Challenges of Digital Era: Potential and Pitfalls of Social Media

Ethics and Trust in Collaborative Cross-Domains

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***Abstract* – The paper surveys the risks and benefits what a user faces in networked environment and how those challenges can be competed. The question is how to measure a potential or benefits of such complex phenomenon as the collaborative cross-domains in social media. We propose an innovative solution – to consider this in context of digital tools and the entities involved into cooperation-collaboration: core researchers, engineers developing information systems and tools, marketing technologists, users-consumers of services and products. The ways of collecting data and measures for protection privacy issues of data collected online as they were applied during the last two decades are overviewed in this paper. There is no universal law protecting online user's privacy in global world and hardly will it be ever. For a while only the awareness of the users, the Codes of Professional Ethics and a fairness of firms involved into collaboration could help them to avoid pitfalls hidden in social media. The summary table shows at a glance benefits and dangers met in social media by its explorers and users. An example included demonstrates how consumers' data can be analyzed and used by companies for behavioral targeting via clustering model and Bayesian approach in recommender systems.**

Keywords* – *social media; networking; digital footprint; data privacy; safety online; professional ethics; recommender systems.

I. INTRODUCTION

Today's Internet is an indispensable condition of normal life. Internet is a remarkable catalyst for creativity, collaboration and innovation providing opportunities that would have been impossible to imagine just two decades ago. Nowadays two contradictory Myths are popular, they stress: (i) unlimited opportunities to user in social media – a techno-enthusiastic vision; (ii) dangers and pitfalls for users of new technologies. Our aim is to investigate these Myths in context of individuals or other entities involved in order to identify WHEN and to WHOM benefits could become a real danger. We will consider how social media can entail both – potential and pitfalls. It is shown that legislation means were not helpful in several countries. The idea that the Codes of Professional Ethics can help users to avoid dangers hidden in social media is the main innovation of this paper and a possible solution.

The World Wide Web rapidly grew since the end of the 90s. An essential base for emerging social media came with Web 2.0. Social media are open, web-based and user-friendly applications that provide new possibilities when it comes to the co-creation of content (blogs, wiki, *Flickr*, *Twitter*), social networking (*Facebook*), the sharing of taste and relevance (*Amazon*, *Google Page Rank*). Besides of a great positive impact, several authors pointed at the disruptive potential of social media, when collecting and sharing consumers' information [1][2].

The entities involved into a cooperation-collaboration are: researchers in core principles and methods, informatics engineers developing systems, networks and applications, marketing technologists, users providing data and the users-consumers of services and products provided by firms involved into entire process of social media development.

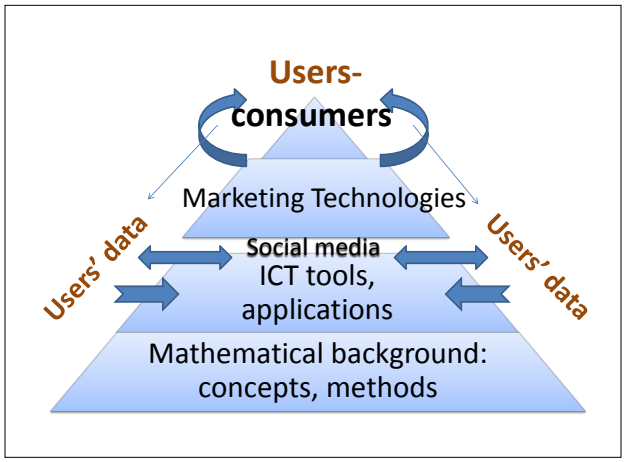

Figure 1. Collaborative cross-domains and users in a process

Fig.1 illustrates how these collaborative cross-domains, theoretical and applied, interact among each other and involve the users in a process. Users' data are the object of investigation, the main goal of a whole process is to focus on satisfaction of users' needs and to ensure profitable business. It is interesting to notice that the mathematical background and principles used in new technologies is almost the same as they were developed in previous centuries. Clustering and decision theory, classification rules for multidimensional data, Bayesian network models – to mention only a few of those methods and models what are widely used nowadays in creating modern information

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communication technologies (ICT) tools and applications for data mining and analysis.

Traditionally, data were gathered using surveys, public records and questionnaires in a very labor intensive way. As digital interaction has become the norm, the labor intensive gathering has become redundant. On line users now present all data via their digital footprint and social graph.

The definitions and explanations of concepts are given in Section 2. Section 3 is devoted to a short overview of extremely rapidly evolving ICT situation, the problems emerging there and the attempts to solve them. Section 4 contains an example – one selected algorithm to demonstrate how data are used to construct a proposal to user. Section 5 considers the Codes of Professional Ethics as one of possible solutions of emerging problems.

II. DEFINITIONS AND IDENTIFICATION OF CONCEPTS

A. Digital Footprint

A digital footprint is a trail left by an entities interactions in a digital environment; including their usage of TV, mobile phone, internet and World Wide Web, mobile web and other devices and sensors [3]. Digital footprints provide data on what an entity has performed in the digital environment and are valuable in other *social media* services [2][3]. In social media a digital footprint is the size of an individual's online presence as it relates to the number of individuals they interact with.

A digital footprint is a collection of activities and behaviors recorded when an entity (such as a person) interacts in a digital environment. It may include the recording of activities such as system login and logouts, visits to a web-page, accessed or created files, or e-mails and chat messages. The digital footprint allows interested parties to access data for data mining or profiling purposes.

Early usage of the term focused on information left by web activity alone, but came to represent data created and consumed by all devices and sensors [2]. Footprints are about where we have been, for how long, how often, and the inter-relationships – for the most part they are memories and moments. But digital footprints are not about user' identity, passport, bank account or social security number.

B. Web Browsing and Digital Shadow

The digital footprint applicable specifically to the World Wide Web is the *internet footprint*; also known as *cyber shadow* or *digital shadow*, information is left behind as a result of a user's web-browsing activities, including through the use of cookies. The term usually applies to an individual person, but can also refer to a business, organization, and corporation or object [3], let us call them stakeholders.

Information may be intentionally or unintentionally left behind by the user; with it being either passively or actively collected by other interested parties. Depending on the amount of information left behind, it may be easy for other parties to gather large amounts of information on that individual using simple search engines. Internet footprints are used by interested parties for several reasons, including *cyber-vetting*, where interviewers could research applicants based on their online activities.

C. Behavioral Targeting

Behavioral targeting is a new marketing technique used by online publishers and advertisers to increase the effectiveness of their campaigns. Behavioral targeting uses information collected on an individual's web-browsing behavior, such as the pages they have visited or the searches they have made, to select which advertisements to display to that individual. Behavioral marketing can be used on its own or in conjunction with other forms of targeting based on factors like geography, demographics or the surrounding content. On line users now present, most often without their conscious awareness, all data via their *digital footprint* and *social graph*. Behavioral targeting is illustrated in Section 4.

D. Social Graph and Social Network

A graph is an abstract concept used in discrete mathematics; the *social graph* describes the relationships between individuals online, as opposed to the concept of a *social network*, which describes relationships in the real world [3] but nowadays these concepts are merged. The data what users provide include preferences, activities, social, economic and demographic facts. Consumers are now unconsciously offering, as a raw data feed, their entire *digital footprint* which includes new data about friends, linkages, location, influences, content created, games, attention and much more from web, mobile and TV. These data streams come in real time; this is an exceptional peculiarity of our modern time.

E. Social Media as Consumer-Generated Media

Social media are media for social interaction, using highly accessible and scalable publishing techniques. Social media use web-based technologies to turn communication into interactive dialogue. Social media is also defined as "a group of Internet-based applications that build on the ideological and technological foundations of Web 2.0, which allows the creation and exchange of user-generated content" [4]. A common thread running through all definitions of social media is a blending of technology and social interaction for the co-creation of value.

There are various statistics that account for social media ever growing usage and effectiveness for individuals and organizations worldwide. Such usage of social media allows digital tracing data to include individual interests, social groups, behaviors, and location. It is important to notice that data can be gathered from sensors within devices, collected and analyzed without user' awareness.

III. CHALLENGES AND PROBLEMS

A. The Potential and Pitfalls of Social Media

The diffusion and usage of social media applications have been growing so dramatically that these applications

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and services have become a mainstream. The research has revealed the explosive development of social computing & informatics activities, social networking sites attract the millions of new visitors, the millions of user-created videos are uploaded onto photo and video-sharing sites [5].

In spite of enormous growth the researchers need to be aware of: (a) different degrees of user participation: active users (contributors) versus passive users; (b) usage divides: young people are quicker to adopt social media. Both aspects force researchers to reflect critically on the potential and pitfalls of a social media. In addition to the aspects mentioned above, we may do not neglect other aspects of a 'dark side' of Web 2.0. More specifically, the active role of the user – as a contributor of so-called 'user-generated content on platforms such as *YouTube*, *MySpace* and *Facebook*' – seems to lead to new forms of exploitation and reorganization of labor in informational capitalism [6].

Users are becoming producers by actively contributing with content and interaction. Simultaneously, however, they constitute an audience commodity that is sold to advertisers. Other aspects that should be taken into account are the issue of trust in information found, privacy and surveillance [7]. The question is to what extent users are self-reflexive about and sufficiently aware of changes in privacy and personal data, i.e., how their digital activities are monitored, processed, analyzed and commoditized by third parties.

TABLE I. SUMMARY OF FINDINGS AT A GLANCE

Actors	**Results of Online Involvement in Social Media**		
	Activity	***Potentials***	***Pitfalls***
Users-consumers	Consuming	Wanted offers	Spammed
Users	Providing data (un)conciously	Targeted adds, self promotion	Privacy infringement
Firms	Profit seeking	Profit, products tailored to needs	Missing techno-knowledge
Marketing	Collecting digital footprints	Effective behavioral targeting, adds	Loss in general if only the economic goals focused
Media Developers	Data mining, strategy for monitoring	Using Internet as new currency in a digital world	Illegal massive data, forensic process
ICT Engineers	Creating soft and tools for networks, DB, applications	Interesting framework for new apps, increased competence	Work for third parties, to become involved into unfair game
Researchers	Developing new concepts, adapting the old one to new situation	Study of new power relation in computer mediated society, new science areas	Loss of IPR* when partners in applications earn a wealth

IPR* – Intellectual Property Rights

The outline of multifaceted investigation of social media and their potentials and/or pitfalls across the various actors-stakeholders of social media is given in Table I, where we summarize the main potentials and pitfalls possible to occur in whole process. It is not a surprise, that all of identified stakeholders have benefits as well as face various dangers in new media. We state that in many cases those dangers can be eliminated by fair role of researchers in the process of policymaking and applying ethics in science and profession. The role of ICT engineers is basic; they can stop malicious use of data by rejecting "dark deals". Now we will consider trials to regulate situation by legislation issues.

B. Trials to Regulate Online Privacy Issues

Many online users and advocacy groups are concerned about privacy issues around doing some type of targeting. Data privacy issues across the countries and trials to regulate behavioral advertising as well as governmental policies concerning social media during the last two decades will be dealt here shortly. The behavioral targeting industry is trying to keep all information non-personally identifiable or to obtain permission from end-users (so called a notice-based approach) [8]. But privacy experts and advocates widely agree that the notice-based model is outdated. Few consumers read privacy policies, and if they do, most consumers are not able to understand the complicated jargon used in such policies to describe increasingly complex data collection practices. Consumers have not complained about data collection online, mainly, because in most cases the collection is invisible to them.

The European Commission (EC) raised a number of concerns related to online data collection (of personal data), profiling and behavioral targeting, and is looking for "enforcing existing regulation" [9] mainly by fixing a time how long collected data have to be stored and how deleted by user. EC initiated the research envisioning a future of digital Europe; the four scenarios are described [10].

The Federal Trade Commission (FTC), an independent agency of the United States government for the promotion of consumer protection adopted a self-regulatory approach since 90th. More recently, FTC has signaled intent to revisit its traditional notice-based framework and will recommend new policies on online privacy & behavioral targeting [11].

Social networking sites provide direct access to the public, but unchecked, these Web 2.0 tools sometimes can do more harm than good. Governments are finding out the hard way that social media is a double-edged sword [12].

C. Is it True that There is no Global Solution?

The potential and pitfalls of social media and several trials to regulate situation in various levels were mentioned here. We have dealt with only a few instances on persons' privacy problems in digital age of an active user of Internet – only one possibility of many others, available as modern world opportunities. Networked world is a world without limits; it is different from a previous world in principle when human beings were accustomed to live thousands of years, having own territory, country and the law system specific to that country. A global world has no separate territories and no common juridical law system applicable to a networked global world for a while. For example, the user

is searching online when being in the country *A*, the server providing information of interest is located in the country *B*, the information was collected from other several countries, say *C*, *D*, *E*. Moreover, a company engaged in behavioral targeting is situated in the country *F*. If some illegal action is suspected in a whole chain of these activities, which country's law should be applied? Usually, the attempts to apply, say, intellectual property rights from offline case do fail in online situation. Not talking about much more complicated situations concerning so called *cyber attacks* or *cyber wars*, happening time to time and showing a tragic vulnerability of networks and systems as well as disabilities of security technologies currently available. Wiki Leaks' recent adventures, as well as the latest events in the North Africa, should lead to rethinking a lot of things. The mass political protests in Tunis and Egypt at early 2011 when *Facebook*, as it was said, helped to organize the meetings really demonstrated the power of social media even in such countries where one can't expect. The first reaction of the government there was to forbid a social media but soon it was converted into usage of it–for propagation of own aims.

IV. How it Works? – an Example of Recommendation Algorithm with Details

Two basic entities which appear in any Recommender system (RS) are the user (consumer, customer) and the item (also referred to as product, service). A user is a person who enters RS providing his opinion (often unconsciously) about various items and receives recommendations of new items from the system. The goal of RS is to generate suggestions of new items or to predict the utility of a specific item for a particular user – to apply a behavioral targeting.

Any RS consists of three parts: the input, the information filtering, and the output level. The input part is a workspace of Data Mining, as seen in the Fig. 2. In the second step – various information filtering algorithms are used. RS is producing recommendation or prediction in the output level.

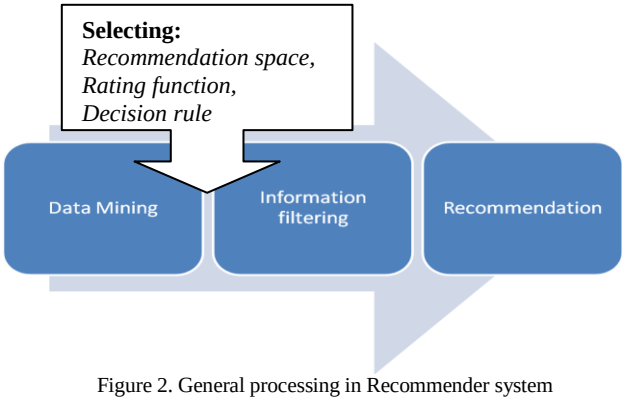

Figure 2. General processing in Recommender system

The input of RS depends on the type of information, filtering algorithms selected. Usually the input data can be divided into three main categories:

1. Rating (or vote) expresses opinion of user on the item in question; usually it has a numerical value (say, from 1 to 10 or often a binary format: 0 and 1 is used).

2. Demographic data providing information about the age, sex, education and etc. of users.

3. Content data, which are obtained from a textual analysis of the user' documents related to the items already rated and the digital footprints collected.

As a rule, RS is collecting information about users and often stores their private data. This is appropriate for RS with the input data belonging to the above-mentioned categories 2 and 3. Demographic data analyzed together with content data – private e-mails, chats, blogs allow identifying the user, and the question is only an acceptable scalability.

Let us formalize a bit the approach. Let m be the number of users u_k in the set $U = \{u_1, u_2,..., u_m\}$ and n – the number of items i_j in the set $I = \{i_1, i_2,...,i_n\}$. Let the opinion of the user u_k about the item i_j is denoted by r_{kj}. All these ratings are collected in the rating matrix of size m x n denoted by $\boldsymbol{R}$. Often a time dimension is added to the user-item space. The item i_j itself can be a vector as well, containing the features as components. In a general case $\boldsymbol{R}$ is a multidimensional space. Each user u_i where $i = 1, 2,..., m$, has rated only a part of items in I therefore he has a list of items I_i as a subset of I, for which he expressed his opinion about. The matrix $\boldsymbol{R}$ then has not rated values, often numerous. There are various techniques [13] for tackling the problems caused by those not available ratings.

An example of the rating matrix with the scale from 1 to 10, where not available ratings are marked as NA, is shown in the Fig. 3. The simplest problem to be solved here is to predict the rating r_{15} of the target user u_1 by joining the opinions of other users, what are most similar to u_1. Various similarity measures are helpful: from the classical Pearson correlation to the k-nearest neighbor rule.

	Item i_1	Item i_2	Item i_3	Item i_4	Item i_5
User u_1	5	7	5	7	**?**
User u_2	5	NA	5	7	9
User u_3	5	7	NA	7	9
User u_4	6	6	6	6	5
User u_5	NA	6	6	6	5

Selections	
	Target user
	Most similar to target users
	Ratings to be used in prediction
	Rating to be predicted

Figure 3. An example of user-item rating matrix $\boldsymbol{R}$

A large part of the information filtering algorithms capture user's opinions on different products and similarities between users. Working through the filtering results, RS generates a proposal for the consumer.

The output of RS can be a Recommendation or a Prediction of rating. The Prediction is a numerical value r^*_{aj} which means a predicted rating of the user u_a to item i_j. The Recommendation is expressed as a list of T items, which the user would like the most, according to the system.

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Recommendation approach can be content-based or based on the collaborative filtering but some authors indicate that results are better by combining collaborative filtering methods and content-based methods in RS. In this case the Bayesian method is used often.

Let us outline the Bayesian approach to RS in networking. Suppose that we have a number of features for products, by which we need to divide products into categories or classes C_j, $j = 1, 2,\ldots, p$ in order to make better recommendations to users who enjoy the products in their category. The probability of product, say D, being in class C_j is calculated, according Bayes theorem, as follows:

$$P(C_j|D) = P(C_j)\,P(D|C_j) / P(D),\ \mathrm{j} = 1, 2,\ldots, p, \quad (1)$$

where $P(C_j|D)$, $P(C_j)$, $P(D|C_j)$, and $P(D)$ are *posterior*, *prior* probabilities, *the likelihood*, and *the evidence*, respectively. Usual assumption is that the product D has a set of features $(F_1,\ldots,F_s)$ that are conditionally independent, then equation (1) can be expressed as follows:

$$P(C_j|D) = P(C_j) \prod_{i=1}^{s} P(F_i|C_j) / P(F_1,\ldots,F_s). \quad (2)$$

In order to apply this formula we need to know or evaluate a priori the probability of each class $P(C_j)$ and to know a distribution of features F_i which the most often is assumed to be the Gaussian. An estimate $P^*(C_j)$ for $P(C_j)$ can be derived from training samples.

The product D is assigned to that particular class for which the posterior probability $P(C_j|D)$ calculated by formulae (2) is the greatest one and will be recommended to other users belonging to that class.

What results can be expected by stakeholders in this example? Users are asked to rate products. If they do, they participate process consciously and will receive targeted adds. A negative aspect could be if a user is misclassified or the proposals become too interfering. Firms and marketing have an effective behavioural targeting if they do a fair business and do not sell the collected data to third parties.

V. CODES OF PROFESSIONAL ETHICS

Investigation of situation concerning privacy matters and a safety of an individual searching Internet or participating in other social media, described in the previous sections of this survey, shows that there are no universal means to overcome possible dangers and to enjoy only the potentials of social media. Self-regulation approach is not working, as interested parties and advocacy groups expected in early days of emerging ICT; the law system in a global level is not available and hardly will be available in real time.

Nevertheless, for a while there is a simple solution – each entity involved into networking, collecting data and marketing activities has to follow the own **Code of Ethics**. The Ethics of Science is applied already many years in all fields of a biomedical and biotechnological research and several others. Now it is a time to discover that the Code of Ethics in Engineering Science has become a pressing need in digital age and especially in the context of new media. In this section we will survey shortly the activities over the world on Science and Professional Ethics fostering.

A. Activities in the North America Continent

Probably the oldest source (issued as early as 1912) is the Code of Principles of Professional Conduct of the American Institute of Electrical Engineers [14], now it is accessible online via Library of the Center for the Study of Ethics in the Professions (CSEP). Very soon this Code will be celebrating a hundred years! General principles remain the same through centenary. CSEP Library [15] contains many other Codes of Professional Ethics.

The Online Ethics Center is maintained by the National Academy of Engineering and is a part of the Center for Engineering, Ethics, and Society at the Center for the Study of Ethics in the Professions at the Illinois Institute of Technology; they are working together [16]. It provides readily accessible literature and information, case studies and references, and discussion groups on ethics in engineering and science. Numerous sample scenarios on issues surrounding Internet privacy can be found in [16]. Many of the contemporary Code of Ethics with principles and guidelines are well applicable in situation of ethics and trust needed in the collaborative cross-domains.

B. European Activities in Fostering Science Ethics

The intense discussions in the research community on the appropriate approaches to maintain high standards in research practice were initiated by the European Science Foundation since 2000. The concerns were raised that the "self-regulation of science, based on traditional approaches was not sufficiently meeting heightened public and political expectations" [17]. This resulted in survey stating that the need has become more pressing today, as national research organizations encourage and support their research communities to engage in collaborative research efforts across borders. The report, where 18 countries covered in detail, provides a basis for an overview of mechanisms to promote good research practice and to handle cases of alleged research misconduct that exist in different European countries. The report contain recommendations to learned societies, research-funding agencies, research-performing organizations. The codes/guidelines analyzed in the report are different in two main aspects. On one hand there are documents which cover all research disciplines and on other hand those presenting the perspective of certain research fields. The situation connected to misconduct in the social media collaborative cross-domains could be improved in the light and recommendations of this report [17].

C. The Global Ethics Observatory

The Global Ethics Observatory (GEObs) – a free global repository of searchable information on ethics institutions,

experts, legislation, codes of conduct and teaching programmes around the world [18]. The GEObs is a system of databases developed and maintained by UNESCO to provide information on ethics in science and technology, launched in December 2005. It consists of five independent databases: experts in ethics; key institutions active in areas of ethics; Ethics Teaching Programmes; Ethics-Related Legislation and Guidelines; Codes of Conduct. This database currently contains 151 codes of conduct of which over 30 are issued by Europe-based institutions.

VI. CONCLUSION AND FUTURE WORK

In the rapidly evolving digital age our theoretical frameworks at hand and used ICT tools, applications must be critically investigated. The concept of mass self-communication provides an interesting framework for studying new power relations in our computer-mediated society; however, it is not free of criticism. This survey summarized the positive and negative sides of social media.

Positive Aspects. Analyzing ever-changing situation during a couple of last decades the positive impact was identified: the users are becoming producers by actively contributing with content and interaction; the firms using personalization of user data are able to offer them innovative products and services and work more effectively. It could lead to new products tailored to the needs of Internet users. Targeted advertising allows customers to receive offers and information about goods and services in which they are actually interested.

Negative Aspects. The benefits mentioned above in real world too often are shadowed by malicious use of data and information. Additional risks to trust arise in the domain under investigation, mainly due to its potential pervasiveness, large scale and involvement of users. The Internet companies collect the massive volume of data. Users constitute an audience commodity that is sold to advertisers. Very often users are left ignorant or they are not informed properly how their digital activities are monitored, processed, analyzed and commoditized by third parties.

Future Tasks. The security technologies have to be developed to address the malicious use of data and information. The aspects that should be taken into account are the issue of privacy and surveillance and special means have to be developed for evaluating a safety of social media, similarly to the quality of digital repository evaluation [19][20]. "The digital community was failing to decently answer the challenge of how to measure or even make sense of the results and impacts of embracing this new world" [21]. The role of researchers in the process of policymaking, applying Codes of Professional Ethics is the most important. For a while only the means increasing awareness of the users, the professional Codes of Ethics and a fairness of firms involved into collaboration could help to avoid pitfalls menacing in social media. The guidelines of Codes of Professional Ethics could help at least partially to contest challenges of social media by all stakeholders involved, while security technologies and laws ensuring privacy in a global world without borders and limits are not developed.

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