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STUDY OF THE IMPACT OF NFC TECHNOLOGY ON THE UNIVERSITY SOCIETY

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Abstract

EHEA guidelines are promoting the modernization of the European universities, focusing on the implementation of new technologies to get services offered by universities closer to society. With this idea in mind, the Universidad Politécnica de Cartagena (UPCT) is involved in the development and implementation of the so-called Smart University model: an ubiquitous computing platform based on NFC, where NFC devices and applications interact with each other to provide an ubiquitous computing system where relationships between people, practice and technology happen as a part of a natural "touching" interaction paradigm; and the interaction in the environment is realized by bringing the mobile device into contact or very close to smart objects. But, the project of the Smart University cannot be addressed if the acceptance of university society is not sufficient. Hence, the first step is to know the impact of the use of NFC technology in a university environment. Under this idea, a deep study has been carried out, finding out the expected impact of the NFC technology use by the university society (teachers, students and personal staff); the degree of penetration; the hardware and software requirements; the concerns about security and privacy; and the technological impact. The study was also focused on extracting the acceptance of some NFC applications projected to be implemented in the UPCT.

Keywords: EHEA, Smart University, NFC.

1 INTRODUCTION

The European universities are involved in adapting themselves to the current European directives in educational matters, the European Higher Education Area (EHEA) [1]. This involves significant changes to create more comparable, compatible and coherent systems of higher education in Europe. EHEA not only involves curricula adaptations and changes in the teaching model, but also to modernize the University through the implementation of new technologies in all university areas, creating a technological environment where students, teachers, university facilities and resources interact in a "natural" way under a ubiquitous computing environment, the so-called Smart University. In this sense, the emerging technology Near Field Communication (NFC) [2] is a possible candidate to fit the requirements of the implementation of the Smart University. NFC is a wireless technology based on proximity communication that permits in a simple and easy way user interaction with the smart computing elements of an environment by simply "touching" them with the user's mobile phones, thereby adding new value to them.

The Telematics Research Area at Technical University of Cartagena (UPCT) [3] is working on an ambitious project to create the UPCT Smart University [4], that is, a ubiquitous computing system to provide Universidad Politécnica de Cartagena (UPCT) with revolutionary NFC applications that replace some of those rudimentary tasks that cause teachers, students and personal staff to spend time daily. This development of this project has not sense if the acceptance of university society is not sufficient. Therefore, the first step is to know the impact of the use of NFC technology, when it is used with different purposes by the University staff, students, etc. Under this idea, a deep study was carried out, finding out the opinion about the NFC technology: degree of penetration, hardware and software requirements, concerns about security and privacy, technological impact, etc. This study has been also focused on extracting the acceptance of some NFC applications projected to be implemented in the UPCT.

The paper is organized as follows: section 2 describes the NFC technology. Section 3 overviews the Smart University concept. Section 4 summarizes the study and results obtained. Finally, section 5 concludes.

2 THE NFC TECHNOLOGY

Near Field Communication (NFC) is a technology based on Radio Frequency Identification (RFID) that combines wireless proximity communication with mobile devices [2]. NFC users interact with the smart computing elements of their surroundings by simply "touching" them with their NFC-enabled devices: readers, mobile phones, proximity cards, etc.

(a) (b) (c)

Figure 1. Examples of NFC communication: (a) mobile phone-NFC tag, (b) mobile phone-NFC reader, (c) mobile phone-mobile phone

On the proximity, NFC devices set up a *peer-to-peer* (P2P) connection and exchange configuration and authentication data. The devices could engage in transactions using any of the compatible protocols or set up a connection using faster and longer range protocols like Bluetooth, IrDA or Wi-Fi. Thereby, NFC turns mobile devices into more valuable tools by providing them with additional applications.

NFC operates in the 13.56 MHz frequency band, allowing data communication over a distance up to 20 cm and data rates up to 424 kbps. NFC is compatible with current standards for contactless communication and supports two communication protocols: NFC Interface and Protocol NFCIP-1 [5] and NFCIP-2 [6]. A built-in NFC chip can operate both as a contactless card and as a contactless reader, making the standard very suitable for device identification and communication initialization. Because the transmission range is quite short, NFC-enabled transactions are inherently secure. Also, physical proximity of the device to the reader gives users the reassurance of being in control of the process. Depending on the final application, NFC makes use of different devices: mobile phones to enable payments, digital cameras to send their photos to other device like a TV with just a touch, etc.

The huge incorporation of NFC technology on mobile phones and the availability of them to final users is a matter of a short time, as Fig. 2 predicts. This is the reason why in recent years several pilots using NFC mobile phones are being conducted for very different proposals [7][8].

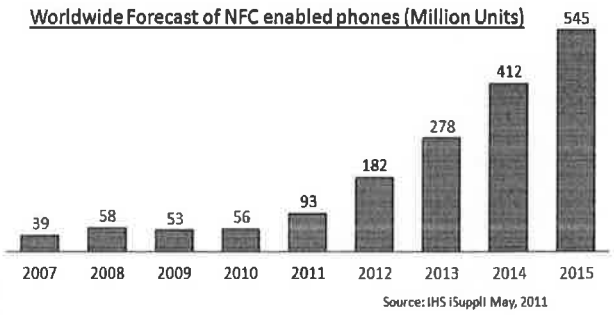

Figure 2. Evolution of NFC enabled phones in million units, by HIS

3 THE SMART UNIVERSITY CONCEPT

From the new trend of sharing knowledge and unlimited use of new technologies comes the concept of "Smart University" or University 2.0. It seeks greater connectivity between students and teachers through different media and platforms to improve the process of learning and communication [4].

The trends of Smart University aim at three objectives: (1) Accessibility: technology is being cheaper and more understandable for everyone without discrimination. (2) Interactivity: an immediate connection and "live" between teachers and students (3) Portability: regards to access knowledge anywhere in the world and not just in places origin.

Nowadays we can find that most Spanish universities walk to the Smart University: they are present in social networks, video sharing platforms, they have a website as a presentation or static platforms to teach online, etc. However, this is not enough. The concept of Smart University goes further. The Smart University also seeks to be closer to students and facilitate their everyday through new technologies, using a smart environment, that is, a technological environment where students, teachers, university facilities and resources, etc., interact in a "natural" way under a ubiquitous computing environment [4]. In this sense, the authors of this work are deeply involved in the development of a smart environment to be implemented in UPCT under NFC technology: a NFC-attendance-registering-system to control the attendance in practice and theory lessons at University, a NFC-payment-system, to speed up administrative fees at University, NFC smart-posters, to obtain real-time info, etc [4].

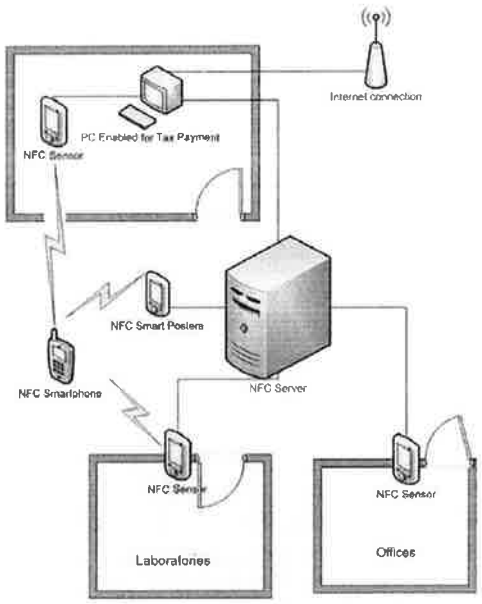

Figure 3. Smart environment based on NFC at UPCT

4 STUDY DEVELOPED AND RESULTS

The study has been carried out with an opinion poll. Twenty five questions were designed to know, from demographic data and general questions about the knowledge of NFC, to more specific questions focused on the secure payments with NFC or the usability of NFC applications in different university facilities. From the UPCT, one hundred people were polled, the 1.4 % of the total population.

First two questions are of demographic interest, sex and age of people surveyed, not relevant for the goal of this work. Next questions were mainly focused on NFC. These are summarized in the following subsections.

4.1 Questions about general knowledge of mobile technologies

These questions were designed to know the general knowledge of population surveyed regarding to mobile technologies and NFC in general.

3. *¿Do yo have a last generation mobile phone (3G, 3.5G)?*

1. Yes 2. No

4. *¿Have you heard or knows anything about NFC technology?*

1. Yes 2. No

The results o this questions show how the most of the people surveyed have a 3G mobile phone- 70% of respondents-, but the vast majority of them do not know about NFC technology- 67% of respondents.

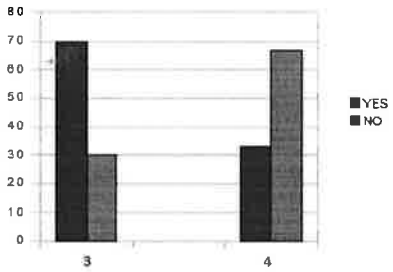

Figure 4. Results of questions 3 and 4

The following questions seek to assess the use of internet as a means to make reservations or payments, and the level of confidence in the use of this method.

5. *Did you do any reservation or payment via Internet?*

1. Yes 2. No

6. *Have you ever used mobile Internet services?*

1. Yes 2. No

7. *Have you used your mobile phone to make or confirm a reservation of a book or other item?*

1. Yes 2. No

8. *Have you made the payment of taxes or other mobile payment by mobile texting message, for example?*

1. Yes 2. No

Results of these questions show that the vast majority use Internet to make reservations and pay but, They have not used their mobile phones to confirm reservations or payments.

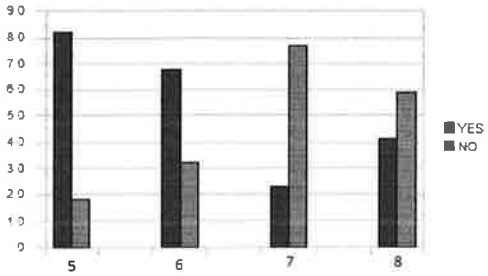

Figure 5. Results of questions 5, 6, 7 and 8.

4.2 Questions about common use of NFC

These questions are designed to discover the students' interest in the implementation of NFC, and their adaptation for use in facilities at UPCT.

9. Have you ever used online services of the library, entering your student password?

1. Yes 2. No

10. Continuing with the previous question. If you could use the same services from your mobile phone, simply waving your phone to a wireless reader, do you trust this?

1. Completely 2. Probably 3. I do not think 4. No way

11. Continuing with the previous question, imagine that you can control attendance labs, with a sensor on the door of each laboratory and before entering you simply must pass your mobile phone to the sensor and to confirm the attendance, is more comfortable as well?

1. Yes 2. No

Results show that, although NFC is not used for borrowing library books or attendance control, most respondents would trust their use, over 50% are in favor of its use and only 12% of respondents do not trust this application. In addition, in case of the application based on control attendance, comfort in use NFC is clear for over 90% of respondents

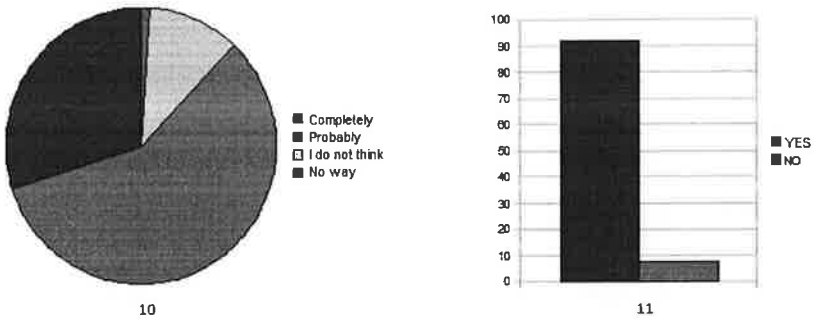

Figure 6. Results of questions 10 and 11

4.3 Questions about payment with NFC

The following questions focus their interest in the ability of NFC to emulate virtual credit cards, allowing payment by mobile phone. They try to find out the willingness of people to include a virtual wallet or a virtual credit card in their mobile phone and its use.

12. Do you own a bank account, where you can direct debit your payments?

1. Yes 2. No

13. Do you have any VISA/MASTERCARD credit card?

1. Yes 2. No

14. Imagine that, in the database of your University, as well as your name and student password, you include your account number or your VISA / MASTERCARD credit card number, Do you trust that this information could be included in the database?

1. Completely 2. Probably 3. I do not think 4. No way

Obviously question 14 generates a great distrust, mainly due to the totally unknown context in which the question is oriented. It is not specified what the purpose of the database is; and the possibility that the integrity of the credit card could be compromised, negatively affects on the opinion of the people. This causes the result of 61% of respondents answered negatively to it.

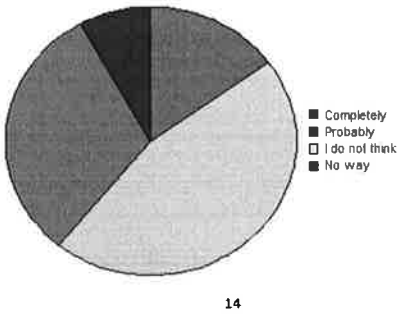

Figure 7. Results of question 14

Despite this, the above rejection changes if we study the following questions that reveal the outlines of an NFC application.

15. Would be willing to link your VISA / MASTERCARD credit card or your bank account number to your mobile number? (This means that at the time of enrollment or payment of university fees, the cost would be automatically redirected to the account or card, without having to submit a bank statement, you would simply pass your mobile phone over a NFC reader to confirm payment)

1. Yes 2. No

16. Each payment or transaction you make through your mobile phone must be approved by you, not completed automatically, by passing your mobile phone at the NFC reader, is this fact gives you more security or confidence?

1. Yes 2. No

17. The bank account information is not stored in the mobile phone, the database of the University only shows that some payments in your name should be charged to the account number / VISA / MASTERCARD contained in the database, and an application will communicate with your bank Do you consider that this keeps the integrity of your account / VISA / MASTERCARD?

1. Yes 2. No

The rejection showed in the responses of question 14 is tempered after the answers of questions 15, 16 and 17. Question 15 states the objective of the database as proposed in the previous question and you can see a change of the respondents' opinion. With questions 16 and 17 the positive change is even more evident and the confidence to include the number of credit card VISA / MASTERCARD is over 70%, which means an even greater change in the percentage of respondents who initially distrusted it - 63% compared to over 70%.

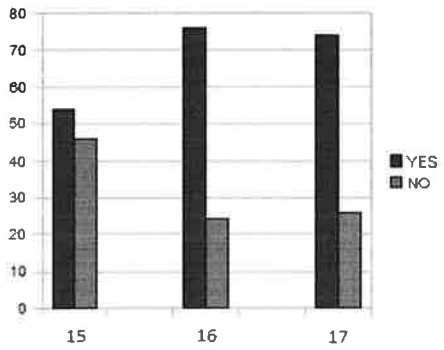

Figure 8. Results of questions 15, 16 and 17

The following questions, although they have not relation with NFC, they are relevant because one of the goals of this team is to develop NFC applications based on University fees payment, and the results of these questions can provide details for the possible application options, on the user side.

18. *Would you prefer to receive a text message to your mobile phone each time you complete a payment this way or to receive it monthly with all the information of your account and / or charge?*

1. I prefer texting message 2. Monthly information 3. Any option

19. *Are you concerned that this type of payment may involve abuse by your telephone company or bank? (Commissions, ...)*

1. Of course 2. No, I don't trust my bank/ telephone company

Although these data do not show info regarding the interest in NFC, if it is significant that 63% prefer texting messages with payment confirmation (18.), even more if the payment is of large amounts of money. Moreover, given the widespread concern about the collection of fees or other charges for the use of NFC payment applications, it is clear that we cannot ignore these results, if we are to ensure the widespread deployment of NFC.

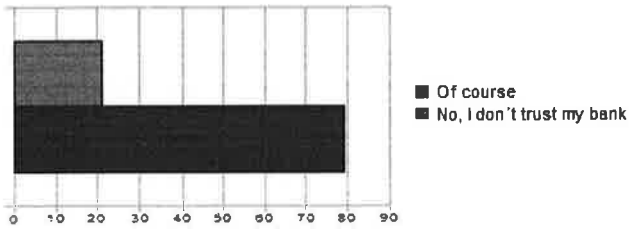

Figure 9. Results of question 19

4.4 Final Questions

Latest questions were designed to collect impressions of respondents compared to the possibilities and features that future NFC applications would provide, both everyday and payment, which can create greater impact on society in a near future.

20. *Do you think that to make reservations and payments of any kind with your mobile phone is an improvement?*

1. Yes 2. No 3. I don't know

21. *Does your mobile phone has NFC?*

1. Yes 2. No 3. I don't know

As noted in Section 3, the NFC mobile market started some years ago. Hence, it is possible to have a mobile phone with these features. However, NFC is still unknown, and that was the goal of the previous question. Obviously if NFC is not known, it is difficult that the results differ from those obtained.

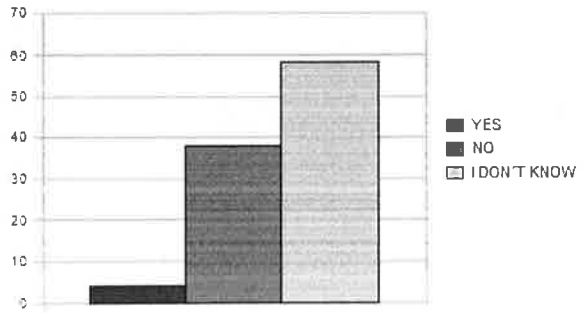

Figure 10. Results of question 21

22. *After you have answered the above questions, would you change your mobile phone with one that would allow use NFC with all applications discussed?*

1. Yes 2. No 3. I don't know

This question is perhaps the most significant of the entire survey, bearing in mind that the purpose of the questionnaire is to find out the impact of NFC and interest in society, the results speak for themselves, for just over half of respondents are willing to change their current mobile phone for one with NFC capabilities.

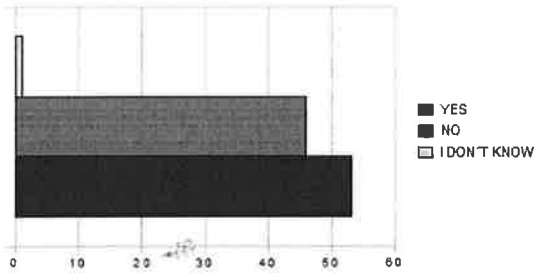

Figure 11. Results of question 22

Finally, we try to discover the general feeling and confidence of respondents in the possible success and opinion regarding the trust and confidence that inspires NFC after having responded to the survey.

23. If you had a mobile NFC, trust him to make payments?

1. Yes 2. No 3. I don't know

24. Do you think this technology is safe in general?

1. Yes 2. No 3. I don't know

25. Do you believe that NFC technology could spread quickly if people knew?

1. Yes 2. No 3. I don't know

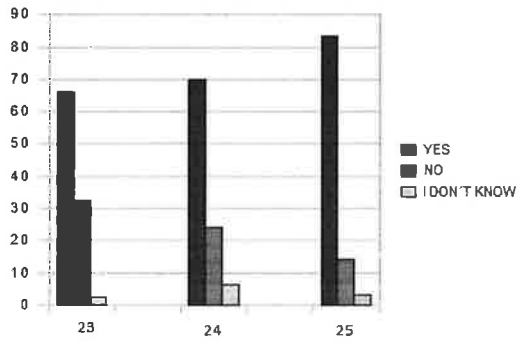

Figure 12. Results of questions 23, 24 and 25

The results could not be more positive, because a large majority of respondents would rely on the use of NFC for payments (66%) in the level of security technology in general (70%), and the confidence in its rapid expansion (83%).

5 CONCLUSIONS

After analyzing the survey results we can say that there is a positive interest in NFC technology and its potential use in UPCT facilities, both general and application for payment by NFC.

We can also assume that if NFC is consolidated across the board for development of applications and devices, people would intend to use this technology. Therefore, it could encourage the development of applications in the field of UPCT to promote the implementation of NFC technology quickly.

Although in general the results are positive, we must not forget that people are still afraid to levy charges on NFC payment applications (79% of respondents), to which must be added that a large percentage of respondents not willing to acquire a mobile NFC (46% of respondents).

Summarizing, results are clearly positive and encouraging and these show (1) a great interest in the potential of this technology; (2) intention to adopt and use NFC in UPCT; (3) opinion of success in the rapid adoption of NFC, for use in the wider society.

ACKNOWLEDGMENTS

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