Revista Iberoamericana para la Investigación y el Desarrollo Educativo
ISSN 2007 - 7467

https://doi.org/10.23913/ride.v11i22.897

Artículos científicos

Análisis de la utilidad del Bastón Blanco Inteligente UAEM para personas con discapacidad visual

Analysis of the usefulness of the UAEM Smart White Cane for people with visual impairment

Análise da utilidade da Bengala Branca Inteligente UAEM para pessoas com deficiência visual

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Resumen

El objetivo de la presente investigación es probar la utilidad del prototipo de Bastón Blanco Inteligente UAEM con sensores ultrasónicos (disparadores de alarmas y vibraciones) y sistema GPS (Sistema de Posicionamiento de Posición Global) para usuarios con discapacidad visual. La tecnología incluida en el Bastón Blanco Inteligente UAEM le proporciona al usuario con discapacidad visual diversas ventajas para ampliar su movilidad de forma segura, lo que en definitiva sirve para mejorar su calidad de vida. Sin embargo, su uso adecuado requiere de un entrenamiento especializado que ayude al usuario a obtener la utilidad que el prototipo promete. Para probar esos beneficios se efectuó un estudio exploratorio donde se analizaron las experiencias de entrenamiento y de consumo de 20 participantes adultos con discapacidad visual severa y ceguera. El análisis estadístico fue descriptivo, y permitió registrar la satisfacción de los usuarios ante las características físicas y los beneficios ofrecidos por el prototipo. Como resultado se observó la asociación entre las vibraciones, los sonidos y los diferentes mensajes emitidos (obstáculos diversos a pequeñas o grandes distancias). El Bastón Blanco Inteligente UAEM con sensores ultrasónicos y sistema GPS es un prototipo que ayuda a la movilidad segura y autónoma, lo que eleva la calidad de vida del usuario porque el dispositivo es ligero, plegable y su material es resistente; además, contiene aditamentos sonoros y vibratorios que proporcionan la simulación de un mapa físico a bajo precio.

Palabras claves: basto blanco inteligente, calidad de vida, discapacidad visual.

Abstract

The aim of this research is to test the usefulness of the UAEM Smart White Cane prototype with ultrasonic sensors (alarm and vibration triggers) and GPS system (Global Positioning System) for visually impaired users. The technology included in the UAEM Smart White Cane provides the visually impaired user with several advantages to expand their mobility safely and improving their quality of life. But the proper use requires specialized training to help the user obtain the utility that the prototype promises. To prove the benefits, an exploratory study was used to analyze the training and consumption experiences of 20 adult participants with severe visual impairment and blindness. The statistical analysis was descriptive where the users' satisfaction with the physical characteristics and benefits obtained by the prototype was observed. As a result, it was observed an association between

vibrations and sounds to different messages (different obstacles at small or large distances). The UAEM Intelligent White Cane with ultrasonic sensors and GPS system is a prototype that helps to the safe and autonomous mobility, increasing the quality of life of the user because the prototype presents portability due to its low weight, folding and resistant material with sound and vibratory attachments that provide the simulation of a physical map and at a low price.

Keywords: intelligent white coarse, quality of life, visual disability.

Resumo

O objetivo desta pesquisa é testar a utilidade do protótipo UAEM Smart White Cane com sensores ultrassônicos (disparadores de alarmes e vibrações) e um sistema GPS (Global Positioning System) para usuários com deficiência visual. A tecnologia incluída no UAEM Smart White Cane oferece ao usuário com deficiência visual várias vantagens para expandir sua mobilidade com segurança, o que em última instância serve para melhorar sua qualidade de vida. Porém, seu uso adequado requer treinamento especializado para auxiliar o usuário a obter a utilidade que o protótipo promete. Para testar esses benefícios, foi realizado um estudo exploratório onde foram analisadas as experiências de treinamento e consumo de 20 participantes adultos com deficiência visual severa e cegueira. A análise estatística foi descritiva e permitiu registrar a satisfação dos usuários com as características físicas e os benefícios oferecidos pelo protótipo. Como resultado, foi observada a associação entre vibrações, sons e as diferentes mensagens emitidas (vários obstáculos a pequenas ou grandes distâncias). A UAEM Smart White Cane com sensores ultrassônicos e sistema GPS é um protótipo que auxilia na mobilidade segura e autônoma, o que aumenta a qualidade de vida do usuário, pois o aparelho é leve, dobrável e seu material é resistente; Além disso, contém acessórios sonoros e vibratórios que proporcionam a simulação de um mapa físico a um preço baixo.

Palavras-chave: smart white rough, qualidade de vida, deficiência visual.

Fecha Recepción: Octubre 2020 **Fecha Aceptación:** Marzo 2021

Introduction

The present research tests the utility of the UAEM Smart White Cane prototype with ultrasonic sensors, alarms (sounds and vibrators) for the detection of obstacles and ground anomalies and GPS to provide information on the user's position. The cane is an intelligent prototype designed by research engineers from the Autonomous University of the State of Mexico (UAEM), whose objective is to provide visually impaired users with a tool that provides three-dimensional security in their mobility, with easy handling and at low cost.

It is true that there is a wide variety of white rods with various technological applications to improve their usefulness (Borenstein and Ulrich, 1997). In fact, prototypes can be found since 2001 with ultrasonic sensors for the detection of obstacles; however, these are large, heavy, and none of them detect anomalies on the ground surface (holes, stairs, potholes, etc.). Although there are white rods with laser, radar and ultrasonic detection, the detection is carried out from the middle part of the body upwards (Abd et al., 2011; Kuchenbecker and Wang, 2012; Ulrich and Borenstein 2001), which prevents the visualization of the ground abnormalities or potholes. For this reason, a prototype has been designed with three-dimensional obstacle detection from head to toe, that is, trying to cover the user's entire environment.

In addition, the prototype to test has great benefits in its malleability, since it is low weight (less than 500 g), high resistance (aluminum), good support (handle and rubber tip), takes up little space (foldable) and is You can buy it at a low price for its design work. The remote sensing for objects is 70 cm, and below the surface from 5 cm or more, which allows to form a bubble of protection for the user with visual impairment.

According to the World Health Organization (WHO), an estimated 1.3 billion people live with some form of vision impairment. In fact, it is considered that worldwide there are 36 million blind people and 217 million people with low vision. The WHO and the International Organization for the Prevention of Blindness (IAPB) carry out projects to reduce blindness, such as Vision 2020: the right to see, created in 1999 with a projection until 2020, which has tried to influence the factors that cause this phenomenon. The achievements have been able to verify that 80% of blindness cases are avoidable, either because they are the result of preventable conditions (20%), or because they can be treated (60%) to the point of regaining vision (Bourne et al., 2017). Avoidable blindness is associated with poverty and lack of access to quality eye care services (Fricke et al., 2018).

Now, regarding the prototype of the intelligent displacement stick, it can be indicated that taking into account the marketing theories, this proposal can be evaluated from the evaluation of the users (Esteban and Mondéjar, 2013; Soriano, 1992). In this sense, the following three essential benefits that customers expect from a product can be highlighted:

1. Features. They are the physical aspects of the product related to the service for which it was made.
2. Advantages. Characteristics of a product that improves the competition.
3. Benefits. Product contributions to the user regarding the following:
    a. Functional: Satisfaction of generic user needs (mobility).
    b. Symbolic: Satisfaction of superficial needs of users (social approval, status).
    c. Emotional: Satisfaction of generic needs associated with feelings (security, autonomy, personal preferences).

Endomarketing promoting training in the use of the UAEM Smart White Cane with ultrasonic sensors

The smart baton market is increasingly competitive, but the characteristics of each smart baton with ultrasonic sensors seeks to meet the main needs of the visually impaired user to be sustainable over time. In this context, various alternatives have been used, one of which is endomarketing, also known as internal marketing; This focuses on proposing the use and training of the product within the institutions that serve users with visual disabilities. The purpose is to motivate health workers and users with visual disabilities to appreciate its advantages of use (Rodríguez Fernández, 2017).

The endomarketing model, based on a management philosophy, optimizes the relationship of internal users (visually impaired) to positively impact external users, thereby increasing the use of the UAEM Smart White Cane with ultrasonic sensors, as this is a product that satisfies utility and training needs in a pleasant and low-cost way. These are key success factors for the successful management of an endomarketing model for training (Regalado, Allpacca y Baca, 2011).

UAEM Smart White Cane with ultrasonic sensors and quality of life improvements

Quality of life refers to the ability to feel good physically and psychologically. In this specific case, the UAEM Smart White Cane with ultrasonic sensors allows safe mobility, being independent and satisfying certain needs, which ultimately serves to increase self-esteem and feel healthier. In fact, with training, this device will teach the user to manage stress and anxiety, because the ultrasonic sensors will communicate the presence of an obstacle in a panoramic way, as if walking in a protective bubble, which will contribute to acquire thoughts of security and attention to alert sounds to anticipate and be able to avoid obstacles (Espinoza-Ramos, 2011).

Explained or above, the following research question arises: do you know the benefits offered by the UAEM Smart White Cane prototype with three-dimensional ultrasonic sensors and sound trigger for visually impaired users after evaluating their own consumer experience?

Method

This was a non-experimental study in the field and exploratory in which the experience of consuming the Smart White Cane prototype was analyzed in a random sample of 20 adult participants with severe visual impairment and blindness; For this, a training intervention and an independent evaluation of the use of the UAEM Smart White Cane were carried out. Likewise, a descriptive statistical analysis was carried out to measure the general characteristics of the sample and its degree of satisfaction with the physical characteristics of the prototype.

Procedure

A study was carried out in three rooms / schools that housed people with severe visual impairment and blindness, located in the northeast of the State of Mexico. Participants were randomly selected because the ranches / schools held raffles for donations from the Autonomous University of the State of Mexico. The Smart White Canes with sensors were used by the participants for three months.

The first stage was training for users to associate the sounds and vibrations with the messages of the presence of obstacles, which were classified within the user manual

according to different characteristics in terms of their dimension, position and distance; that is, the sounds and vibrations were changing intensity according to the characteristics of the obstacle. On average, the training lasted one month for all the members of the sample to master the indications for use.

In the following two months, the participants used it on a daily basis and the proper use of the prototype was observed. It was after this stage of training that the participants perceived the difference with the use of other poles. In this regard, it is worth noting that 6 of the canes that the participants were already using had technological implements and the remaining 14 were only mechanical.

Results

A satisfaction questionnaire on the use of the white cane was applied to one of our 20 patients, mainly adults between 31 and 41 years of age, male and with total blindness caused by accident or illness (Table 1).

Tabla 1. Características generales de la muestra

		Genero		*Tipo de ceguera*		*Causas de la ceguera*	
Edad en años		Masculino	Femenino	Parcial	Total	Nacimiento o hereditaria	Accidente o enfermedad
21 a 30	5	3	2	2	3	1	4
31 a 40	8	4	4	3	5	2	6
41 a 50	5	4	1	2	3	2	3
51 a 60	2	1	1	0	2	1	1
Total de usuarios	20	12	8	7	13	6	14

Fuente: Elaboración propia

In the evaluation survey on the physical characteristics and satisfaction of daily use over three months, most of the participants reported agreeing with its weight, size and resistance, and strongly in agreement with its malleability because it is foldable, its grip, obstacle detection and emitted sound level (table 2).

Tabla 2. Concordancia de satisfacción ante las características físicas del prototipo

Características físicas	Muy de acuerdo	De acuerdo	Indiferente	Desacuerdo	Muy en desacuerdo
Peso (100 g)	3	12	2	3	0
Tamaño único	5	15	0	0	0
Resistencia (aluminio)	3	10	5	2	0
Maleabilidad en lo plegable	12	5	3	0	0
Agarre (mango de goma)	17	3	0	0	0
Detección de objetos y uniformidad del suelo por los sensores	10	7	3	0	0
Intensidad del sonido del zumbador	16	4	0	0	0

Fuente: Elaboración propia

In the application of the evaluation survey on the levels of benefits or contributions of the product, it can be indicated that they strongly agreed with its operation in general. In the symbolic aspect, they reported that the cane —being sound and emitting vibrations— provides information about the physical area, easily detects obstacles, moving objects and even people around. Regarding emotional aspects, they commented that the feeling of security increases because it has a tool that warns of obstacles, which allows them to have greater mobility in familiar spaces and even dare to explore unknown spaces, which offers a feeling of autonomy (table 3).

Tabla 3. Concordancia de satisfacción ante los beneficios del prototipo

Beneficios	Muy de acuerdo	De acuerdo	Indiferente	Desacuerdo	Muy en desacuerdo
Funcionales	15	5	0	0	0
Simbólicos	8	7	5	0	0
Emocionales	18	2	0	0	0

Fuente: Elaboración propia

Discussion

The test of the UAEM Smart White Cane prototype with ultrasonic sensors and sound triggers (alarms) for the detection of obstacles and ground anomalies was developed with 20 participants with severe visual weakness and blind to be able to evaluate a) the physical characteristics of the prototype and b) the level of satisfaction with the benefits of the prototype.

Based on these two evaluations, it can be stated that the majority were satisfied because the prototype provided comfort and safety, so the production objectives were accepted.

It is true that in the market there are other prototypes with ultrasonic sensors (Borenstein and Ulrich, 1997) and with different attachments that seek to satisfy consumer needs (Abd et al., 2011; Kuchenbecker and Wang, 2012; Ulrich and Borenstein 2001); however, some of these accessories raise their prices and make them heavier and less malleable.

On the other hand, it should be noted that the training offered to the users was scheduled for a month so that they would train before the intensity of the sound and the proximity and position of the obstacles (in front, left, right, above or on the ground). This training was carried out according to the pre-established programs of the stays / schools, so only slight adjustments were made for the intensity and frequency of the sounds until the participants mastered the proper use of the cane. This is another advantage to cover the special educational needs of students with visual disabilities (Aguilera, Castaño and Pérez, 2017).

Regarding benefits, the sound emitted by the ultrasonic sensors gave users a sense of identity because their presence makes them notice; This, in addition, allows other people to treat them as subjects who have a visual disability, hence they need to be assisted or receive preferential treatment (Bouhamed, Khanfir and Sellami, 2013).

Likewise, the prototype served to increase the autonomy of the users, since they could detect obstacles in advance and achieve safer movements. All of this contributed to raising their quality of life.

Conclusions

Since the beginning of the 21st century, several prototypes of smart white canes have been developed, to which different accessories have been added thanks to the advancement of technology. Taking these antecedents into account, a UAEM Smart White Cane is now presented with accessories necessary to provide the user with comfort due to its physical characteristics of low weight, resistance and malleability as it is foldable, as well as safety in mobility thanks to sounds and vibrations. it has, which offer a physical map to avoid obstacles.

However, it should be noted that its proper use requires at the beginning a training and adaptation process, which will later be compensated with benefits that will raise the quality of life of the user with a low investment cost. In summary, the contribution shown with this UAEM Smart White Cane prototype with sensors supports mobility systems based on mobile devices for people with visual disabilities.

Future investigations

The development of this UAEM Smart White Cane prototype with sensors for people with visual disabilities offers the basis to generate more electronic prototypes that support people with other types of sensory disabilities, such as hearing or muscular dystrophy, which will ultimately serve to raise the quality of life of users.

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