AI4media
ARTIFICIAL INTELLIGENCE FOR THE MEDIA AND SOCIETY

D7.2

Extended version of the integration result with the AI-on-Demand Platform

Project Title	AI4Media - A European Excellence Centre for Media, Society and Democracy
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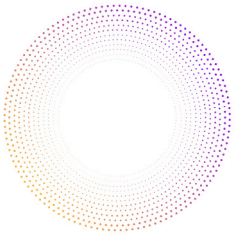

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Abstract	This deliverable is the extended version of AI4Media's integration with the European AI-on-Demand Platform. Being of type demonstrator, it essentially consists of the AI4Media assets in the AI Assets Catalog, the AI-Cafes lectures, the AI4Media models in the AI4EU Experiments marketplace, a concept for interoperability with other media platforms and examples for the technical integration of models into other media platforms. Altogether, these items show that the integration is working as intended.

Keywords	AI-on-Demand Platform, AIoD, integration, AI Assets Catalog, community building, AI4EU Experiments, interoperability, AI-Cafe

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Revision History

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0.1	24/04/2023	Sven Becker	Initial version using template v8
0.2	12/06/2023	Maurizio Montagnuolo	Modifications regarding RAI Concept Book
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0.5	13/06/2023	Sven Becker	Executive Summary and Conclusions
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0.8	18/08/2023	Sven Becker	Update of numbers and final check of references
1.0	23/08/2023	Sven Becker	Final version to be submitted to the EC

Table of Abbreviations and Acronyms

Abbreviation	Meaning
AI	Artificial Intelligence
ADRA	AI, Data and Robotics Association
AI4EU	Project: A European AI-on-Demand Platform and Ecosystem
AIoD	AI-on-Demand Platform
API	Application programming interface
AUTH	Aristotle University of Thessaloniki
CERTH	Centre for Research and Technology Hellas
Claire	Confederation of Laboratories for Artificial Intelligence Research in Europe
CNR	Consiglio Nazionale delle Ricerche
CoEC	Center of Excellence in Combustion
D	Deliverable
DoA	Description of action
FHG-IAIS	Fraunhofer Institute for Intelligent Analysis and Information Systems
FHG-IDMT	Fraunhofer Institute for Digital Media Technology
FocusCoE	Concerted action for the European HPC CoEs
GAR	Grassroots Arts and Research
GDPR	General Data Protection Regulation
gRPC	The acronym is derived from Google Remote Procedure Call, but is used as a proper name
H2020	Horizon 2020 Framework Programme
HiDALGO	HPC and Big Data Technologies for Global Systems
ICT	Information and Communication Technologies
JR	Joanneum Research
JSON	JavaScript Object Notation
KI.NRW	Competence platform for artificial intelligence in North Rhine-Westphalia
KPI	Key performance indicator
KUL	Katholieke Universiteit Leuven
MBD	Mindbugs Discovery
ML	Machine learning
NER	Named Entity Recognition
OCR	Optical character recognition
Protobuf	Protocol Buffers
RAI	Radiotelevisione Italiana Spa
RAISE	European Center of Excellence in Exascale Computing “Research on AI- and Simulation-Based Engineering at Exascale”
REST	Representational State Transfer
T	Task
UC	Use case
UI	User interface
UNITN	Università degli Studi di Trento
URL	Uniform resource locator
WP	Work package

AIoD Terminology

In the context of the AI-on-Demand Platform (AIoD) and the AI4Media project, some terms are frequently used. The terms are used in a certain spelling and with a specific meaning. To make the meaning understandable to the reader, these terms are defined below. It should be noted, however, that not all persons in the AIoD environment use each of these terms with the same meaning. To that extent, the following definition is a delineation to clarify the meaning in the context of this document.

Term	Meaning
AI Asset	An entry in the AI Assets Catalog of the AIoD website consisting of a textual description in predefined metadata fields, web links and an image. An AI asset can be of type Service, Dataset, Docker container, Executable, Jupyter Notebook, Library, ML Model, Tutorial
AI Assets Catalog[1]	List of all AI assets that have been contributed to the AIoD website.
AI component / Component	General term for a part of AI related software, data or system used throughout the DoA of AI4Media.
AI model (in AI4EU Experiments Marketplace)	Metadata record for a Docker container that conforms to the AI4EU container specification. AI4EU Experiments only stores references to docker images (docker image URIs), never the images directly. An AI model can also contain a dataset which is made accessible by so called data brokers. They make the data available as one of the input nodes for a pipeline. They are not uploaded to the platform. Datasets themselves are not uploaded to the platform. AI4EU experiments pipelines (aka composite solutions) are also published as AI models in the Marketplace.
AI model / ML model / data model	In general language usage this refers to a derivate of data produced by some technology. A model has been generated from training data that is processed by some algorithms and is used for the inference of AI/ML tasks.
AI module / Module	General term for a part of AI related software, data or system mainly used in WP8 of the Description of action (DoA)of AI4Media.
AI resource	General term for AI related tools, data and models used in context of the AIoD and in WP7 of the DoA of AI4Media.
AI-Cafe	Live web lecture.
AI-Lab Playground	Execution environment for AI models.
AI-on-Demand Platform	Abbreviation: AIoD Alternative use: AIoD Platform
AI4EU Experiments[2]	Technical part of the AIoD providing a marketplace for AI models and a GUI-based application for the creation of AI experiments.

[1] https://www.ai4europe.eu/research/ai-catalog, last visited 18/08/2023
[2] https://aiexp.ai4europe.eu/#/home, last visited 18/08/2023

	AI4Europe is using the alternative name AI4Experiments.
AI4EU Experiments Design Studio	GUI-based application for the creation of AI experiments integrated in AI4EU Experiments.
AI4EU Experiments Marketplace	Catalogue of AI models available in AI4EU Experiments
Composite solution	In AI4EU Experiments this term is used for AI pipelines, stressing that a pipeline is composed of several models.
Contribution Gateway	Part of the AIoD website for the contribution of content by the AI community
gRPC Interface	gRPC is an open source remote procedure call (RPC) framework initially created by Google. The gRPC interface allows for the seamless communication and interaction between different software systems. By default, gRPC uses Protocol Buffers.
Protobuf definitions	Protobuf definitions are structured data schemas defined using the Protocol Buffers (Protobuf) language. They specify the format and structure of data that can be serialized and transmitted between different programming languages and software systems.
Solution	In the AcuCompose Design Studio of AI4EU Experiments, this is a category for AI pipelines.

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1 Executive Summary

The deliverable D7.2 is the second out of three iterations (initial/extended/final version) to present the results of the tasks T7.1 to T7.4 from work package 7 (WP7) of AI4Media. As the purpose of WP7 is the integration of AI4Media outcomes with the European AI-on-Demand Platform (AIoD), this deliverable provides information about this integration and proves that it has been very successful so far.

The AIoD is a community-driven channel designed to empower European research and innovation in Artificial Intelligence (AI). It aims to bring together the AI community while promoting European values, and to facilitate technology transfer from research to industry. Users can contribute AI-related knowledge, assets, services or tools as well as make use of numerous resources available, including educational resources.

The type of this deliverable is "demonstrator". Unlike other deliverables provided by AI4Media, this means that it is publicly available content representing the results of tasks T7.1 to T7.4 up to the time of submission. In particular, it should be noted that the essence of this deliverable is not this document. It serves as an entry point/index for the related sub-deliverables, providing links pointing to these publicly available components.

Section 2 provides an introduction to the scope of work of WP7 as well as the integration of AI4Media outcomes into the AIoD. A detailed description of the results of tasks T7.1 to T7.4 is given in sections 3 to 6.

The publicly available components of this deliverable are the following:

- Content on the AIoD website including assets in the AI Assets Catalog which are linked to AI4Media[3]
- AI-Cafes (lectures) published on the public AI-Cafe video channel[4] as well as on the AI-Cafe YouTube channel[5]
- AI models contributed by AI4Media to the AI4EU Experiments Marketplace (see section 10)
- AI pipelines created by AI4Media for different experiments and published in the AI4EU Experiments Marketplace (see section 5.4)
- Showcases for the interoperability of AI4EU Experiments with other media platforms (see section 6)
- Open call challenge developed for the contribution of a new experiment to AI4EU Experiments (see section 5.5)

[3] https://www.ai4europe.eu/ai-community/projects/ai4media?category=ai_assets, last visited 18/08/2023
[4] https://www.gotostage.com/channel/ai-cafe, last visited 18/08/2023
[5] https://www.youtube.com/channel/UCWjwTdAPRKHVcj6zudV6ZXQ, last visited 18/08/2023

These results are complemented by the results already presented in detail in the previous version of this deliverable, i.e. D7.1 (Integration plan and initial version of the integration result with the AI-on-Demand Platform):

- First public demonstrator of a working AI pipeline[6]
- Concept for interoperability with the Fraunhofer Mining Platform
    - Slides of the presentation[7]
    - Recording of the presentation[8]
- Summary of the results from a survey regarding candidate platforms for achieving interoperability with AI4EU Experiments (D7.1[9], section 6.1)

Altogether, these components constitute the extended version of AI4Media's integration with the AIoD.

[6] https://dev01.ki-lab.nrw/ai4media/d7_1/demo.html, last visited 18/08/2023
[7] https://www.ai4media.eu/wp-content/uploads/2021/12/AI4Media_WP7_Workshop_2021-11-11_5_Fisseler_compressed.pdf, last visited 18/08/2023
[8] https://www.youtube.com/watch?v=tu89N8n0zEk&t=8214s, last visited 18/08/2023
[9] Document is available for download at https://www.ai4media.eu/wp-content/uploads/2022/03/AI4Media_D7.1_final.pdf, last visited 22/08/2023

2 Introduction

As it is stated on its own website, the European "AI-on-Demand Platform (AIoD) is a community-driven channel designed to empower European research and innovation in Artificial Intelligence (AI), while ensuring the European seal of quality, trustworthiness and explainability"[10]. The aim of this platform, which has been initiated by the AI4EU project[11] and is currently being continued by the AI4Europe project[12], is to bring together the AI community while promoting European values, and to facilitate technology transfer from research to industry. Being one of the Networks of Excellence of the H2020-ICT-48 programme,[13] AI4Media is committed to the AIoD by integrating the project's outputs such as modules, services, algorithms, and datasets into the platform as well as by organizing AI-Cafes for community building, sharing news and events. Due to these activities, AI4Media is one of the pillars for ensuring the sustainability of the AIoD over years to come.

2.1 About the document

This document is part of a series of deliverables that build on each other in terms of time and content:

- D7.1 - Integration plan and initial version of the integration result with the AI-on-Demand Platform[14] (delivered in M16)
- D7.2 - Extended version of the integration result with the AI-On-Demand Platform (delivered in M36)
- D7.4 - Final version of the integration result with the AI-On-Demand Platform (to be delivered in M48)

For this reason, the content of this document builds on the previous version. The document structure has been retained as far as possible. Contents were updated, partially summarized, and supplemented by reports on further activities and new results.

2.2 AI4Media's integration with the AI-on-Demand Platform

In January 2019, the AI4EU consortium was established to build the first European AIoD and ecosystem with the support of the European Commission under the H2020 programme. As more and more features are integrated, the AIoD serves as a catalyst to aid AI-based innovation, resulting in new products, services, and solutions to benefit European industry, commerce and society. By bringing people together, the platform counterbalances the fragmentation of the European AI landscape.

[10] https://www.ai4europe.eu/, last visited 18/08/2023
[11] For details see https://cordis.europa.eu/project/id/825619, last visited 18/08/2023
[12] For details see https://cordis.europa.eu/project/id/101070000, last visited 18/08/2023
[13] For details see https://cordis.europa.eu/programme/id/H2020_ICT-48-2020, last visited 18/08/2023
[14] Document is available for download at https://www.ai4media.eu/wp-content/uploads/2022/03/AI4Media_D7.1_final.pdf, last visited 18/08/2023

Following the efforts of AI4EU, in 2022, the AI4Europe project has taken over the responsibility for operations and further development of the AIoD. This is supported by the projects within the funding H2020 initiatives ICT-48 and ICT-49 by integrating new assets and features. Within AI4Media, WP7 has been established for exactly this purpose. In fact, the integration of AI4Media outcomes with the platform covers a wide spectrum of aspects, which are reflected by the different sub-tasks of this work package:

- T7.1 Publication of AI resources to the AI-on-Demand Platform
- T7.2 Community building using the AI-on-Demand Platform
- T7.3 Using and supporting the experimentation services of the AI-on-Demand Platform
- T7.4 Achieving interoperability between the AI-on-Demand Platform and media platforms
- T7.5 Platform liability vs. platform responsibility for third party content
- T7.6 Management of the European AI-on-Demand platform, development and operation of AI4EU Experiments

The results achieved so far for the tasks T7.1 to T7.4 and T7.6 are described, in this order, in the following sections of D7.2. The task T7.5 will have its own deliverable (D7.3) and is thus not represented in this document.

The full spectrum of all possibilities for integrating project results into the various AIoD offerings is illustrated by the example of the multilingual named entity recognition (NER) by Fraunhofer. This component has been published as an AI Asset[15]. It was onboarded to AI4EU Experiments Marketplace with different interfaces[16] to support different pipelines[17] built on AI4EU Experiments as well as integrations into media platforms. The interoperability to use the component was proven by the integration into the Fraunhofer Mining Platform as a mining service and into the RAI Concept Book application in the context of use case 3 of WP8. Furthermore, the multilingual NER component has been presented in an AI-Cafe[18] in 2022.

[15] https://www.ai4europe.eu/research/ai-catalog/entity-recognizer, last visited 18/08/2023
[16] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=e3794e16-0225-4bf1-a99c-b99638a22232&revisionId=f7447500-0c8d-4ca7-be7e-24ce3fefd144, https://aiexp.ai4europe.eu/index.html#/marketSolutions?solutionId=e3794e16-0225-4bf1-a99c-b99638a22232&revisionId=41df686d-9fa3-4104-996f-fa926332adbb, https://aiexp.ai4europe.eu/index.html#/marketSolutions?solutionId=e3794e16-0225-4bf1-a99c-b99638a22232&revisionId=7220ac2a-a908-46df-a58d-bad87bbbad23, https://aiexp.ai4europe.eu/index.html#/marketSolutions?solutionId=27e777bc-2968-427c-9df5-9f5593613475&revisionId=77f58af9-73d4-48b8-9237-7c6e1d3cdb97, last visited 18/08/2023
[17] ner-pipeline: https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=612a819c-66fe-4ac4-86ae-b04e95ef4624&revisionId=a63bc9db-1691-45ca-a022-98e89ff43fd5,
AI4Media Demo: https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=a87cb119-168c-45b0-9a3e-6963396c1acf&revisionId=ca6125ff-b507-4c9a-b223-5440316a15d4, last visited 18/08/2023
[18] Recording on: https://www.youtube.com/watch?v=MfGhPjqYBbQ, last visited 18/08/2023

2.3 Further activities of WP7

WP7 has organized a public AI4Media workshop[19] on the AIoD, which took place on 11 November 2021. The goals of this workshop were:

- to create a better understanding of the technical and non-technical facets of the AIoD
- to highlight the role of the platform as the central link between the European AI networks
- to encourage everyone interested in AI to join it

A recording[20] of the workshop is available in AI4Media's YouTube channel[21].

2.4 Acknowledgements

The core part of this deliverable are the contributions from AI4Media to the AIoD. Therefore, we would like to thank all contributors for their input and all AI4Media partners for their support.

[19] See https://www.ai4media.eu/event/ai4media-workshop-on-the-ai-on-demand-platform/, last visited 18/08/2023
[20] https://www.youtube.com/watch?v=tu89N8n0zEk, last visited 18/08/2023
[21] https://www.youtube.com/channel/UCuy1hzpZpLiFwJmoIlrRiKQ, last visited 18/08/2023

3 Publications on the AIoD website

The AIoD website is a community-driven channel that allows participating projects to publish different types of content. An essential part of the website is the AI Assets Catalog, which allows searching all registered AI resources. AI4Media ensures that AI resources developed within the AI4Media project are published to the AI Assets Catalog of the AIoD.

Section 3 summarises the outcomes of the activities performed in the context of Task 7.1 "Publication of AI resources to the AI-on-Demand Platform".

3.1 Community contributed content on the AIoD website

In addition to the publication of AI assets, projects can publish news, events, educational resources, open calls and more content types on the website. As part of the AIoD website, the Contribution Gateway is offered, to allow any registered user holding an EU Login to contribute content to the platform.

So far, AI4Media contributed all AI-Cafes, other public events, both open calls, selected news, and a significant number of AIDA courses to the content repository of the AIoD. Figure 1 provides an overview of content contributed to the AIoD website by AI4Media broken down by content type.

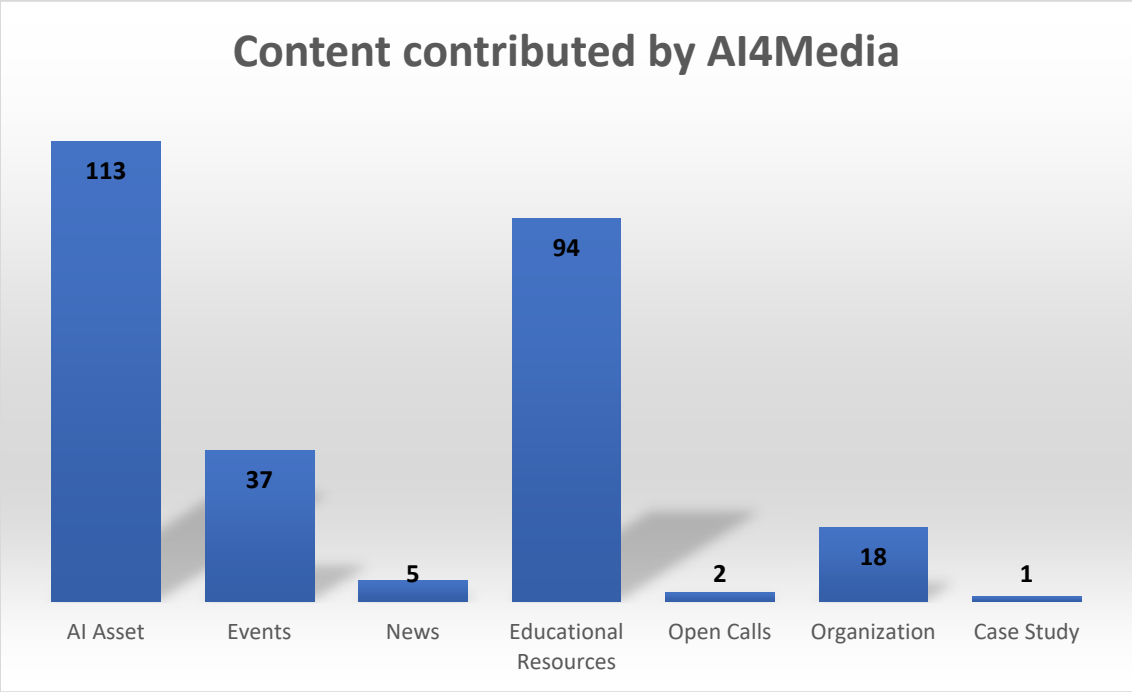

Figure 1: Content contributed by AI4Media to the AIoD website[22].

[22] Numbers as of 18/08/2023

3.2 AI Assets contributed by AI4Media

The AI Assets Catalog of the AIoD allows the publication of a variety of types of assets. An asset can be of the type:

- AI as a service
- Dataset
- Docker container
- Executable
- Jupyter Notebook
- Library
- ML Model
- Tutorial

Each asset is published by its creator, who contributes the necessary detailed information. The quality of the assets is ensured by predefined mandatory and optional meta data fields and the moderation process established by the platform. Each asset shall contain detailed information about the respective resource including a textual description, links to relevant documents, the license, a classification regarding research area and technical category, and keywords. In addition, information can be provided about the trustworthiness of the asset and applicable GDPR requirements. Figure 4 provides an example for an AI asset.

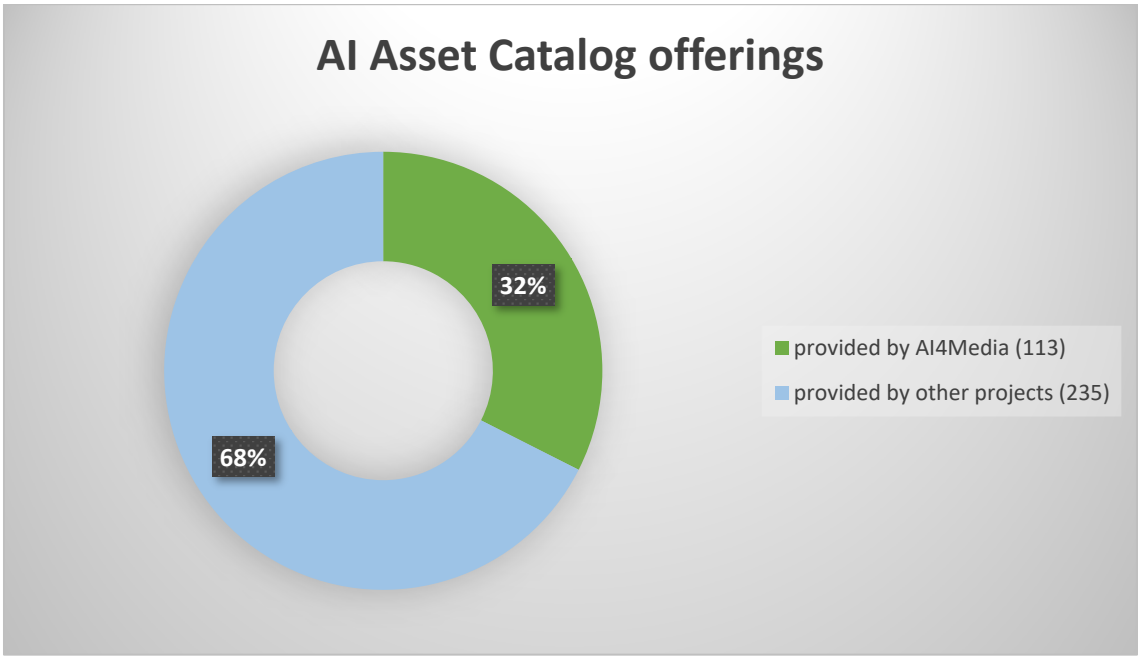

Figure 2: AI Asset in the Catalog (contributions from AI4Media compared to other contributions)[23].

[23] Numbers as of 18/08/2023

At the time of creation of this deliverable, there are **113 AI assets** published in the AI Assets Catalog which are linked to AI4Media. In relation to the total number of 348 published entries, it can be seen that AI4Media has contributed a significant share to the Asset Catalog offering. Figure 3 provides an overview of these assets broken down by asset type. Section 9 "Appendix 1: List of AI assets in Assets Catalog" contains a detailed list of these assets. An overview, including any updates which meanwhile might have been applied, can also be accessed on the AI4Media project page on the AIoD website[24]. The publication of further AI assets is an ongoing process that will continue for the remaining duration of the project. For an up-to-date list of published AI assets please always visit the AI4Media project page online.

In addition to the publication of AI assets on the AIoD, it should also be noted that some partners of the consortium have published project results such as datasets and software on other platforms such as GitHub, Zenodo and other websites. The results section[25] of the AI4Media website is also linking to these resources.

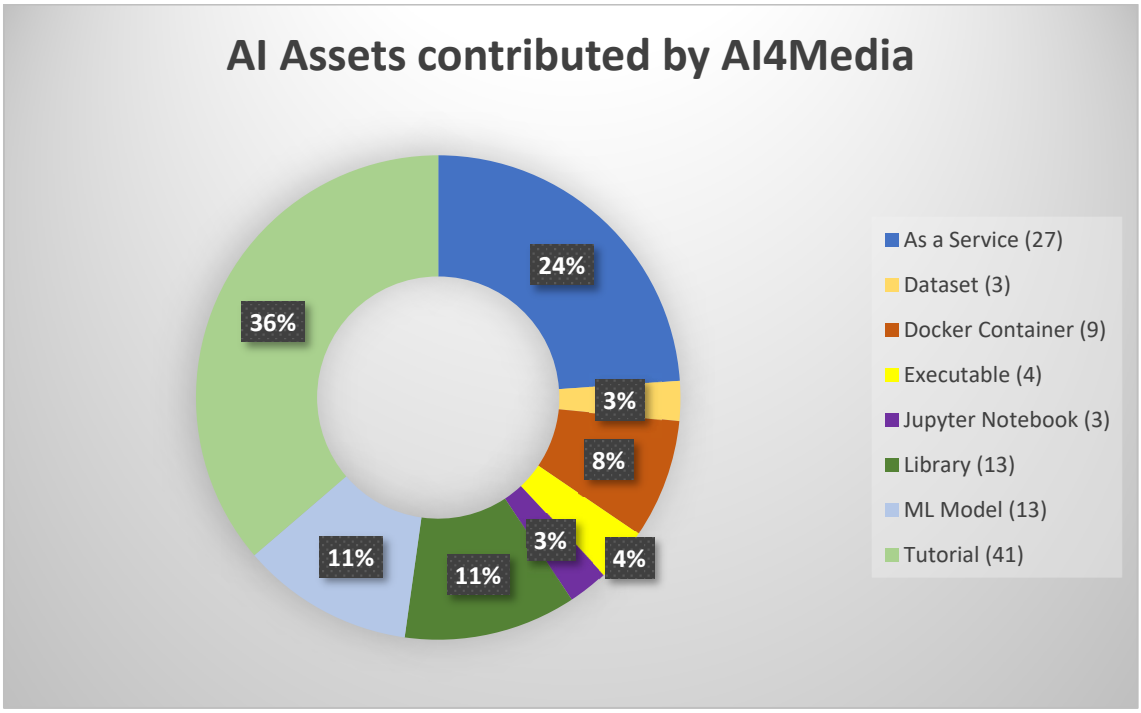

Figure 3: AI Assets contributed by AI4Media to the AIoD Assets Catalog[26].

[24] https://www.ai4europe.eu/ai-community/projects/ai4media?category=ai_assets, last visited 18/08/2023
[25] AI4Media Open Datasets: https://www.ai4media.eu/open-datasets/,
AI4Media Software: https://www.ai4media.eu/software/, both last visited 18/08/2023
[26] Numbers as of 18/08/2023

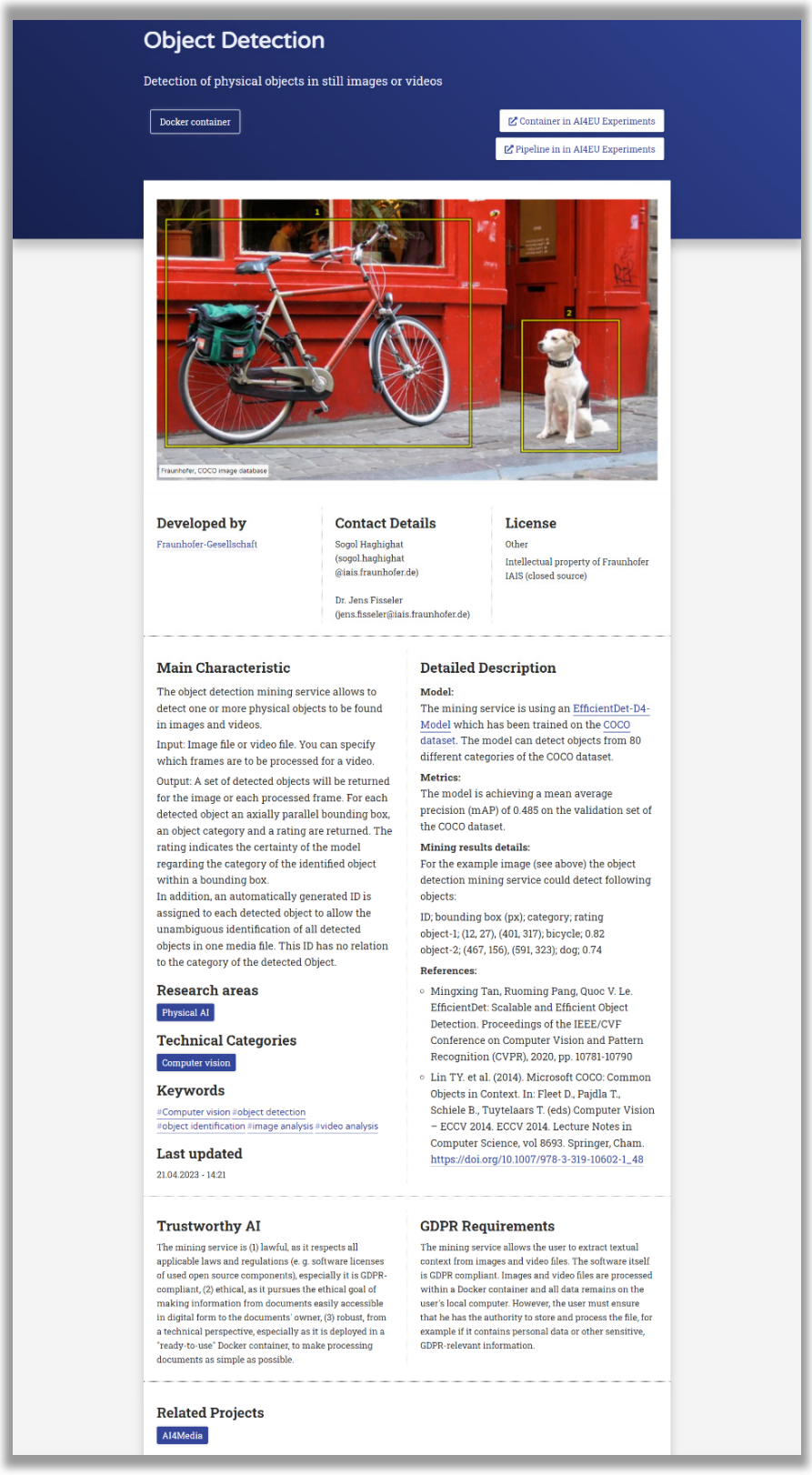

Figure 4: Example of an AI Asset contributed by AI4Media to the AIoD Assets Catalog.

4 Web AI-Cafes

AI4Media supports the community building activities of the AI-on-Demand Platform (AIoD) by offering a series of live Web Cafes[27] on AI called **AI-Cafe**. The goal of these sessions is to gain insights into the international AI scene, to share knowledge and experiences, and to meet stakeholders from various areas of AI research and application. The AI-Cafe is coordinated by the AI4Media partner Grassroots Arts (GAR).

Figure 5: AI-Cafe banner used in mass mailing.

Section 4 summarises the outcomes of the activities performed in the context of Task 7.2 "Community building using the AI-on-demand Platform".

4.1 Online Publication of AI-Cafes

Invitations for upcoming AI-Cafes are sent out by email to the AI-Cafe mailing list. Since 2022, a total of 350 people has signed up to the AI-Cafe mailing list and agreed in writing to receive AI-Cafe invitations by email from GAR. To reach non-subscribers, the AI-Cafes have been also published on the AI4Media website[28], the AIoD[29] as well as on the AI-Cafe website[30].

[27] https://www.ai4europe.eu/news-and-events/events/webcafes, last visited 18/08/2023
[28] https://www.ai4media.eu/ai-cafes/, last visited 18/08/2023
[29] https://www.ai4europe.eu/news-and-events/events?category=43, last visited 18/08/2023
[30] https://ai-cafe.eu/, last visited 18/08/2023

Figure 6: Example of AI-Cafe banner used for social media campaigns.

The AI-Cafes have been also promoted in social media comprising more than 2400 followers from Twitter, Facebook, and LinkedIn, and they have been announced through AI4Media mailing lists to more than 2200 people comprising AI4Media partners, AI4Media associate members, AIDA members, and AI4Media subscribers.

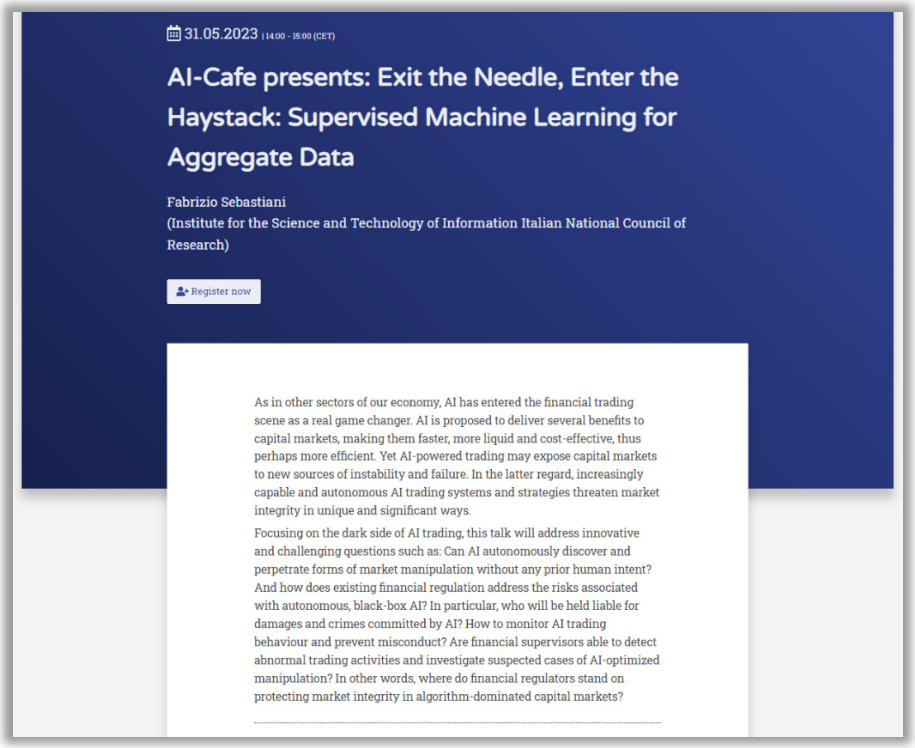

Figure 7: AI-Cafe announcement on the AIoD website.

Recordings of past AI-Cafes are only available if the speaker has consented to their publication. Some speakers do not agree with their recordings being published on a video channel such as YouTube and therefore do not allow them to be published. The 27 recordings of the past AI-Cafes where the speakers have given their consent can be found on the public AI-Cafe video channel[31] (see Figure 8) as well as on AI-Cafe YouTube channel[32] (see Figure 9).

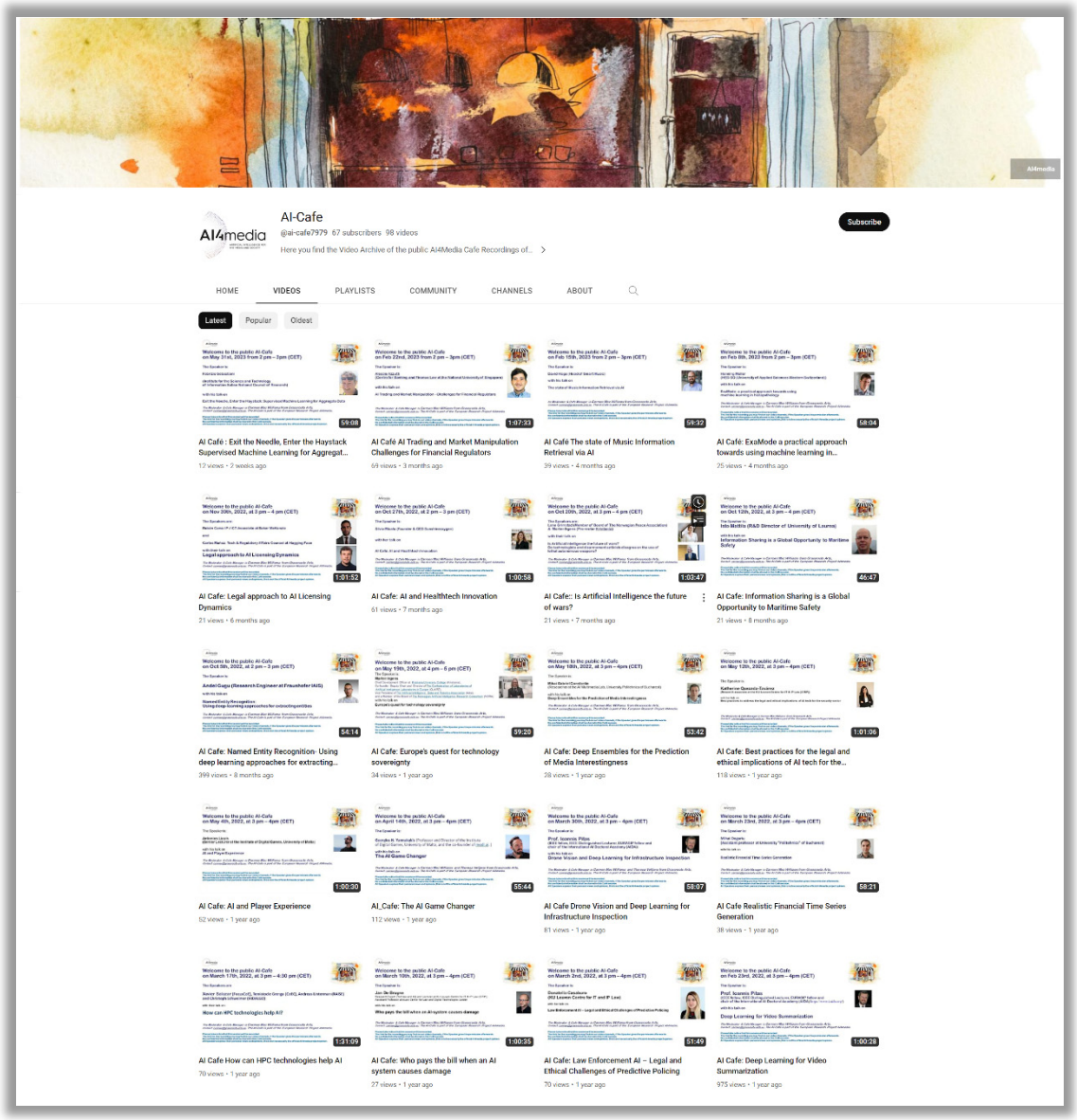

Figure 8: AI-Cafe recordings are also available on the AI-Cafe YouTube channel.

[31] https://www.gotostage.com/channel/ai-cafe, last visited 18/08/2023
[32] https://www.youtube.com/channel/UCWjwTdAPRKHVcj6zudV6ZXQ, last visited 18/08/2023

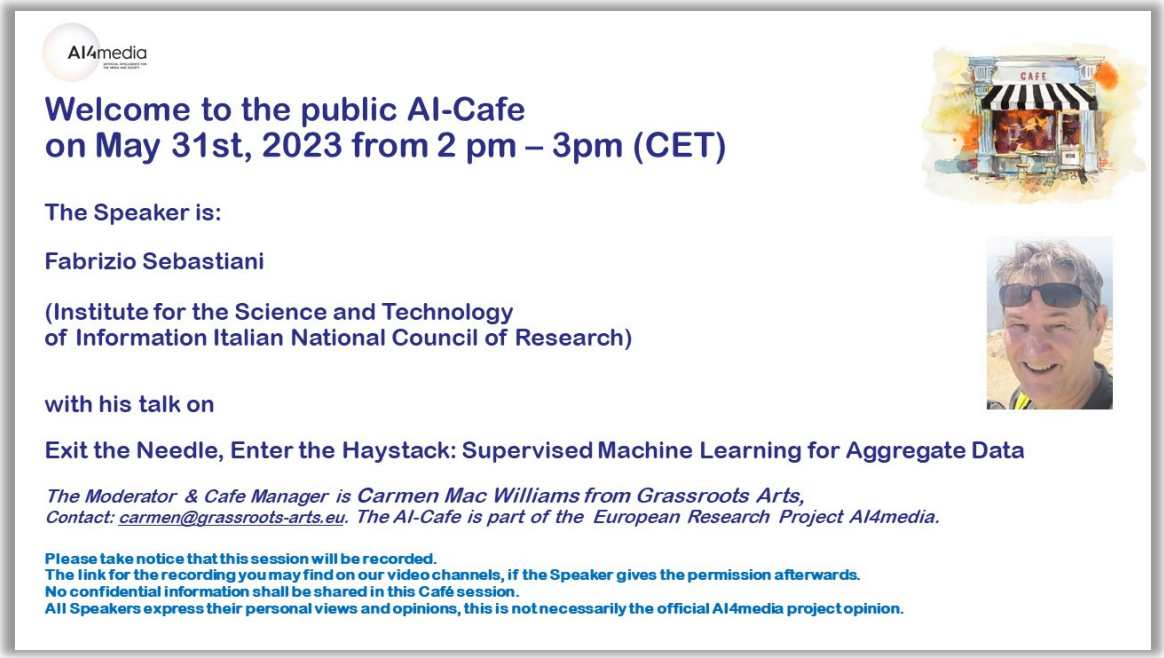

Figure 9: Thumbnail of the last AI-Cafe recording in May 2023.

4.2 Overview of the previous AI-Cafes

So far, there have been **29 AI-Cafes**. A target of 24 AI-Cafes had been defined as KPI5.4 for the project, so this KPI has already been exceeded.

In 2020/21 there have been the following 6 AI-Cafes with contributions from AI4Media members:

Number	Speaker	Affiliation	Talk Title
1	Ioannis Pitas	Aristotle University of Thessaloniki	Face De-identification for privacy protection
2	Yiannis Kompatsiaris	Centre for Research and Technology Hellas	A European Centre for Media, Society and Democracy
3	Symeon Papadopoulos	Centre for Research and Technology Hellas	Deepfakes: An Emerging Internet Threat and their Detection
4	Hannes Fassold	Joanneum Research	Employing AI for the semantic analysis of conventional and immersive video
5	Roberto Iacoviello	Radiotelevisione Italiana	Video Compression turns to Artificial Intelligence

6	Nicu Sebe	University of Trento	Image and Video Generation: A Deep Learning Approach

Table 1: Web AI-Cafes with contributions from AI4Media members in 2020/21 (titles are linked to video recordings[33]).

In 2022, there have been the following 19 AI-Cafes:

Number	Speaker	Affiliation	Talk Title
7	Mark Duranton	Commissariat à l'Énergie Atomique et aux Énergies Alternatives	The Convergence of AI, Cyber-Physical Systems, the Continuum of computing: the next evolution of the Internet
8	Stefan Wellsandt	Bremer Institut für Produktion und Logistik	Applying Digital Intelligent Assistants in Manufacturing
9	Ioannis Pitas	Aristotle University of Thessaloniki	Deep Learning for Video Summarization
10	Donatella Casaburo	KU Leuven Centre for IT & IP Law	Law Enforcement AI – Legal and Ethical Challenges of Predictive Policing
11	Jan De Bruyne	KU Leuven Centre for IT & IP Law	Who Pays the Bill when AI Causes Damage?
12	Temistocle Grenga, Andreas Lintermann, Xavier Salazar, Christoph Schweimer	CoEC, RAISE, FocusCoE, HiDALGO	How can HPC technologies help AI?
13	Mihai Dogariu	University Politehnica of Bucharest	Realistic Financial Time Series Generation
14	Ioannis Pitas	Aristotle University of Thessaloniki	Drone Vision and Deep Learning for Infrastructure Inspection
15	Georgio Yannakakis	University of Malta	The AI Game Changer
16	Antonios Liapis	University of Malta	Artificial Intelligence and Player Experience
17	Katherine Quezada-Tavárez	KU Leuven Centre for IT & IP Law	Best practices for the legal and ethical implications of AI tech for the security sector
18	Mihai Gabriel Constantin	University Politehnica of Bucharest	Deep Ensembles for the Prediction of Media Interestingness

[33] All links were last visited 18/08/2023

19	Morten Irgens	ADRA/Claire	Europe's Dream of Tech Sovereignty
20	Andel Gugu	Fraunhofer IAIS	Named Entity Recognition: Using deep-learning approaches for extracting entities
21	Isto Mattila	University of Laurea	Information Sharing is a Global Opportunity for Maritime Safety
22	Morten Irgens, Lene Grimstad	Kristiania University College, The Norwegian Peace Association	Is Artificial Intelligence the future of wars? Do technologists and disarmament activists disagree on the use of lethal autonomous weapons?
23	Silvia Micalo	Sunshineoxygen	Artificial Intelligence and Healthtech
24	Rubén Cano, Carlos Muñoz	Baker McKenzie, Hugging Face	Legal approach to AI Licensing Dynamics
25	Anastasia Siapka	Katholieke Universiteit Leuven	AI and the Future of Work

Table 2: Web AI-Cafes in 2022 (titles are linked to video recordings[34], if available).

Finally, in 2023 there have been so far the following 4 AI-Cafes:

Number	Speaker	Affiliation	Talk Title
26	Henning Müller	HES-SO Valais-Wallis	ExaMode: a practical approach towards using machine learning in histopathology
27	David Hoga	Songtradr Inc.	The state of Music Information Retrieval via AI
28	Alessio Azzutti	National University of Singapore, Centre for Banking and Finance Law	AI Trading and Market Manipulation - Challenges for Financial Regulators
29	Fabrizio Sebastiani	Consiglio Nazionale delle Ricerche	Exit the Needle, Enter the Haystack: Supervised Machine Learning for Aggregate Data

Table 3: Web AI-Cafes in 2023 (titles are linked to video recordings[34]).

4.3 Future plans: Outlook for fall 2023 and spring 2024

GAR will organise and moderate more AI-Cafes in Fall 2023 and Spring 2024 in collaboration with T7.2 Task Partners FHG-IAIS and KUL. The AI4Media use case leaders are encouraged to present their results as speakers in this season of the AI-Cafe series. Meanwhile any potential speaker can suggest an AI-Cafe to the moderator by writing to the organiser[35].

[34] All links were last visited 18/08/2023
[35] For contact details please visit https://www.gotostage.com/channel/ai-cafe, last visited 18/08/2023

5 Contributions to AI4EU Experiments

The AI4EU Experiments Marketplace[36] is a publicly accessible platform for the development, training, sharing and deployment of AI technologies. Hence, AI4EU Experiments constitutes the technical part of the AI-on-Demand Platform (AIoD).

AI4Media's partners have contributed to the AI4EU experiments in different ways. On the one hand, AI technologies have been technically integrated into the platform and published on the marketplace for general use. A selection of the resources published in the AI Assets Catalog is also technically integrated into AI4EU Experiments. However, this only applies to those types of resources where technical integration makes sense, such as datasets and Docker containers, but not to assets of other asset types. On the other hand, experiments were conducted on the platform in which AI technologies were assembled into pipelines. Each experiment was conducted for a specific purpose, to demonstrate certain functions and possibilities. The pipelines have also been published so that they can be used by others.

Section 5 summarises the outcomes of the activities performed in the context of Task 7.3 “Using and supporting the experimentation services of the AI-on-demand Platform”.

5.1 Models in AI4EU Experiments Marketplace

Resources in the marketplace are called “models”. A model consists of a few descriptive information elements, depending on the type of the model, which can be models for Docker containers or models for pipelines. Figure 10 shows an example for a model in AI4EU Experiments.

Models for Docker containers

The AI4EU Experiments Marketplace makes AI technologies accessible in a uniform format. Therefore, all contributed AI technologies are wrapped into Docker containers. A Docker container is a standardized package of files containing software and possibly data that can be executed by a Docker engine. A Docker container can also contain a dataset that can be used for training or inference of AI technologies.

Models for Docker containers, also referred to as single models, are composed of a description (text, image) of the AI technology included and associated artifacts like license information, link to the Docker container, a signature defining the interface of the model in Protocol Buffers (Protobuf) syntax (see Figure 11), author information and other optional documents. All artifacts of a model are provided for download.

Single models can be roughly divided into three different subtypes: (1) AI models that contain some kind of software for training or inference of AI tasks, (2) connector models that enable data input/output handling or user interfaces for human interaction with pipelines, and (3) dataset models that provide access to internal or remotely stored datasets. Section 10 “Appendix 2: Single models in AI4EU Experiments Marketplace” provides an overview of the

[36] https://aiexp.ai4europe.eu/#/marketPlace, last visited 18/08/2023

models in AI4EU Experiments that can be considered as useful for experiments in AI4Media. The above classification serves to facilitate the reader's assignment of the different models.

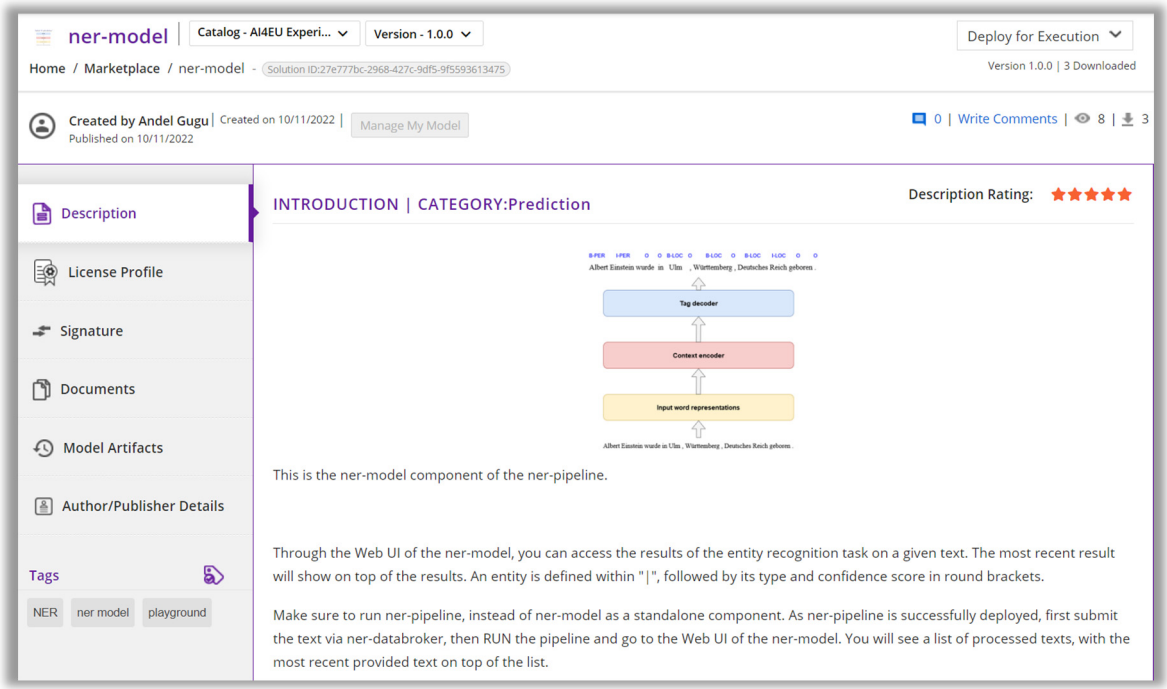

Figure 10: Description of a model in AI4EU Experiments Marketplace.

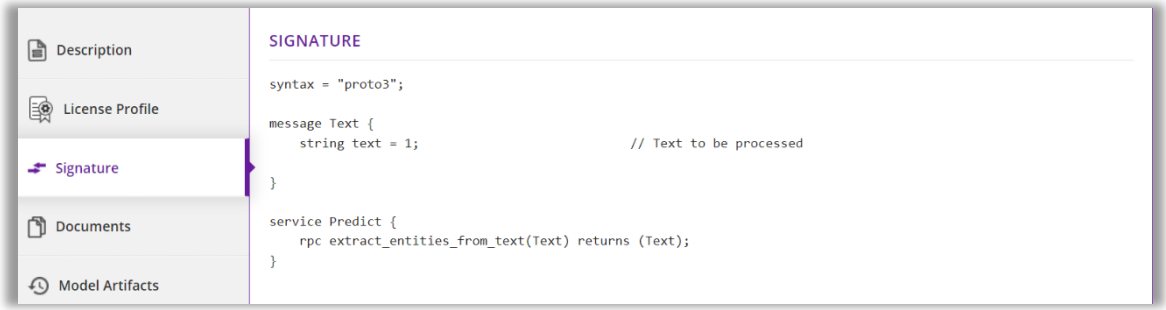

Figure 11: Protobuf signature of a model in AI4EU Experiments Marketplace.

It should be mentioned that the actual Docker container is not stored in the AI4EU Experiments. The marketplace only provides metadata and access information for these containers. The Docker containers themselves can be either publicly accessible or protected. The decision not to host any data or software in the marketplace itself, but only to offer links to external resources, was made consciously when designing the platform. This enables both freely accessible and commercially offered data and solutions to be managed equally in the marketplace without having to worry about access or intellectual property protection.

Models for pipelines

Multiple models can be joined together to build AI pipelines. Therefore, the AI4EU Experiments platform provides the Design Studio application, which is an interactive application that runs in the web browser. The Design Studio verifies the connectivity of models according to the provided Protobuf signatures. In this way, every user can compose AI pipelines and save and edit them in a personal workspace in the Design Studio application. Completed pipelines can be deployed for execution, either to a local execution environment or to the AI-Lab Playground.

Models for pipelines, also known as composite solutions, can also be published in the marketplace. An example for such a model is shown in Figure 12. Published models for pipelines are composed of a description (text, image) of the pipeline and associated artifacts like license information, author information and other optional documents. In addition, 2 text files in JSON syntax are provided, which carry all the information about the composition of the required models and their connections using the Protobuf interfaces of the models (see Figure 13).

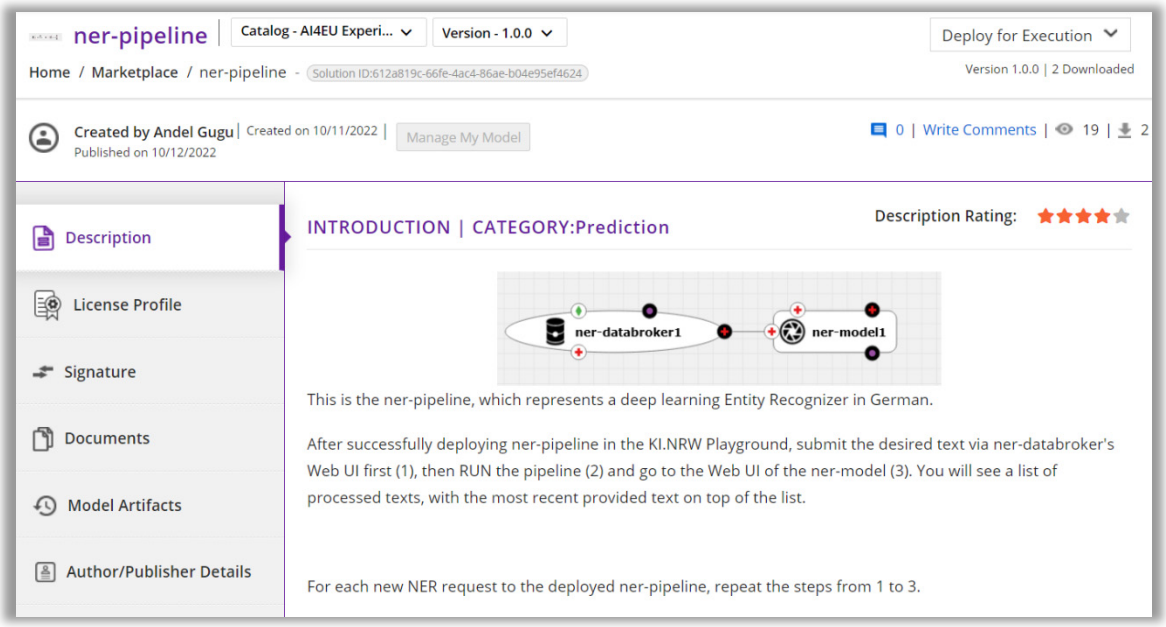

Figure 12: Pipeline model in AI4EU Experiments Marketplace.

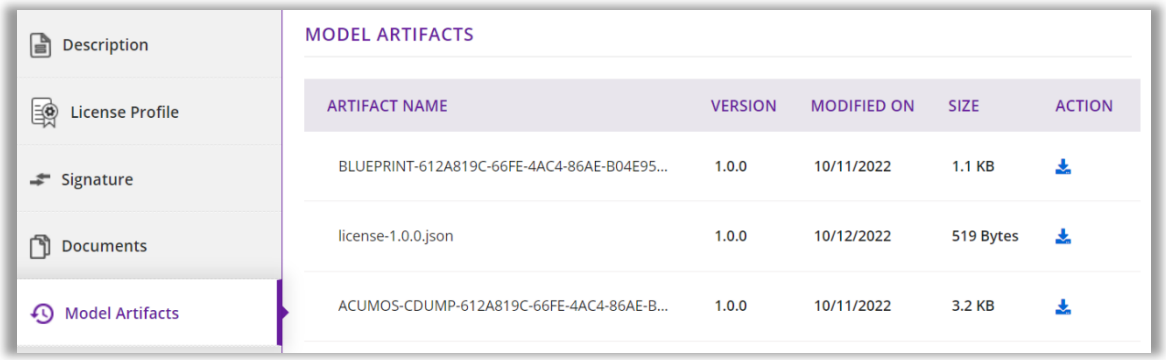

Figure 13: Artifacts of a pipeline model in AI4EU Experiments Marketplace.

Statistics about AI4EU Experiments Marketplace

The AI4EU Experiments Marketplace is available to the public since late 2021. Initial model contributions have been provided by partners of the AI4EU project. After the end of AI4EU, additional models have been provided by partners of ICT-48 and ICT-49 projects as well as AI4Europe project. In 2022, 39 models were launched, 10 of which came from AI4Media. In the period from January to August 2023, 37 models were added, 11 of which were again from AI4Media. At the time of preparation of this deliverable the marketplace included a total of 329 models[37], 40 of which were composite solutions. AI4Media contributed a total of 35 models so far (25 single models, 10 composite solutions).

5.2 Conducting experiments on the AI4EU Experiments platform

Conducting experiments on the AI4EU Experiments platform requires adherence to certain technical preconditions as well as onboarding models to the marketplace and designing pipelines with Design Studio.

As a result of the AI4EU project, some manuals and tutorials are available:

- YouTube Playlist[38] with tutorials and presentations
- Source Code Tutorials[39]
- Docker container specification[40]

This deliverable also contains a detailed technical tutorial for the construction of a pipeline in section 11 “Appendix 3: Tutorial about the technical integration in AI4EU Experiments”. Using ObjectDetection as an example, it explains the required provision of the AI technology as a Docker container, the definition of suitable model interfaces (Protobuf Definition), the onboarding of the model to AI4EU Experiments Marketplace, the design of a pipeline in Design

[37] Numbers as of 18/08/2023
[38] https://www.youtube.com/playlist?list=PLL80pOdPsmF6s6P6i2vZNoJ2G0cccwTPa, last visited 18/08/2023
[39] https://github.com/ai4eu/tutorials, last visited 18/08/2023
[40] https://github.com/ai4eu/tutorials/tree/master/Container_Specification, last visited 18/08/2023

Studio and the deployment of the pipeline to either a local execution environment or the deployment to AI-Lab Playground.

5.3 Single Models published in AI4EU Experiments Marketplace

To date, 25 single models published in AI4EU Experiments Marketplace have been provided by AI4Media[41]. Table 4 provides an overview of these models. Section 10 provides a detailed list of these models.

Type of model	Number of models
AI model	**20**
Connector model	**5**

Table 4: Number of single models in AI4EU Experiments Marketplace contributed by AI4Media broken down by model type.

5.4 AI Pipelines created in the AI4Media project

As presented in detail in deliverable D7.1[42] earlier in the project, the provision of the first publicly accessible demonstrator proved the technical feasibility of creating AI demo systems built with AI4EU Experiments.

Since then, additional pipelines have been developed by AI4Media, each designed to demonstrate different aspects of the capabilities of AI4EU Experiments and the Design Studio. Different types of media were also considered, and pipelines were developed to process images, video, audio, and text inputs. Table 5 gives an overview of the experiments conducted and pipelines published so far by AI4Media:

Pipelines	Text	Audio	Image	Video
ner-pipeline	X			
news-training-pipeline	X			
RecognaizePipeline	X		X	
sentiment-analysis-pipeline	X			
MusicDetectionPL		X		
MusicDetection-pipeline		X		
audio-pipeline		X		
ObjectDetectionPipeline			X	X
ObjectDetectionP			X	X
AI4Media Demo	X	X		

Table 5: AI4Media pipelines in AI4EU Experiments by media type (titles are linked to models in marketplace[43]).

The different aspects of the use of the platform and the requirements set with the experiments are now explained in detail.

[41] Numbers as of 18/08/2023
[42] Document is available for download at https://www.ai4media.eu/wp-content/uploads/2022/03/AI4Media_D7.1_final.pdf, last visited 22/08/2023
[43] All links were last visited 18/08/2023

Reusable input and output interfaces

Many experiments follow the same scheme of data flow. Data is passed to an AI model in the form of a file for analysis. The model stores the data in a file system, analyzes it and generates an output, often also in the form of a file. Thus, for interactive experiments, each AI model must be augmented with models for data input, storage, and output in a pipeline. To avoid that every user must develop his own implementation for data input, storage, and output, suitable connector models have been developed and published in the marketplace for general use:

- FileUploadDataBroker[44]: This simple file upload data broker can be used as a starting point for pipelines which process files. It offers a web interface with a simple file upload dialog. The uploaded files are saved on a shared volume, then the corresponding paths are sent to the next model in the pipeline.
- SharedFolderProvider[45]: The shared folder provider is a virtual node that is representing Kubernetes persistent volume. It provides a file system that can be mounted by the containers of a pipeline to store and access data at runtime.
- file-viewer[46]: The model offers a web interface to show a list of files of a dedicated shared folder and links to download the files.

These connector models were used in the following pipelines:

- MusicDetectionPL[47]
- MusicDetection-pipeline[48]
- ObjectDetectionPipeline[49]

Reproducibility of experiments

This experiment serves to prove that the construction of identical pipelines by different people is possible. Two people independently used the same models to construct and then deploy a simple pipeline using Design Studio in AI4EU Experiments. As a result of this successfully conducted experiment, both pipelines are published in the AI4EU Experiments Marketplace:

[44] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=1681c927-ae2c-41f6-9ee4-51ece5e80806&revisionId=f5f3b0cc-2486-45ac-8928-8769b89c8825, last visited 18/08/2023
[45] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=152894f9-853e-45fc-8879-7bfcb852c7a7&revisionId=4a6eea59-f40b-453b-a1d6-e1677bcb42b0, last visited 18/08/2023
[46] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=bb1c9198-b230-4cd5-bda5-866c689fc1b4&revisionId=811faf16-86aa-41a0-8720-4e4dcc352074, last visited 18/08/2023
[47] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=eea265e1-f1b8-4f5d-8694-299b37fc3d0d&revisionId=a44f39bb-56b2-4d5e-b72c-f36cd24a9992, last visited 18/08/2023
[48] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=0fc0b6dc-46e5-468b-9adf-841d9b062e51&revisionId=1b067b23-4730-4dc1-95aa-0bfc78b0a6ce, last visited 18/08/2023
[49] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=cd303086-6599-41cf-b89b-66f31f7c4f44&revisionId=0d4d73db-e069-447f-949f-2eb1bc9e98e5, last visited 18/08/2023

- MusicDetectionPL[47]
- MusicDetection-pipeline[48]

Examples with publicly accessible model containers for deployment in AI-Lab Playground

In addition to the projects funded by the European Commission, the KI.NRW competence platform[50] has contributed the AI-Lab Playground as a new subsystem to the AIoD. The AI-Lab Playground offers an execution environment for Docker containers designed for a very simple deployment of pipelines created in AI4EU experiments. It allows experimenting with AI technologies without the need to have experience with the technical deployment of Docker containers.

The AI-Lab Playground provides a web-based user interface for conducting experiments using AI technology. So far, deployments in the AI-Lab Playground require that all used Docker containers are publicly accessible. The following experiments were conducted by AI4Media to demonstrate the interaction of AI4EU Experiments and AI-Lab Playground and show the added value of the very easy Deployment of pipeline into an execution environment by clicking only one button (see Figure 14):

- ner-pipeline[51]
- news-training-pipeline[52]
- RecognaizePipeline[53]
- sentiment-analysis-pipeline[54]
- ObjectDetectionPipeline[49]

[50] https://www.ki.nrw/en/, last visited 18/08/2023
[51] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=612a819c-66fe-4ac4-86ae-b04e95ef4624&revisionId=a63bc9db-1691-45ca-a022-98e89ff43fd5, last visited 18/08/2023
[52] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=b979dabb-b461-47ae-8459-37b3f4be8851&revisionId=efe8ef3d-0d79-4347-abd7-c675411e9b50, last visited 18/08/2023
[53] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=fca70f4f-d6b7-4fed-a98a-8800b7831ef8&revisionId=c7b3cfaf-7960-472b-91e3-03b930dca96a, last visited 18/08/2023
[54] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=24269432-3dcf-42a8-a04e-463ed0c59757&revisionId=a951dffc-98f8-4914-a1d5-0fa79cb76640, last visited 18/08/2023

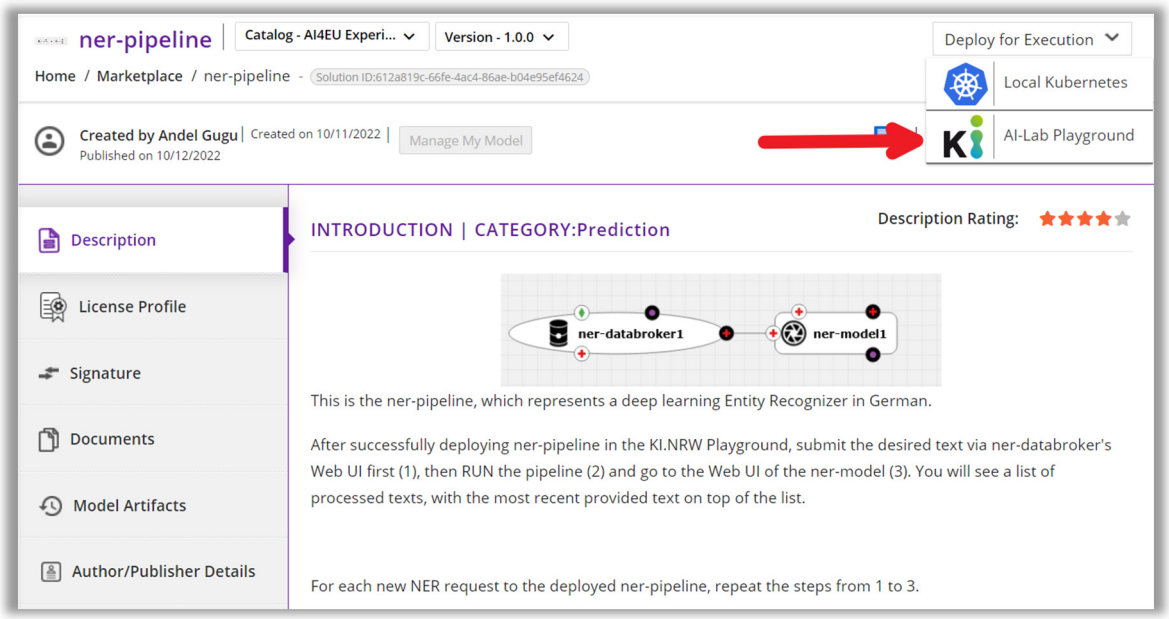

Figure 14: Deployment of a pipeline model to AI-Lab Playground in AI4EU Experiments Marketplace.

Provision of models with different interfaces for different use cases

Depending on the particular use case, there may be different requirements for the interface of an AI model. This was demonstrated in experiments using the multilingual NER as an example. AI4EU Experiments allows to onboard the AI component as different models as well as to create different versions for a model. Both approaches have been used for the experiments.

The following models and versions have been created by AI4Media to support different interfaces:

- ner-model[55]: The input interface supports the submission of plain text. The output interface provides the processed text with detected entity types and confidence values inline. This model is used in the experiment of ner-pipeline[51] (see Figure 15).
- EntityRecognizer 1.0.0[56]: The input interface supports a text stream that is created by SpeechRecognition[57] model for live speech-to-text transformation. The output interface provides a list of detected entities with their respective confidence values.

[55] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=27e777bc-2968-427c-9df5-9f5593613475&revisionId=77f58af9-73d4-48b8-9237-7c6e1d3cdb97, last visited 18/08/2023
[56] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=e3794e16-0225-4bf1-a99c-b99638a22232&revisionId=f7447500-0c8d-4ca7-be7e-24ce3fefd144, last visited 18/08/2023
[57] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=65f43abe-ea13-45d1-9078-ce7fbbcb0d07&revisionId=3057c3ee-99e6-42f8-b398-05290d643917, last visited 18/08/2023

- EntityRecognizer 1.0.1[58]: The input interface a text stream like version 1.0.0. The output interface provides the processed text with detected entity types inline. This model is used in the experiment of AI4Media Demo[59] (see Figure 16).
- EntityRecognizer 1.0.2[60]: The input interface supports the submission of plain text. The output interface provides a list of detected entities with their entity types, respective confidence values and text position. This model is used in the experiment of RAI Concept Book system in the UC3 demonstrator (see Figure 17).

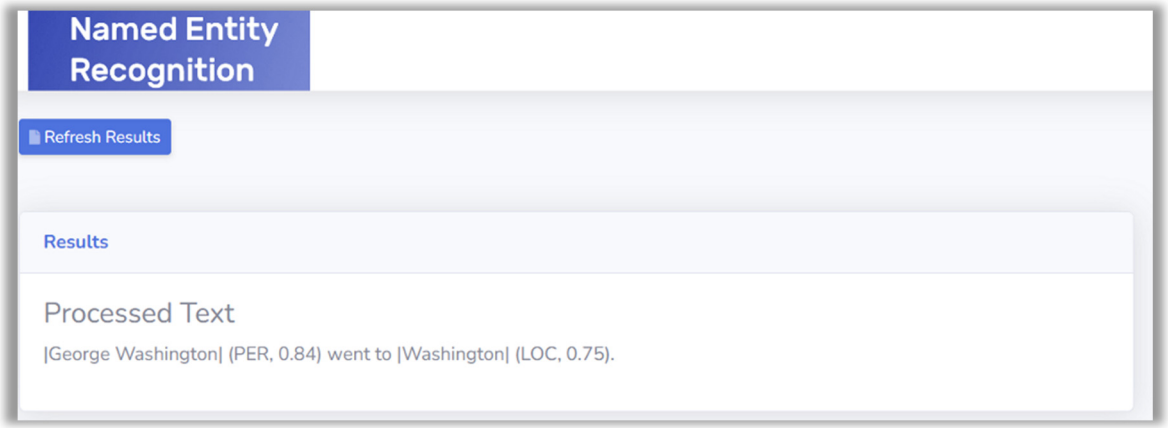

Figure 15: User interface of ner-pipeline presenting the result of ner-model output.

[58] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=e3794e16-0225-4bf1-a99c-b99638a22232&revisionId=41df686d-9fa3-4104-996f-fa926332adbb, last visited 18/08/2023
[59] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=a87cb119-168c-45b0-9a3e-6963396c1acf&revisionId=ca6125ff-b507-4c9a-b223-5440316a15d4, last visited 18/08/2023
[60] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=e3794e16-0225-4bf1-a99c-b99638a22232&revisionId=7220ac2a-a908-46df-a58d-bad87bbbad23, last visited 18/08/2023

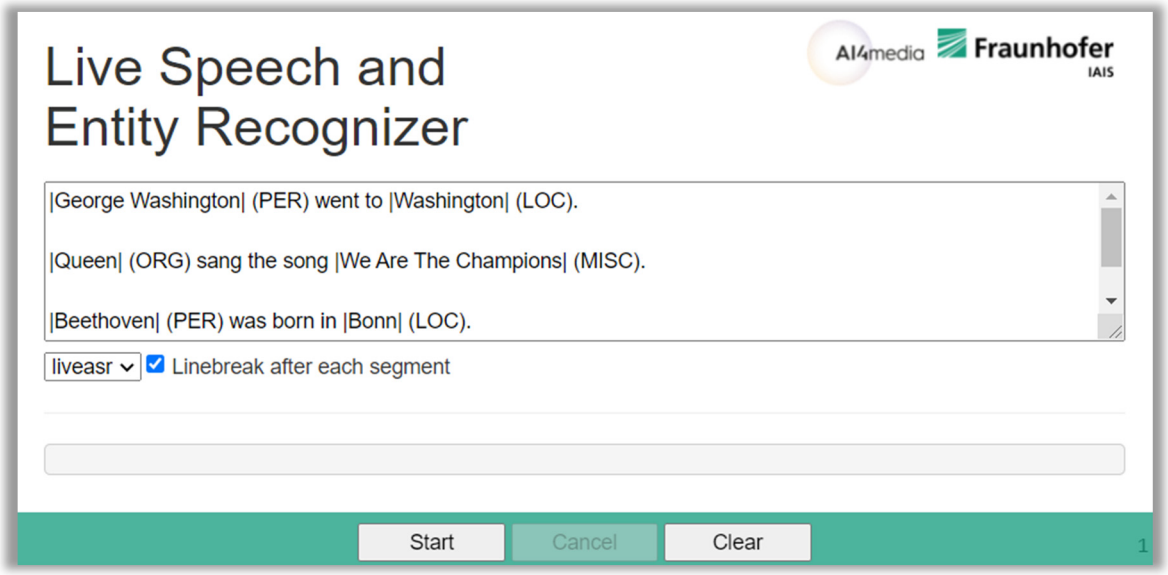

Figure 16: User interface of AI4Media Demonstrator using the result of EntityRecognizer 1.0.1 model output.

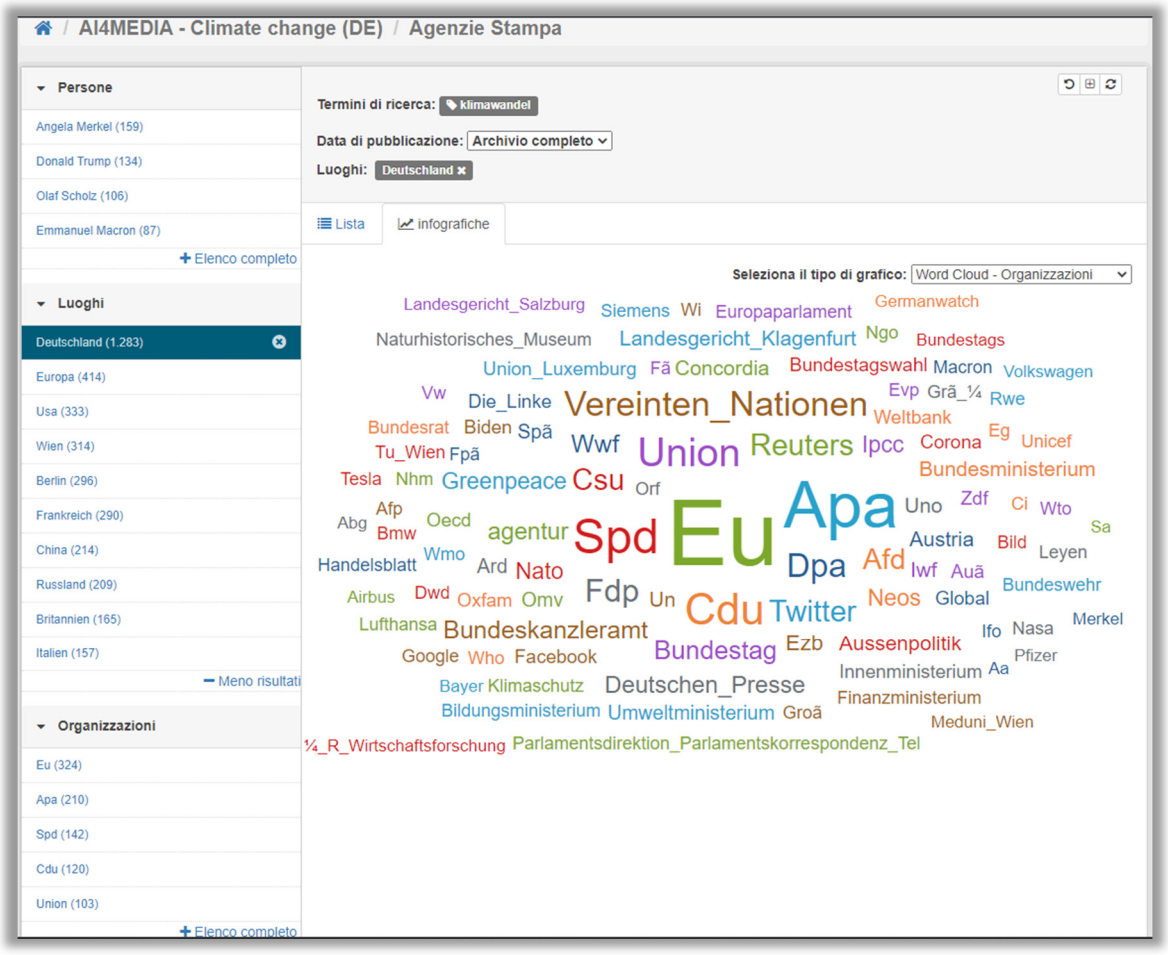

Figure 17: User interface of RAI Concept Book using the result of EntityRecognizer 1.0.2 model output.

Provision of models with restricted or publicly accessible Docker containers

The AI4EU Experiments platform was designed to offer both freely accessible and commercially offered data and solutions equally in the marketplace. Therefore, the respective Docker containers of the models can be hosted in either publicly accessible repositories or restricted access repositories that require credentials to access the containers.

Freely accessible solutions can be readily deployed in the AI-Lab Playground or in local execution environments. This is demonstrated with the ObjectDetectionPipeline[61], which is using the model with the publicly accessible Docker container of model ObjectDetection 1.0.2[62].

Protected solutions building on models with restricted accessible model support all kinds of licensing options and commercial offerings. An example for such a solution is the pipeline named ObjectDetectionP[63] that is using the same technology provided by the model with the restricted accessible Docker container of model ObjectDetection 1.0.1[64].

5.5 Open Call challenge for contributions to AI4EU Experiments

AI4Media is implementing Open Calls for the funding of several projects to engage AI-driven third parties to be part of the AI4Media programme. The Open Calls are structured around challenges that have been designed to provide value to the AI4Media ecosystem and contribute to the richness of the AIoD. These challenges complement or expand on research being addressed in the project or are aligned with a selection of the project's use cases.

WP7 has provided the challenge "Realising a hybrid AI application in AI4EU Experiments" for Open Call #2. The challenge consists in the realisation of a hybrid AI application on AI4EU Experiments. More concretely, the requirements are as follows:

- The main outcome must be a working pipeline on AI4EU Experiments.
- This pipeline must combine machine learning modules with modules for symbolic reasoning.
- The pipeline and the modules therein must be provided under an open-source licence.
- It must be possible to run the pipeline in the AI4EU Experiments playground.
- The pipeline must offer a web UI which allows basic handling and progress tracking, depending on the implemented functionality.
- The functionality provided by the pipeline must be suitable for the media sector.

[61] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=cd303086-6599-41cf-b89b-66f31f7c4f44&revisionId=0d4d73db-e069-447f-949f-2eb1bc9e98e5, last visited 18/08/2023
[62] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=1c97e098-d7c7-4fb5-83ca-a5202efc5e90&revisionId=85536789-c619-4003-87c2-868e8971a597, last visited 18/08/2023
[63] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=b08401ec-f24a-452b-bf42-c57cb91b21e8&revisionId=490b5ed8-b498-4ddb-a99b-0cb1662f533c, last visited 18/08/2023
[64] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=1c97e098-d7c7-4fb5-83ca-a5202efc5e90&revisionId=6efaddee-cb74-4995-a8c3-9bc8e3f9c29b, last visited 18/08/2023

The project funded under this challenge is titled “Mindbugs Discovery” (MBD) and it is implemented by Tech Wave Development Srl from Romania[65]. MBD aims to create a deeper understanding of the structure and key elements of fake news. The information discovered will be integrated in a visual and interactive way into their mobile AR application. The Mindbugs team began creating and merging fake news databases in order to produce a high-quality, high-value dataset of fake news representatives for the East European region. The project will create an API where specialists can add trending fake statements, make their dataset publicly available on the AIoD for the first time, as well as construct a pipeline to create a knowledge base on misinformation (see also relevant detailed description in deliverable D10.3[66]).

The project was launched in March 2023 and is being carried out at the time of preparation of this deliverable. Results of this project will be included in the upcoming deliverable D7.4 (Final version of the integration result with the AI-On-Demand Platform).

[65] Mindbugs Discovery Open Call #2 project: https://www.ai4media.eu/winners2/mbd/, last visited 18/08/2023

[66] Document will be made available after approval of the European Commission on: https://www.ai4media.eu/reports/analytics-on-submitted-proposals-d10-3/, last visited 18/08/2023

6 Interoperability with other media platforms

Going beyond the publication and technical integration of AI resources, AI4Media also provides showcases for the interoperability of AI4EU Experiments with other media platforms, which is a key success factor for wider dissemination on both sides.

In terms of the work of Task 7.4 "Achieving interoperability between the AI-on-Demand Platform and Media Platforms", interoperability of different systems is demonstrated by reusing individual components in another system. This works excellently if the systems have a modular structure, for example in the sense of a microservice architecture. The concept of AI4EU Experiments allows the provision of individual AI components as models in the AI4EU Experiments Marketplace. These must be provided as Docker containers according to a uniform container specification. The Docker containers must be able to communicate via a formally defined interface. These technical properties make it very easy to use components from AI4EU Experiments in other systems if they implement the same interfaces. Likewise, modular components from other systems can be used in AI4EU Experiments if they are deployed as Docker containers according to the specification.

The following showcases demonstrate both directions of interoperability of the AIoD with different media platforms.

6.1 Provision of the recognAIze system in AI4EU Experiments

This showcase demonstrates that components of an existing media platform can be made available for public experimentation through AI4EU Experiments.

Fraunhofer IAIS offers a system for the extraction of information from scanned documents. With the software solution recognAIze[67], which recognizes, extracts, and automatically evaluates data using AI methods and Deep Learning, the full potential of scanned documents can be exploited. Through image enhancement, layout, and optical character recognition (OCR), a good result can be ensured, even for documents that have poor quality. With recognAIze, all information can be extracted from images or scanned material and made available for content analysis using Natural Language Processing (NLP) or Natural Language Understanding (NLU).[68]

Independent of the commercially offered service, some essential components of the recognAIze system have been published in AI4EU Experiments as models:

- recognaize-preprocessing[69]
- recognaize-segmentation[70]

[67] https://recognaize.de/, last visited 22/08/2023
[68] https://www.iais.fraunhofer.de/en/business-areas/document-analytics.html, last visited 22/08/2023
[69] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=a9958ec2-900b-4abe-9d96-c8e0913cf5a9&revisionId=0d727a79-dfde-43fc-90b5-7ffc385c1d3f, last visited 22/08/2023
[70] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=92e7428a-fd2b-4d8b-949f-18b852213298&revisionId=529c3a56-faa1-4589-af62-6bd16d6146da, last visited 22/08/2023

- recognaize-ocr[71]

A simple user interface is provided with the recognaize-ui model[72] (see Figure 18). All models are using freely accessible Docker containers.

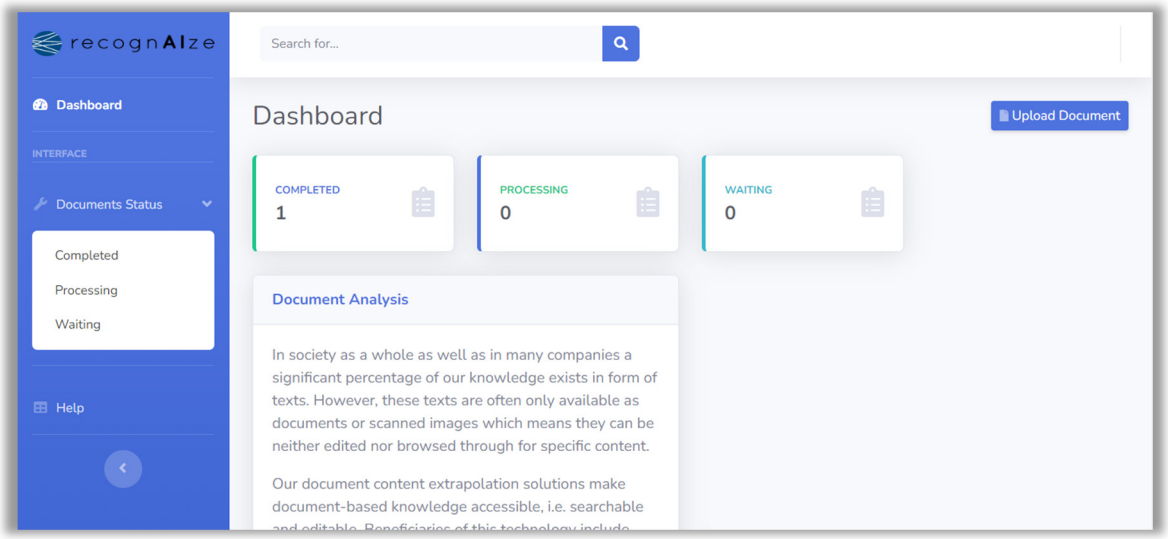

Figure 18: Web user interface of RecognaizePipeline.

All models have been composed to the RecognaizePipeline[73] (see Figure 19) that can be deployed either locally or in the AI-Lab Playground (see Figure 20). This means that experiments with the underlying technology can be carried out by anyone.

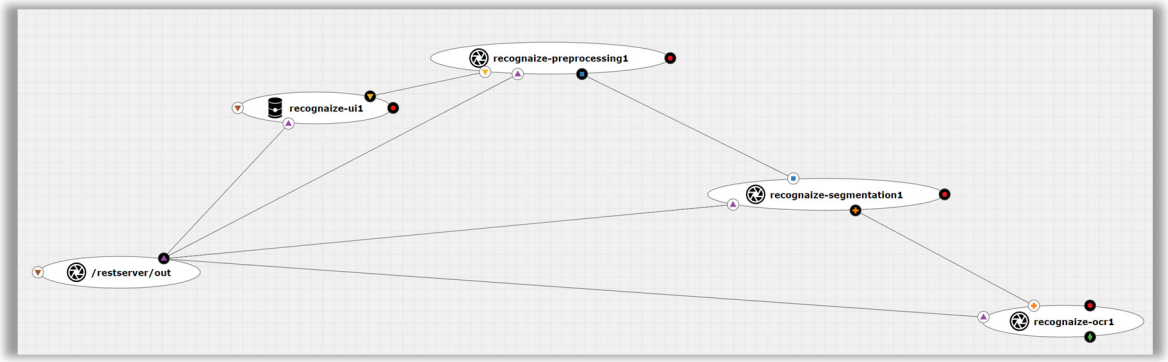

Figure 19: Model RecognaizePipeline in Design Studio.

[71] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=2ddd740b-b31e-4933-a6c5-39613d720f61&revisionId=d02cc906-ec13-42fc-96ab-f9dc232848b5, last visited 22/08/2023
[72] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=bc867fa6-eb1d-4905-bb76-2ebe413c2e91&revisionId=c7add00b-b4b4-46ee-8594-bd0e067f5665, last visited 22/08/2023
[73] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=fca70f4f-d6b7-4fed-a98a-8800b7831ef8&revisionId=c7b3cfaf-7960-472b-91e3-03b930dca96a, last visited 22/08/2023

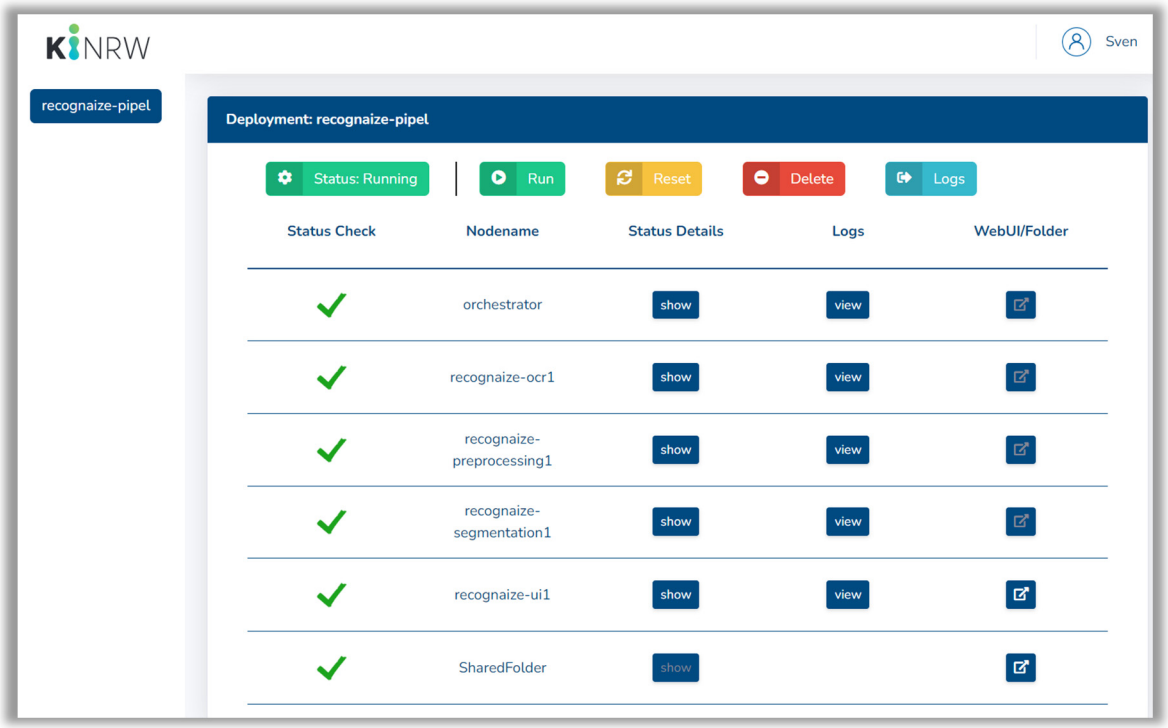

Figure 20: RecognaizePipeline deployed to AI-Lab Playground.

6.2 RecognAIze pipeline integration to Truly Media platform

This showcase demonstrates the reusability of pipeline models from AI4EU Experiments in other media platforms.

In this showcase, the RecognaizePipeline from AI4EU Experiments was selected as an implementation of a tool that provides OCR functionality and was integrated in the Truly Media platform. RecognaizePipeline is composed of four different models with separate functionalities and working all together, they achieve the extraction of the text on the provided image as input.

The four separate models are:

- recognaize-ui
- recognaize-preprocessing
- recognaize-segmentation
- recognaize-ocr

In addition to the four modules, the pipeline is also connected to a shared storage volume used to store intermediate files generated at each step of the process and the final result, a text file. Figure 19 visualizes the RecognaizePipeline with all the connections among all the modules.

6.2.1 Idea and integration plan

The Truly Media platform[74] by ATC and DW aggregates content from a large variety of sources such as different Social Media platforms, blogs, websites, RSS feeds etc. In most cases, content includes media assets like videos and images. In the latter case, there is the need of an automated process that will extract the text from an image so that further analysis and validation of the authenticity of the content creator can be possible. For that reason, the RecognaizePipeline was selected as a candidate to be integrated to the Truly Media platform and bring the desired automation.

From an architectural point of view, the same module setup as in the RecognaizePipeline has been used except for the original UI module which was removed. The replacement of the removed module exposes a REST API, which expects a URL pointing to an image as an input rather than a manual provided image, which was the case for the original UI (see Figure 21). Once the input image is available, a gRPC client/server, which is also implemented in the new module, forwards the image (and other default configuration for the extraction) to the next stages of the pipeline to be further processed. Figure 22 shows the integration architecture that has been implemented.

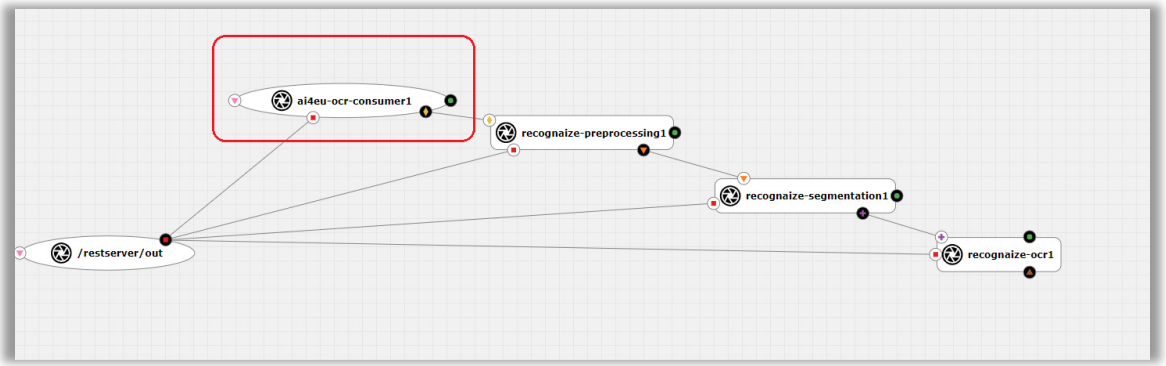

Figure 21: Modified RecognaizePipeline on the AIoD.

From a high-level point of view, the workflow that has been implemented is the exchange of an image URL for a text, generated by the custom RecognaizePipeline. The new module can be dockerized and uploaded to any registry with public access so that it can be retrieved by the AIoD. Currently, the latest docker image can be found at ATC's docker hub[75]. In the AIoD, it can be onboarded and published in the marketplace. The modified pipeline is deployed using the AI-Lab Playground that is provided for easy deployments from the AIoD.

[74] https://www.truly.media/, last visited 22/08/2023
[75] https://hub.docker.com/r/atchub/ai4eu-atcrecognize, last visited 22/08/2023

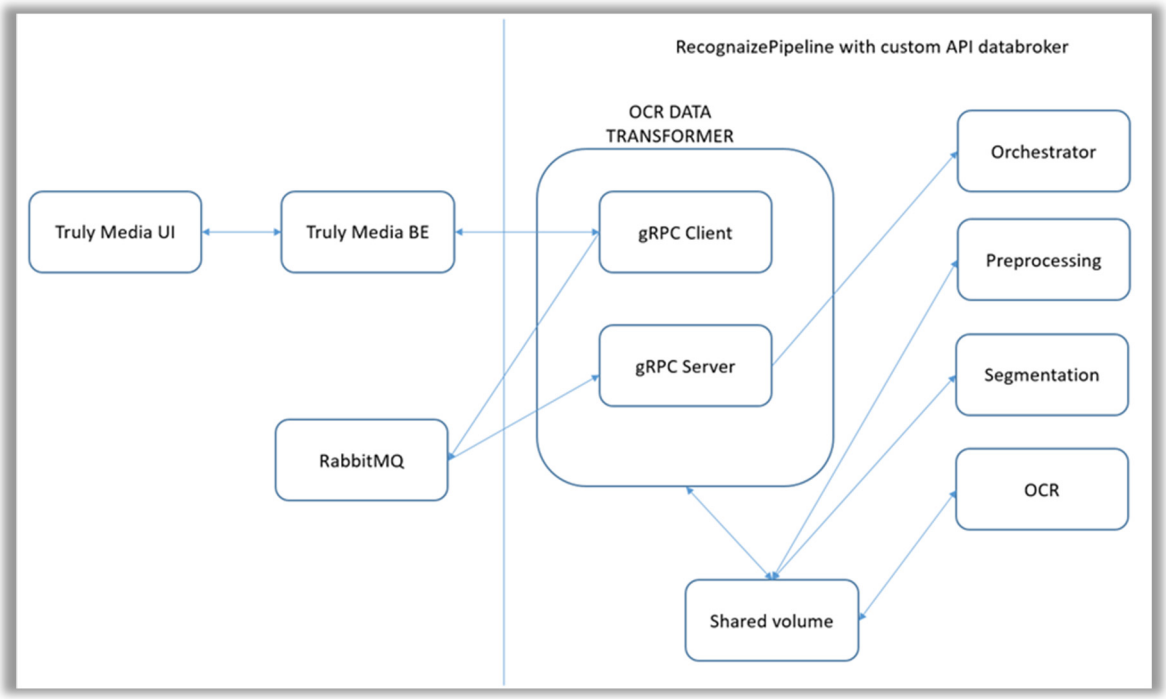

Figure 22: Truly Media and modified RecognaizePipeline integration architecture.

6.2.2 Truly Media and modified RecognaizePipeline workflow

The following steps represent the workflow when using Truly Media with the modified RecognaizePipeline:

- A Truly Media user needs to extract the text from an aggregated image.
- The image's URL is provided to the modified RecognaizePipeline, which downloads the image to the local storage and triggers the rest of the modules to process it.
- When the image is processed successfully, the results are persisted to the local storage.
- The Truly Media user requests to download the results.
- The new module finds the results from the local storage and creates a zip file which is downloaded through the Truly Media platform.
- The user is provided with the generated results from the OCR service for further analysis.

6.2.3 Truly Media and modified RecognAIze pipeline demonstration

In the verification page of the Truly Media platform there are a lot of image utilities for the users to modify and apply AI services. Figure 23 shows the actual image where the users can select the OCR option and trigger the workflow described in the previous section.

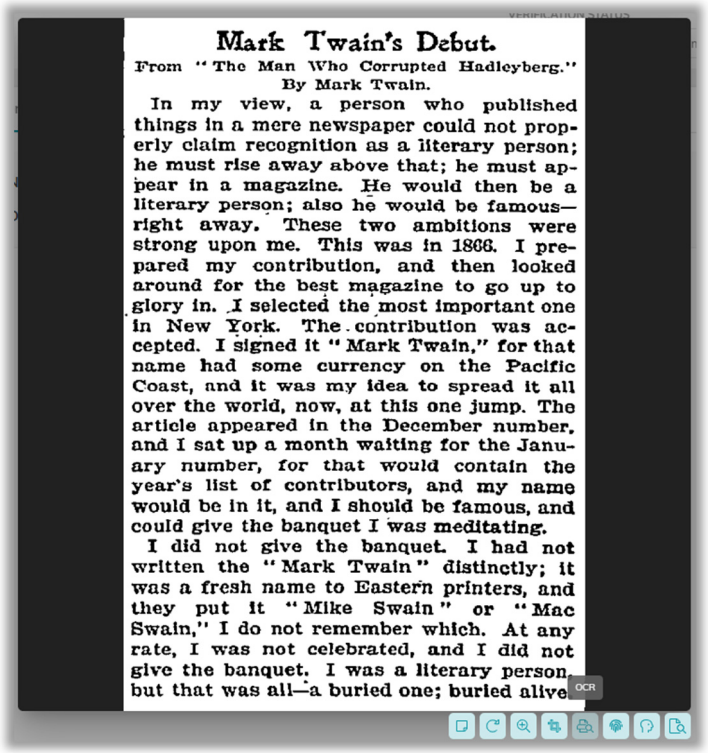

Figure 23: Trigger the OCR service in Truly Media.

When the OCR service has processed the image, the users are able to download the results for further analysis. The users will receive the results as shown in Figure 24. Figure 25 provides an example for the extracted text.

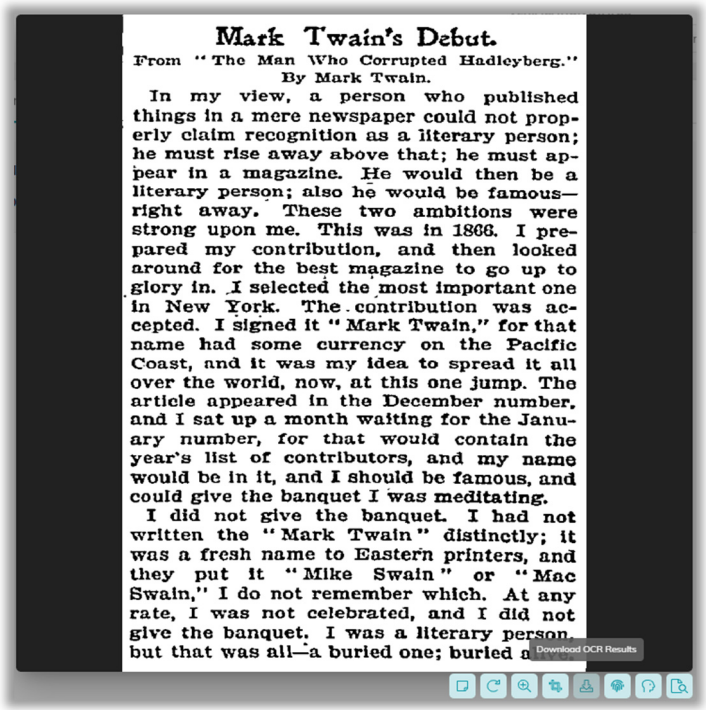

Figure 24: Download the results in Truly Media.

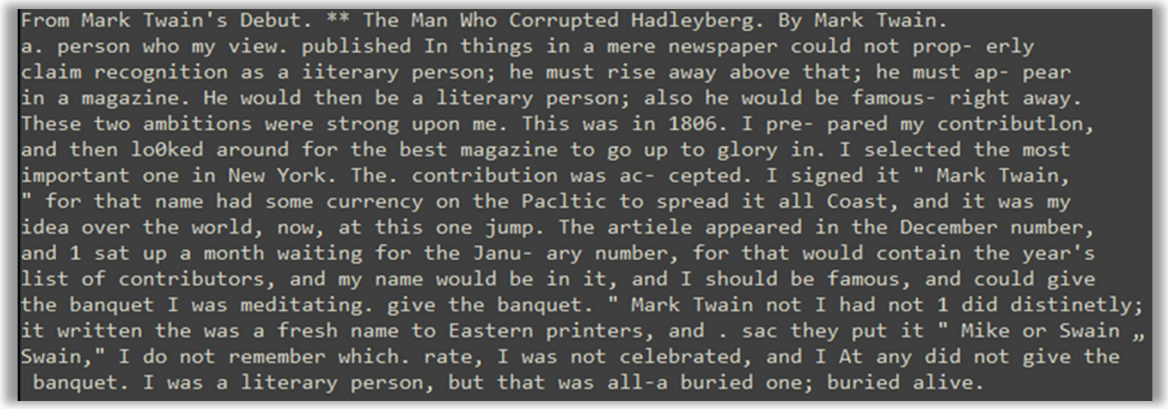

Figure 25: View the extracted text result in Truly Media.

6.2.4 Future plans for integration

For further integration of other modules provided by the AI4EU Experiments, the marketplace will be investigated to find other useful candidates that can be used and give added value to the Truly Media platform. A few candidate modules have already been identified, but these options need to be further investigated to better understand if they fit into the platform's workflow and can provide added value to the existing functionalities.

6.3 Integration of Mining Services from the Fraunhofer Mining Platform in AI4EU Experiments

This showcase demonstrates the reusability of components from other media platforms in AI4EU Experiments.

A concept for achieving interoperability between AI4EU Experiments and the Fraunhofer Mining Platform has been provided in D7.1 (Integration plan and initial version of the integration result with the AI-on-demand platform)[76]. The concept has been implemented so far by adapting mining services from the Mining Platform and making them available as models in AI4EU Experiments.

The prominent example in this deliverable is the multilingual NER mining service. As a mining service this component was already available as a Docker container. Since the communication with the container in the Mining Platform is always based on REST, the REST interface had to be replaced by a gRPC interface. The component was onboarded as a model in different versions. Each version has a different input/output data configuration to serve different use cases, as described in section 5.4.

Another example is the object detection technology mining service that is under development at Fraunhofer IAIS. This technology has also been contributed to AI4EU Experiments as an AI model. “Appendix 3: Tutorial about the technical integration in AI4EU Experiments” in section 11 contains a detailed description about the onboarding of this component.

6.4 Integration of multilingual NER model from AI4EU Experiments in RAI Concept Book

This showcase demonstrates the reusability of single models from AI4EU Experiments in other media platforms.

The RAI Concept Book is a system to perform thematic searches across heterogeneous information sources, such as press agencies, national and international newspapers, and national TV newscasts. Extracted entities are indexed by the RAI Concept Book and made available to users through its graphical user interface (see Figure 17 on page 37) for content search and filtering and data visualisation.

The NER model EntityRecognizer 1.0.2[77] has been provided in the AI4EU Experiments Marketplace with an adapted output data interface for the optimal integration into the RAI Concept Book. The Docker container is deployed locally and accessed by the RAI Concept Book application through an integrated gRPC server. Figure 26 shows the interaction flow between the RAI Concept Book and the NER component. For a detailed documentation of the integration

[76] Document is available for download at https://www.ai4media.eu/wp-content/uploads/2022/03/AI4Media_D7.1_final.pdf, last visited 22/08/2023

[77] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=e3794e16-0225-4bf1-a99c-b99638a22232&revisionId=7220ac2a-a908-46df-a58d-bad87bbbad23, last visited 22/08/2023

of the NER model into RAI Concept Book please consult deliverable D8.4 “Intermediate Use Case Demonstrators and Applications”.

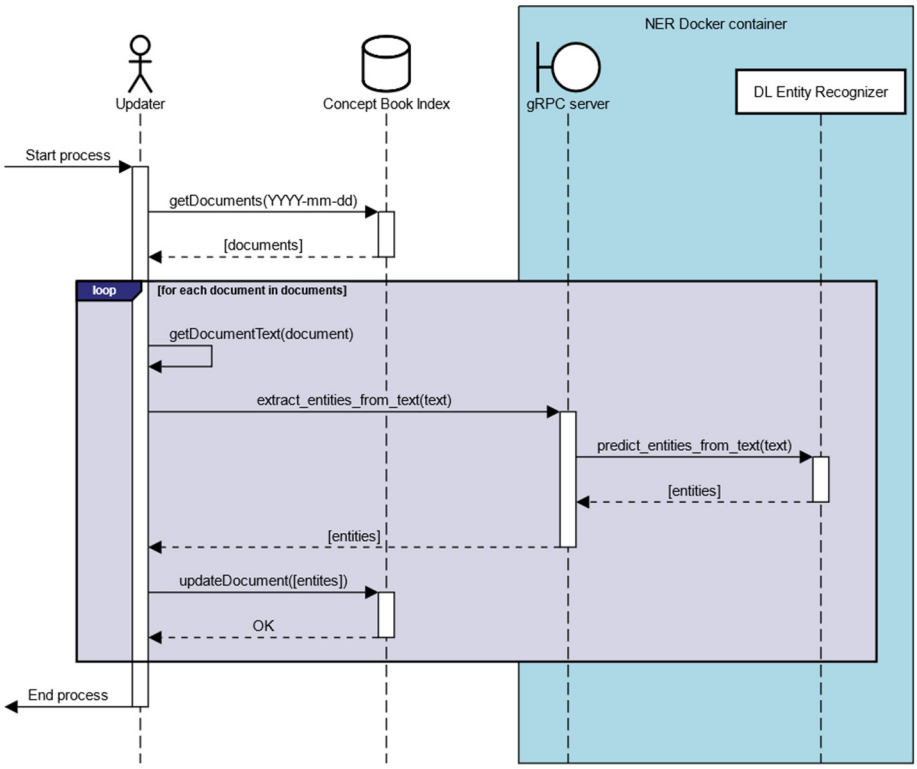

Figure 26: Interaction and data exchange between the RAI Concept Book and the AI4Media NER component.

7 Management of the European AI-on-Demand Platform, development and operation of AI4EU Experiments

Task T7.6 was established in AI4Media[78] to ensure the sustainability of the AI-on-Demand Platform (AIoD) after the end of the AI4EU project and to bridge a time gap of 6 months until the start of the AI4Europe project on 01/07/2022. The goal of this task was to seamlessly continue the technical governance, the operation and maintenance of the infrastructure for the AIoD.

Section 7 summarises the outcomes of the activities performed in the context of Task 7.6 "Management of the European AI-on-demand Platform, development and operation of AI4EU Experiments".

7.1 Continuation of Technical Governance Board (TGB)

The Technical Governance Board (TGB) was introduced by AI4EU as a regular bi-monthly meeting to discuss technical contributions and connect the relevant experts to advance the platform. The continuation of the AI4EU Technical Governance Board (TGB) after 31/12/2012 was implemented with T7.6. The TGB was chaired by FHG-IAIS.

The management of the TGB covered several aspects. Mainly, the chair set up regular meetings and maintained their agenda. This task further included technical hosting and the management of the already existing mailing list. The Chair invited presentations on technical advances and contributions to the platform from various projects represented in the TGB. All TGB meetings are documented on GitHub[79] for public access. For clarification, it is important to mention that AI4Europe has renamed the Technical Governance Board (TGB) in 2023 to Technical Contributors Board (TCB).

The following TBG meetings have been organized within AI4Media:

- Meeting #1: 14/01/2022[80]
- Meeting #2: 04/03/2022[81]
- Meeting #3: 29/04/2022[82]

[78] This was approved with the first amendment to the grant agreement: AMENDMENT Reference No AMD-951911-18
[79] https://github.com/ai4eu/Technical-Contributors-Board, last visited 22/08/2023
[80] https://github.com/ai4eu/Technical-Contributors-Board/tree/main/Meeting-2022-01-14, last visited 22/08/2023
[81] https://github.com/ai4eu/Technical-Contributors-Board/tree/main/Meeting-2022-03-04, last visited 22/08/2023
[82] https://github.com/ai4eu/Technical-Contributors-Board/tree/main/Meeting-2022-04-29, last visited 22/08/2023

- Meeting #4: 03/06/2022[83]

7.2 Development of AI4EU Experiments

The following developments have taken place during AI4Media's responsibility for AI4EU Experiments:

- The integration of the EU Login was completed.
- The publication of the platform's source code as an Eclipse project (Eclipse Graphene™[84]) was advanced.
- The AI-Lab Playground was provided and integrated into AI4EU Experiments with a one click deployment.
- An example for a complex pipeline (audio-pipeline[85]) was provided in AI4EU Experiments Marketplace to demonstrate how Protobuf definitions play together and can be used in the Design Studio (see Figure 27).

Progress on these developments was regularly reported in the TGB meetings.

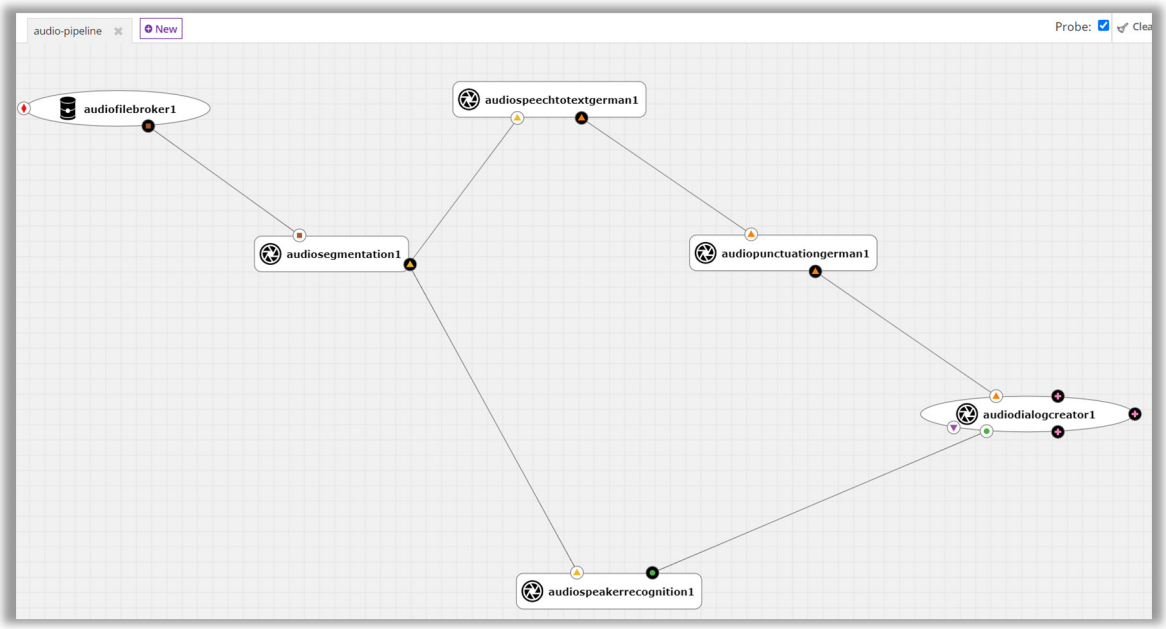

Figure 27: Example for a complex pipeline in Design Studio canvas.

[83] https://github.com/ai4eu/Technical-Contributors-Board/tree/main/Meeting-2022-06-03, last visited 22/08/2023
[84] https://projects.eclipse.org/projects/technology.graphene, last visited 22/08/2023
[85] https://aiexp.ai4europe.eu/#/marketSolutions?solutionId=df1f1286-0071-4df8-afd7-fe5dd20f9cd4&revisionId=8b7d0433-56c8-48bf-8654-3ac87eb630e9, last visited 22/08/2023

7.3 Hosting of website and AI4EU Experiments

The AIoD website and AI4EU Experiments were hosted by FhG-IAIS within the AI4EU project. In AI4Media, the hosting of the two platforms continued seamlessly, including the necessary technical support and operational infrastructure (e.g., regular backup, security updates)

7.4 Operation of AI4EU Experiments

This task formally recognizes FHG-IAIS as the responsible organization for hosting the AI4EU Experiments platform instance. In addition to the technical operation of the servers, this primarily includes content moderation work. As users of the platform are onboarding models for publication, each contribution is reviewed by a member of the AI4EU Experiments Marketplace governance team. The review relates to the information to be published on the marketplace to ensure that all necessary information is adequately provided.

8 Conclusions

This deliverable, with the publicly available components listed in this document, proves that the integration of AI4Media into the AI on Demand platform has been very successful in all aspects[86]:

- **AIoD website**: AI4Media has contributed significantly to the content created by the AI community on the website. Among them, there are already 113 assets published in the AI Assets Catalog which are linked to AI4Media, see section 3.2. KPI 5.1 in AI4Media had the objective of at least 30 assets to be published. This KPI has already been exceeded by far. There are still potential candidates for more assets under development in AI4Media. AI4Media partners can publish their assets themselves, once they are available. They will continue to be supported by WP7 for this task, and WP7 ensures close collaboration with the content management team of the AIoD.
- **AI-Cafes**: There were 29 AI-Cafes in the period from 2020 to 2023 so far. The target number of 24 live recorded webinars (KPI 5.4) has already been exceeded. The AI-Cafe series will continue in the 2023/2024 winter season, offering AI4Media use case partners the opportunity to present their demonstrators.
- **AI4EU Experiments Marketplace**: The technical integration of AI4Media results into AI4EU Experiments is working. This has been proven by 50 models published on the AI4EU Experiments Marketplace, which can be considered suitable for use in AI4Media experiments and demonstrators[87].
    - KPI 5.2 targeted ">15 AI4EU components used in AI4Media research and use cases"[88]. To date, 30 components are already used. This number far exceeds the target.
    - ">10 experiments (research, use cases, cascading funding, etc.) from AI4Media carried out on the AI4EU platform"[88] is the goal of KPI 5.3. So far, ten pipelines have been published to the AI4EU Experiments Marketplace which can be used for experiments. An open call challenge was initiated, and the winning project will contribute another experiment. To date, there are plans for at least three more experiments, for which new pipelines are being created by WP7.
- **Interoperability with other media platforms**: A concept for interoperability between AI4EU Experiments and the Fraunhofer Mining Platform as an example media platform has been presented in the earlier deliverable D7.1 (Integration plan and initial version of the integration result with the AI-on-demand platform). In the meantime, four different integrations of media platforms with AI4EU Experiments have been performed, as described in section 6. In addition, 14 experiments and use cases demonstrators have been developed in AI4Media WP8. All of them use AI components, some of which are also already onboarded in AI4EU Experiments.

[86] All numbers about achieved results as of 18/08/2023
[87] For details see section 10, tables 7 and 8
[88] AI4Media Grant Agreement (Grant agreement ID: 951911)

The earlier deliverable D7.1 lists a number of areas for improvement for the AIoD. AI4Media has contributed these suggestions in appropriate places, such as in the AI4Europe and Pre-PAI[89] projects, which are currently shaping the future of AIoD. The lack of availability of a public execution environment for the pipelines was successfully addressed within the publicly funded competence platform KI.NRW. A solution has been developed providing the AI-Lab Playground. When it was made available, AI4Media immediately took the opportunity to create and publish some free-to-use pipelines, so that the AI-Lab Playground was also integrated into the project activities.

In the final year of the AI4Media project, ongoing work will continue to integrate the project results into AIoD. This includes the support of the project partners in contributing their results on the AIoD website, further AI-Cafes to offer use cases the opportunity to present developed use case demonstrators as well as the publication of more modules and AI pipelines in AI4EU Experiments.

[89] https://ec.europa.eu/info/funding-tenders/opportunities/portal/screen/opportunities/projects-details/43152860/101083674/DIGITAL, last visited 22/08/2023

9 Appendix 1: List of AI assets in Assets Catalog

The following assets have been published in the AIoD Assets Catalog[90]. For an up-to-date list of published AI assets and links to the assets please always visit the AI4Media project page[91] on the AIoD website.

Name	Contributor	Asset Type
2D Computer Vision and Image	AUTH	As a Service
2D Digital Filter Design and Implementation Lecture	AUTH	Tutorial
2D Systems Lecture	AUTH	Tutorial
3D Computer Graphics and Virtual Reality	AUTH	As a Service
3D Imaging	AUTH	As a Service
3D Object Localization Lecture	AUTH	Tutorial
Acoustics, Speech, Natural Language Processing and Analysis	AUTH	As a Service
AdaFamily optimizer	JR	Library
Advanced Deep Learning	AUTH	As a Service
AI for Visual Vehicles Counting	CNR	Docker Container
AI Science and Engineering: A new scientific discipline?	AUTH	As a Service
AniFormer	UNITN	ML Model
Audio Reuse Detection	FhG-IDMT	Executable
AUTH GreekPolitics Dataset	AUTH	Dataset
Autonomous Cars	AUTH	As a Service
Autonomous Drones	AUTH	As a Service
Autonomous Marine Vessels	AUTH	As a Service
Autonomous Systems	AUTH	As a Service
Camera geometry Lecture	AUTH	Tutorial
Cascaded Cross MLP-Mixer GANs for Cross-View Image Translation	UNITN	ML Model
CGTransformer	UNITN	ML Model
CO2A - Contrastive Conditional domain Alignment	UNITN	ML Model
Color Theory Lecture	AUTH	Tutorial
Communications	AUTH	As a Service
Computational Aesthetics Lecture	AUTH	Tutorial
Computational Cinematography Lecture	AUTH	Tutorial
Computational Geometry Lecture	AUTH	Tutorial
Computer Vision	AUTH	As a Service
CVML Development and Programming Tools	AUTH	As a Service
CVML Mathematical Foundations	AUTH	As a Service
Cycle-In-Cycle GANs	UNITN	ML Model

[90] as of 18/08/2023

[91] https://www.ai4europe.eu/ai-community/projects/ai4media?category=ai_assets, last visited 18/08/2023

Name	Contributor	Asset Type
decentralized-gnn	CERTH	Library
Deep Micro-Dictionary Learning and Coding Network	UNITN	ML Model
Differentiable SVD	UNITN	Library
Diffprivlib: The IBM Differential Privacy Library	IBM	Library
Digital Image Compression Lecture	AUTH	Tutorial
Digital Image Filtering Lecture	AUTH	Tutorial
Digital Image Formation Lecture	AUTH	Tutorial
Digital Image Processing Lecture	AUTH	Tutorial
Digital Images and Videos Lecture	AUTH	Tutorial
Digital Images Lecture	AUTH	Tutorial
Digital Signal Processing and Analysis	AUTH	As a Service
Discrete Variational Multiple Sequence (DVMS) (Head Motion Prediction in 360° Videos)	3IA	ML Model
Edge Detection Lecture	AUTH	Tutorial
Efficient Training of Visual Transformers with Small Datasets	UNITN	ML Model
Entity Recognizer	FhG-IAIS	Docker Container
Face Detection	FhG-IAIS	Docker Container
Fast 2D Convolutions Algorithms Lecture	AUTH	Tutorial
Few-Shot Object Detection (FsDet) - Training tools for custom data	JR	Library
Fraunhofer OCR Engine (recognaize-ocr)	FhG-IAIS	Docker Container
Fraunhofer Table Extraction	FhG-IAIS	Docker Container
GAP: Differentially Private Graph Neural Networks with Aggregation Perturbation	Idiap	Jupyter Notebook
gnntf: A Flexible Deep Graph Neural Network Framework	CERTH	Library
GTA Dataset	CNR	Dataset
High-Dynamic Range Imaging Lecture	AUTH	Tutorial
Human Centered Computing	AUTH	As a Service
Human Visual System Lecture	AUTH	Tutorial
IEP-GAN: Intrinsic-Extrinsic Preserved GANs for Unsupervised 3D Pose Transfer	UNITN	ML Model
Image / Video DeepFake Detection service	CERTH	As a Service
Image Acquisition Lecture	AUTH	Tutorial
Image Features Lecture	AUTH	Tutorial
Image Perception Lecture	AUTH	Tutorial
Image Processing	AUTH	As a Service
Image Quality Lecture	AUTH	Tutorial
Image Registration Lecture	AUTH	Tutorial

Name	Contributor	Asset Type
Image Sampling Lecture	AUTH	Tutorial
Image Transforms Lecture	AUTH	Tutorial
Image Typology Lecture	AUTH	Tutorial
Image Verification Assistant	CERTH	As a Service
Introduction to 2D Computer Vision Lecture	AUTH	Tutorial
Introduction to AI Science and Society	AUTH	Tutorial
Introduction to Computer Vision Lecture	AUTH	Tutorial
Introduction to Image Processing Lecture	AUTH	Tutorial
JGNN library for native Java implementation of graph neural networks	CERTH	Library
Live Speech Recognition	FhG-IAIS	Docker Container
Locally Private Graph Neural Networks	Idiap	Jupyter Notebook
Machine Learning	AUTH	As a Service
Mathematical Morphology Lecture	AUTH	Tutorial
Medical Image and Signal Analysis	AUTH	As a Service
Memory-based Multi-Source Meta-Learning (M3L)	UNITN	ML Model
Mini-batch trimming	JR	Library
Music Classification	FhG-IDMT	Docker Container
Music Detection	FhG-IDMT	Executable
NDISPark Dataset	CNR	Dataset
Neighborhood Contrastive Learning for Novel Class Discovery	UNITN	ML Model
Network Theory & Social Media Analysis	AUTH	As a Service
Neural Image Compression Lecture	AUTH	Tutorial
Neural Networks and Deep Learning	AUTH	As a Service
Neural Semantic 3D World Modeling and Mapping Lecture	AUTH	Tutorial
Neural SLAM Lecture	AUTH	Tutorial
Object Detection	FhG-IAIS	Docker Container
Object Pose Estimation Lecture	AUTH	Tutorial
ObjectGraphs (Video Event Detection)	CERTH	Library
Playable Video Generation	UNITN	ML Model
pygrank	CERTH	Library
Robotics and Automatic Control	AUTH	As a Service
Semantic Middleware	CNR	Executable
Shape Description Lecture	AUTH	Tutorial
Signals and Systems	AUTH	As a Service
Simultaneous Localization and Mapping Lecture	AUTH	Tutorial
Social Impact of AI Science and Engineering: Information Filtering and Disinformation	AUTH	As a Service

Name	Contributor	Asset Type
solo-learn	UNITN	Library
Speech Detection	FhG-IDMT	Executable
Stereo and Multiview Imaging Lecture	AUTH	Tutorial
Structure from Motion Lecture	AUTH	Tutorial
Super Resolution Lecture	AUTH	Tutorial
Text-to-Visual Search Engine	CNR	Docker Container
The Devil is in the GAN: Defending Deep Generative Models Against Backdoor Attacks	IBM	Jupyter Notebook
Video Classification	FhG-IAIS	Library
Video Processing and Analysis	AUTH	As a Service
Video Shot Detection	FhG-IAIS	Library
Whitening for Self-Supervised Representation Learning	UNITN	ML Model
Zero-Shot Visual Concept Recognition	FhG-IAIS	Docker Container

Table 6: List of AI assets in Assets Catalog contributed by AI4Media (titles are linked to assets in Assets Catalog[92]).

[92] All links were last visited 18/08/2023

10 Appendix 2: Single models in AI4EU Experiments Marketplace

The following single models were contributed by AI4Media to AI4EU Experiments Marketplace[93]:

Model Name	Model type
AudioDialogCreator	AI
AudioPunctuationGerman	AI
AudioSegmentation	AI
AudioSpeakerRecognition	AI
AudioSpeechToTextGerman	AI
EntityRecognizer 1.0.0	AI
EntityRecognizer 1.0.1	AI
EntityRecognizer 1.0.2	AI
FileUploadDataBroker	connector
file-viewer	connector
MusicDetection	AI
ner-databroker	connector
ner-model	AI
Object Detection 1.0.0	AI
Object Detection 1.0.1	AI
Object Detection 1.0.2	AI
recognaize-ocr	AI
recognaize-preprocessing	AI
recognaize-segmentation	AI
recognaize-ui	connector
SpeechRecognition	AI
SpeechRecognitionWebUI	connector
Text2ImageSearch	AI
VideoObjectRecognition	AI
VideoShotDetection	AI

Table 7: List of single models in AI4EU Experiments Marketplace contributed by AI4Media (titles are linked to models in marketplace[94]).

[93] https://aiexp.ai4europe.eu/#/marketPlace, last visited 18/08/2023
[94] All links were last visited 18/08/2023

The following single models published in AI4EU Experiments Marketplace[95] can also be considered suitable for use in experiments and demonstrators in the project's field of application[96]. Unfortunately, it was not possible in all cases to find out through which project the model was contributed.

Model Name	Model type	contributing Project
AIA-obfuscation	AI	?
AudioFileBroker	connector	AI4EU
audio-file-broker	connector	AI Regio
Augmented data registry	AI	?
Coverpageanalysis	AI	AI4EU
Entity extractor	AI	?
FaceAI	AI	AI4EU
forWoT	AI	AI4EU
Idiap BEAT Databroker - M-NIST	dataset	AI4EU
Idiap BEAT Face Recognition - Eigenfaces trained on ATNT	AI	AI4EU
Idiap BEAT Face Recognition - FaceNET	AI	AI4EU
Idiap BEAT Handwritten Digit Recognition - Multiclass Logistic Regressor trained on M-NIST	AI	AI4EU
news-classifier	AI	AI4Europe
NewsTrainer	AI	AI4Europe
pira-analyzer	AI	?
reedee	AI	?
sentiment-analysis-databroker	connector	AI4Europe
sentiment-analysis-model	AI	AI4Europe
SharedFolderProvider	connector	AI4EU
speech2text-en	AI	AI4Regio
SwabAI	AI	AI4EU
Tag-my-outfit	AI	AI4Europe
Tensorboard	connector	AI4Europe
viume-pic2text	AI	?
YoloV5	AI	AI4EU

Table 8: List of single models in AI4EU Experiments Marketplace provided by other projects and considered suitable for use in AI4Media (titles are linked to models in marketplace[97]).

[95] https://aiexp.ai4europe.eu/#/marketPlace#marketplaceTemplate, last visited 16/06/2023
[96] as of 16/06/2023
[97] All links were last visited 22/06/2023

11 Appendix 3: Tutorial about the technical integration in AI4EU Experiments

This section provides a tutorial about the technical integration of the object detection technology in AI4EU Experiments. All required steps are documented on a detailed technical level. This tutorial could serve as a helpful resource for other developers who want to use AI4EU Experiments.

11.1 Dockerization of the technology

The object detection Docker container image is provided on a publicly accessible container registry and can be pulled using the following command:

docker pull hub.cc-asp.fraunhofer.de/ai4media-public/object-detection-public:[tag]

[tag] can be replaced by available tags listed on this registry at *hub.cc-asp.fraunhofer.de/ai4media-public*.

The underlying model is a tensorflow EfficientDet D4[98] trained on MSCOCO 2017[99], which is downloaded and built within the Docker image. This means that the model is already loaded when the container is started and is ready for use shortly. This container will have an *input* directory that is used by the model to find an input file for the analysis and a *results* directory which is used for storing the analysis results. To interact with the container, two volumes need to be mounted onto */input* and */results* paths. The user can then submit images and videos by placing them in the volume which is mounted on */input* and access the analysis result from the folder which is mounted on */results*.

By running the following command, the server script inside the container starts the object detection server by loading the model while two volumes are mounted onto this container for accessibility. Please note that port 8061 is used for the communication between the client and server.

docker run -p 127.0.0.1:8061:8061 -v /local-dir1:/input -v /local-dir2:/results hub.cc-asp.fraunhofer.de /ai4media-public/object-detection-public:latest

/local-dir1 and */local-dir2* refer to desired local storage paths that allow access to the container via mounted volumes. If using an editor such as Visual Studio Code with a Docker extension available, the container can be interactively accessed by attaching a shell to it. The entry point of the container is */home/object-detection-public/src/object-detection-public*, which holds the source code to the object detection server.

[98] Mingxing Tan, Ruoming Pang, Quoc V. Le. EfficientDet: Scalable and Efficient Object Detection. Proceedings of the IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR), 2020, pp. 10781-10790.

[99] in TY. et al. (2014). Microsoft COCO: Common Objects in Context. In: Fleet D., Pajdla T., Schiele B., Tuytelaars T. (eds) Computer Vision – ECCV 2014. ECCV 2014.

For testing the functionality, place a file named *image.jpg* inside the folder mounted on */input* and run the client script. A message appears that the process started and after the process is done, the message will be concluded. To access the analysis results, refer to the mounted volumes on */results* directory. A *json* file for each analysis will be stored there.

The result *json* file contains information about every detected object within a visual scene (image or video frames). This information will contain the object category, location of each object in forms of a bounding box and detection confidence score. In case of analysing videos, every 5th frame will be processed.

11.2 Definition of interfaces (Protobuf Definition)

A suitable Protobuf signature is defined for the object detection package module as shown in Figure 28:

object-detection.proto 253 bytes | Open in Web IDE | Replace | Delete

```
syntax = "proto3";

message ObjectDetectionInputFile {
    string path = 1;
}

message ObjectDetectionOutputFile {
    string path = 1;
}

service ObjectDetection {
    rpc detect_objects(ObjectDetectionInputFile) returns (ObjectDetectionOutputFile);
}
```

Figure 28: Protobuf signature for object detection package module.

Using this signature file, and with gRPC compiler, two pb2.py files need to be created followed by the server and client scripts to be able to interact with the model as a service. The docker container starts by running the server script which will load the model once, and then waiting to receive inputs (video or image). Client script is created to test the functionality. In practice, this model can be deployed via the AI4EU Experiments platform on a local Kubernetes or AI-Lab Playground.

11.3 Onboarding of the model to AI4EU Experiments Marketplace

For onboarding a model to AI4EU Experiments Marketplace, please refer to https://aiexp.ai4europe.eu and create an account. After signing in, a model can be onboarded by filling out the following form as below. The model's name, the container image holding the model or service, licensing information as well as the Protobuf file are required to onboard a model. The registry hosting the image container can be a public or private registry. However, for deploying models a publicly accessible image is required. After onboarding the model, it can be used in the Design Studio to build pipeline solutions.

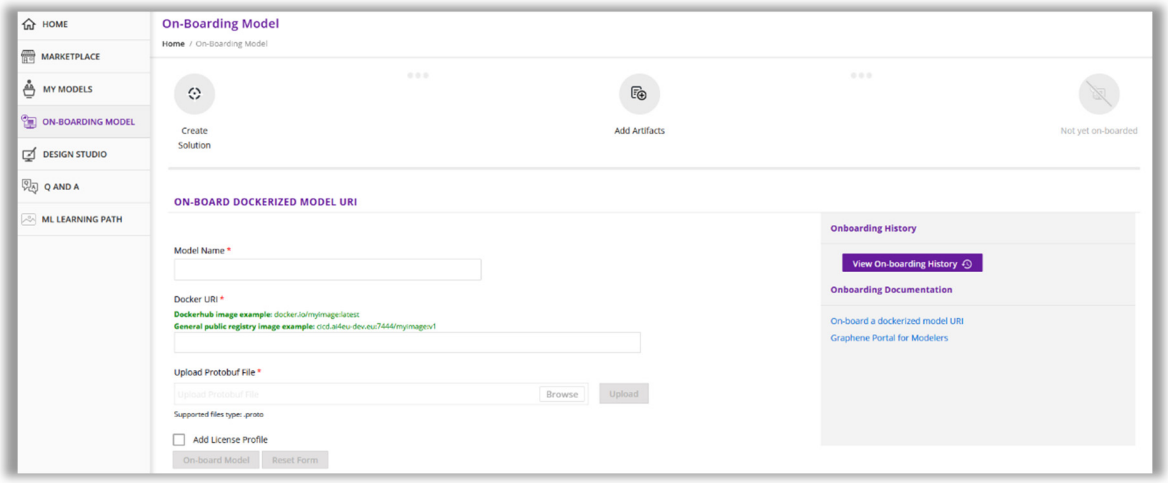

Figure 29: Form for onboarding of models in AI4EU Experiments Marketplace.

At this point the model can be used in Design Studio by selecting it and dragging it to the studio canvas. Usually, the model can be listed under certain categories to make it easier to search the models. For example, the *ObjectDetection model* is categorized under *classification* tasks.

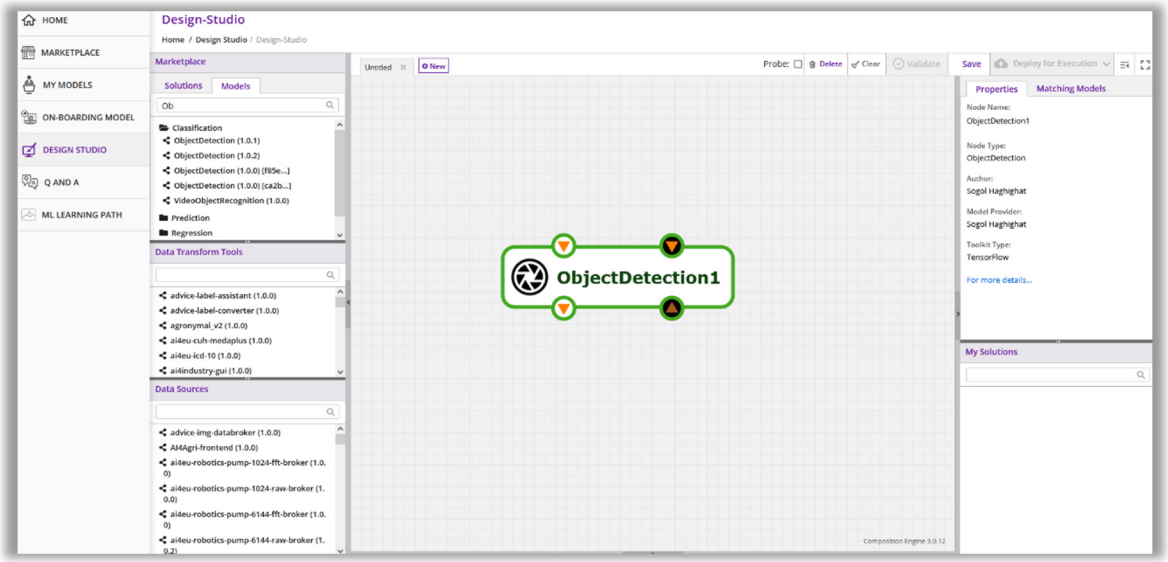

Figure 30: ObjectDetection model on Design Studio canvas.

To make the model available to all the users of the platform, the model needs to be published to the Marketplace. The following figure shows how the model can be managed. By completing the process on the *Publish to Marketplace* tab, the model is accessible for all users. Other information fields such as *Manage Publisher/Authors* may also be required as a contact person for the published models.

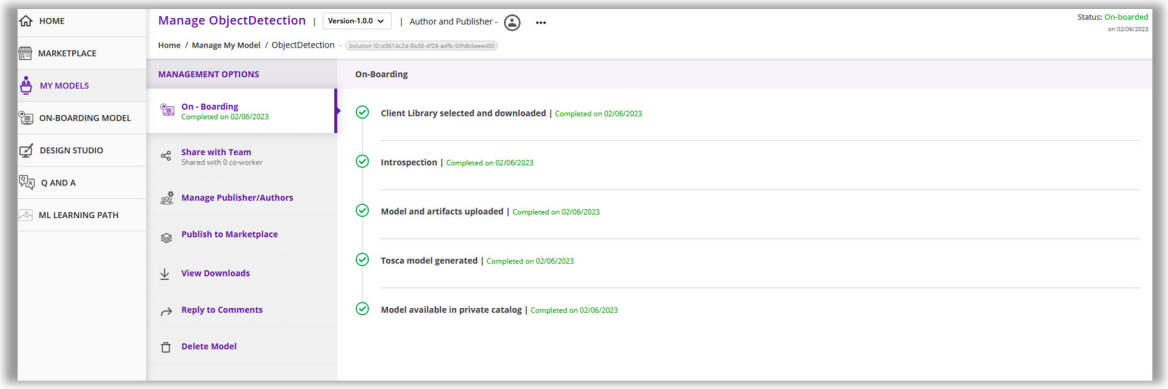

Figure 31: Management of a model in AI4EU Experiments.

If a new version of the model needs to be published, the same process must be performed and after publishing to the marketplace, it appears as the new version of the existing model. This is only possible if the owner of the model is publishing a new version.

11.4 Designing a pipeline in Design Studio

To build an object detection pipeline, four components are required:

1. Model: which is the main module. The model with a publicly accessible Docker container (*ObjectDetection v1.0.2*) is published to the marketplace. It can be found under the classification category.
2. Data Transform Tools: The second module is a *SharedFolderProvider* (the purpose of this module is similar to when mounting a volume on a container), which is shared between all modules of the pipeline and works as a data storage. After inserting this module, it should be renamed to */data* to be recognized as the mount point. When deploying the pipeline, */data* will contain two directories, */input* and */results*. */input* contains all the submitted files to the pipeline and */results* contains all the corresponding analysis results.
3. Data Sources:
    a. *FileUploadDataBroker*: this module provides a way to pass an input file to the main module, which in this case is the object detection model and it can be accessed via a WebUI.
    b. *File-viewer*: this module provides a way to view the output file after the input file was processed by the model. There is a WebUI available for this module, which allows to download the result of each analysis and check the analysis id.

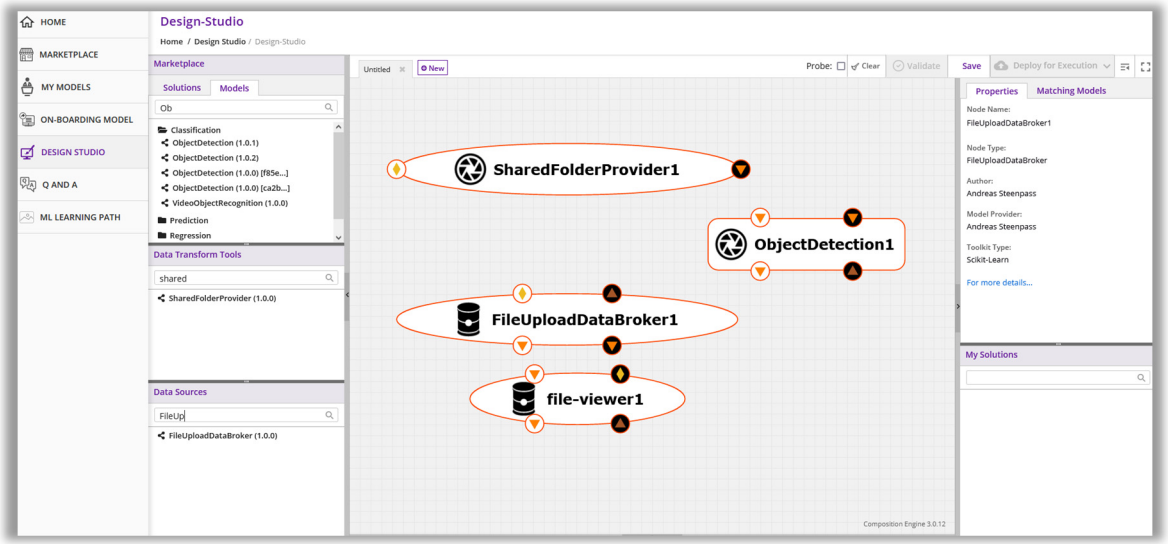

Figure 32: Four modules required for object detection pipeline on Design Studio canvas.

All these modules have designated ports and the matching ports need to be connected to each of them. Note that *sharedfolderrequest* and *input/output* connectors look similar and need to be connected carefully. All modules need to be connected to */data* too. By hovering over the connectors, the provided message indicates which ports are matching and can be connected. A 3-step example is illustrated by Figure 33.

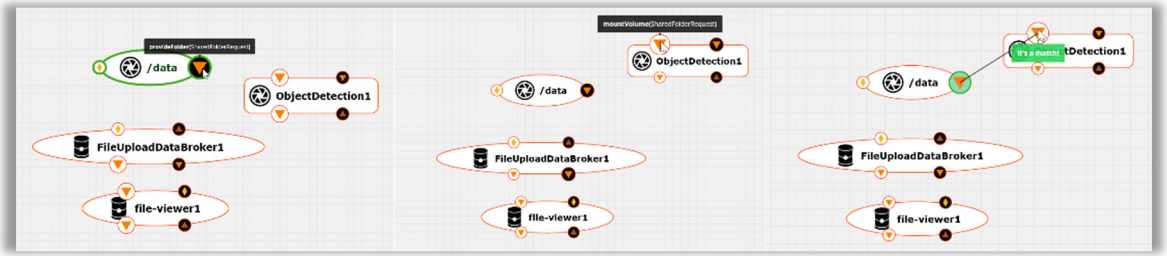

Figure 33: Connecting ports of modules in Design Studio.

After creating the pipeline, it needs to be saved and validated. At this point the model can be accessed for local deployment or deploying on AI-Lab Playground. After controlling the functionality of the pipeline, it can be published to the Marketplace similarly to publishing a model. When the process is approved, the pipeline will appear as a solution offered to users of the Design Studio. There already exists *ObjectDetectionPipeline v1.0.1* available to users of the platform. This pipeline is shown in Figure 34.

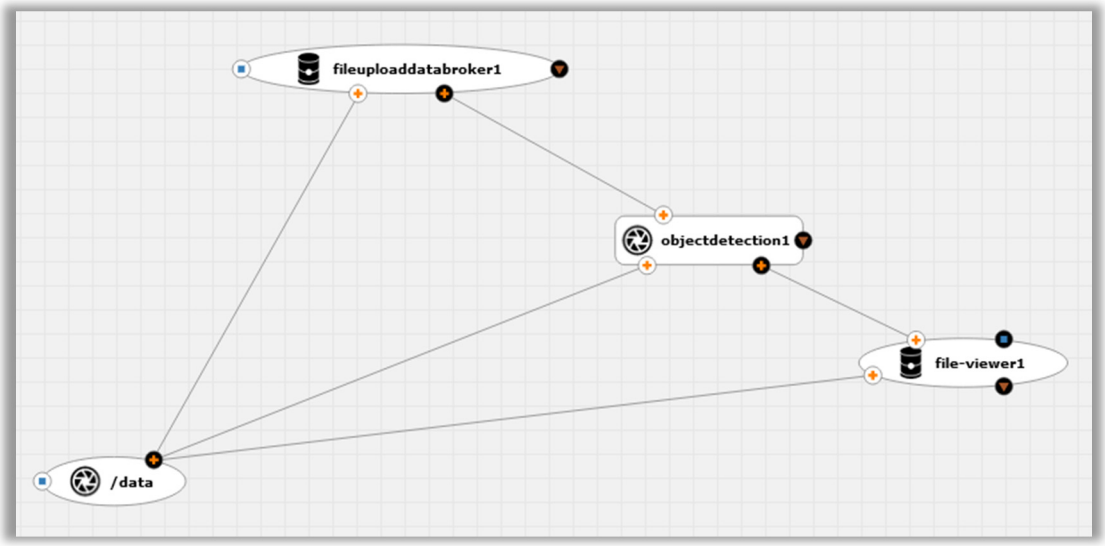

Figure 34: ObjectDetectionPipeline v1.0.1 in Design Studio.

11.5 Deployment of the pipeline

After a pipeline is saved and validated, it can be deployed either on a local Kubernetes or on AI-Lab Playground.

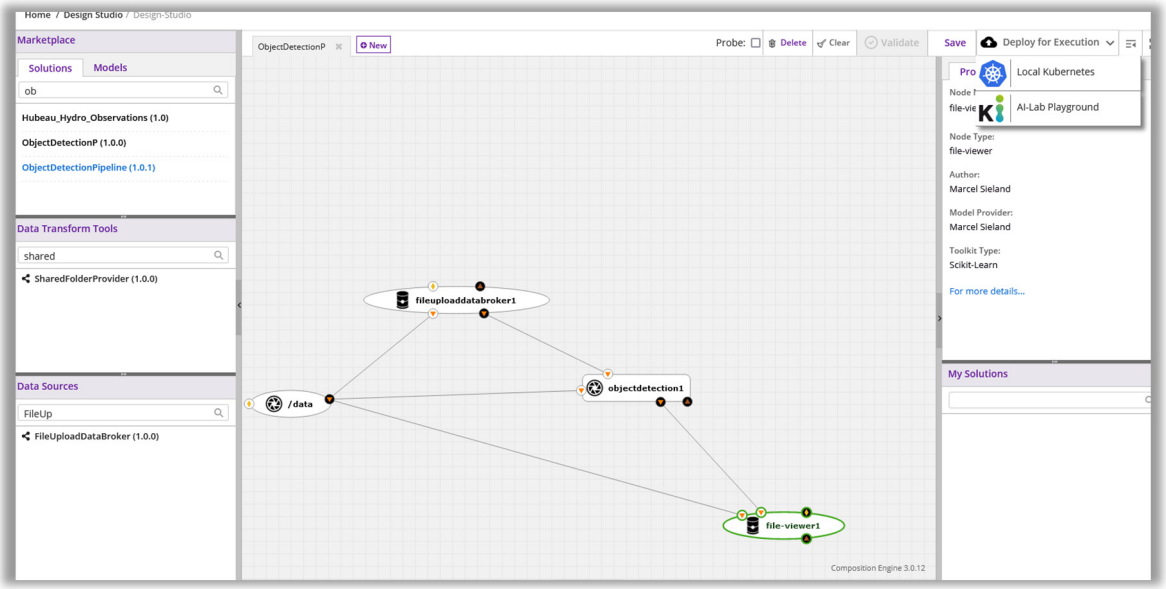

Figure 35: Deployment of a pipeline in Design Studio.

11.5.1 Deployment on a local Kubernetes

By selecting "*Local Kubernetes*", a zip file will be downloaded which contains the pipeline and orchestrator script for running this pipeline locally. The zip file needs to be extracted and stored where the pipeline is going to run. The user will require a Kubernetes namespace to be able to run the scripts. After extracting the files, a python file "*kubernetes-client-script.py*" should exist

among the files. This file needs to be run using the user's namespace to initiate the pods and services on the local Kubernetes. In case of no errors, at the end of the run, a recommended command will appear. By running this command, an orchestrator will start the server and make the analysis ready to use.

By using commands such as "*kubectl -n user-namespace get pod*" and "*kubectl -n user-namespace get services*", the status of the generated pods and services can be checked. Services also show the accessible port for *file-viewer* and *fileuploaddatabroker*. By accessing the relevant ports via a browser, a WebUI becomes available for submitting files to the service and receiving the analysis results. The WebUI interfaces look as shown in Figure 36 and Figure 37.

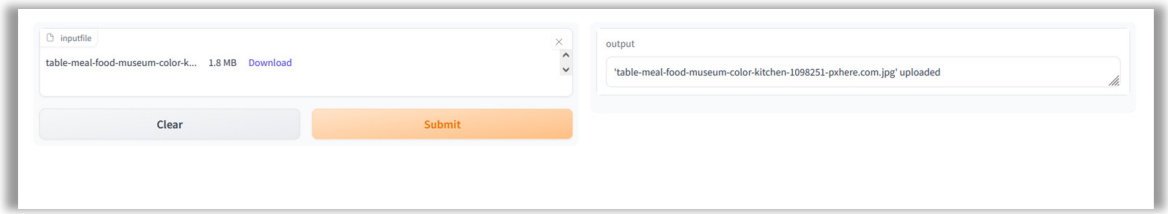

Figure 36: WebUI of the Fileuploaddatabroker.

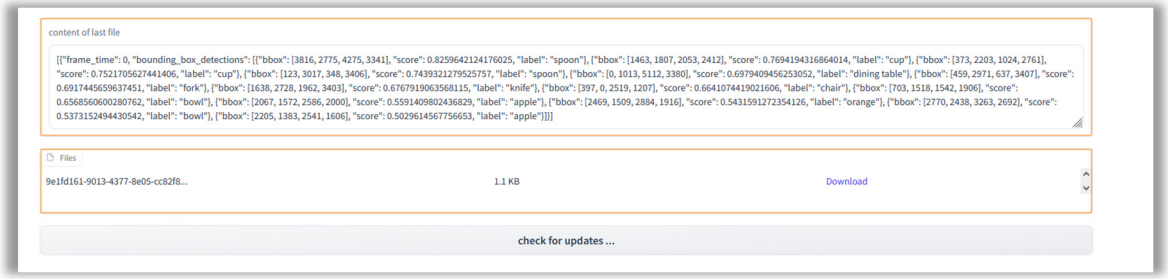

Figure 37: WebUI of the File-viewer.

By dragging an image or a video onto the input file section and submitting to the service, the object detection service, which is running on a local Kubernetes, will perform the detection on the submitted file and will store the analysis result given a unique id into the */results* directory of the pipeline. This location can be accessed via *file-viewer* UI. The process can be repeated and after each analysis is finished a file in *json* format will appear on the *file-viewer* UI, which can be viewed or downloaded. This file contains detection results.

11.5.2 Deployment on AI-Lab Playground

Another way to deploy a pipeline is on AI-Lab Playground using an EU account. By clicking on the deployment on *AI-Lab Playground*, all the steps for downloading and extracting files will be done automatically on AI-Lab Playground platform. This process can take a few minutes. When the pipeline is ready to be used the AI-Lab Playground WebUI will look like in Figure 38.

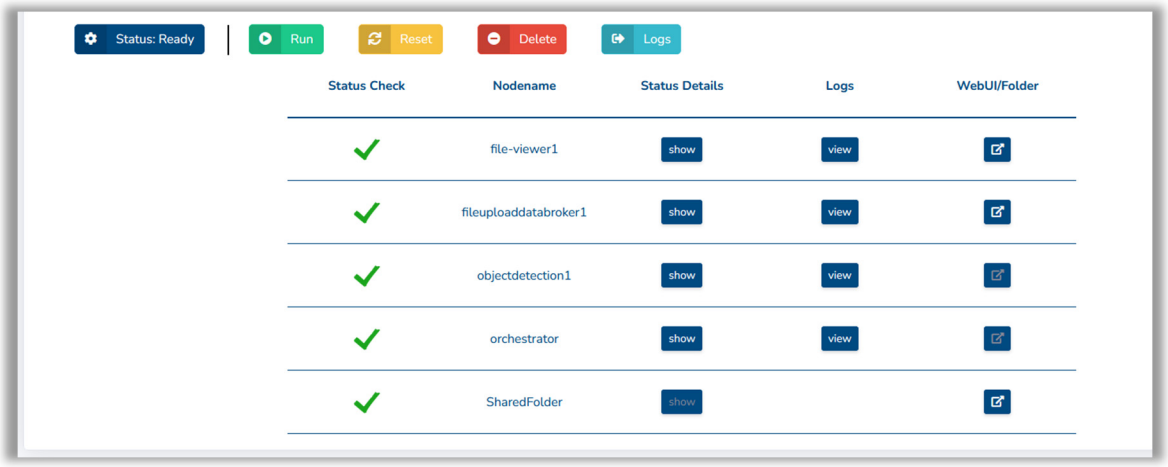

Figure 38: AI-Lab Playground WebUI showing a successfully deployed pipeline.

At this stage, the pipeline is ready to run. After clicking on the button *Run*, the status will change to *Running*, which means an instance of object detection server is continuously running until it is deleted. The environment will look as in Figure 39.

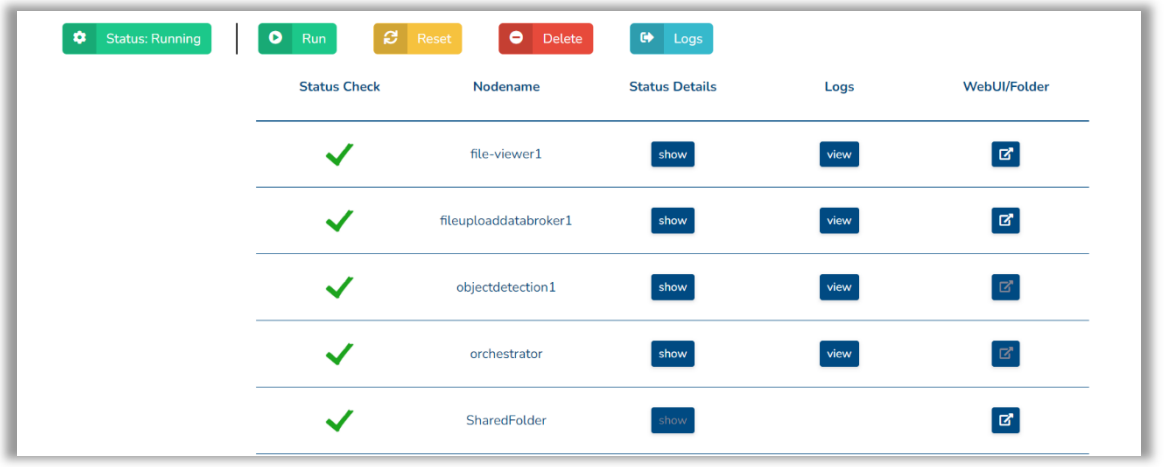

Figure 39: AI-Lab Playground WebUI: object detection server is continuously running.

At this stage it is possible to access WebUI of *fileuploaddatabroker* and *file-viewer* to submit files and access the results multiple times as long as the pipeline status is running. The interfaces look like the ones for local deployment. *SharedFolder* is the location where all the submitted files and all the analysis results will be stored and will be available to access by the user.

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