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Sounak Dey

I am currently a PhD student in Computer Vision Center at Universitat Autonoma de Barcelona started from 14th of October, 2016. As of now I am working on learning based multimodal data fusion and their applications in visual retrieval and recognition problems such as sketch based image retrieval. Born in Kolkata, West Bengal, Indian. Read, Write & Speaks British English, Hindi & Bengali & Spanish (but not with the same proficiency as the rest).

Research Interest

Image Processing and Analysis, Pattern Recognition, Computer vision, Machine learning, Deep Learning based complete AI, Computational Mathematics, Statistics, Mathematical modeling.

Education

2014–2015 **Master's Degree in Computer Vision**, jointly by Universitat Pompeu Fabra, Universitat Autonoma de Barcelona, Universitat Politecnica de Catalunya and Universitat Oberta de Catalunya

2009–2011 **Master's Degree in Instrumentation and Control Engineering**, University College of Science and Technology (Rajabazar Science College) under Calcutta University; ***DGPA*** (Degree Grade Point Average***) 8.2/10***

2004–2008 **Bachelor's Degree in Electronics and Instrumentation Engineering**, West Bengal University of Technology, West Bengal, India; ***DGPA 8.07/10***

Publications

Referred Journals

- **Sounak Dey**, Palaiahnakote Shivakumara, KS Raghunandan, Umapada Pal, Tong Lu, G Hemantha Kumar, Chee Seng Chan, **"Script independent approach for multi-oriented text detection in scene image,"** ***Neurocomputing,*** *Elsevier,* 96-112, **2017**. [**Latest Impact Factor: 3.317**]
- **Sounak Dey**, Anguelos Nicolaou, Josep Llados, Umapada Pal, "**Evaluation of Word Spotting under Improper Segmentation Scenario,**" Under revision in **International Journal on Document Analysis and Recognition (IJDAR)**.
- Nilangshu K. Das, **Sounak Dey**, Sarbajit Pal, P. Barat, "***Innovative Instrumentation to Measure Magnetic Susceptibility***", ***IEEE Transactions on Magnetics***, Vol. 49, Issue. 9, 4965-4969, 2013, IEEE. (**Impact Factor: 1.213**)
- Nilangshu K. Das, Parthasarathi Barat, **Sounak Dey**, and Tammana Jayakumar," **Design of Miniature Coil to Generate Uniform Magnetic Field**", ***Progress In Electromagnetics Research*** *M, Vol. 34, 99-105, 2014.* (**Impact Factor: 5.298**)
- Nilangshu K. Das, Parthasarathi Barat, **Sounak Dey**, and Tammana Jayakumar," **Frequency-adapted crossover from para-to-dia magnetization in an Ising-like dipole-dipole model**", ***Journal of Nano Science Letters****, Cognizure, 5:8, 2014.*

Referred Conferences

- **Sounak Dey**, Pau Riba, Anjan Dutta, Josep Llados and Yi-Zhe Song "**Doodle to Search: Practical Zero-Shot Sketch-based Image Retrieval,**" accepted **CVPR 2019**. (**Oral**). (Acceptance Rate: 25.2%).

- **Sounak Dey**, Anjan Dutta, Suman K. Ghosh, Ernest Valveny, Josep Llados and Umapada Pal "**Aligning Salient Objects to Queries: A Multi-modal and Multi-object Image Retrieval Framework,**" 1-16 **ACCV 2018**. (Acceptance Rate: 27.9%).

- **Sounak Dey**, Anjan Dutta, Suman K. Ghosh, Ernest Valveny, Josep Llados and Umapada Pal "**Learning Cross-Modal Deep Embedding for Multi-Object Image Retrieval using Text and Sketch,**" 216-221, **ICPR 2018**.

- Anguelos Nicolaou, **Sounak Dey**, Vincent Christlein, Andreas Maier and Dimosthenis Karatzas, "**Non-deterministic Behaviour of Ranking-based Metrics when Evaluating Embeddings,**" arXiv:1806.07171[cs.CV].

- **Sounak Dey**, Anjan Dutta, J. Ignacio Toledo, Suman K. Ghosh, Josep Llados, Umapada Pal, "**SigNet: Convolutional Siamese Network for Writer Independent Offline Signature Verification,**" arXiv:1707.02131 [cs.CV].

- Juan I. Toledo, **Sounak Dey**, Alicia Fornes and Josep Llados, "**Handwriting Recognition by Attribute Embedding and Recurrent Neural Networks**". 1038-1043, **ICDAR 2017**.

- Pau Riba, Anjan Dutta, **Sounak Dey**, Josep Llados and Alicia Fornes, "**Improving Information Retrieval in Multiwriter Scenario by Exploiting the Similarity Graph of Document Terms**" 475-480, **ICDAR 2017**

- **Sounak Dey**, Anguelos Nicolaou, Josep Llados, Umapada Pal, "**Local binary pattern for word spotting in handwritten historical document,**" Joint IAPR International Workshops on Statistical, Structural and Syntactic Pattern Recognition **(S+SSPR) 2016**, 574-583, Springer, Merida, Mexico.

- N. C. Deb, **S. Dey**, S. Pal, T. K. Mandal, S.K. Sharma, S. K. Sarkar and H. N. Dutta, " ***Estimation of OC & EC from WSIC of PM10 Samples using Neural Network***", In International Conference on Emerging Trends in Physics for Environmental Monitoring & Management (ETPEMM-12).

Project Summary

Projects Performed in Computer Vision and Document Imaging Domain

Sketch Based Image Retrieval

Place : Computer Vision Center (CVC), Barcelona, Spain.
Study Topics : Image Processing, Pattern Recognition and Computer Vision
Technology : Python, Pytorch.
Roles : Study, Design and Development

Description : An approach for multi-modal image retrieval in multi-labelled images. A multi-modal deep network architecture is formulated to jointly model sketches and text as input query modalities into a common embedding space, which is then further aligned with the image feature space. Our architecture also relies on a salient object detection through a supervised LSTM-based visual attention model learned from convolutional features. Both the alignment between the queries and the image and the supervision of the attention on the images are obtained by generalizing the Hungarian Algorithm using different loss functions. This permits encoding the object-based features and its alignment with the query irrespective of the availability of the co-occurrence of different objects in the training set.

Responsibilities : Studied the factors related to sketch based image retrieval and while developing the network, get to know Pytorch framework very well.

Consolidated Research Group DAG-CVC (SGR)

Place : Computer Vision Center (CVC), Barcelona, Spain.
Study Topics : Image Processing, Pattern Recognition and Computer Vision
Funding : AGAUR.
Roles : Study, Design and Development.

CONtextualising the COntents in the Recognition of Document Images from Archives (CONCORDIA)

Place : Computer Vision Center (CVC), Barcelona, Spain.

Study Topics : Image Processing, Pattern Recognition and Computer Vision
Funding : FEDER, MINECO.
Roles : Study, Design and Development

Description : The project CONCORDIA aims to make a qualitative leap forward in the interpretation of historical documents with the incorporation of context and knowledge from the experts through advanced human interfaces.

Responsibilities : Studied the factors related to incorporating context to human interface for historical documents.

Signature Verification

Place : Computer Vision Center (CVC), Barcelona, Spain.
Study Topics : Image Processing, Pattern Recognition and Computer Vision
Technology : Python, Keras, Tensorflow
Roles : Study, Design and Development

Description : A convolutional Siamese network, named SigNet, for offline signature verification problem. This, in contrast to other methods based on hand crafted features, has the ability to model generic signature forgery techniques and many other related properties that envelops minute inconsistency in signatures from the training data. In contrary to other one shot image verification tasks, the problem with signature is far more complex because of subtle variations in writing styles independent of scripts, which could also encapsulate some degrees of forgery. We mine this ultra fine anamorphosis and create a generic model using SigNet.

Responsibilities : Studied the factors related to signature aberration and while developing the network, get to know Tensorflow framework very well.

BLSTM and CTC

Place : Computer Vision Center (CVC), Barcelona, Spain.
Study Topics : Image Processing, Pattern Recognition and Computer Vision
Technology : Python, Keras, Tensorflow
Roles : Study, Design and Development

Description : A handwriting recognition method that adapts the attribute embedding to sequence learning. Concretely, the method learns the attribute embedding of patches of word images with a convolutional neural network. Then, these embeddings are presented as a sequence to a recurrent neural network that produces the transcription. Without the use of any kind of dictionary or language model.

Responsibilities : Studied the factors related to blstm, recurrent neural network, auto-encoders and developing the network in Tensorflow framework.

Mutli Oriented Text Detection in Scene text Images

Place : Indian Statistical Institute (ISI), Kolkata, India.
Study Topics : Image Processing, Pattern Recognition and Computer Vision
Technology : C++, MatLab
Roles : Study, Design and Development

Description : One of the major challenges in Scene Text document analysis is dealing with the illumination variation and perspective distortions. Current systems do not expect these types of artifacts, and have poor performance when applied directly to the documents.

Responsibilities : Studied the factors related to image enhancement, filtering, component labeling, statistical model fitting and image binarization approaches. Studied and developed best suitable algorithms to achieve the optimum accuracy.

Word Spotting in Bangla and English Graphical Documents

Place : Indian Statistical Institute (ISI), Kolkata, India.
Study Topics : Computer Vision, Image Processing and Pattern Recognition.
Technology : C++, MatLab
Roles : Development

Description : Word spotting in graphical documents is a very challenging task, which includes the following steps needed in the project: preprocessing (text/graphic separation); recognition of characters (rotation invariant feature coupled with Support Vector

Machine (SVM) classifier); localizations/detection of characters corresponding to the query. Computer vision applied in localizations/detection of characters to detect local key points from image, extract features and matching from those points.

Responsibilities : Studied and applied SIFT, used optimal features and classifier, learned different matching techniques.

Feature Descriptors

Place : Indian Statistical Institute (ISI), Kolkata, India.
Study Topics : Computer Vision, Image Processing and Pattern Recognition.
Technology : C++, MatLab
Roles : Coding and Development

Description : Heat kernel signature (HKS) is a feature descriptor. The heat kernel is invariant under scale transformations and stable under small perturbations to the isometry. HKS (Heat Kernel Signature), SI-HKS (Scale Invariant HKS), DALI (Deformation and Light Invariant)

Responsibilities : Understood from scratch, coded and developed HKS, SI-HKS, DALI descriptor for feature extraction from images.

Development of Contact Angle Measurement System

Place : Variable Energy Cyclotron Centre (VECC), Kolkata, India
Study Topics : Digital Image Processing
Technology : Linux, C, MatLab, RTOS.
Roles : Feasibility Study, Design and Development

Description : Development of table top, cost effective system. The system is used to measure the efficacy of paint on a specific surface.

Responsibilities : Designed the optical system in the laboratory and set up an image acquisition system. From the raw image, profile of the paint drop is extracted. Contact angle of the liquid drop is measured.

Projects Performed in **Digital Signal Processing**

Real-Time Atmospheric Data logger

Place : Electronics, Communication and Science Unit (ECSU), Kolkata, India
Study Topics : AVR architecture, Electronics and Sensors.
Technology : Embedded C, NI Multisim.
Roles : Study, Design and Guiding Bachelor's Intern Student.
Description : Development of stand-alone compact data logger.
Responsibilities : Development and implementation from scratch.

Real-Time Data Analysis of SODAR technology as precursor of earthquake

Place : Electronics, Communication and Science Unit (ECSU), Kolkata, India.
Study Topics : Pattern Recognition, Machine Learning and Digital Signal Processing.
Technology : C, NI Multisim, Matlab, OpenGL, OpenAl
Roles : Study, Design, System Integration.
Description : The toll rate charged by seeing the number of axles possessed by a vehicle, an automatic system that can identify the number of axles is sought, so that the toll charge can be automatically charged.
Responsibilities : Studied and developed modules of pre-processing, filter, GUI, and implementation of hybrid artificial neural network technique for classification and prediction.

Prediction of Atmospheric Aerosols

Place : Electronics, Communication and Science Unit (ECSU), Kolkata, India.
Study Topics : Pattern Recognition, Machine Learning and Mathematical modeling.
Technology : C, MatLab
Roles : Study, Design and Guiding Bachelor Intern Student
Description : The use of the connectionist approach to predict atmospheric aerosols for understanding environmental conditions.

Responsibilities : Studied the factors relating to enhancing feature extraction, minimizing feature, and obtaining meaningful feature for applying into classifier.

Development of Data Acquisition and Processing System for ECG signal

Place : Rajabazar Science College, Kolkata, India
Study Topics : 8051 microcontroller, RTOS and Digital Signal Processing
Technology : C, MatLab
Roles : Study, Design and Development
Description : Development of portable, cost effective, robust and hassle free system for easy viable to the remote areas of the country.
Responsibilities : Studied the factors relating to obtaining high performance feature point's detection algorithm, such as PQR complex region, segmentation, signal enhancement, feature detection, feature verification and filtering, data compression.

Projects Performed in Material Science Domain

Innovative Instrumentation for measurement of magnetic Susceptibilty

Project : Automated measurement of magnetic susceptibility of nano magnetic particles
Place : Variable Energy Cyclotron Centre (VECC), Kolkata, India
Study Topics : Magnetism, Nano materials structure, ARM processor, RTOS.
Technology : MatLab, C, Embedded C
Roles : Study, Design and Development
Description : A simplified instrumentation with nominal circuitry has been developed to measure in- and out-of-phase complex magnetic susceptibility of bulk magnetic samples. A unique shape of the absolute coil is implemented to improve the magnetic field homogeneity inside the coil. Complex susceptibility of nano-composite is measured by an innovative phase detection circuit. In this paper, we also discuss in detail the principle, design, and the performance of the instrumentation. This susceptometer is also suitable for liquid samples, viz., ferro-fluids, blood samples, etc.
Responsibilities : Studied and developed modules of automated magnetic field generation. System Integration.

Design of Miniature Coil to Generate Uniform Magnetic Field

Project : Automated measurement of magnetic susceptibility of nano magnetic particles
Place : Variable Energy Cyclotron Centre (VECC), Kolkata, India
Study Topics : Genetic Algorithm
Technology : MatLab, C
Roles : Study, Design and Development
Description : In various technological and scientific applications, types of coil systems are being used to produce uniform alternating magnetic field. The dimensions of these coil systems are considerably larger than the volume of interest. There is a necessity to reduce the dimension of the coil system without sacrificing the extent of uniformity of the magnetic field. This problem has a wide audience and still remains as a topic of contemporary research in the development of miniaturized devices especially for calorimetric measurements of nano-particles, cancer therapy, and detection of minute surface defects by eddy current probes, etc. We present how we can modify the shape of a miniature solenoid to produce uniform magnetic field. A Genetic algorithm has been implemented to get the optimum dimension of the miniature solenoid. Our distinct shape design has achieved 97 % uniformity for a 60% volume of interest.
Responsibilities : Studied and developed a complete architecture of the project. Studied the factors related to genetic algorithm and best suitable algorithms to achieve the optimum accuracy.

Frequency-adapted crossover from para-to-dia magnetization in an Ising-like dipole-dipole a model

Project : Automated measurement of magnetic susceptibility of nano magnetic particles
Place : Variable Energy Cyclotron Centre (VECC), Kolkata, India
Study Topics : Genetic Algorithm
Technology : Linux, MatLab, C++
Roles : Study, Design and Development

Description : The aggregation of interacting nano-magnetic dipoles, demonstrated both experimentally and theoretically as a model system to detect intriguing co-operative physical phenomena. A crossover from paramagnetic to diamagnetic state by changing the frequency of the applied sinusoidal magnetic field for an ensemble of nano-magnets was noted. This phenomenon unravels an

insight of physics and it may be significant on the design and development of magnetic devices.

Responsibilities : Studied and developed a complete simulation of the nano magnetic dipoles ensemble. Studied the factors related to crossover from paramagnetic to diamagnetic.

Projects Performed in Software Domain

Online Exam Software

Project : Design of Online Exam Software and Implementation
Place : Guru Nanak Institute of Technology, Kolkata, India
Study Topics : Java, Database.
Technology : Java, JSP, My-SQL, Microsoft Access.
Roles : Study, Design and Development
Description : Robust, secured, fail safe architecture for online exam. The objective of this work is to get a detail understanding of development and deployment of software packages.
Responsibilities : Studied and developed modules of online examination.

Professional Experience

Research Assitant at *CVC Universitat Autonoma de Barcelona, Spain*
1st October, 2015- 31st September, 2016, ***Document Analysis Group***

Project Linked Peronnel at *CVPR Unit Indian Statistical Institute, India*
1st June, 2013- 23rd November, 2014, ***Computer Vision Group***

Project Linked Peronnel at *ECS Unit Indian Statistical Institute, India*
14th October, 2011- 31st March 2013

Research Trainee at *Variable Energy Cyclotron Center, Atomic Energy of India*
1st May 2011 –13th October, 2011, with *Material Science Group & Computational Instr. Unit*

Project Engineer at *Enterprising Developers. Kolkata, India*
7th July 2008 – 1st May 2009.(PLC Drives and Conveyer Belts Installation, Development Standalone Drivers.)

Awards and Activities

- Awarded PIF grant from Universitat Autonoma de Barcelona (UAB-PIF) for Doctoral Studies. (2016-2019)
- Awarded scholarship from Computer Vision Center to do Master Degree and Research work. (2014-2016)
- Bhavishojoyti scholarship from NIIT India (2008).
- Stood 2nd in Dept. of Electronics and Instrumentation during B.Tech (Bachelor of Technology).

Software & Hardware Proficiency

OS	Linux, Windows, OSX, RTOS	**Design**	Adobe Photoshop, Adobe Flash, LaTeX.
Languages	Python, C++, Embedded C, Java	**Libraries**	OpenGL, OpenCV, OpenAL
Scientific	Matlab, FEMM, NI Multisim	**Assembly language**	8085 microprocessor, 8051 microcontroller, AVR's ARM processor (ADCu7020).
Framework	Pytorch, Tensorflow, Caffe, Theano		

Extracurricular

- Music, Cricket
- Watching documentaries on huge machineries, future architectural works, and sharks.

References

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