RCTA
Revista Colombiana de Tecnologías de Avanzada
UNIPAMPLONA

Digital Object Identifier: 10.24054/rcta.v2i44.2809

Systematic review of robotics applications for victim care

Revisión sistemática de aplicaciones de robótica para atención de víctimas

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Received: *march 7, 2024.* ***Accepted:*** *june 12, 2024.* ***Published:*** *july 1, 2024.*

How to cite: *A. A. Espitia Cubillos and R. Jiménez Moreno, "Systematic review of robotics applications for victim care", RCTA, vol. 2, no. 44, pp. 12–25, Jul. 2024.*
Recovered from https://ojs.unipamplona.edu.co/index.php/rcta/article/view/2809

Abstract: This document shows an analysis of the results of a literature search on technological support systems for people who are victims of various events that involve loss of mobility to some degree, requiring developments such as assistive robotics. The PRISMA 2020 guideline is used as a reference for the systematic review. Publications on robotics and victims of violence from the last three years were consulted in the Scopus database, bibliometric networks were built with Vosviewer, the results were filtered, characterized and grouped by care for victims after disasters and diseases. It is concluded that it is necessary to direct efforts in robotics towards the care of victims of violence in Colombia supported by the identified advances documented at a scientific level given the absence of evidence in this regard..

Keywords: Robotics, Artificial Intelligence, Assistive Robotics, technological support systems, victims of violence.

Resumen: Este documento muestra un análisis de los resultados de búsqueda de literatura sobre sistemas tecnológicos de apoyo a personas víctimas de diversos eventos que implican perdida de movilidad en algún grado, requiriendo de desarrollos como la robótica asistencial. Se usa la guía PRISMA 2020 como referente de la revisión sistemática. Se consultó en la base de datos Scopus publicaciones sobre robótica y víctimas de la violencia de los últimos tres años, se construyeron redes bibliométricas con Vosviewer, se filtraron los resultados, se caracterizaron y se agruparon por la atención a víctimas tras desastres y enfermedades. Se concluye, es necesario encaminar los esfuerzos en robótica hacia la atención de víctimas de la violencia en Colombia apoyado en los avances identificados documentados a nivel científico dada la ausencia de evidencia al respecto.

Palabras clave: Inteligencia artificial, Robótica, Robótica asistencial, Sistemas tecnológicos de apoyo, Víctimas de la violencia.

1. INTRODUCTION

Robotics began its rise in the seventies and eighties, however, it achieved its greatest consolidation in the nineties, this is reflected in its acceptance and particularly its demand at an industrial level, [1], which became the beginning of the Robotic Era.

In the 2000s, robotics made great advances, reaching what is currently known as intelligent robotics, which consists of the integration of robotics with artificial intelligence. What allowed us to have robots with the ability to execute actions with a greater degree of complexity and precision. Regardless of the advances, the objective of achieving autonomous systems independent of human action capable of improving people's quality of life remains.

Support systems for people with special health needs based on robotics constitute an increasingly closer and accessible scenario thanks to advances in this regard. The term assistive robot is now common, which corresponds to robots designed to help people with special needs in terms of mobility, ease of access and better functionality in both physical and social aspects.

In general, reduced mobility can arise from people's health conditions and/or be a natural consequence of aging, however, in countries with internal conflict such as Colombia it can also be the result of being a victim of violence, even in a period of post-agreement with the FARC given the presence of dissidents and other armed groups that continue to attack the population.

The Central Military Hospital reported 3,600 amputated people as part of the negative effects derived from the country's armed conflict, between 1986 and 2016 [2]. Which involved an investment of close to 3 million dollars for the care of mutilated soldiers, who are mostly young people (under 35 years of age) with difficulties in their lower limbs.

Therefore, the purpose of this document is to identify the existing advances in this regard documented in scientific texts, which serve as a starting point to direct efforts in robotics towards the care of victims of violence in Colombia. Since the scientific examination of the literature is essential to understand the general structure and evolution of the domain [3].

2. METHODOLOGY

The PRISMA 2020 guide [4] is used, which allows us to identify, select, evaluate and synthesize studies and serves as a reference to carry out the literature review in a transparent manner.

For the development of this research, a review of the literature consulted in the Scopus database was carried out using as the initial search equation: "victims of violence" + AND robotics, which did not yield any results, so determined to use two search equations: robotics AND victims and robotics AND violence, as it was considered a cutting-edge topic, the search was restricted to recent years. Thus, the initial inclusion criteria are essentially: being a scientific document published in the Scopus database, having been published in the last 3 years (2021 to 2023), and complying with the defined search equations. The last consultation in Scopus was carried out on 01/24/2024.

Secondly, to synthesize and visually present the relationships between the studies, bibliometric networks were created using Vosviewer.

Subsequently, the authors of this study jointly read the summaries of the 126 documents found, and determine as an exclusion criterion those that do not present robotic applications that help people in their content. From there and by common agreement, 51 unrelated works are eliminated. direct with the topic studied and 2 duplicates, leaving 75 documents.

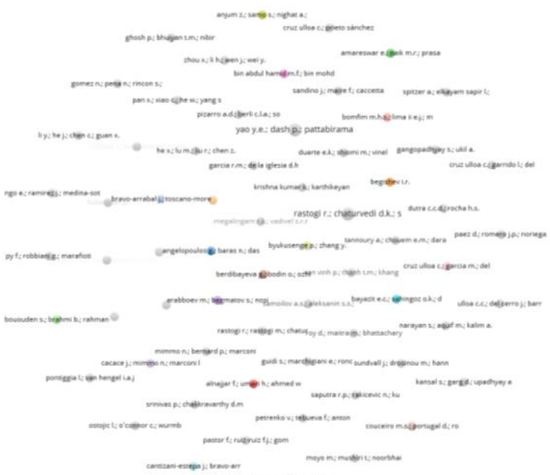
Finally, the studies were grouped, distinguishing the contributions of robotics to victims in different scenarios, on the one hand for care after disasters and on the other hand for care due to the consequences of diseases.

3. RESULTS

In order to know the relationships between the studies, bibliometric networks were created using the Vosviewer software. To see the presence of co-authorship, using the authors as the unit of analysis with the complete count method, limiting the number of authors per document to 10 and including documents with at least one citation (Fig. 1a) or with at least five (Fig. 1b), the little connection in both cases is evident. The authors with the most citations, who could be considered references on the topic, are in their order: Cruz Ulloa C.; Prieto Sánchez G.; Barrientos A.; Del Cerro J.; Dutra C.CD.; Rocha

H.S.; Begishev I.R.; Sandino J.; Maire F.; Caccetta P.; Sanderson C.; González F.; Bravo-Arrabal J.; Toscano-Moreno M.; Fernández-Lozano J.J.; Mandow A.; Gomez-Ruiz J.A.; García-Cerezo A. Pontiggia L.; Van Hengel I.A.J.; Klar A.

Also to identify the presence of co-authorship, but at the level of organizations, limiting the number of entities per document to 3, the network in Fig. 2 is obtained, which relates 3 of the 144 organizations, these are: Almaty University of Power Engineering and Telecommunications, Satbayev University and Penza State University.



a)

b)

***Fig. 1**. Co-authorship graphs by author.*
***Source:** own elaboration using Vosviewer.*

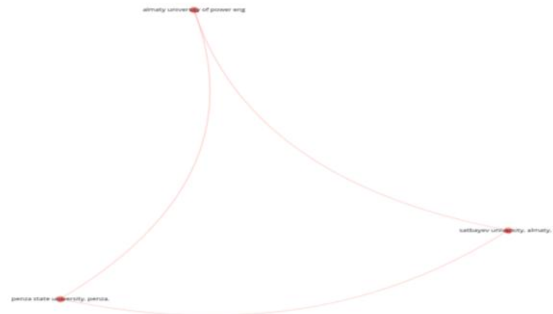


***Fig. 2**. Co-authorship network between organizations*
***Source:** own elaboration using Vosviewer.*

In order for the results of co-authorship between countries to be representative, the number of countries per document was limited to 3 and the number of documents per country to a minimum of 3, thus obtaining the network in Fig. 3, which relates 12 of the 51 options, these, according to their participation, in order are: India, the United States, Spain and China. It is highlighted that India, despite being the country with the greatest presence, only establishes relations with Saudi Arabia; while the United States maintains ties with China, Spain, Norway and Japan; On the other hand, Spain also relates to Indonesia, Norway and Japan.

***Fig. 3**. Co-authorship network between countries*
***Source:** own elaboration using Vosviewer.*

The network of keywords, includes those that appear at least 5 times, relates 30 of the 1298 existing ones (Fig. 4), the most prominent, in their order, are: Robotics, search and rescue, disasters, robots, deep learning, computer vision, search and rescue robot, machine design, antennas, internet of thing, mobile robots, drones, human, motion planning, search and rescue operations, ROS, artificial intelligence, swarm intelligence, behavioral research, rescue robot. The network (Fig. 4) allows you to identify five work areas in different colors and the interconnections between the concepts. The search and rescue keyword is the main node of the red cluster and directly links: multi-agent systems, motion planning, behavioral research, exoskeleton (robotics), deep learning and robot programming. Furthermore, search and rescue exhibits an immediate connection with the robotics concept, which corresponds to the node in the center of the cluster presented in yellow, which is intertwined with: artificial intelligence, human, internet of things and article, and, in turn, is It connects with disasters, which is the central node of the green cluster, which groups keywords such as: mobile robots, search and rescue operations, swarm intelligence, drones and spoofing attacks. The blue cluster has robots as its most representative node, and includes keywords such as: computer vision, robotics system, convolutional neural networks and search and rescue robot. Finally, the purple cluster contains the concepts: rescue robot, machine design, antennas and rescue robotics

The visualization of the citation of sources, limited to those with a minimum of 2 documents per source, shows the 10 of the 90 most indicated sources, in Fig. 5. These sources do not form a network, given the absence of a relationship between them.

The countries with more than 10 citations are: Spain, United States, India, Brazil, Russia, Japan and China.

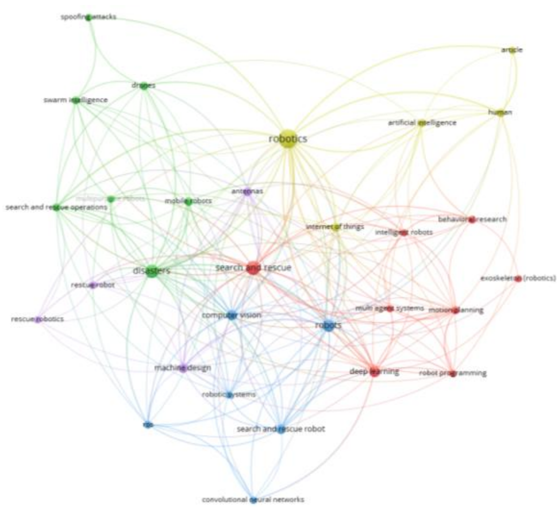


***Fig. 4**. General Keyword Network.*
***Source:** own elaboration using Vosviewer.*

***Fig. 5**. Source citation graph*
***Source:** own elaboration using Vosviewer.*

The selection of the studies to be included in this document followed the process presented in the flow chart in Fig. 6, which shows in the first phase the documents identified in the database and those eliminated due to duplication, in the second phase. presents the screening of documents by publication date, by absence of direct relationship with the topic studied or by corresponding to the presentation of an event, to reach the final phase where the total number of documents to be included in the review is indicated. As can be seen, the process of selecting studies with inclusion criteria allowed us to go from 656 to 75 scientific documents published in the Scopus database in the last 3 years with the search equations defined and related to the topic under study.

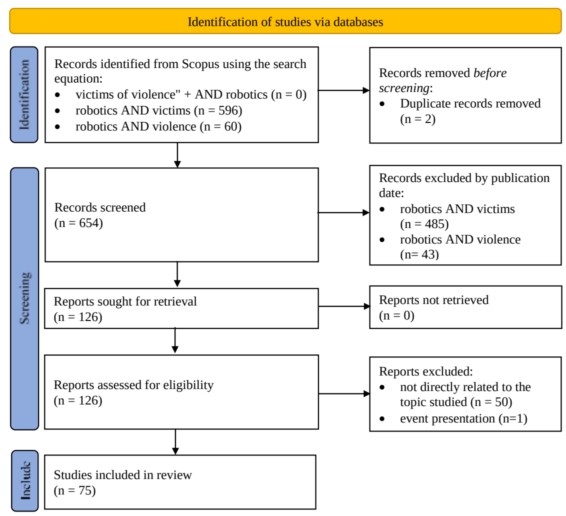


***Fig. 6**. Flowchart of document selection for literature review.*
***Source:** Adapted from* [4]

The general characterization of the selected documents is presented below.

Firstly, it is possible to see in Fig. 7, the distribution of the years of the documents analyzed: 20 were published in 2021, 31 in 2022, 22 in 2023 and 2 in 2024, the year 2022 stands out with the largest number. of published documents.

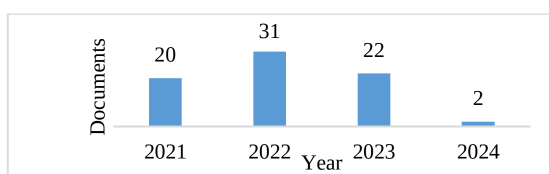


***Fig. 7**. Years of publication of the documents studied.*
***Source:** own elaboration.*

For its part, Fig. 8 reveals that the majority of the documents correspond to conference proceedings with a total of 37, followed by 31 articles, in addition there are 6 book chapters and a review article.

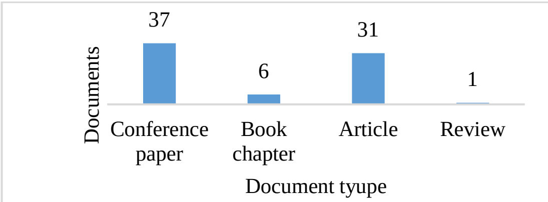


Fig. 8*. Document type.*
Source*: own elaboration*

The interval of citations per document shown in Fig. 9 varies between 0 and 19, where it is observed that the majority have not been cited. There are 16 documents that had a single citation, while the highest rate of citations, which was 19, was recorded in the document Autonomous thermal vision robotic system for recognition victims in search and rescue missions [5].

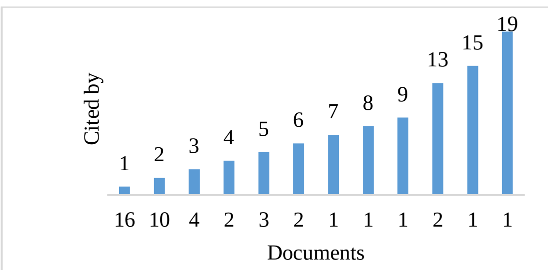


Fig. 9*. Citations per document.*
Source: *own elaboration*

Next, the characteristics of the studies are presented, which were classified according to the applications for victims in two settings: disasters (natural or not) and diseases.

3.1. Diseases

Various robots have been created to provide care after earthquakes and landslides, [6] designed one that searches for victims, collects voltage and current data in each area to determine if the power supply is normal, which can be used as a criterion to predict the collapse and thus formulate effective rescue plans. [7] designed another robot that aims to traverse all terrains, locate the position of survivors inside the rubble for quick rescue operations and reduce the need for trained manpower. For their part, [8] propose an autonomous victim detection system that is implemented in [5] using a quadruped robot to capture data in the absence of light or the presence of debris and transmit it to a central station.

[9] present CURSOR (Coordinated use of miniaturized robotic equipment and advanced sensors for search and rescue operations), an ongoing European project whose main objective is to improve the efficiency and safety of urban search and rescue operations in disaster sites, His research and project are structured around an earthquake scenario. [10] simulate transceiver sensors in search and rescue operations to locate victims buried under snow.

Regarding fire response, [11] design a robot that can detect and extinguish home fires while firefighters arrive. [12] presents a description of sensor technologies (single and multi-sensor) and their algorithms for human detection in regular and smoky environments, new sensor approaches in fire engineering are led by artificial intelligence, 3D mapping and fusion. of multiple sensors. [13] point out that robotic assistance helps in the search and rescue of victims in urban fires, and the importance of association between humans and robots to provide a more effective response to mitigate the danger to the lives of first responders and victims. Finally, [14] design an autonomous ground robot that can obtain real-time environmental data related to the presence of dangerous gases and location, as well as a simulator that reproduces these emergency scenarios to plan the mission, so emergency teams can know the conditions of the scenario before, during and after the intervention.

Regarding victim extraction, [15] designed a mechatronic hand with a visualization module for rescuing people who have fallen into wells. [16] present a mobile rescue robot that helps first responders save victims from a dangerous area using stretcher-type extraction, ensuring that the operation does not cause additional injuries to victims or put more lives at risk.

According to [17], search and rescue explorations supported by neural networks and their application in image detection can be carried out; Their results show that the models obtained from virtual environments apply to real ones. [18] present MR-RAS (Mixed Reality for Robotic Assistance), to help rescuers and protect their integrity when exploring areas after a disaster, facilitating the robot's gesture guidance and allowing them to manage visual information about the environment. The Human-Robot interaction is executed using Hololens glasses, the robot detects victims through thermal images, as it does [19], and also uses RGB images and neural networks as techniques that together allow helping victims by giving them medical equipment to recognize their healthy conditions. Also, [20] present a new hybrid approach to control the position of a pneumatic manipulator that makes the physical interaction between humans and robots safer, since it can avoid collisions between people and robots, between robots with the environment or between different robots.

[21] developed a mobile robot for data collection from disaster victims that can operate on inclined and rocky terrain with the use of low-priced sensors. For their part [22] create an intelligent rescue and surveillance system with multifunctional robots to mitigate accidents in rescue activities in dangerous situations. They guide you to the use of a mobile robot deployed in the area to collect data from the environment and obtain live video, this system measures environmental conditions that may affect the health of the rescue team and detects victims; The system can be controlled and managed remotely through a friendly web-based user interface. In this same sense [23] designed a small two-wheeled search robotic platform that recognizes the environment and efficiently finds victims trapped under rubble, allowing for response and support recovery after disasters such as earthquakes, floods, landslides. land, strong winds, explosions, structural failures, etc. Also [24] present a wheeled robot using IoT devices (ultrasonic sensors, GPS module and infrared camera) to autonomously navigate in an unexplored region, avoid obstacles and identify human presence using the SSD Inception V2 model. [25] design a 9-degree-of-freedom robotic manipulator to be used for rescue and site cleanup in disaster areas. [26] created a teleoperated all-terrain search and rescue robot to perform various tasks, such as climbing stairs, overcoming obstacles, opening and closing valves, maneuvering, inspecting plants, etc. [27] created a multifunctional search and rescue robotic system that allows remote monitoring of the disaster zone in real time, also [28] created the SR2, a search and rescue robot to save endangered civilians in dangerous areas.

For the individualization of disaster victims [29] formulated a method that allows the placement of a removable sensorized bracelet that is placed around the victim's forearm in a search and rescue scenario, with an all-terrain mobile robot.

The use of unmanned vehicles has been proposed for different scenarios. For example, [30] propose locating avalanche victims through the use of unmanned aerial vehicles with an electromagnetic sensor. [31] propose the use of unmanned aerial vehicles in search operations, which can detect disaster-affected areas to find people with thermal images or videos, addressing the challenge of bad weather conditions. Similarly, [32] develops his research with drones by using a deep learning algorithm and computer vision to search for people during natural disasters such as floods, volcano eruptions, forest fires, cyclones, earthquakes, etc. [33] present the design of an autonomous surface vessel for search and rescue operations in deep water applications to search for victims, black boxes, debris or other evidence both on the surface and underwater. Likewise, [34] use two autonomous unmanned aerial vehicles in environments without GPS for search and rescue, additionally the location of the victims can be saved in the generated maps to help human rescuers locate them. Also, [35] create a prototype of an unmanned ground vehicle, which can be controlled and monitored through a cell phone application, with dual robotic arms with five degrees of freedom that, when it finds an injured person, pulls them into the vehicle. vehicle and then take it to the nearest safe point.

According to [36], advances in the autonomy of unmanned aerial vehicles have increased their use in remote sensing applications, such as: disaster tracking and surveillance, autonomous object search systems and movement planning under uncertainty and partial observability. in outdoor environments. In this regard, [37] present deep learning methods for autonomous drone race perception and planning with two different approaches: system decomposition and end-to-end planning, in pursuit of long-term drone autonomy for aerial robotics, which can be used for: search and rescue missions in underground mines, detection and monitoring of victims trapped under collapsed buildings, detection of aerial radiation in nuclear energy, plants after an accident or extraterrestrial explorations. Likewise [38] created a method of voice control systems to operate robotic mechanisms during search and rescue operations with a heterogeneous group of unmanned aerial vehicles that gives the injured portable cardiac analyzers to evaluate the functional state of their body and perform the initial medical assessment of the injured and thus determine the order to provide emergency medical assistance to the victims. For their part, [39] present an iterative method to distribute surveillance and reconnaissance tasks, detection of dangerous objects or emergency places, search for victims, inspection and scanning of several areas in parallel, between unmanned aerial vehicles when the number of tasks significantly exceeds the number of agents.

At the level of collaborative robotics for care after earthquakes [40] exposes the development of autonomous systems of quasi-intelligent mobile robots, which create quasi-social structures to better perform their task, but without any observable central control/management subsystem. In this case, the robot is designed for earthquake rescue operations in unstable city ruins to search for victims buried under rubble, unearth victims, create evacuation scaffolding, etc.

According to [41] joint autonomous robotic exploration in disaster areas accelerates search and rescue operations in places such as space, ocean, forest, etc. [42], from the mobile robotics approach, propose a methodology to deploy a team of cable-driven mobile robots for exploration tasks and assistance to victims trapped in wells. [43] also propose a multirobot system where a team leader who knows the location of the victim is followed to carry out assistance tasks in disaster areas. [44] present a distributed architecture based on a swarm of robots, this solution finds potential victims in a short time. Likewise [34] use the sequential flight of two drones, the first uses a simultaneous localization and mapping algorithm while exploring the disaster area in search of victims, the second is sent with rescue packages to the identified victims. [45] designed a detection system based on Bluetooth low energy carried by ground and aerial robots, for locating victims in complex and unknown disaster areas.

The authors [46] use cloud robotics and advanced communications to foster a step-change in cooperative robots and hybrid wireless sensor networks for demanding environments (such as disasters, mining, demolition, and nuclear zones) by enabling data sharing and computational resources between teams of robots and humans to achieve information feedback, implementation of search and rescue architecture, route planning, tracking and information processing in real time.

[47] expose a control scheme based on virtual regions to explore an unknown environment obstructed by a swarm of robots with two characteristics: division and fusion, oriented to search and rescue applications, improving time efficiency; with initial assessment, environment mapping, real-time monitoring and surveillance operations. [48] present an algorithm that allows the swarm of robots to avoid obstacles and find possible victims, through cooperative robotics, which accelerates the process of searching for survivors by avoiding collisions with static or dynamic obstacles.

Also [49] propose a software architecture for the Miniaturized Underground Robotic Searcher designed by [23] to assist search and rescue teams during their operations.

There are several developments focused on the planning of entry and exit routes from disaster zones, [50] they consider this problem in an environment with obstacles applicable to rescue missions from natural disasters; To do this, a robotic agent explores the affected roads and helps victims find the best way to go to a safe place. [14] include in the design of their robot a simulator that reproduces fire scenarios and shows alternative routes to access and exit the scene more quickly and safely. For their part, [51] design an algorithm for planning routes for unmanned marine surface vehicles (USV) to locate drowned victims in open waters. In this same sense [52] estimate the movement in the XY plane (water surface) to help the search and rescue team find drowning victims with remotely operated aquatic robots. Also to explore disaster areas [53] design a strategy based on entropy that allows evaluating the borders of the known part of a map.

[3] explore the role of information technology in disaster management and resilience, conclude that it has potential roles in prevention and preparation before disasters occur, and in the recovery and response phases and identifies important technologies such as big data, global information system, artificial intelligence, Internet of Things (IoT), drones and advanced robotics that can help in disaster management.

3.2. Health

In response to the pandemic arising from the coronavirus, [54] designed a portable robotic ventilator with the help of the latest accessible technologies. [55] propose a safe and efficient programmable system that uses a humanoid robot capable of moving and detecting survivors autonomously in emergency scenarios, with the potential to communicate verbally with Covid victims. [56] train a mobile agent using computed tomography (CT) and X-ray reports under deep learning using a VGG-16 network to classify COVID and non-COVID patients and provide recommendations to the victim about being affected by the disease.

In [57] for lung cancer in old age, a classification scheme was made by studying micrographs in a deep neural network using a machine learning framework for medical diagnosis. In order to address the needs of post-stroke patients with upper extremity involvement, [58] design a 3D printed wearable hand exoskeleton controlled by electromyography to improve the gripping ability of the hand. [59] present a compact manual assistance device to help perform activities of daily living. [60] propose a smart glove or robotic hand to measure and improve the mobility and range of motion of the paralyzed hand. [61] using a 7 degrees of freedom exoskeleton robot, with uncertain non-linear dynamics and unknown limited external perturbations due to the user's physiological conditions, seek to help with passive, active or assistive control to provide physical assistance and rehabilitation.

Also for stroke patients with damage to their lower extremities [62] point out that motor images plus brain-computer interfaces could be used for communication, and for the control of wheelchairs, robotic arms and other medical equipment, as well as orthoses. and prostheses, as a result they have the EEG signal of motor images classified. [63] share their conceptual design of an exoskeleton suit that allows people to go from sitting to standing positions and vice versa, very versatile for reduced mobility problems. [64] designed a robotic car that can be controlled with eye movements. [65] do a biomechanical and dynamic analysis of human gait to design exoskeletons for rehabilitation, providing better living conditions and reintegration into society for people with partial or total loss of gait due to spinal cord injury.

In the context of robot-assisted therapy to recover the motor capabilities of stroke victims, [66] propose a simulation algorithm to perform analysis, evaluation and development of human interaction controls applied to robotic neuro-rehabilitation. [67] propose the use of robot-assisted therapy also based on electromyography to improve and evaluate movement control in clinical settings and thus improve sensory and motor recovery. [68] design a 5-degree-of-freedom parallel robotic structure to assist in the gait rehabilitation process, which functions as an active body weight support for treadmill or ground exercises. And [69] designed a self-monitoring elbow rehabilitation tool.

For identification and response to emergencies [70] propose an intelligent robotic system based on IoT and deep learning to help people who are alone at home to detect anomalies and provide first aid and/or call emergency contacts in minimal time. ; The system detects distress by audible screams and frequent monitoring of its surroundings, once it detects a tragic situation, it tries to detect the person in the frame of its camera, then, it searches for them and tries to get feedback from them and provide a suitable remedy to the victim, if the victim is unconscious, contact emergency services. [71] create a drone-based rescue and first aid system in Emergency Medical Services aimed at health emergencies, the objectives are to improve response time, evaluate the health of the victim, assist in the administration of first aid, transmit live in real time the vital signs of the victim to first responders and, mainly, describe how sustainability can be achieved in healthcare. [72] point out that rescue robots record large amounts of images, so a quick overview based on this data can help medical personnel find appropriate treatment strategies after rescue.

The robotic unit (SkinFactory) created by [73] for 3D bioprinting of pigmented and prevascularized dermoepidermal skin, allows development using fibroblasts, blood and lymphatic endothelial cells, keratinocytes and melanocytes derived from human skin, they are used as substitutes for the human skin to treat large defects such as severe burns.

To help perform physical therapy exercises at home after a car accident [74] designed an interactive computer vision-based application that, with posture estimation, supports therapists by providing them with real-time metrics, allowing patients to be properly evaluated. through remote care.

Finally, [75] designed a technological platform that offers medical and telesurgical care in remote and austere environments on the Moon, Mars and Earth, this system will be able to provide medical training, search and rescue, medical triage and surgical interventions in real time.

Up to this point and in a general way, the applications were classified for the care of victims of disasters or those with health problems. Within disasters there are specific applications for earthquakes, avalanches, fires, drownings, falls into wells and applications for disasters in general. At the health level, there are applications for the care of COVID-19, lung cancer, strokes, emergencies, burns and physiotherapy.

4. DISCUSSION

In Fig. 10, it is highlighted that the most prevalent type of document deals with disasters, covering a total of 53 documents, while there are 22 documents related to supporting disease care.

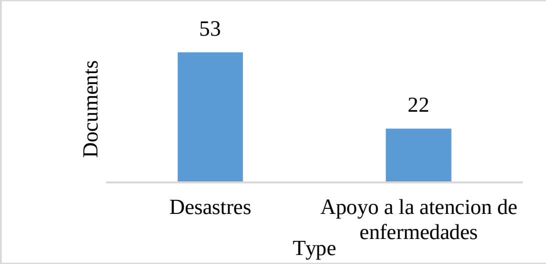


***Fig. 10**. Theme of the documents studied.*
***Source:** own elaboration*

Most applications are presented for scenario visualization activities for the identification of victims in different disaster, disease and accident contexts, some robots deliver materials and make diagnoses while rescue personnel respond.

A trend is observed in collaborative work at all levels, whether between robots and rescue personnel, or between robots. As well as between different group work technologies between robots where the swarm type stands out, with different robots that play different roles that can be autonomous or teleoperated. Cooperative robotics makes it possible to take greater advantage of the advantages and compensate for the disadvantages of the different elements that participate in its execution.

In general, it is observed that it is not possible to replace human rescue with a purely robotic rescue; on the contrary, the work of humans is strengthened, streamlined and made safer, but caring for disaster victims requires expert personnel. to attend to the particularities of each of the victims.

As an effect of having real-time information on the characteristics of the environments where each disaster occurs, uncertainty is reduced, this allows better planning of the form of reaction, reducing the risk of the people who care for the victims and the victims.

The care of disaster victims occurs in complicated environmental conditions such as lack of light, the presence of gases, debris, noise, unstable surfaces and even various weather conditions that make the performance of both humans and robots difficult and constitute a challenge of permanent research, the reduction of response time can represent the difference between life and death of people, which is why it is predicted as a line of research with permanent developments.

There are important advances in route planning algorithms applicable to both robots and people, not only for entering disaster zones, but also for exiting with and without victims.

Rescue robots are currently being developed with functions including finding, mapping, clearing debris, delivering supplies, sharing information in real time, providing first aid and evacuating victims, these search and rescue robot developments could be used for other assistive purposes.

At the level of health applications, advances in robotics are observed for the care and rehabilitation of patients with significant mobility difficulties derived from having suffered strokes. These advances can be applicable to the population victims of violence that have seen their mobility capacity reduced in both their lower and upper limbs due to exposure to mines buried in the surfaces in the most remote areas of the country where the conflict and the presence of organizations outside the law.

The use of pattern recognition algorithms such as neural networks and deep learning is evident, which enhance the powers of a robotic agent for the recognition of victims, health problems and/or execution of tasks.

4. CONCLUSIONS

In direct relation to the consequences of violence, the results show the absence of scientific publications in the Scopus database, so it is concluded that there are no advances at the robotics level to specifically serve the population that has been a victim of violence. or at least the existing advances have not been documented at a scientific level. However, it is possible to show that it is possible that existing advances in assistive robotics could be useful in caring for the population that is the victim of violence, which is why its analysis is proposed as future research.

On the other hand, bibliographic networks show the almost non-existence of co-authorship work between authors, little between organizations and countries, nor are networks formed at the level of citations, which is why it is suggested to promote collaborative work in the search for results that have greater impact. and possibility of disclosure.

The particular conditions of Colombia require research into assistive robotics to care for victims of the conflict that continue to occur despite being in a post-agreement stage. These advances are not exclusive and could benefit other people with physical disabilities. It can also be supported by the progress made in disaster and health care related to this document.

RECOGNITION

Product derived from the research project code IMP-ING-3405 entitled "Mobile robotic prototype for care tasks in residential environments" funded by the vice-chancellor's office for research at the Universidad Militar Nueva Granada.

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