AVI SINGH

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RESEARCH INTEREST

Computer Vision, with a special interest in Robot Vision and working with RGB-D data. Related areas of interest include **Machine Learning** (convolutional neural networks, gaussian process), **Probabilistic Robotics** (localisation, mapping, vSLAM) and **Mathematical Optimization** .

EDUCATION

Indian Institute of Technology, Kanpur *2012-2016(expected)*
Degree: Bachelor Of Technology (B.Tech)
Major: **Electrical Engineering** • Minor: **Computer Science (Artificial Intelligence)**
Cumulative Performance Index(CPI): **9.3/10** (at the end of fourth semester)

DAV Public School, Kota *2010-2012*
CBSE XIIth Grade Cumulative Percentage: 86%

Ira International School, Nagpur *2006-2010*
CBSE Xth Cumulative Grade Point Average: **10/10**

SCHOLASTIC ACHIEVEMENTS

- **Academic Excellence Award 2012-13**, given to **top 7%** students out of a batch of 840.
- All India Rank(AIR) **387** in IIT-JEE 2012 (out of **0.52m** applicants)
- All India Rank(AIR) **345** in AIEEE-2012(out of **1.2m** applicants)
- Top 1% in National Physics Olympiad 2011-2012 (among 40, 000 students).

RESEARCH EXPERIENCE

Visual Odometry Ongoing since August 2014
Under Prof.KS Venkatesh, Department of Electrical Engineering *UG Project-1, IIT Kanpur*

- Performing a literature survey of various stereo and monocular approaches of Visual Odometry.
- A multi-modal approach is planned, with methods involving feature tracking, and also a geometrical analysis of the tracks left by a vehicle in a sandy/muddy terrain.

Extension of Optical Flow to 3D (Range Flow) using RGBD (Kinect) Data May 2014 - July 2014
Under Prof.KS Venkatesh, Department of Electrical Engineering *Computer Vision Lab, IIT Kanpur*

- 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

Vision-Based Robotic Localisation December 2013
Funded by Dean of Resources and Alumni, IIT-Kanpur *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 FPGA, ECDC, Techkriti '14(National level tech festival) *IIT Kanpur*

- Implemented a 32-point discrete Hilbert Transform in **Verilog**, using FFT and IFFT as intermediate stages in the overall computation.
- Secured **2nd position in FPGA, Techkriti 2014(National level tech festival)**.

Cashless Campus (POS Device/Service) May 2013 - July 2013
Under Electronics Club *IIT Kanpur*

- Developed an **arduino-based** point-of-sale device, with **biometeric (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**.

Snake 64 (Game Console) March 2013
For Electromania, ECDC, Techkriti '13 (National level tech festival) *IIT Kanpur*

- Implemented the classic "Snakes" game on a LED Matrix with various levels on it by writing an original code for **ATmega8** in **C**.

TECHNICAL SKILLS

Programming Languages	**C, C++,** Python, CUDA (for GPGPUs)
Microcontrollers	Atmel ATmega, dsPIC, Arduino
Imaging Systems	Microsoft Kinect, PST-110
Image Processing Tools	**OpenCV**, Point Cloud Library (PCL)
Other Software Tools	**ROS**, MATLAB/GNU Octave, LaTeX
Other Hardware	Raspberry Pi, Beagleboard, Servos, IMUs
Operating Systems	UNIX/Linux (Ubuntu), Microsoft Windows

COURSES DONE/ ONGOING* / NEXT SEMESTER**

Mathematics •Probability and Statistics•Linear Algebra•Applied Game Theory•Real Analysis •Multi-variate Calculus •Ordinary/Partial Differential Equations •Complex Analysis
Computer Science •Introduction to Programming •Data Structures and Algorithms •Introduction to Artificial Intelligence**
Electrical Engineering •Introduction To Electronics •Signals, Systems, and Networks • Digital Electronics*• Digital Signal Processing**•Principles of Communication* •Control Systems Analysis •Analog Circuit Design •Electromagnetic Theory •Controls Systems Lab •Electronics Circuits Lab

POSITIONS OF RESPONSIBILITY

Electronics Club Coordinator March 2014 - Present
Core Team, Science and Technology Council *IIT Kanpur*

- 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.

Student Guide April 2013 - Present
Counselling Service *IIT Kanpur*

- 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.