

Codebook on Visualizations of Artificial Intelligence in News Media Coverage

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1. Research objective

The aim of this analysis is to determine how six German print media visualize and frame articles related to artificial intelligence (AI). Based on a qualitative frame analysis from 2019, a quantitative visual content analysis of illustrated German print media articles was carried out in the period between January 1 and December 31, 2019 and between November 1, 2022 and October 31, 2023.

2. Units of analysis

All images accompanying news articles published in the above mentioned period of investigation in one of our selected media titles (Frankfurter Allgemeine Zeitung (FAZ), Süddeutsche Zeitung (SZ), Die WELT, Die ZEIT, taz, die tageszeitung, Der SPIEGEL) that contain the keywords “Künstliche* Intelligenz OR *KI*” (German search string) in the title or subtitle are analyzed. Variables are collected at both article and image level, with the variables at article level serving almost exclusively to contextualize the individually coded images.

3. Category system and procedure

The coding takes place within an excel sheet.

Coder-ID (coder_id)

A unique coder ID is assigned to each coder so that the coded entries can subsequently be assigned to this coder.

- 1 Anonymized for blind review
- 2 Anonymized for blind review
- 3 Anonymized for blind review
- 4 Anonymized for blind review

Note: It is sufficient to enter the coder ID once in the code sheet.

3.1 Formal categories (article level)

ARTICLE-ID (article_id)

Each item is assigned a specific, predefined three-digit ID between 001 and 999.

ARTICLE TITLE (article_title)

In this category, the title of the article is noted in words. The text can either be copied from the PDF into the Excel spreadsheet or the corresponding text can be typed in. Ensure, entering the entire title with its special characters and punctuation marks.

SUBTITLE (article_subtitle)

Similar to the category “ARTICLE TITLE”, the subtitle of an article, if available, is noted here in words including punctuation and special characters. Only short subheadings that are visually separated from the body text count as subtitles, not rooflines or visually separated teasers of more than two sentences.

AUTHOR (author)

The author(s) of the article will be recorded in this category with their first name and surname (or the name to be taken from the article in the form of an abbreviation/alias).

DATE (pubdate)

The date on which the image to be coded was published in an article is recorded in this category. The following notation is specified for the date:

DD.MM.YYYY

Example: 01.01.2023

Note: If several days are specified as the publication date for an article (e.g. for weekend issues), the first day is noted as the date.

MEDIUM (source)

The newspaper or news magazine which published the article is recorded here. The following values are assigned here:

- 1 Frankfurter Allgemeine Zeitung
- 2 Süddeutsche Zeitung
- 3 Die Welt
- 4 Die Zeit
- 5 taz, die tageszeitung
- 6 Der Spiegel

DEPARTMENT (department)

The department in which the article was published is noted here. If individual newspapers/ magazines use specific designations that differ from the standard departments, the thematically matching designation should be used if possible. If there is no suitable code in the list or if the department is not specified, value 9 = other is assigned.

- 1 politics
- 2 economy
- 3 local
(also location-based department names, such as Hamburg, Dresden, etc.)
- 4 culture
(also subcategories like literature, film, media ...)
- 5 sports
- 6 feuilleton
- 7 science
(also AI-specific categories, if the focus lies on technology, e. g. artificial intelligence)
- 8 reader's letters
- 9 other
(e.g. special issues, puzzle pages ...)

3.2 formal and content (image level)

IMAGE-ID (image_id)

In order to make each image clearly identifiable and to be able to assign it directly to the corresponding article, four-digit image IDs based on the articleID were assigned in advance. The first three digits correspond to the article-ID, while the last digit localizes the image positioned in the text with a number between 1 and 9:

Example:

First image of the article with the article-ID 310 = **3101**

Fifth image of the article with the article-ID 002 = **0025**

VISUALIZATION-TYPE (visualization)

This category describes the visualization type of the image, i.e. the way in which an image was created. The following codes can be assigned:

1 Photograph

A photograph is a picture, produced by photographic processes. Whether the respective image is stored in analogue or digital form is irrelevant for the assignment of this definition. According to the prevailing understanding in this analysis, these are depictions of real-world events for which the photographer had to be on site with a camera (see also differentiation from 2 = photorealistic depiction).

Example:

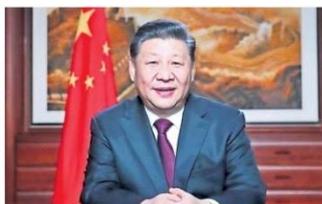


2 Photorealistic depiction

In this analysis, photorealistic representations are defined as images that appear very realistic due to their artistic depiction, but do not originate from a photographic process that requires a photographer to be on site. This includes for example very realistic paintings, in this case also AI-generated images.

ATTENTION: If it is not recognizable to the coder that a realistic image was generated by an AI, it should be coded as 1 = photograph. Only if it is clearly indicated that AI-generated images were used in the article and/or the real-world event depicted certainly did not take place in this way (e.g. Trump's arrest on an open street), should this code be selected.

Example:

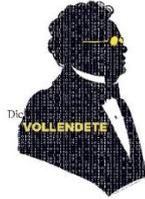


(Ai-generated image)

3 Illustration

Illustrations are visualizations that have been drawn by hand or digitally and do not convey any content other than the actual image (e.g. text). This means that cartoons, caricatures, infographics, etc. are explicitly NOT to be labelled with this code (see codes 7 and 9).

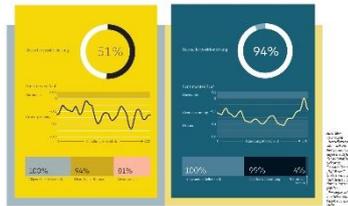
Example:



4 Diagram / chart

All statistical graphics and tables are recorded under this code. The type of diagram is irrelevant. Forms of presentation that depict distributions using pictograms are also to be coded under this characteristic (see code 5).

Example:

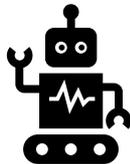


5 Pictogram

Pictograms are simple, graphic symbols that convey information, e.g. on road signs or public toilets. They are usually similar to the object they describe, but do not represent it in its full complexity.

ATTENTION: Icons and pictograms that are used in journalistic texts to visualize data are recorded under 4 = diagram / chart.

Example:

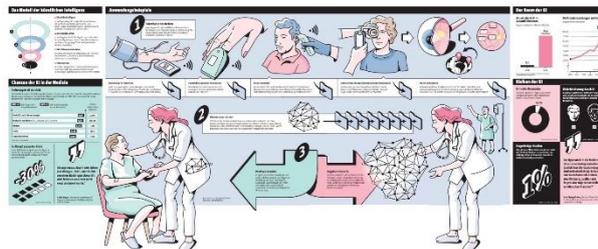


6 Infographic

Infographics depict interrelationships in an illustration and accordingly combine different forms of presenting information, including images, graphics, pictograms, charts, text, etc.

ATTENTION: If infographics contain individual elements that can be coded differently, e.g. pictograms, these are only coded under this category 7 = Infographic. Accordingly, the individual elements are NOT described using other suitable characteristics, as they are perceived as part of the overall graphic.

Example:



7 Collage / Photo montage

Collages and photomontages consist of several recognizable individual images that are combined to form an image. This can be either the arrangement of individual images in a specific frame (example on the left = collage) or the combination of various recognizable individual images/image elements in one image (example on the right = photomontage)

Example:



8 Other

This category is a collection category for all images that can't be described by the other characterizations, including cartoons and caricatures, as well as abstract paintings or similar.

DEPICTION (depiction)

This category records what the coded image illustrates at first glance. It is therefore not about the individual image objects, but about which (real-world) object is to be depicted in the respective image. For this reason, only the image should generally be used to determine the depiction. Only if no clear depiction can be identified on this basis may the caption be used for further clarification.

1 AI

This code is assigned if the image is used to depict a form of artificial intelligence or AI discourse. In the simplest case, these are real-world AI objects such as robots, models of neural networks (simulated brains) or other AI applications. However, artistic or cartoonish representations that create an idea of AI or visualize a characteristic of AI or the AI discourse (e.g. ambivalence of AI...) are also given this code.

DECISION RULE for the delimitation of 9: If a connection with AI can be inferred at first glance on the basis of an image, code 1 = AI is coded - regardless of whether AI is actually integrated in a depicted technology or not, for example. The decisive factor is that the viewer needs almost no information from the text, title or subtitle to infer the topic of AI from the illustration. Technologies are always coded with 1 = AI in cases of doubt where it cannot be clearly decided whether they represent an AI application or not.

Examples:



2 Involved Persons

This code covers images depicting people who have a connection to an AI topic in various forms. These can be, for example, inventors and developers of AIs, politicians who deal with their regulation, people affected by the use of AI, etc. In principle, all images that provide “faces” for the articles should be coded under this code, unless the images only represent the author of the text (see category 4).

Example:



3 Non-human Stakeholders

This code is to be assigned if an image depicts non-human actors influenced by AI, e.g. companies, brands, universities, etc., that have a connection to an AI topic. For

example, this could be logos or buildings of companies that drive AI developments or use AI, etc.

ATTENTION: If it is not immediately clear from the image (and caption, if applicable) that this is a “representative motif” used for a non-human participant, code 9 should be assigned.

Example:



Caption: Bloomberg headquarters in New York

4 Author

This code is assigned if an image represents the author(s) of the article and they are not thematically linked to the text.

ATTENTION: If authors are depicted together with AIs or involved persons/non-human stakeholders, the respective category 1, 2 or 3 is assigned.

Example:



9 Other

Catch-all category for all images for which none of the previous categories appear suitable. For example, images could be coded here where no direct thematic reference to AI or the AI discourse can be identified and where no AI-involved persons or authors are depicted, but which have been added to an article for decorative, structuring or aesthetic purposes, for example. Such images may appear incoherent at first glance and may have no caption or a meaningless and/or incoherent caption.

DECISION RULE for differentiating from 1: If an image cannot be used to draw direct conclusions about the topic of AI, i.e. without references from text components (e.g. image of a roof, animal, etc.), then category 9 = Other is coded.

pictorial object (object_toplevel, object_sublevel1, object_sublevel2)

In this category, the individual pictorial objects in the images to be coded are described in more detail. If necessary or feasible, coding takes place on three levels, which differ in their level of detail. The first level to be filled in is the variable “toplevel” for each image object. It records the image objects at the highest level of abstraction and is therefore most suitable for generalizing statements. Optionally, the variables “sublevel1” and “sublevel2” can then be filled in to add more detailed descriptions. Single-digit codes therefore refer to the top level, two-digit codes that begin with the number of the top level are assigned to the sublevel 1 and three-digit codes that begin with the numbers of the top level and sublevel 1 refer to the sublevel 2. Several top levels (1 per item) can be assigned per image and several sublevel 1 and sublevel 2 values per item in separate columns (and rows) in the code sheet (unless a different coding rule is formulated in the respective value).

ATTENTION: Only elements clearly inserted into the image or objects deliberately depicted as individual objects in the image are to be regarded as pictorial objects. As a rule, it is sufficient to code the individual objects **placed in the foreground**. In the case of photographs of actions/events, not all objects associated with this action need to be captured as individual pictorial objects – unless they are “actively” placed in the foreground (e.g. through the choice of perspective) and therefore convey key information that would be lost if they were not included.

ATTENTION: If there are no sublevel1/2 values in the codebook that match a pictorial object, the corresponding cells in the code sheet are left empty and only the matching toplevel value(s) are noted for the pictorial object concerned.

Note: In some cases, it can be helpful to start with the sublevel coding and then deduce the higher level of abstraction of the top level.

Note II: If individual pictorial objects are not clearly recognizable or it is unclear which objects are the information carriers and should therefore be coded, the caption can first be used as a contextual unit. If this still does not provide clarity, the entire text or article title/subtitle can also be used.

Instruction for coding in the code sheet: If an image contains several image objects that can be assigned to the same top- or sublevel 1, the respective code is only noted once. If there are differences in the sublevel 1/2 codes, these are noted in different lines, whereby the columns for the top or sublevel 1 are then left empty.

Example:



toplevel	sublevel1	sublevel2
1 (human)	13 (profession)	131 (manager)
	14 (gender)	141 (male)

The following codes can be assigned to the image objects:

1 human

This attribute is always assigned if a natural person is depicted. Even if “individual components” of a human being are depicted, e.g. body parts, organs, cells, etc., this toplevel code is selected.

Example:



11 body part

This sublevel 1 attribute is to be assigned if only individual parts of the body are depicted rather than an entire person. These body parts can be described in more detail in the following sublevel 2 codes:

- 111 brain**
- 112 eye**
- 113 hand / arm**
- 114 foot / leg**

Example:



→ 113 hand / arm

12 model

Models are all physical/cellular units of human beings visualized with the aid of diagnostic procedures or scientific theories. This includes the following sublevel 2 codes:

121 DNA (z. B. helix model, genetic code...)

122 diagnostics image (e.g. X-ray, MRI, ultrasound images ...)

Example:



→ 121 DNA

13 profession

This sublevel 1 code is usually assigned if a person depicted can be assigned to a specific profession in sublevel 2 on the basis of the depiction (e.g. professional clothing), caption or general awareness (e.g. in the case of celebrities). The following coding options are available:

131 managers (as well as investors, entrepreneurs and founders)

132 journalists (always coded with DEPICTION „4 – author“)

133 politicians

134 IT specialists (z. B. computer scientists, software developers ...)

135 other (other professions not included in this list)

136 scientists (including humanities and social studies; persons engaged in research activities at a university or non-academic research institute, including pollsters.

137 cultural professionals (e. g. painters, musicians, actors...)

138 athletes

139 soldiers

1310 physicians

1311 ecclesiastics (e. g. priests, pastors...)

1312 factory workers

Example:



Klinische Intelligenz auch in Deutschland: Automatische Lagerung von Proben im Extraktalkohol-Lager → 136 scientists

14 gender

This sublevel coding is *always* applied when the gender of a person depicted is recognizable. This also applies to cropped pictorial objects, such as individual body parts, etc., where gender differences are recognizable (we are guided here by the criteria generally or widely perceived as male or female in our society, for example: breasts = female; nail polish = female). In general, however, this sublevel 1 coding is only carried out if features can be recognized in the picture that make an assignment to the following sublevel 2 codes possible (if, for example, only the back of the head with an ambiguously male or female hairstyle can be recognized, sublevel 2 is not coded):

141 male

142 female

143 other

Example:



→ 142 female

2 supernatural motifs (depiction of gods)

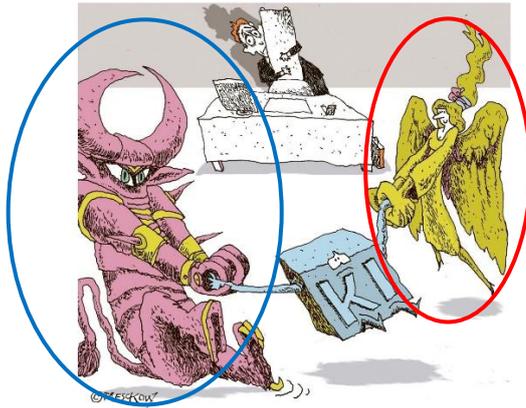
This code is assigned if various non-mundane pictorial objects are contained in a picture. The following more specific codes can also be assigned in sublevel 1:

21 angel

22 devil

23 ancient deity (e. g. Roman or Greek gods)

Example:



→ 21 angel; 22 devil

3 robots

Robots are always to be coded if the subject of the image is a programmed and autonomously operating machine and/or individual components of it. It is irrelevant whether it is a humanoid or human-like robot or industrial machine.

Example:



This distinction is made in the following sublevel codes:

31 cyborg

Cyborgs are all robots that have a human-like appearance, properties whose construction/design is modeled on human attributes, or which develop their function in direct contact with humans (e.g. prostheses). The following sublevel 2 codes can describe this category in more detail:

311 robotic arm

312 humanoid robot („doll“)

313 prosthesis

Example:



→ 311 robotic arm

32 technology

This sublevel 1 specification is assigned if individual components of a robot or for operating a robot are to be described. In more detail at sublevel 2 the following codes can be assigned:

321 remote control

322 laser

Example:



→ 322 laser

33 industrial robot

This code is assigned if the robot depicted has no human characteristics and is used in industry. Indicators for this can be, for example, mass occurrence or placement in a factory hall or similar.

Example:



4 computer

This toplevel code covers all image objects that represent computers, computer programs or objects associated with computers (e.g. keyboard, computer mouse, etc.). It is not necessary for a computer to be recognizable as an entire device.

ATTENTION: Smartphone/tablet applications are also provided with this code (instead of 5).

Example:



41 software

This includes all computer, smartphone or tablet applications and the representation of their logos, icons or screen interfaces. Abstract references that indicate the functionality of such programs (e.g. networks, measuring points) are also described with this sublevel 1 category. To specify these pictorial objects, the following sublevel 2 codes are permitted:

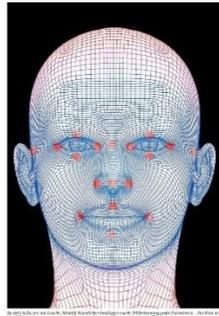
411 code / pixel / backends

412 measurement (measuring points, e. g. for digital modeling)

413 network

414 ChatGPT

Example:



→ 412 measurement

42 hardware

This specification can be used to describe components of computers (or similar devices) in more detail. The following sublevel 2 specifications are provided:

421 chip / circuit board / microchip

422 cable

423 USB stick

Example:



→ 421 chip / circuit board / microchip

5 other technical devise

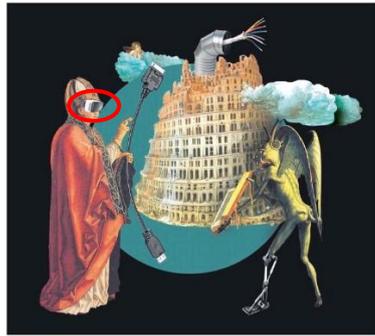
If technologies are shown that cannot be recorded under 4 = computer, this category should be assigned. If necessary, a more precise description can be recorded using the sublevel 1 categories.

Example:



51 VR technologies (z. B. VR glasses)

Example:



- 52 **smart home technologies** (e. g. voice assistants, household items, thermostates...)

Example:



- 53 **camera**

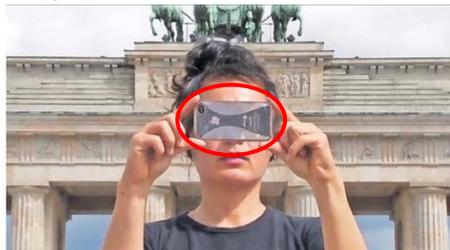
Example:



- 54 **Smartphone**

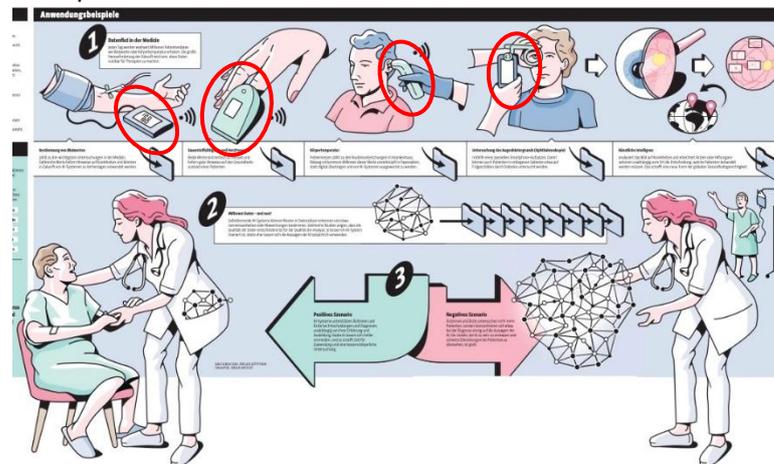
ATTENTION: Only mobile phones/smartphones shown entirely are recorded here. If the focus of the display is on the screen (e.g. icons, applications...), top level code 4 must be assigned!

Example:



55 measuring instrument (e. g. blood pressure monitor, scales...)

Example:



6 nature

All natural (non-human) pictorial objects are summarized under this toplevel code. This includes living creatures such as animals and plants as well as non-living but naturally occurring pictorial objects such as soil, stones, etc.

Example:



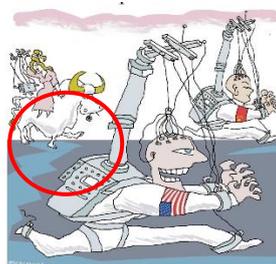
61 animal

All animal life forms can be recorded under this sublevel 1 code. If possible, the following animals can be categorized at sublevel 2:

611 mouse

612 bull

Example:



→ 612 bull

62 landscape

All natural, but not animal, pictorial objects that are part of a (natural) landscape are coded here, e.g. meadows, fields, plants (trees), mountains...

621 rock

Example:



7 symbol

All pictorial objects that either originate from a defined sign system (e.g. alphabet, numbers, special characters...) or contain/imply a figurative meaning or require interpretation are to be understood as symbols. This type is therefore relevant for cartoons and data visualizations, for example.

Example:



71 paragraph

Example:



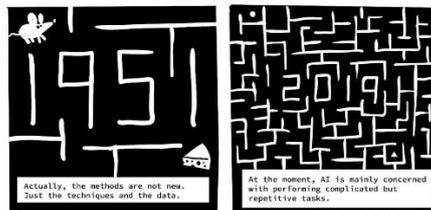
72 metaphor

All pictorial objects that need to be interpreted in order to unfold their meaning, e.g.:

721 labyrinth

722 curtain

Example:



→ 721 labyrinth

73 caricature / map

This attribute can be assigned across the board to caricatures and/or maps if no specific metaphor (72) can be specified.

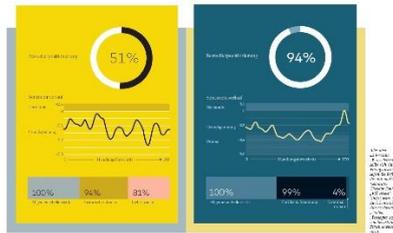
Example:



74 data visualization / diagram

This also includes tables and pictograms, provided that no other image objects to be described individually are included..

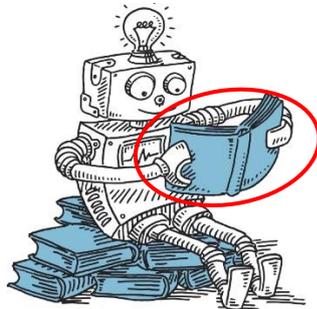
Example:



8 cultural object

This toplevel code describes image objects that are linked to a cultural or artistic creative process or arise from it.

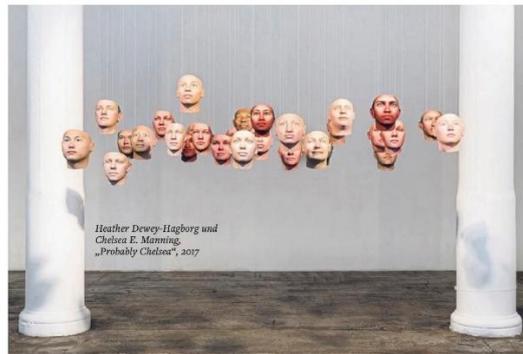
Example:



81 art

This includes art objects such as paintings, sculptures, mosaics, statues, etc.

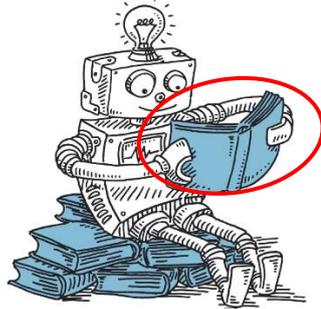
Example:



82 literature

This can be used to describe all literary products such as books, booklets, newspapers or magazines. Book covers are also labeled with this code regardless of their motifs and are not described in more detail (no analysis of the pictorial objects on covers!)

Example:



83 music

This code covers all pictorial objects associated with the creation of music.

The following codes can also be assigned at sublevel 2:

831 instrument

832 techno (e. g. mixing console, loop stations...)

ATTENTION: Objects that are required for the reception of music, e.g. headphones or similar, are coded with 5 (other technical equipment).

ATTENTION: User interfaces of programs for the production of electronic music (editing programs, sampling...) are coded with 41 (software).

Example:



→ 831 instrument

84 other

This includes other items related to (popular) culture that are not of technological origin, e.g. board games or stage works (theater, dance...)

ATTENTION: Video games and objects for the consumption of video games (e.g. controllers) are coded with 32 (technology) or 321 (remote control), 4 (computer) or 5 (other technical device) depending on how they are embedded.

Example:



Poker-Turniere werden üblicherweise im Mehrspieler-Modus ausgetragen. Wer seinen Chipstapel los ist, fliegt raus. Sieger ist, wer am Ende alle Chips hat. FOTO: AP

9 landscape

If a picture primarily represents a man-made environment, this code is assigned. It is usually accompanied by a specification on the sublevels.

Example:



91 buildings

Buildings and houses are labeled with this sublevel 1 code. Both the facades and the interiors of the buildings can be coded as image objects with this code. If interiors are depicted, a specification can be made at sublevel 2:

911 furnishing object (e. g. furniture, indoor plants...)

Example:



92 laboratory

If a (scientific) laboratory is depicted, it is coded separately with this code. At the same time, code 91 is NOT assigned, even though it is a building or a room in it.

Example:



93 retail sector

The same rule as for laboratories also applies to retail premises (e.g. sales areas, cash registers). If these are included in an image as an image object, code 91 is NOT assigned, but this code is selected.

Example:



10 traffic object

Pictorial objects that originate from the transportation sector are recorded under this toplevel. These are primarily individual vehicles and means of transportation.

Example:



101 airplane

This sublevel 1 code covers all pictorial objects associated with airplanes. It is sufficient if sections of the airplanes are depicted. Airports and corresponding furnishings are also recorded under this code. In individual cases, this can be described in more detail at sublevel 2:

1011 cockpit

1012 airport (e. g. display board, security check...)

Example:



→ 1011 cockpit

102 car

Automobiles (cars and trucks) are assigned this sublevel 1 code. The mapping of sections or individual components (e.g. tires, steering wheels) is sufficient to assign this code. In individual cases, a more detailed description can be provided at sublevel 2:

1021 console / cockpit (driver's seat)

Example:



Zuerst wird geforscht: Bosch-Chef Volkmar Denner in einem Konzeptauto Foto: AFP

→ 1021 console / cockpit

11 military object

If weapons (firearms, knives, etc.) are depicted as individual image objects, this top-level code can be assigned. This attribute is also used to capture military actions and/or war scenarios.

Example:



In a world where technology is advancing so rapidly, it's essential to ensure that our workforce is equipped with the skills and knowledge needed to thrive in a digital economy. This is why we are investing in training and development programs that focus on upskilling and reskilling our employees. By doing so, we can ensure that our organization remains competitive and innovative in a rapidly changing market.

3.3 Frame elements (text-image level)

The following subcategories are used to record the interaction of text and image as binary frame elements (frame element is present/ not present), which can then afterwards be assembled into frames via cluster analysis. To decide whether a frame element is present, the image and its respective caption as well as the title and subtitle/teaser of the article are used. In cases of doubt, excerpts from the entire article text can also be read. The following codes are assigned in each subcategory:

- 0** frame element is NOT present
- 1** frame element is present

POTENTIAL USES OF AI (*chance_frame*)

Image and text address positive or uncritical social aspects of a concrete application of AI as opportunities or advantages for a society or social actors (e. g. accelerated production, effective law enforcement...).

DANGER POTENTIAL (*risk_frame*)

Image and text address social risks of a widespread, hasty or unconsidered use (e.g. surveillance, job loss, alienation...) of AI applications or solution strategies to counter these risks (e.g. regulations, AI education...).

COMPETITION (*competition_frame*)

Image and text address national or international competition in AI development, research and implementation. This can involve competitive situations between countries (e. g. economic comparisons, migration of AI specialists...), institutions (e.g. receipt of funding/incentive system for AI research, development of specialist networks...) or individuals (e. g. awarding of prizes).

CULTURAL AND ARTISTIC DEBATE (*culture_frame*)

Image and text deal with an artistic examination of the topic of AI (e. g. exhibitions on the topic, theater performances about AI...). This is about taking up social discourse in the arts and culture sector and NOT about the use of AI technologies within this sector.

NOTE: The frame element is also present if screenshots or similar images from cultural products (e. g. films, video games...) are used, provided that the article also refers to this cultural product in its overall composition and the corresponding screenshot is not used as a "symbolic image" for another topic.

(FURTHER) DEVELOPMENT (*development_frame*)

Image and text focus on the technical/scientific aspects of creating new AI applications or further developing existing models. These are the (functionalities of the) technologies themselves (e.g. invention of a new application, technical hurdles in the simulation of emotions...). The frame element is NOT present if the social, institutional framework conditions under which this technical/scientific development is carried out (e.g. equipment of research institutions, shortage of skilled workers...) are the focus of the text-image composition.

HUMAN ROLE MODEL (*human_ai_frame*)

Image and text focus on the imitation/simulation of human characteristics by AI systems. This includes, for example, the visual orientation of the external appearance towards humans (e.g. humanoid/android robots) or the description of cognitive abilities or other mental states that an AI is (not) able to simulate.

NOTIONS (notion)

At this point, anomalies identified during frame coding can be noted as free text. This may, for example, be information that points to a new frame/frame element and can therefore be used to further develop the categories in future projects.

3.4 Subject coding

SYSTEMATIZATION (ai_type)

With the help of an inductively developed systematization of artificial intelligence, in a mixture of concrete applications and their basic technical requirements, an attempt is made to capture the AI application reported on in the article.

As some articles deal with AI in general, the first code mentioned indicates the main topic (primary) that is most frequently present in an article. All of the following were addressed in at least one paragraph (secondary).

- 0 no specification – AI in general**
This also includes visions of the future, cultural perceptions or generalizing statements such as “evil AI” etc.
- 1 generative AI (genAI)**
 - 1.1 large language models (LLM)**
 - 1.1.1 ChatGPT**
 - 1.1.2 Google Bard (now Gemini)**
 - 1.1.3 Facebook LLaMA**
 - 1.2 image generation**
 - 1.2.1 Dall-E**
 - 1.2.2 Stable Diffusion**
 - 1.2.3 MidJourney**
 - 1.2.4 DeepDream**
 - 1.2.5 Adobe Firefly**
 - 1.3 sound, music & voice generation**
- 2 image processing**
 - 2.1 object recognition**
 - 2.2 image classification**
 - 2.3 face recognition**
 - 2.4 image enhancement**
- 3 natural language processing (NLP)**
 - 3.1 text classification**
 - 3.2 text processing**
 - 3.3 language processing / understanding models**
 - 3.4 voice recognition**
 - 3.4.1 Google voice recognition**
 - 3.4.2 Amazon Alexa**
 - 3.4.3 Apple Siri**
 - 3.4.4 Microsoft Cortana**
 - 3.5 Text-to-Speech, speech synthesis**
 - 3.6 translation**
 - 3.6.1 DeepL**
- 4 reinforcement learning**

- 4.1 games & simulation**
 - 4.2 robotics**
- 5 data processing**
 - 5.1 recommendation algorithm**
 - 5.2 crime investigation / prediction**
 - 5.3 datamining**
 - 5.4 pattern recognition in other areas**
 - 5.5 life science research**
 - Applications in chemistry, biology and medicine
- 6 autonomous systems**
 - such as cars
- 7 medical AI**
 - 7.1 diagnosis**
 - 7.2 imaging procedures**
 - 7.3 surgery (robots)**
- 8 financial AI**
 - 8.1 algorithm-based trading**
 - 8.2 risk assessment**
- 9 not specified**

The topic of the article does not indicate an AI application. This includes articles that report on the stock prices of AI companies, main focus on human portraits or news behind the companies/models, or articles in which human products are presented as if they could have been produced by an AI.
- 10 other AI models / mixed models**

Mainly mixed models, or no clearly recognizable pattern recognition (otherwise 54)
- 999 duplicates**