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Description App for Visually Impaired People

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Abstract

Assistive technologies are tools and/or services that can guarantee accessibility to people with visual impairments in society. The aim of this work was to present the development of the "Description App for composition reading" (Barcode Speak) for people with visual impairment. The study was qualitative and exploratory in nature, based on scientific and technological data. The prototype was developed using the Java language. The results showed that Barcode Speak is capable of identifying and characterizing product packaging and labels, through barcodes and QR Codes, using the cell phones camera and similar devices for description. The app can offer more autonomy and independence to the visually impaired consumer for the product description exploration and previously marked objects, facilitating the daily and professional tasks performance, favoring social and citizen inclusion as a consumer.

Key-words: Assistive Technology, Accessibility, Blind, Low Vision.

1. Introduction

According to the World Health Organization (2021), around 2.2 billion people have some type of visual impairment, such as low vision and blindness. In Brazil, the most recent data show that visual

impairment is the most expressive, affecting approximately 36 million people, according to the Brazilian Institute of Geography and Statistics (IBGE, 2010).

In order to reduce the barriers of access to information and social integration between people with visual impairment and the environment surrounding them, the assistive technologies gather tools, techniques and services which may provide assistance and improve the quality of life of these people, promoting autonomy, independence and social inclusion (BRASIL, 2015; COOK; POLGAR, 2014).

With the advent and improvement of smartphones, people with visual impairment have had more opportunities to act in the various spaces of social life, as a result of the use of methods and/or devices that assist them in their routines. Morris and Mueller (2014) and Griffin-Shirley et al. (2017) reported that the mobile devices considered most useful and accessible for most people with visual impairments were Android and iOS. Examples of currently used apps are VoiceOver, which describes in detail what is being presented on the mobile device (apple.com); ScanLife Barcode & QR Reader, which uses smartphone camera to read codes and receive information (apps.apple.com); Aipoly Vision, used for object recognition and color identification (play.google.com); Ultra Magnifier, allows screen magnification (apps.apple.com); AccessNote and BrailleTouch, used for writing (iaccessibility.com; techtudo.com.br).

Used as a resource in several accessibility tools for people with visual impairment, the audio description is a modality of audiovisual and intersemiotic translation essential for the understanding of the environment by people with visual impairment, or even by illiterate people, with dyslexia or intellectual disability, through the translation of visual signs into acoustic signs, i.e., turning images into words, such as literary, theatrical, cinematographic, cultural, educational, television works, among others (VIEIRA; LIMA, 2010).

Despite the innovations and technologies available in the market, people with visual impairment tend to face difficulties in simple daily tasks, due to the lack of adaptation, reduced mobility and difficulty in discovering and moving around in new and unknown environments (OLOFSSON, 2017), or even due to problems inherent to human society, such as low tolerance, prejudice, stigmas, stereotypes and discrimination, which limit the integration and reach of this public to services, policies and rights constituted (SASSAKI, 2009). In addition, the market value of technologies (e.g. smartphones) is often outside the financial reality of those who need to acquire it (MAFFEI et al., 2019).

Visual impairment presents specificities that challenge the development of increasingly assertive innovations and technologies that are convergent to meet this audience needs (MAFFEI et al., 2019). Griffin-Shirley et al. (2017) reported that people with low vision find apps designed specifically

for visually impaired individuals inaccessible, possibly because they are used to using apps designed for sighted people rather than those designed for blind people.

By identifying barriers that produce difficulties in access to information and communication for people with visual impairment, it is evident the need to develop innovative technologies to provide accessibility to this group of people, who face limiting barriers in their routine life in society, either as a consumer, as a citizen who uses public spaces, as a worker in search of opportunities or as a student, who needs to have unrestricted access to education. In this sense, this work's objective was to present the development of the "Composition Reading Description App" (Barcode Speak) for visually impaired people.

2. Methodology

The methodology applied in this study was qualitative and exploratory in nature, from scientific research in Google Scholar and the journals portal of the Coordination for the Improvement of Higher Education Personnel (Capes), in the Federated Academic Community (CAFe).

For the development of the prototype "Description App for reading composition", the Java language was used. The data obtained in the technological prospection (data not shown) and of technologies available in the market were evaluated to identify points of improvement and convergences of the proposed product, with the objective of guiding the App functionalities and its differentials.

In modeling the software development cycles, the following diagrams were developed: (a) Results, which depicts the app usage flow; (b) Use Cases, which shows the step-by-step that the user must follow to perform actions in the app; and (c) Components, which describe the technical flow and other app components. To elaborate the Diagrams, the draw.io modeling tool was used.

The first environment for testing the prototype was the Central Library of the Universidade Federal do Sul e Sudeste do Pará (Unifesspa), Marabá campus. The goal was to evaluate the barcode and QR Code reading functionalities in books and other publications available in the space and possible improvements in the product's applicability, simulating a real circumstance.

For the tests, the sample content was the barcodes and numerical values from the book catalog Then, the descriptions of each book code read in the previous step were added to the app's database. The next step was to read the descriptions with the app, already using the voice accessibility mechanisms. With this process, it was possible to verify the viability of reading barcodes and QR Codes of different types by the app, because there were more than one type of barcode in the books. It was

also possible to observe that the app would need an action that could identify the barcode detection, which was solved with a vibration mechanism when locating it. The tests made it possible to apply improvements to the app's interface, as well as to identify possible code detection errors that were fixed in the test versions of the app.

The second test environment was with one of the app's target audiences, a student at the Universidade Federal do Sul e Sudeste do Pará (Unifesspa) with visual impairment - blindness The verification sought to evaluate the app´s functionalities, interfaces, and purpose in product packaging At first, the test had a satisfactory return, and the description codes were activated through voice, going through all the steps until the end of the purchase process. The student also identified the agility to activate the app, unlike other programs aimed at the visually impaired. As an improvement point, it was necessary to correct the product's description, which was with the numbering corresponding to its classification in the database. During the description of the product, the respective numbering was mentioned at the end of the object and/or merchandise detailing.

The "Description App for Composition Reading" was registered at the INPI under the number BR512020001689-8, published on August 25, 2020, aiming to ensure the ownership and confidentiality of the work, as well as to guarantee the owners the commercial exploitation of the product (BRASIL, 1998).

3. Results and Discussion

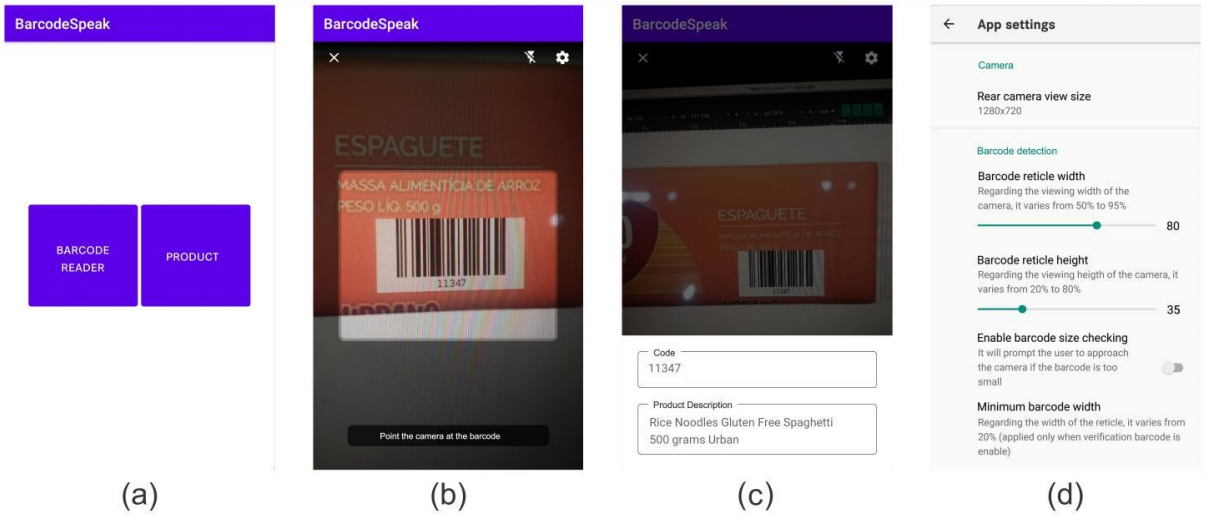
3.1 Assistive Technologies as Tools for Social Inclusion

Although they have access to assistive technologies, people with visual impairment face daily challenges, including at home, due to obstacles which prevent them from using and moving around in physical spaces, either by architectural barriers (e.g. sidewalks, walls, posts, stairs), by the arrangement of furniture and ornaments (e.g. armchairs, sofas, tables) in internal environments or even by barriers in the access to information, by the products with accessible packages unavailability, as we problematize in this study, in search of solutions and/or improvement of solutions.

The Barcode Speak prototype showed promising results in barcode and QR Code description, using cell phone cameras and similars. Figure 1 shows in detail the graphical interfaces of the Barcode Speak prototype's barcode reading path. After the App is started, an audio message is automatically generated informing the two commands (Barcode/QR Code Capture and Products), their position on the cell phone screen or similar equipment, and the indication to select one of the commands to

continue. This message will repeat until the user defines which command will be executed. The following steps also have audio messages informing the user step by step.

Figure 1 - Screenshots from the Barcode Speak App Image Capture: a) Access to the Barcode/QR Code Reading Button; b and c) Image Capture through the Device Camera; d) Textual and Audio Description of the Text; d) Camera and Barcode/QR Code Reading Settings



Source: Own authorship (2020)

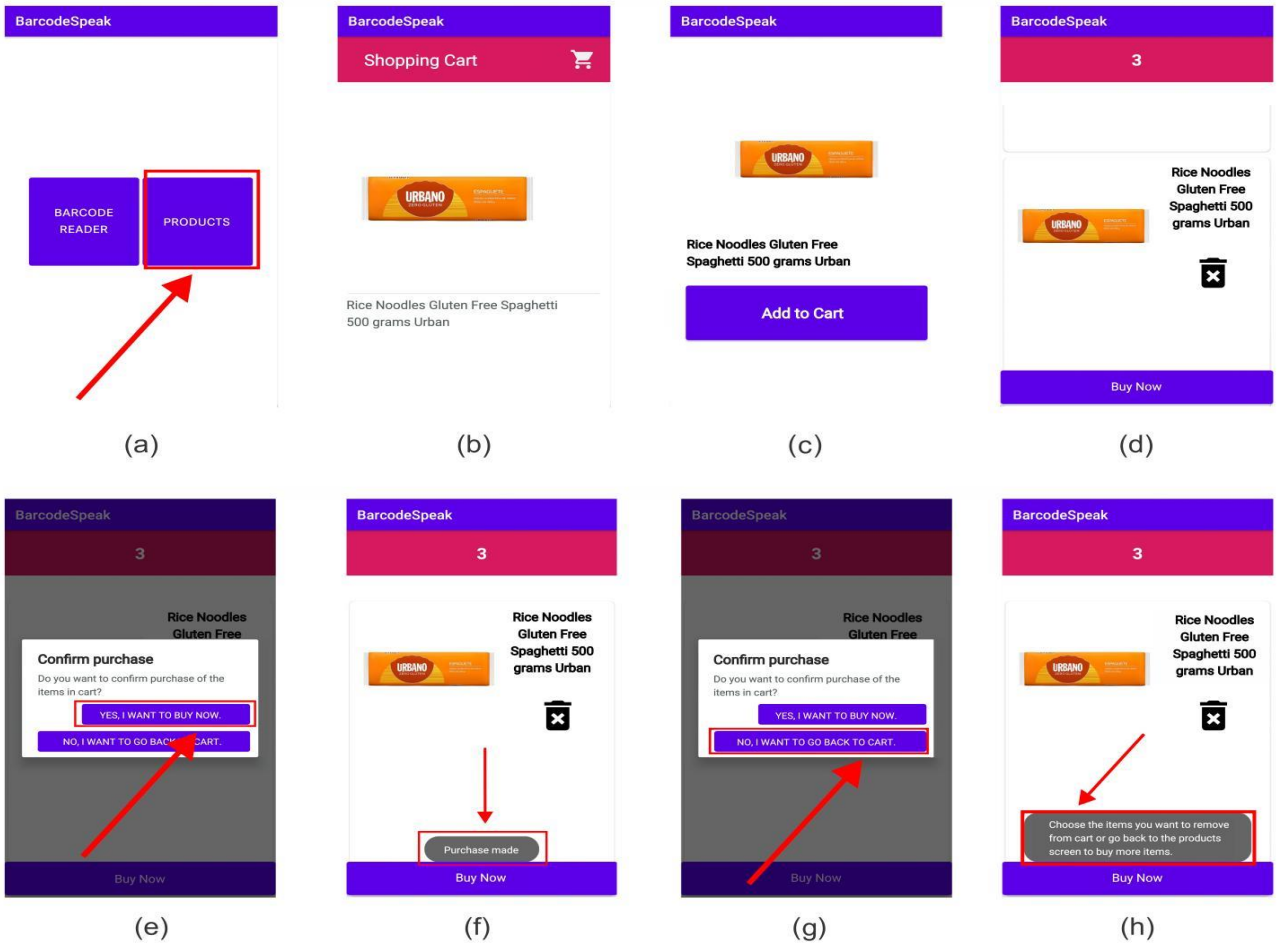
Studies have shown that assistive technologies are important tools to support the visually impaired person (DOBOSZ, 2017; GRIFFIN-SHIRLEY, 2017; MAYORDOMO-MARTÍNEZ et al., 2019). These technologies can be used to recognize label text (product information), since packaging and labels are similar, especially canned and glass goods, which makes differentiation by this audience difficult.

Jones, Bartlett, and Cooke (2019) and Yu, Tullio-Pow, and Akhtar (2015) reported that visually impaired people had difficulty understanding product labels/labels, such as food, due to font size and type, color contrast, as well as product specifications, e.g., expiration date. The labels/tags were considered limiting factors, because they impair the information visualization, since it is necessary to have the third parties with vision support or to use some instrument to magnify the image.

In this work, it was shown that the Barcode Speak prototype can become an essential tool to minimize the problems faced by people with visual impairment in the identification and characterization of product packaging and labels, choice options between similar items, price composition, quality assessment, brands and expiration date, via bar code and QR Code, using the camera of cell phones and similar to perform the reading (description).

Another great potential is the possibility of making purchases through a delivery system, with the support of product description and resources made available in the app, and can be aimed at supermarket chains, pharmacies, convenience stores, restaurants, snack bars, libraries, bookstores, among other segments, seeking to bring brands and companies closer to this potential niche consumers. The graphical interfaces of the Barcode Speak prototype for adding products to the shopping cart are shown in figure 2. By clicking on the products option, the shopping cart screen and the audio message informing the product description are automatically generated. This message will repeat until the user decides whether to add the product to the cart or choose another product by sliding the finger on the screen (from right to left or vice versa) so that a new product appears. The next steps also have audio messages informing the user step by step.

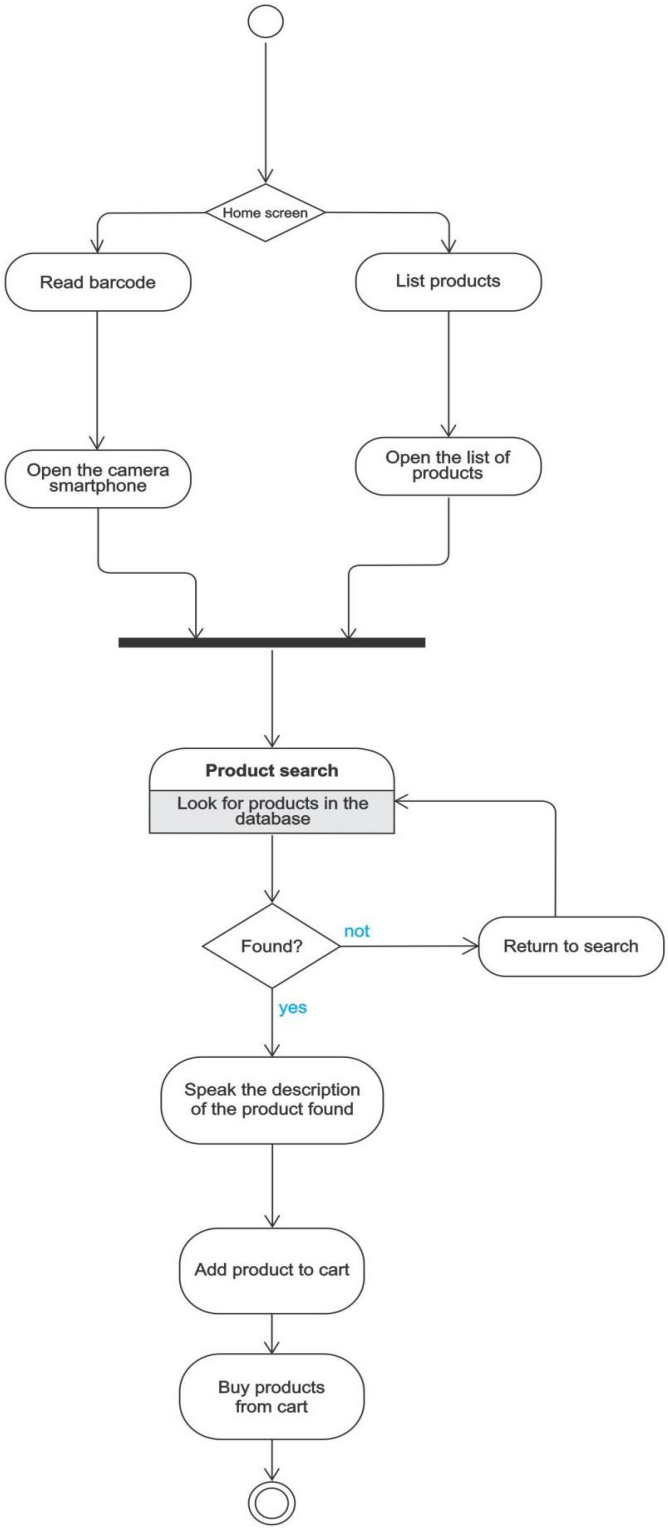
Figure 2 - Screenshots of the Process of Adding Products to the Shopping Cart of the Barcode Speak App: (a) Access to the Products Button; (b) Shopping Cart with Textual and Audio Description of the Product; (c) Shopping Cart with Button in the Lower Region of the Screen to Add the Item to the Cart; (d) Definition of the Purchase or Exclusion of the Product; (e) Button in the Central Region of the Screen to Confirm the Purchase or Return to the Cart; (f) Message that the Purchase has been Made, If You Choose the Confirm Purchase Option; (g) When You Click on Return to the Cart, You Return to the Purchase Process Menu; (h) Shopping Cart to Choose the Item that the User Wants to Remove or Add.



Source: Own authorship (2020)

In the app usage flow, it is possible to add, remove, and replace products and number of items in the cart, as well as purchase them, using the functionality of listening to the description of the products, according to the activity diagram (Figure 3).

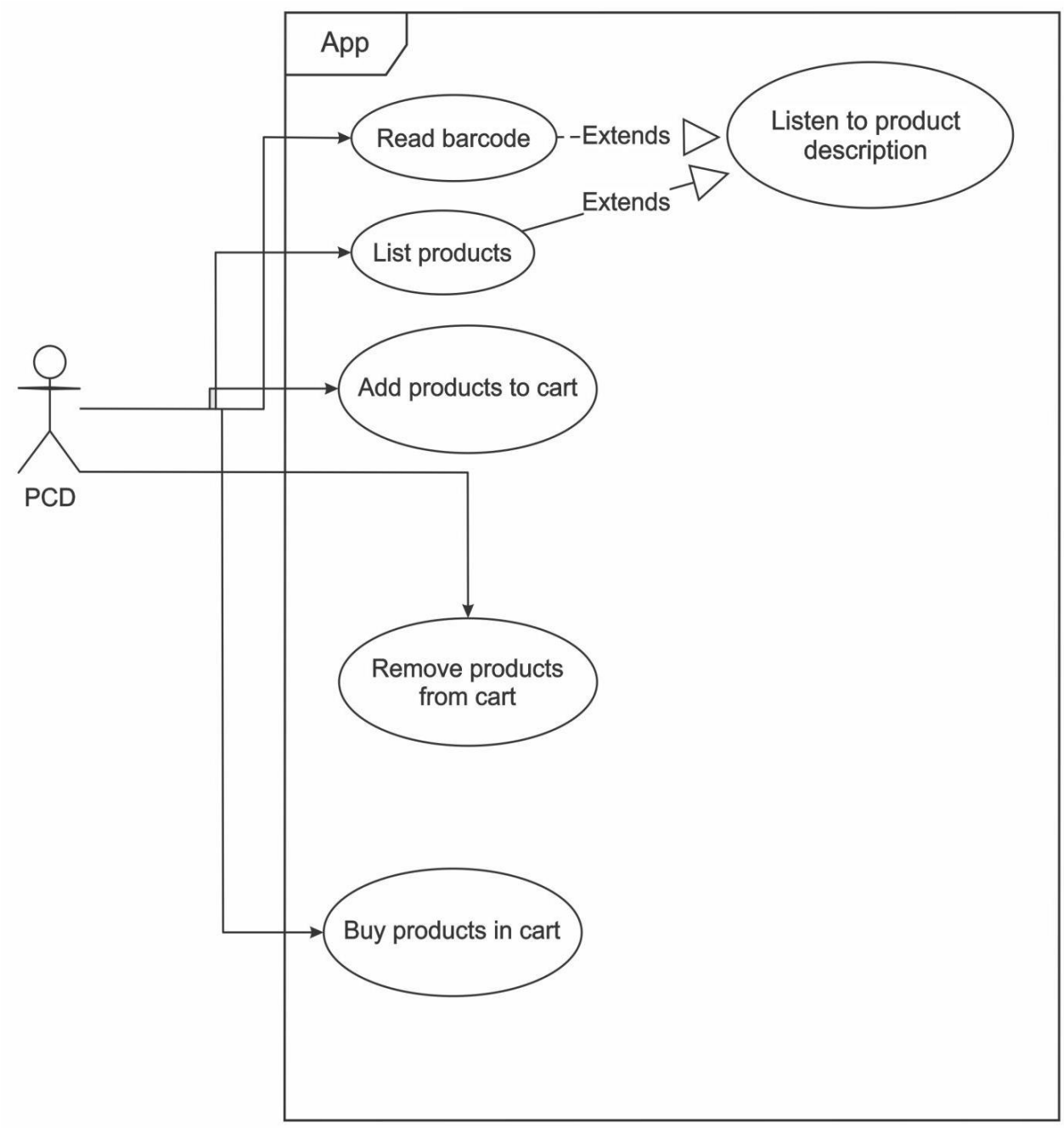
Figure 3 – Diagram of Activities Performed in the App



Source: Own Authorship (2020)

In the Use Cases diagram the actions that the user can perform within the app are presented, among which are the reading of the barcode, QR Code, and the products list (Figure 4). To these items, the listening functionality to the product description is extended, which is of utmost importance to the app target user.

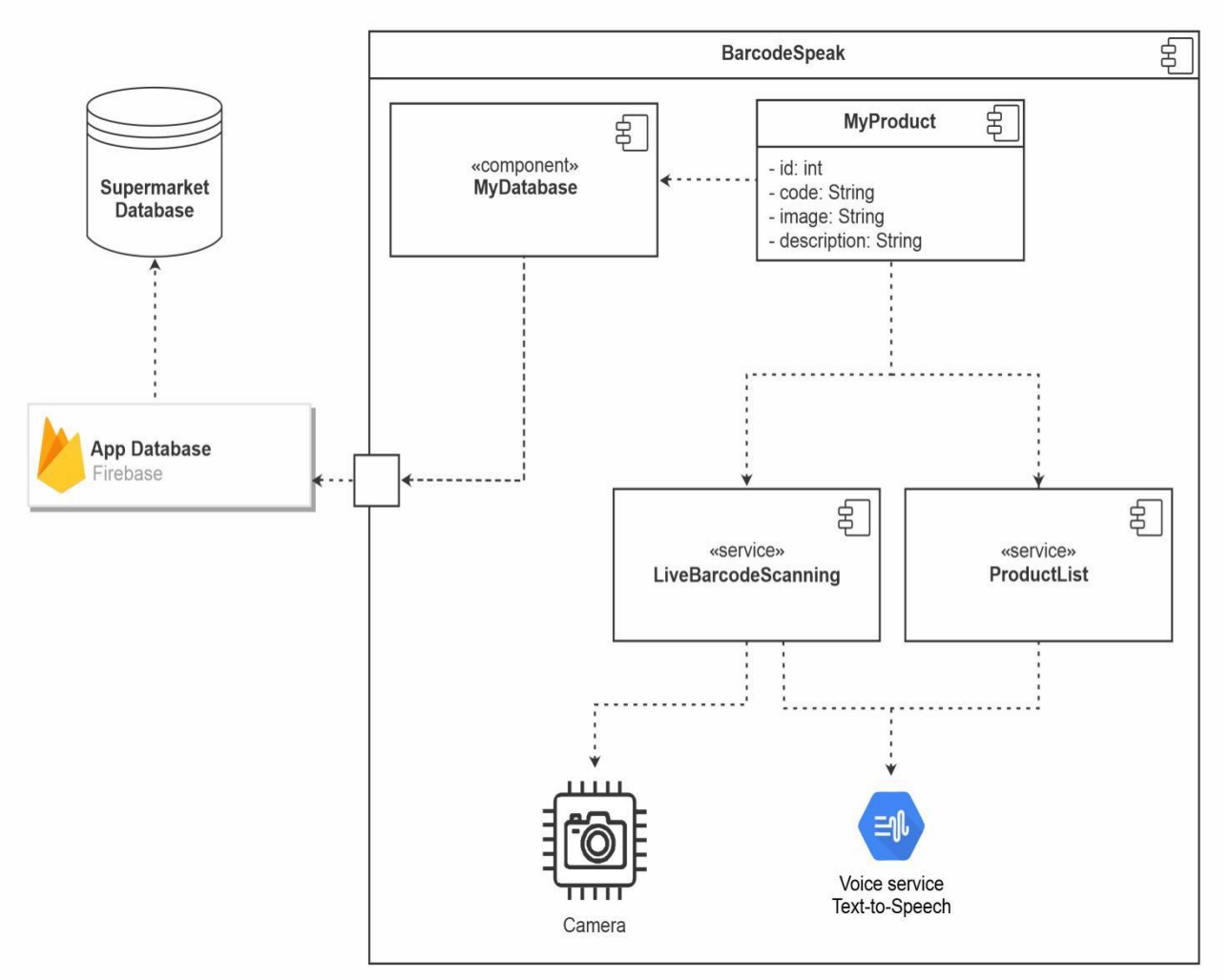
Figure 4 - Use Cases Diagram



Source: Own Authorship (2020)

The app flow technique requires access to the database (e.g. library, supermarket, pharmacy) in which the user is present; the items are registered in the app's database hosted in Google Firebase (Figure 5). The app has a connection to Firebase, which is represented in the image as "MyDatabase". This component provides communication with the other components of the app and transports the product data, which is loaded into an object with the details. The object is represented by "MyProduct", which has the fields: 1) ID, field of type integer that stores the product identification for queries within the app; 2) Code, field of type String (text) that stores the product barcode for queries, using the camera to scan the products; 3) Image, stores the address in which the product image is stored in the database; and 4) Description, where the text with the product description to be read by the voice service to the user is located.

Figure 5 - Components Diagram Showing the Application Flow to the Database



Source: Own authorship (2020)

The "LiveBarcodeScanning" service is responsible for making the communication of the smartphone camera with the barcode and QR Codes reading service, turning them into a scanner. The voice service is also inserted, which, when scanning and searching for the product in the database, returns the product description by the service that transcribes text to voice. Finally, the "ProductList" service, which lists all the products available to the user, containing the description and communication with the mobile voice service.

Pache et al. (2020) developed the Speakcode App for "reading and transcribing the content of QR codes into audio", which allows the visually impaired user to identify products and objects previously marked, making it easier to perform everyday and professional tasks. The main difference between Barcode Speak and Speakcode applications is in the possibility for the user to choose products in the shopping cart and to opt for home delivery, bringing more comfort and convenience, speed, and eliminating attitudinal barriers in external environments to the visually impaired group, especially in a pandemic scenario, as caused by COVID-19. The delivery type of food delivery has been a trend to prevent consumers from being exposed to diseases (SEBRAE, 2020).

For Santomé (2013), the barcode and QR Code readers are among the technological resources that help access information, influencing the way people learn, work, relate and live. However, it is important to note that the QR Code has a greater capacity to store characters, a fast reading code, and the possibility of being scanned from different angles (bidirectional) (LIAO; LEE, 2010).

As a connection between the physical world and the digital world, the QR Code becomes very effective in various sectors of society and the market, such as in brand promotion, social networks, advertising, payments, among other features performed (LANE, 2016), mainly by mobile devices, such as cell phones and tablets. Added to these applications are the use in location instructions, menus, purchase of electronic tickets, among other services. This way, it is highlighted the importance of the use of communication tools with quick answers in the daily life, especially for the instantaneous information and for being of easy access, becoming an alternative to meet the specific needs of the person with visual impairment.

However, even though people with visual impairment have shown great satisfaction in using mobile applications to perform daily activities, there is still the need for improvements of existing applications and the development of new applications (CROSSLAND; SILVA; MACEDO, 2014; GRIFFIN-SHIRLEY et al., 2017), considering the recommendations for designers of mobile applications for people with disabilities of the WEB WORLD WIDE CONSORTIUM (2015) and the particularities of people with low vision and blind people.

This study indicates that there is still a way to go in order to decrease the people with visual impairment exclusion and the freedom to come and go safely, and the choice of autonomy practice, as provided in the current legislation (BRASIL, 2015). According to Maffei et al. (2019), accessibility tools impact on improving the quality of life of this portion of the population, since access to technology contributes to the social inequalities.

There is a vast field to be explored for technological solutions to become, in fact, an effective and integrated alternative for access to society in various aspects. According to Bersch (2008), it is by means of technologies that the functional abilities of the person with disability are increased, allowing the decoding of a series of products and services which are essential for a more inclusive and independent life routine.

3.2 Public Policies to Encourage the Use and Development of Assistive Technologies

It is observed that most Brazilian companies do not invest in the adequacy of their labels and packaging with the purpose of serving people with visual impairment (GOYA; CARRARA; ANDRADE, 2015), since there is no specific legislation and with sanctions on accessibility in product labels and food in Brazil, as occurs in the legislation of medicines.

For this scenario change, public policies implementation favoring inclusion need to be effective through governmental responsibility initiatives, enforcement actions by legal sectors, social and political movements organization that supervise and propose regulatory actions and effectiveness of Brazilian legislation, especially with regard to the right to accessibility. Considering this study results, we see it as urgent to discuss, propose and claim advances in specific legislation that deals with the auditory identification (barcode or QR Code) of available products in the market.

Government initiatives, such as the Connected Citizen Project, which aims to "promote digital inclusion through the acquisition of IT solutions consisting of computers, computer programs (software), and technical assistance" (BRASIL, 2005), helps to reduce the digital exclusion, which more directly affects the low-income population, illiterates, indigenous people, the elderly, and people with disabilities. According to the United Nations Organization (UNO), about 82% of people with disabilities live below the poverty line in the world. In developing countries, such as Brazil, 400 million people with disabilities live in precarious conditions. Thus, there is a direct and reciprocal relationship between poverty and disability (HAZARD; GALVÃO FILHO; REZENDE, 2007). These data reiterate the need for the development of applications to contribute to the exercise of citizenship by people with disabilities.

4. Conclusion

People with visual impairment, as in the case of other disabilities, face obstacles, barriers which produce disability conditions which could be minimized or even suppressed with a set of assistive technologies. Among the restrictions, we highlight the attitudinal barriers, architectural and physical barriers of access to environments, barriers in communication and information which produce unequal living conditions for people with disabilities in society. This inaccessibility is also a result of the absence of technologies capable of suppressing the existing barriers in the daily life of these people.

From the idea that every person has the same institutionally constituted right, in order to have the effectiveness of the right to human dignity guaranteed, based on the safety of the exercise of social and individual rights, freedom, safety, development, equality and justice, it is observed how necessary it is to develop resources and technologies which may contribute to the social inclusion and citizenship of the population with visual impairment. This population requires a set of adjustments in services, information, products and social interactions, which the technologies development and improvement may provide.

Although it has expanded its participation, claiming its rights in society and with a high consumption potential, the person with disability makes up a part of the market which experiences many access restrictions. Even in the face of a growing niche in the market and with very relevant advancements for society in the discussions on diversity and inclusion, studies referring to the attendance to the specific demands of the person with visual impairment are still very reduced, especially in the access to market goods and services.

The legal literature also has few discussions about the behavior of the consumer who has visual impairment and its consumption relations. Thus, expanding research and development of assistive technologies is essential to provide accessibility and socio-cultural and citizen inclusion to this audience.

Barcode Speak App meets this opportunity, not only bringing people with visual impairment closer to the consumer market, but also trying to eliminate attitudinal barriers imposed in the streets, public spaces and other structures, promoting safe and convenient product delivery service at the user's home, a business trend worldwide, especially in the period of the new coronavirus pandemic.

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