Summary of sub-project 5 activities: Experimental development of a Romanian-specific ontologia and testing the effects of semantic web-based searches at the level of online social networks" (Semantic Media)

-Sumary 2019-

Activity 5-2-1: Formulation of functional and non-functional requirements of Romanian-specific ontology

A clear definition of functional and non-functional requirements is an essential condition for the successful development of any software product. In the case of FutureWeb ontology, six functional requirements and twelve non-functional requirements were defined. Functional requirements define the functionality of a system or its components, each functionality being described by specifying the system's behavior between outputs and inputs. Thus, in the development process of the proposed ontology, the following functional requirements (***FR***) were considered: ***FR1.*** Ontology will allow the identification of general concepts in relation to a particular concept, ***FR2***. Ontology will allow the identification of specific concepts for a particular concept, ***FR3.*** Ontology will allow the identification of concepts related to a particular concept, ***FR4.*** Ontology will allow the identification of concepts by using different terms, ***FR5.*** Ontology will facilitate the identification of concepts using the usual abbreviations, ***FR6.*** Ontology will allow the identification of concepts in case of common typos.

Non-functional requirements consider various types of constraints imposed on the system, orthogonal to functional requirements. In the case of ontologies, non-functional requirements concern the characteristics, qualities or general aspects of ontology, such as ease of use, scalability and subsequent maintenance (Noy and McGuinness, n.d.; Allemang and Hendler, 2011; Horridge, n.d.; Bergman, 2010b), which has nothing to do with its actual content (Suárez-Figueroa, Gómez Pérez and Villazón-Terrazas, 2009). In the case of the proposed ontology, it was envisaged to meet the following non-functional requirements (***NFR***): ***NFR1.*** Use of concepts and properties from ontologies recognized or standardized by W3C, ***NFR2.*** Ontology must be able to be extended to other languages, ***NFR3.*** Using a modular structure, ***NFR4.*** Compliance with conventions for the designation of classes and properties, ***NFR5***. Versioning of ontology, ***NFR6.*** Description of ontology using Turtle syntax, ***NFR7***. Use of prefixes for ontology and its modules, ***NFR8***. Separation between TBox and ABox, ***NFR9***. Declaring classes as disjointed, ***NFR10.*** Declaring from reverse properties, ***NFR11***. Include labels and descriptions for defined classes and properties and, ***NFR 12***. Avoiding inconsistencies in ontology.

Activity 5-2-2: Development of an experimental model (prototype) of Roman language-specific ontology at the level of an online social network

The development of the ontology prototype was aimed at meeting functional and non-functional requirements, taking into account good practices for the creation of ontologists and methodologies approached by the existing literature. On the one hand, developed ontology aims to model concepts relevant to the FutureWeb social network, such as user accounts or published messages, and on the other hand the concepts in the field of software development, of interest to students at the faculties of profile. The proposed ontology is named in the rest of the Future Web document and uses the prefix fw as well as the URI (Uniform Resource Identifier) *http://www.futureweb.ro/fw* .

Taking into account good practices in the field, the steps and development of ontology was chosen as follows: Stage 1. Determining the scope and objectives of ontology, Stage 2. Analysis of existing ontologists, Stage 3. Make up a list of the terms that will appear in ontology, Stage 4. Definition of classes and class hierarchy, Stage 5. Definition of class properties, Stage 6. Defining Property Types, Stage 7. Creating instances. During the development of the experimental model of ontology, compliance with all functional and non-functional requirements was verified.

Activity 5-2-3: Achieving the methodology of testing and evaluating the developed prototype

Within the framework of the methodology for testing and evaluating the ontology prototype developed, the following steps were identified: **Step 1**. A test sheet that includes questions about the accuracy of the results returned by the platform by comparing them with the data in the ontology. In this respect, the test sheet will include explaining the purpose of the platform, elements such as the key concepts to be tested, the steps needed to be followed, the expected results for each key concept, for each functionality, how to record the performance of each test element and how to describe the situations in which the platform does not behave according to the specifications.
Step 2. Select a team of four people with web application testing skills to test the platform and complete the evaluation sheet. **Step 3.** Browse with members of the test team the evaluation sheet and clarify any concerns related to its content. **Step 4.** Effective testing of the platform by the test team and recording of responses on individual test sheets. **Step 5**. Collecting and analyzing the responses recorded for each item on the test sheet. **Step 6**. Report on any deficiencies discovered in the app and how to correct them. If inconsistencies are identified between the expected and obtained results, for at least one of the elements considered in the test sheet, this shall be specified in the test report. **Step 7**. Fixing any deficiencies found and resuming testing to validate their correction.

To test and validate the ontology prototype, a web application developed in the

C# language has been implemented using the Microsoft ASP.NET Core platform, which implements the Model-View-Controller pattern. The Apache Jena Fuseki server was used to run SPARQL queries. Testing of possible inconsistencies in the declaration of classes and properties was carried out from the development stage using an inference engine.

Activity 5-2-4: Experimental testing of semantic web-based searches at the level of the online social network after the development of Romanian-specific ontology

For experimental testing, an evaluation sheet was carried out in two main sections, a section for testing and evaluation in the case of a single concept search, and a section dedicated to testing and evaluation in the case of several concepts search. For each test, the steps to be taken were specified and the results obtained were recorded. The results obtained from the testing carried out with the help of four users were included in a centralised report. In the case of a single concept search, the following aspects were verified: Testing the identification of concepts by name, Testing concept identification using acronyms, testing concept identification using different terms, testing concept identification in case of common errors, Testing concept identification using singular/plural terms, testing concept identification using articulated terms, testing concept identification using articulated plural terms, testing the display of concepts with a higher degree of generality, Testing the display of concepts with a lower degree of generality, Testing the display of similar concepts. In the case of searching for several concepts, the following aspects were identified: Testing the identification of concepts by name, Testing the identification of concepts when using connecting words, Testing the identification of concepts using acronyms, testing the display of concepts with a higher degree of generality when searching for similar concepts, Testing the display of concepts with a higher degree of generality if one of the concepts has a higher degree of generality compared to the other concepts sought, Testing the display of concepts with a higher degree of generality when searching for several different concepts.

Activity 5-2-5: Conducting qualitative research to determine the functionality and utility problems of ontology at the level of the online social network

Six studies were carried out to determine the functionality and usefulness of ontology. The first study aimed to understand users' opinion on the shortcomings present in classical search engines, on the advantages offered by a semantic search engine, and to highlight the level of importance of the additional functionalities that a semantic search engine can provide. The second study aimed to understand the user's opinion on the usefulness and improvements needed for the functionality of determining concepts with a higher degree of generality, implemented in the developed prototype. The third study aimed to understand users' opinion on the usefulness and improvements needed for the functionality of determining concepts with a lower degree of generality. The fourth study aimed to understand users' opinion on the functionality of identifying concepts similar to the user-sought concept, implemented in the prototype

developed. The fifth study aimed to understand users' opinion on the functionality of identifying concepts from the use of abbreviations. The sixth study aimed to understand users' opinion on the ability of the implemented prototype to provide functionalities such as identifying concepts sought, identifying concepts with a lower or higher degree of generality, identifying similar concepts, searching by acronyms. The aim was to obtain suggestions for improvement and comments from the participants.

Activity 5-2-6: Achieving improvement specifications at the ontology level based on research results

On the basis of the studies carried out, the need to expand both the list of concepts and the lists of terms and abbreviations related to has been drawn up. Two steps will be considered to remedy the observed deficiencies. The first stage will consider including in FutureWeb ontology the concepts and abbreviations identified through the studies carried out: Step 1 - Expanding the list of concepts by including the concepts mentioned by respondents in the studies; Step 2 - Expanding the list of abbreviations by including the abbreviations mentioned by respondents in the studies; Step 3 - Validation of the updated version of ontology.

The second stage involves identifying new concepts in fields related to computer science and including them in FutureWeb ontology: Step 1 - Automatic processing of documents in these fields, such as teaching materials (course materials / seminar); Step 2 – Remove the punctuation marks; Step 3 - Move to split text into individual words; Step 4 - Individual words will then be reduced to the basic form using a stemming algorithm; Step 5 - Then use the technique called TF-IDF (Term Frequency-Inverse DocumentFrequency) to differentiate words specific to the domain of connecting words and general terms; Step 6 - Organizing terms in a hierarchy with the help of industry experts; Step 7 - Inclusion of new concepts in the ontology developed by creating the related courts and necessary relationships; Step 8 - Validation of the updated version of ontology.

Activity 5-3-1: Building an online social network test

In view of the construction of an online social network test were completed the following steps: Step 1 - Comparison of online social networks for which the source code is available free of charge; Step 2 - Analysis of the advantages and disadvantages of developing a new social network in relation to the adaptation of an existing one; Step 3 - Implementation of the social network test. Thus, in the first stage, online social networks for which the source code is available free of charge were analysed. These were highlighted by the active community, through detailed documentation, through the possibility of implementing new features in the form of HumHub and Elgg modules. In the second phase, an analysis of the advantages and disadvantages of developing a new social network was carried out in relation to the adaptation of one of the existing social networks, such as HumHub. While the development of a new social network offers the

advantage of the possibility of fully adjusting the social network to the requirements of the project, adapting an existing social network by building new modules offers important benefits from the dissemination of project results. Thus, if in the case of the construction of a new social network the chances of its adoption by the community are very low, in the case of the development of new modules for popular social networks, they can be easily taken over by the community. Based on the comparison made in stage 1 and the analysis carried out in stage 2, it was chosen to adapt the HumHub social network to the requirements of the project. In the third phase, the necessary modules were developed using the PHP and JavaScript languages, along with the jQuery and Bootstrap libraries.

Activity 5-4-3: Widespread dissemination of project results

For the dissemination of the results obtained within the project, all communication media available were used: Website, Social Media, Communications within each partner faculty, as well as workshops and conferences.

A scientific article was published in an 0.3 impact factor journal:

- C. Delcea, L.-A. Cotfas, C. L. Trică, L. Crăciun, and A. G. *M*olanescu, "Modeling the Consumers Opinion Influence in Online Social Media in the Case of Eco-friendly Products," Sustainability, vol. 11, no. 6, p. 1796, Jan. 2019.

The following articles were published and presented:

- Liviu-Adrian COTFAS, Mihai ORZAN, Camelia DELCEA, Chuanmin MI - Corporate Social Responsibility Evaluation on Social Media using Machine Learning and Semantic Web, 29th EBES Conference, Lisbon, 2019.
- Camelia DELCEA, Liviu-Adrian COTFAS, Rafal Mierzwiak, Mihai ORZAN - Consumers Contagion in Online Social Networks Regarding Recycling Habits, 29th EBES Conference, Lisbon, 2019.
- Liviu Adrian COTFAS, Ionut Costinel NICA - Uncovering Social Media Users Emotions towards Companies using Semantic Web Technologies, 28th EBES Conference, Coventry, 2019.
- Camelia DELCEA, Liviu-Adrian COTFAS, Ionut Costinel NICA - Analyzing Customers' Opinions towards Product Characteristics using Social Media, 28th EBES Conference, Coventry, 2019.
- Liviu-Adrian COTFAS, loan ROXIN, Camelia DELCEA - SEMANTIC SEARCH IN SOCIAL MEDIA ANALYSIS. In: Proceedings of the 18th International Conference on Conference on Informatics in Economy (IE 2019), Bucharest University of Economic Studies Press, Bucharest, 2019
- Alexandra Cristina Dinu, Raluca Giorgiana Chivu, Alexandru Valentin Teodorov, Otilia Platon, Gheorghe ORZAN - The impact of semantic web in user-machine interaction, SCM 4 ECR Technology and Innovation in Supply Chain Management for Creating New Value for Consumers, Valahia

University of Târgoviște, 2019

- Alexandra Cristina Dinu, Violeta Rădulescu, Anca - Francisca Cruceru & Mihai Orzan, Necessity for Semantic Web development in user interaction. Emerging Trends in Marketing and Management International Conference (ETIMM), 4, Bucuresti, 2019
- Alexandra Cristina Dinu, Violeta Rădulescu, Anca – Francisca Cruceru & Mihai Orzan, How Semantic *W*eb Can be used in Better Machine Decision