Proxémique pour premier secours pour une personne inconscient ou blessé

Paulo Pérez
Université de Pau
des Pays de l'Adour
LIUPPA – T2I
64600, Anglet, France
pperez003@iutbayonne.univ-pau.fr

Nadine Couture
ESTIA Technopole Izarbel
64210, Bidart, France
n.couture@estia.fr

Philippe Roose
Université de Pau
des Pays de l'Adour
LIUPPA – T2I
64600, Anglet, France
Philippe.Roose@iutbayonne.univ-pau.fr

Yudith Coromoto
Universidad Simón Bolívar
89000, Sartenejas, Venezuela
ycardinale@usb.ve

Dalmau Marc
Université de Pau
LIUPPA – T2I
dalmau@iutbayonne.univ-pau.fr

Dominique Masson
Technopole Izarbel
64210, Bidart, France
d.masson@dev1-0.com

Résumé
Aujourd'hui, il y a une grande variété d'applications mobiles de premiers secours pour les appareils Android et iOS pour aider les utilisateurs en situations dangereuses. Cependant, leur utilisation massive est limitée en raison de plusieurs aspects, tels que l'interaction complexe pour l'utilisateur ou le besoin d'appareils spéciaux pour l'identification médicale. Pour trouver une solution au problème décrit précédemment, nous adoptons une approche basée sur les interactions proxémiques. Dans ce contexte, nous proposons une premier Application de secours mobile (FAMA) basée sur l'interaction Proxémique, développé avec Bluetooth à basse consommation (BLE) et la balise (Beacon) technologie. Dans la première évaluation, nous décrivons les aspects et les défis liés au développement de FAMA.Ces résultats démontrent l'avantage de l'utilisation de l'interaction proxémique pour mettre en œuvre l'IHM, dans le contexte de l'urgence et des services de secours, en termes de meilleure performance et d'accessibilité, par rapport aux applications mobiles de premiers soins existantes.

Mots Clés
Interactions proxémiques; beacon; applications mobiles.

Abstract
Nowadays, it exists a wide variety of first aid applications for android and iOS devices to help users in unexpected

Proxemics zones

- Intimate (0-50 cm): This space is reserved for close relationships, generally the people can manage this space and allows the other person to share his/her space, only if it has been permitted.
- Personal (0.5 cm- 1 m): In this area the people could have a natural interaction with other persons, it is possible to barely reach contact with his/her arms.
- Social space (1-4 m): This area can be related to the work space(e.g., a meeting table, where the people could maintain communication without touching each other).
- Public (>4 m): It describes the distribution of people in urban spaces or public meeting, where the people's attention is focused on the moderator.

or dangerous situations. However, their massive use is limited due to several aspects, such as the complicated user interaction or the wearing of special devices for medical identification. In order to find solutions to the problems mentioned above, we have adopted an approach based on proxemic interaction. In this context, we propose a First Aid Mobile Application (FAMA) based on Proxemic-interaction and developed with Bluetooth Low Energy (BLE) Beacon technology. In the first evaluation, we describe the technical aspects and challenges related with the development of FAMA. The results demonstrate the benefit of using proxemic interaction to implement HCI, in the context of emergency and rescue services, in terms of better performance and accessibility, compared with existing first aid mobile applications.

Author Keywords
Proxemic interaction; beacon; mobile application.

CCS Concepts
Human-centered computing → Interaction paradigms → *Graphical user interfaces*

Introduction
Recent advances on mobile technology boost the development of a wide variety of applications to support users in their daily life activities (e.g., sports, health care, on-line services, business) or to help users in unexpected or dangerous situations (e.g., first aid, natural disasters) [9, 4]. Our interest in this paper is focused on first aid applications.

In the last decade, researchers have demonstrated that the concept of proxemics can support Human-Computer Interaction (HCI) in several uses, such as remote controls, interaction for ubiquitous computing, home management, and first aid. Proxemics is an area that studies the territory of people and the implications of distance in relationships between persons. It helps on identifying the dependent ways in which people use interpersonal space to understand and mediate their interactions with others [14, 16].

In the context of first aid for unconscious persons, generally, the unconscious person does not receive properly assistance until paramedics arrive on the scene. The medical identification is not available for people around the unconscious person, who could help meanwhile the paramedics arrive.

This paper explores the use of the proxemic concept, to manage effectively social proxemics distance, for implementing a first aid mobile application that provides rapid identification of unconscious people, generates alerts, and shares medical identification in a secure way. In this context, we propose a First Aid Mobile Application (FAMA) developed with BLE Beacon technology. The identification of the unconscious injured person can be accessed from other smartphones by BLE. In an emergency situation, the unconscious person's smartphone can start acting like one virtual Beacon, that can emit emergency information to other smartphones based on proximity.

This paper is organized as it follows: the background describes the basic concepts of proxemics. The state of the art makes reference to previous works. Our proposal shows our technical aspects related to the development of the prototype. The scenario presents the results from the evaluation of our prototype. We present, our conclusion and recommendations for future work.

Proxemics Concepts: The Background
Proxemics is a concept used mainly to describe the human use of space. The first definition was proposed by Edward T. Hall in 1966, who pointed out proxemics as "the interre-

Proxemics dimensions used by our proposal.

- Distance: This is a physical measurement (generally measured in meters), that allows us to determine interaction zones. To determine such zones, we evaluate the distances in order to fix general criteria of communication between both devices (unconscious person device and helper device).
- Movement: It is the change of position over time by the people around unconscious person, when the helper person walks towards the unconscious person.
- Identity: Uniquely describes the different entities in the space. When a person changes his phone settings to a helper mode, he/she could identify people around him/her.

lated observations and theories of humans use of space as a specialized elaboration of culture" [14]. He presented how people perceive, interpret, and use space, specially related with distance between people [13]. According to the Hall's proxemics theory, the interaction zones have been classified as four proxemics zones of interaction: intimate (defined by a distance of 0-50 cm, personal (when people proximity is 0.5-1m), social (if distance is 1-4 m), and public (with distance > 4 m). He emphasized the role of proxemics relationships as a form of communication between persons.

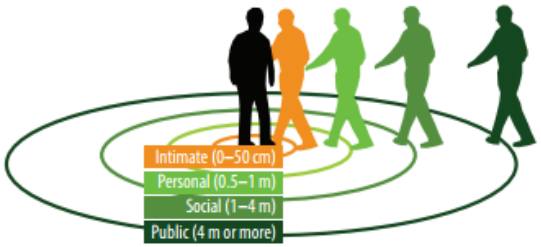

Figure 1: Edward Hall's proxemics theory interpersonal distances of man, showing radius in meters.[14]

State of the art

In this section, we focus on studies and works using proxemic interaction to support HCI. We also evaluate mobile first aid app that currently exist in the marketplace.

Proxemics and HCI

The proxemic interaction has been implemented to design ubiquitous environments [15] and proximity has been used as a user's interface [20], where the human computer interaction (HCI) is based on physical distances between the users and ubicomp devices. For example how a system can adapt the display content according to proximity to users [5]. The study presented in [22], shows how people can make interaction in different zones of distances around one device.

Previous works have employed a set of proxemic dimensions (i.e., distance, orientation, movement, identity, location) [6, 12, 17] that allow to determine relationships between entities and people, for example: digital devices, non-digital devices and persons. These proxemic dimensions have been identified by Greenberg[16, 15]. In this regard, we will quote proxemic dimensions, since they describe the variables that could be considered for our work which is based on proxemic interaction.

The work presented in [15], describes the construction of a proactive context-aware framework, with comparable objectives related to FAMA, such as how proxemic dimension can support interaction between entities and people or objects. The main idea of the framework, it is to show information relevant to only one person, when the person walks toward a display. This framework uses a variety of sensors for this purpose (e.g, infrared, magnetometer, accelerometer, and gyroscope). In contrast, our proposed FAMA is based on BLE Beacon technology, that offers great possibilities to detect movement and distance, as well as allowing to get identity of an object, without needing the use of infrared sensors.

The use of beacons to support human interaction is not new. The work presented in [7], shows how blind people or visually impaired users equipped with smartphones can interact with beacons in order to receive assistance. In that work, the resolving of proximity detection (distance) takes great relevance. This study shows the advantage of implementing BLE Beacon. The work described in [11], implements beacon to rescue persons caught in an avalanche (skiers). Authors propose the use of two physical beacons: transmitter and receiver, one for victim and the other for the rescuer. In a rescue situation, the victim and a rescue group need to work, both individually and collectively,

FAMA's zones and interactions.

- Rescue Zone (0-1m). Represents the intimate and personal space. In this zone, the helper can interact with mobile apps and reports events.
- Alert Zone (1m-4m). It represents the social space. People in this area, related to the unconscious person, can see the alert on their smartphones.
- Neutral Zone(4m). It represents the public space where nobody receives information.

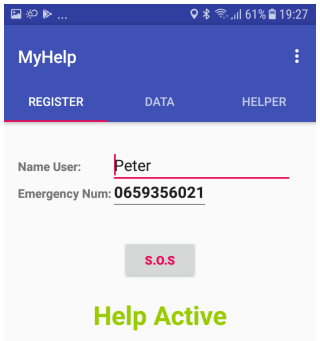

Figure 3: Graphical user interface for creating an alert .

the Beacon transmits an electromagnetic signal, allowing achievement of the goal. This work has demonstrated how the beacon technology has contributed to save human lives. However, the implementation of this solution requires sophisticated beacons. In contrast, in our proposal, we develop an application for android mobile devices, that allows virtualization of beacons, which can be easily accessed and is low cost, while simple to execute.

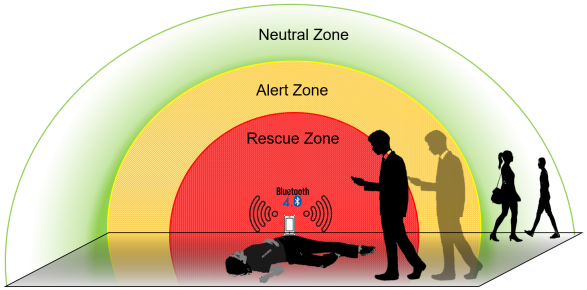

Figure 2: FAMA's zones and interactions between users in the public space.

First Aid Applications

Today, we can find a variety of first aid apps for Android [3, 8, 18]. In such as apps, the helper person can access emergency medical identification. However, these apps have the disadvantage that helper persons need to access to the injury person, in order to check the victim medical identification. It is a fact that with these kind of apps, the user (helper) must access to physical device of unconscious person's smartphone for reading emergency identification. Another way to get the unconscious medical information, is with the use of medical alert bracelets [1, 10].

These accessories allow sharing information directly or by interaction between the bracelet and the application on the smartphone. These solutions need additional accessories.

In contrast, in our proposal users only use the smartphone to provide aid and assistance. There are devices that can detect an emergency situation (Fall Detection) and automatically triggers an emergency calling [19, 21] without considering the proximity of the people around the victim. In this respect, we could integrate our proposals into these devices.

FAMA: Proxemic-based First Aid Mobile Application – Our proposal

In this section, we describe the advantages offered by proxemics for human-computer iteration and how our prototype based on proxemic interaction, is capable to give benefits to first aid mobile apps.

Proxemic interaction provides foundational principles for our proposal. The development of FAMA, our fist aid app prototype, takes in consideration the proxemics dimensions (i.e., distance, movement, identity) that have been used by different studies [6, 12, 15, 16, 17, 23]. On the left side, we explain these proxemic dimensions and how these contributed in our proposal.

Problem

In the context of first aid applications with unconscious persons, we have identified difficulties related to the interaction between unconscious person's app and helper persons. Generally, the helper person needs to access a physical device in order to see emergency identification on his/her smartphone. In other cases, the victim should wear special accessories (e.g., an alert id bracelet, smart watches, key fob card, NFC id card). With this kind of solutions, the intimate space of the unconscious person or victim can be affected by helper. Given that situation, we have formulated two hypothesis as follows.

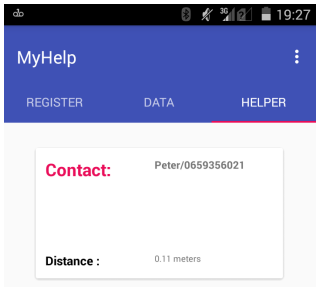

Figure 4: Graphical user interface for helper module.

User	MID	FAMA
	Seconds	**Seconds**
H1	75	17
H2	122	15
H3	32	12
H4	95	18

Table 1: Recognition time for Medical Id (MID) and FAMA Prototype.

User	MID	FAMA
H1	7	8
H2	6	9
H3	7	7
H4	6	8

Table 2: Opinion score (on a scale from 1 to 10, 10 being the best) relate to accessibility.

Hypothesis 1: Is it possible that a helper person can interact with unconscious person's smartphone, in order to obtain his/her emergency identification, without physical contact and reduce the recognition time with respect to current applications?

Hypothesis 2: An unconscious person or victim can share emergency identification without explicit interaction with a device.

Challenge
Rapid identification of unconscious people and facilitating more seamless and natural interactions between human and mobile devices, without touching the unconscious person represent big challenges.

For our FAMA prototype, we define three interactive zones: Rescue Zone, Alert Zone, and Neutral Zone; to offer better opportunities to unconscious or injury person to receive appropriate rescue aid. Each zone interaction was established in relation to distance between unconscious and helper person. Figure 2 shows the interaction zones for FAMA, these zones are inspired on previous researches [22].

Mobile application prototype
Our first aid mobile application, so called FAMA, was developed for android BLE mobile devices. This consists of two modules: Register and Helper modules. Figure 3 shows a print screen for the Register module. This is dedicated to create an alert when the unconscious or injured person demands help. The initial conditions must be filled out by users in order to share his/her emergency contact number. The Helper module is able to see emergency identifications of all unconscious or injured persons, depending on the helper person's location in the interaction zones. Figure Figure 4 shows a print screen for the Helper module.

Beacon virtualization
To build virtual beacons for smartphones, it was required to use Beacon protocols. In our prototype, we need to transmit string data that we will use to demonstrate that a virtual beacon can diffuse different kinds of information by interaction zones. We use the Java library AlteBeacon [2] which allows us to do that. This Java library only works on mobile devices with Android 5.0+ and BLE.

Scenario and evaluation

To illustrate our scenario, we consider a person in a public space, who feels weak and is about to faint. His/her smartphone will act as a virtual BLE Beacon and will start to share emergency identification by establishing a Bluetooth connection. In the current version of FAMA, the user has to explicitly start the S.O.S mode by pressing a button.

This emergency identification can be read by the smartphone of a helper person, exclusively when this is moving toward the Rescue Zone . People in the Alert Zone will then be able to see the notification; however, people in the Neutral Zone will not receive any notification. This scenario illustrates unexpected episodes in a public space, where people carry their smartphone practically everywhere and at all times. We can illustrate how proxemic interactions between humans and ubiquitous devices provide a positive contribution to the society.

This section have provided a description of scenario and how to use a First Aid Mobile Application (FAMA) based on proxemic iteration that allows to verify our hypothesis (H1 and H2).

To evaluate the effectiveness of FAMA, we asked five PhD students to be in a university classroom (Neutral zone). We provided four smartphones running our prototype to students who play the role of helpers (H1, H2, H3, H4) and

one for the unconscious or injured person whose device, in addition of our prototype, is running Medical ID (MID) [18], an available first-aid mobile application. We choose MID, because it has the same purpose of our prototype related to obtain emergency identification of unconscious or injured person.

We measured the time from which the helper person tries to identify an unconscious person until the moment when obtains emergency identification. This time was measured, both for FAMA and MID. For MID the helper must search the smart cellphone inside the pants pocket or handbag of unconscious or injured person. In this case the intimate space of unconscious or injured person could be affected by helper. While for FAMA the helpers used the proxemic interaction application running on their smartphones in order to obtain the emergency identification of unconscious person.

Results
Both questions are resolved with our experiments:

Hypothesis 1: A helper person, utilizing the FAMA application, can identify an unconscious person faster than the MID mobile app, without touching him/her. For MID, the recognition time can be long, depending on where the unconscious person carry his/her phone. This could represent a waste of time. Table 1 shows the recognition time of each helper person by using our proposal and MID solution. In our prototype, the recognition time is faster because the helper person does not need to physically access the smartphone of the unconscious person. These experiments demonstrate the functionality of FAMA and the successful use of proxemics concepts to implement a faster first aid mobile application.

Hypothesis 2: The unconscious person has been identified by helper people without using additional peripherals. The helper person accesses his own smartphone for recognizing unconscious person. Table 2 shows opinions related to accessibility of the applications FAMA and MID, by participants who chose a scale from 1 to 10 (10 being the best). When we talk about accessibility, it holds features as the rapidness of obtaining the medical identification and the respect of the unconscious person privacy.

Conclusion and perspectives

In this work, we have developed a first aid application, called FAMA, based on proxemic interaction. Proxemics offer advantages for human-computer interaction(HCI). Through the first aid scenario, our prototype was evaluated. Our analysis found that technologies used by FAMA behaves better than the current first-aid applications, because FAMA is based on interaction zones. This zones can offer benefits for faster identification of unconscious or injured people, only with the use of smartphones.

The current version of FAMA is focused only on the improvement of interaction with first aid mobile applications. However, to improve the FAMA functionality, as future work, we are looking for (i) integrating fall detection capabilities (to automatically start the S.O.S mode); (ii) combining other type of information to detect the gravity of injured persons, then be able to manage priorities, and (iii) implementing other capabilities to support helper persons to coordinate their actions.

We intend to explore and extend the concept of Physical Web in the environment: how it can be implanted with a BLE beacon in order to store and recover information regarding its objects. We also want to extend the use of proxemic interaction to other applications that will support everyday life human activities that demand HCI.

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