INFORMATION PROCESSES AND THREATS IN SOCIAL NETWORKS. A CASE STUDY.

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ABSTRACT: *The paper presents a conceptual model based case study of information processes and threats of the most fast progressing social network in Internet for 2010 – Facebook. The key idea is to study the Web.2 technology feedback effects in social networks by using E-R system notation and software environment for modelling and simulation support. The obtained results are based on high-level subject matter experts' opinion usage. The input data was filtered with Delphi technique, including fuzzy sets uncertainty copying support. The created model is further analyzed, providing general sensitivity assessment of the user account settings within the context of the information processes, which are connected with them.*

ACM Computing Classification System (1998): H.5, I.2.4, I.6.5, K.4.2, K.6.5

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Introduction

Social networks are a human society phenomenon that strongly emerged in the 21 century as a result of information technologies boom and the world globalization via Internet. The consecutive development of standardizations for web contents starting from Web 1.0 and walking towards Web 3.0 for 2020 (where AI is becoming more and more significant for the web contents) is really a challenge for both sides – developers and users. Fortunately, however we are still in the Web 2.0 age where the user is not just a passive observer but participant in the web contents generation. But, in relation to this we should mark that because of the multiple aspects of human interactions and its use [15], one of the best places to monitor the interactions effects in the web space are the social networks. This phenomenon started in 1997 with the *Six.Degrees.com* and nowadays has produced a social network boom of more than few hundred according to [21], to mention: *LinkedIn, Plaxo, MySpace, YouTube, Twitter* and of course *Facebook*. We explicitly marked Facebook because currently according to VINCOS [20] and the *Facebook* own blog [18] this is the most used social network with more than half a billion users. It started in 2004 as a Harvard-only social network website, which was further expanded to include other high-school students, professionals inside corporate networks, and eventually everyone who have access to the online world [2].

Currently, *Facebook* provides to its users a personalized profile, giving possibilities for sharing multimedia information, messages exchange and chat, tagging and poking, joining, creating and sharing information amongst groups, adding kinds of applications, and playing different on-line games, while putting of all these a track on friends' walls.

These, however opens an enormous positive and negative possibilities for influencing the different multicultural users. Some recent publications [9], [11] related to *Facebook*, are addressing its usage for training, that could be explained as nothing more but another aspect of biofeedback training phenomenon. However, there are plenty of others, addressing the hidden threats existing behind [6]. Considering these we should truly mark its anagram *Koobface*, which in fact is a new generation of computer worm that is constantly progressing [19].

In the present paper we will try to make a high-level analysis and classification of the emerging threats in *Facebook*, being a widely used social network, by creating a model of the information processes connectivity within the *Facebook* user profile and implementing experts' opinions gathered recently, during two round table discussions and one international conference for the future cyber security challenges and threats.

Methodology

The approach that has been chosen for models creation is based on the utilization of the well-known General Systems Theory [1], because the object of interest could be easily approximated to a complex dynamic system with a lot of objects, time-dependent relations sufficient enough for complicated behaviour interpretation.

As far as the model interpretation is not unique, due to experts' opinion usage and different projections of interest we consider initially to accomplish the workshop method and/or brainstorming continued further with Delphi filtering for data convergence [13]. The selected formalism for objects machine interpretation is very controversial, so the most intuitive one is the Entity-Relationship (E-R) model for machine data/knowledge representation [3], which shows a nice closure to the reality implementing the cause-effect modus and giving at the same time a convenient ability for machine programming within modern object oriented environments like Java, .Net, C# and Delphi.

To be more realistic and close to the reality we further implement and the Dynamical Systems Theory [7] in the discrete case adding weights and time lags (steps number) to the relations between different objects, thus approximating the transition functions that characterize the connections between system's objects. Because, generally, values discretization puts a lot of questions about the accuracy that in combination with the information reliability can make this very difficult and complex for partial solving of this the information uncertainty of the relations' weights is used.

It is well-known that the uncertainty problem has been considered from long ago [10], and though the Shannon's Information Theory achievements [16] and lots of other probabilistic approaches [4], [8], [17] still has no

universal solution, which has no a reasonable answer and is still an open problem from a long time [5].
Here a modification of the fuzzy sets – intuitionistic fuzzy sets is proposed because it removes the necessity of statistical analyses (which is important when a work with experts' data is accomplished) and directly offers abilities for uncertainty influence [12].
Finally, we should mark that this however is not a panacea because the observation, modelling and discretization errors related to the processes of validation and verification are accumulated and should be corrected on the different stages of the modelling and simulation processes related to the idea of using digital world techniques for predicting real world processes dynamics within a certain acceptable uncertainty level [14].

Software implementation

The software implementation is based on the E-R paradigm developed in the object oriented environment Borland Delphi 7® as I-SCIP-SA v.1.0 program, originally designed for scenario development [12], [13], which was a little modified into I-SCIP-SA v.2.0 (see Fig.1).
Briefly, this software allows creation of models using objects (interpreted as rectangles, squares and circles), which are connected with relations (interpreted as headed weighted arrows – uni- and bi- directional). The arrows' weights are marked as yellow labels over the arrows and are expressed in percentages using the following scale: low [0-30], middle [30-50] and high [50-100]. Additionally, if a dynamical classification is performed, the time steps number showing the discretes of the transition function are marked within blue labels above the arrows.
The original I-SCIP-SA v.1.0 offers 2D Sensitivity Diagram (SD) object classification in four zones in accordance with influence/dependence ratio (IDR), which was kept in v.2.0: red (active, IDR=100/50, SE part of SD cube), blue (passive IDR=50/100, NW part of SD cube), yellow (critical, IDR=100/100, NE part of the SD cube) and green (buffering, IDR=50/50, SW part of SD cube). However we realized that this in fact does not directly evaluate the system elements' (objects) sensitivity, either distinguish the feedforward/feedbackward (influence/dependence) relations of the system's building elements, so 3D version of the SD was developed

(thus transforming the square into a cube with the same zones of classification). The 3D one turned to be more convenient for immediate sensitivity (z-coordinate, marked with red arrow in Fig 1 - right) calculation of a given object from the system as an absolute difference between the influence (y-coordinate, marked with blue arrow in Fig 1 - right) and dependence (x-coordinate, marked with green arrow in Fig 1 - right) values, concerning a certain object from the system of interest. When this difference is negative the object in SD is classified as *passive* and is coloured in light grey, otherwise it is *active* and is colorized in white.

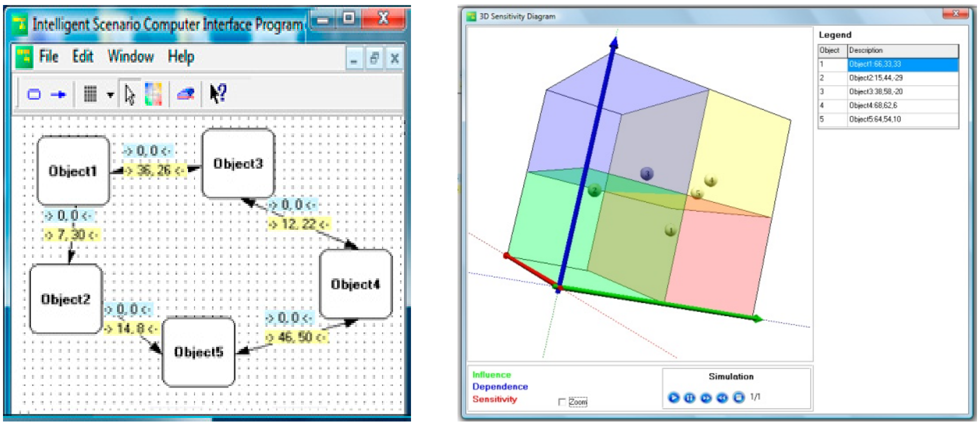

Fig. 1. A screen-shot of I-SCIP v.2.0 program (left) and its 3D SD (right).

The Model

The *Facebook* information flows model is based on the assumption of using the user profile characteristic: *Messages*, *Groups*, *Friends*, *Profile*, *Events*, *Photos & Videos* (also used: *Photos_Videos*), *Wall* that generally encompass current *Facebook* user profile features. We have removed the privacy statements from this model, because we assume that they are controlled by the user on a meta-level, thus are not part of the active information flows. Apart of this however, we have enumerated and the possible activities related to these features: *Share*, *Respond*, *Comment*, *Tag*, *Download*, *Report*, *Create Event*, *Suggest*, *Chat*, *Connecting*, *Post*, *Poke*, *Create Applications*, *Search*. This approach allows description of the existing information flows in the context of the user profile based on the everyday user activities.

The *Facebook* information flows model graphical notation in I-SCIP-SA v 2.0 environment is depicted in Fig.2:

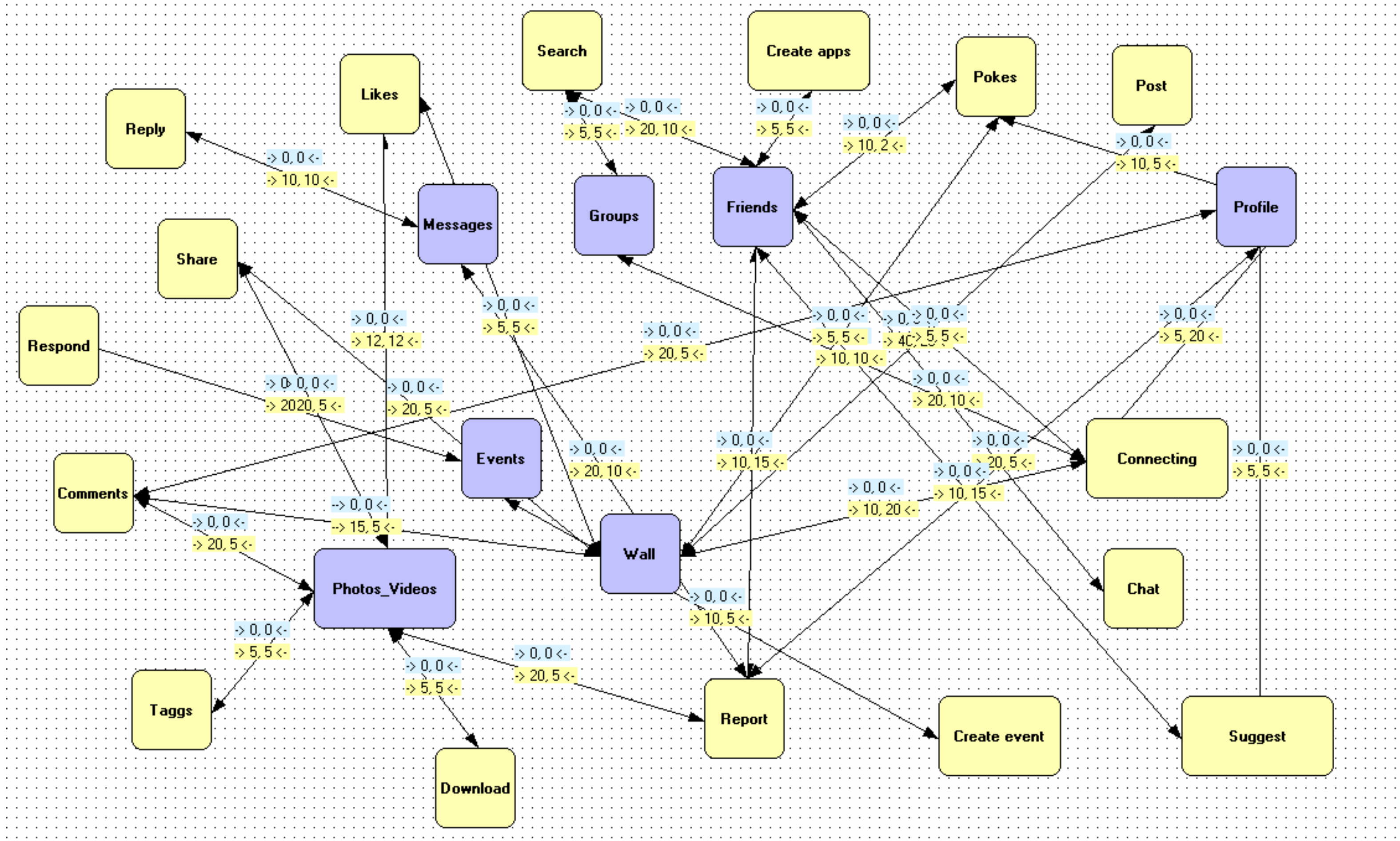

Fig.2. A screen shot of the *Facebook* information flows model in I-SCIP-SA v.2.0 environment.

Following Fig.2 however we should also mark that the relations amongst the model objects have been weighted in a modified scale [0-20] that in fact is a subscale of [0-100] with a lower granulation. This was performed for achieving an additive summing of the input/output flows' weight (for a certain object) that does not require normalization, omitting in this way the normalization wraps, thus misinterpretations due to usage of small and big numbers in one SD graphic (see Fig.3).

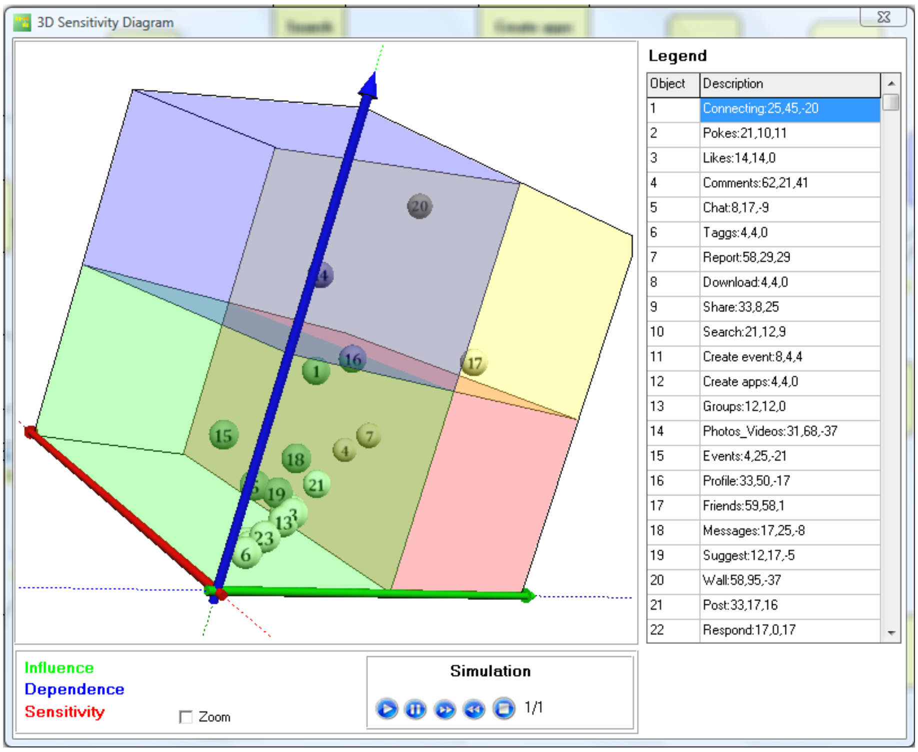

Fig.3. *Facebook* information flows model SD in I-SCIP-SA v 2.0.

Finally, following Fig.3 results we should note that according to the experts' assumptions gathered amongst more than 80 national and 20 international high-level ITs, during two round table discussions (*Bulgarian Cyber Security Status and Problems*, Organized by: Association of the Officers in the Reserve - Atlantic, Association of Communication and Information Specialists and Ministry of Defence, Republic of Bulgaria, Sofia, September 28, 2010; *Security and Defence IT Aspects in the Context of NATO New Strategic Concept and EU Strategy*, Organized by: Hitech, Deloitte-Bulgaria, FIPRA and the Association of Communication and Information Specialists, Sofia, November 12, 2010) and one international conference (*C4ISR in South-East Europe - Problems and Solutions*, AFCEA Varna 10 Years Anniversary International Conference, Plovdiv, October 12, 2010) as critical object (yellow zone, NE part of SD cube) of this *Facebook* information flows model they have marked: *Friends* (active) and *Wall* (passive); *Reports* and *Comments* were marked as active objects (red zone, SE part of SD cube); *Profile* and *Photos_Videos* have been marked as passive (blue zone, NW part of SD cube). All other model elements have been considered to be buffering (green zone, SW part of SD cube).

Discussion

The presented model of the information flows that identify current (critical and active elements of model SD) and potential threats (passive and buffering elements of model SD) of the social network *Facebook* from a user point of view was developed to demonstrate two basics: (i) to show that social networks could be fast and easily described and studied as a system; (ii) to identify and classify the basic elements of this system and to try to analyze their bahaviour. Regarding (ii) however, we should mark that it is necessary to implement also some statistical data trends for the dynamics of the system and to try to implement methods like non-linear forecasting [13] in order to match data trends within experts data. Additionally, as far as the present paper is in fact a *Facebook* case study on social networks, we plan to extend our future work with other social networks' investigation and results comparing.
We believe that in this way a better model for identification of the future threats in social networks is possible to be achieved.

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