

► Dr. Avinash Kumar Singh

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Other Links: [Google Scholar](#), [LinkedIn](#), [YouTube](#),

Education

Ph.D. (2016)

Indian Institute of Information Technology, Allahabad, India

- Specialization in Human Robot Interaction
- Course Work: Soft Computing, Image Processing, Machine Learning, Robotics and Industrial Automation, Research Methodology
- Obtained 9.0 CGPI

M.Tech. (2011)

K.I.I.T University, Bhubaneswar, Odisha, India

- Specialization in Information Security
- Obtained 8.91 CGPI

MSc. (2009)

Kumaun University Nanital, Uttarakhand, India

- Specialization in Information Technology
- Obtained 76%

BSc. (2007)

Kumaun University Nanital, Uttarakhand, India

- Specialization in Mathematics, Chemistry, Information Technology
- Obtained 65%

Experience

Intain Technology Pvt. Ltd. (January 2018 – Cont.)

Designation: Lead Consultant (Artificial Intelligence)

Projects Executed: Intelligent Character Recognition, Credit Risk Assessment, Invoice Management, Information Processing.

Umeå University, Sweden (February 2018 – January 2020)

Designation: Post-Doctoral Researcher

Project Title: Autonomous Systems' Ability to Understand Their Own Limitations

HCL (February 2017 – January 2018)

Designation: Deputy Manager

Projects Executed: Optical Character Recognition, KYC- A machine learning approach, Information Extraction, Document Classification.

eClerx Services Limited (November, 2015 – February 2017)

Designation: Associate Process Manager

Projects Executed: Optical Character Recognition, Email Classification, Information Extraction, Document Colouring, Anaphora Resolution.

PH.D (November, 2011 –November, 2015)

Designation: Research Scholar at Indian Institute of Information Technology, Allahabad

Projects Executed: Designed and developed algorithms for Human-Robot Interaction, Face Recognition, Anti Face Spoofing, Robot Drawing.

Technical Skills

- Deep Learning (Convolution Neural Network, Recurrent Neural Network, Long Short Term Memory (LSTM), Reinforcement Learning, Transfer Learning)
- Machine Learning (Bayes Classifier, Artificial Neural Network, Convolutional Neural Network, Support Vector Machine, Logistic Regression, Linear Regression, Clustering, Linear Discriminant Analysis, Principal Component Analysis, Hidden Markov Model)
- Computer Vision (Stereovision, Object Detection, Face Recognition, Scale Invariant Feature Transform, Optical Character Recognition)
- Image Processing (Segmentation, Edge Detection, Denoising, Morphological Processing, Image Enhancement)
- Natural Language Processing (Named Entity Recognition, Part of Speech Taggers, Anaphora Resolution, Email Classification, TF-IDF, N-gram Language Modelling)
- Robotics (Manipulator Design, Inverse Kinematics, NAO Humanoid Robot, Robot Sketch Drawing, Human Robot Interaction)

Tools Used

- Machine Learning (Python/MATLAB/TensorFlow)
- Computer Vision (OpenCV/MATLAB/VC++)
- Image Processing (Python/OpenCV/MATLAB/VC++)
- Natural Language Processing (NLTK, SCIKIT, Numpy, Pandas)
- Robotics (Webots/Choregraphe/ MATLAB/Hardware Interfacing)

Academic Projects

- Understandable systems.

Abstract: In order to make understandable robots it is required that they understand natural language and relate it with visual perception. In order to make the system fault tolerance, we have

added the context specific response generation which resolves conflict between human and robot. We have also implemented natural language generation for multi-agent systems (robots) to make them explainable.

Techniques: convolutional neural networks, fuzzy inference system, cooperating distributed grammar system, recurrent neural network.

Publications:

[1] Singh A.K., Baranwal N., Richter K.F. (2020) An Empirical Review of Calibration Techniques for the Pepper Humanoid Robot's RGB and Depth Camera. In: Bi Y., Bhatia R., Kapoor S. (eds) Intelligent Systems and Applications. IntelliSys 2019. Advances in Intelligent Systems and Computing, vol 1038.

[2] Baranwal, N., Singh, A. K., & Bench, S. (2019). Extracting Primary Objects and Spatial Relations from Sentences. In 11th International Conference on Agents and Artificial Intelligence, Prague, Czech Republic, 19-21 February 2019.

[3] Singh, A. K., & Richter, K. F. Conflict Detection and Resolution in Table Top Scenarios for Human-Robot Interaction. In 32nd Swedish AI society workshop

[4] Singh, A.K., Baranwal, N., Richter, K.F., Hellström, T., Bensch, S.: Understandable collaborating robot teams. In: International Conference on Robotics and Automation (ICRA) - SUBMITTED - (2020)

[5] Singh, A.K., Baranwal, N., Richter, K.F., Hellström, T., Bensch, S.: Verbal Explanations of Robot Teams. In: The Eleventh International Conference on Social Robotics (ICSR)

[6] Singh, A.K., Baranwal, N., Richter, K.F.: A Fuzzy Inference System for a Visually Grounded Robot State of Mind. In: 24th European Conference on Artificial Intelligence (ECAI) - ACCEPTED - (2020)

► Visual perception-based criminal identification.

Abstract: The visual perception of eyewitness plays a vital role in criminal identification scenario. It helps law enforcement authorities in searching particular criminal from their previous record. We have proposed a query-based approach which minimizes the computational cost along with the reduction of search space.

Techniques: Knowledge Acquisition and Representation, Rough Set Theory, Decision Tree Classifier.

Publications:

[1] Singh, A. K., & Nandi, G. C. (2017). Visual perception-based criminal identification: a query-based approach. Journal of Experimental & Theoretical Artificial Intelligence, 29(1), 175-196.

[2] Singh, A. K., Baranwal, N., & Nandi, G. C. (2019). A rough set based reasoning approach for criminal identification. International Journal of Machine Learning and Cybernetics, 10(3), 413-431.

► NAO humanoid robot sketch drawing.

Abstract: The proposed approach addresses the fundamental issue of defining a relationship between the NAO humanoid image plane (camera plane) and its end effector position (hand). This relationship enables NAO to perceive points of image plane with respect to its body coordinate system.

Techniques: Artificial Neural Network based regression analysis, Gradient Descent, Numerical Analysis, Computer Vision-Connected Component Labeling, Edge Detection, Inverse Kinematics, Forward Kinematic, Robotics.

Publications:

- [1] Singh, A. K., & Nandi, G. C. (2016). NAO humanoid robot: Analysis of calibration techniques for robot sketch drawing. *Robotics and Autonomous Systems*, 79, 108-121.
- [2] Singh, A. K., Chakraborty, P., & Nandi, G. C. (2015, November). Sketch drawing by NAO humanoid robot. In *TENCON 2015-2015 IEEE Region 10 Conference* (pp. 1-6). IEEE.
- [3] Singh, A. K., Baranwal, N., & Nandi, G. C. (2017). Development of a self reliant humanoid robot for sketch drawing. *Multimedia Tools and Applications*, 76(18), 18847-18870.

► **Face Recognition.**

Abstract: Face recognition has various open challenges such as change in facial expression, variable light condition, occlusion, orientation and time complexity. We have proposed facial symmetry and macro component based face recognition techniques to handle some of these uncertainties.

Techniques: Principal Component Analysis, Linear Discriminant Analysis, Artificial Neural Network.

Publications:

- [1] Singh, A. K., & Nandi, G. C. (2012, October). Face recognition using facial symmetry. In *Proceedings of the Second International Conference on Computational Science, Engineering and Information Technology* (pp. 550-554). ACM.
- [2] Singh, A. K., Kumar, A., Nandi, G. C., & Chakraborty, P. (2014, July). Expression invariant fragmented face recognition. In *2014 International Conference on Signal Propagation and Computer Technology (ICSPCT 2014)* (pp. 184-189). IEEE.

► **Anti-Face Spoofing.**

Abstract: Face spoofing is an attack where attacker tries to impersonate the identity of the legitimate user by showing his/her photograph/video/mask in front of the camera. We have proposed face texture, facial movements and face depth perception based analysis techniques to detect the liveness of the person.

Techniques: Face detection, Haar classifier for object detection, Local Binary Pattern, Linear Classifier, Stereovision, Point Cloud, 3D Face Visualization, Fuzzy Inference System, C-Means.

Publications:

- [1] Singh, A. K., Joshi, P., & Nandi, G. C. (2014, July). Face recognition with liveness detection using eye and mouth movement. In *2014 International Conference on Signal Propagation and Computer Technology (ICSPCT 2014)* (pp. 592-597). IEEE.
- [2] Singh, A. K., Joshi, P., & Nandi, G. C. (2014). Face liveness detection through face structure analysis. *International Journal of Applied Pattern Recognition*, 1(4), 338-360.
- [3] Singh, Avinash Kumar, Piyush Joshi, and G. C. Nandi. "Development of a Fuzzy Expert System based Liveliness Detection for Biometric Authentication." *Elsevier science and technology* (2013), Vol. 4, pp. 96-103.

► **Possibility Theory based Gesture Recognition.**

Abstract: Hidden Markov Model and Possibility theory were applied to model the gesture problem. We have conducted experiment on our in house Indian Sign Language gesture dataset. There are two modes of the experiment one is in the controlled environment where illumination and background is constant while in the second experiment we used the outdoor environment.

Techniques: Background Subtraction, Mixture of Gaussian, Histogram of Gradient (HoG), Convex Hull, Hidden Markov Model, Possibility Theory.

Publications:

[1] Baranwal, N., Singh, A. K., & Nandi, G. C. (2017). Development of a Framework for Human–Robot interactions with Indian Sign Language Using Possibility Theory. *International Journal of Social Robotics*, 9(4), 563-574.

[2] Baranwal, N., Nandi, G. C., & Singh, A. K. (2017). Real-Time Gesture–Based Communication Using Possibility Theory–Based Hidden Markov Model. *Computational Intelligence*, 33(4), 843-862.

Industry Projects

► Email Classification

Abstract: A classification system requires two things, features which can represent the sample uniquely and classifier who will classify these feature to their respective class. We have used bag of words model, nGram, and TF-IDF to define the features while Linear, Naïve Bayes, Support Vector Machines are used to classify these emails to one of the defined classes. Since email signatures, Images etc. are not required in email classification. A separate module is written for email cleansing.

Techniques: TD-IDF, Bayes (Multinomial, Unigram), Linear Classifier, SVM.

Platform: Python, Scikit, Numpy, Beautifulsoup, NLTK, SQL

► Email Content Extraction

Abstract: The system is designed to extract particular values from the email. There are three parameters such as field type, background, context are needs to be configured in order to extract the particular field values. In order to define the field type, we have used Stanford and NLTK named entity recognition. Field types helps us to localize the organization, person name, location etc. in the sentence. Context is used to find the relevant value, if a field have multiple instance of the same field type. For example there are two organization in the same sentence, context guides us to pick up the right one. Background is a check, if a field can have only certain allowed values, it can be used to check whatever the value retrieved by the system is correct or not.

Techniques: POS Taggers, Named Entity Extraction, Data Mining

Platform: Python, NLTK, Stanford NER, SQL

► A KYC Verification System

Abstract: The designed system checks for the negative news about the given entity(person/organization) in the given document. In a document, there are only few sentences which belongs to the given entity. Hence, here the challenge is to find the relevant sentences for the given entity. We have created a Anaphora Resolution framework to construct the relative sentence set and later the sentiment analysis if performed to find out the sentiment about the

entity. We have utilized the named entity recognition and POS taggers to establish the linking between the relative sentences while TextBlob library is used to estimate the sentiment.

Techniques: POS Taggers, Named Entity Extraction, Data Mining

Platform: Python, NLTK, Stanford NER

► **Relative Page Extractor:** An approach for document colouring

Abstract: Relative page extractor used to extract the relevant pages from the document. The problem is defined such as: we have a magazine who have different sections such as politics, bollywood, cricket and finance. We have to extract only those pages where cricket news lies. A training module is created which requires the training samples (the document) and the page number where the particular section lies. The system utilizes the Natural Language Processing and Machine Learning to identify particular features of the page. Later these features are utilized to find the match with the other pages of the document. Based on the matching an score is calculated which defines the colour score of that page. We have defined a criterion function to estimate the relative pages.

Techniques: POS Taggers, Named Entity Extraction, Data Mining

Platform: Python, NLTK, Stanford NER

Academic Achievements & Memberships

- Certified Professional Hacker by Techdefence.
- Got First rank in MSc (IT) at University level.
- Got 2nd position in M.Tech (Information Security) at University level.
- IEEE Professional Student Member.
- Official Mentor of IEEE in IIIT-Allahabad student chapter from June 2013.
- Chair of IEEE in IIIT- Allahabad student chapter from June 2014.
- Program Committee member of "Second International Conference of Networks and Communications (NC 2014)", Sydney, Australia.
- Technical Program Committee member of "International Conference on Signal Propagation and Computer Technology", organized by Government Engineering College Ajmer and Technically Sponsored by IEEE Delhi Section.
- Organizing committee member of "SERB sponsored 1st summer school on robotics", organized by IIIT Allahabad.

Workshop and Certification Course Attended

- Attended Microsoft Summer School on “**Distributed Algorithms, Systems, and Programming**” organized by Microsoft Research India, held at Indian Institute of Science (IISc) Bangalore from 28th May to 8 June 2012.
- Attended the National workshop cum training program on “**Computing Techniques and Applications (NWCTP-CTA)**” organized by Center for Mathematics of Banaras Hindu University Campus – Varanasi during July 01 – 07, 2012.
- Successfully completed Three Months “**Certificate Course on Machine Intelligence and Soft Computing**” with B+ grade offered by Center for Soft Computing Research (CSCR) of Indian Statistical Institute – Kolkata during September 21 – December 21, 2012.
- Attended 1st Indian Workshop on “**Machine Learning**” organized by Indian Institute of Technology, Kanpur, July 1 – 3, 2013.
- Attended Faculty Development Program on “**Image Processing, Computer Vision and Pattern Recognition**”, conducted from 18th June – 22nd June, 2013 at National Institute of Technology Delhi.
- Attended DAAD Supported International Workshop on Advances in “**PDE Modeling and Computation (APDEMC 2013)**” organized by Department of Mathematics Indian Institute of Technology Madras – Chennai during October 21-25 2013.

Invited Talks

- Presented poster on “**Conflict Detection and Resolution in Table Top Scenarios for Human-Robot Interaction.**” in a three days (June 18-19, 2019) event on “31st Swedish AI Society Workshop”, organized by Computing science department, Umea University, Sweden.
- Presented talk on “**Autonomous Systems' Ability to Understand Their Own Limitations.**” in a one day (November 15, 2018) event on “Cognitive Science Day”, organized by Computing science department, Umea University, Sweden.
- Presented talk on “**Deep learning and its applications**” in a one day (June 15, 2018) event on “Umea center for Functional Brain Imaging (UFBI) day”, organized by UFBI department, Umea University, Sweden.
- Presented demo on “**Robotic Manipulator and sketch drawing**” in a one day (April 11, 2018) event on “AI4X- Collecting Ideas and Identifying Challenges for Future AI Research in Sweden”, organized by WASP, Stockholm, Sweden.
- Presented 3 day talk on “**Authentication Techniques and Web Application Security**” in a one week long (June 23-28, 2014) workshop on “Information Security and Computer Forensic (WISCF-2014)”, organized by Department of Computer Science & Engineering, Motilal Nehru National Institute of Technology Allahabad, Allahabad, India.
- Presented talk on “**Computer & Network Security**” in a one day workshop (September 7, 2014), at UPTEC Computer Consultancy Ltd Allahabad organized by Computer Society of India, Allahabad Chapter.
- Presented talk on “**Spoofing Attacks & System Security**” in a one day workshop (January 31, 2015), at Arcade Business College, Patna, Bihar, India organized by Ph.D. chamber of Commerce, India.

- Presented one day talk on “**Robotic Vision: Detection and Tracking**” in a one month long (June 8-July 5, 2015) summer school on “Emerging Trends in Computer (ETCS-2015)”, organized by Department of Computer Science & Engineering, Motilal Nehru National Institute of Technology Allahabad, Allahabad, India.
- Presented Tech Talk on “**Artificial Intelligence and the Future of Robotics**” in one day Tech Talk (11-03-2017), organized by Kalinga Institute of Industrial Technology, Bhubaneswar, Odisha, India.
- Presented talk on “**Object Localization and Recognition**” in Computational Intelligence & Cloud Computing (CICC-2017) workshop organized by Department of Information Technology, NIT Raipur (26th - 30th December 2017).

References

Name	Prof G C Nandi	Prof Kai-Florian Richter	Prof Thomas Hellström
Address	Robotics & Artificial Intelligence Laboratory, CC-I, Building, IIIT-A	Plan 4, MIT-huset, B439 Umeå universitet, 901 87 Umeå, Sweden	Plan 2, MIT-huset Umeå universitet, 901 87 Umeå, C233, Sweden
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Personal Profile

Mother's Name : Vibha Singh
 Father's Name : L. P. Singh
 Nationality : Indian
 Gender : Male
 Date of Birth : 28-December-1986
 Language Known : Hindi, English, Bengali.
 Permanent Address : S/O L. P. Singh, House No: 610/1292, Kesav Nagar, Sitapur Road, Lucknow-226021, Uttar Pradesh

Declaration

I hereby declare that the above mentioned particulars are true to the best of my knowledge and belief.

Place: Umea, Sweden

Avinash Kumar Singh