AYANGA IMESHA KALUPAHANA

Personal Information

UNIVERSITY:	National University of Singapore
MAJOR:	Computer Science
EMAIL:	ayangaim@comp.nus.edu.sg
ADDRESS:	Systems and Networking Lab, School of Computing, NUS
PERSONAL WEBPAGE:	https://ayanga1991.github.io
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Research Interests

Wearable computing/sensing, Differential Privacy, application of privacy and security to energy constraint devices, wearable health sensing, wearable energy harvesting, wearable power and latency optimization, edge AI, embodied AI

Education

Jan 2020-Jun 2026	Ph.D. Candidate in Computer Science National University of Singapore Advisor : Prof. Peh Li-Shiuan CAP: **4.08/5**
2011-2016	BSc. Eng. (Hons) specialized in Electronics and Telecommunication Engineering University of Moratuwa (UoM), Sri Lanka FYP Advisor: Dr. Ajith Pasqual CGPA: **3.57/4.2 (34th of 101)**

Work Experience

Jan 2025 - May 2025 | **Visiting Doctoral Researcher**
@ Chair of Security in Information Technology, TUM School of Computation, Information and Technology, Technical University of Munich, Germany
Advisors: PD Dr.-Ing. habil. Michael Pehl and Prof. Dr.-Ing. Georg Sigl

- Conducted research on how to integrate Allan Deviation's noise characterization and estimations to benefit Physical Unclonable Function(PUF)s and True-Random Number Generator(TRNG)s
- Implemented Allan Variance algorithm with varying average time on FPGA platform and performed area, power, speed evaluations

May 2024 - Aug 2024 | **Graduate Teaching Assistant -CP2107 Independent Introduction to CS Research (Odyssey)**
@ School of Computing, NUS
Module Instructor: Prof. Bimlesh Wadhawa

- Mentored two NUS Computer Science undergraduate research projects related to EEG based attention application developments and EEG based meditation application development

Jan 2024 - May 2024 | **Graduate Teaching Assistant -CS4222/CS5222 Wireless Networking**
@ School of Computing, NUS

Module Instructor: Prof. Ambuj Varshney

- Conducted tutorials and provided consultation for Final-year undergraduate and postgraduate students
- Evaluated assignments and course projects of 164 enrolled students

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- Evaluated assignments and course projects of 150 enrolled students

Aug 2019 - Dec 2019

Graduate Researcher @ LSP Group, NUS
Advisors : Prof. Peh Li-Shiuan and Prof. Xiaokui Xiao
Evaluated Rastogi et al.s' Distributed Differential Privacy algorithm's performance and limitations on off-the-shelf smartwatches

May 2016 - July 2019

Research Engineer @ Synergen Technology Labs LLC, USA
(Headquarters in Dallas, Texas, USA, Innovation center in Sri Lanka)

- Designed a 4-layer PCB (36mmx19mm) for a spine care wearable patch with inductive wireless charging circuit
- Developed a single IMU-based smoke detection mechanism
- Developed an algorithm for de-noising Ambulatory ECG by fusion with accelerometer data and activity detection for Synergen's now FDA-approved Scio-Cardio ambulatory ECG monitor
- Developed a respiration estimation algorithm for the PPG signal input taken from the infant's ankle-worn wearable in patented Synergen Baby monitor which is available in the market as Hälsa Baby.
- Developed a cry detection algorithm
- Supervised five UoM undergraduate engineering students' internships related to wearable stress monitor, smoke detection and baby monitor in 2016, 2018 and 2019

Nov 2014 - March 2015

Research & Development Engineering Undergraduate Intern
@ Integrated System Development (ISD) Ltd, UK
(Headquarters in London, UK, Research & Development center in Sri Lanka) Now ISD is operated as Verox Labs Ltd
Mentor: Mr. Harin De Silva, Managing/Technical Director

- Assisted in developing their next version of the "Heated Glass Stage Device", which is used to inject sperm into egg cells in-vitro fertilization process
- Researched, experimented, and developed algorithms to provide even heat signature to the living cell
- Designed a heated glass stage protection circuit

Journal Publications

1. SeRaNDiP - Leveraging Inherent Sensor Random Noise for Differential Privacy Preservation in Wearable Community Sensing Applications
Ayanga Kalupahana, *Ananta Narayanan Balaji, Xiaokui Xiao and Li-Shiuan Peh*
Proceedings of the ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies 2023 (IMWUT/Ubicomp)

Project webpage : SeRaNDiP: Leveraging Inherent Sensor Random Noise for Differential Privacy Preservation in Wearable Community Sensing Applications

Conference Publications

1. E-MagDiP:Electro-Magnetic based Differential Privacy for EEG based Community Sensing
   Ayanga Kalupahana, *Vishruti Ranjan and Li-Shiuan Peh*
   Proceedings of the 24th ACM International Conference on Mobile Systems, Applications, and Services(Mobisys), 2026, Cambridge, United Kingdom (Under Review)
   Project webpage : E-MagDiP: Electro-Magnetic based Differential Privacy for EEG based Community Sensing
2. FPAA and FPGA Based Universal Sensor Node Design
   Ayanga Kalupahana, *Nisal Hemadasa, Nipun Wijerathne, Anuranga Ranasinghe and Ajith Pasqual*
   Proceedings of the 11th International Conference on Sensing Technology (ICST 2017), Sydney, Australia

PhD Thesis

Advisor: Prof. Peh Li Shiuan, Dept. of Computer Science, NUS

Under my Ph.D. thesis, I am studying and solving problems, gaps, and bottlenecks in implementing privacy and security algorithms for wearable devices in both community sensing and remote monitoring.

First I have proposed SeRaNDiP which is a framework that leverages low-power wearable sensors' inherent noise for varying Differential Privacy noise requirements without hardware modification. As per our knowledge, this is the first inherent noise-based Differential Privacy-providing framework applicable to existing smartwatches and fitness trackers. It resulted in 1.4X-1.8X computation/communication speedup and 1.2X-1.5X energy savings against state-of-the-art DP implementation.

Secondly, I proposed E-MagDiP, a framework work to leverage Amplitude Modulated RF signals to induce statistical noise required for Differential Privacy in EEG based community sensing programs (with smaller number of community participation) without any hardware or software modification to commercially available off-the- shelf EEG headsets and headbands. Experiments on three off-the-shelf headsets showed E-MagDiP's ability of providing DP guarantee 38.12 for 100 participants. E-MagDiP is the first framework to use RF signals for privacy instead of attacks, enabling practical DP for EEG community sensing without any user-level modification.

Thirdly, I am proposing a run-time noise characterization and estimation ASIC design to facilitate real-time on device randomness evaluation health test to facilitate recommendations in AIS 20/31, while being alternative to complicate NIST SP 800-22 tests for random number generators and physical unclonable functions used for encryption and fingerprinting in hardware-level security accelerators developed for wearable application targeted processors.

Research Collaboration-Work in Progress

I am collaborating with Prof. Ambuj Varshney's Wireless, Embedded Intelligence, Sensing and Emerging Technologies (WEISER) group to develop low power EEG headset by leveraging tunnel diodes and off-the-shelf EEG electrodes.

Undergraduate Student Mentoring

May 2024 - Aug 2024

CP2107-Odyssey 2024
@ School of Computing, NUS
I am co-mentoring two NUS computer science undergraduate students'
- Kim Munhui
- Wen Fanyu

summer research projects related to EEG application development (Attention and Relaxation) focusing on both edge devices and community sensing servers with fellow PhD student, Goh Teck Lun.

June 2019 - July 2019

Synergen Undergraduate Industrial Training Program 2019
@ Synergen Technology Labs LLC, USA
(Headquarters in Dallas, Texas, USA, Innovation center in Sri Lanka)
I co-mentored two University of Moratuwa Electronics and Telecommunication undergraduates :
- Malitha Gunawardhana
- Methni Weerasinghe

for their engineering internship projects related to baby monitor along with two newly joined junior research engineers: Rasangika Wetthasinghe and Pubudu Roopasinghe.

June 2018 - December 2018

Synergen Undergraduate Industrial Training Program 2018
@ Synergen Technology Labs LLC, USA
(Headquarters in Dallas, Texas, USA, Innovation center in Sri Lanka)
I mentored two University of Moratuwa Biomedical Engineering undergraduates:
- Sachithra Warnakula
- Anosha Iggi

for their engineering internship projects related to wearable stress monitoring.

June 2016 - December 2016

Synergen Undergraduate Industrial Training Program 2016
@ Synergen Technology Labs LLC, USA
(Headquarters in Dallas, Texas, USA, Innovation center in Sri Lanka)
I mentored one University of Moratuwa Electronics and Telecommunication Engineering undergraduate:
- Harshani Prasangika

for her engineering internship project related to wearable smoke detection.

Reviewer

2023	ACM Conference on Human Factors in Computing Systems(CHI)
2023,2024,2025	Moratuwa Engineering Research Conference (MERCon)
2022,2023,2024	ACM on Interactive, Mobile, Wearable and Ubiquitous Technologies(IMWUT)

Awards and Scholarships

2025Jan-2025May	TUM Visiting Research Scholarship Award
2024-2026	NUS Research Scholarship Award
2023	SOC Research Incentive Award worth SGD 2,500 (One-time award)
2023	Graduate Student Travel Grant worth SGD 4,000 (To attend Tier 1 ACM Ubicomp 2023)
2020-2024	NUS Research Scholarship Award
2017	Presentation Award- 2nd Runner up (Student Category), 11th International Conference on Sensing Technology, ICST 2017, Sydney, Australia
2011	18 plus Scholarship 2010 Award For the outstanding academic performance of G.C.E. Advanced Level 2010

Programming Skills

Proficient:	C/C++ (Embedded software development), Python, Java, Matlab, Bluetooth Low Energy, AI models, Differential Privacy,
Basic Knowledge:	Verilog, Altium, Solid Works, Eagle, VHDL, TRNG, PUF
Development Boards:	Raspberry Pi, Beaglebone, Odroid, Artix-7 FPGA, ESP-32, Spartan 3E FPGA, AN231E04 FPAA etc.
Sensors:	PPG, ECG, Temperature, Accelerometer, Barometer sensors, GSR and microphones

References

1. Dr. Li-Shiuan Peh
   Provost's chair professor, School of Computing, National University of Singapore.
2. PD Dr.-Ing. habil. Michael Pehl
   Senior Researcher, Chair of Security in Information Technology,
   TUM School of Computation, In-formation and Technology,
   Technical University of Munich, Germany