Chapter 14
Assistive Technologies in Function of Visual Impaired Person Mobility Increases in Smart Shopping Environment

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14.1 Introduction

Continuous development of modern information–communication (IC) solutions and services contributes to the development of functionally efficient assistive technologies. Assistive technologies represent the application of information and communication in easier mastering the everyday living and needs of persons with disabilities (free time, business, and sporting activities, etc.) [1]. Visually impaired persons require adjustment of IC solutions and services because of a specific form of visual damage and methods which they use in moving in the external and internal environment [2]. User requirements represent the starting point in defining the functionality of IC services that are designed for visually impaired persons; therefore, this research was conducted on students with visual impairments, University of Zagreb. The aim of this research is to show the possibilities of IC technology in the function of the increasing mobility of visually impaired persons during daily shopping. With the above solution, it is possible to increase the degree of the user quality of life and their easier integration in society. In this work, Society 5.0 characteristics are also shown as a possible concept of future services of assistive technologies.

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14.2 Previous Research

Research in this area covers the topic of assistive technologies application in shopping processes for visually impaired people. It was also published a patent of smart shopping carts customized for visually impaired people during the shopping process [3]. In the above patent, shopping cart does not have the ability to guide and direct the user to the requested goods, but according to the sensor, user information is performed so he knows if he is on a good route. For obstacle detection, the use of the camera is stated or *Lidar* system and they are installed on the shopping cart. During the detection of the obstacle, via vibrating motors and loudspeakers on the handle of the shopping cart, the user is notified that he must change the direction to avoid obstacle. This mode of operation increases user stress because if he does not change the direction there will be a collision with the obstacle thereby jeopardizing the safety of movement. Proposed solution does not also specify the possibility of shopping cart location when user enters the shop, nor what will happen if the user moves away from the shopping cart during the shopping. Moreover, there is no goods verification system (e.g., product in bulk quantity determination, like fruit and vegetables) and the possibility of scanning of goods when placing in the shopping cart. Product detection on store shelves it is possible to use portable solutions located on the body of the user (finger) [4]. That concept is described in the form of the solution which is implemented on finger or arm in the form of bracelet. Navigation and guidance of user additional aids are used, such as a white cane or guide dog. The survey describes the presentation of different solutions on the market which were represented for the past 10 years [5]. Described solutions: *RoboCart*, *ShopTalk*, *GroZi,* and *iCare* and they base their work on contemporary IC technologies and have the possibility of user navigation and detection of the goods. *RoboCart* represents solutions in the form of shopping cart that enables user navigation across the shop based on RFID labels while for obstacle detection it uses laser sensors. Product search on the shelf takes place using the scanner for barcode, which is mounted on the shopping cart, or connected wirelessly, which user leans on the shelf to find the desired product. Shopping carts have built-in *Belkin* keyboard, which emulates function of classical keyboard for mobile phones by which the user enters next product to which he wants the shopping cart to take him. *ShopTalk* presents system for user navigation in the shop and product detection on the shelf which is based on scanning barcodes on shelves. It is based on the use of MSI type of barcode which represents topological markings for navigation and goods detection, and they are connected in BCM (Barcode connectivity matrix). The solution consists of barcode reader which is connected on OQO portable computer which user carriers in the form of a backpack. A keyboard worn by the user on the shoulder is connected to it. This type of solution is not suitable for users because it requires additional preparation before going to the shop, by putting this type of solution on itself. Also, it is not described in the method of detection and the way of avoiding obstacles, so the user must carry a product basket. *GroZi* represents the solution in the form of a user bracelet, which allows product detection using cameras

to record the product on shelf, and via a portable device which the user carries on his back in a form of a backpack, analyzing the image from the camera. When the product the user is looking for appears in the image, using vibrating motors in the glove, the solution signals to the user that the product is on the shelf. Once the product is detected, the solution guides user toward the product by informing it about the direction with vibrating motors. Such a solution requests from the user that using glove constantly records the shelf in front of which it is located. The user can create a list by the website, which is then loaded on the portable device. *iCare* presents the solution that also includes the glove, containing an RFID reader which links to the database via Wi-Fi network. When the customer, with the help of the glove, passes in front of the part of the shelf on which the product is located, he gets the information about product department on which it is located, via PDA (Personal Digital Assistant) device. When the user receives the product, he gets additional information about it based on RFID tag located on the product. The main purpose of this solution is browsing products that are in the store. For the purpose of product detection using mobile devices (MD), it is possible to use photography functionality of different barcodes or QR codes, and through the application on MD perform verification of these codes in code database [6, 7]. In the addition to the possibilities already mentioned for products scanning, detection can be performed using specially designed Barcode Pencil device. The concept also uses specially designed device Barcode *IDBlue Pen* for scanning RFID tags [8]. The buying process can be divided on the preparation of the shopping list, user navigation in the store, and product detection on the shelf [9]. List preparation represents useful possibility for the user because most people with visual impairment prefer to use premade list when shopping.

14.3 Defining User Requirements in the Shopping Process

User requirements during the shopping process are defined on the basis of conducted research among the target population of student-age users. The research was conducted at the University of Zagreb where, according to the official data, the Office for Students with Disabilities has 40 students with visual impairments, who has active student status. Approach to respondents was organized with the help of a coordinator for students with disabilities. In this research, population includes 34 students with visual impairments who were able to access the survey. They are members of the Up2Date association. In survey questionnaire, 34 respondents of which 18 males and 16 women participated. Most respondents are between the age of 18 and 25, 17 respondents are blind, and 17 visually impaired (Table 14.1). The data were analyzed by the IBM computer program SPSS Statistics 21.

To the question "How often do you do the shopping?" 47.1% of respondents responded that they go shopping several times a week, 38.2% of respondents go shopping several times a month, 11.8% of respondents never make purchase in the store. To the question "What bothers you the most while shopping at the store?" 22

Table 14.1 Age of respondent

Age of respondent	Frequency	Percentage
18–24	23	67.6
25–29	10	29.4
30–39	1	2.9
Overall	*34*	*100.0*

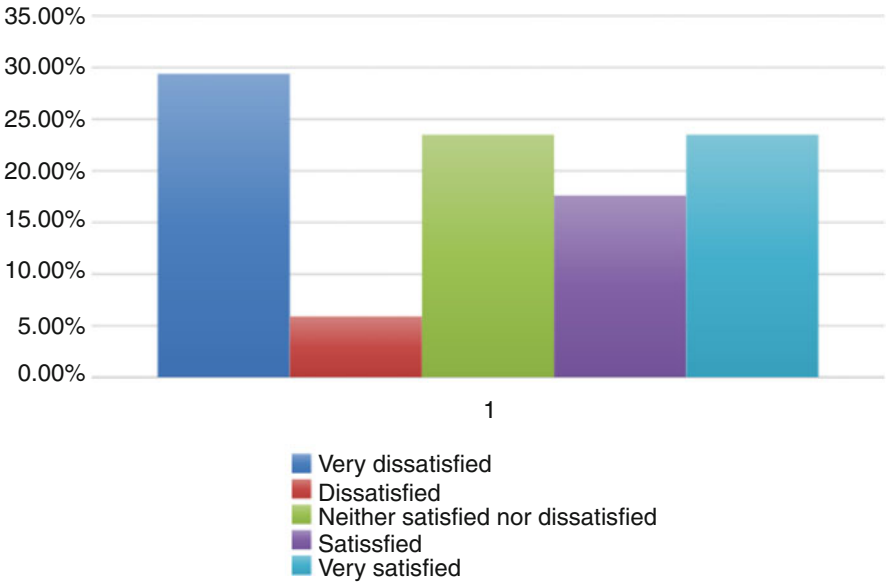

Fig. 14.1 Satisfaction of independent shopping

respondents responded that they are most disturbed by the external disturbances, 9 respondents as the greatest obstacle see misunderstanding by the other buyers, and 7 of them misunderstanding by the employers. Those respondents who independently perform shopping in 29.4% cases claim that they are very dissatisfied by making self-purchase; 5.9% of respondents are dissatisfied while 23.5% of respondents are of neutral status. Satisfaction with the independent shopping expresses 17.6% of respondents, while 23.5% of respondents are very satisfied, Fig. 14.1.

The highest percentage of blind and visually impaired persons (35.3%) is neither satisfied nor dissatisfied by the care of stores for them during the shopping. Still, 29.4% of respondents are satisfied with store care about blind and visually impaired persons and 8.8% of them are very satisfied; 11.8% of respondents are dissatisfied; and 14.7% of respondents are very dissatisfied with the store care for blind and visually impaired persons. Data processing showed that 60.7% of respondents have a habit of shopping always the same product and if there are no desired products, 76.5% of respondents have the habit of shopping a similar product. To the question

"Do you use possibility of product delivery to avoid going to the shop?" 76.5% of respondents answered that they do not use the possibility of product delivery and 23.5% of them use the possibility of product delivery. Of the total number of the respondents who use product delivery, 12.5% of them are very dissatisfied with the service provided, 50% of them are satisfied and 37.5% are very satisfied with the service provided; 20.6% of the respondents use product recognition application and 79.4% do not use those applications. Respondents mostly use *TapTapSee* (83.3%) and *BeMyEyes* (16.7%) applications. Sensor technology is reliable for 76.5% of respondents and 82.4% of the respondents would use the shopping cart based on sensor technologies; 76.5% of respondents use the possibility of contactless bill payment in stores. However, 17.6% of respondents consider very insecure the possibility of linking the mobile phone with the shopping cart, 5.9% insecure, and 14.7% are neutral; 41.2% of respondents consider that the possibility of linking the mobile phone with the smart shopping cart is secure and 20.6% very secure. The highest number of respondents (46%) states the sound as the desired method of obtaining feedback; 33% state an enlarged font, and 21% vibration as desired mode of obtaining feedback.

Considering the importance of feedback (Fig. 14.2), information about obstacles is important for 38.2% of respondents and for 29.4% it is very important. Information about store location is important for the highest number of respondents (47.1%). Route information, location of desired products, and choosing the right type of products, in most cases respondents consider important (41.2%). However, in relation to the three variables, a slight advantage is given to information, which allows them to choose the right type of product (35.3%), then information about desired products location (29.4%) and route information (17.6%). Most respondents take neutral position toward the importance of information about the possibility of

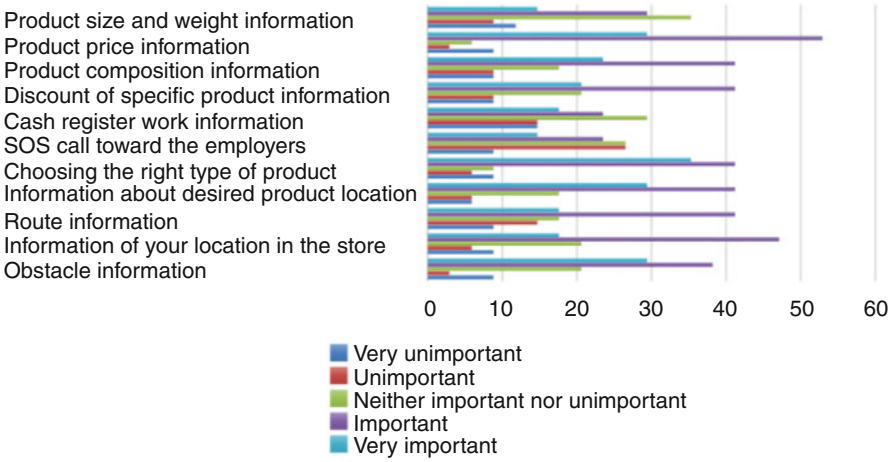

Fig. 14.2 The importance of information during purchase

SOS call toward employers, information about cash register work, and information about product size and weight. Furthermore, discount of specific products information and product composition information are important for respondents (41.2%) as a product price information (52.9%).

For the question "Do you agree that our solution will help you when performing independent purchase?" 20.6% of respondents think that solution will not help them at all when performing independent purchase, while 26.5% of them think that it will help them and 23.5% think that will completely help them while performing independent purchase. Most respondents, 44.8% of them have neutral attitude toward usefulness of education in using smart shopping cart and mobile application; 31.00% of respondents think that education will not be useful at all and 13.8% of them think that education will be useful in the use of shopping carts and mobile application. Respondents would, to the greatest extent, access online education (50%), group education (31.2%), and individually (3.6%); 14.3% of respondents would not attend education. Based on the results obtained, user requirements are defined as well as the information required for navigation system design and information of users during shopping, as shown in Fig. 14.2.

14.4 Proposal for a Conceptual Architecture of the Navigation and User Information System in the Smart Shopping Environment

The architecture of the proposed system is based on *Cloud Computing for the Blind concept–CCfB* that provides the user with the ability to manage the data necessary to achieve all the functionalities of the proposed service [10]. The proposed system consists of a mobile application and specially designed shopping cart equipped with sensor technology. Based on the conducted research, the functionalities of the system were defined. The defined functionalities aim to facilitate the process of independent shopping for visually impaired users. The architecture of the system is shown in Fig. 14.3, and it contains the following elements: CCfB, the users MD on which the required application is installed, a shopping carts equipped with sensors, a user database and a store database, Indoor Positioning System (IPS) for indoor navigation, and a point of sale (POS) device for credit card payments.

Communication between a user's MD and a shopping cart belongs to the Machine-to-Machine (M2M) mode of communication. It is performed by using Bluetooth technology, which represents an open wireless technology standard for data transmission. Communication between the devices works by transmitting radio waves in the frequency range from 2400 to 2485 GHz, better known as the industrial, scientific, and medical frequency band (ISM), for the use of which no payment of a concession is required thus making this standard widespread and accessible to users. Bluetooth 4.0 BLE technology version is used for M2M communication in the Internet of Things (IoT) and Ambient Assisted Live (AAL) concepts. Its

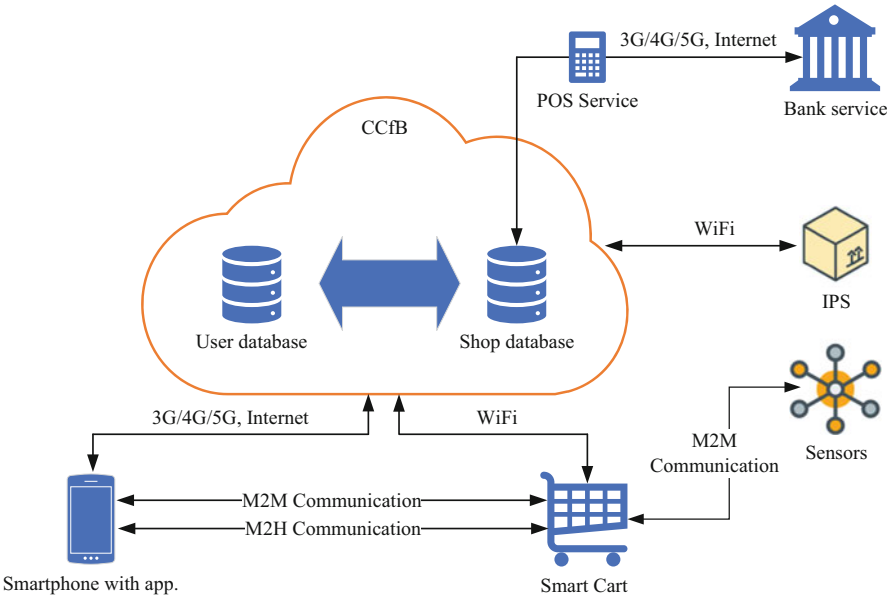

Fig. 14.3 Conceptual architecture of the navigation and user information system in the smart shopping environment

main advantage is the reduced energy consumption when connecting devices and exchanging a small amount of data [11].

In addition to wireless mode, M2M communication can also be performed by a wired connection. This form of connection is used in the communication of shopping carts with built-in sensors because it provides security against interference during data transmission, which can occur in wireless communication. Sensors built-in the shopping cart are used to collect data from the environment in which shopping carts are located. Data are collected and processed in the central processing unit located on the shopping cart, which then performs certain activities based on the collected data.

Communication between the user and the application that is installed on the user's MD and communication of the user with the shopping cart belongs to the machine-to-human (M2H) mode of communication. This form of communication allows the user to receive the right information at the proper time, and the presentation of received information can adapt to his type and degree of disability. The mobile application allows the visually impaired user to receive feedback via a text-to-speech synthesizer (TTS) that works on a combination of application and MD hardware for the artificial reproduction of the human voice. The information can also be displayed with certain design modifications in the form of font and different background and text colors that will make it easier for a partially blind user or users with other visual impairments such as color blindness to read information.

The feedback that the user receives from the shopping cart can be in the form of sound signals of different frequencies. It will signal to the user a certain level of danger, for example, when encountering an obstacle when moving through a store or signaling the successful completion of a certain action such as scanning a product when placing a product in the cart. Obtaining information in the form of sound signals is enabled through the functionality of an MD. After performing a specific action that triggers obtaining audio information, shopping carts signal the application to notify the user.

Feedback in the form of vibration informs the user about the arrival at a certain destination, the way of the turn when moving through the store, and when avoiding obstacles. There are built-in vibration motors on the handle of the shopping cart, one on each side of the handle that can be activated as needed. For example, if it is necessary to make a left turn, the shopping cart will inform the user about that action by activating the vibrating motor located on the left side of the handle. Another example is that when arriving at a destination, the shopping cart can activate both vibrating motors to notify the user of the stop.

User account information is stored in the user database. The data are stored after successful user registration, and once stored, the data can be later edited by the user if necessary. In addition to user account data, the database also contains data on created shopping lists and purchase history. The store database is divided into a part that contains data of products that can be found in a store, a part that's connected to the shopping cart, and a part that stores data on purchases made. The part of the database that is connected to the shopping cart contains a temporarily stored shopping list that is transferred from the user's application and a created shopping bill that updates when a new product is placed in the shopping cart. The user can access the store database with his application, but only to the part where the data about the products are stored. The user needs that data when he is creating or editing the created shopping list. To access the product database with his application, the user must have an Internet connection. He can make that connection by using a mobile data network (3G, 4G, 5G) or wireless networking (Wi-Fi). Shopping carts gain access to the database with wireless networking technology (Wi-Fi), provided to them by the store itself. IPS system is based on the following technologies: Bluetooth BLE, Wi-Fi, NFC (near-field communication—NFC), and RFID (radio-frequency identification). It represents a network of devices like wireless access points, Bluetooth beacons, RFID tags, and NFC tags that are connected to enable users to locate and navigate indoors [12].

14.5 Functionalities of Navigation and User Information Services

14.5.1 The Functionality of Smart Shopping Carts

The functionalities of shopping cart are defined on the basis of conducted research, so as to facilitate the process of self-purchase for visually impaired and provide a new shopping experience for the non-visually impaired people.

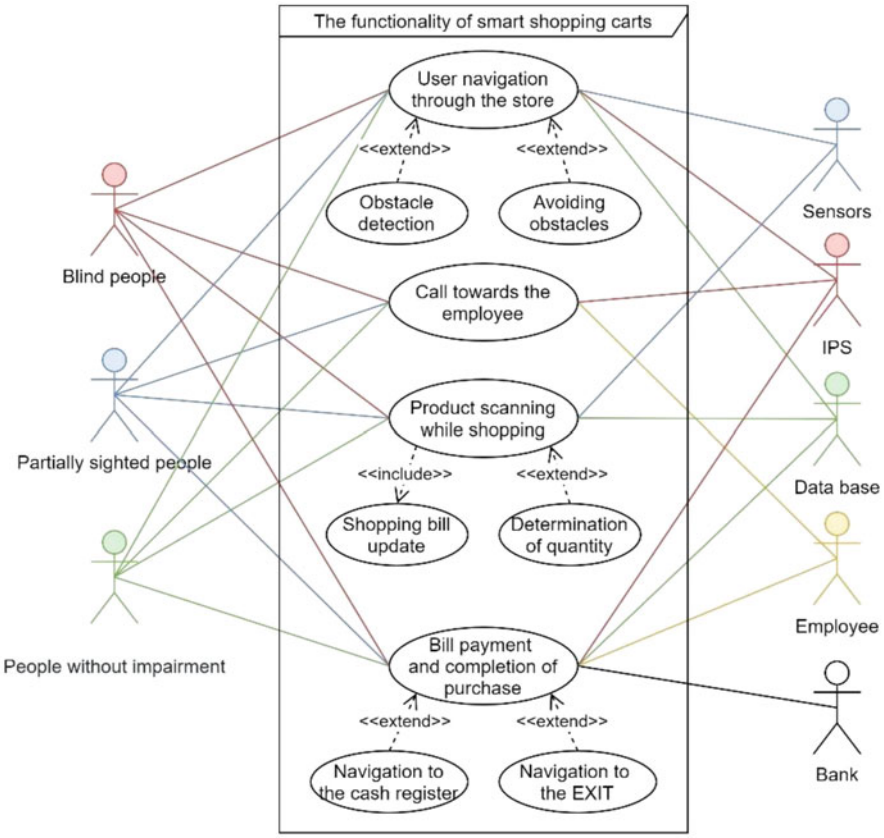

Fig. 14.4 Use-case diagram of shopping cart functionality

According to Fig. 14.4, the following functionalities are shown: user navigation by store to a specific product that includes obstacle detection and avoidance processes, the ability to call an employee by pressing a button on the cart, product scanning when placing a new product in the cart, control of the quantity of products placed in the cart, and navigation of users to the cash register and exit from the store.

User Navigation Through the Store

Shopping cart allows the user to safely and reliable move throughout the store without the use of aids in the form of a cane or a guide dog. The cart moves at a user-friendly speed and performs the processes of detection and avoidance of obstacles and enables the easier finding of products as well as customer orientation within the store itself (Fig. 14.5).

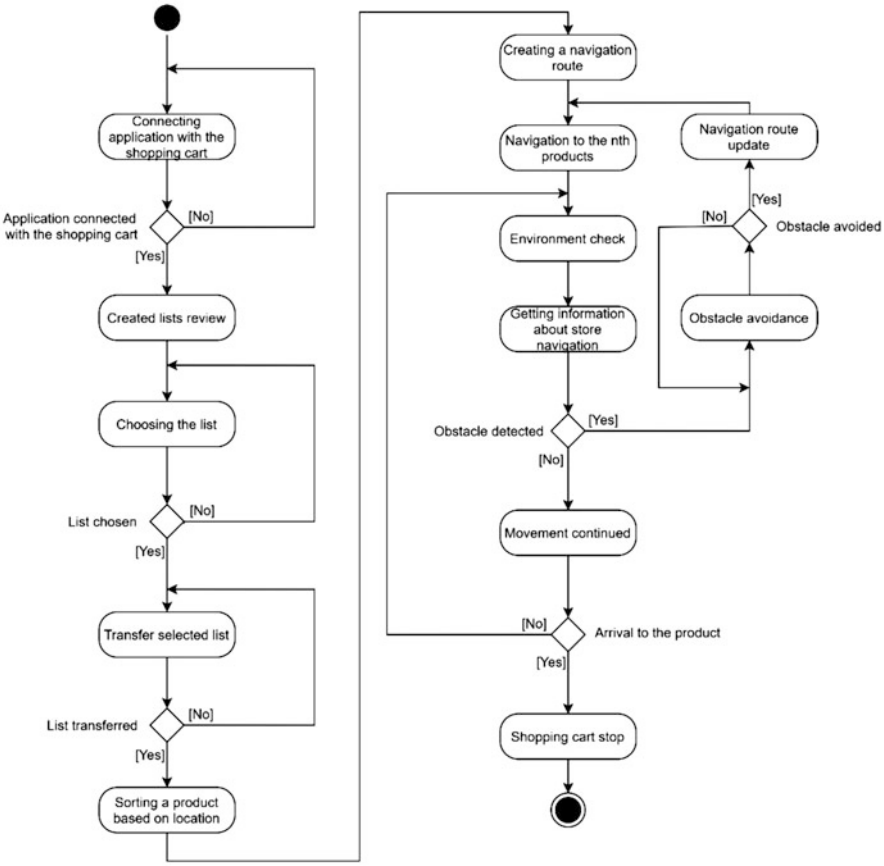

Fig. 14.5 Activity diagram for user navigation through the store

Once the connection between the MD and the shopping cart is completed using the Bluetooth technology wireless connection, the user will select the previously created list of products he wants to use through the application. The created list from the user database will then be transferred to the shopping cart and they will store it in the part of the store database to which they have access. The products on the list stored in the store database will be sorted depending on their location and after sorting the products, the locations of the products on the list will be forwarded to the IPS system for determining the route of movement through the store. When the route creation is complete, the information needed to navigate the cart to a specific product will be passed between the IPS system and the shopping cart. Before the cart starts moving, the sensors built into the cart start the process of checking the environment near the shopping cart to detect obstacles that may appear on the predetermined route. The shopping cart then starts moving along the route provided by the IPS system and through the application they pass the information to

the user about his movement through the store. When moving through the store, the user may encounter movable obstacles in the form of other customers and their carts, and immovable obstacles in the form of shelves, product pallets, carts left by other customers, or products that have fallen off the shelf. In order that cart can identify the various obstacles encountered, a camera was built into the front end of the cart. The camera scans the environment and forwards the recording to the microcomputer located in the central processing unit of the cart, which then processes the recording and makes a conclusion about the obstacles type encountered by the user. Once the type of obstacle has been identified, the cart performs the obstacle avoidance procedure and the movement route is updated because there is a possibility that the obstacle directly affected the route that was previously defined.

Call Toward the Employee

If the user is in a situation where he needs the help of another person or when he wants to be further informed about some things in the store, he was given the option of calling the employee. When the user selects the option to call the employee at the info desk, the application starts searching in-store database for the number needed to establish a call, and then the application establishes a VoIP (Voice over Internet Protocol—VoIP) call between users mobile device and mobile device on the info desk.

Product Scanning While Shopping

Inside the store, the user can find two types of products, products already packaged and products in bulk condition, such as fruits and vegetables. Packaged products are marked with RFID tags. Tagging products with RFID tags allows users to scan products more easily, as opposed to using a barcode, because there is no need to lean the product on the tag reader itself as is the case with the barcode. Once the user successfully arrived with his cart to his destination and by destination meaning a product from the list and after detecting and taking the product from the shelf, he puts the product into the cart. In the case of a packaged product marked with an RFID tag, when placing the product in shopping cart RFID tag reader will scan the product and will give a user an audio signal through the application notifying the user of a successful product scan. The information about the scanned product is going to be shown on the user's mobile device screen display and the user is expected to confirm the product entry to avoid the possibility of taking and purchasing the wrong product. After the user confirms the product, the current state of the user's bill is updated, and the updated tab balance is displayed to the user through the application. If the user puts the products in bulk state in the cart a change in weight will be detected using a scale located on the bottom of the cart. While creating a product list, users are expected to define the amount of product they want to buy. When placing a bulk product into the cart, the cart will compare the achieved

weight in the cart with the weight on the stored list in the store database. The cart will inform the user through the application about the currently achieved weight of the product. After reaching the weight on the created list, the user will be shown a notification that the desired weight has been reached and he will be required to confirm the entry of the product.

Bill Payment and Completion of Purchase

After the user puts the last product in the cart, the user will receive a notification through the application which they must confirm to complete the purchasing process. After confirmation, a final tab is created, which is then stored in the store database and the user database. The users are then shown the menu where they select the payment method. The user is offered two options, going to the cash register, and paying by cash or credit card, or payment through the application.

When the user reaches the cash register, he is expected to show the employee the QR code on the mobile device. The employee scans the displayed QR code and the user can pay the bill in cash or by using a credit card. Once the payment is made and the employee confirms that the user has paid the bill, the store system that is connected to the cart sends the user an information that the payment has been made and that they can leave the store. The cart then requires the route toward the exit from the IPS system and guides the user toward it. For the user to avoid using the cash register, he is given the option of paying through the application. The condition for using this form of payment is that there is stored information in the application about a credit card that the user wants to use when making a payment. Once the user has selected this payment method, they are expected to select which credit card they will use, if more than one is stored in the application. Once the card is selected, a form for payment is created and automatically filled in with credit card information and the amount on it, and an online transaction is made through the application. After the transaction between the application and the bank is successfully completed, the user will receive a notification about the performed transaction. The application notifies the cart that the transaction has been done and the cart then requires a route to the exit from the IPS systems and guides the user to the exit.

14.5.2 The Functionality of Mobile Application Services

Based on the obtained results of the conducted research with the target user population, the functionalities of the MD application service were defined (information provided to the user of the system). The following basic functionalities of the application are defined: creating an account that includes registration and login, creating a list of products, detecting products on the shelf, locating shopping cart at the entrance, locating carts during shopping, and receiving SOS notifications. In addition to the listed functionalities of the application, additional functionalities

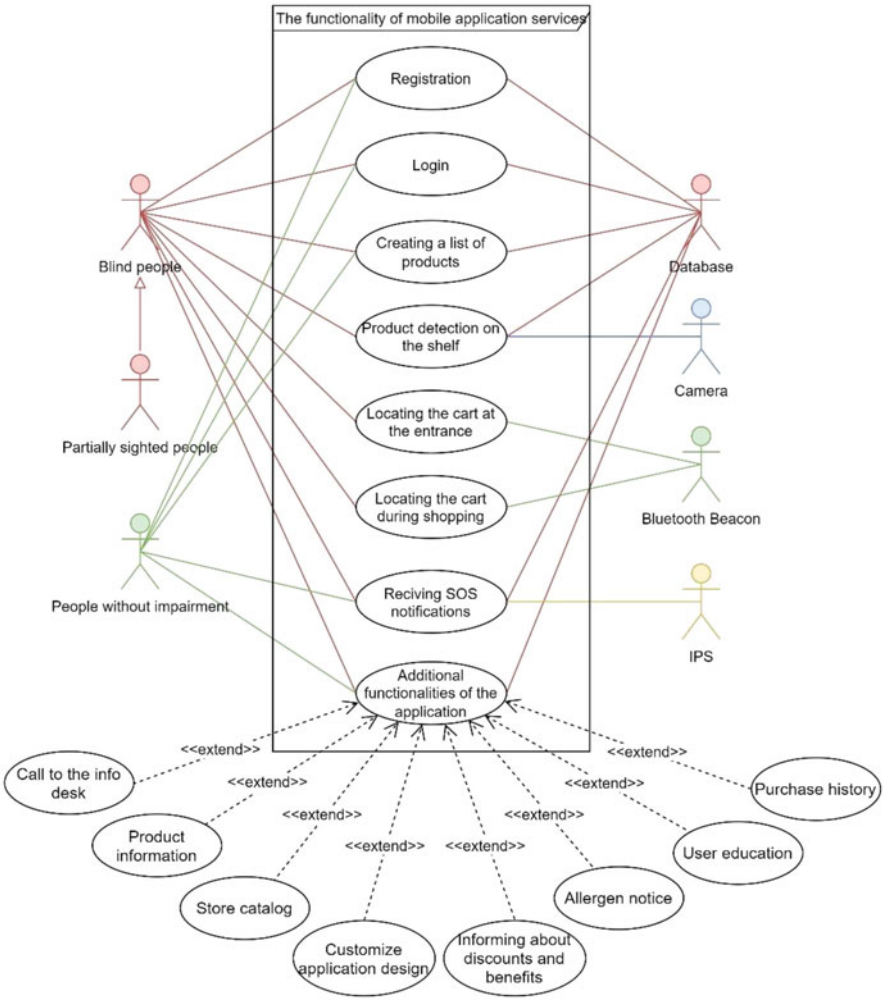

Fig. 14.6 Use-case diagram of mobile application service

can be included: call to the info desk, customization of the application design, product information, information on discounts and benefits, store catalog, allergen notification, user education, and purchase history, as shown in Fig. 14.6.

User Registration

After the installation is completed, the user is expected to create a user account, i.e., registration. When registering, it is necessary to enter personal data such as name, surname, password, and email. In addition to personal data, the user is required

to enter their disability status, because on this basis it is possible to adjust certain functionalities of the use of the application itself. Entering disability status will enable blind and partially sighted users to have a talk-back function. Besides the talk-back function, for visually impaired users, the application allows to select the color and font size as well as the background colors to make it easier to use the application.

After entering the type of disability, the user will have the option to choose if he is allergic to any ingredient. If a user indicates that he is allergic to certain ingredients, each time he enters a product on the shopping list that contains an ingredient that is labeled as an allergen, he will receive an information notice stating that the allergenic ingredient is in that product. Except for paying at the cash register, users are also able to pay the products using the application. Payment using the application requires the user to enter information about the cards with which he wants to make a purchase. Data entry is possible during registration or later within the application. The data required for this type of payment: card type, name, surname, card number, card validity, i.e., month and year of card expiration, and CVV/CVC code (card verification value/code). Once these data are stored within the user database, the user will be able to pay via the entered cards.

Creating a List of Products

Using the application, users can create and edit a list of products before going to the store. The user will be shown in all the necessary information about the products, i.e., the ingredients, price, weight, etc., which will help him decide on choosing the type of product. If the user selects a product that contains an allergen, which he defined during registration, he receives a warning. Furthermore, adding a product to the list will automatically calculate the price of all chosen products to get information about the future cost of the purchase.

Product Detection on the Shelf

After the shopping cart has brought the user to a specific location, i.e., place where the product is located, it is necessary to detect the product on the shelf. After the user selects the product detection option, the camera is turned on. Then, the user takes a picture of the products using the camera on the mobile device. The input data in the form of an image from the camera are obtained, which are compared with the data from the list of products, i.e., from the user database, which contains the image of the product itself, so the two images are compared. When the images match, the user receives an audible notification that the correct product has been photographed. After the user has taken the correct product, he selects the option to exit the camera on the application and the camera will turn off.

Locating the Cart at the Entrance

Just before entering the store, the user's task is to turn on the Bluetooth connection option on his MD. The reason for this is that there is a Bluetooth beacon embedded in the shopping cart, a small device that is powered by batteries. The moment the user with his MD is within the radius that the Bluetooth beacon is covering, it will detect the beacon signal and launch the application on the user's MD. Once the application has launched, the user will select the shopping cart locating option after which he will start receiving sound signals that will guide him to the cart.

Locating the Cart During Shopping

Functionality designed to help the user if he moves away from the shopping cart for any reason. When choosing a product from the shelf, there is a possibility of moving the user away from the shopping cart. If the user is too far from the cart, sound signals will be sent to the user to return to them.

Receiving SOS Notification

By sending an SOS notification, the user can be informed about an unexpected or dangerous situation in the store. The user needs to be protected in case of an accident, whether if it is a fire, flood, or some other dangerous situation. Once the store's security system sensors have detected the danger, the app will notify the user of the situation. Once the shopping cart is located, an evacuation route is created from the IPS system. Through the application, the user receives a notification about the danger and the cart safely leads him, according to the defined route, to the nearest exit.

Additional Functionalities of the Application

Their task is to make it easier for the user to use the application, inform the user about the products, and provide them with education. During registration, visually impaired people can customize the design of the application according to their own needs. By selecting the background and text colors, as well as the font size, it is easier for the user to use the application. The application provides the possibility of informing users about current discounts and benefits. At the moment when the product that the user often buys is at a discount, the user receives a pop-up notification on the MD screen via the application. Also, by selecting the option to display the discount and benefits in the main menu of the application, the user is shown those products that are currently at a discount, and their reduced price is displayed. Through the application, users are enabled to collect points with which they can gain additional benefits when making a future purchase, as well as to collect

points for participating in prize games, but these possibilities depend on the store itself. By opening the store catalog option from the main menu, the user can view the store catalog. By selecting a specific product, the user can find out details about the product itself, such as the composition of the product, price, weight, etc. In the group of additional functionalities, it is possible to educate users about the use of the service. The user can choose the desired way of education, online through the application or can apply through the application for group education organized in the store. According to the results of the survey and the wishes of the users, it can be held online or live with a group of users. Education is needed to explain to users the process of using the service, thus facilitating their purchase. During the group training, users can ask questions and get additional information about the service. An additional functionality of the application is the purchase history by selecting an option from the main menu. The user is given the opportunity to view the list of completed purchases, which can be sorted according to the desired criteria. By selecting the list, the user can see what was bought and how much money was spent.

14.6 Society 5.0

With the development of AT, new concepts of smart environments and Society 5.0, it is possible to raise the level of quality of life of people with disabilities and people with reduced and difficult communication skills. A sustainable ecosystem is a starting point in the integration of AT and the inclusion of people with disabilities in a smart environment in general (shopping, factory, education, etc.) [13]. It is also important to integrate science, technology, and innovation into the Society 5.0 area from a sustainable ecosystem perspective. In September 2015, the United Nations adopted the 2030 Agenda for Sustainable Development with the Sustainable Development Goals (SDGs) as its core. The goal is to achieve a comprehensive system in which all nations work together in a sustainable world that hopes to achieve economic development and address social issues. In such an environment, greater application of assistive technologies is possible, and greater involvement of people with disabilities in smart environments based on IoT technology. Figure 14.7 shows the concept of Society 5.0 and key technologies with 17 sustainable development goals.

Key IT technologies in Society 5.0 process and possible integration assistive technologies in smart environment are:

- Application program interface (API)
- Machine learning
- IoT
- Big data analytics
- Distributed ledger technology (DLT)
- Smart contracts
- Cloud computing

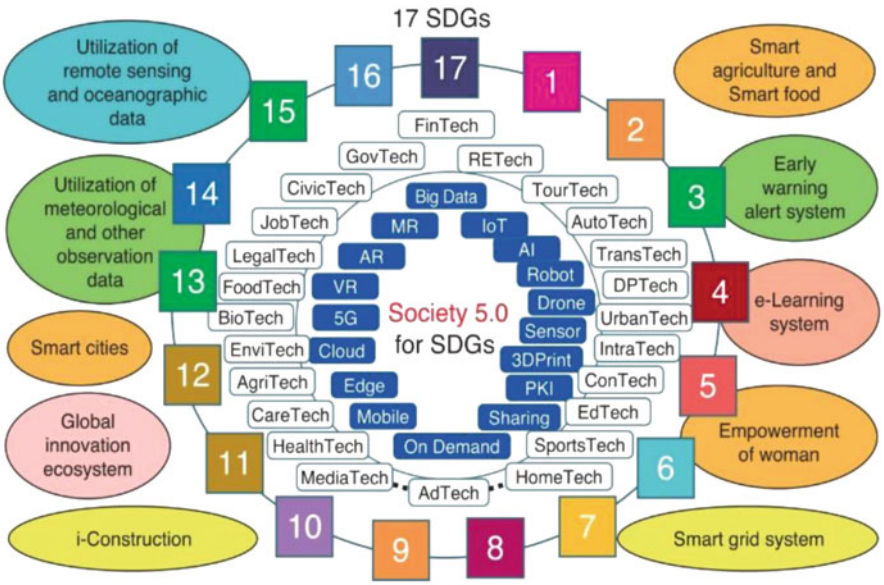

Fig. 14.7 Society 5.0 [14]

- Cryptography
- Biometrics

Quality of Life (QoL) stands as an important aspect in the field of Society 5.0. IC technologies have the task of raising the level of customer satisfaction in smart environments.

14.7 Conclusion

The conducted analysis of user needs defines the basic functionalities of the system of guiding and informing users in smart stores. A guidance system composed of smart cart elements and application services integrated in an MD aim to increase the mobility of blind and partially sighted people. Previous solutions are partial solutions as a form of assistance to blind and partially sighted people, while the presented solution represents the entire IC system as a department of assistive technology. This system architecture can also be implemented through the goals of the Society 5.0 environment as one of the key factors in the integration of blind and partially sighted people into the social context. By applying such solutions, it is possible to increase the degree of mobility and quality of life of each user, regardless of the type of damage.

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