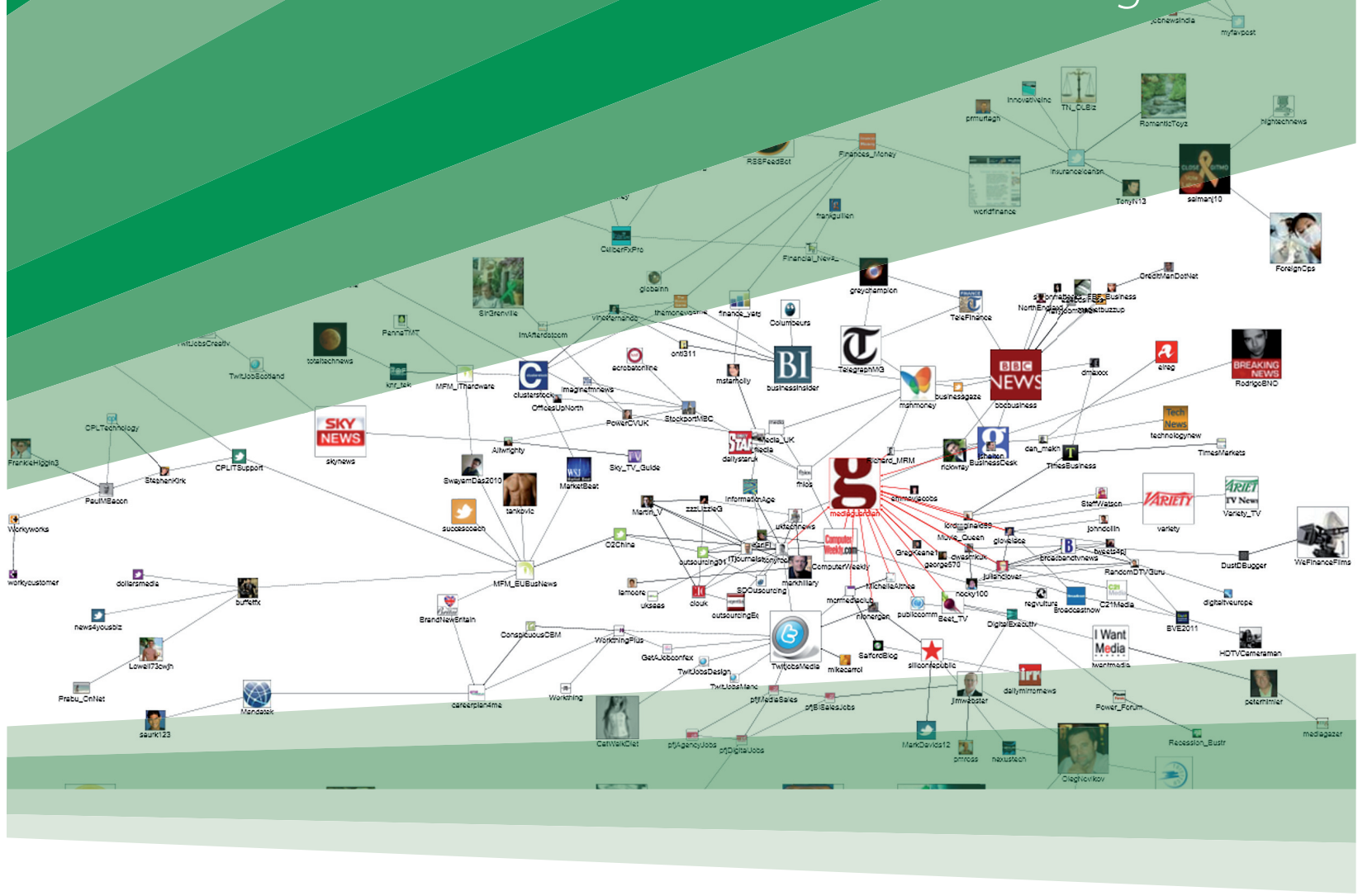# Social Networks Overview:

Current Trends and Research Challenges

November 2010

Coordinated by the "nextMEDIA" CSA.

Supported by the Future Media Networks cluster.

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NEXT-Media is supported by FP7, DG Information Society,
Unit D2 Networked Media

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1. Executive Summary

The emergence and popularity of online social networks in recent years has changed the Internet ecosystem leading to a more collaborative environment. Nowadays, hundreds of millions of Internet users participate in social networks, form communities, produce and consume media content in revolutionary ways. There are very successful EU online Social Networks that account for more than 200 Mio registered users. They would benefit from working together with other relevant EU players to increase their own competitiveness and the competitiveness of the whole EU economy. A partnership among EU partners successfully active on the web (e.g. social networks, gaming, broadcasters, ICT users, incumbent ICT industry and academia) would certainly contribute to increase the competitiveness of EU industry on the web. The partnership would design measures (research, skills, regulatory, access to capital, etc.) to overcome the bottlenecks in order to increase the competitiveness of EU industry on the web.

This paper focuses on the research and technological measures to be adopted. It investigates online social networks as an emerging multidisciplinary research field that bridges social science and multimedia computing. It reflects the consolidated opinion of the members of the NextMEDIA project and the Future Media Networks (FMN) cluster with the collaboration with well known experts, under the guidance of the Networked Media Systems Unit of the Information Society and Media Directorate General of the European Commission.

The paper reviews the current state-of-the-art in selected aspects of social networks and presents a set of open research challenges related to online social networks. The challenges suggest that significant further research is required in the following areas:

- Social graph analysis

- Social media search and management

- Exploiting social graphs
    - for predicting traffic demands and dimensioning media applications
    - for personalising search and recommending content

- Identity algorithms

- Mobile social networks

- Social ranking and opinion sites

- Business and social networking

- Architectures for open and federated social network platforms

The aforementioned fields of research challenges are only few of the dozens of research challenges that the research community faces towards the quest for a ubiquitous, intuitive and secure social web.

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1 The views expressed are those of the authors and do not necesarily reflect those of the European Commission.

2. Introduction

Social Networks have undergone a dramatic growth in recent years. Such networks provide an extremely suitable space to instantly share multimedia information between individuals and their neighbours in the social graph. Social networks provide a powerful reflection of the structure and dynamics of the society of the 21st century and the interaction of the Internet generation with both technology and other people. Indeed, the dramatic growth of social multimedia and user generated content is revolutionising all phases of the content value chain including production, processing, distribution and consumption. It also originated and brought to the multimedia sector a new underestimated and now critical aspect of science and technology: social interaction and networking. The importance of this new rapidly evolving research field is clearly evidenced by the many associated emerging technologies and applications including online content sharing services and communities, multimedia communication over the Internet, social multimedia search, interactive services and entertainment, health care and security applications. It has generated a new research area called **social multimedia computing**, in which well established computing and multimedia networking technologies are brought together with emerging social media research.

Social Networking Internet services are changing the way we communicate with others, entertain and actually live. Social Networking is one of the primary reasons that many people have become avid Internet users; people who until the emergence of social networks could not find interests in the web. This is a very robust indicator of what is really happening online. The Web 2.0 era passed leaving behind great strength to the end-users. Nowadays, users (also known as prosumers[1]), both produce and consume significant quantities of multimedia content. Moreover, theis behaviour when combined with Social Networking (i.e. communication between users through online communities) has formed a new Internet era where multimedia content sharing through Social Networking Sites (SNSs) is an everyday practice. More than 200 SNSs of worldwide impact are known today and this number is growing quickly. Many of the existing top web sites are either pure SNSs or offer some social networking capabilities[2].

Except for the well known "first tier" social networks with hundreds of millions of users that span in the entire world, there are also many smaller social networking sites that are equally as popular within the more limited geographical scope of their membership, within a city, country or continent, for example. There are also many vertically oriented communities that gather users around a specific topic and thus, they have many dedicated members[3].

Facebook[4] is ranked as one of the most visited sites in the world, with over than 500 million subscribed users to date. Moreover, Friendster[5] is popular in Asia, Orkut[6] in Brazil and Vkon-takte.ru[7] in Russia. On top of that, there are dozens of other purely social networks with vibrant communities, such as Vznet[8] (~17 Mio users),

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1 http://en.wikipedia.org/wiki/Prosumer

2 http://www.alexa.com (accessed Nov 2010)

3 http://www.research-write.com/2010/02/social-networking-by-the-numbers.html

4 http://www.facebook.com/

5 http://www.friendster.com/

6 http://www.orkut.com/

7 http://www.vkontakte.ru/

8 http://www.vznet.net/

Xing[9] (8 Mio users), Badoo[10] (>70 Mio users), Netlog[11] (> 70 Mio users), Tuenti[12] (8 Mio users), Barrabes[13], Hyves[14] (> 10 Mio users), Nasza Klasa[15] (> 11 Mio users), LunarStorm[16] (> 1.2 Mio users), Zoo[17] (~1 Mio users), Sapo[18], Daily-Motion[19], VBOX7[20], iwiw[21] and so on. There are also many vertically oriented communities that gather users around a specific topic, such as Last.fm[22] for music or Goodreads[23] for books. Finally, many mobile social networks appear to fill the gap and detach social networks from desktops. Some of them are aka-aki[24], itsmy[25], brightkite[26] and mobiluck[27], to name a few.

Not all social networks are oriented to non-professional users. LinkedIn[28] with over 80 Mio users or Viadeo[29] with 30 Mio and Xing are mostly oriented in establishing professional connections between their users and initiate potential business collaborations.

The rapid growth in popularity of social networks has enabled large numbers of users to communicate, create and share content, give and receive recommendations, and, at the same time, it opened new challenging problems. The unbounded growth of content and users pushes the Internet technologies to its limits and demands for new solutions. SNSs have the audience to claim their place in the primetime if they solve the challenges they face. Twitter's[30] "fail whale" (twitter's downtime icon) became a social media brand thanks to the frequent twitter's outages when (and not only) worldwide events take place. Facebook gets severe criticism due to privacy concerns. Such challenges are present in all other SNSs to a greater or lesser extent.

Considerable amount of effort has already been devoted worldwide for problems such as content management in large scale collections, context awareness, multimedia search and retrieval, social graph modelling - analysis and mining, etc.

This paper aims to draw the state-of-the-art and identify the research challenges that emerge from the Social Networking reality.

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[9] https://www.xing.com/

[10] http://badoo.com/

[11] http://netlog.com/

[12] http://www.tuenti.com/

[13] http://www.barrabes.com/home.asp

[14] http://www.hyves.nl/

[15] http://nk.pl/

[16] http://www.lunarstorm.se/

[17] http://www.zoo.gr/

[18] http://www.sapo.pt/

[19] http://www.dailymotion.com/

[20] http://vbox7.com/

[21] http://iwiw.hu/

[22] http://www.last.fm/

[23] http://www.goodreads.com/

[24] http://www.aka-aki.com/

[25] http://www.itsmy.com/

[26] http://www.brightkite.com/

[27] http://www.mobiluck.com/

[28] http://www.linkedin.com/

[29] http://www.viadeo.com/

30 http://twitter.com/

The rest of the paper is organised as follows: Section 3 presents the state-of-the art in selected areas of current Social Networks and their unique features. In Section 4 the provisional research challenges are analysed. Finally, conclusions are drawn in Section 5.

3. Current situation in selected areas of Social Networks

In this chapter, the current situation in selected areas of SNSs, is described as they have been highlighted by the authors of this paper. It should be noticed that the purpose of this chapter and the paper in general, is not to give an exhaustive and thorough state-of-the art in each and every area. Other areas should not be excluded. Yet, we highlight the areas that have been selected as the most important ones and give the interested readers 'the first step' for their further research.

3.1 Social graphs

A graph is a mathematical abstraction for modelling relationships between things. A graph is constructed from nodes (the things) and edges (the relationships). This mathematical tool that can model natural and artificial systems such as economy, deceases, power grids, etc. has been used by the anthropologists, sociologists and other humanities oriented academics. However, graph analysis and social network analysis are also valuable tools for studying the web and human behaviours of the web users.

Social network analysis may be applied in any web field where a graph may be constructed. From the appearance of social networking sites, users were forming graphs with their friends and this was the ideal source of fresh data to apply social network analysis. One of the most prominent issues in social networks is the formation or the identification of a network of nodes based on real world knowledge (school friends, colleagues etc.) or web extracted knowledge (they are part of the same online community, they like the same movies, etc.).

3.1.1 Social graph expansion

Social network analysis applied in the web by utilising the interconnected Web 2.0 blogs and their comments. Backlinks of posts and the blogroll (list of other blogs) of each blog constructed a graph that could provide some information. This structure was difficult to update, error prone (copy paste links, write urls, etc.) and the users had to have a web page or blog of their own.

Social networking sites created the tool that made relations easier to track and build. Now every user that has an account in a SNS can "tag" information and propagate it to that network. "Likes", "tweets", "diggs", etc. are one button actions that users perform while surfing the web in order to post a piece of information without leaving from the current web page.

3.1.2 Facebook open graph

Facebook Open Graph[31] provides an interface for interconnecting web pages with the Facebook social graph. The most common practice is to add a "Like" button near a media object in a web page and let users share their "Likes". When a user clicks the "Like" button outside the Face-book platform, a new connection is formed in the user's profile. This simple API has significant impact on the generated content in the Facebook platform considering the 500 million active Facebook users that surf the web and collect "Likes".

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[31] http://developers.facebook.com/docs/opengraph

3.2 Microblogging

Microblogging websites are services, which enable their users to post small text messages that will update their personal profile and will also be delivered to their list of friends. Microblogging became extremely popular due to twitter, however other microblogging sites exist as well with similar functionalities. Twitter currently has approximately 190 million users and growing. After its extreme popularity and due to its flexibility and integration in several platforms (mobile phones, desktop apps, email alerts etc.) marketing experts invented a new tool for fast and targeted advertising. The statistics provided from pearAnalytis[32] study reveal that almost 44% of the posts are spam and pointless, about 6% are personal or product advertising, while 3.6% are news and 37.6% are conversational posts.

However, there are many other microblogging services available. Tumblr[33] provides similar functionalities, however more focus on the design and styling is given. A more flexible microblogging solution is posterous[34] that provides a unique way to post small messages to various destinations. Posterous enables a user to connect his/her social networking accounts to the posterous platform and to deliver the posts also to other social networking sites or email addresses of choice. One very powerful feature that is relatively new for microblogging as well as for the social networking platforms is the ability for the user to post a message only to a selected group of friends or other recipients and not necessarily for the whole list of friends. A new mobile service that extends this feature and works on the boundaries of microblogging is GroupMe[35]. Users of GroupMe compile groups of their contacts and use a new unique tele-phone number to reach the group.

3.3 Identity algorithms and APIs

Identity algorithms are used to avoid the pollution of the social graph or provide easy access to potential users. In the process of opening their platforms to the outside world, SNSs embraced or build several APIs. The aims of these APIs are to engage more users, get more content from the web or ease the access of users and interlink their content in various sites. The following paragraphs of the subsection refer to such APIs and protocols that are used in most of the known SNSs or sites that provide third party social networking functionalities.

3.3.1 OAuth

OAuth provides a method for clients to access server resources on behalf of a resource owner (such as a different client or an end-user). It also provides a process for end-users to authorise third-party access to their server resources without sharing their credentials (typically, a user-name and password pair), using user-agent redirections[36]. Facebook platform uses OAuth 2.0 for authentication and authorisation in desktop as well as in mobile applications.

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[32] http://www.pearanalytics.com/blog/wp-content/uploads/2010/05/Twitter-Study-August-2009.pdf

[33] http://www.tumblr.com/

[34] https://posterous.com/

[35] http://groupme.com/

[36] http://oauth.net/ (accessed Nov 2010)

3.3.2 openID

OpenID is a protocol that provides easy sign up or sign in functionality for the users. Most of the widely known web and social networking sites use openID to provide their users with single sign in username and password. Sites like Google, Yahoo!, Facebook, MySpace[37], flickr[38], wordpress[39] and many others use it in order to allow users to enter without the discouraging registration forms and with a unique login for every service. By registering once, a user is able to access any service that supports openID with the same username-password pair that s/he used for the first service. Except for the above mentioned services that act also as openID providers, there are also dedicated openID providers such as claimID[40], myOpenID[41], etc.

3.4 Social media search and management in large scale

3.4.1 Social media search

Since the domination of social networking sites as the primary channel of communicating ideas and sharing media, new social search engines emerged. However, these search engines crawl the social networks and index the available content based only on text. Some of these keyword-based social search engines are: Spy[42], SamePoint[43], SocialMention[44], WhosTalkin[45], wikio.com.[46]

Spy is a web application that is updated in real time and provides the user with the ability to watch what is being said in a certain topic in specific social networking sites and blogs. Same-Point provides an easy interface for the user to select in which of the social networks to search for a keyword or topic. SocialMention works like Google alerts[47] but for social media. Whos-Talkin is a social media search tool that allows users to search for conversations surrounding the topics that they care about the most. Wikio is a personalisable news page featuring a news search engine that searches media sites, blogs and the contributions of Wikio members.

3.4.2 Content management in large scale

In the scale that most of the prime social networks operate, even the most common operations are not trivial. The most powerful example is Facebook that has to handle almost 500 Million active users that share more that 3 billion photos per month and its servers should serve about 1.2 million photos per second[48].

For such volumes of content management becomes a very crucial issue. Here we refer to some technologies and tools that most of the social networks use in order to survive the torrents of queries.

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[37] http://www.myspace.com/

[38] http://www.flickr.com/

[39] http://wordpress.com/

[40] http://claimid.com/

[41] http://openid.net/get-an-openid/ (accessed Nov 2010)

[42] http://spy.appspot.com/

[43] http://www.samepoint.com

[44] http://socialmention.com/

[45] http://www.whostalkin.com/

[46] http://www.wikio.com/

[47] http://www.google.com/alerts/

[48] http://royal.pingdom.com/2010/06/18/the-software-behind-facebook/ (accessed Nov 2010)

Memcached[49]

Memcached is a distributed caching system that caches database queries in order to minimise the relatively slow database access. Memcached started from LiveJournal blogging and social networking site and released as open source. At this time Facebook runs thousands Memcached servers with tens of terabytes of cached data.

Custom compilers or special programming languages

Most of the social networking sites in the race to optimise their source base to the limits use custom compilers for the special needs of their hardware or use new special programming languages that fulfill their custom needs.

Some examples are "HipHop for PHP" which converts PHP to C++ in order to be compiled and run natively on the servers for better performance. Another example is Twitter that dropped ruby for its back-end servers and uses Scala[50], a new programming language that handled well the vast amount of parallel requests.

Haystack[51]

Haystack presents a generic HTTP-based object store containing needles (objects representations) that map to stored opaque objects. Storing photos as needles in the haystack eliminates the metadata overhead by aggregating hundreds of thousands of images in a single haystack store file. This keeps the metadata overhead very small and allows the user to store each needle's location in the store file in an in-memory index. This allows retrieval of an image's data in a minimal number of I/O operations, eliminating all unnecessary metadata overhead.

Cassandra[52]

Cassandra is a distributed storage system with no single point of failure. It's one of the poster children for the NoSQL movement (others are MongoDB, Redis etc.) and has been made open source (it becomes an Apache project). Cassandra is in use at Digg[53], Facebook, Twitter, Reddit[54], Rackspace[55], Cloudkick[56], Cisco[57], SimpleGeo[58], Ooyala[59], OpenX[60], and more companies that have large, active data sets. The largest production cluster has over than 100 TB of data in over than 150 machines.

3.4.3 Human powered and community question answering

Human powered systems emerged from the social networks, which provided the ability to the user to contribute with web content. Since artificial intelligence and computer vision problems were consistent, the researchers envisioned that the solution to unsolved problems was to har-ness the human intelligence. However, to engage users to answer questions, annotate image or proofread OCR extracted text for free had to have something as a reward. Towards this end the "games with a purpose" (GWAP) appeared. In a GWAP the user answers or solves difficult for a computer but easy for a human problems while s/he plays an online game.

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[49] http://memcached.org/

[50] http://www.scala-lang.org

[51] http://www.facebook.com/note.php?note_id=76191543919

[52] http://cassandra.apache.org/

[53] http://digg.com/news

[54] http://www.reddit.com/

[55] http://www.rackspace.com/

[56] https://www.cloudkick.com/

[57] http://www.cisco.com/

[58] http://simplegeo.com/

[59] http://www.ooyala.com/

[60] http://www.openx.org/

In the same track, online community question answering sites provide a place that everyone can contribute by answering questions from other members. The answers are validated by a "start-based" system where the end user gives feedback whether the answer was helpful or not. Some of the well known community questions answering systems are yahoo! Answers[61] for general questions, stackoverflow[62] for questions on programming, serverFault[63] for server administrators and IT professionals or "Seasoned Advice"[64] for cooking professionals and many others.

A very interesting service is the Aardvark[65] search engine, which finds the most relevant person from the user's contact list and the entire community of the users to answer a question. Aardvark accepts questions in natural language (not just keywords) and uses a novel algorithm[66] in order to map the question to the most relevant recipient.

3.5 Mobility and geolocation

Location-based social networks allow members to share their location through GPS, Bluetooth, email or text messaging. The member of the network may also add comments about restaurants, allow friends to know where you are going, share information, or find friends that are few blocks away or even in the Café across the road.

Several mobile-only social networks have emerged, all with unique features that would potentially attract users. However, there is one feature that every mobile social network should have and this is physical presence detection and information exchange[67]. This is exactly the reason for porting a community in a mobile device and detach it from a desktop PC.

Some of the well known location based mobile social networks are: BrightKite[68], Aka-Aki[69], Mobiluck[70]. The mobile social network sites may be clustered in 6 main categories[71] based on their dominant features. These are:

1. *The group texter*: This service focuses on sending short, text-based messages in a group of people at once.

2. *The radar*: The radar knows where the user and his/her friends are. These sites support location-based services by keeping track of where the user's contacts are. Most of these sites allow the user to check if there is anyone close to a particular venue or location, while some of them actively alert him/her if any of his/her contacts are within a certain distance.

3. *The Geotagger*: These sites allow users to tag locations with images and information that appear on a world map. The user may tag favourite places for shopping, dining or any other activity and share these tags with their friends and the network.

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[61] http://answers.yahoo.com/

[62] http://stackoverflow.com/

[63] http://serverfault.com/

[64] http://cooking.stackexchange.com/

[65] http://vark.com/

[66] http://vark.com/aardvarkFinalWWW2010.pdf

[67] Michael Arrington, Techcrunch.com, http://techcrunch.com/2007/09/11/the-holy-grail-for-mobile-social-networks/ (accessed Nov 2010)

[68] http://brightkite.com/

[69] http://www.aka-aki.com/

[70] http://www.mobiluck.com/en/

[71] http://www.gomonews.com/moso/

4. *The dating service*: These sites are identical to their online counterparts. Users create a profile and they are matched with other users. Some also use radar features to alert the user if an interesting (according to the profile) person is nearby.

5. *The social networker*: These sites aim to be as similar as possible to online social networking platforms. Some of the well known SNS such as Facebook and twitter have also a mobile version.

6. *The Media share*: These sites share media files with groups of people.

There are also location-based social networks that are not targeting mobile devices only, such as picasa and flickr image geotagging services.

3.6 Social rankings and vertical social networks

Although these may not be considered as pure social networks, special attention should be given to the social sites which are dedicated to vertical markets such as the travellers community (for example tripadvisor[72], travbuddy[73] or dopplr[74]), films or music. These sites offer services opinion sharing by the users and they compute rankings. For example, dopplr allows its members to register their personal and business travel plans and get alerts for friends in same places, travel overlaps, or get travel advice from other travellers. One of the open issues is to establish methodologies and tools to distinguish between real and fake opinions on those social sites, which is applicable to social networks in general.

Another relevant social opinions exchange tool is the "social bookmarking", which main site is del.icio.us[75] with 9 Mio users who share and establish collections of bookmarks between users.

3.7 Business and Social Networking

Another area with huge growth potential is the use of social networks and/or social networking techniques for business whether it is for improving communications, for marketing or by deriving business intelligence. There are now many different solutions in the market for "Social Business Solutions" and large IT companies and consulting forms are starting to create new departments in this area.

Businesses are slowly coming to the realisation that traditional communication methods are often less effective than social networking.

3.7.1 Social Businesses

Intra company relations: The enterprise can be considered as a dedicated social network and all of the employees as members. In a social network the relationship between members is flat rather than hierarchal. This flat relationship between employees can foster collaboration, brain-storming and creativity.

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[72] http://www.tripadvisor.com

[73] http://www.travbuddy.com/

[74] http://www.dopplr.com/

[75] http://www.delicious.com/

"Social CRM": Just as with intra company relations, a more informal hierarchy can allow companies to work together in a more collaborative way.

Blogging: Blogging can be a very direct, and interactive, way for companies to relate to their customers, clients, shareholders, providers, etc. It is much more immediate and personal way to transmit news and information and to get feedback directly from the recipient.

Viral marketing (basically driven through social networks). In the last few years viral advertising has taken on a fundamental role in the marketing campaigns of many companies. An ad, new product or news item is directed to key persons who the company knows or suspects have an important social position on the net and especially within social networks. These persons pass on the ad or information to their contacts rapidly, if the key person has been chosen adequately it can soon reach thousands or even millions of people.

3.7.2 Social Analytic tools

The technique of data analysis of the communications in social communications (often referred to as the "social graph") is an extremely powerful tool for business. For example, analysis of relations and communications between members of a group or a community can show which are the most important ones (socially). This information can be vital when a viral marketing plan is being formulated or when a loyalty scheme is going to be implanted amongst a company's customers.

A great market has been opened to both the clients of the data analysis and to the researchers and developers of new solutions for the data analysis. Argyle Social[76], Trackur[77] and Radian6[78] are some of the examples of commercial tools which are used to analyse the data coming from social networks, profile the users and personalise the marketing strategies.

3.8 Social Television

Social Television stands for technology that provides social interaction in the context of watching TV-programs or related to television content. It is a very active area of research and was named one of the 10 most important technologies by the MIT. Social Television is a fast growing market and multiple startups have recently appeared.

Social TV has been around for more than 10 years already but not till the rise of social networks it has become feasible, since it already encourages constant connection between members of the network and the creation of likely minded groups. Today's 18-28 years old access the internet more often than they watch television and a growing number among them is interested in having more social features integrated into their TV-experience. Furthermore 23 % of U.S. broadband users want to view online content from sites like YouTube or Flickr on their TVs.[79]

Social television is connecting viewers with their friends, families and people with same interests giving them a space to discuss and exchange recommendations. But how should this interaction be provoked? Demanding from the user to sit in front of his/her TV-Set using mouse and keyboard for interaction does not sound like the best solution. With Sonys release of its Playstation Move Controller all three major gaming platforms (Sony Playstation, Microsoft XBOX and Nintendo Wii) are now using alternative haptical user interfaces Additional

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[76] www.argylesocial.com

[77] www.trakur.com

[78] www.radian6.com

[79] http://www.parksassociates.com/press/press_releases/2009/mar10-socialnetworking.html

drivers to use the Nintendo's Wii controller on Mac, PC or even on a Smartphone already exist for years[80], Microsoft's Kinect has been reported to be hacked just recently[81] and an open source solution for using Sony's Move controller on PCs[82] is on its way opening up an interesting research field of how to use these controllers as interaction devices for other purposes like controlling Social TV content.

3.9 Social Gaming

Social Gaming is a term for games that are based on social interaction. By augmenting the game logic with social aspects players have to deal with each other in various ways to advance throughout the game. While social aspects have been part of massively multiplayer online role playing games (MMORPG) like World of Warcraft for quite a while already, the rise of Facebook and Co created the ground for a new field of games with social interaction as the main focus.

52% of the US adult population plays online games whereas 21% of this group is playing on a regular basis.[83] Just recently EA-Games announced the signing of a contract for five year partnership with facebook, producing online games for the world´s biggest social online platform using the new Facebook Credits system[84]. Playfish[85] and Zynga[86] are also sound examples of game development agencies that develop social games and use online social networks (Facebook, myspace, etc.) as their main distribution channels.

While games in 2009 were often rough-hewn affairs, with a focus on often-spammy viral tech-niques, 2010 has seen rapidly improving production values with the market being taken over by international companies like Disney[87] and games like Farmville are played by millions of people.

For 2010 the sales volume of Social Gaming is expected to reach one billion US dollar, still a small number compared to the 19 billion dollar being awaited for the whole global online gaming market. But keeping in mind that last year´s sales volume only reached 500 million and in 2008 it only were a mere 100 million the tremen-dous speed of the growth of the social online gaming market becomes visible.[88] But these numbers also make an underlying problem of the social gaming market visible. Big companies, with the expectations of gaining high profit, are pumping a lot of capital into this sector. Some analysts already fear that a bubble is being created that sooner or later is going to pop[89]. Research projects aiming at the Social gaming market should keep an eye on dissemination possibilities beside of the usual distribution channels (Facebook and Co.) as well.

[80] http://www.ehow.com/how_2102972_control-computer-wii-remote.html

[81] http://www.engadget.com/2010/11/10/open-source-kinect-camera-driver-now-available-for-download/

[82] http://code.google.com/p/moveonpc/

[83] http://pewinternet.org/~/media//Files/Reports/2010/PIP_Nielsen%20Apps%20Report.pdf

[84] http://www.facebook.com/help/?page=1038

[85] http://www.playfish.com/

[86] http://www.zynga.com/

[87] http://techcrunch.com/2010/07/27/playdom-acquired-by-disney-for-up-to-763-2-million/

[88] http://www.gamesbrief.com/2010/06/the-online-games-market-was-worth-15-billion-in-2009-and-will-grow-to-20-billion-in-2010/

[89] http://techcrunch.com/2010/09/17/social-gaming-hi5/

4. Social Networks - Research Challenges

This section presents selected open research challenges that are currently being investigated by the research community. The authors would like to make clear that these are only few of the dozens of research challenges that the research community faces towards the quest for a ubiquitous, intuitive and secure social web.

Avoiding fragmentation of the social graph through open cross-platform interactions

A major hindrance to exploitation of social network data is the fragmentation of the population of social network users into numerous proprietary and closed social networks. This issue is compounded by the fact that each new game or media application tends to build its own social network around it rather than building upon the rich data available about existing social relationships. Also applications are often restricted to execute within the confines of specific social network platform. A major research challenge, therefore, that would benefit the exploitation of social network graphs for future media networking, is in finding solutions to open up social network platforms to allow cross-platform information exchange and usage. Of course, reliable mechanisms to preserve privacy are an essential prerequisite.

Communities discovery and analysis in large scale online and offline social networks

As social networks will continue to evolve, discovering communities and constructing specific social graphs from large scale social networks will continue to be a dynamic research challenge [15].

Security by means of Social Networks Analysis

The information extracted from Social Networks proved to be a useful tool towards security. One example of an application related to security is the Analysis of terrorism [20], as for instance, the Analysis of the 9-11 Terrorist Network [21] . This study was done by gathering public information from major newspapers on the WWW and analysed it be means of Social networks. A major research challenge on social network analysis is also cyber surveillance for unlawful activities for critical infrastructure protection [21].

Social and Ethical Issues in a Networked World

As in every small or large community, online social communities face also critical social and ethical issues that need special care and delicate handling. Sharing of personal information, protection of child exploitation and many other problems have to be studied and answered ap-propriately [19].

Searching blogs, tweets, and other social media

Searching in blogs, tweets and other social media is still an open issue since posts are very small in size but frequent, with little contextual information and sometimes extremely temporal [4]. Moreover, different users have different needs when it comes to the consumption of social media. Real time search has to balance between quality, authority, relevance and timeliness of the content.

Human-powered community question answering and expert finding.

Human powered (aka crowdsourcing) systems gave promising solutions to problems that were unsolved for years. The research community should continue working on leveraging human intelligence to solve critical problems and answer questions that otherwise would be impossible to answer automatically [5][6]. Social networks contain immense knowledge through their users. However, it is not trivial to find the one that has the knowledge and is also available to share it [7].

Traffic prediction for dimensioning media applications

Investigation of how to exploit knowledge of social network relationships to predict how media consumption may be correlated between groups of users. This information can be used to dimension media servers and network resources to avoid congestion and improve QoE.

Social, mobile, pervasive content sharing and live media distribution

Since users act as prosumers, content sharing and distribution needs will continue to increase. Mobile phones, digital cameras and other pervasive devices produce huge amounts of data that users want to distribute if possible in real time [13] [14].

Spam, opinions and adversarial interactions in social media

Spam detection and advertisement detection are research challenges that need extra attention from the research community. Since users and data production increase, spam (irrelevant in-formation) and advertisements will continue growing [1].

In addition, the importance of social networks to influence the opinions of the users should be protected with the adequate mechanism to avoid biased and fake opinions due to the relevance to the businesses.

Personalisation for social interaction

In order to improve social interaction and enhance social inclusion, personalization engines that locate peers with possibly common likes, dislikes or developing trends should be engineered. Towards more efficient search engines that will be able to serve the users only with relevant content, personalisation algorithms have to be studied in a greater extent.

Dynamics and evolution patterns of social networks, trend prediction

Research in dynamics and trends in social networks will provide more valuable tools for information extraction that may be used for content management and delivery, epidemic predictions or recommender systems[2][3].

Information diffusion in Social Networks

Research in Information diffusion is more than ever needed since the domination of social networks as a communication platform [16][17][18].

Use of Social Networks for business and marketing

Social networking introduced novel collaboration paradigms between network users and serious study is conducted on the use of such platforms for internal business purposes [11]. However, one of most prominent research challenges is how to use social networking for external communications, customer support and of course targeted marketing [12].

Social gaming and social television

Research is needed on better mass feedback mechanisms for both social gaming and social television. For social gaming as "serious game" is a research challenge.

Immersive Social Networks

Immersive social networks will be the future web platforms for social interaction, communication and infotainment. Immersion will provide an intuitive environment and enhance user experience in order to let the users socialize and interact in a more natural way.

5. **Conclusions**

This paper examined social networks as a new multidisciplinary research field that bridges social science and multimedia computing. It introduced the most important aspects of social networks by considering four main aspects: state of the art overview, trends, challenges and open questions. EU social networks, accounting more that 200 Million registered users, are able to improve competitiveness of European web industry by collaborating with established EU ICT industry and academia

The goal of this publication was to provide an initial base line to build a discussion forum on the most critical issues related to social networks. The outcomes of these discussions could feed into the research agendas of the European Union programmes for the near future.

6. **References**

[1]   Benjamin Markines, Ciro Cattuto, and Filippo Menczer; "Social spam detection". In Proceedings of the 5th International Workshop on Adversarial Information Retrieval on the Web (AIRWeb '09), Dennis Fetterly and Zolt\&\#225;n Gy\&\#246;ngyi (Eds.). ACM, New York, NY, USA, 41-48. DOI=10.1145/1531914.1531924 http://doi.acm.org/10.1145/1531914.1531924

[2]   Takeshi Sakaki, Makoto Okazaki, and Yutaka Matsuo; "Earthquake shakes Twitter users: real-time event detection by social sensors". In Proceedings of the 19th international conference on World wide web (WWW '10). ACM, New York, NY, USA, 851-860. DOI=10.1145/1772690.1772777 http://doi.acm.org/10.1145/1772690.1772777

[3]   Lampos, Vasileios; Cristianini, Nello; "Tracking the flu pandemic by monitoring the social web," Cognitive Information Processing (CIP), 2010 2nd International Workshop on , vol., no., pp.411-416, 14-16 June 2010 doi: 10.1109/CIP.2010.5604088

[4]   White, T.; Chu, W.; Salehi-Abari, A.; "Media Monitoring Using Social Networks," Social Computing (Social-Com), 2010 IEEE Second International Conference on, vol., no., pp.661-668, 20-22 Aug. 2010 doi: 10.1109/SocialCom.2010.102

[5]   Rodrigues, E.M.; Milic-Frayling, N.; Fortuna, B.; "Social Tagging Behaviour in Community-Driven Question Answering," Web Intelligence and Intelligent Agent Technology, 2008. WI-IAT '08. IEEE/WIC/ACM International Conference on vol.1, no., pp.112-119, 9-12 Dec. 2008 doi: 10.1109/WIIAT.2008.138

[6]   Li, G.; Li, H.; Ming, Z.; Hong, R.; Tang, S.; Chua, T.; "Question Answering over Community Contributed Web Video," Multimedia, IEEE, no.99, pp.1-1, 0 doi: 10.1109/MMUL.2010.47

[7]   Jian Jiao; Jun Yan; Haibei Zhao; Weiguo Fan; "ExpertRank: An Expert User Ranking Algorithm in Online Communities," New Trends in Information and Service Science, 2009. NISS '09. International Conference on, vol., no., pp.674-679, June 30 2009-July 2 2009 doi: 10.1109/NISS.2009.75

[8]   Walenz, B.; Gandhi, R.; Mahoney, W.; Quiming Zhu; "Exploring Social Contexts along the Time Dimension: Temporal Analysis of Named Entities," Social Computing (SocialCom), 2010 IEEE 2nd International Conference on, vol., no., pp.508-512, 20-22 Aug. 2010 doi: 10.1109/SocialCom.2010.80

[9]   Yu-Ru Lin; Sundaram, H.; De Choudhury, M.; Kelliher, A.; "Temporal patterns in social media streams: Theme discovery and evolution using joint analysis of content and context," Multimedia and Expo, 2009. ICME 2009. IEEE International Conference on, vol., no., pp.1456-1459, June 28 2009-July 3 2009 doi: 10.1109/ICME.2009.5202777

[10] Trier, M.; Bobrik, A.; "Social Search: Exploring and Searching Social Architectures in Digital Networks," Internet Computing, IEEE , vol.13, no.2, pp.51-59, March-April 2009 doi: 10.1109/MIC.2009.44

[11] Fortino, A.; Nayak, A.; "An architecture for applying social networking to business," Applications and Technology Conference (LISAT), 2010 Long Island Systems , vol., no., pp.1-6, 7-7 May 2010 doi: 10.1109/LISAT.2010.5478285

[12] Yu Zhang; Zhaoqing Wang; Chaolun Xia; "Identifying Key Users for Targeted Marketing by Mining Online Social Network," Advanced Information Networking and Applications Workshops (WAINA), 2010 IEEE 24th International Conference on , vol., no., pp.644-649, 20-23 April 2010 doi: 10.1109/WAINA.2010.137

[13] Conti, M.; Delmastro, F.; Passarella, A.; "Social-aware Content Sharing in Opportunistic Networks," Sensor, Mesh and Ad Hoc Communications and Networks Workshops, 2009. SE-CON Workshops '09. 6th Annual IEEE Communications Society Conference on , vol., no., pp.1-3, 22-26 June 2009 doi: 10.1109/SAHCNW.2009.5172964

[14] Santos, R.O.; Fabris, F.; Martinello, M.; Marcondes, C.; "JoinUs: Management of Mobile Social Networks for Pervasive Collaboration," Sistemas Colaborativos, 2008 Simpósio Brasileiro de , vol., no., pp.224-234, 27-29 Oct. 2008. doi: 10.1109/SBSC.2008.14

[15] Prakash, B.A.; Seshadri, M.; Sridharan, A.; Machiraju, S.; Faloutsos, C.; , "EigenSpokes: Surprising Patterns and Scalable Community Chipping in Large Graphs," Data Mining Workshops, 2009. ICDMW '09. IEEE International Conference on, vol., no., pp.290-295, 6-6 Dec. 2009 doi: 10.1109/ICDMW.2009.103

[16] Bo Xu; Lu Liu; "Information diffusion through online social networks," Emergency Management and Management Sciences (ICEMMS), 2010 IEEE International Conference on , vol., no., pp.53-56, 8-10 Aug. 2010 doi: 10.1109/ICEMMS.2010.5563505

[17] Jin-Tao Tang; Ting Wang; Ji Wang; "Measuring the influence of social networks on information diffusion on blogspheres," Machine Learning and Cybernetics, 2009 International Conference on , vol.6, no., pp.3492-3498, 12-15 July 2009 doi: 10.1109/ICMLC.2009.5212771

[18] Apolloni, A.; Channakeshava, K.; Durbeck, L.; Khan, M.; Kuhlman, C.; Lewis, B.; Swarup, S.; "A Study of Information Diffusion over a Realistic Social Network Model," Computational Science and Engineering, 2009. CSE '09. International Conference on , vol.4, no., pp.675-682, 29-31 Aug. 2009

[19] Garcia-Ruiz, M.A.; Martin, M.V.; Ibrahim, A.; Edwards, A.; Aquino-Santos, R.; , "Combating Child Exploitation in Second Life," Science and Technology for Humanity (TIC-STH), 2009 IEEE Toronto International Conference, vol., no., pp.761-766, 26-27 Sept. 2009doi: 10.1109/TIC-STH.2009.5444398

[20] Uffe Kock Wiil, Jolanta Gniadek, Nasrullah Memon; Measuring Link Importance in Terrorist Networks. Social Network Analysis, 225-232. Ed. Nasrullah Memon, Reda Alhajj (Eds.): Interna-tional Conference on Advances in Social Networks Analysis and Mining, ASONAM 2010, Od-ense, Denmark, August 9-11, 2010. IEEE Computer Society 2010, ISBN 978-0-7695-4138-9

[21] Krebs Valdis. "Uncloaking Terrorist Networks." First Monday 7, no. 4 (March2002). http://www.firstmonday.org/issues7 4/krebs..

[22] Vaclav Snasel, Ajith Abraham, Khalid Saeed and Hameed Al-Qaheri, A Framework for Cyber Surveillance of Unlawful Activities for Critical Infrastructure Using Computational Grids, Editors: Sixth International Conference on Information Assurance and Security (IAS), USA, IEEE, ISBN 978-1-4244-7408-0, pp. 345-350, 2010.

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Social Networks Overview:

Current Trends and Research Challenges

DG Information Society and Media of the European Commission.

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