

AVI SINGH

Third Year Undergraduate, IIT-Kanpur

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RESEARCH INTERESTS

Computer Vision, Machine Learning, 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 six semesters)
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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

INTERNSHIP

Brain4Cars - Anticipating Maneuvers via Learning Temporal Driving Models under Prof. Ashutosh Saxena, Robot Learning Lab, Department of Computer Science, Cornell University Brain4Cars takes input from driver-facing and road-facing cameras, and predicts what maneuvers the driver is going to perform in the next few seconds. My contribution to the project was in the following areas: <ul style="list-style-type: none">• Incorporated a Constrained Local Neural Field model for improved head pose tracking of the driver.• Implemented Gaussian Mixture Model-based initialization, and LBFGS optimization for training Autoregressive Input Output Hidden Markov Models.• The above changes improved the performance of the anticipation system from a Precision/Recall of 77.4/71.2 to 86.7/78.2.	MAY 2015 - JULY 2015 Project Website
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RESEARCH EXPERIENCE

Visual Odometry for Ground Vehicles under Prof. KS Venkatesh, Computer Vision Lab, Department of Electrical Engineering, IIT-Kanpur Two stereo approaches were implemented and evaluated on KITTI odometry benchmark: <ul 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. Implementation available on Github. A monocular visual odometry approach was also implemented: <ul style="list-style-type: none">• Utilizes Nister's five point algorithm for essential matrix computation. Implementation available on Github.	AUG 2014 - DEC 2014
Estimation of Range Flow from RGBD data under Prof. KS Venkatesh, Computer Vision Lab, Department of Electrical Engineering, IIT-Kanpur <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++.	MAY 2014 - JULY 2014

SELECTED PROJECTS

Hidden CRFs for Human Activity Classification from RGB-D sequences FOR CS679, UNDER PROF. VINAY NAMBOODIRI, DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING, IIT-KANPUR <ul style="list-style-type: none">• Hidden Conditional Random Fields were used for human activity classification from RGBD sequences.• Pose features were extracted from a skeleton detection pipeline• A novel normalization operation was developed for reducing the effect of variance in body sizes of different subjects• An accuracy of 71% was achieved on a reduced version of MSR Daily Activity 3D Dataset (6-class classification)	APRIL 2015
Hilbert Transform on FPGA/Verilog For Techkriti 2014 <ul style="list-style-type: none">• 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.	MARCH 2014 [Github]

UNDER MR. ARJUN BHASIN, PROJECT ENGINEER 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.

DAAnt - Dental Automated Analysis Tool (Computer Vision for intraoral cameras)

JANUARY 2015

MIT REDX CAMP, under Dr. Hyunsung Park, Postdoc at Camera Culture, MIT Media Lab

We developed Computer Vision algorithms for diagnosis of dental diseases from images obtained from an intraoral camera. My contribution in the eight-member team was primarily in the following areas:

- 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.

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: 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 UDP/TCP stacks), an LCD, a touchscreen, a thermal printer, and an SD card via **SPI and UART**. [\[Github\]](#)

SNAKE64: 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.

Laser Tag: 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 Engineering 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, \LaTeX		Servos, IMUs

POSITIONS OF RESPONSIBILITY

Electronics Club Coordinator, Science and Technology Council

2014-2015

- 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.