Rahul Vishwakarma

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Education

California State University, Long Beach — California, United States
M.S. Computer Science — Jan 2022 - May 2024
Thesis: *Towards Uncertainty-Aware Hardware Trojan Detection.*

SRM Institute of Science and Technology — Chennai, India
Bachelors of Technology **Computer Science & Engineering** — Aug 2005 - May 2009
Thesis: *High Density Data Storage in DNA Using an Efficient Message Encoding Scheme.*

Employment

California State University, Long Beach — California, United States
Graduate Research Assistant (NSF Grant 2245247) *Advisor: Dr. Amin Rezaei* — Spring 2022 - May 2024

- Designing a conformal prediction-based machine learning approach for detecting evolving hardware trojans.

Dell Technologies — Bangalore, India
AI Product Owner | Machine Learning Engineer — **June 2018 - Dec 2021**

- Responsible for driving Go To Market strategies, develop the business case by analyzing customer needs, market trends, feature prioritization, and Product Road-map for AI features in Dell Power Protect Data Manager (PPDM) - self-guided recovery (US Patent. 17/667,176) and upgrade recommendations (US Patent. 17/388,847).
- Created detailed requirements based on a deep understanding of user requirements and customer usage data. Worked closely with engineering to deliver high-quality AI product feature for Dell Cloud IQ data criticality (US Patent. 17/236,044) based on the KPI and customer demand using agile development process.
- Conducted market analysis, competitive analysis for security and cloud tier products (Cloud Tier for LTR - long term retention with AWS, Azure, GCP). Direct engagement with the support, sales, marketing, advertisement to make the product more customer focused and updated with market trends.

Senior Software Engineer — **Mar 2017 - May 2018**

- Architected and developed anomaly aware log retrieval from DAE (U.S. Patent 11/513,931) and adaptive key rotation based on critical data (U.S. Patent 17/652,606) implemented in Dell Power Protect Data Domain.
- Planned, designed, and implemented Data Domain interoperability integration with Dell products and third-party vendors by creating automation libraries in Python, which significantly enhanced customer operations.
- Designed and patented an internal tool for ECS Cloud capacity planning (time-series) and disk failure detection (classification and clustering) for Data Domain install base (90,000+ systems) using telemetry data.

Hewlett Packard Enterprise — Bangalore, India
Solution Architect — **May 2015 - Mar 2017**

- Enhanced OS efficiency and scalability on HPE Converged Systems 900 by creating optimized modular images for Red Hat Enterprise Linux and SUSE Linux Enterprise Server by ensuring compatibility with hardware and optimized performance, enhancing reliability and performance of Mission Critical Solutions at HPE.
- Led certification and automated deployment of HPE Converged Systems for SAP HANA, designing a scalable backup architecture with HPE 3PAR ensuring SAP HANA operations and data protection.
- Implemented HPE 3PAR as external storage for ProLiant DL580, integrating with SAP HANA studio for efficient Backup/Recovery operations using backint with HPE Data Protector improving data management efficiency.

Tata Consultancy Services — Bangalore, India
Information Technology Analyst — **Oct 2009 - Apr 2015**

- Directed ACS development for collections at CITI Bank N.A., led a team of 6 as a COBOL developer, coordinated projects, collaborated effectively with clients, and achieved a 30% collection efficiency improvement.
- Managed the automation of regression testing for Symmetrix VMAX and EMC Celerra (VNX), implemented automation scripts resulting in reduced testing time by 40% and decreased number of bugs.
- Led QA team for Virtualized Data Protection software with IBM and Oracle databases, developed strategies, applied project management techniques, and achieved a 25% reduction in software defects.

Skills

Programming Languages	Python
Database	Oracle, SAP HANA, mongoDB
Cloud Platform	AWS, Azure, GCP
Infrastructure	HPE and Dell Servers, Microservices, Virtualization, Storage Array
Operating Systems	Linux, Solaris, z/OS
Machine Learning	Deep Learning, Statistical Learning, PyGraph, Tensorflow

Mentoring

CSULB AI Research Club 2024

Teaching

***Teaching Assistant**, Instructor: Dr. Mahshid Fardadi* Fall 2022 - Spring 2023

Graduate teaching assistant and co-instructor for Fall 2022 and Spring 2023. 50 students in graduate courses and 80-120 in undergraduate courses.

- **CECS 229 - Discrete Structures**
  Undergraduate Course, California State University Long Beach, Fall 2022
- **CECS 451 - Artificial Intelligence**
  Undergraduate Course, California State University Long Beach, Spring 2023
- **CECS 456 - Machine Learning**
  Undergraduate Course, California State University Long Beach, Fall 2022, Spring 2023
- **CECS 550 - Pattern Recognition**
  Graduate Course, California State University Long Beach, Spring 2023
- **CECS 551 - Advanced Artificial Intelligence**
  Graduate Course, California State University Long Beach, Fall 2023

Journal

[1] **Vishwakarma, Rahul**, Ravi Monani, Ava Hedayatipour, and Amin Rezaei. "**Reliable and secure memristor-based chaotic communication against eavesdroppers and untrusted foundries.**" Discover Internet of Things 3, no. 1 (2023): 2. 2023

[2] Hwang, Jinha, Gauri Kale, Persis Premkumar Patel, **Rahul Vishwakarma**, Mehrdad Aliasgari, Ava Hedayatipour, Amin Rezaei, and Hossein Sayadi. "**Machine Learning in Chaos-Based Encryption: Theory, Implementations, and Applications.**" IEEE Access 11 (2023): 125749-125767. 2023

Conferences

[1] **Vishwakarma, Rahul**, Satyanand Vishwakarma, Amitabh Banerjee, and Rohit Kumar. "**Message encoding in nucleotides.**" In Advances in Computing and Information Technology: First International Conference, ACITY 2011, Chennai, India, July 15-17, 2011. Proceedings, pp. 185-191. Springer Berlin Heidelberg 2011

[2] **Vishwakarma, Rahul**, and Newsha Amiri. "**High density data storage in DNA using an efficient message encoding scheme**." International Journal of Information Technology Convergence and Services. 2012

[3] **Vishwakarma, Rahul**, Jinha Hwang, Soundouss Messoudi, and Ava Hedayatipour. "**Enterprise Disk Drive Scrubbing Based on Mondrian Conformal Predictors.**" In Conformal and Probabilistic Prediction with Applications, pp. 56-73. PMLR 2023

[4] **Vishwakarma, Rahul**, Ravi Monani, Amin Rezaei, Hossein Sayadi, Mehrdad Aliasgari, and Ava Hedayatipour. "**Attacks on continuous chaos communication and remedies for resource limited devices.**" In 2023 24th International Symposium on Quality Electronic Design (ISQED), pp. 1-8. IEEE 2023

[5] **Vishwakarma, Rahul**, and Amin Rezaei. "**Risk-Aware and Explainable Framework for Ensuring Guaranteed Coverage in Evolving Hardware Trojan Detection.**" In 2023 IEEE/ACM International Conference on Computer Aided Design (ICCAD), pp. 01-09. IEEE (**22.9**% acceptance) 2023

[6] **Vishwakarma, Rahul**, Mahshid Fardadi, and Bing Liu. "**Variable Sparing of Disk Drives Based on Failure Analysis.**" In Conformal and Probabilistic Prediction with Applications, pp. 172-174. PMLR 2023

[7] Malawat, Rohit, Shrey Modi, and **Rahul Vishwakarma**. "**Tunable Sparing of Disks in a Cloud Data Center.**" In 2023 7th International Conference on Computer Applications in Electrical Engineering-Recent Advances (CERA), pp. 1-6. IEEE 2023

[8] Dalal, Riya, Simrat Kaur Randhawa, Shrey Modi, and **Rahul Vishwakarma**. "**Position Mapping using Content Based Image Retrieval and Annoy.**" In 2023 International Conference on Modeling, Simulation & Intelligent Computing (MoSICom), pp. 24-29. IEEE 2023

[9] **Vishwakarma, Rahul**, and Amin Rezaei. "**Uncertainty-Aware Hardware Trojan Detection Using Multimodal Deep Learning.**" arXiv preprint arXiv:2401.09479 (2024). 2024

Poster

[1] **Vishwakarma, Rahul**, Bing Liu, Peter Gatsby, and Jinha Hwang. "**Selective scrubbing based on algorithmic randomness.**" In Proceedings of the 15th ACM International Conference on Systems and Storage, pp. 141-141. (**29**% acceptance) 2022

[2] **Vishwakarma, Rahul**, Jinha Hwang, and Benyamin Ahmadnia. "**Enhancing Risk Aware Decision in Healthcare Through Probabilistic Modeling of Uncertainty.**" 29th ACM SIGKDD Conference on Knowledge Discovery and Data Mining: **SoCal Data Science Day**, https://doi.org/10.5281/zenodo.8170271. 2023

[3] Hwang, Jinha, **Rahul Vishwakarma**, Amin Rezaei, and Ava Hedayatipour. "**Enhancement of Continuous Chaos Communication Using Machine Learning in Resource-Limited Devices.**" In 2023 IEEE 16th Dallas Circuits and Systems Conference (DCAS) IEEE 2023

Talks - Storage Networking Industry Association (SNIA) Developer Conference

YouTube: https://www.youtube.com/playlist?list=PLDqvvIThxoueOJyjtLx-ldMjQihLisKNa

[1] Understanding the Reliability of Predictions Made by Machine Learning. (SNIA India) 2019
Rahul Vishwakarma, Supriya Kannery

[2] New Perspective on Machine Learning Predictions Under Uncertainty. (SNIA USA) 2019
Rahul Vishwakarma, Jayanth Reddy

[3] Rethinking Blockchain in Storage. (SNIA India) 2020
Parmeshwr Prasad, **Rahul Vishwakarma**

[4] Ranking based Dynamic Hot Sparing. (SNIA India) 2021
Hemant Gaikwad, **Rahul Vishwakarma**

[5] Transforming monolith to microservices. (SNIA India) 2021
Parmeshwr Prasad, **Rahul Vishwakarma**

[6] Smart contract for DNA based archival storage. (SNIA EMEA) 2022
Rahul Vishwakarma, Hemant Gaikwad

[7] Certainty to Enterprise disk-drive failure management with Conformal Prediction. (SNIA EMEA) 2022
Hemant Gaikwad, **Rahul Vishwakarma**

[8] Power of Chaos: Long-term Security for Post-quantum Era. (SNIA USA) 2022
Rahul Vishwakarma, Dr. Amin Rezaei, Dr. Ava Hedayatipour

[9] Effective device thermal management based on dynamic ranking of device cooling needs. (SNIA India) 2022
Hemant Gaikwad, Shelesh Chopra, **Rahul Vishwakarma**

Book

Conformal Prediction: An Inventor's Approach 2024
Independently published ISBN-13: 979-8884663619
https://www.amazon.com/dp/B0CY43HQRX

Membership

[1] IEEE Senior Member (99106509)
[2] IEEE Computer Society - Professional Member (99106509)
[3] SAS Eminent Fellow Membership, Scholars Academic and Scientific Society (SAS/SEFM/269/2024)
[4] Association for Computing Machinery (ACM) Student Member (8875839)
[5] International Society of Service Innovation Professionals (ISSIP)

Software

[1] **ConfClr**: Implemention of Conformal Classification algorithm. 2020
https://pypi.org/project/ConfClr/

[2] **PALETTE**: Risk-Aware and Explainable Framework for Ensuring Guaranteed Coverage in Evolving Hardware Trojan Detection 2023
https://github.com/cars-lab-repo/PALETTE

[3] **NOODLE**: Uncertainty-Aware Hardware Trojan Detection Using Multimodal Deep Learning 2023
https://github.com/cars-lab-repo/NOODLE

[4] **Valentine Promise**: Conformal Prediction based matchmaking. 2024
https://github.com/Valentine-Promise

[5] **Conformal Prediction for Neural Controlled Differential Equations** (NCDE) 2024
https://github.com/rahvis/ncde_cp

Awards

[1] **Recognition for Innovation**: Congratulations on the Innovation Drive at Dell Technologies 2019

[2] **Patent Filing Milestone Award FY2020** at Dell Technologies 2020

[3] **GITC Patent Mentoring**: Dell Technologies 2021

[4] **Recognition for Innovation**: Making innovation contagious by leading by example at Dell Technologies 2021

[5] **Dell Patent Award**: Long Term Incentive (LTI) cash and Restricted Stock Units (RSU). 2021 - 2022

[6] **ASI Student Travel Grant**, ($900), California State University Long Beach 2023

[7] **Student Travel Grant**: National Science Foundation (NSF) : **HOST**, San Jose, USA May 2023

[8] **DAC Young Fellows Program**: 60th Design Automation Conference, San Francisco, USA. **335** applicants. Complimentary DAC full conference registration. ($840) July 2023

[9] **ICCAD 2023 Student Scholar Program Travel Support Grant**, ($600), San Francisco, USA 2023

[10] **Outstanding Graduate Research, Scholarly, and Creative Activity** (RSCA) Award ($500) - California State University Long Beach April 2024

Conference Review

[1] Great Lakes Symposium on VLSI 2023 (GLSVLSI), Knoxville, TN, USA. Sponsored by ACM SIGDA (**27**% acceptance rate). **ACM Digital Library** (**1 Paper**) 2023

[2] 2023 International Conference on Computer-Aided Design (ICCAD), San Francisco, California, USA. (**23**% acceptance rate) **ACM Digital Library and IEEE Xplore** (**3 Papers**) 2023

[3] 24th International Symposium on Quality Electronic Design (ISQED'23), San Fransisco, California, USA. **IEEE Xplore** digital library and indexed by Scopus. (**2 Papers**) 2023

[4] ASP-DAC 2023 28th annual international conference on VLSI design automation in Asia and South Pacific regions. Miraikan (The National Museum of Emerging Science and Innovation), Tokyo, Japan. (**31**% acceptance rate) **ACM Digital Library and IEEE Xplore** (**2 Papers**) 2023

[5] 4th Congress on Intelligent Systems (CIS 2023) Organized in In-person and Online (Hybrid Mode) by CHRIST (Deemed to be University), Bengaluru and Sponsored by AICTE, New Delhi & Soft Computing Research Society, India. **Springer** (**4 Papers**) 2023

[6] 3rd International Conference on Intelligent Vision and Computing (ICIVC 2023), Organized in In-person and Online (Hybrid Mode) by National Institute of Technology Agartala and sponsored by Soft Computing Research Society Agartala, India. **Springer** (**3 Papers**) 2023

[7] Congress on Smart Computing Technologies (CSCT 2023), organized by Soft Computing Research Society and SAU Center for Research and Innovative Learning (SCRIL), New Delhi, India. **Springer book series: Smart Innovation, Systems and Technologies** (**1 Paper**) 2023

[8] 5th International Conference on Communication and Intelligent Systems (ICCIS 2023), Organized in In-person and Online (Hybrid Mode) by Malaviya National Institute of Technology Jaipur, India Technically and sponsored by Soft Computing Research Society Jaipur, India. **Springer: Lecture Notes in Networks and Systems** (**2 Papers**) 2023

[9] 2nd International Conference on Power Engineering and Intelligent Systems (PEIS 2024), Organized in In-person and Online (Hybrid Mode) by National Institute of Technology Uttarakhand, India and sponsored by Soft Computing Research Society Srinagar, India. **SCOPUS-indexed Springer book series Lecture Notes in Electrical Engineering (LNEE)** (**2 Papers**) 2024

[10] International Conference on Computing and Machine Learning (CML 2024), organized in In-person and Online (Hybrid Mode) by Department of Computer Applications, Sikkim Manipal Institute of Technology, Sikkim Manipal University, India and technically Sponsored by Soft Computing Research Society Sikkim, India. **Springer Lecture Notes in Networks and Systems** (**3 Papers**) 2024

[11] International Conference on Business Intelligence and Data Analytics (BIDA 2024), Organized by RV Institute of Management (RVIM), Bangalore, India and technically sponsored by Soft Computing Research Society, India. **Springer Book Series: Smart Innovation, Systems and Technologies** (**1 Paper**) 2024

[12] 4th International Conference on Paradigms of Communication, Computing and Data Analytics (PCCDA 2024), Organized by Pt. Lalit Mohan Sharma Campus, Rishikesh, Sri Dev Suman Uttarakhand University, Uttarakhand, India and technically sponsored by Soft Computing Research Society Rishikesh, India. **Springer Book Series: Algorithms for Intelligent Systems** (**2 Papers**) 2024

[13] 4th International Conference on Computer Vision and Robotics (CVR 2024), Organized in In-person and Online (Hybrid Mode) by Symbiosis Skills and Professional University (SSPU), Pune, India. **Springer Book Series: Algorithms for Intelligent Systems** (**4 Papers**) 2024

[14] World Congress on Smart Computing (WCSC2024), Organized by Artificial Intelligence Research Centre, Babu Banarasi Das University, Lucknow, India and technically sponsored by Soft Computing Research Society Lucknow, India. **Springer Book Series: Studies in Smart Technologies** (**4 Papers**) 2024

[15] IEEE The 4th International Conference on Electrical, Computer and Energy Technologies (ICECET2024), Sydney,

Australia. **IEEE Xplore (1 Paper)** 2024

Book Review

Manokhin,Valery. **Practical Guide to Applied Conformal Prediction in Python: Learn and Apply the Best Uncertainty Frameworks to Your Industry Applications**.
United Kingdom: Packt Publishing (ISBN: 9781805120919, 1805120913) 2023

IEEE Senior Member Application Review

Reviewed 7 applications of IEEE Members who applied for an elevation to the Senior Membership position at IEEE. 2024

AI Research Club - Founder

Founded the first **AI Research Club** at California State University Long Beach. The first among 23 campuses across California State University (CSU). 2024
https://www.csulb.edu/college-of-engineering/article/ai-research-club-launches

News Coverage

[1] SNIA Author Biography
[2] CSULB RSCA
[3] CSULB Newsletter
[4] IEEE Author Page
[5] Online Conformal Prediction page
[6] CSULB Alumni Page for VP Post.
[7] COB Newsletter
[8] iDiyas

Issued: US Patents (51)

[1] **Vishwakarma, Rahul**, and Supriya Kannery. "System and method for capacity forecasting in backup systems." U.S. Patent 10,509,586, issued December 17, 2019.

[2] **Vishwakarma, Rahul Deo**, Jayanth Kumar Reddy Perneti, and Gopal Singh. "System and method for autonomous and dynamic resource allocation in storage systems." U.S. Patent 11,018,991, issued May 25, 2021.

[3] **Vishwakarma, Rahul Deo**, and Jayanth Kumar Reddy Perneti. "Method and system for countering capacity shortages on storage systems." U.S. Patent 10,936,464, issued March 2, 2021.

[4] **Vishwakarma, Rahul Deo**, and Supriya Kannery. "Method and system for intelligently provisioning resources in storage systems." U.S. Patent 11,507,422, issued November 22, 2022.

[5] **Vishwakarma, Rahul**, Hemant Gaikwad, and Gopal Singh. "Automatically allocating device resources using machine learning techniques." U.S. Patent 11,455,577, issued September 27, 2022.

[6] **Vishwakarma, Rahul Deo**, Shelesh Chopra, and Parmeshwr Prasad. "System and method for prioritizing and preventing backup failures." U.S. Patent 11,227,222, issued January 18, 2022.

[7] **Vishwakarma, Rahul**, Shelesh Chopra, Gopal Singh, and Sujan Kumar Shetty. "Analyzing time series data for sets of devices using machine learning techniques." U.S. Patent 11,663,290, issued May 30, 2023.

[8] **Vishwakarma, Rahul Deo**, Jayanth Kumar Reddy Perneti, and Gopal Singh. "System and method for autonomous and dynamic resource allocation in storage systems." U.S. Patent 11,018,991, issued May 25, 2021.

[9] **Vishwakarma, Rahul Deo**, Shelesh Chopra, Parminder Singh Sethi, and Parmeshwr Prasad. "System and method for scheduling backup workloads using a trained job resource mapping model." U.S. Patent 11,604,701, issued March 14, 2023.

[10] **Vishwakarma, Rahul Deo**, and Jayanth Kumar Reddy Perneti. "Method and system for reliably forecasting storage disk failure." U.S. Patent 11,599,402, issued March 7, 2023.

[11] **Vishwakarma, Rahul**, Lu Chen, Jitendra Singh, and Bing Liu. "System and method for approximating replication completion time." U.S. Patent 11,593,014, issued February 28, 2023.

[12] **Vishwakarma, Rahul Deo**, and Jitendra Singh. "System and method for probabilistically forecasting health of hardware in a large-scale system." U.S. Patent 11,915,160, issued February 27, 2024.

[13] **Vishwakarma, Rahul Deo**, G. Vaideeswaran, Parmeshwr Prasad, and Hemant Ramesh Gaikwad. "Context-aware maintenance window identification." U.S. Patent 11,921,735, issued March 5, 2024.

[14] **Vishwakarma, Rahul**, Bing Liu, Parmeshwr Prasad, and Parminder Singh Sethi. "Storing digital data in storage devices using smart contract and blockchain technology." U.S. Patent 11,928,091, issued March 12, 2024.

[15] Liu, Bing, and **Rahul Vishwakarma**. "Anomaly aware log retrieval from disk array enclosures (DAEs)." U.S. Patent 11,200,132, issued December 14, 2021.

[16] Kannery, Supriya, and **Rahul Deo Vishwakarma**. "Method and system for dynamic backup policy handshak-

ing." U.S. Patent 11,029,864, issued June 8, 2021.

[17] Perneti, Jayanth Kumar Reddy, **Rahul Deo Vishwakarma**, and Kalyan C. Gunda. "System and method for efficient backup system aware direct data migration between cloud storages." U.S. Patent 11,023,332, issued June 1, 2021.

[18] Singh, Jitendra, and **Rahul Deo Vishwakarma**. "System and method for survival forecasting of disk drives using semi-parametric transfer learning." U.S. Patent 11,561,701, issued January 24, 2023.

[19] Chopra, Shelesh, Hemant Ramesh Gaikwad, and **Rahul Deo Vishwakarma**. "Method and system for determining favorability of upgrade window." U.S. Patent 11,531,592, issued December 20, 2022.

[20] Perneti, Jayanth Kumar Reddy, **Rahul Deo Vishwakarma**, and Kalyan C. Gunda. "System and method for efficient backup system aware direct data migration between cloud storages." U.S. Patent 11,520,669, issued December 6, 2022.

[21] Liu, Bing, and **Rahul Vishwakarma**. "Anomaly aware log retrieval from disk array enclosures (DAEs)." U.S. Patent 11,513,931, issued November 29, 2022.

[22] Chopra, Shelesh, Mahantesh M. Ambaljeri, **Rahul Deo Vishwakarma**, and Parmeshwr Prasad. "Method and system for risk score based asset data protection using a conformal framework." U.S. Patent 11,507,469, issued November 22, 2022.

[23] Singh, Gopal, Pooja Singh, **Rahul D. Vishwakarma**, and Shelesh Chopra. "Dual relationship-based hash structure for non-volatile memory technology." U.S. Patent 11,500,815, issued November 15, 2022.

[24] Chopra, Shelesh, Mahantesh Ambaljeri, Girish Chandra Belmanu Sadananda, Gururaj Kulkarni, and **Rahul Deo Vishwakarma**. "Method and system for intelligent proactive error log activation." U.S. Patent 11,500,712, issued November 15, 2022.

[25] Prasad, Parmeshwr, and **Rahul Deo Vishwakarma**. "Method to suggest best SCM configuration based on resource proportionality in a de-duplication based backup storage." U.S. Patent 11,500,560, issued November 15, 2022.

[26] Chopra, Shelesh, Mahantesh Ambaljeri, Girish Chandra Belmanu Sadananda, Gururaj Kulkarni, and **Rahul Deo Vishwakarma**. "Method and system for variable level of logging based on (long term steady state) system error equilibrium." U.S. Patent 11,494,250, issued November 8, 2022.

[27] Singh, Jitendra, **Rahul D. Vishwakarma**, and Shelesh Chopra. "Estimating replication completion time using machine learning techniques." U.S. Patent 11,436,396, issued September 6, 2022.

[28] Prasad, Parmeshwr, **Rahul Vishwakarma**, and Bing Liu. "Decreasing data restoration times using advanced configuration and power interface (ACPI)." U.S. Patent 11,436,104, issued September 6, 2022.

[29] Prasad, Parmeshwr, and **Rahul Deo Vishwakarma**. "Managing utilization of storage class memory (SCM) resources." U.S. Patent 11,422,702, issued August 23, 2022.

[30] Prasad, Parmeshwr, Bing Liu, and **Rahul Deo Vishwakarma**. "Accelerating backup by writing to performance ranked memory." U.S. Patent 11,403,186, issued August 2, 2022.

[31] Nelogal, Chandrashekar, **Rahul Deo Vishwakarma**, and Parmeshwr Prasad. "System and method for managing cleaning policies of storage devices in storage device pools using self-monitored statistics and input/output statistics." U.S. Patent 11,403,029, issued August 2, 2022.

[32] Chopra, Shelesh, **Rahul Deo Vishwakarma**, Sharath Talkad Srinivasan, and Parmeshwr Prasad. "Systems and methods for selecting devices for backup and restore operations for virtual machines." U.S. Patent 11,379,145, issued July 5, 2022.

[33] Chopra, Shelesh, Hemant Ramesh Gaikwad, and **Rahul Deo Vishwakarma**. "Method and system for managing updates of a data manager." U.S. Patent 11,330,078, issued May 10, 2022.

[34] Singh, Gopal, **Rahul Vishwakarma**, and Parmeshwr Prasad. "System and method for variable sparing in RAID groups based on drive failure probability." U.S. Patent 11,321,000, issued May 3, 2022.

[35] Prasad, Parmeshwr, Bing Liu, and **Rahul Deo Vishwakarma**. "Data placement method based on health scores." U.S. Patent 11,314,600, issued April 26, 2022.

[36] Perneti, Jayanth Kumar Reddy, and **Rahul Deo Vishwakarma**. "Method and system for policy class based data migration." U.S. Patent 11,243,705, issued February 8, 2022.

[37] Liu, Bing, Parmeshwr Prasad, and **Rahul Deo Vishwakarma**. "Forwarding incoming IO to SCM namespaces." U.S. Patent 11,836,095, issued December 5, 2023.

[38] Chopra, Shelesh, **Rahul Deo Vishwakarma**, Sharath Talkad Srinivasan, and Parmeshwr Prasad. "Systems and methods for selecting optimal proxy devices for backup and restore operations for virtual machines." U.S. Patent 11,782,801, issued October 10, 2023.

[39] Martin, Owen, Earl Medeiros, Parmeshwr Prasad, and **Rahul Deo Vishwakarma**. "Dynamic use of non-volatile ram as memory and storage on a storage system." U.S. Patent 11,782,634, issued October 10, 2023.

[40] Chopra, Shelesh, Mahantesh M. Ambaljeri, **Rahul Deo Vishwakarma**, Gopal Singh, and Parmeshwr Prasad.

"Method and system for health rank based virtual machine restoration using a conformal framework." U.S. Patent 11,755,433, issued September 12, 2023.

[41] Chopra, Shelesh, Sharath Talkad Srinivasan, and **Rahul Deo Vishwakarma**. "System and method for ranking data storage devices for efficient production agent deployment." U.S. Patent 11,755,421, issued September 12, 2023.

[42] Sampath, Kapil, **Rahul Deo Vishwakarma**, and Paul Hammer. "Intelligent protection of virtual machine by identifying the degree of risk at a granular level." U.S. Patent 11,709,738, issued July 25, 2023.

[43] Prasad, Parmeshwr, **Rahul Vishwakarma**, and Bing Liu. "State semantics kexec based firmware update." U.S. Patent 11,709,683, issued July 25, 2023.

[44] Chopra, Shelesh, Hemant Gaikwad, **Rahul Vishwakarma**, and Sharath Talkad Srinivasan. "Variable sparing of disk drives in storage array." U.S. Patent 11,604,611, issued March 14, 2023.

[45] Chopra, Shelesh, Hemant Gaikwad, and **Rahul Deo Vishwakarma**. "Method of creating an intelligent upgrade flow for a heterogeneous data center." U.S. Patent 11,599,352, issued March 7, 2023.

[46] Prasad, Parmeshwr, Bing Liu, and **Rahul Deo Vishwakarma**. "Configuring unused SCM memory space to support namespaces based on IO patterns." U.S. Patent 11,586,368, issued February 21, 2023.

[47] Chopra, Shelesh, Hemant Ramesh Gaikwad, and **Rahul Deo Vishwakarma**. "System and method for intelligent update flow across inter and intra update dependencies." U.S. Patent 11,561,777, issued January 24, 2023.

[48] Liu, Bing, and **Rahul Deo Vishwakarma**. "Managing storage device scrubbing." U.S. Patent 11,899,633, issued February 13, 2024.

[49] Prasad, Parmeshwr, and **Rahul Deo Vishwakarma**. "Message broker resource deletion." U.S. Patent 11,917,031, issued February 27, 2024.

[50] Chopra, Shelesh, Parminder Singh Sethi, Anannya Roy Chowdhury, and **Rahul Vishwakarma**. "Method and system for predicting user involvement requirements for upgrade failures." U.S. Patent 11,914,464, issued February 27, 2024.

[51] Chopra, Shelesh, Mahantesh Ambaljeri, Girish Chandra Belmanu Sadananda, Gururaj Kulkarni, and **Rahul Deo Vishwakarma**. "Intelligently determining when to perform enhanced logging." U.S. Patent 11,914,460, issued February 27, 2024.

Filed: US Patents (20)

[52] **Vishwakarma, Rahul Deo**, Jayanth Kumar Reddy Perneti, and Nupur Gupta. "System and method for backup failure prevention in deduplication-based storage system." U.S. Patent Application 16/231,237, filed June 25, 2020.

[53] **Vishwakarma, Rahul Deo** and Bing Liu. "System and method for persistent storage failure prediction." U.S. Patent Application 16/656,875, filed April 22, 2021.

[54] **Vishwakarma, Rahul Deo**, Hemant Gaikward, and Ashish Singh. "Systems and methods for device thermal management using dynamic ranking of device cooling needs." U.S. Patent Application 17/092,812, filed May 12, 2022.

[55] **Vishwakarma, Rahul Deo**, Bing Liu, and Parmeshwr Prasad. "Stochastic risk scoring with counterfactual analysis for storage capacity." U.S. Patent Application 17/153,294, filed July 21, 2022.

[56] **Vishwakarma, Rahul**, Bing Liu, Parmeshwr Prasad, and Parminder Singh Sethi. "Storing digital data in dna storage using blockchain and destination-side deduplication using smart contracts." U.S. Patent Application 17/155,505, filed July 28, 2022.

[57] **Vishwakarma, Rahul**, Bing Liu, Parmeshwr Prasad, and Parminder Singh Sethi. "Securely archiving digital data in dna storage as blocks in a blockchain." U.S. Patent Application 17/155,552, filed July 28, 2022.

[58] **Vishwakarma, Rahul**, Lu Chen, Jitendra Singh, and Bing Liu. "System and method for approximating replication completion time." U.S. Patent 11,593,014, issued February 28, 2023.

[59] **Vishwakarma, Rahul Deo**, Parmeshwr Prasad, and Pooja Singh. "Adaptive key rotation based on critical data in storage system." U.S. Patent Application 17/652,606, filed August 31, 2023.

[60] **Vishwakarma, Rahul Deo**, Bing Liu, and Hemant Ramesh Gaikwad. "Smart telemetry method based state transition prediction." U.S. Patent Application 17/657,800, filed June 8, 2023.

[61] Chopra, Shelesh, and **Rahul Deo Vishwakarma**. "Systems and methods for determining data criticality based on causal evaluation." U.S. Patent Application 17/236,044, filed October 27, 2022.

[62] Chopra, Shelesh, **Rahul Deo Vishwakarma**, and Sharath Talkad Srinivasan. "Predictive optimal queue length management for backup sessions using distributed proxies." U.S. Patent Application 17/198,386, filed September 15, 2022.

[63] Sethi, Parminder Singh, **Rahul Deo Vishwakarma**, and Vasanth Sathyanarayanan. "Using prediction uncertainty quantifier with machine leaning classifier to predict the survival of a storage device." U.S. Patent Application 17/141,551, filed July 7, 2022.

[64] Chopra, Shelesh, **Rahul Deo Vishwakarma**, Sharath Talkad Srinivasan, and Parmeshwr Prasad. "Systems and methods for selecting devices for backup and restore operations for virtual machines." U.S. Patent 11,379,145, issued July 5, 2022.

[65] Prasad, Parmeshwr, **Rahul Vishwakarma**, and Bing Liu. "State semantics kexec based firmware update." U.S. Patent 11,709,683, issued July 25, 2023.

[66] Chopra, Shelesh, Mahantesh Ambaljeri, Girish Chandra Belmanu Sadananda, Gururaj Kulkarni, and **Rahul Deo Vishwakarma**. "Method and system for determine system upgrade recommendations." U.S. Patent Application 17/388,847, filed December 15, 2022.

[67] Liu, Bing, and **Rahul Deo Vishwakarma**. "Stochastic risk scoring with counterfactual analysis for storage capacity." U.S. Patent Application 17/178,504, filed August 18, 2022.

[68] Vithalkar, Suraj D., **Rahul Deo Vishwakarma**, and Parmeshwr Prasad. "Smart datastore selection for protection engines based on uncertainty quantification." U.S. Patent Application 17/652,405, filed August 24, 2023.

[69] Sampath, Kapil, Veenu Gupta, and **Rahul Deo Vishwakarma**. "System and method for generation of self-guided recovery procedures and suggestions." U.S. Patent Application 17/667,176, filed August 10, 2023.

[70] Prasad, Parmeshwr, Bing Liu, and **Rahul Deo Vishwakarma**. "Based on io pattern influence nfit table for persistence for scm firmware." U.S. Patent Application 17/512,953, filed March 2, 2023.

[71] Chopra, Shelesh, Hemant Ramesh Gaikwad, and **Rahul Deo Vishwakarma**. "Efficient updates of information handling systems with localized aggregated transfer and storage of update packages." U.S. Patent Application 17/384,705, filed January 26, 2023.