EDITORIAL

Context interaction systems for learning support

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Editor Revista Ingeniera e Innovación

The interaction with context has undergone major transformations over time, all thanks to advances in nanotechnology that have facilitated the creation of much more robust hardware in terms of processing capacity, storage and high-speed telecommunications systems. Allowing a migration from explicit interactions that were only limitplicit and peripheral).

Nowadays, implicit interactions are very common in contextual awareness systems, due to the diversity of sensors, new context modelling techniques that allow to execute tasks without the user's intervention. Schmidt proposes to define the concept of Implicit Human Computer Interaction (iHCI) as "the interaction of a human being with the environment and with artifacts, which is intended to achieve a goal. Within this process, the system acquires an implicit input from the user and may present implicit output to the user" (Schmidt, 2000). Furthermore, it poses the implicit input as user perceptions that interact with the physical environment, allowing the system to anticipate the user by offering implicit outputs. In this way the user can concentrate on the activities he is developing and not on the computational tool. The executions of actions are not only due to the information obtained from the sensors, but also to the profile of the student, the activities he is performing and obviously the location and time. So, given a daily situation for a student, the implicit interaction of the contextual awareness system will depend on the information of his profile, his preferences, the courses he is taking in a given academic period, the time, date and place where he will perform learning activities. On the other hand, the implicit interaction will come from the different learning objects with which you have to interact; these objects are tagged with technologies such as (NFC, RFID, BLE, QRCode, among others)

The purpose of learning scenarios today is to allow students to be active agents of their learning, to have the possibility to interact with the context around them. Since context is a relevant factor in learning experiences, in recent year's research work has been developed to facilitate student interaction with their environment. According to (Dey and Abowd 1999) context is "all information that can be used to characterize the situation of an entity; an entity is a person, place or object that is considered relevant to the interaction between a user and an application, including the user and the applications themselves". Some works place much more emphasis on explicit and implicit interactions and do not consider peripheral interactions in context. Table 1 lists some relevant research that looks at implicit and explicit interactions, technologies for obtaining context information including student profile, location, and temporal context.

Table 1 Review of literature on types of interaction to support teaching

	IMPLICIT	EXPLICIT		PERIPHERAL					
Author	NFC/RFID	QRCODE	AR	RFID + BLE		GPS	Profile	Time	Peripheral
Ogata et al, 2005		x					x	x	none
Yin et al, 2010	x					x	x	x	none
Goh et al, 2012	x						x		none
Tsai y Huang, 2014			x			x	x	x	none
Yang, S. J. (2006).						x	x	x	none
Liu et al, 2015	x	x			x			x	none
Hsu et al, 2016		x	x		x	x		x	
noneHuang, 2015		x						x	none
Zimmerman et al 1998			x			x			none
Hou et al, 2010				x	x		x		none
Chen y Li, 2010	x				x	x	x		none
Jones y Jo, 2004	x						x		none
Liu et al, 2009	x		x		x		x		none
Tan et al, 2007	x					x			none
Liu et al, 2015	x				x	x			none
Gómez et al, 2016		x	x	x	x	x	x	x	none

ed to navigation interfaces between the user and the devices to other types of interactions (im

As shown in table 1, some works use explicit interactions based on NFC technologies, RFID with passive tags, QR codes and others with AR, this in great measure because of the low implementation costs and the ease of use. In addition, some mobile devices already have built-in NFC sensors and cameras for reading QR codes, this being an important advantage, allowing the development of solutions for the generation of interactive learning spaces. The big limitation with this technology is that the student must constantly read the RFID tags or QR codes to identify the associated context, whether it is a tagged object or the location. Sometimes the search for these tags to read them makes the learning activities less efficient or the objective of the tasks is lost. Faced with this situation, solutions of implicit interactions such as context detection with GPS have been proposed. The problem associated with this technology is that it works perfectly for external environments, but in internal environments it is usually inefficient. This limitation of GPS is solved with IPS (Indoor Location Systems) (Zou et al, 2013), however, these solutions are usually expensive to implement. Depending on the technology used, costs can greatly increase the development of solutions for ubiquitous learning environments, for example, it is not very common to find tablets and smartphones with the ability to read active RFID tags, because it requires an infrastructure to deploy location services. As can be seen in table 1, few jobs have been done due to the costs involved in implementation. An alternative solution to the limitations outlined in IPS are the ZigBee Beacons / 802.15.4, and Bluetooth Low Energy BLE, which are easier to deploy and implement, in addition, the latter consume less energy and are interoperable with existing smartphones (Siekkinen et al, 2012). BLE is very attractive for the implementation of context-sensitive systems, because it can be used not only for location, but also to identify objects implicitly. By using BLE in the identification of objects, the student does not have to constantly read the labels, but the system of contextual awareness based on inference rules or other techniques, presents the appropriate information according to the learning activity being developed. Finally, the temporal context and the student's profile are used to generate implicit interactions, but, in any case, these will be conditioned with the interaction that the individual has with the objects that surround him and the location.

On the other hand, peripheral interactions in context-conscious systems as a support to education have not been addressed as shown in the table above. However, peripheral interactions are a topic that has been worked on since (Weiser and Brown, 1997; Pousman and Stasko, 2006; Eggen and Mensvoort, 2009), with the purpose of presenting information to users in a subtle way, that is, that it can be perceived from the periphery of attention of the same. In other words, peripheral interaction refers to the diversity of computer devices that manage to capture the user's attention in a peripheral way. These interaction

systems can quickly change the user's attention depending on the relevant information provided by the user. Peripheral interaction helps make computer technology seamlessly incorporated into people's daily lives. Figure 1 shows the three types of interaction according to (Bakker et al, 2015). The first interaction refers to the focused or explicit interaction, it is one of the most common, where the user's attention is focused and he is aware of the actions he is performing, such as reading an NFC or QrCode tag. Implicit interaction according to (Abowd et al., 1999) "is used to identify which ubiquitous sensors can be used to determine and take into account environmental information in the actions taken by a computer". This type of interaction is out of the user's field of attention, this operation is subconscious and unconscious, there is no control over the actions, such as regulating the temperature of a room according to the data obtained by a sensor. At the intersection of explicit and implicit interaction are peripheral interactions, which are on the periphery of the user's attention, are subconscious and unconscious, and have no precise control over actions. However, they arise spontaneously in the system and manage to capture the user's attention. This concept is taken from people's daily lives and the actions they permanently perform.

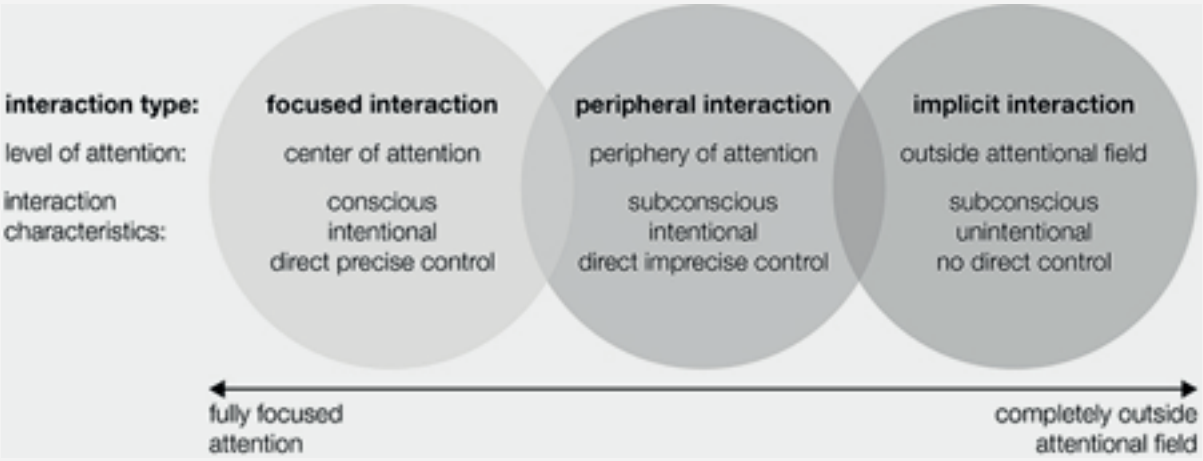

Figure 1. Types of interaction with computer devices (Bakker et al, 2015)

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