

# Priyanka Singla

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## Profile

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Presently a PhD student working with Prof. Smruti R. Sarangi at IIT Delhi. My research is focused on increasing the efficiency in IoT based intelligent systems, and particularly includes sensor networks and vehicular systems. Along with this, I am also interested in the concurrency aspect in distributed sensor systems. Apart from this, I am working on 5G networks.

## Academic Profile

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<b>PhD</b>	Doctor of Philosophy in Computer Science (9.56/10) <b>Indian Institute of Technology, Delhi</b>
<b>ME</b>	Master of Science (Engineering) in Computer Science (6.0/8.0) Computer Science and Automation Department <b>Indian Institute of Science, Bangalore</b> <b>Thesis:</b> “Handling Overloads with Social Consistency”
<b>BE</b>	Bachelor of Engineering in Computer Science (9.8/10) <b>Thapar University, Patiala, Punjab</b>

## Publications

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ISVLSI-2022 at Cyprus	<i>CmpctArch: A Generic Low Power Architecture for Compact Data Structures in Energy Harvesting Devices</i> , Priyanka Singla and Dr. Smruti R. Sarangi, accepted as a regular paper.
IPSN-2022 at Milan, Italy	<i>Polar Code-based Approximate Communication System for Multimedia Web Pages</i> , Aman Shreshtha, Priyanka Singla, and Dr. Smruti R. Sarangi, accepted as an extended abstract.
JSA-2022	<i>A Survey and Experimental Analysis of Checkpointing Techniques for Energy Harvesting Devices</i> , Priyanka Singla, Dr. Smruti R. Sarangi, accepted as a journal paper.
ASPDAC-2021 at Tokyo, Japan	<i>EHDSketch: A Generic Low Power Architecture for Sketching in Energy Harvesting Devices</i> , Priyanka Singla, Chandran Goodchild, and Dr. Smruti R. Sarangi, accepted as a regular paper.
DAC-2020 Virtual	<i>ApproxEHD: A Sketching based Generic Architecture for Energy Harvesting Devices</i> , Priyanka Singla, Chandran Goodchild, and Dr. Smruti R. Sarangi, accepted as a poster.
DATE-2019 at Florence, Italy	<i>FlexiCheck: An Adaptive Checkpointing Architecture for Energy Harvesting Devices</i> , Priyanka Singla, Shubhankar S. Singh, and Dr. Smruti R. Sarangi, accepted as a regular paper.
HiPC-2018 at Bangalore, India	<i>Probabilistic Sequential Consistency in Social Networks</i> , Priyanka Singla, Shubhankar S. Singh, Prof. K. Gopinath, and Dr. Smruti R. Sarangi, accepted as a regular paper.

## Research Projects

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- Generic Architecture for Compact Data Structures in Energy Harvesting Devices (ISVLSI'22)**
  - Proposed reduce the memory footprint of EHD applications by replacing the traditional data structures with compact data structures (CDS), which allows accessing data without uncompressing the compact data.
  - Proposed a generic hardware architecture that reduces the memory footprint up to  $3.5\times$  compared to that of the traditional algorithms. Furthermore, it could achieve an energy saving of  $160 - 1200\times$  and  $280 - 620\times$  speedup over the software implementations of CDSs.
- Generic Architecture for Sketching in Energy Harvesting Devices (DAC'20, ASPDAC'21)**
  - Proposed to use sketching algorithms to perform approximate computations on streaming data. Sketching algorithms provide quick answers with significantly lower energy consumption and memory usage.

- Proposed a generic hardware architecture that can implement most of the popular sketching algorithms. It could achieve an energy saving of  $4 - 10\times$  and  $> 10\times$  speedup over state-of-the-art software implementations.
- 3. A Survey and Experimental Analysis of Checkpointing Techniques in EHDs (JSA'22)**
    - Performed an extensive survey on energy harvesting devices (EHDs). We provided a deep background of the fundamental concepts in the domain and have discussed the existing checkpointing techniques.
    - Performed a rigorous experimental comparison among these approaches and studied their sensitivity with respect to various factors such as the nature of the energy source, the energy storage capacity, and the size of the SRAM.
  - 4. Adaptive Checkpointing in Energy Harvesting Devices (DATE'19)**
    - Presented a formal model for checkpointing in energy harvesting systems. Showed that an optimal checkpointing schedule can be obtained using a quadratically constrained linear program (QCLP) solver.
    - Proposed a checkpointing algorithm that adapts itself according to the ambient energy. Presented a SW/HW implementation of the algorithm that predicts the ambient power profile at runtime and intelligently takes checkpointing decisions. The proposed algorithm obtained a speedup of  $2-5\times$  over the nearest competing approaches.
  - 5. Probabilistic Sequential Consistency in Social Networks (HiPC'18)**
    - Proposed a theoretical model that can be used to analyze systems that are comprised of multiple sub-domains – each sequentially consistent.
    - Proposed a new client-based consistency model - social consistency - that provides a stronger set of guarantees within a subset of socially related client nodes. We created a prototype social network application over Cassandra, and it showed  $2.4\times$  more throughput than Cassandra and provided 37% better quality-of-experience.
  - 6. Tejas: An Architectural Simulator**
    - Contributions to Tejas, a Java-based architectural simulator developed and maintained by Srishti research group at IIT Delhi.
    - Extended it to support the simulation of energy harvesting devices.

## Master's Project

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- **Scalable and Socially Consistent Systems** [Published in HiPC '18]  
 This work aims to handle the system overloading by splitting/merging the objects. Particularly, in social-networking sites like Facebook/Twitter, some posts can be accessed by a large number of users, resulting in a hot spot, which the current systems are not able to handle and hence resulting in enormously high latency and finally in a system crash. In our system we came up with a model in which the users are responded in approximately constant time and the system can scale easily according to increase in the number of users.

## Papers Reviewed

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Conferences	MICRO 2022, CASES 2022, ICPP 2021, ICCD 2021, HPCA 2021, HiPC 2020, HPCA 2020, VDAT 2020, ICPP 2020, ICCD 2019
Journals	JSA 2022, PHYCOM 2022, JPDC 2019

## Work Experience

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Junior Research Fellow (JRF) at IIT-Delhi, Aug 2017 - Sep 2018	Worked with Prof. Smruti R. Sarangi on energy harvesting devices, and worked on efficient techniques for checkpointing in these devices.
Internship at Max-Planck Institute for Software Systems, Saarbrücken, Germany, May 2013 - July 2013	Devised a system called “BLAST: Bounded Latency And Scalability Together”, which provides almost constant (bounded) latency even upon system overloading and throughput increases linearly with request rate.
Samsung Electronics Pvt Ltd, Noida, Jan 2011 - May 2011	Worked as software development Trainee at Samsung, Noida. Worked on a project in mobile applications, to lock a particular folder, for providing security. Also worked on a project to implement KHMER language (Cambodian language).

## Mentoring Students

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Divya Chakarwari (2019)	Trace generation for multithreaded programs for Tejas simulator using Qemu.
Ravi Shankar Singh (2019)	Optimal placement of RSUs maximizing the V2I coverage.
Nikhil Kumar (2020)	Optimal placement of electric vehicles charging stations with electricity theft control.
Sakshi, Ashish (2020)	Increasing the performance of existing RSU placement strategies.
Aman Shreshtha (2020)	Power characterization of MSP430FR5969 device.
Ashutosh Agarwal (2020)	Improving EmuArm - a graphical ARM and Thumb ISA emulator.
Rohit, Ishvik (2021)	Designed a framework in Rebeca for verifying energy harvesting based applications.
Harsh, Aravind (2021)	Extended the electricity theft model for EV charging stations.
Akash Kumar (2021)	Designing an open source simulator for automotive cars - CarSim.
Dipika Tanwar ('21-'22)	Designing an intelligent logger for CAN data in automotive cars.
Aman Shreshtha ('21-'22)	Designing an <i>approximate communication system</i> for wireless applications.
Priyal Thakkar ('21-'22)	Developing a dynamic 5G testbed.
Mehul, Bivas (2022)	Topological analysis based EV charging stations placement.

## Teaching Assistantship

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Digital Logic and System Design (2022)	Instructor: Prof. Anshul Kumar, Prof. M.Balakrishnan, and Prof. Vireshwar Kumar (180 students).
Real Time Systems (Spring 2022)	Instructor: Prof. Smruti Ranjan Sarangi (10 students).
Discrete Mathematics (Fall 2020)	Instructor: Prof. Amitabha Bagchi (150 students).
Intro to Computer Sc. (Spring 2020)	Instructor: Prof. Subhashis Banerjee and Prof. Subodh Sharma (600 students).
Computer Architecture (Fall 2019)	Instructor: Prof. Smruti Ranjan Sarangi (192 students).
Operating Systems (Spring 2019)	Instructor: Prof. Smruti Ranjan Sarangi (120 students).

## Talks

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ISVLSI'22	CmpctArch: A Generic Low Power Architecture for Compact Data Structures in Energy Harvesting Devices.
ASP-DAC'21	EHDSketch: A Generic Low Power Architecture for Sketching in EHDs.
DAC'20	ApproxEHD: A Sketching based Generic Architecture for Energy Harvesting Devices.
PhD Symposium'19, IIT Delhi	FlexiCheck: An Adaptive Checkpointing Architecture for Energy Harvesting Devices.
IIT Delhi'19	Efficient Intermittent Systems: A Survey and Research Proposal.
DATE'19	FlexiCheck: An Adaptive Checkpointing Architecture for Energy Harvesting Devices.
HiPC'18	Probabilistic Sequential Consistency in Social Networks.
IISc Bangalore'18	Handling Overloads with Social Consistency.
NetApp, Bangalore'13	Consensus in heterogeneous systems.
MPI SWS, Germany'13	BLAST : Bounded Latency And Scalability Together.
IISc Bangalore'12	An Efficient and Flexible Consistency Framework for Distributed Systems.

## Workshops and Conferences attended

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ISVLSI'22	IEEE Computer Society Annual Symposium of VLSI, Jul 4-6, 2022, hybrid.
ASP-DAC'21	Asia and South Pacific Design Automation Conference, Jan 18-21, 2021, held virtually.
DAC'20	Design Automation Conference, July 19 - July 33, 2020, held virtually.
ISCA'20	International Symposium on Computer Architecture, May 30 - June 3, 2020, Virtual.
ACM India Grad Cohort'19	ACM India Grad Cohort for women in computing, July 6-7, 2019, IIT Delhi, India.
DATE'19	Design Automation and Test in Europe, March 25-29, 2019, Florence, Italy.
HiPC'18	The 25th IEEE International Conference on High Performance Computing, Data, and Analytics, December 17-20, 2018, Bangalore, India.
SOSP'13	The 24th ACM Symposium on Operating Systems Principles, November 3-6, 2013, Pennsylvania, USA.
Women Techmakers	An event organized by Google India, March 22, 2014.
IBM ICARE Winter School	Winter school on "Big Data and Cloud Computing, October 18-19, 2012, IBM-Bangalore, India.
MSR India Summer School	Microsoft sponsored "MSR India 2012, Summer School on Distributed Algorithms, Systems and Programming", May 28-June 8, 2012, IISc Bangalore.

## Course Projects

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- **AppSche: Intelligent Scheduler for Approximate Tasks on EHDs [IIT-Delhi]**  
Developed a scheduling algorithm for approximate tasks on Energy Harvesting Devices. The aim of the scheduler is to minimize the per application error. The system was evaluated on Tejas - A cycle accurate simulator.
- ***Rēχplore- Explore as you research* [IIT-Delhi]**  
A php based web application that basically forms a platform for research collaboration within the department. The main features are profile management, event calendar management, publication repository and recommendations. The application also uses HTML and Mysql.
- **Operating Systems [IISc]**  
Worked on a Unix based simple operating system PintOs implemented in C.
- **Communication Networks [IISc]**  
Studied and implemented a paper titled “A SLA Framework for QoS Provisioning and Dynamic Capacity Allocation”, which proposes an efficient SLA (service level agreement) based three tier pricing model with penalties for QoS provisioning and dynamic capacity allocation.
- **Program Analysis and Verification [IISc]**  
Implemented an intra-procedural data-flow analysis for detecting null dereference bugs in Java programs using Soot analysis framewok.

## Academic Achievements

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- Secured 1st position in 11th and 12th Std.
- Secured 2nd position in BE 2nd year and was awarded with a scholarship.

## References

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**Dr. Smruti R. Sarangi**, Associate Professor, Indian Institute of Technology, Delhi, [srsarangi@cse.iitd.ac.in](mailto:srsarangi@cse.iitd.ac.in)