless Networks, ISSN: 10220038, eISSN: 15728196, Pages: 235-246, Published: 1 January 2016
15. Seema Nagar, Sandhya Aneja, Harshad Khadilkar, Sampath Dechu, Zainul Charbiwalal, "[SMOME: A Framework for Evaluating the Costs and Benefits of Instrumentation in Smart Home Systems](#)", The International Conference on Smart Grid Communications, Pages: 134-139, ISBN: 978-1-5090-4076-6, eISBN: 978-1-5090-4075-9, December 2016.

## 2015

16. Rahul Johari, Neelima Gupta, and Sandhya Aneja, "[CONCOR: context-aware community-oriented routing for intermittently connected network](#)", Eurasip Journal on Wireless Communications and Networking, ISSN: 16871472, eISSN: 16871499, Volume: 2015, Published: 8 December 2015
17. Rahul Johari, Neelima Gupta, and Sandhya Aneja, "[POSOP routing algorithm: A DTN routing scheme for information connectivity of health centres in hilly state of North India](#)", International Journal of Distributed Sensor Networks, ISSN: 15501329, eISSN: 15501477, Volume: 2015, Published: 2015
18. Seema Nagar, Sandhya Aneja, Harshad Khadilkar, Sampath Dechu, Zainul Charbiwalal, "[A Framework for Evaluating the Costs and Benefits of Instrumentation in Smart Home Systems](#)",

The sixth International Conference on Future Energy Systems (ACM e-Energy), Pages: 221-222 April 2015.

19. Preeti Nagarath, Sandhya Aneja and G. Purohit, "[BlackBox as DTN device](#)", International Journal of Next-Generation Computing, Pages: 57-65, Volume 6, issue 1, March 2015
20. Preeti Nagarath, Sandhya Aneja and G. Purohit, "[Defending flooding attack in Delay Tolerant Networks](#)", 2015 International Conference on Information Networking (ICOIN), Pages: 40-45, 2015
21. Anshu Dhawan, Sandhya Aneja, Shikha Jain, and C.K. Jha, "[A Comparison Study on Route Stability of On-Demand Routing Protocols in CRAHNs](#)", 2015 Fifth International Conference on Communication Systems and Network Technologies, Pages: 98-101, 2015

#### **-2014**.....

22. Swati Singhal, Sandhya Aneja, Frank Liu, Lucas Villa Real, Thomas George, "[IFM: a scalable high resolution flood modeling framework](#)", European Conference on Parallel Processing, Pages 692-703, 25 October 2014
23. Swati Singhal, Lucas Villa Real, Thomas George, Sandhya Aneja, Yogish Sabharwal, "[A hybrid parallelization approach for high resolution operational flood forecasting](#)", 20th IEEE Annual International Conference on High Performance Computing, Pages 405-414, 18 December 2013
24. Rahul Johri, Neelima Gupta and Sandhya Aneja, "[CACBR: Context Aware Community Based Routing for Intermittently Connected Network](#)", In ACM International Symposium on Performance Evaluation of Wireless Ad Hoc, Sensor, and Ubiquitous Networks, Pages: 137-140, November 2013.
25. Shikha jain and Sandhya Aneja, "[Spread and Erase: Efficient routing algorithm based on Anti-message Info Relay Hubs for Delay Tolerant Networks](#)", Pages: 643-651, 26 February 2013
26. Rahul Johri, Neelima Gupta and Sandhya Aneja, "[DSG-PC: Dynamic Social Grouping based Routing for Non-uniform Buffer Capacities in DTN Supported with Periodic Carriers](#)". In 9th International Conference on Heterogeneous Networking for Quality, Reliability, Security and Robustness, Pages: 1-15, ISBN: 978-3-642-37948-2, January 2013.
27. Sandhya Khurana and Neelima Gupta "[Discovering Minimum Exposed Path to Attack in Mobile Ad hoc Networks in optimal  \$O\(|P|\)\$  time after pre-processing](#)", International Journal of Next-Generation Computing, ISSN: 0976-5034, Pages: 45-61, Published: March 2013
28. Garima Gupta, Preeti Nagarath , Sandhya Aneja, and Neelima Gupta, "[Reference based approach to Mitigate Blackhole Attacks in Delay Tolerant Networks](#)", ACM International Symposium on QoS and Security for Wireless and Mobile Networks, Pages: 85-88, 24 October 2012.
29. Sandhya Khurana and Neelima Gupta "[Reliable Distance Vector routing protocol to handle Blackhole and Selfish \(RDV BS\) nodes in Ad hoc Networks](#)", International Journal of Next-Generation Computing, ISSN: 0976-5034, Published: March 2012
30. Sandhya Khurana and Neelima Gupta "[End-to-end protocol to secure ad hoc networks against wormhole attacks](#)", Security and Communication Networks, ISSN: 19390114, eISSN: 19390122, Pages: 994-1002, Published: September 2011

31. Sandhya Khurana, Neelima Gupta, "[FEEPVR: First End-to-End Protocol to secure Ad Hoc Networks of Variable Range against Wormhole Attacks](#) ", IEEE The International Conference on Emerging Security Information, Systems and Technologies, SECURWARE 2008, Pages: 74-79, August 25-31, 2008
32. Neelima Gupta, Sandhya Khurana, "[SEEEP: Simple and Efficient End-to-End Protocol to secure Ad Hoc Networks against Wormhole Attacks](#)", IEEE The International Conference on Wireless and Mobile Communications, ICWMC 2008, Pages: 13-18, July 27 - August 1, 2008
33. Sandhya Khurana, Neelima Gupta, Nagender Aneja, "[Minimum Exposed Path to the Attack \(MEPA\) in Mobile Ad Hoc Network \(MANET\)](#)", Sixth International Conference on Networking, 2007. ICN '07
34. Sandhya Khurana, Neelima Gupta, Nagender Aneja, "[Reliable Ad-hoc On-demand Distance Vector Routing Protocol](#)", International Conference on Networking, International Conference on Systems and International Conference on Mobile Communications and Learning Technologies, 2006
35. Sarva Jit Singh and Sandhya Khurana , "[Reflection of P and SV waves at the free surface of a monoclinic elastic half-space](#)", Journal of Earth System Science volume 111, pages401–412 (2002)
36. Sarva Jit Singh, Neelam Sachdeva and Sandhya Khurana , "[A note on the dispersion of Love waves in layered monoclinic elastic media](#)", Proceedings - Mathematical Sciences volume 109, pages417–423 (1999)

Table 1: Number of Publications / Patents

Total Pubs	Total Patents	Scopus Pubs	Journal Pubs	Conference Pubs	Patents Filed	Patents Granted
42	2	38	18	23	2	1

### Selected Research Activities.....

1. "[Editorial board member](#), Hindawi Journal of Wireless Communications and Mobile Computing, 2021- current
2. [Reviewer](#), Springer Journal of Wireless Networks, 2020- current
3. Reviewer IEEE Transactions on Mobile Computing, 2021- current
4. [Technical Program Committee Member](#) IEEE International Conference on Ubiquitous and Future Networks, 2021- current
5. [Technical Program Committee Member](#) International Symposium on Security in Computing and Communications (SSCC), 2020

6. [Technical Program Committee Member](#) ACM International Conference on Big Data and Internet of Things (BDIOT2021) 2020- current
7. [Technical Program Committee Member](#) IWCMC Symposium on Smart cities and mobile platforms 2017- current
8. [Program Committee Member](#) 2018 IEEE International Conference on Intelligence and Security Informatics (ISI) 2018

**Presented**.....

1. "Short Term Training Programme (STTP) on Internet of Things (IoT): Architecture & System Level Design", organized byUSIC&T, GGSIP University, India, September 30, 2021
2. "Cyber Security Course" from 12.04.2021 to 23.04.2021, National Institute of Technical Teachers Training and Research (NITTTR), Chandigarh, India, April 19, 2021
3. "Short Term Training Programme (STTP) on Internet of Things (IoT): Challenges and Applications", organized byUSIC&T, GGSIP University, India, February 06, 2021
4. "GIS Based Flood Mitigation" Seminar 2014 was jointly organized by the Survey Department, Ministry of Development, Brunei Darussalam