TCSN Newsletter –Issue Six– December 2020

Social Networks Technical Committee

Editors: Prof. De-Nian Yang, Prof. Neeli Prasad, Prof. Damla Turgut

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CHAIR'S MESSAGE

When social media dominates the traffic over the Internet and mobile communication networks, there are further insights and engineering that could be developed based on understanding social networks in depth. Such interplay between technological networks and social networks has so many different aspects to inspire IEEE Communications Society members toward the further frontier of communication technology and benefits of human society. Under such background, Technical Committee on Social Networks (TCSN) is established in 2016, after incubation as a sub-committee in Emerging Technology. We believe that the TCSN newsletters allow us a more fluent exchange of vision, ideas, and technological opportunities, in addition to the website and social media platforms. We greatly appreciate all the members who have contributed to this issue of the newsletter. Last, but not least, we wish TCSN newsletters serve as an effective means for this exciting multi-disciplinary knowledge on social networks to blend humanity and technology in an even better way. Most important, please welcome you to actively participate or initiate more volunteer services to TCSN and IEEE Communications Society.

Best wishes,

Neeli Prasad, Chair, TCSN, 2018-2020

UPCOMING CONFERENCES & CFP FOR SOCIAL NETWORKS TRACK

IEEE Globecom 2021: December 7 – December 11, Madrid, Spain
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Social networks have become prevalent forms of communication and interaction on the Internet and contribute to an increase in network traffic. As a result, social networks have attracted significant research interests in many related areas. Social networks have traditionally been studied outside of the technological domains; however, the focus is now changing towards networking challenges such as cloud, privacy, data analytics, and so on while still keeping the social perspective such as focusing on improving quality of life. The interplay between social networks and technological networks such as mobile networks and mobile computing is becoming still strong and many areas are still to be exploited.

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VISUALIZING TRUSTWORTHINESS IN SOCIAL MEDIA

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Dissemination of disinformation in social media

Social media have become a part of our daily life, and a huge amount of information is communicated over them. As a result, several platforms have been implemented that either specialize on a specific domain, or are of general interest, while even the architecture over which they are based differs from completely centralized and moderated, to entirely free and decentralized. The frequent and increasing use of social networks undoubtedly has shortened distances in communication like never before. Information can be available all over the world from the first second of its publication, alas, with risk of being subjective or unreliable, or even manipulated. The recent example of disinformation during the pandemic of COVID-19 that flooded the internet can give an excellent picture of the situation. The particular example is also characteristic of the extent that the perils that false information broadcasted in the form of disinformation introduces; in this case on public health. Objections to conforming with health instructions on protective measures such as the use of masks and anti-vaccination trends were (and still are) fueled by disinformation widely disseminated through social networks. Hence, recognizing disinformation is an indisputable necessity of our times and the scientific research has already made progress in this area. Here, the challenge is to determine how to visualize information related to the trustworthiness of information in a transparent and understandable manner.

Visualization proposals in the course of assisting disinformation detection

Researchers have proposed different solutions on visualization of trustworthiness of social media content, developing tools, in an attempt to provide easy ways for users to understand and at the same time draw useful conclusions about the information they read on social media. An excellent example is the work of Kaur, Kumar and Kumaraguru who have investigated the detection of disinformation news comparing

different Machine Learning techniques using data from New Trends, Kaggle and Reuters [1]. They have proposed visualizations that can help users identify the efficiency of the used methods, proposing word cloud charts indicating the topics with the most frequent fake and real news.

Another example, is the work of Shahi, Dirkson and Majchrzak, which presents study results related to disinformation on COVID-19 through the use of graphs on false tweets dissemination chronologically based not only on hashtags, but also on emojis and linguistic analysis evaluating tweets with fact-checking sources [2]. Visualizations on COVID-19 vaccination have also been provided by CoVaxxy [3], a tool giving information about disinformation on this topic with plots representing the credibility of sources and metric data about tweets, and geographical data on vaccine refusal by state of USA. Another web application that focuses on how information is diffused and spread in the social web is Social Web Observatory [4]. This tool enables the search according to specific keywords and returns plots about trends, coverage, events, sentiment, stance, etc.

The EUNOMIA project approach

Project EUNOMIA, funded under the EU H2020 Innovation Action framework, proposes a solution based on the concept of "human as trust sensor". It features an architecture built on the codebase of the Mastodon [5] decentralized social network, enriched along with a range of peer to peer, blockchain and artificial intelligence technologies also with the feature of letting users assess the trustworthiness of each post. This voting process is by default anonymous, yet guaranteed to allow only one vote per registered user as well as their right to change their own vote. By this feature, EUNOMIA can help readers of posts have a first indication on their trustworthiness, making use of the power of humans as trust sensors.

EUNOMIA provides a Digital Observatory that visualizes information related to the posts processing from the social network, based on the processing of data about content of posts, date, hashtags, sentiment analysis of the text and popularity of posts according to their reshares. Users can choose a time period to search for hashtags and the Digital Observatory returns plots with sentiment analysis of the found posts and also the trustworthiness votes of these posts. In this way, users can draw conclusions about the general feeling on a subject. Plots depict the most shared posts accompanied by their date and their trustworthiness according to their total votes, while a hover pop-up box displays the content. The trustworthiness is visualized in an interactive way, with different colors for the representation of trusted and non-trusted contents. Users also have the ability to select a level of reliability, setting the number of votes a post must have in order to take into consideration the trustworthiness score. Thus, it is possible to identify popular issues with additional credibility information, observing if the related content being transmitted is considered valid or not.

Compared to the research work presented earlier, EUNOMIA is providing a real-world tool for anyone who wishes to setup a social network that focuses on trust as opposed to likes. It is open-source (https://gitlab.com/eunomia-social) and can be deployed by anyone.

Conclusion

Trustworthiness in social media is an issue that increasingly concerns data scientists. Data visualization can be very helpful to derive insights in different domains and therefore prove a valuable tool in combating false news. Both the research results so far, and the paradigm of EUNOMIA project, show that this is feasible, and that the tools exist and are starting to be available, respecting privacy and personal

data protection of users. Features as sentiment analysis, metric data and evaluation of trustworthiness can be vital in the fight against disinformation.

So let us arm ourselves with the confidence provided by the power of data visualization in the fight against disinformation!

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DIGITAL CONTACT TRACING AND ITS PRIVACY CONSIDERATIONS

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Contact tracing has been an effective method for controlling infectious diseases historically. As its name suggests, an essential step of contact tracing is to identify people who have been in close contact with diagnosed individuals during the disease's infectious period. Before the COVID-19 outbreak, contact tracing primarily relied on trained public health professionals to interview diagnosed individuals to gather their contact histories. During the world's fight against this pandemic, many governments have also embraced *digital contact tracing*, which uses digital logs collected from mobile apps or telecommunication providers to help identify contacts between mobile device users. With the prevalence of mobile technology, digital contact tracing is promising to scale to the unprecedented number of confirmed cases.

Approaches to digital contact tracing can be categorized along two dimensions, according to the type of data they collect and where the data are stored. Considering the type of data they collect, some collect a person’s location, while some collect the proximity between pairs of people. The other dimension has centralization and decentralization at the two ends of the spectrum, depending on whether the data are accessible by a centralized entity or kept locally on devices.

However, the possibility of collecting personal information on a nationwide scale has caused widespread concerns about mass surveillance and privacy violation. The public fears that the information may be

misused for other purposes, such as crime investigation or targeted advertisements. It is thus vital to understand the level of privacy protection provided by digital contact tracing, among other factors that affect their effectiveness and adoption.

Privacy protection in digital contact tracing

We must define an adversary model before reasoning about security and privacy. Here we assume entities involved in digital contact tracing (e.g., governments or private companies developing contact tracing apps) are honest but curious. While they will honestly follow the specification, they will also be curious and attempt to infer additional information from what is available. We now discuss whether each type of digital contact tracing can defend against this adversary.

Location logging: To obtain location information, some rely on apps to report GPS coordinates and some ask users to scan location-encoding QR codes. Several governments have also leveraged cell-tower connection history to determine users' rough locations.

- ***Centralized:*** A centralized entity collects users' location information and identifies those whose trajectories intersect with infected individuals'. This approach raises significant privacy concerns because the centralized entity can recover a user's trajectory, which often reveals the user's personal preferences and social interactions.
- ***Decentralized:*** A user may detect contacts with infected individuals without revealing her trajectory to a centralized entity by leveraging cryptographic techniques, such as private set intersection used by MIT SafePaths. However, its privacy guarantee relies on the underlying cryptographic techniques, which may be challenging for app developers to implement correctly, particularly under time pressure to combat the pandemic. To our knowledge, this type of approach mostly remains an academic curiosity and has not been implemented for practical use.

Proximity detection: A wide range of applications uses Bluetooth technology to detect whether two mobile devices are in proximity. Typically, each device will broadcast its identifier (ID) via Bluetooth. Because Bluetooth has a short communication range and its signal strength attenuates with distance, a device can detect others nearby by listening to the broadcasted IDs and can estimate the distance via the received signal strength. When applied to contact tracing, devices can use pseudonyms (i.e., anonymized IDs) and change their pseudonyms periodically to avoid being linked.

- ***Centralized:*** A centralized entity can link each user to their pseudonyms by requesting the users to upload their pseudonyms or by assigning pseudonym generation keys to users. A famous example in this category is Singapore's TraceTogether app. Logging proximity instead of location provides slightly better privacy against the centralized entity because it is not handed the users' exact locations. However, it can still infer their social interactions.
- ***Decentralized:*** Bluetooth-based proximity detection naturally works well in a decentralized setting. Although infected individuals may still be required to upload their pseudonyms to a centralized database, others are not required to reveal their own information. Users can download pseudonyms of infected people and locally determine whether they have been in close contact. Many governments developed their privacy-focused contact-tracing apps using the Google-Apple Exposure Notification (GAEN) API and Exposure Notifications Express, leveraging Bluetooth signals for decentralized proximity detection.

Generally speaking, decentralization has better privacy protection than centralization; tracking proximity is less privacy-intrusive than tracking location.

Privacy vs. detection accuracy

To some extent, privacy-focused contact-tracing apps trade detection accuracy for privacy. Thus, it is crucial to gauge these apps' accuracy in realistic settings.

Leith and Farrell conducted a series of empirical studies using GAEN-based contact-tracing apps [1]. They measured Bluetooth Received Signal Strength Indication (RSSI) under different phone placements and orientations. Similarly, our team empirically investigated Bluetooth RSSI in crowded environments, such as standing still classrooms and outdoor gatherings [2]. We ran an experiment with 80 participants and used the COVID Watch exposure notification apps, one of the earliest apps available. The results of both studies demonstrated the inaccuracy of Bluetooth-based proximity detection for contact tracing purposes. The signal strength can be easily affected by obstacles (including human bodies), phone orientation, surface material, etc. One good thing is that the number of true positives (i.e., correctly identifying infected users' contacts) increases with the exposure time. The question is thus whether we are willing to tolerate false positives and false negatives to catch more true positives.

Adoption issues of privacy-focused contact-tracing apps

Privacy-focused contact-tracing apps showed signs of success in some places. A 2020 study reports that the UK's app is used regularly by 16.5 million users and helps contain the spread of COVID-19, as it caught a substantial number of true-positive cases [3].

However, several issues hinder their adoption. First, the high number of *false positives and false negatives reduces users' trust* in contact-tracing apps. Second, this underlying technology is not straightforward to regular users, and users may have wrong expectations about the apps. This misunderstanding amplifies users' distrust of the apps. By reviewing the comments for Taiwan's GAEN-based app on app stores, we spotted comments complaining that the app provides little information about where and when they got exposed and what to do. Some wrongly believed that the app would send real-time alerts or that the government keeps track of their location. Users do not understand that it is normal to have false negatives and positives, and it is by design to not disclose too much information for better privacy.

Perhaps due to these issues, the Taiwanese prefer using another centralized contact-tracing tool that uses QR codes and SMS, which is easier to understand. It simply requires users to scan QR codes posted at storefronts and send a free SMS message containing the location information to a number dedicated for contact tracing. The data (consisting of a person's mobile number, timestamp, and location) is stored by telecommunication companies and accessible by the health authority upon request.

Takeaways

When societies are fighting against the global healthcare crisis, privacy often becomes a secondary concern. However, many new technologies and infrastructures invented to help control the pandemic at the cost of privacy will likely stay or be repurposed in the post-pandemic world. It is thus important to understand what privacy protections we have now and where we might be heading.

This article introduced four types of digital contact tracing and their privacy protection against honest-but-curious adversaries. While decentralized proximity detection is the least privacy-intrusive type, it suffers from inaccuracies and adoption issues. Further cross-disciplinary research is needed to utilize the technology's strengths better while preserving users' privacy.

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COLLECTIVE ENVIRONMENTAL INTELLIGENCE DEVELOPMENT FOR ADDRESSING SOCIO-ENVIRONMENTAL CHALLENGES

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Human and Natural Environments Interplay

Nowadays, we have reached a critical point where human communities are having a drastic impact on natural environments, and vice-versa, the natural phenomena affect our societies in an unprecedented manner. The fundamental and unavoidable interplay between natural and societal systems needs to be jointly modelled and analyzed, to understand the basic underlying factors that will enable us to gain different capacities of control over it in the future, while ensuring a more virtuous cycle between human communities and natural environments.

Moving from Individual to Collective Intelligence Construct

To represent the main stimuli, socio-environmental interrelationships and economic trends that would drive human behaviors towards environmental sustainability, we introduce the concept of Collective Environmental Intelligence. Collective Environmental Intelligence considers both Environmental Intelligence (EI) and Collective Intelligence (CI) indicators. EI is considered as the integration of environmental and sustainability research with cutting-edge technologies to provide meaningful insight addressing environmental challenges. EI allows us to comprehend systems in all their complexity, as well as the interplay between the natural and man-made worlds. CI is considered as shared or group intelligence that emerges from the collaboration, collective efforts, and competition of many individuals and appears in consensus decision-making. Even if psychologists conventionally consider intelligence from an individual's point of view, the shared nature of EI makes it synergistic with CI, since the development of environmental awareness is a necessity to promote a more symbiotic relationship among humans and the environment. Such a blending is considered as the construct of Collective Environmental Intelligence.

We consider Collective Environmental Intelligence as an important element to manage a class of environmental problems, based on its inclusion at the modeling of Socio-Environmental Systems (SES). Such problems occur often enough in environmental management, but their proper interdisciplinary handling has been hampered so far [1]. To overcome existing impediments, there is a need to support

participatory modelling of SES and manage epistemological and ontological differences and misunderstandings across disciplines. Emphasis has to be placed at modelling behavioral change at individual and social level as a cornerstone of a transition to a more sustainable way of interacting with nature.

Though significant progress has been achieved over the past years in modelling user behavioral aspects and perspective, with reference to various fields and socio-technical systems [3], there is still limited understanding of how people perceive risk information and make decisions under uncertainty, in particular when we refer to environmental issues. Thus, the consideration of behavioral aspects towards uncertainty, should begin at the problem defining stage, integrated into the workflow and involve all relevant stakeholders. Models of human behavior are often designed for the individual or small group scale [4], while many environmental problems are global in nature. In this direction, macroscopic patterns and phenomena observed at higher scales in complex SES, are required as a result of microscopic behavior and interactions at lower scales.

Enabling Technologies for Participatory Socio-Environmental Systems Modelling

To manage to support participatory SES modeling taking into account the need for modeling of collective behavioral aspects, fusion of knowledge coming from interdisciplinary domains has to take place. To achieve so, a set of emerging technologies can be exploited, such as Knowledge Graphs and Social Network Analysis (SNA) techniques.

The main idea under the concept of a Knowledge Graph (KG) is the usage of graphs to represent data, often enhanced with some way to explicitly represent knowledge [2]. A KG is considered as a variant of a semantic network, where constraints, structural elements and characteristics of nodes and links are continuously evolving based on the processing of the collected data. KGs are considered suitable for the representation of knowledge in complex and dynamic systems where relationships among the denoted concepts may evolve across time. Furthermore, within a KG, semantic alignment of concepts defined in similar but different ways by scientists in different disciplines (e.g., social cohesion can have different interpretation if seen by a psychologist, an economist or an environmental scientist) may take place. Through a KG, access to a constantly refreshed repository of knowledge is provided, where information can be represented in a homogeneous way, while analysis mechanisms can be applied over it. Based on the applied analysis mechanisms, the scientific community is going to be able to explore and make sense of the complex and interlinked processes of natural and societal systems and provide advanced models able to transform economies, human behaviors and manage global environmental issues. As already mentioned, such mechanisms include SNA techniques.

Social network theory examines how actors in dynamic and complex systems may be interrelated and exchange resources of many kinds, analyze how these actors engage with one another, as well as assess the group dynamics in terms of influence forces among the actors. Natural resources usage and management in local or global scale can be modeled based on the adoption of SNA techniques, considering humans as an integral part of the produced models. In this way, Collective Environmental Intelligence indicators can be assessed based on the application of sociocentric SNA techniques, where an overall ecosystem can be examined in the form of a network with dynamic links and interactions among the nodes.

Addressing Environmental Challenges through a Humanity's Collective Spirit

To manage to address modern environmental challenges and mitigate as much as possible the impact of the climate change in local, regional and global level, the development of a humanity's collective spirit is considered a must. Such a spirit can be assisted by exploiting in the most prominent way the advantages that can be provided within a knowledge-driven society, where interdisciplinary scientists will be able to join forces towards a common objective.

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