Manu Goyal

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Summary

A talented, passionate and self-motivated computer vision scientist. Ph.D. in Computer Vision and M.S in Computer Applications. Proficient in Image Processing, Computer Vision, Deep Learning and Medical Imaging.

Skills

Techinal Specialities: Applied Machine Learning, Regression, Basic Image Processing Techniques, Machine Learning, Computer Vision, Deep Learning (Caffe, TensorFlow, PyTorch), Interactive Data Visualization, Clustering Algorithms, Bio-inspired Optimization Algorithms, Internet of Things (Arduino and Sensors)

Programming: MATLAB, Python (Pandas, Matplotlib, NumPy, Sci-kit), OpenCV, R, Android software development and familiar with C++, Java, HTML, and CSS.

Experience

Dartmouth College — Hanover, NH, USA
Postdoctoral Research Associate — *Sep '19 –*
I am currently working as a postdoctoral at Biomedical Data Science Department, Dartmouth College. At the moment, I am working on mainly three medical imaging projects that are recognition of skin cancer on dermoscopic and clinical images, bladder cancer detection on histopathological images and free air detection on chest radiographs.

Manchester Metropolitan University — Manchester, United Kingdom
Research Scholar — *Sep '16 – Aug '19*
I worked in the number of part-time medical imaging projects, including detecting melanoma and other skin cancers in dermoscopic images and breast cancer in ultrasound images during my Ph.D. Further details of my Ph.D. project and these part-time projects is provided in the projects section.

Punjab Technical University — Jalandhar (Punjab), India
Assistant Professor — *September '12 – August '16*
I taught various computer courses such as Simulation Theory, Soft Computing, C++ and Java programming, operating system, and database management system to the graduate students. I acted as supervisor and co-supervisor to the post-graduate students on different multidisciplinary research projects such as Routing protocols in Wireless Sensor Networks and Sensors for the Internet of Things.

Please refer to My Linkedin profile for complete list of work experiences along with recommendations

Publications

Published papers in leading Conferences, IEEE and Elsevier Journals

Please refer to My Google Scholar & Researchgate profile for complete list of my research papers.

Education

Manchester Metropolitan University — Manchester, United Kingdom
Ph.D. in Computer Vision — *2016 – 2019*

Thapar University — Patiala, India
Master in Technology in Computer Application (CGPA: 7.2) — *2010 – 2012*

Punjab Technical University — Jalandhar, India
Bachelor of Technology in Computer Engineering (percentage: 71) — *2006 – 2010*

Natural languages: Punjabi (*mother tongue*), English (*full professional proficiency*), Hindi (*full professional proficiency*).

Interests

Non-exhaustive and in alphabetical order: Computer games, cooking, football, music, mobile applications, philosophy, software engineering, travel, typography (e.g., web design, LaTeX)

Details of Referees

Dr. Moi Hoon Yap Reader in Computer Vision, Manchester Metropolitan University, Manchester, UK. Email: m.yap@mmu.ac.uk and Phone: +44 (0)161 247 1503

Prof. Neil Reeves Faculty Head of Research & Knowledge Exchange, Manchester Metropolitan University. Email: n.reeves@mmu.ac.uk and Phone: +44 (0)161 247 5429

Prof. Subhas Mukhopadhyay School of Engineering, Macquarie University, NSW 2109, Australia. Email: subhas.mukhopadhyay@mq.edu.au and Phone: +61 2 9850 6510

Research Projects

Summary

I am currently working as a Postdoctoral Research Associate at Dartmouth College, USA I completed my P.hD. in Computer Vision from Manchester Metropolitan University. My Ph.D. title is 'Novel Computer Vision techniques for Recognition and Analysis of Diabetic Foot Ulcers'. Although during my Ph.D., I have also worked on other medical imaging projects: 1. Detection of Melanoma and other Skin Cancers; 2. Segmentation and Recognition of Breast Cancer on Ultrasound Images, 3. Segmentation of thigh muscles on MRI.

Diabetic Foot Ulcers

A Diabetic Foot Ulcer (DFU) is a frequent complication of diabetes mellitus. Since computerized methods in the current literature based on traditional machine learning and image processing are not robust enough to detect the DFU of various grades and stages. In this Ph.D. project, I have developed and established fully automatic computerized methods to recognize and analysis of DFU. Primary responsibilities and contributions of this project are mentioned below:

1. I worked with clinicians to clean the dataset and refine the expert annotations to perform three popular computer vision tasks for the medical imaging to establish a baseline for **DFU classification, segmentation, and localization**.

2. For **DFU classification**, I used the machine learning algorithms to extract the features for two classes i.e., DFU and healthy skin patches, to understand the differences in the computer vision perspective. I designed a novel deep learning classification framework is introduced - DFUNet, which outperformed the state-of-the-art traditional machine learning and deep learning methods [1].

3. For **DFU segmentation**, I proposed a two-tier transfer learning technique for deep learning segmentation methods for semantic segmentation of DFU and its surrounding skin, which is an important indicator for clinicians to assess the progress of DFU [2].

4. For **DFU Localization**, I used state-of-the-art deep learning localization methods on the DFU dataset of 1775 images and the FootSnap dataset. Then, I transfer the robust and lightweight models on mobile devices such as Nvidia Jetson TX2 and smart-phone android application for remote monitoring of DFU [3].

5. Finally, I used image processing techniques and machine learning algorithms to determine the important conditions that are **bacterial infection and ischemia** of DFU [4].

Skin Cancer

Skin cancer is the most common cancer among all other cancers. I worked part-time on this project with the collaboration of DermaNetNZ for the exchange of knowledge and data. In this project, I have developed deep learning methods for segmentation and multi-class classification to detect skin cancers. Primary responsibilities of this project are mentioned below:

1. I designed the deep ensemble methods based on Mask RCNN and DeeplabV3+ to provide precise segmentation annotations of skin lesions [5].

2. I used image processing techniques and deep learning algorithms for the segmentation of skin lesions [5, 6].

3. I utilized pixel-wise classification networks to provide lesion diagnosis [7].

4. I reviewed the studies that have claimed their AI algorithms match or exceed the performance of dermatologists for the diagnosis of skin cancer across all diagnostic image modalities and presented the technical challenges and new opportunities [8, 9].

5. I developed deep learning algorithms for ROI detection algorithms for skin lesions. I demonstrated the potential of my work by developing a natural data-augmentation technique and a real-time mobile application for automated skin lesions detection [10].

Breast Cancer and Human Thigh Muscles

Breast cancer is the most common cancer in the UK I worked part-time on these projects with my supervisor and colleagues on these projects. My contributions to these projects were mainly on developing machine learning algorithms.

1. We used the end-to-end deep learning approaches using Fully Convolutional Networks (FCNs), namely FCN-AlexNet, FCN-32s, FCN-16s, and FCN-8s, to determine the benign and cancerous breast lesions [11, 12].

2. We used transfer learning and propose a new 3-channel artificial RGB method for breast ultrasound ROI detection and lesion localisation [13].

3. We worked on deep learning solutions for MRI thigh quadriceps segmentation [14].

References

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[3] Manu Goyal, Neil D Reeves, Satyan Rajbhandari, and Moi Hoon Yap. Robust methods for real-time diabetic foot ulcer detection and localization on mobile devices. *IEEE journal of biomedical and health informatics*, 23(4):1730–1741, 2018.

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[5] Manu Goyal, Amanda Oakley, Priyanka Bansal, Darren Dancey, and Moi Hoon Yap. Skin lesion segmentation in dermoscopic images with ensemble deep learning methods. *IEEE Access*, 2019.

[6] Jia hua Ng, Manu Goyal, Brett Hewitt, and Moi Hoon Yap. The effect of color constancy algorithms on semantic segmentation of skin lesions. In *Medical Imaging 2019: Biomedical Applications in Molecular, Structural, and Functional Imaging*, volume 10953, page 109530R. International Society for Optics and Photonics, 2019.

[7] Manu Goyal, Saeed Hassanpour, and Moi Hoon Yap. Multi-class semantic segmentation of skin lesions via fully convolutional networks. *Biostec*, 2020.

[8] Manu Goyal. Artificial intelligence in dermatology. *DermNet NZ*.

[9] Manu Goyal, Thomas Knackstedt, Shaofeng Yan, and Saeed Hassanpour. Artificial intelligence for diagnosis of skin cancer: Challenges and opportunities. *arXiv preprint arXiv:1911.11872*, 2019.

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[13] Moi Hoon Yap, Manu Goyal, Fatima M Osman, Robert Martí, Erika Denton, Arne Juette, and Reyer Zwiggelaar. Breast ultrasound region of interest detection and lesion localisation. *Artificial Intelligence in Medicine*, 2020.

[14] Ezak Fadzrin Ahmad Shaubari. *Automatic segmentation of the human thigh muscles in magnetic resonance imaging*. PhD thesis, Manchester Metropolitan University, 2018.