Systematic Review of Bibliography on Social Interactions using the Meta-analytical Approach

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Abstract: The general objective of this systematic review was to evaluate the evolution of studies on social interactions up to 2018, in addition to proposing a diagnostic tool on social interactions, sensors used, among others. The methodology of the research was the bibliographic research of an exploratory nature, using the data collection, it was possible to see that there is a significant growth of articles on this subject. The analysis identified different countries that conducted research on this subject and the most cited articles with their authors. Different jobs were found, such as care for the elderly, interactions in vehicular networks, social interactions in public environments, among others.

1 INTRODUCTION

Humans are constantly developing and for this, they have the need to communicate, whether through spoken language, writing or even by gestures. According to (de Mello and Teixeira, 2011), since birth the individual is already a social being in development and all its manifestations happen because there is another social being that corresponds, even using the sign language the individual can interact, getting used to the environment in which it lives.

We could consider that the interaction is one of the main principals means of development of the human being, especially in the initial years of life in which the child is interacting crying, pointing, babbling, knowing and adapting to this new environment in which he lives and the culture that there is submitted. For (Rabello and Passos, 2013), humans are born 'immersed in culture', and this will be one of the main influences on the development of it.

The interactions can be face-to-face or virtual, where face-to-face interaction happens in a context of co-presence, in which all involved are present and share the same referential system of space and time, being of great importance gestures, posture, facial expression and even the physical distance between the interlocutors (Gumperz, 1998).

The virtual interaction according to (Leontiev, 1978), the subject is perceived in its relations with the object to be learned, a relation made through a mediation instrument. This subject is not isolated in space but situated within a context in which he interacts with other people, forming a community to achieve a certain goal that is shared by all.

The structure of the present study is given below. Section 2 presents the background, section 3 presents the areas of knowledge that will be applied as criteria in the comparison of works, section 4 presents the methodology and analysis on the Search String in addition to the questions that should be answered. Section 5 will present the criteria for inclusion and papers, synthesis, and synthesis and a comparative table, and in section 6 a report and the answers to the questions will be presented, and section 7 will present the conclusions of the research.

2 BACKGROUND

This section will present the background needed to understand this systematic review. Context Awareness concepts, which is a subarea of Ubiquitous Computing will be presented.

Context Awareness is represented by the ability of the system to use the context in which it is currently

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providing appropriate information/responses to users. Several systems can be considered as Context Awareness, but they are often called by other names like intelligent systems, evolutionary systems, etc.

In Ubiquitous Computing it is important that modules and sensors interact with each other and between users, making them sensitive, allowing interaction with users through response actions and/or reactions, and these characteristics make them aware or sensitive to the context, these are designated as a subgroup of Ubiquitous Computing.

According to (Abowd et al., 1999), there are different ways of using Context Awareness, which may interact together or separately. According to (Kofod-Petersen and Cassens, 2006), the context can be divided into five subcategories: environmental context, personal context, social context, task context, and temporal space context, these subcategories are:

Environmental Context: This context captures the user environment, such as existing elements in the environment, services, people, and information accessed by the user.

Personal Context: This context captures the physical and mental information about the user, such as mood, abilities, and disabilities.

Social context: This context captures the social aspects of the user, such as information about the different functions that a user can assume.

Task Context: This context captures what the user is doing, can describe the user's goals, tasks, and activities.

Temporal Space Context: This context captures attributes such as: time, location, and community present.

3 RESEARCH DIMENSIONS

This section presents concepts related to the areas of knowledge involved in this systematic review, which include Social Context, Social Signal Processing, and Intrusiveness.

3.1 Social Context

According to author (Kofod-Petersen and Cassens, 2006), social context describes the social aspects of the user, such as information about friends, relatives, and colleagues. For (Carter, 2013) the social context is the medium by which people can relate easily, including the culture in which the individual lives and was educated and the people and institutions he interacts with. It's possible to add places and activities to this concept. Therefore, according to the definition of (Schilit and Want, 1994) mentioned above, the social context addresses two of the main aspects to define the context, which is: "where are you?" and "who are you with?".

3.2 Social Signal Processing (SSP)

To automate the process of evaluating human behavior, the Social Signal Processing (SSP) has emerged. The purpose is to use the maximum number of sensors to collect data and automatically detect information about users' social behavior, identifying the information of the context in which the user is. SSP addresses the issues of impartiality, indifference, and scalability.

The author (Vinciarelli et al., 2010) defined some procedures for the detection of social behavior, which were later adapted to the mobile environment by (Palaghias et al., 2016), who concluded that to extract knowledge about social behavior in mobile devices four steps are necessary:

Sensing: It is done by the sensors present in the device, such as a gyroscope, accelerometer, camera, microphone, etc. Each sensor is responsible for generating the data of certain characteristics, the microphone will generate the data referring to the user's speech, for example.

Detection of social interaction: It can be performed using a single modality or multiple modalities. In the single mode, Bluetooth or Wi-Fi connections are used to identify nearby people. In the multiple modes are used Bluetooth and Wi-Fi connections, microphone, camera, among other sensors.

Extraction of behavioral cues: Behavioral cues are characteristics, habits or patterns of user interactions with people.

Obtaining knowledge about social behavior through the inference of social signals: During a social interaction, in addition to dialogue, there are gestures, features, directing speech, etc. All these attributes are called social signs. The author (Eagle and Pentland, 2005) describes that social cues as signs of non-verbal communication emitted when people are interacting socially. The union of these social signs for a period of time leads to the knowledge of social behavior.

3.3 Intrusiveness

Second author (Palaghias et al., 2016) the understanding of human behavior in an automatic non-intrusive way is an important area for several applications. These applications will reduce the human error that is introduced by intrusive methods used, one of the most widely used methods known to be intrusive are

questionnaires. Below can be seen non-intrusive and intrusive technological methods:

Non-intrusive: Through mobile devices and their internal sensors, not changing the daily routine of the user; Smart glasses that have several built-in sensors (only if the user already uses glasses); Sound transmission from mobile devices; Applications that the user must fill in few data to enjoy the same is considered non-intrusive.

Intrusive: Sensors attached to the user's body; Video or external sensor for monitoring; force the user to place their smartphone in a respective position; force the user to hold something.

4 PLANNING

As planning of this section of the work, the methodology of exploratory bibliographic research was utilized through the meta-analytical approach, aiming to combine a well-known database, in order to present a reliable material base. The meta-analysis allows to obtain the best authors, articles, and journals, as well as to perform an analysis of the statistical techniques, the sampling techniques, the most searched lines and the approaches used in the works.

The methodology of the systematic review applied in this work was based on the use of the meta-analytic approach, and was subdivided by the author (Correa and Cruz, 2005), in four stages: (1) choice of articles for the study; (2) reading articles, planning items for exclusion and inclusion of articles; (3) build a basis for analyzing the articles; and (4) analysis and exposure of results. In this section, you will see the selection of the search source, the search string, graphical analysis of the return of the searched string, and a comparative analysis of the articles.

4.1 Research Questions

The objective of this systematic review is to answer the following research questions:

Q-1 What does it take to create applications that span the social context in an automated way without interfering with the user's life?

Q-1.1 What is the intrusiveness of each job?

Q-1.2 What types of interaction sensors were used?

Q-1.3 How much was the percentage used in the works in what is said referring to the SSP?

Q-1.4 What works have contributions to face-to-face social relations?

4.2 Selecting Fonts and Search String

As a data source for this review, the Scopus search engine was used, as it indexes other data sources such as ACM Digital Library, IEEE Xplore and Science Direct. Table 1 below shows the search string developed for the search, which considers the terms in the title, abstract and keywords fields of the article.

Table 1: Search string.

(TITLE-ABS-KEY "Context Awareness" AND TITLE-ABS-KEY "Social Context" OR TITLE-ABS-KEY "Social Interaction"

In the return of the search, it was possible to verify in the area of the computation the quantity of 93 publications of the year of 1999 until 2018, this can be seen in Figure 1.

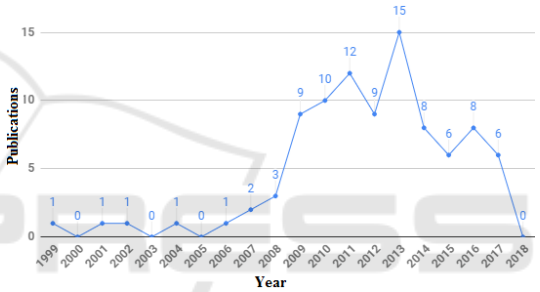

Figure 1: Representation of the number of publications x year.

An analysis was also made of the number of citations per year, the total citation is 591 between the years 1999 and 2018, this information can be seen in Figure 2.

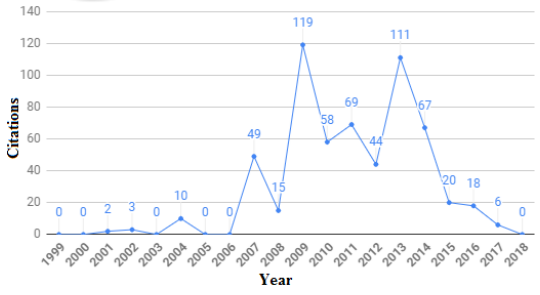

Figure 2: Representation of the number of citations x year.

4.3 Analysis of the Most Cited Publications

For the analysis of the most cited publications, we chose to identify 10 articles with their authors, and

these will be presented in Table 2. We obtained a total of 289 citations from the 10 articles most cited, that corresponds to approximately 49% of the total citations which is (591).

Table 2: Ten most cited articles and their year of publication.

Titles	Authors	Year	Country	Amount of Publications
Designing viable business models for context-aware mobile services	de Reuver M., Haaker T.	2009	Netherlands	82
Contextual experience sampling of mobile application micro-usage	Ferreira D., Goncalves J., Kostakos V., Barkhuus L., Dey A.K.	2014	Finland	42
Utilizing physical and social context to improve recommender systems	Woerndl W., Groh G.	2007	Germany	39
Pervasive social context: Taxonomy and survey	Schuster D., Rosi A., Mamei M., Springer T., Endler M., Zambonelli F.	2013	Germany	30
Modeling social contexts for pervasive computing environments	Biamino G.	2011	Italy	19
Indexicality: Understanding mobile human-computer interaction in context	Kjeldskov J., Paay J.	2010	Finland	18
Towards interactive smart spaces	Gilman E., Davidyuk O., Su X., Riekki J.	2013	Denmark	15
Implementation of CAMEO: A context-aware middleware for opportunistic mobile social networks	Arnaboldi V., Conti M., Delmastro F.	2011	Italy	15
The live social semantics application: A platform for integrating face-to-face presence with on-line social networking	Van Den Broeckt W., Cattutot C., Barrat A., Szomszor M., Correndo G., Alani H.	2010	Italy	15
Socially aware interactive playgrounds	Moreno A., Van Delden R., Poppe R., Reidsma D.	2013	Netherlands	14
Total				289

4.4 Distribution of Articles by Countries of Origin

Table 3 presents the 10 articles classified by the countries of origin. Data analysis shows that 27 countries as a whole contribute to the research of this theme, considering the Scopus database. These 10 countries account for 65.66% of the total of 93 articles published in the area of computing.

Table 3: Ten countries that contributed the most in the publications.

Países	Registros	% dos 93
Italy	14	15,05
USA	7	7,52
Germany	6	6,45
China	6	6,45
Spain	6	6,45
Netherlands	5	5,37
Australia	5	5,37
Brasil	5	5,37
United Kingdom	4	4,3
Portugal	3	3,22
Total	61	65,55

5 CRITERIA FOR INCLUSION AND EXCLUSION OF WORKS

The inclusion (I) and exclusion (E) criteria were elaborated for the selection of the studies, as shown in Table 4. The criteria have the objective of selecting relevant studies that can answer the research questions previously described in this review.

Table 4: Inclusion and exclusion criteria.

(I-1) Studies containing terms from the Social Features area in the title, abstract or keywords.
(I-2) Studies published in workshops, conferences or periodicals.
(I-3) Complete studies (4 or more pages).
(E-1) Studies not related to the area of Social Characteristics.
(E-2) Works in research areas other than computing.
(E-3) Works prior to the year 2000.
(E-4) Works that are not in Portuguese / English.
(E-5) Studies not entirely available on the web.

5.1 Leading

The research was carried out in the Scopus database, held on October 18, 2017, until October 22, 2018, using filter tools, returned 111 papers. Out of this total, 18 papers were excluded because they were not from the Computing area, with 93 papers remaining.

Then of this result were excluded after reading titles and keywords 19 articles, the remaining 74 studies to be analyzed. Of these, 44 were excluded after reading summaries, totaling 30 remaining studies, after which the other criteria for inclusion and exclusion of work were used, which were cited in Table 4 above. Thus remaining 11 papers, which were included in

this systematic review. In Figure 3 the process described can be seen in detail.

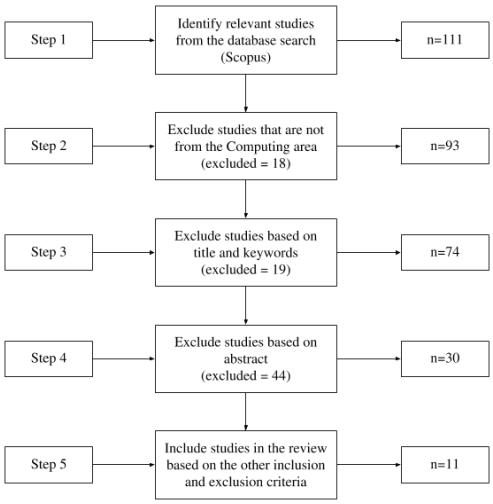

Figure 3: Steps of the study selection process.

5.2 Selected Works

After the exclusion step using different criteria presented in Figure 4, we obtained 11 selected papers, Figure 6 will present a Word Cloud, which returns a cloud of words that illustrate the most used words in the titles of the 11 selected papers. The larger the word the greater the number of occurrences of it, after the segment will be presented the proposals of each selected work.

Figure 4: Word Cloud with the titles of the selected articles.

5.3 Synthesis of Selected Works

In the article in (Correa and Cruz, 2005) it shows that society is represented by one or more human beings, they have visual contact and interact with each other in casual situations, talk, dance, play and so on. The most significant part of our long-term research is how to enable the AffectiveWare platform to convey inferred user mood from the aesthetics of the wearer's clothing.

As a result of this article, it was possible to detect through a graphical analysis whether the system user was feeling sad, cheerful, accepting or angry. In the work of (Paay and Kjeldskov, 2008) a prototype system was created to promote social connections in places of the city. A 2-day planning workshop was conducted to derive ideas of applying sensitivity to the environment so that the context-aware mobile system assists sociality in City.

With this article, it was discovered that people were fascinated with the idea of meeting people, places, and activities in the space around them. This was from the great interest and value to get an overview of a public place and generate discussions between groups about possible activities that the user can do next to their current action or even a next place he can go.

In the article of (Izumi et al., 2009) the uEyes prototype was implemented, and some experiments were carried out based on several real-life scenarios. It was assumed scenario where an elderly person is seen by his family and neighbors of the local community. It was assumed that when the old man was in his room, a low quality live video streaming system would work, it was set up in such a way as to protect the maximum of his privacy.

As a result, it has been confirmed that uEyes can provide real-time multimedia viewing services for seniors with reasonable quality of service and privacy according to each user's situation.

In the article (Pernek and Hummel, 2009), SocioNet, a social network platform dedicated to mobile devices to support social interactions between people, was presented. SocioNet provides tips for people who are willing to interact, interact, follow the view that human interaction allows a better resolution of everyday problems through the richness of human social interactions. In order to find the best people, a representative model of social relations was presented.

After testing the application in a group of people, a questionnaire was done with 40 people, of whom 75% answered that SocioNet would be better to establish communication channels with friends and people of similar interest than with unknown people, even if they are friends of friends .

The article (Tran et al., 2009) presents a prototype for cars, these are equipped with context-sensitive telematics systems that allow interactions between them. Relationships can be formed ad-hoc.

The results of this article show that with the help of contextual information and the connectivity of

users between cars it is possible to detect improvements in overall drivability performance.

The article (Yasar et al., 2010) shows how a social network of vehicles is part of the general context, allowing to significantly improve the sharing of information in the vehicular network. The goal is for vehicles to be able to acquire information from relevant contexts of other nodes based on their social profiles and subsequently manipulate this information to perform context-sensitive tasks so that this information can be shared with a friend or friend of a friend.

The results show that with the help of quality and relevance information provided by the social network and the sociability among friends, we can limit the flow of messages between a smaller number of nodes, but with a high degree of reliability, improving the overall performance of a network vehicle.

In the article of (Hasswa and Hassanein, 2010) a new conscious architecture was proposed in a context that captures multiple properties of the environment through different sources, using different contexts of location, social, network, physical device, physical environment.

As a result, greater socialization of people was achieved because of separate groups in different themes/categories, directing users to social groups that satisfied them at that time.

The article (Biamino, 2011) presents a proposal for an ontology-based social context model to enable intelligent objects to communicate through social reasoning in a pervasive computational environment. For this, a social context approach was introduced based on the idea of relying on social network structures for classification and reasoning of the context.

As a result of this article, it is concluded that the analysis of group and user modeling improves the reasoning and the prospective group-centered perspective.

The article of (O'Connor, 2012) aims to contribute with research on social context and to help in the development of machines for social purposes through the provision of contexts information, currently, several questions are produced regarding the definition, detection and processing contextual information related to the use of this information in applications.

As a result, we have identified that it is possible to identify possible user social events from a collection of data collected from YouTube.

In the article of (Gilman et al., 2013) an intelligent space interaction was defined as a sequence of interactions between actors (or a group of actors) that take into account the context, including the actions and behavior of these actors. Actors in such interaction are independent entities, able to detect and receive information, act on their own and communicate with one another through the environment (eg, outdoors, wireless networks, etc.).

This work served to help researchers recognize human social activities in intelligent spaces, and with these activities being recognized, it is possible to provide support and services for them, considering the intelligent space as an active actor.

In the article (Moreno et al., 2013) SSP was applied in interactive parks/playgrounds the SSP can lead to a new generation of playgrounds where each game acts differently depending on the game and the children, the way they play, and the type of behavior promoted or discouraged. The game helps children explore the capabilities of their bodies, develop their motor skills, coordination and cognition.

Activities such as jumping and running can help develop and maintain muscular fitness and flexibility, creating positive social relationships between players. Finally, the game allows children to feel part of a group, helping children to interact with others. The interactive game fields are composed of three main elements: sensors, actuators, and gameplay.

In this article, it is concluded that the evaluation of entertainment facilities particularly those aimed at free play is difficult. Current playing fields are usually assessed using questionnaires, group discussions, or observational studies. The SSP could assist in the assessment process by automatically measuring raw data instead of annotated and subjective data. This could help to better determine if goals were achieved.

5.4 Comparation of Works

After reading the 11 selected papers, it was possible to generate a table that can verify if there is intrusiveness to the user, the types of sensors used in each work and an analysis of which steps of the SSP were used, besides detecting if there was a social relation of mode virtual or face-to-face, these relationships can be seen in Table 5.

6 REPORT AND ANSWERS OF QUESTIONS

In this section, the different proposals present in the domain of the different types of interactions, whether face to face or virtual, are evaluated and compared. The selected papers provide an overview of the techniques used to apply these contexts to Context Awareness. By explaining the works, it was possible to answer the questions asked in this systematic review and their answers will be presented below.

Table 5: Comparative work table.

Works	Intrusive	Sensors of interaction detection	Processing of Social Signals (SSP)				Social Relation	
			Sensing	Detection of social interaction	Extraction of behavioral clues	Obtaining knowledge about social behavior through inference of social signals	Virtual	Face to face
Undertanding Situated Social Interactions: A Case Study of Public Places in the City	No	Available network access (Wi-Fi, 3G, etc), user location (GPS)	X	X	X		X	X
Ubiquitous Supervisory System Based on Social Contexts Using Ontology	Yes	Available network access (Wi-Fi, 3G, etc) , image detection with (Cameras and monitors), Internet Acess, user location (GPS)	X	X	X		X	
SocioNet: A Context-Aware Approach for Lowering the Communication Barrier	No	Available network access (Wi-Fi, 3G, etc), user location (GPS)	X	X	X		X	X
Social Context: Supporting Interaction Awareness in Ubiquitous Enviroments	No	Interpersonal distance (ID Bluetooth), user location (GPS)	X	X	X		X	
Where People and Cars Meet: Social Interactions to Improve Information Sharing in Large Scale Veicular Networks	No	Available network access (Wi-Fi, 3G, etc), Internet Acess, user location (GPS), Time, Interesse, accelerometer	X	X	X	X	X	
Using Heterogenious and Social Contexts to Create a Smart Space Architecture	No	Available network access (Wi-Fi, 3G, etc), user location (GPS), Time, Interesse, accelerometer, enviroment sensors, pressure sensors, temperature sensors, etc	X	X	X		X	
Modeling Social Contexts for Pervasive Computing Enviroments	No	Available network access (Wi-Fi, 3G, etc), user location (GPS), time, activity and identity	X	X	X			X
Machine Analysis and Regognition of Social Contexts	No	Available network access (Wi-Fi, 3G, etc), activity and identity	X		X		X	
Towards Interactive Smart Spaces	No	Available network access (Wi-Fi, 3G, etc), user location (GPS), time, activity and identity	X	X	X	X		X
Socially Aware Interactive Playgrounds	No	Available network access (Wi-Fi, 3G, etc), camera, projetors, light, personal	X	X	X	X		X
Computer Aided Emotional Fashion	Yes	Available network access, clothes sensor, light, personal	X	X	X	X		X

Q-1.1 What is the intrusiveness of each job?

Of the 11 papers selected, 9 papers have a low degree of intrusiveness that can be considered non-existent, since the work of (Izumi et al., 2009) presents a high level of intrusiveness due to being an assisted environment for elderly people containing cameras, monitors, among others; the work of (Goulev et al., 2004) also has a high level of intrusiveness using sensors in the user's clothing to measure the degree of user's mood from the wearer's clothing being able to define their primary emotions as anger, joy, sadness and acceptance, thus resulting in 81,81% of the articles selected have a low degree of intrusiveness or are not intrusive.

Q-1.2 What types of interaction sensors were used?

Besides the works, they need to have network access be it Wi-Fi, 3G, etc. They use a variety of different sensors such as image detection through (cameras and monitors), GPS, interpersonal distance, time, accelerometer, environment sensors, pressure sensors, temperature, sensors for clothes, light sensors, etc.

Q-1.3 How much was the percentage used in the works in what is said referring to the SSP?

Of the 11 works, 4 use 100% of the techniques available through the SSP, 6 works use 75% of the techniques and 1 work uses 50%.

Q-1.4 Do the papers contain contributions to face-to-face social relations?

The works that have contributions to social relations are 6 out of 11, which use techniques that focus on users to have possible face-to-face social interactions.

Q-1 What does it take to create applications that span the social context in an automated way without interfering with the user's life?

After reading the selected works, it was possible to detect that it is necessary to implement contextually aware applications since Context Awareness has the ability to identify the current context of the user by providing appropriate information/responses to users automatically. It is important that the application becomes ubiquitous in the user's day-to-day life, and that it is not intrusive to the user, and utilize the SSP techniques because these techniques help to solve the user's impartiality and indifference problems.

7 CONCLUSION

Due to the constant growth and development of human beings in relation to social interactions, different ways of communicating human beings were unveiled. Being able to communicate with oral language

(face to face), but also through virtual means expressing himself through a mediation tool, to interact with other people.

Interaction through virtual means can help human life in daily life, being relevant to different tasks in order to achieve a certain goal, which is shared by all, can be given as example basis a trip between friends, who suffers the intermediation of a conscious application of context that aims to travel together to a certain destination in safety.

This systematic review had as a contribution of research to the academic community, how the dynamics of social interactions between individuals are done either face-to-face or virtual, using context-aware computing.

We also interpreted all selected works for the use of social signals behavior, recognizing which steps are appropriate for each work, being (1) sensing, (2) detecting social interaction, (3) extracting behavioral cues, and (4) obtaining knowledge about social behavior through the inference of social signs, these were presented in a comparative table in order to contribute with possible future work that will be carried out in this area.

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