PORTFOLIO

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Areas of Interest

Mathematics, Robotics, Control Theory, Computer Vision, Machine Learning

Education

- **Indian Institute of Technology Roorkee** — Uttarakhand, India
  Bachelor of Technology (B.Tech.); GPA: 85.68% — *Jul 2014 – Apr 2018*
  Major: Mechanical Engineering • Minor: Computer Science
  Relevant Coursework:
  • Advanced Robotics • Robotics and Control • Mechatronics • Automatic Control • Artificial Neural Networks
  • Mathematical Imaging Techniques (Audited) • Vibration and Noise • Kinematics and Dynamics of Machines
  • Mathematical Statistics • Data Structures • Design and Analysis of Algorithms • Computer Graphics
  • Tensors and Differential Geometry (Audited)
- **Delhi Public School, Indore** — Madhya Pradesh, India
  Mathematics and Science; GPA: 89.4% — *Jul 2012 – Mar 2014*

Experience

- **Software and Embedded Systems Engineer** — Tokyo, Japan
  JIG-SAW INC. — *Feb 2019 - Current*
  - Developed image processing algorithms for edge processing in Internet of Things
  - Designed libraries for custom JS firmware (neqto:) for IoT gateway device
  - Created internal automation tools for testing, deployment and documentation packages with CI/CD
  - Lead a team of engineers to design experiments and develop libraries for various sensors
  - Prepared technical demonstrations for novel IoT use cases and showcased them in large expos like MWC (Barcelona), IoT M2M (Tokyo), IoT World (San Jose) and AWS Summit (Tokyo)
  - Worked extensively with AWS cloud services, particularly Lambda, S3, CloudFront, and IoT Core
- **Developer (Internship)** — Tokyo, Japan
  JIG-SAW INC. — *Oct 2018 – Jan 2019*
  - Developed testing suite for a Django Rest Framework API for CI/CD
  - Developed an IoT AR application on Microsoft HoloLens and Sony SmartGlass for industrial monitoring
- **Engineering Intern, ITC Ltd.** — Guntur, India
  Project: Mechanization of De-Stemming Operation of Dried Chili — *May 2017 – July 2017*
  - Identified possible solutions for automation of the manual and tedious de-stemming operation on chili
  - Innovated technologies and mechanisms, oversaw the fabrication of prototypes and assessed them on the basis of cost, production and quality to get the best possible solution
  - Brought 7-fold decrease in the manufacturing cost with IRR of $50,000/year [recommendation]
- **Controls Engineer, Team Robocon IIT Roorkee** — IIT Roorkee
  Control and Automation Division — *Jan 2015 - Apr 2018*
  - Worked on year long projects in 25 member team to represent IIT-R in ABU Robocon 2016, '17 and '18
  - In the competition, robots compete to complete a task within a set period of time
  - Developed control systems, worked on sensor integration, designed and fabricated the robots
  - 2015-16 (Core Member)
    * Worked on navigation of different semi-automatic chassis using sensor fusion and image processing
    * Secured 5^{th} *position* in 108 Teams at national level and *Best Aesthetics Award*
  - 2016-17 (Mentor) and 2017-18 (Senior Mentor)
    * Oversaw the overall design and automation of the robots to solve the problem statement
    * 2018 - Secured 7^{th} *position* in 107 Teams at national level and *Best Innovative Award*

Projects

- **Humanoid Modelling for Walking on Vibrating Beam** — IIT Roorkee
  B.Tech. Project — 2nd best project in 32 projects in the department — *Aug 2017 – May 2018*
  - Studied human gait and analyzed vibrations generated due to human-beam interaction in sagittal plane
  - Mathematical dynamics modelling of biped robot using Lagrangian mechanics and bond graphs
  - Developed a control system to synthesize gait pattern on the basis of vibrations and verified it on a fabricated biped robotic model [presentation] [report]

- **Telescope Automation** — IIT Roorkee
  2nd Position in Engineers' Conclave, Inter-IIT Tech Meet 2018 — *Jan 2017 – Mar 2017*
  - Automated equatorial mount telescope using stepper motors, Raspberry Pi and 3-D printed parts
  - Developed an API to Interface with Stellarium to point the telescope automatically towards the object selected on the GUI [report]

- **Design of 8-DOF Manipulator on Holonomic Platform** — IIT Roorkee
  Summer Undergraduate Research Award, 2016 — *May 2016 – Dec 2016*
  - Designed, analyzed and fabricated a redundant manipulator on a three (omni-)wheel platform
  - Performed CAD modelling, structural analysis and rigid body dynamics analysis of the robot
  - Automated the robot using encoders, hall effect sensors (Maxon Motors) and optical flow sensors
  - Programmed the robot on the IEC-61131-3 programming environment on EPOS studio
  - Forward/inverse kinematics/dynamics of the robot using bond graphs
  - Simulated path planning algorithms for trajectory generation/optimization in MATLAB [report]

- **3D-Line Follower Using Image Processing** — IIT Roorkee
  Member of Team Robocon IIT Roorkee — *Jan 2016 – Feb 2016*
  - Developed a 3-wheeled robot with front wheel steering for line following over a contoured surface
  - Streamed image from an on-board camera, finding the orientation of line using edge/contour detection algorithms and passing appropriate signal to a servo motor for steering
  - Experimented with multiprocessing and GPU rendering for increasing speed

- **General Curve Tracing – Four (Omni-)Wheel Chassis** — IIT Roorkee
  Member of Team Robocon IIT Roorkee — *Oct 2015*
  - Developed an algorithm and control system to trace any mathematical curve given in explicit notation
  - Used machine learning algorithms to get an equation of the sensor mapping, by training using the data-set obtained by moving the bot on the desired path manually [report]

- **Coordinate Based Navigation – Four (Mecanum-)Wheel Chassis** — IIT Roorkee
  Member Of Team Robocon IIT Roorkee — *Sept 2015*
  - Built a navigation control algorithm for point to point traversal with or without orientation lock
  - Interfaced magnetometer, IR sensor and encoder; Kalman filter for smoothing sensor data

- **Stair Climbing Robot** — IIT Roorkee
  Member of Team Robocon IIT Roorkee — *Aug 2015*
  - Designed a small pneumatic based RC wheeled robot that could climb stairs of variable dimensions

- **Fuzzy Logic Library in C++** — IIT Roorkee
  Member of Team Robocon IIT Roorkee — *May 2015 – July 2015*
  - Developed a general fuzzy logic library in C++ for control of wheeled robots
  - Formulated a generalized automatic fuzzification rule base [github-repository]

- **Quadcopter** — IIT Roorkee
  Best Project, Models and Robotics Section; Srishti 2015 — *Feb 2015 – Mar 2015*
  - Fabricated and automated a quad-copter using BLDC motors, Arduino and IMU
  - Implemented and compared various control algorithms for stable flight

Other Projects

- **An Evolutionary Approach to a Modified Multi-Objective Job-Shop Problem** — IIT Roorkee
  Course Project, Operating Systems — *Mar 2018*
  - Researched about scheduling problems and the existing approaches to their solution
  - Compared evolutionary algorithms (GA, PSO, SA and ACO) to optimize the number of machines given a time constraint, single task jobs and identical machines in MATLAB [presentation] [report]
- **Digital Circlism (Algorithmic Art)** — IIT Roorkee
  Course Project, Computer Graphics — *Oct 2017*
  - Conceptualized a method for digital circlism, a form of digital art
  - Implemented mean-shift segmentation and euclidean distance transform [report]
- **Comparison of Regression Techniques for Short-Term Time-Series Prediction** — IIT Roorkee
  Course Project, Artificial Neural Networks — *Apr 2017*
  - Compared LSTM, SVR and ARIMA to determine the best model for short-term time-series prediction
  - Used Sklearn library for SVR and TensorFlow for LSTM [report]
- **Stereo-Imaging Using Segmentation** — IIT Roorkee
  Course Project, Mathematical Imaging Techniques — *Oct 2016*
  - Reviewed existing stereo imaging techniques and formulated a method to generate the disparity map using hierarchical segmentation and iterative cluster comparison [presentation] [report]
- **SVM Classifier for Satellite Images in C++** — IIT Roorkee
  For a competition > Top 5 — *Sept 2015*
  - Implemented an SVM classifier using LIBSVM library to classify satellite images. [presentation]

Skills

Programming Languages	C/C++, Python, JavaScript/TypeScript, Processing, C#, JAVA, Bash, LaTeX
Software	MATLAB, Mathematica, GNU Octave, Git, AWS, GCP, openCV
	Solidworks, Fusion 360, Ansys, MSC ADAMS, ABAQUS, AutoCAD, Eagle
Languages	English (RWS), Hindi (RWS), Japanese (Basic ∼*JLPT-N5*)

Leadership/Positions of Responsibility

- **Convener**
  Srishti 2018 (Annual Techno-Hobby Exhibition, IIT Roorkee) — *Jan 2018 – Mar 2018*
  - Srishti is the two day annual techno hobby exhibition of IIT-R in which all the major technical groups of the campus exhibit their past years work.
  - My team planned, organized and managed the event which had more than 500 exhibitors and 73 projects
- **Secretary**
  Tinkering Lab, IIT Roorkee — *Aug 2017 – Apr 2018*
  - Tinkering Lab is the state-of-the-art rapid prototyping lab of IIT-R that was established to encourage the spirit of innovation, invention and entrepreneurship among students
  - As the first student secretary of the lab, took responsibility to promote its usage among students and professors, and making the access to the lab easy for all students by digitally reforming the lab procedures
- **Models and Robotics Section (MaRS)** — IIT Roorkee
  Joint Secretary — *Apr 2016 – Apr 2017*
  Project Mentor — *Aug 2015 – Apr 2016*
  - MaRS is the official robotics club of IIT-R which provides a platform for students to pursue their interest in a variety of projects which may be just for fun, or towards solving a real-life problem
  - Conducted and spoke in open lectures on robotics for all student of the campus
  - Guided more than 100 students from all academic years and branches, for projects like Waste Segregation Robot, Robotic Band, Humanoid, Robotics Fish, Automatic Aiming System; most of which were exhibited in Srishti 2016 and 2017 [github]

- **Member**
  Students' Technical Council (STC), IIT Roorkee — *Aug 2017 – Apr 2018*
  Institute Technical Council (ITC), IIT Roorkee — *Jan 2017 – Apr 2017*
  - STC (prev. ITC) is the technical decision-making body of IIT-R, composed of students, professors and deans which oversees the workings of all technical groups, organizes competitions, promotes technical activities and projects, and effectuates technical changes in the campus
- **Co-ordinator**
  Cognizance 2016 (Annual Technology Festival, IIT Roorkee) — *Mar 2016*
  - Organized a centre-stage unmanned ground vehicles competition – 'Cyborg Break-In'
  - Participation of over 500 students from colleges all across India

Academic Achievements (Awards/Honors)

- **Trust Scholarship - Dean of Resources and Alumni Affairs**
  For overall performance during B.Tech. — *2019*
- **Annual Excellence Award — IIT Roorkee Heritage Foundation**
  For outstanding curricular, co-curricular and extra-curricular achievements — *2017*
- **Summer Undergraduate Research Award**
  Sponsored Research And Industrial Collaboration (SRIC), IIT Roorkee — *2016*
- **Certificate of Merit in Mathematics — Top 0.1%; Marks:100/100**
  AISSCE, Central Board Of Secondary Education, India — *2014*
- **JEE Advanced**
  National Rank: 1331 in 150,000 selected candidates from 1.5 million students — *2014*

Additional Experience (Workshops/Competitions/Summer-Schools/Co-Curricular)

- **SRISTI-UNICEF Summer School on Inclusive Innovations** — Gandhinagar, India
  Project: An Ergonomic and Efficient Chula — *May 2018 - Jun 2018*
  - Engaged in the analyzing the problem with the traditional wood-based 'chula' (stoves used in rural India)
  - Innovated solutions to counter the problems like unavailability of wood and associated health hazards by increasing the efficiency of the chula and redesigning to make an ergonomic chula
  - The developed chula could be readily adapted by all existing users, fabricated only using easily available natural materials, making it a no-cost easy solution that increases the efficiency about 40%

  [presentation] [report]
- **6th Inter-IIT Tech Meet** — IIT Madras
  2nd Position in Engineers' Conclave — *Jan 2018*
  - Mentored (Telescope Automation Project), one of the four projects selected to represent IIT Roorkee
- **5th Inter-IIT Tech Meet** — IIT Kanpur
  Represented IIT Roorkee in Indoor Localization Competition — *March 2017*
  - Designed a wheeled robot to locate a WiFi beacon based on the received signal strength [picture]
- **Industrial Automation Workshop** — Gurgaon, India
  Delta Electronics — *Feb 2017*
  - Week long industrial automation workshop organized by Delta Electronics
  - Taught with hands-on experience on programming industrial standard PLC, motors and drives
  - Researched and conceptualized 'warehouse automation and monitoring' solutions [proposal]
- **Techfest 2016 – 17** — IIT Bombay
  Ranked in the Top 5 Teams in Resemblance – A Satellite Image Classification Competition — *Dec 2016*
  - Implemented a SVM based classifier using LIBSVM in C to classify satellite images [report]
- **Short Term Course** — IIT Roorkee
  Modelling and Control of Robots — *July 2016*

- **Code.Fun.Do** IIT Roorkee
  Hackathon, Microsoft *Oct 2015, Mar 2016 and Mar 2018*
  - 2015 - C# and XML app to detect material of an object using the sound generated on its vibration
  - 2016 - Android app implementing a CNN classifier for crop disease detection using leaf images
  - 2018 - A web app that shares the victim's id and medical data to nearest hospital in case of emergency
- **Robosapiens** IIT Roorkee
  Cognizance 2015 (Annual Technology Festival, IIT Roorkee) *Mar 2015*
  - Won 2nd position in over 50 teams from colleges all across the country
  - Fabricated two small wheeled robots, automatic (line following) and manual robot with a pneumatic gripper capable of picking and throwing small sized wooden blocks at small distances (5m-6m)

Other Experience

- **Teaching Assistant** IIT Roorkee
  Engineering Drawing *Jan 2018 – Apr 2018*
  Programming And Data Structures *Oct 2017 – Nov 2017*
  - Guided a class of 100 freshmen to understand the basics and important concepts of the subjects
  - Took lectures and discussed difficult topics after class hours
- **Senior Mentor** IIT Roorkee
  Student Mentorship Program *Sept 2016 – Apr 2018*
  - One of the few students selected to mentor freshmen to make their transition into campus life easier and enable them to make better decisions to face the challenges of academic or non-academic nature

Extra-Curricular

- **Member, National Sports Organization (NSO)** IIT Roorkee
  Among 200 students selected to be a member of NSO (Proficiency: Table Tennis) *Aug 2014 – Apr 2015*
- **2nd Position, Intra-College Table Tennis Competition, 2016 and 2018** IIT Roorkee
- **Marathon** IIT Roorkee
  Sangram 2017 (Annual Sports Festival, IIT Roorkee) *2017*
- **Football** Delhi Public School, Indore
  School Team *2011 – 2012*
- **Table Tennis** Ujjain, India
  Division Level, (Under 17) *2011*
- **Chess** Mandsaur, India
  District Level, (Under 17) *2011*

Hobbies

• Photography • Guitar • Soccer • Swimming • Automation • Puzzles • Hiking

References

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