

Communication Tool to Improve the Collaborative Work Using Emerging Mobile Technologies

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Abstract: - Since mobile technologies are fully introduced in our society these technologies are used daily in workplaces to improve the communication between co-workers. In this work is presented a communication tool available for mobile devices. This tool, a SaaS (Software as a Service) in the cloud, have been developed by us. It combines several emerging channels of communication such as instant messaging, social networks and micro-blogging and it allows the exchange of information between members of a domain. One of the main advantages is that ensures the digital anonymous, another advantage is that it is fully customized so it can be use in any kind of organization.

The tool has been customized for a university educational context and it has been analyzed. A small group of students (first and fourth course of Computer Science Degree) and teachers have participated in the experiments and they emphasized the advantages that collaborative working provides. Also we got promising results considering the usefulness of our tool because both students and teachers greatly appreciated the tool.

Key-Words: - Mobile communication tool, mobile instant messaging, social media, cloud computing, collaborative work, mobile technologies

1 Introduction

Recently, the mobile technology evolution, its market penetration by means of smartphones and tablets and its massive acceptance in the society has opened huge possibilities in several scopes, not only in leisure time but also in workplace. Factors such as the social relationships and mobile technologies greatly affect to the human behavior in daily tasks such as the communication between people.

Also, the boom that both, social networks and the microblogging have suffered, makes that these media have become in a new channels of broadcast. In social networks, people with similar interest are found and are connected with other people. Mobile social networks are characterized because they are social networks where the communication is carried out by means the mobile or tablet.

A report of Deloitte [1] predicts that in 2014 instant messaging services on mobile phone will carry more than twice the volume of SMS. Other reports point in the same direction. They say that communication services are not increasing except instant messaging. Instant messaging is increasing in 8.9 percentage points, and nowadays, is the most

used; it is used by 56% of young [2] and [3]. Other metrics are also important such as frequency of use (83% use it daily) or user satisfaction (7.9 of 10). So, instant messaging is, nowadays, a very important communication media.

WhatsApp is a special example of instant messaging; with this app the interchange of messages is possible without any additional cost. Also using this service is possible for sending of images, videos or audios.

By other hand, nowadays workplaces are inherently collaborative and the success of this collaboration is determined by an effective communication between co-workers. Always the informal communication in the workplace has been considered very important and it has permitted to carry out important tasks such as coordination, problem solving or learning [4]; with the advent of new technologies, a lot of efforts were carried out to make possible this communication by means of media such as audio or video, but this kind of media had not the hoped success because some difficulties were found: their implantation was very difficult and with high cost [5]. In contrast to this fact, instant messaging and mobile instant messaging are

becoming in very useful tools that support the informal communication in a successful way and much more effective way than others traditional media [6] [7] [8]. IM and MIM are less intrusive tools than phone and also they are more immediate tools than email. With them is gotten a quick, agile and effective medium of communication with a low cost in general workplaces, and in particular, in some scopes or areas, such as health or education, where the collaboration and coordination is very important and where the collaborative learning and collaborative work nowadays is essential [9, 10] [11, 12] [13].

But not only IM and MIM are getting importance but also that several research studies say that the use of all of these emerging communication technologies in the workplace are successful and their use is profitable [14] [15] [16] [17] [18] [19].

In some scopes, such as the health scope [20] [21], the benefits that are provided by the social networks and mobile technology to carry out the communication is even more relevant

Also in educational environments, a lot of studies explain the satisfaction of the students when they use these technologies [22] [23] [24] [25] [13] [26] [27] [28] [29]. The features that mobile devices have of ubiquity, immediacy, interactivity, and communication are the main benefits identified by the students. Also, all of these communication services are closely related to the learning process, and by other hand, they are capable to provide an efficient environment to share and to distribute information, so important to acquire collaborative knowledge [30].

In this paper is presented a communication tool available for mobile devices. This tool combines several of these emerging channels of communication such as instant messaging, social networks and micro-blogging. These channels are used in a daily context and they are very important for communication in workplaces. This tool could be used in any context, but in the study that it is presented now, it is customized for an educational university environment where the collaborative learning nowadays is so important. This tool provides new possibilities of communication by means of building a collaborative learning environment focused on student. SCHOM has been developed for us and with it, it is possible to send messages through different channels of communication and also, alike, it is possible to receive these messages through several and different devices. Possible devices are mobile phones, tablets and computers and all of them, may run operating systems (Android, IOS). The different channels

through of which the messages could be sent are: instant messaging, social networks, micro-blogging and email. This tool, as we explain later, assures the digital anonymity, is multichannel and multidirectional. Then, in this paper, we are presenting the tool and it is showed the advantages and disadvantages that teachers and students found when they used the tool in the university context as a communication tool to support collaborative learning.

2. SCHOM. Concepts

Users of SCHOM can send and receive messages and also they can use discussion forums. SCHOM classifies messages according to nature of messages or to usefulness of these.

So, according to nature of message, messages are classified in:

- Non-persistent. When the message is delivered to the receiver, the system loses its reference. Only sender and receiver have a copy of it. This kind of message is used in private communication between users, using instant messaging.
- Persistent. This kind of messages is used in discussion board, important notices and topic subscription. They may be reviewed at any time.

According to usefulness of message, messages are classified in:

- Notice: It is a message used to post a notice. This kind of message can be send by users with permissions of sending; also the own SCHOM system can send this kind of message to report an error or a warning, in other words, the senders of this type of messages can be users with permissions or the own system. It is a unidirectional message; the sender is not waiting for a response from receiver.
- Private: It is used in n:m communications between users, using instant messaging.
- Discussion: It is used in discussion forums.

The user decides what kind of message he wants to receive for each of his channels and then he can configure his account in the system according to his preferences. Furthermore he can block private messages from a particular sender. On the other hand, when a user sends a message, he has available the option to choose all users that he needs to send a message. We will use the term “contact” to refer to the receivers of a message.

A contact can be: individual or group.

- Individual. It is a contact representing a user. We will use contact or user indistinctly.

Every user belongs to an organization or domain. Every individual contact (or every user) must have a profile. A user profile represents the role of the user in the domain that he belongs to.

It is possible to have individual contacts without domain associated but in this case, we are talking about special users who are responsible to make configuration and administration tasks. They are called system users.

- Group. Individual contacts must be organized in groups, so a group represents a list of contacts. To describe the group contacts, we will focus on four aspects: composition, security, structure and types.

2.1. Composition

Composition describes who members of a group are. Members of a group may be individual contacts or group contacts. So it is possible nested groups. When a group is into other group, we can talk about “supergroup” and “subgroup”. On the other hand, “descents” of a group are all subgroups of the group, regardless of its nesting level. And the term “ancestors” represents to all supergroups of a group.

When a group contact is the receiver of a message, the real receivers are every individual contact belongs to the group and its descent. Obviously, a group cannot be in its descent.

Although a group cannot have repeated a same individual contact as a direct member, it is possible that an individual contact is in a group and, at the same time, it is in some other subgroup of it. In order to improve system performance, every group has an “individual set”. The individual set of a group G consists of every individual contact of G and the individual contacts of each group of its descent. This set assures that an individual contact won't appear twice or more times in the same group.

Fig.1 shows an example of the composition of groups. The individual set of Group-Y will be all its individual contacts and the individual contacts of Group-Z. On the other hand, you can observe that the contact D is only one time in the individual set of Group-X.

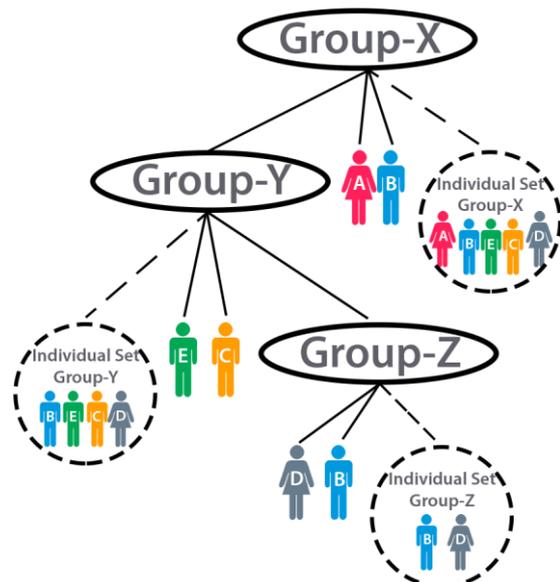


Fig.1. Contact group composition

2.2. Security

By means of this characteristic, we explain how security is managed and what kind of operations is possible to make with groups. It is possible to assign a security policy to a group. This policy defines the operations that a contact is authorized to do in a group. "Authorized contact" is a contact (independently of its kind) that is granted some kind of permissions in a group. An authorized contact may not be member of the group.

Security policy is represented as an access control list (ACL). Each authorized contact has an entry (license) in the group ACL. The license consists of an authorized contact and the operations. If an authorized contact is a group we talk about "role".

When a license is associated to a role, by default, every individual contact that belongs to the individual set of the role are authorized. But it is possible modify this behavior using a "profile" in the license. In this case, only individual contacts of the individual set of the role with that profile are authorized. If in the license doesn't specify a profile, the authorization is granted to all individual set of the role.

By default, the fact that a contact is authorized to do some operation in a group, not involve that the contact is authorized in the subgroups of the group descent. Only the contact will be authorized if there is an explicit license in the ACL of these subgroups authorizing it. In any case, this default behavior can be modified. It is possible to mark that licenses can be inherited.

The kinds of user permissions that can be granted to a user in a contact group are:

- Send notification message: Users are allowed to send messages to contacts in the individual set of the group contact.
- Send private message: Users are allowed to send instants messaging (private message) to contacts in the individual set of the group.
- Send discussion message: Users are allowed to update the discussion board with a new message.
- Publish message: Users with this permission become in publisher of the topic represented by this contact group. This kind of permission is only used in groups of type topic (this kind of groups is explained later).

A user can have zero, one or many permissions granted in a same contact group.

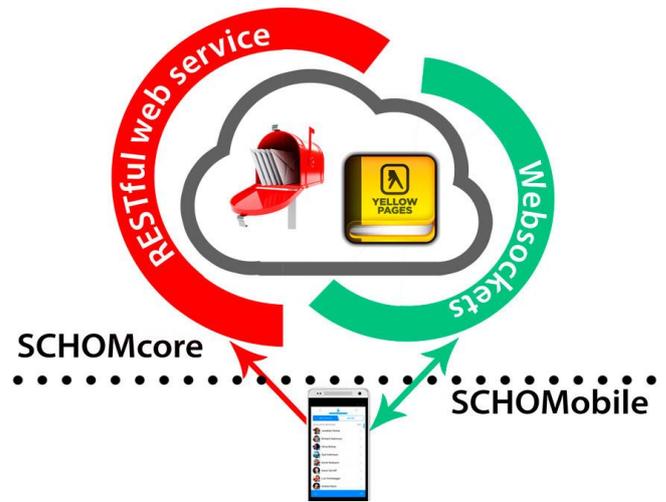


Fig.2. SCHOM tool Model

2.3. Structure

We are talking about how contact groups are structured, in other words, how contact groups are related to or connected to each other groups in a hierarchy structure.

A group can be part of a hierarchical structure where a parent group can have a lot of child groups and a child group can have only one parent group. Only one root group is possible in the hierarchy structure. The root group is that group without parent group.

On the other hand, a group can be linked with other group if you need related to each other. But if a contact group A is linked with a contact group B does not involve that group A is within group B or vice versa. Therefore, the individual sets of both linked-groups are independent.

3 SCHOM Tool

General SCHOM Model is showed in Fig.. SCHOM tool has two parts: backend (SCHOMcore) and frontend (SCHOMobile).

SCHOMcore is a JEE application deployed in the Cloud [31]. It provides two facades for the user access (final or system administrator users). These facades are implemented using RESTful web services and Websockets. On the other hand, SHCOMcore has two parts: YellowPages and MailBox.

YellowPages manages SCHOM contacts, their configuration and queries. These services are used by SCHOM users and by MailBox service. With YellowPages you can set up a new contact group composition and register users and specify user channels. For this task RESTful facade provides resources by means of them, this initial configuration is possible to be represented by XML or JSON files.

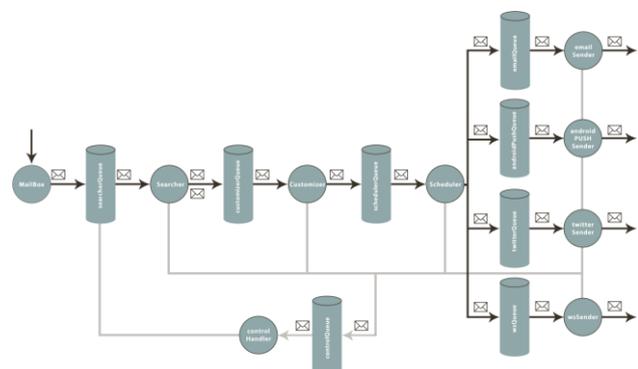


Fig.3. MailBox module schema

MailBox service schema is showed in Fig.3. This service is used to manage sending messages

between users. Its architecture is MOM (Message Oriented Middleware) and in this architecture each distributed module is in charge of making a specific task.

3.1. SCHOM performance

Users are automatically registered using their users and passwords of Virtual Campus University. SCHOM is initially configured with some contacts groups, one contact group for Faculty, other for Degree, other for Course and finally other for Subject. All users are member of the groups that represent their subjects (like student or teacher). In the default configuration, a user can send private messages to any user of his groups. In Fig.4 an example of individual private message is showed, and in Fig.5 a group private message.

All users have at least one of the next profiles: Teacher, Student or Secretary. There are two profiles more: Dean and StudentRepresentative. All student users (users with Student profile) can send private messages to any other user in their groups. So, a student can send messages to his classmates and to his teachers (teachers of his subjects). On the other hand, teachers (users with Teacher profile) can send private messages and notices to any user in their groups and to any other teacher and secretary (users with Secretary profile). And Secretary users can send notices to teachers, students and other secretary users and they can send private messages to dean (user with Dean profile) and teachers.

A teacher, who is in the Deanery, will have Dean profile too. Dean profile users can send private messages and notices to any other user in their faculty (Faculty group). In Fig.6 and Fig.7 there is a notice example received in the app or received using a PUSH notification.



Fig.4. Individual private message

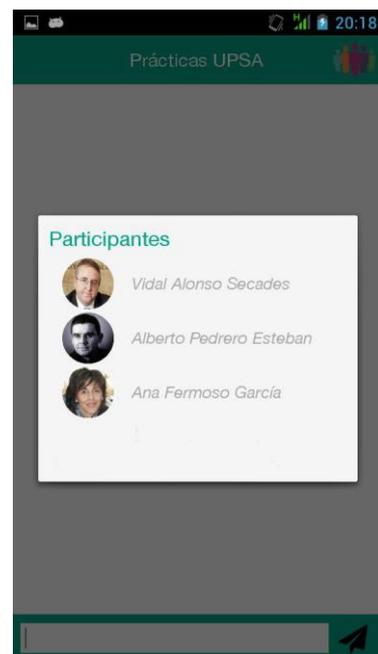


Fig.5. Group private message

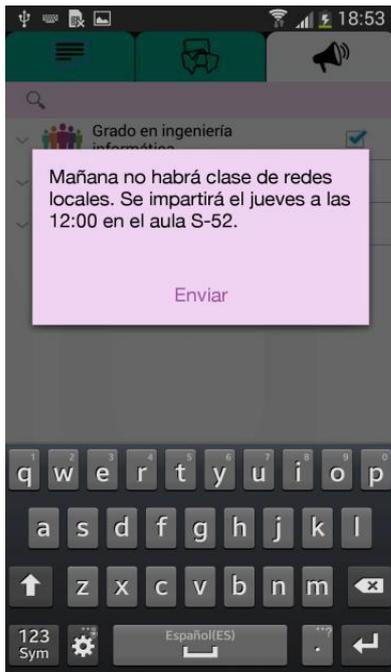


Fig. 6. Notice received in the app

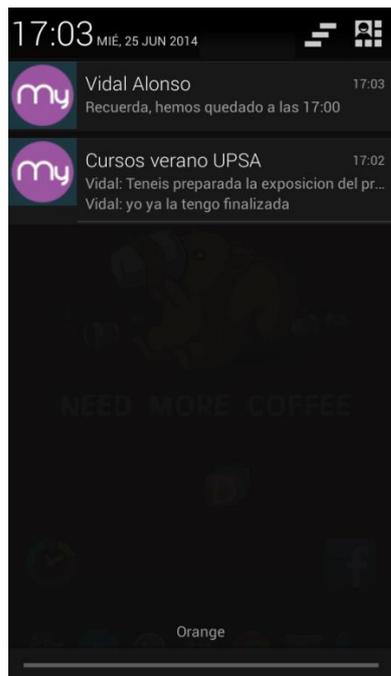


Fig.7. Notice received using PUSH notification

On the other hand, users with studentRepresentative profile can send private messages and notices to any other user in the groups of his course (i. e. to all users in all subjects of his course), and private messages to Dean. Moreover, all subjects are discussion forums, teachers and students can create discussion threads and they can publish in them (see Fig. 8)



Fig.8. Subject forum topics

One of the advantages of SCHOM is that it assures digital anonymity. For example, a student can send a message to a teacher via instant messaging although he does not know the teacher mobile number. The student only has to know the teacher name because SCHOM is who send the message and SCHOM is the only who knows the links between user names and their digital ids (email, mobile number, twitter account).

Another advantage is that the user is who decides the channel for receiving the information (PUSH notification, instant messaging, email or twitter) and he can modify his channel configuration in any moment (see Fig. 9).



Fig.9. User channel configuration

SCHOM was used for 63 students and 7 teachers in first and last courses of Computer Science Degree during four months. At the end of the course, a

satisfaction questionnaire was filled. The objective was check if SCHOM improves the communication. The questionnaire was answered for 26 student of first course, 32 of fourth course and 7 teachers.

The questionnaire had questions YES/NO/No Answer (NA). Also they have available an answer of type “open” and a space to comment any suggestions where they could express their opinion about the use of SCHOM. The questions were:

- Item A. Do you think <TYPE> messages are useful?
- Item B. Would you remove <TYPE> messages of SCHOM?
- Item C. Why?

Where TYPE is: notice, private and forum.

3 Analysis of results

	First course students		
	YES	NO	NA
ItemA: notice	92,31	3,85	3,85
ItemB: notice	3,85	96,15	0,00
ItemA: private	88,46	0	11,54
ItemB: private	0	100	0
ItemA: forum	84,62	0	15,38
ItemB: forum	96,15	0	3,85

Table 1. Percentages of answers for first course students

	Forth course students		
	YES	NO	NA
ItemA: notice	84,38	6,25	9,38
ItemB: notice	6,25	93,75	0
ItemA: private	100	0	0
ItemB: private	0	100	0
ItemA: forum	93,75	0	6,25
ItemB: forum	96,88	0	3,13

Table 2. Percentages of answers for forth course students

If we analyse the students’ answers of all kind of messages: notice, private and forum (see Table 1. and Table 2. We can observe that for all students (first and fourth course) all kind of messages were useful (between 90%-100%). In the comment part of the questionnaire some students said that they utilized Whatsapp for private conversation with his classmates but they preferred use SCHOM for “academic messages” and a lot of students (30) admitted that one of the most important advantages

of SCHOM was that with this tool the communication with the teacher was instant. On the other hand, some students told about forums in Moodle versus SCHOM forums and they declared that SCHOM forums were better because the interaction was quicker and more agile.

Some students of fourth course talk about MoviUPSA (an old tool for communication in the University [32] [33]) and obviously they preferred SCHOM. MoviUPSA is a tool only for notices; the user cannot interact with it.

Furthermore, SCHOM registers each type of sent message. The number of sent messages was: 3243 privates; 630 notices and 245 forums (see Fig. 10). So we can confirm that private messages are significantly the most used.

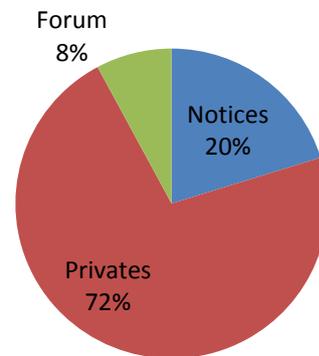


Fig.10. Percentage of use of different types of messages

4 Conclusion

In this paper we present a powerful tool for communication. This tool uses emerging mobile technologies to improve the communication process. Although students have embraced mobile technologies, nowadays there are not dedicated tool that use this so new technology in a learning scenario. In this sense, our tool (SCHOM) is unique and original.

SCHOM takes advantage of the communication possibilities that smartphones provide nowadays, mainly if we consider instant messaging. But it does not force us to use it because the user is who chooses the channels to receive the information (push notification, emails, SCHOMobile app or Twitter). One of the main advantages is that ensures the digital anonymous, regardless of the channel chosen. So a user can send a message to other user, using for example instant messaging, knowing only his name.

Also it is an entirely customizable tool so it could be used in any educational context or any organization where an effective informal communication is needed.

In future researches we want to repeat the study but with more students of different Degrees, not only of Computer Science Degree. So, the study will be more complete but our hypothesis is that the result will be similar because university students are digital native and they are in the same age range.

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