Summary of sub-project 1 activities: „Experimental development of emerging technologies in the field of referral systems (deep learning on big data) at the level of online social networks and study of their impact on users (AI Media)", carried out in 2020

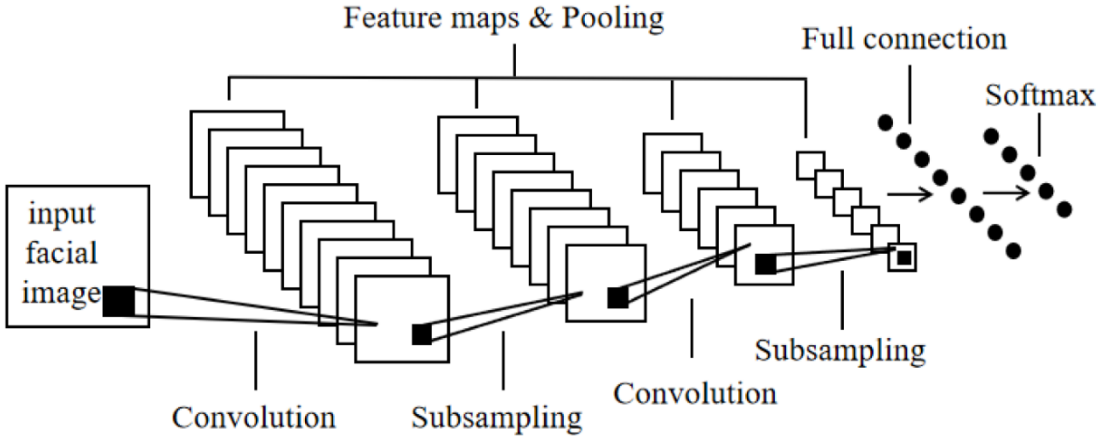
Activity 1-3-3: Developing the sentiment analysis service for people who appear in photos or media clips that contain the logo of a particular brand or company.

In this activity, we addressed the detection of emotions in the images in which the logos of interest appear. This involves detecting people in images where logos appear, detecting people's faces and classifying their facial expression as one of the basic emotions.

For the sentiment analysis, the Haar Cascade Classifier algorithm was used, based on machine learning in which a cascading function is driven from a lot of positive and negative images, clasificating emotions in several categories:

- Basic Emotions - BEs – refer to six basic human emotions, i.e. happiness, surprise, sadness, anger, disgust and fear.
- Compound Emotions - CEs – combinations of two basic emotions.
- Micro Expressions – MEs – represent more spontaneous and subtle facial movements that occur involuntarily.
- Facial Action Units - AUs – facial action units encode the basic movements of the individual or muscle groups.

A convolutive neural network - CNN is directly adapted to most approaches to detecting feelings based on deep learning.



Structure of a CNN network in the context of emotion recognition

For each of the images and videos uploaded to the AI Media app, the sentiment analysis service applies.

Deliverable: *Study_1_3_3_setiment_analysis_image*

Activity 1-3-4: Developing the additional context recognition service (regarding customer feelings and intentions) in which the name of a brand or product is used in the text (comments, discussions, reviews, etc.) of online social networks or blogs and forums.

In this study, the analysis of feelings was applied at the word, sentence or document level, or at the entity or aspect level (Entity and Aspect or Feature Analysis). While document analysis specifies whether the opinion expressed is positive or negative, the entity or aspect analysis specifies the entity of the opinion.

Choosing the characteristics for the classification of feeling is important for achieving the best possible accuracy. Examples of possible characteristics for the classification of feelings would be: Feeling Lexicon, Rules for Opinions, Emoticons, Frequency and Presence of Terms, etc.

Model testing is based on classification. Transfer learning is used for the classification of the text, where, in the first phase, the training is done on a large corpus. Then, it ends on a target corpus. Finally, the classifier is instructed by using labeled examples. The following example illustrates the training process.

Text classification. Training process

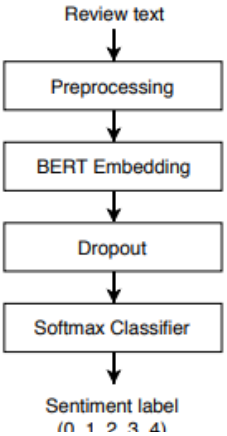
The model does not require labeled data for pre-preparation. Initially a model is pre-trained in an unsupervised manner, then it is adjusted to a domain-specific data set. Thus, classification is done using much less data. This is important because in practice there are no large data sets to be labeled. The model is the combination of neural network architecture and specific settings (*hyperparameter*).

For implementation, the FastText library, launched by the Facebook AI Research (FAIR) team in 2016 was used, which is based on CPU processing and used for effective word representation learning (word incorporation) and text classification. It is written in C and supports multiprocessing during training. One of the objectives of fastText is to allow the formation of models without the need for a GPU. FastText enables both supervised and unsupervised word representation training and sentence classification and is able to achieve very good performance for word representations and sentence classification.

For good efficiency on datasets with a very large number of categories, a hierarchical classifier is used instead of a flat structure, in which the different categories are organized into a tree (binary tree instead of list).

The BERT model is a two-way transformer driven on the masked language modeling (MLM) load and the prediction load of the next sentence (NSP).

Proposed architecture for the classification of fine-grained feelings:



Classifier of feelings using the pre-trained BERT model

Two models of deep learning networks have been identified and tested for the detection of feelings within the text, for which the best results were identified in the studied literature: fastText and BERT. Datasets for text sentiment detection have been identified, including Large Movie Review Dataset, Amazon Reviews for Sentiment Analysis and Amazon Earphones Reviews Kaggle. These sets are available for research and contain the attitudes and feelings of some customer users who have purchased certain products and services and who express their opinion on various social networks. Based on selected sets was built its own set by combining them and presented in a unique format, set subsequently used for training networks. Thus, rre-trained network models resulted, having 88.10% accuracy on fastText and 95.38% on BERT.

Deliverable: ***Study_1_3_4_sentiment_analysis_text***

Activity 1-3-5: Developing a company's additional physical product recognition service by analyzing the content of eCommerce platform images

Selecting appropriate photos for products and marketing campaigns containing products is extremely significant for promoting the e-Commerce platform. This year Google launched "Google feed for merchants", a feature that allows you to view products under the search bar. Effective use of product images in marketing campaigns can be a significant strategic differentiator.

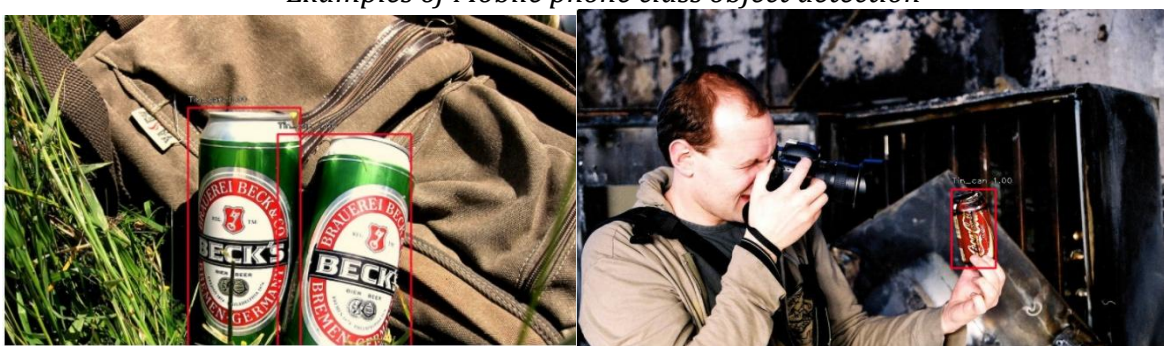
Images are very diverse and often contain complex scenes with multiple objects (8.4 per image on average). We used image-level tag annotations, object delimitation boxes, object segmentation, visual relationships, localized narratives etc.

We used the RetinaNet network, based on cassettes that were entered once with Faster RCNN and were used by developed algorithms. Prior to this method, the selective search algorithm was used, however, objects may have different dimensions. This method is useful for generating proposals for regions with variable shape. In the table below you can see the obtained results.

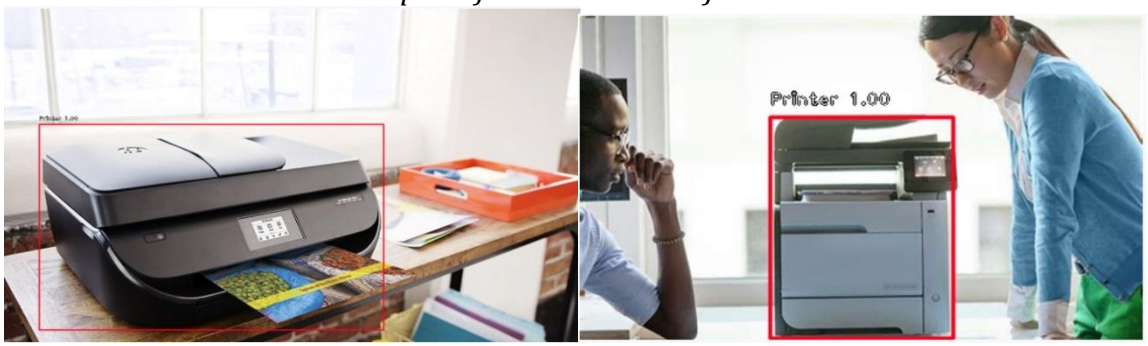
Category	Number of drive images	Number of rating images	Accuracy
Tin can	500	31	84 %
Mobile phone	500	98	82,7 %
Printer	210	19	95%

We considered it appropriate to include images detected with networks trained as an example:

Examples of Mobile phone class object detection



Examples of Tin Can class object detection



Examples of Printer class object detection

The limits of this analysis are due to the long training time of the algorithm before it is used, and manual labeling of the products. To reduce this time, a cloud service that uses GPU or TPU drive can be used.

Deliverable: *Study_1_3_5_recognition_products_image*

Activity 1-4-1: Integrating the app within the project and adjusting the AI Media app by directly contributing research consortium members and app users

Three integration methods were identified, which were tested alternately by the research team.

The first way involves *REST web services*. Integration of the AI Media subproject with the project-level unit application can be done through REST web services. Anumber of REST services have been developed for the AI Media app through which other apps can connect with the AI Media app. Based on these web services, you can call the functions implemented at the AI Media subproject level.

The second way involves development of one *link* towards the *existing app*. A web interface has been developed within the AI Media subproject to facilitate the operation and testing of the REST web services developed. This interface could be used as such. To access the web interface, in the unit application that integrates all subprojects, you can reserve a link that will refer to the web interface of the AI Media subproject.

The third method, *Iframe connection*, assumes that the interface developed within the AI Media subproject could be used as such, integration with the unit application can be done by using iframe. Specifically, within the unit application, an iframe is used in one of the pages in which the AI Media app will run. The application appears to be run directly from the unit application server, in fact the AI Media application is only integrated into one page of it.

The folders allocated to the results of this task include the following resources:

- Description of services AIMedia REST (file *aimedia-api-docs.json*, which can be viewed on https://editor.swagger.io/)
- providing a description of how to integrate AImedia REST services into the FutureWeb application - futureweb_aimedia_integrare_servicii_rest_v1.txt
- REST web services, which users can access to the web address: https://195.34.77.2:12184/ro.ugal.futureweb.aimedia/api/v4

Deliverable: *1.4.1. App integration*

Activity 1-4-2: Promote the AI Media app among potential users

A webinar dedicated to online promotion of the AI Media application among potential users was planned between 4.05.2020 and 18.06.2020. A landing page was made https://aimedia.thecon.ro/, which was promoted by the team members. Morover, the process related to the participants' records was managed and presentations of the project manager were prepared by one of the partners – "Dunărea de Jos" University of Galati – Prof. univ. dr. Adrian Micu, with the contribution of two other research team members: Prof. univ. dr. Alexandru Căpăţînă and dr. Dan Munteanu. The webinar was held on the 19th of June 2020 and was attended by nearly 30 people interested in implementing the AI Media app. The webinar's content has been fully recorded on the Zom platform and is available on Youtube: https://www.youtube.com/watch?v=ORsbKDa6glI&feature=youtu.be

We have chosen a webinar instead of a workshop due to the special conditions imposed by the COFID-19 pandemic.

Deliverable: webinar presentations and screeshots

Activity 1-4-3: Developing a Guide to Using and Deploying the AI Media App

The development of the AI Media app aims to address directly the factors that drive success in social media campaigns. At the same time, this application can also be used as a statistical monitoring and analysis system, for example to track whether the brand or products concerned have been placed in accordance with the manufacturer's requirements in social media campaigns. Analyzing a considerable sample can lead to the identification of influencers whose role can be extended, acting as product ambassadors in campaigns aimed directly at a targeted audience. Using deep learning algorithms to identify the feelings of these influencers in the different content paragraphs that the AI Media app analyzes and taking into account the wealth of data related to social context, geographic location, sentiment analysis will be possible by performing quantitative analyses based on qualitative content resources, using artificial intelligence algorithms predominantly using artificial intelligence algorithms. In the context of the social media impact on brands, an analysis of the marketing research of a product using neural networks is required.

The AI Media app is a tool for marketing analysis of brands/companies on social networks. Provides the ability to import posts, comments, pictures, and videos from a social network chosen for research.

The guide presented in extenso the 5 services of the AI Media platform (Logo Recognition Service, Geographical Location Recognition Service, Social Context Recognition Service, Sentiment Analysis Service and Physical Product Recognition Service of a company), as well as print-screens from the application user interface.

Deliverable: ***1.4.3. AI Media Usage Guide***

Activity 1-5-1: Widespread dissemination of project results (through scientific workshops and conferences, marketing offers and the production of articles in publications of wide interest, at the local and national level)

In 2020, members of the research team produced and published 5 articles with FutureWeb project acknowledgement:

1. Micu A., Geru M., Micu A.E., Capatina A., Avram C., Rusu R., 2020, Empirical Insights on Cloud Services for Machine Learning Applications, Annals of Dunarea de Jos din Galati. Fascicle I. Economics and Applied Informatics, no. 2/2020, pp. 85-90, ISSN 1584-0409
http://www.eia.feaa.ugal.ro/images/eia/2020_2/Micu_Geru_Micu_Capatina_Avram_Rusu.pdf
https://dbh.nsd.uib.no/publiseringskanaler/erihplus/periodical/info?id=493270
https://www.aeaweb.org/econlit/journal_list.php
2. Capatina, A., Kachour, M., Lichy, J., Micu, A., Micu, A. E., & Codignola, F. (2020). Matching the future capabilities of an artificial intelligence-based software for social media marketing with potential users' expectations. Technological Forecasting and Social Change, 151, 119794.
https://www.sciencedirect.com/science/article/abs/pii/S0040162519310613
https://apps.webofknowledge.com/full_record.do?product=WOS&search_mode=GeneralSearch&qid=3&SID=C4YQm3CbWU1rMvZkgU7&page=1&doc=1
3. Enache M.C., 2020, AI for Advertising, Annals of Dunarea de Jos din Galati. Fascicle I. Economics and Applied Informatics, no. 1/2020, pp. 28-32, ISSN 1584-0409
http://www.eia.feaa.ugal.ro/images/eia/2020_1/Cristina_Enache_1.pdf

https://dbh.nsd.uib.no/publiseringskanaler/erihplus/periodical/info?id=493270
https://www.aeaweb.org/econlit/journal_list.php
4. Enache M.C., 2020, Sentiment Analysis in Tourism, Annals of Dunarea de Jos din Galati. Fascicle I. Economics and Applied Informatics, no. 1/2020, pp. 81-85, ISSN 1584-0409
http://www.eia.feaa.ugal.ro/images/eia/2020_1/Cristina_Enache_2.pdf
https://dbh.nsd.uib.no/publiseringskanaler/erihplus/periodical/info?id=493270
https://www.aeaweb.org/econlit/journal_list.php
5. Munteanu D., Munteanu N. (2020). Sentiment Analysis Based on Deep Learning Techniques Applied to Children in Logical Games from Nonformal Education eLearning sustainment for never-ending learning, Proceedings of the 16th International Scientific Conference "eLearning and Software for Education" Bucharest, April 23-24, 2020, Volume 1, DOI: 10.12753/2066-026X-20-007,Pages: 57-65, Publisher: Carol I National Defence University Publishing House
https://proceedings.elseconference.eu/index.php?r=site/index&year=2020&index=papers&vol=35&paper=45bbd04c72d2864a66d90a96b38c3649

Deliverables/Achievement indicators:

4 studies (research services) - *4 finalised studies – Reports 1.3.3, 1.3.4, 1.3.5 and dissemination of results to firms within the webinar*

1 database - *fw_senti_text_dataset* (The database can be downloaded from the https://195.34.77.2:12183/. Database (dataset) with texts called fw_senti_text_dataset fully presented in Study_1_3_4_sentiment_analysis_text.docx, in chapter 7.4 Future Web DataSet. Data was extracted from the 3 sets IMDb movie review data set (50.000 reviews), Reviews for Sentiment Analysis - Amazon] (4.000.000 reviews si 100.000 de reviews) și Earphones Reviews (14.337 reviews). All texts (reviews and respective feelings) have been stored in CSV files containing the fields: 'sentiment', 'text', 'negative', 'neutral', 'positive', 'set'.)

1 AI Media integration documentation within the FutureWeb online social network – *Report 1.4.1*

1 young researcher training internship – *1 type B check mobility for young researchers – in progress at ASE Bucharest during 21.09.2020 – 7.10.2020 – Rusu Robert*

5 articles in publications of wide interest at the local/national level – *1 ISI article published in Technological Forecasting and Social Change, IF 5,846, Q1 red zone; 3*