

AVI SINGH

Third Year Undergraduate, IIT-Kanpur

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RESEARCH INTERESTS

Computer Vision, Machine Learning for Artificial Intelligence, AI for Robotics

EDUCATION

Indian Institute of Technology Kanpur 2012-Present	Bachelor of Technology (expected July 2016) Major: Electrical Engineering • Minor: Computer Science(Artificial Intelligence) GPA: 9.4/10 (after five semesters)
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DAV Public School, Kota 2010-2012	CBSE Class XII Subjects: Maths, Physics, Chemistry, English Percentage: 86%
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IRA International School 2005-2010	CBSE Class X Subjects: Science, Maths, English, Social Science GPA: 10/10
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SCHOLASTIC ACHIEVEMENTS AND AWARDS

2014	Awarded an A* grade , for exceptional performance in Undergraduate Project - 1
2012-2013	Academic Excellence Award , IIT Kanpur (Awarded to 60 students out of 840).
MAY 2012	Secured All India rank 387 in Joint Entrance Exam (JEE) out of 500K candidates
JAN 2012	Top 1% in National Physics Olympiad

RESEARCH EXPERIENCE

High Altitude Monocular Visual Odometry for Fixed Wing Aircrafts COMPUTER VISION LAB, IIT KANPUR, under Prof.KS Venkatesh	ONGOING SINCE JANUARY 2015
<ul style="list-style-type: none">It is planned that video captured from a single camera attached to an aircraft will be used for attitude estimation, to either serve as a redundant system, or to provide additional data to the pilot.A probabilistic approach for detection of probable landing sites is also planned.	

Stereo Visual Odometry for Ground Vehicles COMPUTER VISION LAB, IIT KANPUR, under Prof.KS Venkatesh	ONGOING SINCE AUGUST 2014
Two approaches were implemented and evaluated on KITTI odometry benchmark:	
<ol style="list-style-type: none">Jiang2014: Model Based ICP: 3D points triangulated from stereo data, inliers detected via the use Iterative Closest Point Algorithm that uses a 1-DOF motion model for initial estimate. Efficient PnP Algorithm is then used on the selected inliers to obtain the final rotation and translation.Howard2008: Inlier detection using an assumption of scene rigidity. Problem reduced to finding the maximum clique in a graph, solved using a heuristic. Levenberg-Marquardt used for minimizing the reprojection error on the selected inliers.	
Work is ongoing to improve the accuracy and speed of computation of the above existing methods.	

Estimation of Range Flow from RGBD data COMPUTER VISION LAB, IIT KANPUR, under Prof.KS Venkatesh	MAY 2014 - JULY 2014
<ul style="list-style-type: none">Designed and implemented two approaches for estimation of Range Flow from RGB-D data, one using 'Total Least Squares Solution', the other utilizing 'Global Minimum Energy Solution'.A third approach, Physical RGBD Flow, attempting to capture the physical flow (instead of apparent flow) was also implemented.The Physical RGBD Flow approach was evaluated against data generated using a highly accurate 6-DOF tracking device, the Personal Space Tracker (PST-110).Captured RGBD Data from a Microsoft Kinect using OpenNI and OpenCV libraries, and did all the processing using C/C++.	

SELECTED PROJECTS

DAAiT - Dental Automated Analysis Tool (Computer Vision for intraoral cameras) MIT REDX CAMP, under Dr.Hyunsung Park, Postdoc at Camera Culture, MIT Media Lab	JANUARY 2015
We developed Computer Vision algorithms for diagnosis of dental diseased from images obtained from an intraoral camera. My contribution in the eight-member team was primarily in the following areas:	
<ul style="list-style-type: none">Stitching Images: Used Affine SIFT to overcome the difficulties in feature matching due to changes in perspective, and then computed Homography with RANSAC to stitch the images.Segmenting Every tooth: Marker-controlled watershed transform was used to segment every tooth from the image. Both semi-automated and automated approaches were implemented and compared.	

UNDER MR. ARJUN BHASIN, RESEARCH ASSOCIATE AT MECHATRONICS LAB, IIT-KANPUR

- Geometric Triangulation was used to determine the pose (modelled as a set of random variables with Gaussian Distribution) of a robot, from information obtained from noisy landmarks.
- A Microsoft **Kinect** was used to identify the landmarks (using color histogram based models), **CAMshift** algorithm was used to track these landmarks, and bearing measurements were calculated using the depth data.
- An error model for the data obtained from a Kinect was used along with the Error Propagation Law to arrive at the uncertainty in the final pose computed using the Geometric Localisation Algorithm.

Hilbert Transform on FPGA/Verilog

MARCH 2014

For Techkriti 2014

[Github]

- Implemented a 32-point Discrete Hilbert Transform in **Verilog**, making use of the **Fast Fourier Transform** in the intermediate stages.
- Won **2nd position** in FPGA Design, Techkriti 2014.

Kaggle	Titanic: Learning from Disaster Classifying MNIST digits	Used Random forest to achieve an accuracy of 72% (for the prediction of survival). Used random forest with 100 estimators to achieve an accuracy of 96.6%.
Hardware Hacks @ Electronics Club	Cashless Campus: SNAKE64: Laser Tag:	Developed an arduino-based point-of-sale device, with biometric (fingerprint) authentication . An Arduino Mega was interfaced with an ethernet shield (with Wiznet51000 chip for UDC/TCP stacks), an LCD, a touchscreen, a thermal printer, and an SD card via SPI and UART . [Github] Implemented the classic 'Snakes' game on a self-fabricated LED matrix of size 8x8, and wrote an original C code for ATmega8 to drive the matrix. An infrared-based gun was implemented using IR leds and 38KHz modulated wave was generated on an ATmega32. The receiving unit employed a TSOP to detect bursts of infrared sent from the gun.

RELEVANT COURSES COMPLETED AND ONGOING(*)

Mathematics	Electrical Enginering and Computer Science	Other
Probability and Statistics	Machine Learning for Computer Vision*	Engineering Graphics
Linear Algebra	Digital Signal Processing*	Applied Game Theory
Multivariate Calculus	Data Structures and Algorithms	Intro to Psychology
Ordinary/Partial Differential Equations	Communication/Information Theory*	Art of Video Making

TECHNICAL SKILLS

Programming Languages	C, C++, MATLAB, Python	Microcontrollers	Atmel ATmega, dsPIC, Arduino
Software Packages	OpenCV, ROS, Point Cloud Library (PCL)	Imaging Systems	Microsoft Kinect, PST-110
Operating Systems	GNU/Linux (Ubuntu), Microsoft Windows	Other Hardware	Raspberry Pi, Beagleboard,
Other	Git, L^AT_EX		Servos, IMUs

POSITIONS OF RESPONSIBILITY

Electronics Club Coordinator, Science and Technology Council

2014- Present

- Floated, mentored and ensured the completion of **nine summer projects** including a **3D Laser Scanner**, **A Video Surveillance Robot**, Conway's Game of Life simulation using FPGAs, Fast Fourier Transform on FPGA, An accelerometer based fitness and sleep tracker with accompanying Android App, a Surveillance system with **face recognition**, and a Laser Tag system.
- Leading a team of **16 secretaries** and handling a budget of **Rs.76,000** to organize lectures, workshops, competitions, and another **Rs.4,74,000** for funding projects and for participation in external events.
- Lectures attended by 400+ people, workshops attended by 200+ people, and participation of 100+ people in Takneek (intra-IIT Kanpur technical festival) Electronics competitions.

Coordinator, ECDC, Techkriti 2014

2013 - 2014

Designed and verified the problem statement for the event Electromania. Prepared sample codes and tutorials for the participants.

Secretary, Electronics Club

2013 - 2014

Assisted in organisation of lectures, workshops, tutorials, and maintenance of club.

Student Guide, Counselling Service

2013 - Present

Assisted in the organisation of various counselling service activities such as the Orientation Program and helped a group of six freshers in settling in the new college environment.