D5 v2

Results Report

Video Processing and Understanding Lab

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HISTORY

Version	Date	Editor	Description
1.0	01/03/2021	Pablo Carballeira López	First version
2.0	01/03/2022	Pablo Carballeira López	Second version

CONTENTS:

1. Introduction

This *report* summarizes the results obtained within the AISEEME project. The results and deliverables referenced here are available in the project website (http://www-vpu.eps.uam.es/projects/aiseeme/).

2.   Publications

2.1. Journals

[1] Kirill Sirotkin, Marcos Escudero-Viñolo, Pablo Carballeira, Juan Carlos San Miguel, "Improved skin lesion recognition by a Self-Supervised Curricular Deep Learning approach", submitted to IEEE Journal of Biomedical and Health Informatics, (under review).
Preprint available at: https://arxiv.org/abs/2112.12086)

2.2. Book Chapters

2.3. Conferences

[2] Kirill Sirotkin, Pablo Carballeira, Marcos Escudero-Viñolo, "A study on the distribution of social biases in self-supervised learning visual models", submitted to IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 2022.

2.4. PhD Thesis

2.5. Master Thesis

[3] Self-supervised Deep Learning for Image Classification, Zahid Hassan Tushar (advisors: Marcos Escudero Viñolo and Pablo Carballeira López), Trabajo Fin de Máster (Master Thesis), Máster Universitario en Image Processing and Computer Vision, Univ. Autónoma de Madrid, Jul. 2021

2.6. Graduate Thesis

[4] Aprendizaje auto supervisado para reconocimiento de objetos, Alejandro Camacho Valladares (advisor: Marcos Escudero Viñolo), Trabajo Fin de Grado (Graduate Thesis), Grado en Ingeniería de Tecnologías y Servicios de Telecomunicación, Univ. Autónoma de Madrid, Jun. 2020.

[5] Detección precoz de cáncer de piel en imágenes basado en redes convolucionales, Francisco Javier Martín Ameneiro (advisor: Juan Carlos San Miguel Avedillo), Trabajo Fin de Grado (Graduate Thesis), Grado en Ingeniería de Tecnologías y Servicios de Telecomunicación, Univ. Autónoma de Madrid, Jun. 2020.

[6] Análisis de la evolución, en número y tamaño, de lesiones de piel en zonas amplias del cuerpo, Juan Antonio Álvarez Castillo (advisor: Jesús Bescós Cano), Trabajo Fin de Grado (Graduate Thesis), Grado en Ingeniería de Tecnologías y Servicios de Telecomunicación, Univ. Autónoma de Madrid, Jun. 2020.

[7] Detección de lesiones cutáneas en imágenes basado en redes generativas adversarias, Nicolás Alexander Wolyniec Rojas, (advisor: Juan Carlos San

Miguel Avedillo), Trabajo Fin de Grado (Graduate Thesis), Grado en Ingeniería Informática, Univ. Autónoma de Madrid, Jul. 2020.

[8] Aplicación para el análisis de la evolución de lesiones de piel en zonas amplias del cuerpo, Daniel Armengod, (advisor: Jesús Bescós Cano), Trabajo Fin de Grado (Graduate Thesis), Grado en Ingeniería de Tecnologías y Servicios de Telecomunicación, Univ. Autónoma de Madrid, Jul. 2021.

3. Project Documents

3.1. Published Deliverables

3.1.1. D1.1 "System Infrastructure" (version 1: Jan 2021, version 2: Jan 2022)

This deliverable describes the activities related to the maintenance and update of the data processing infrastructure available at VPULab for the development of the tasks within the AISEEME project.

3.1.2. D1.2 "Evaluation datasets" (Jan. 2021)

This deliverable describes the work related to task T.1.2 "Collection and generation of datasets": the aim of this task is to support to other tasks by generating train and test data and associated evaluation methodologies. It includes the selection of appropriate datasets (images and associated ground-truth) and their generation if required.

3.1.3. D2 "Enabling technologies: algorithms and findings" (Mar 2022)

This deliverable describes the work related to tasks T2.1: "Self-supervised frameworks and pretext tasks", T2.2: "Skin lesion assessment" and T2.3: "Lung nodule malignancy evaluation". The aim of T2.1 is to compare state-of-the-art SSL approaches, exploring the influence of the CNN architecture, the pretext task, and the training schedule. The aim of tasks T2.2 and T2.3 is to compare deep learning state-of-the-art approaches to skin lesion assessment and lung nodule malignancy evaluation.

4. Public Resources

4.1. Software

- SB-SSL: Source code for the paper "A study on the distribution of social biases in self-supervised learning visual models", submitted for IEEE/CVF CVPR 2022 Main Conference. https://github.com/vpulab/SB-SSL

5. Main Achievements of the Project

5.1. Main achievements during months 1 to 12

5.1.1. WP1: Infrastructure and datasets

- T1.1: Infrastructure update and maintenance (Deliverable D1.1)
  - o Acquisition and configuration of new hardware for GPU-based processing of visual data
- T1.2: Collection and generation of datasets (Deliverable D1.2)
  - o Collection of generic wide-range and narrow-domain image classification datasets
  - o Collection of skin lesion and lung malignancy assessment datasets
  - o Collection of additional X-Ray and COVID-19 datasets
  - o Post-processing of three-dimensional lung CT scans

5.1.2. WP2: Enabling technologies

- T2.1: Self-supervised frameworks and pretext tasks (Deliverable D2)
  - o Set up of an open-source self-supervised learning framework
  - o Initial analysis of self-supervised model representations for an automatic definition of a pretext task curriculum
- T2.2: Skin lesion assessment (Deliverable D2)
  - o Evaluation of state-of-the-art methods on the ISIC-17 and ISIC-19 skin lesion datasets
- T2.3: Lung nodule malignancy evaluation (Deliverable D2)
  - o Preliminary evaluation of suitable reference benchmarks

5.1.3. WP3: Curriculum-based multi-task self-supervised learning

- T3.1: Empirical definition and completion of a pretext task curriculum (Deliverable D3)
  - o Exploratory experiments on the transferability of features learned by SSL methods to different image datasets
- T3.2: Evaluation of the impact of the architecture and training schedule (Deliverable D3)
  - o Preliminary experiments on the effect dataset size and CNN extraction layer
- T3.3: Self-paced multi-task self-supervision (Deliverable D3)
  - o No relevant activity on this task during this period

5.1.4. WP4: Use cases in medical imaging

- T4.1: Multi-task SSL approaches for skin lesion assessment (Deliverable D4)
  - o No relevant activity on this task during this period
- T4.2: Multi-task SSL approaches for lung nodule malignancy detection (Deliverable D4)
  - o No relevant activity on this task during this period

5.1.5. WP5: Management and dissemination

- T5.1: Management
    - o Relevant workplan and budget adjustments performed due to the COVID-19 pandemic
    - o Ethical committee approval for a collaborative project with Puerta de Hierro hospital
- T5.2: Dissemination
    - o Publication of four Bachelor Thesis.

5.2. Main achievements during months 13 to 24

5.2.1. WP1: Infrastructure and datasets

- T1.1: Infrastructure update and maintenance (Deliverable D1.1)
    - o Acquisition and installation of one additional GPU for the VPULab processing network
    - o Initiated the deployment of cluster management software to maximize the usage of the computing resources of the VPULab processing network.
- T1.2: Collection and generation of datasets (Deliverable D1.2)
    - o Collection of new datasets for: bias identification in SSL methods, skin lesion provided by project observer, Chest X-Ray for pneumonia recognition, and eye fundus.

5.2.2. WP2: Enabling technologies

- T2.1: Self-supervised frameworks and pretext tasks (Deliverable D2)
    - o Study on the distribution of social biases in self-supervised learning visual models
- T2.2: Skin lesion assessment (Deliverable D2)
    - o Completed the evaluation of state-of-the-art methods for skin lesion assessment.
- T2.3: Lung nodule malignancy evaluation (Deliverable D2)
    - o Evaluated the state-of-the-art approach for pneumonia detection and COVID-origin assessment

5.2.3. WP3: Curriculum-based multi-task self-supervised learning

- T3.1: Empirical definition and completion of a pretext task curriculum (Deliverable D3)
    - o Design and implementation of a framework to train visual models based on CNN architectures using a sequence of different SSL pretext tasks.
- T3.2: Evaluation of the impact of the architecture and training schedule (Deliverable D3)
    - o Initiated the evaluation of learning-rate optimization in the training scheme of T3.1
- T3.3: Self-paced multi-task self-supervision (Deliverable D3)
    - o Initiated the comparative analysis of internal representations learned by SSL methods

5.2.4. WP4: Use cases in medical imaging

- T4.1: Multi-task SSL approaches for skin lesion assessment (Deliverable D4)
  - o Evaluation of the performance of the training scheme in T3.1 in skin lesion assessment.
- T4.2: Multi-task SSL approaches for lung nodule malignancy detection (Deliverable D4)
  - o No relevant activity on this task during this period

5.2.5. WP5: Management and dissemination

- T5.1: Management
  - o Two support technicians have been hired to support the research activities of the project.
- T5.2: Dissemination
  - o Paper submitted to IEEE Journal of Biomedical and Health Informatics JBHI. The preprint is available in ArXiv.
  - o Paper submitted to IEEE/CVF Conference on Computer Vision and Pattern Recognition.