AI4media

ARTIFICIAL INTELLIGENCE FOR THE MEDIA AND SOCIETY

ROADMAP ON AI TECHNOLOGIES & APPLICATIONS FOR THE MEDIA INDUSTRY

SECTION: "AI FOR SOCIAL SCIENCES AND HUMANITIES RESEARCH"

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AI for Social Sciences and Humanities research

Current status

The emergence of ***digital humanities*** (DH) has fundamentally changed the way ***social sciences and humanities*** (SSH) researchers can perform research on media content. The ***Computational Turn*** allows scientists to ask completely new research questions and investigate existing research questions in new ways.[1] While previously the field was dominated by "close reading" methods, in which individual sources are analysed, DH brought about a turn towards "distant reading" that allows researchers to scrutinise and compare a large number of sources, spanning across extended periods of time, languages and media formats. For instance, researchers now can investigate gender representation in the media by comparing air time given to male and female speakers on television, and analyse how this has changed throughout years. With the help of AI-based research methods, it became possible to detect and observe patterns from an extensive historical perspective (Figure 1).

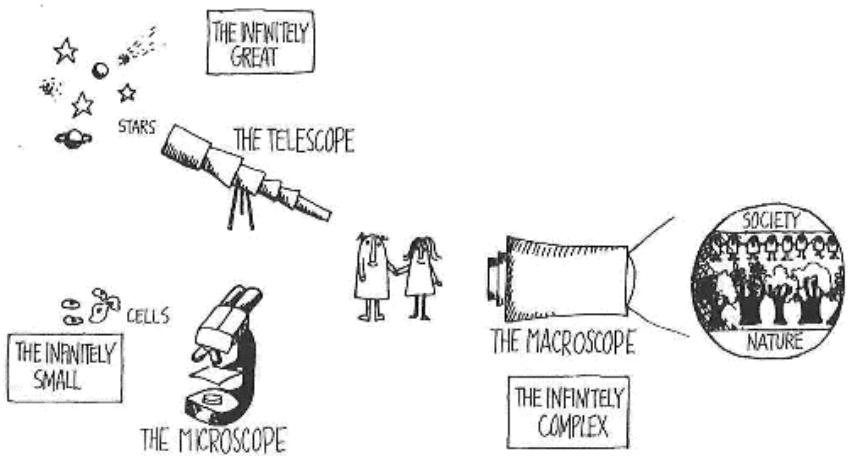

Figure 1: Microscope / Telescope / Macroscope[2].

In Europe, these developments in the SSH field would not have been possible without significant investments made over the last decade in the heritage sector, both towards digitising archival materials and also ensuring that born-digital materials (ranging from documents to social media data) are archived. Recognising the research potential of these digital materials, several pan-European initiatives such as CLARIN[3], DARIAH[4] and E-RIHS[5] have emerged to support the SSH field. These initiatives, supported by universities and cultural heritage organisations, are developing infrastructures and tools that enable DH research as well as building the capacity of researchers to work with computer-based research methods (Figure 2). Alongside them, pan-

[1] S. Wyatt. "A Computational Turn in the Humanities? A Perspective from Science and Technology studies." *Journal of Siberian Federal University* 9, 2016, 517-524.
[2] Drawing by Joël de Rosnay: https://scottbot.net/the-historians-macroscope/
[3] CLARIN (Common Language Resources and Technology Infrastructure): https://www.clarin.eu/
[4] DARIAH-EU (DIgital Research Infrastructure for the Arts and Humanities): https://www.dariah.eu/
[5] E-RIHS (European Research Infrastructure for Heritage Science): http://www.e-rihs.eu/

European data aggregators and providers such as Europeana[6] provide access to carefully collected and curated multimodal data that have huge potential for training machine learning models.

From the outset, DH scholarship was largely dominated by text-based analysis.[7] This is due to the early maturity of AI-based tools for text recognition, as well as the availability and accessibility of large corpora of textual content as training data. With the growing maturity of computer vision techniques, availability of processing power, analysis of visual culture is increasingly gaining prominence, which is an essential development for SSH scholars who work with multimodal data.[8]

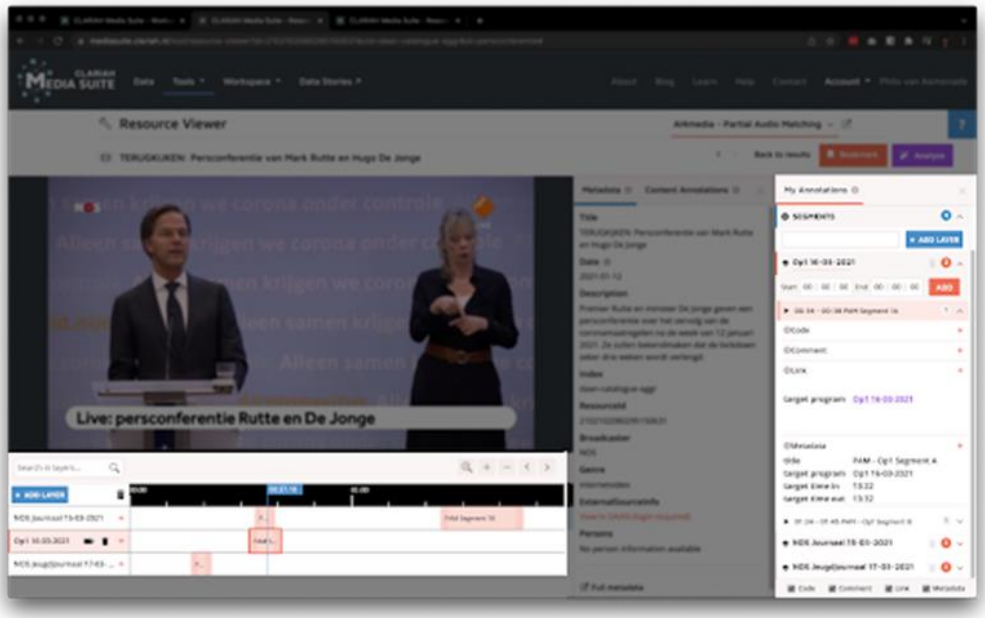

Figure 2: Interface of the CLARIAH Media Suite[9] research infrastructure for SSH scholars showcasing partial audio matching functionality that enables researchers to track the reuse of a particular audio segment in other programmes.

Research challenges

A number of challenges need to be addressed to fully exploit the potential of AI-based research methods in SSH:

Processing big multimedia data. Media collections are massive and the individual items are rich with information, which means that performing even basic analyses requires large amounts of storage and processing power. From the perspective of a researcher, this means significantly limiting the scale of their investigation as performing research on the entire media collection

[6] Europeana: https://pro.europeana.eu/
[7] M. Wevers, T. Smits, The visual digital turn: Using neural networks to study historical images, *Digital Scholarship in the Humanities*, 35:1, 2020, 194–207, https://doi.org/10.1093/llc/fqy085
[8] T. Arnold, S. Scagliola, L. Tilton, and J.Van Gorp, Introduction: Special Issue on AudioVisual Data in DH. *Digital Humanities Quarterly. Special Issue: AudioVisual in the Digital Humanities*, 2020. http://www.digitalhumanities.org/dhq/vol/15/1/000541/000541.html
[9] CLARIAH Media Suite: https://mediasuite.clariah.nl/

held by an organisation might not be attainable. From the perspective of an organisation facilitating access to their collections via AI-based tools, the processing power required leads to significant costs, which means that not all organisations can afford this. This scalability challenge of processing big data is particularly pertinent in broadcast archives, where the collection grows every day with industry-standard high-quality audiovisual content. The negative environmental impact of such high-demand AI systems is also a great concern that calls for solutions for optimising algorithms and infrastructure for energy efficiency.

Managing the complexity of cultural heritage data. Deep-learning algorithms may yield impressive results in supervised training on data when given large numbers of labelled patterns but its utility decreases in the context of digital collections such as news content where the continuous stream of new annotations and changing interpretations of existing data hamper a better understanding of multimodal meaning making.[10] The data-hungry nature of deep learning algorithms obstructs their use in sparse or incomplete data situations such as those in the cultural heritage domain. Moreover, heritage collections pose an epistemological challenge to AI systems as a multitude of different, even conflicting meanings that coexist and evolve over time can be associated with a single cultural object, making it difficult to classify them.

Usability of AI systems for SSH researchers. Due to the complexity of AI systems, the availability of user-friendly AI tools for media scholars is very limited. The entry barrier for a researcher to start using such tools is high and often requires additional training. There is a lack of interdisciplinary understanding between those who are developing the tools (AI experts) and those who would benefit from them (SSH researchers). Equally, SSH scholars do not receive sufficient digital training to (i) benefit from the opportunities opened by AI tools, and (ii) execute tool criticism.[11] While commercially available tools often provide more easily-accessible interfaces, they are too generic to support the complex analyses required by the SSH scholars. Media content holders implementing AI tools in their technical infrastructures face similar skill-related challenges. AI skills especially in the cultural heritage sector are rare, making it difficult for such organisations to support SSH researchers with cutting-edge AI technologies.

Lack of training data. IP regulations built on protecting the commercial interests of media content creators limit the accessibility of professionally-produced audiovisual content available for model training. Due to this, many available AI systems are trained on datasets from widely accessible online platforms such as YouTube, that have not undergone rigorous quality checks and considerations for biases that such datasets would introduce. Moreover, people whose data have been included in such datasets have not been informed about this and have not given their consent. Often, this results in algorithms that are prejudiced against non-Western societies and minorities.[12] Researchers working with such AI systems might not even be aware of the provenance of the data used to train models and what repercussions it could have on the results as the biases might not be immediately visible. While the discourse around the need for more

[10] Muccini, H. & Vaidhyanathan, K. (2020). Towards self-learnable software architectures, ERCIM News 122, p. 33-34.
[11] M. Koolen, J. van Gorp, J. van Ossenbruggen, Toward a model for digital tool criticism: Reflection as integrative practice, *Digital Scholarship in the Humanities*, Volume 34, Issue 2, June 2019, Pages 368–385, https://doi.org/10.1093/llc/fqy048
[12] J. Buolamwini and T. Gebru, Gender Shades: Intersectional Accuracy Disparities in Commercial Gender Classification, *Conference on Fairness, Accountability and Transparency*, 2018, 77–91.

diverse training data is gaining momentum in the academy and the commercial sector, there is still a lack of standardisation and best practices for creating and documenting datasets.

Generic AI models. Currently used off-the-shelf AI models are not suitable to address the complex research of SSH scholars. In particular, they are lacking in understanding of cultural and historic sensitivities, domain-specific knowledge, co-existence of multiple meanings and interpretations defined by the context.[13] Additionally, translating purely visual or abstract concepts that are relevant for SSH is a complex undertaking that requires high-quality annotations from topical experts. Techniques that enable adjusting or "fine tuning" of pretrained generic models to a particular context (such as transfer learning) are promising in this regard.

Technology-driven development. Many of the above-listed challenges are to some extent caused by the lack of interdisciplinary approaches applied to the development of AI. All too often, AI engineers and domain experts speak completely different languages which prevents meaningful collaboration. In most projects, the intersection between technology and SSH is not fully realised (e.g. humanities researchers are involved only to provide the initial user needs and test the final outcomes, but they are not involved in the decisions regarding model training). Hence, in many AI initiatives from academia considerations for biases and user-friendliness come as an afterthought rather than primary requirements.

Societal and media industry drivers

Vignette: AI-enabled Social Sciences and Humanities research

Luna is a psychology professor leading a lab of researchers who study cultural differences in body language. She is collaborating with an audiovisual archive that provides access to its collection via a research tool with integrated AI solutions, including identification of gestures and poses which are essential for Luna's research. Before using the tool, she consults documentation about the algorithm behind the tool - this information is displayed via non-technical visualisations that allow her to immediately see what data was used for training. She quickly notices that training datasets predominantly consist of content from contemporary Western data sources which would skew her research results. She also sees the algorithm's provenance - it was taken from a European online platform of open-source pre-trained AI models for media archives. On the platform, she starts a discussion about the concerns she has and quickly finds a critical mass of scholars who are also interested in addressing this. Led by Luna's team, together they create a small dataset with high-quality annotations, mainly using historic content that the archive provides to them. This dataset is then used to fine-tune and improve the AI model and is integrated into the archive's research infrastructure. Luna's team also documents decisions made when creating their dataset and annotations, and publishes it on the online platform for other scholars to consult and improve in the future.

[13] T. Smits and M. Wevers, "The Agency of Computer Vision Models as Optical Instruments," Visual Communication, 2021, https://doi.org/10.1177/1470357221992097

Future trends for the media sector

With the above-listed challenges in mind, we foresee the following trends that would both strengthen the use of AI for SSH scholarship and support AI research through SSH involvement.

Trends related to technological advances

High-quality annotations. While model training requires high volumes of data rendering many quality control processes unscalable, even small amounts of high-quality annotations can significantly improve models. SSH scholars can play an important role in providing domain-specific annotation and meaning, which can be used to increase the usability of AI tools for research purposes as well as be transferred to other application domains. Here it is important to recognise that just like textual data, visual language is also culturally-specific therefore including media scholars with pluralistic perspectives in annotation efforts is key to avoiding skewed results. Equally, heritage organisations should increase their efforts on treating their collections as potential training datasets. This should inform their data enrichment strategies – for instance, consulting communities represented in the data to ensure that their perspectives are adequately captured and represented fairly.

Focus on interface design. User-friendly interfaces that do not require advanced computational skills will play a key role in boosting the uptake of AI-based research methods by SSH scholars. However, usability should not come at the cost of reduced complexity. On the contrary, developments in this domain should be driven by rigorous research methodologies that SSH researchers require, prioritising transparency and explainability.

New media formats. New media formats such as web-based, VR and XR productions are increasingly entering the media sector and archival collections. Analysis and creation of annotations for these non-linear, multilayered media artefacts ask for new solutions. While this challenge does not stem directly from the SSH field, we strongly believe that SSH scholars, especially (new) media experts, can play a key role in these research efforts.

Trends related to Ethical Legal and Societal Aspects (ELSA)

Opening black boxes. Users know little about the ways in which their queries produce results. Currently used algorithms, while expediting access, usually do not account for potential bias, incompleteness of data, unless they are designed and trained to do so. New generations of AI solutions need to remedy this lack of knowledge by developing self-correcting, contextualising and human decision-enabling tools that increase the user's confidence and ability to "make sense" of the data.

Shared infrastructures. Shared infrastructures that support the exchange and reusability of datasets, trained models and best practices will provide a significant push towards the emergence of better tailored AI solutions for SSH and the wider media sector. In particular, the creation of Data Spaces will offer opportunities to train algorithms on more diverse, cross-institutional datasets.

Convergence of models. AI models that can perform multiple tasks dealing with different modalities of media content (combining visual, textual and audio analysis) will render AI-based research methods much better suited for the needs of SSH scholars.

Interdisciplinary projects. The growing number of SSH researchers equipped with computational skills is going to result in more meaningful interdisciplinary collaboration in the field. Currently, many projects at the intersection of AI and SSH are still driven by either technology or theory. In the future, we hope to see theoretical approaches from SSH playing an equally important role as technology-focused research, and in particular strongly permeating data collection and model training practices.

Goals for next 10 or 20 years

Towards customisability. SSH scholars approach digital tools with requirements that are very specific to their research questions and cannot be always satisfied with generic solutions. The attractiveness of AI techniques in this field will dramatically increase with the growing customisability of AI-based research tools. Users should be able to adjust and experiment with the parameters of such tools and fine-tune existing models with custom concepts relevant for their research (for instance, by using few shot learning), as well as set up collaborative experimentation environments where they can compare their analyses. This would not only enable researchers to get more satisfactory and meaningful results, but also improve their overall trust in AI techniques and critically engage with them.

Aim for meaningful interdisciplinarity. With a growing number of concerns about biases and social injustices replicated and amplified by commercial AI systems, the intersection between AI experts and SSH scholars has the potential to grow in significance, with the goal to question current practices and collaboratively develop more equitable solutions. The critical analytical approach that SSH scholars apply when working with AI tools would result not only in better tailored research tools but also produce better AI models and practices that could be transferred to wider societal contexts. To achieve this, it is of essence to strengthen interdisciplinary education efforts. While digital literacy skills are becoming more commonly introduced in the humanities, the same cannot be said about exact sciences - AI and machine learning curricula lack the humanities perspective that is essential to redress algorithmic biases. Design could act as an intermediary discipline that bridges the two sides together, making it easier for technologists to translate user needs into technical requirements and interface design features and for humanities scholars to interact with and question AI tools.

Towards more equitable AI research. Access to high-quality big data will be one of the determining factors of Europe's leadership in AI for SSH and the media sector at large. Currently, social media companies dictate the rules in the market by determining who gets to access their vast datasets necessary for model training. In the next ten years, we hope to see heritage organisations emerging as strong competitors in this domain, offering access to high-quality, culturally-aware and contextualised datasets. To get there, we need to see concerted advocacy efforts from the European media industry and the research community for radically increasing the openness of media collections, ensuring that scholars and machine learning engineers have

the right resources and skills to develop AI tools. The European legislative framework for AI[14] can play a crucial role here by positioning open collaboration and resource sharing as essential ingredients of AI research that can elevate Europe's economic and societal wellbeing.

[14] European Commission, A European approach to artificial intelligence: https://digital-strategy.ec.europa.eu/en/policies/european-approach-artificial-intelligence

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