

## TOWARDS PAYMENT SYSTEMS FOR ALL: ACCESSIBLE POS

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### *Abstract*

The project presented here is a first step towards building a more accessible world through Payment Systems and a successful implementation of a User Centered Design. By means of a beep-system, a Point of Sale (POS) payment device informs the user of those transaction steps that require his/her attention at the moment of payment, such as when:

- The card has been successfully read.
- The Personal Identification Number (PIN) must be entered.
- The transaction has been successfully processed.
- The transaction has not been completed due to an error.

The proposed solution increases the personal autonomy and security of blind people when paying at a merchant.

**Keywords:** payment systems, accessibility, POS.

## **Introduction**

According to the World Health Organization [1] 1000 M people suffer some type of disability -15% of the population-. In Spain, more than 3,85 M people (8.5% of the population) have some disability [2]. While the disparity in numbers may be due to different survey sample and disability criteria, both reports show that a very significant group of people have disabilities worldwide. It is not quite the same to suffer an impairment than being disabled by it. It will depend on the activity the person wants to perform and the available resources. For example, 10.8% of survey participants would like to go shopping but are unable to do so due to their disabilities [2]. Not all impairments will have the same impact during a purchase process. Buying a train ticket may not be possible if the vending machine is too high to be operated by a person in a wheelchair, thus there are specific guidelines to ensure access [3]. A blind person may not be able to operate the same vending machine if it does not provide an alternative to the visual information.

Accessibility is an issue of equal rights [4], but it is also a profitable one, since accessible services tend to be easier to use for all customers, especially online services, increasing visits and purchases [5].

### **Difficulties in Payment Systems for blind users**

In the project described here the focus given is on the visual impairment, which total some 285 million people worldwide [6], and it was carried out with the collaboration of the main association of blind people in Spain (ONCE). There are close to 75,000 ONCE [7] members, all potential users of payment cards, and the partially blind population is much greater, although it is not quantified. In addition, 1000 to 2000 of them also own businesses that require card payments [7]. Some of them have smartphones, a trend that continues to grow.

The most pressing user challenges in Payment Systems are the following scenarios:

- When **purchasing tickets and travel passes**, despite the terminals being already quite accessible, the moment of payment is still rather complicated. When paying, the user has no way of knowing if the card fails to communicate an error, if it asks for a pin or whether the pin is incorrect. At present, many users use a trial-error method: that is to say, when a reasonable time elapses they introduce the pin, and if the receipt is finally obtained, it is assumed that the operation has been successful. There are many other products and services using such unattended terminals. However, for blind users, buying transport tickets is particularly important for their self-independence [8].

An international consortium has deployed in 2013 accessible, usable and personalised services in real-life settings: 24 TVMs of Hoeft & Wessel in Paderborn (Germany) [9].

- When **purchasing in shops**, users rely on the seller to enter the correct amount and hand the POS over to the user to enter the pin when required. It is possible to enter the correct pin by identifying number 5 via a tactile dot in relief. Nonetheless, verifying the amount is not possible. Neither can they be sure that the PIN is not visible if entered during another phase of the operation (for instance, when entering the amount) [8]. In general terms, traditional POS devices use a tiny LCD display to show the user instructions, and the amount that they will be charged, which are difficult to read even by people with a moderate vision impairment [10].

In the case of touch POS it is even more complex since they have no tactile references. [8] As an example, a class action lawsuit has been filed in march 2014 against Apple because visually impaired customers cannot operate the company's touchscreen iPod POS without assistance, with added security concerns regarding PIN introduction, which takes place in a traditional pinpad. This is a violation of the American with Disabilities Act (ADA), which calls for retail outlets to provide a POS system independently accessible by a blind customer [11].

- There is also the case of many blind people who manage their own businesses, but cannot **charge with a card** since they are unable to follow the entire operation process [8].

A new solution has been developed recently by pairing a Bluetooth keyboard with an iPad and installing an [accessibility app](#). The solution talks back to the user to indicate what is being done with an order [12]. Functionality includes adding items and discounts to an order as well as credit card payment, being useful for both business owner and customer [13].

- The **use of ATMs** faces several challenges: such as, knowing whether it is operating or not, identifying the desired operation or where to press. Basically, the same thing applies here as with the POS terminals, once inserting the card is accomplished, knowing exactly when to enter the PIN or that everything is correct, etc. At present, users memorize sequences of the most common operations, but when the bank changes the ATM software menu, the sequence is no longer valid. In the same way, audio jacks available in many ATMs are not being used by the financial institutions' applications, and the trend towards touchscreens to the detriment of keyboards and buttons, also makes access much more difficult [8]. Despite clear recommendations such as ADAAG [14], it is difficult to implement in a mass market. American banks have faced class action lawsuits grounded on ADA's [4] accessibility guidelines. However, the consortium APSIS4All has supported the launch of 1000 accessible ATMs of "la Caixa" in Barcelona and Madrid (Spain) [12].
- Finally, when the **card is inserted incorrectly** the terminal prevents full access, this also occurs when an ATM is out of service. Hence, the reason for the error is unknown. A method is needed to ensure that the card is inserted in the right direction, so that if it does not enter it is because the device is out of service. Some financial institutions resolve this problem with a notch on the side of the card that indicates the right direction, but this solution is neither standardized nor mandatory [8].

## **Methods**

A leading Payment Systems' company in Spain has set-up a plan to sensitize with the needs of all their users, including those with disabilities, beginning with blind users. From this Payment Systems' company perspective, the challenge to meet the needs of blind users is solely limited by the technical and economic viability, as well as the regulations. The company followed Tusler's best practices for implementing accessibility within the industry [5]:

- create an implementation plan
- create clear documentation of accessibility features for developers
- integrate accessibility into the existing company practices

In order to address the above issues, the company designed an "Accessible payment plan", whose first priority was improving POS experience. They have carried out a thorough analysis of the Point of Sale (POS) usage requirements and looked for accessibility solutions that are technically viable, while meeting current regulations. Moreover, not only do they improve the quality of life of this particular group, but also make them more accessible to the rest of the population, especially those with partial blindness.

This paper describes the solution proposed by a Payment Systems company to bring greater independence and security to blind users during POS payments. This solution is the definition of the technical specifications that include a beep code (described below) which will gradually be deployed throughout the company's certified POS park.

The most common payment process requires, first entering the amount, then inserting the card and finally the PIN. Should the transaction be approved, a receipt is issued at the end.

## **Methodology**

The underlying work philosophy is to create standard products or services, which are accessible, with no special design, as stated by the Universal

Design principles [15]. The Accessible Payment Plan schedules first the essential barriers to accessibility and plans for incremental improvements as recommended by WHO [16].

"To succeed, accessibility initiatives need to take into account affordability, availability of technology, knowledge, cultural differences, and the level of development. Solutions that work in technologically sophisticated environments may be ineffective in low-resource settings. The best strategy for achieving accessibility is usually incremental improvement. Initial efforts should focus on removing basic environmental barriers." [16]

When evaluating the different solutions, priority was given to reaching the largest amount of population possible in the most efficient way, which means paying attention to the availability of technology (types of POS managed by the company). Thus, although using a talking system was considered, only a small percentage of POS deployed could handle it. It was agreed with the experts that for the solution to be useful, it had to be as universal as possible.

A human-centred design approach was followed [17] as part of the user centered methodology since it was considered essential to collaborate with the target user population due to their specific needs. The approach taken was Rubins' [18]:

1. Early focus on users and tasks
2. Empirical Measurement and testing of product usage
  - a. Focus on ease of learning and ease of use
  - b. Testing of prototypes with actual users
3. Iterative Design

### **Technical Validation.**

A preliminary meeting with ONCE technical experts allowed to assess the pain points of the interaction with the device in addition to brainstorm viable solutions. During a second session a demo version of the solution was presented and validated by the experts. Finally, a session with users was organized to validate the solution by means of open discussion and testing.

After analysing the difficulties and the current legislation, three POS leading manufacturers were asked to perform demo versions incorporating a beep code indicating the correct reading of the card, PIN code request and error occurrence.

The sounds in the three demos were as follows:

- A beep every time a card is correctly read
- Three high pitched beeps to request pin introduction. If the pin is incorrect, there will be the same three beeps
- One low-pitched beep: operation accepted.
- Two high-pitched beeps: operation denied.

ONCE's technical team evaluated this first version and recommended that all correct or accepted action beeps, use high-pitched tones and leave the bass tones for incorrect actions (i.e.: denied operations), which seems more intuitive to the user.

Thus, the new sounds are as follows:

- A beep every time a card is correctly read
- Three high pitched beeps to request pin introduction.
  - If the pin is correct, 1 single high pitched beep.
  - If the pin is incorrect, there will be the same three request beeps. After a third failed attempt, the transaction is denied.
- One high pitched beep: operation accepted.
- Two low pitched beeps: operation denied.

It is important to bear in mind that when defining the appropriate tones for each step of the transaction process, there are international standard regulations that must be met. For example, due to VISA regulations it is not possible to use the same frequency and tone they establish for their own functions [8].

It is also necessary to point out that the resulting audio coming from each of the prototypes mainly depends on the type of hardware employed. Therefore, no beeping sound is alike even though the specification is the same. However, according to ONCE's experts this is not a difficulty or a problem.

For users with reduced vision, it was recommended to use the brightness of the screen as recommended in the norm UNE 170002 (2009) [19].

### **User validation**

Once implemented ONCE's recommendations, an evaluation test took place at ONCE's Regional office in Madrid to evaluate the solution.

Out of the 9 participants appointed, two had partial blindness and 7 were blind (Nielsen recommends recruiting at least 5 participants for usability evaluation studies [20]). There were two retired persons (>65), one trainee student (<30) and the remaining were active workers. The group consisted of five women and four men. All of them own one or more payment cards and all but one have used them to pay for goods in a retail store.

The session lasted 2 hours and started with an introduction of all parties and the goal of the session. Then, in a first exchange of experiences the two most common situations were clearly identified:

- Users who avoided using POS and tried to make payments in cash.
- Users who used the POS at a considerable risk, such as not being able to identify the keyboard easily to type numbers and having to, in most cases, ask the cashier to type the OK for them to accept the insertion of the PIN.



Everyone (users and experts) agreed that the touch POS is impossible to use. Subsequently, various tests were conducted using two different devices with the following scenarios:

- Valid PIN card and operation completed successfully.
- Invalid PIN.
- Valid PIN and rejected operation.
- Correct operation without PIN request.

During the tests several discussions arose about the convenience of alerts (beeps), the structure and the reasons behind every decision as well as the regulatory restrictions.

## Results

### **Specifications: Guiding the user with interface tones during a card transaction with a POS**

Following user evaluation, a new and final set of POS specification was defined.

#### *Operational description*

The purpose of this section is to describe the beep system guidelines that allow the POS to guide the user through the different steps of a card transaction.

The POS must comply with the following previous requirements:

- The POS must be capable of producing audible tones.
- The volume of the tones produced by the terminal must be set at an appropriate hearing level so that it may be clearly heard by the user.
- The set of tones produced by the POS are used to show the user the progress of the transaction. Different beeps in the terminal are employed to indicate whether the result of the process is successful or not, and to indicate when data must be entered in the POS.

- The three different beep tones must be clearly distinguishable from each other and any other sounds used in the POS.
- Functionality must be compliant with all international standards and requirements formerly defined by the financial institutions and the card transaction payment schemes.

Defined below are the tones to be incorporated in the terminal's transaction operating process:

- Card correctly read tone: a single beep at a frequency of approximately 1500 Hz, sinusoidal waveform and approximately 500 ms duration.
- Correct process tone: a single beep at a frequency of approximately 2000 Hz, sinusoidal waveform and:
  - If the PIN is correctly entered in the POS, a long tone with a duration of about 500 ms.
  - If the transaction is accepted, a short tone with a duration of approximately 200 ms.
- Tone for correct POS data input (PIN entry): the PIN entry tone will be a triple beep at a frequency of approximately 2000 Hz, sinusoidal waveform and duration of approximately 200 ms. The gap between the three beeps will be approximately 200ms.
- Alert tone: a double beep at a frequency of about 750 Hz, sinusoidal waveform and duration of approximately 200 ms. The gap between the two beeps will be approximately 200 ms.
- Keystroke tone: the frequency and length of the sound has not been specified yet but should be clearly distinguishable from the other tones defined here for the transaction process, and must be indistinctly the same tone for all keys regardless of the key(s) pressed.
- Tone to alert the user that the card has been forgotten in the reader: the frequency and duration of this alert has not been stipulated but must be distinctly different from the other tones defined here for the transaction process.

In order to make each step of the transaction process completely clear to the user, the POS must only use the beeps and tones described above and avoid any background sound during the transaction.

It should also be noted that during the transaction the terminal will always generate only these tones and no other than those specified.

## **Discussion**

There are some limitations in the results, such as the lack of quantitative data from the user testing session. The goal of the project was to develop an accessible solution the most efficient way and, while opinions were collected, performance data was not recorded. Due to the great dependence on others at the time of payment, with the lack of autonomy and security risks involved, the time required to perform a task was not analyzed.

The solution itself is limited since the test was conducted in a quiet room, but most payment takes place in a noisy environment making it more difficult to hear the device beeps. However, the specifications listed here are a simple way of increasing autonomy and security for blind people in card payments. They have been tested and agreed upon with users as part of a user-centered design approach, and they will be put into place by the main POS providers in Spain. They should be known and applied in a standardized manner, and therefore must be conveyed beyond the Payment Systems company's operating environment.

## **Conclusions**

After the accessible POS tests, users expressed the following conclusions:

- This system would provide greater security and autonomy to end-users.
- That the beep sequence requesting the PIN again, in case of it being invalid, is a crucial feature.

- Users who are now reluctant to use these terminals would be willing to use them.

The experience shows the successful implementation of user-centered methodologies: the Payment Systems' company has developed in collaboration with ONCE new specifications that facilitate the use of POS for blind people. From this moment on, manufacturers incorporate an acoustic system in the final products they develop while meeting with the Payment Systems' company POS functional specifications. As of September 2014, the number of POS which include the new specifications in their operating systems is over 320.000, which is above 50% of the total of POS managed by the company across the country [21].

Currently, their goal is to promote these developments and contribute to their standardization, even beyond national borders, improving accessibility to the payment system devices that the company manages. The choice of a solution that can be implemented in very old devices makes it possible to replicate by other payment processors around the world.

## **Further work**

As part of the commitment to the user a new area of User Experience was created in may 2014, with the purpose of allocating the necessary resources to ensure the usability and accessibility of their products and services as well as improving the overall user experience. The corporate UX policy informs the goals and good practices in UX throughout the company, starting with user-centered design methodology and integrating accessibility and usability requirements within development methodologies. It is far less expensive and more efficient to design an accessible product than to adapt one that is not. They have also developed a corporate manual that includes, not only new designs adapted to new mobile devices, but also usability and accessibility criteria to ensure that every new product is accessible from the outset.

The company is currently addressing the needs of blind users to accept card payments by means of a mobile POS, available for iOS and Android (Windows

Phone is under way). In the initial stage of the application design, ONCE's technical team was called to learn the functionality and advice on accessibility issues. When developing the first version, ONCE team analysed it and their findings were adopted in the following version. Next steps involve user testing to further fine tune accessibility issues and make it fully functional for blind users.

Another priority project is to address the accessibility of unattended terminals, to facilitate the purchase of Metro and train tickets. The company intends to make online payment accessible to all. The first step was to analyse the accessibility state of the company's payment platform, which is used by some of the most important banks in Spain. The company has also launched a digital wallet in February 2014, and is now focused on improving the user experience for all.

While they try to respond in a first stage to the needs of blind users, such as unattended terminal payments or the possibility of charging independently, they are also considering addressing the needs of users with other profiles in future stages. Along these lines, the Payment Systems' company aims to be an accessibility reference within the Payment Systems market.

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