JPJO 9 (2) (2024) 185-195

Jurnal Pendidikan Jasmani dan Olahraga

Available online at:
https://ejournal.upi.edu/index.php/penjas/article/view/69964
DOI: https://doi.org/10.17509/jpjo.v9i2.69964

Development of Running Assistive Technology to Improve Mobility of Blind People: A Systematic Literature Review

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Article Info

Article History :
Received Mei 2024
Revised July 2024
Accepted August 2024
Available online September 2024

Keywords :
assistive technology, blind, mobility, run, systematic literature review

Abstract

Blind people often face barriers to access information, reducing their ability to participate fully in daily activities such as education, employment, finances, communication, recreation, and independence. This research used the Systematic Literature Review (SLR) method to investigate developments in the use of assistive technology aimed at improving the mobility of people with visual impairments, especially in the context of runners. This study followed the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) guidelines. Data were collected from Google Scholar with the help of Harzing's Publish or Perish application. Of the 67 international journal articles downloaded, strict selection was carried out through inclusion and exclusion stages in accordance with established criteria, resulting in 6 journal articles that were relevant to the focus of this research. This study provided a systematic overview of the development of assistive technology to improve the mobility and independence of blind runners. Various technological innovations are discussed in this research, including electromagnetic navigation systems, mechatronics, navigation for marathons, smartphone applications (SPAs), and devices such as EyeVista. The research results conclude that these technologies have great potential to improve mobility and independence of blind people, especially in physical activities such as running. These innovations help individuals navigate complex environments, avoid obstacles, and participate in running with more confidence and independence. Although there are challenges that need to be overcome, the potential of this technology is significant in supporting individuals to achieve a full independence and active participation. It is recommended to continue the research and development of the technology as well as increasing the collaboration among developers, researchers, and visually impaired communities, especially runners, to ensure more effective and widely accepted solutions.

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INTRODUCTION

Mental People who are visually impaired often experience significant challenges in accessing information in various aspects of their lives. Barriers to information accessibility can hinder their ability to participate fully in daily activities, such as education, employment, finances, communication, recreation, and independent living. However, due to technological advances, a number of innovative solutions have emerged to overcome these obstacles (Kim et al., 2022).

Technological advances have allowed the possibility to increase the accessibility of information for visually impaired individuals (Yahaya et al., 2019). Innovative solutions such as screen readers, text recognition software, voice recognition technology, and adaptive hardware are examples of solutions that can provide easier access to written information, websites, or applications. Screen readers, for example, allow users to hear content displayed on the screen, while voice recognition technology can help identify objects around them. The application of this technology not only opens up access to information, but also helps blind individuals participate actively in everyday life (Alfiqi & Sembiring, 2023). In education, technology can be used to access textbooks and learning materials. In the workplace, technology helps them execute office tasks, and in communication, voice and text applications facilitate social interaction (Legiana & Yuliana, 2023).

Along the way, humans continue to strive to create innovative solutions to improve the quality of life and inclusivity for every individual, including those with disabilities. Individuals who often face mobility challenges are people with visual impairments. Despite facing significant accessibility barriers, technological developments have paved the way for advances in running assistive technology specifically designed to increase their mobility and independence (Mestika & Sriwarno, 2014).

Technological advances continue to play a key role in shaping the way people interact with the world, especially in the context of improving the quality of life for individuals with disabilities. One recent development is the assistive technology tools to improve the mobility of blind individuals (Ball et al., 2022). With the focus on innovation and technology integration (Anshori, 2018), the effort aimed to provide more effective solutions to the mobility challenges faced by these communities. The importance of this discussion does not only lie in physical solutions, but also in the psychosocial impact, inclusivity, and full participation of blind individuals in various aspects of life (Kuzdeuov et al., 2023).

Visual assistive technology is divided into three main categories, namely vision enhancement, vision substitution, and vision replacement. This technology is specifically intended to help blind people through the use of electronic devices equipped with sensors to detect and localize objects (Amini et al., 2020). The sensor allows assistive technology to provide information to the user about the external environment; these sensors also support mobility tasks by determining the dimensions, reach, and height of objects around the user (Avila et al., 2023).

In the vision enhancement category, this technology is focused on improving existing vision capabilities. An example is the use of smart glasses that can increase contrast, strengthen colours, or record and display high-resolution images. Meanwhile, in the vision substitution category, assistive technology involves the use of other senses to replace the lost vision. For example, a sonar system can help detect objects around the user through sound or vibration. In the vision replacement category, this technology aims to replace lost or limited vision abilities by providing replacement of information (Okolo et al., 2024). For example, speech recognition systems or devices that can convert text to sound help blind people to read and understand written information. Overall, this visual assistive technology provides a significant support to blind people in accessing information about the environment around them and carrying out daily tasks more independently (Khan & Mahmood, 2022).

The solution being pursued does not only refer to technical or hardware aspects. Apart from that, this effort also considers psychosocial impacts, realizing that technological advances are not just about overcoming physical obstacles but also paying attention to the emotional and mental well-being of blind individuals (Prananda, 2019). By integrating technology, such as psychosocial support services and innovation in non-physical aspects, it is hoped that we can provide a more holistic and effective solution. Additionally, the focus on inclusivity reflects a determination to create solutions that are not only accessible but also provide full

opportunities for visually impaired individuals to engage in various aspects of life. Inclusivity is not only limited to technology access but also includes social integration and active participation in society (Smith et al., 2018).

Thus, technological innovation, especially in the development of running aids, is not just a technical aspect but also a mean of providing a positive impact on the quality of life of blind people. Assistive technology is able to provide concrete solutions for overcoming mobility barriers, with a primary focus on blind individuals (Finetti & Luongo, 2023; Khan & Mahmood, 2022). With these innovations, it is hoped that running aid technology can continue to make a positive contribution to increase the mobility and participation of blind people in various sporting activities, one of which is running. Through the development of innovative running aid technology, it is hoped that we can continue to expand the range of motion and opportunities for blind people to engage in physical activity and sports to improve their fitness and quality of life.

Therefore, this systematic observation aimed to identify and critically appraise the available evidence regarding the development of running assistive technology to improve mobility of the blind. This article presents a novelty by highlighting the latest assistive technological innovations to assist runners in running activities, which are expected to continue expanding the range of motion and opportunities for physical activity and sports and improving fitness and quality of life. By using a systematic literature observation method, various research related to technological assistance in the field of sports had been analyzed comprehensively, aiming to identify and provide a solid foundation for understanding trends, challenges, and potential for further development in this field.

METHODS

The method used in this research was the systematic literature review (SLR) method. SLR is a thorough research approach for evaluating all research findings related to a particular research question, topic, or phenomenon. Basically, systematic review is a research method that combines primary research results to present more comprehensive and objective information.

The research phases include data collection, data analysis, and conclusion drawing (Dadang Juandi, 2020). The collected data involve primary research published in international journal articles. The data are collected from registered electronic databases and indexed by Scopus. Only relevant articles that meet the inclusion criteria are included in the analysis stage (Dadang Juandi, 2020). In this study, the researchers selected all published journal articles related to the development of assisted running technology to improve the mobility of blind people using the Google Scholar database. The literature search was performed using a previously specified keyword, namely Assistive Technology; Run; Running; Blind; Visual Impairment; Disabilities.

The search used the Google Scholar database because Google Scholar is regarded as an influential source of reference where the articles have undergone a peer-review and review process from interdisciplinary sciences and have a broad view of the article. This database is one of the most commonly used databases by researchers and academics. This research was conducted using Harzing's Publish or Perish application by setting up a special database, namely Google Scholar. Harzing's Publish or Perish is a software with a free utility that facilitates the process of searching articles by quickly organize and connect various publication sites (including Google Scholar, Microsoft Academic, Scopus, and Web of Science), thus providing a facility for researchers for searching articles as the reference materials for a literature study (Asy'ari et al., 2021). This application is designed to help individuals find and analyze the sources of information they need.

Inclusion Criteria

To obtain the data relevant to the purpose of the research, inclusion criteria are required. The followings were the inclusion criteria of this study: (1) studies evaluating the development of assisted running technology to enhance the mobility of runners, (2) studies analyzing the evolution of assistive running technology for enhancing runner mobility, (3) research consisting the sample of run, (4) studies published from 2014 to 2023, (5) studies containing the approach or method used, and (6) studies including the material used in the investigation. A study that did not meet the criteria was excluded from the process of the systematic review study.

Instruments

A research instrument is an observation sheet or

protocol related to inclusion and exclusion criteria. The criteria were based on the year of publication, the number of samples, the location of the research, the index of the journal, and the material used. The protocol the author used in this study was the PRISMA Protocol (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) (Widiasih et al., 2020). The primary study selection process was carried out through four stages referring to PRISMA, including identification, screening, eligibility, dan inclusion (Wang et al., 2019)

Populations and Samples

The population of this study was all the research on the development of assistive running technology to improve mobility using Harzing's Publish or Perish application by embedding a special database, namely Google Scholar. Searches were performed based on subject areas, including article titles, abstracts, and keywords using the terms "Run Aids Technology" or "Improving Blind Mobility." The references taken were all references indexed and published from 2014 to 2023. Reference searches were limited to specialties, such as its relevance, updates, and methodology of research information. From the filtering process, 22 articles matched research topics. Data were generated in the form of a matrix format, including the purpose of research, methods, problem formula, citations, bibliographic information, abstracts, keywords, year of publication, as well as results and discussions. The 22 articles were examined according to their research characteristics, such as the author, year of publication, research design, research model, and research results. After data were selected based on inclusion and exclusion criteria, the data were evaluated for their quality (QA) based on the following question, "Has the journal been indexed Q (quartil)?." In the quality assessment phase, there were 17 articles excluded because they did not meet the quality criteria. Articles that meet the quality criteria were then further evaluated, producing 6 articles that contained the development of assistive technology to improve mobility. In this study, the collected journal articles were selected using the PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analysis) method. Figure 1 presents the flow diagram of the PRISMA.

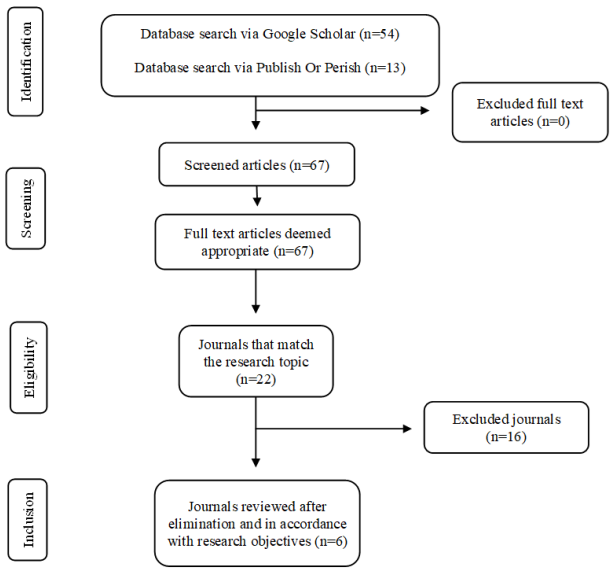

Figure 1. PRISMA Diagram of Literature Review

RESULT

The data collection of this study was administered by accessing various research articles that specifically discussed advances in Running Assistant Technology aimed at improving individual mobility. The process began with identifying research topics covering critical aspects, such as innovation in design, development of sensor technology, improved comfort, and its impact on the health of users.

After setting the research framework, the literature search was conducted using various databases, such as Google Scholar and Harzing's Publish or Perish. The keywords included "assistive running technology," "blind mobility devices," and "technology for visually impaired runners." During the search process, a total of 67 articles were produced; 54 articles were obtained from Google Scholar and 13 articles were acquired from Harzing's Publish or Perish application by setting up the dedicated database. During the filtering process of the article, the relevance, update, and methodology of the research information were analyzed. After the analysis, 22 articles that matched the research topic were selected. These article were then included into the validity test stage by defining some research criteria. Data extraction included the collection of information related to research characteristics, such as the author, year of publication, research design, research model, research outcome, etc. At this stage, 16 articles were excluded because they did not meet the criteria. The articles that met the criteria were then selected for further evaluation, resulting in 6 final articles.

Table 1. Journal Articles Included in Inclusion Criteria

Paper ID	Authors /Years	Title	Source	Quartil	Results
A1	(Pieralisi et al., 2015)	Design and Realization of an Electromagnetic Guiding System for Blind Running Athletes (Pieralisi et al., 2015)	Sensors Publish by Multidisciplinary Digital Publishing Institute (MDPI) DOI: https://doi.org/10.3390/s150716466	Q1	The results show that an electromagnetic guidance system is capable of helping athletes walk or run independently by guiding them along the desired path.
A2	(Mancini et al., 2018a)	Mechatronic System To Help Visually Impaired Users During Walking And Running (Mancini et al., 2018a)	IEE Transactions on Intellegent Transportation Systems DOI : http://dx.doi.org/10.1109/TITS.2017.2780621	Q1	The result of this research is the development of a monocular vision-based system that can help people with visual impairments walk, jog, and run in outdoor environments.
A3	(Zhu et al., 2019a)	Running Guide: Design of a Marathon Navigation System for Visually Impaired People (Zhu et al., 2019a)	Association for Computing Machinery DOI : http://dx.doi.org/10.1145/3332169.3333579	Q1	The result of this research is the development of a prototype marathon navigation system that utilizes GPS modules, touch information, vibration, and 3D spatial audio.
A4	(Hubicki et al., 2018)	Walking And Running With Passive Compliance: Lessons from Engineering: A Live Demonstration of the ATRIAS Biped (Hubicki et al., 2018)	IEEE Robotics and Automation Magazine DOI : http://dx.doi.org/10.1109/MRA.2017.2783922	Q1	This study included a variety of experiments with ATRIAS, including walking on grass, moving from sidewalk to grassland, walking on slopes, transitions between different fields, and running on flat ground. The results show that ATRIAS can run stably without significant sensitivity to surface dynamics.
A5	(Peiris et al., 2016)	EyeVista: An Assistive Wearable Device for Visually Impaired Sprint Athletes	IEEE International Conference on Information and Automation for Sustainability (ICIAfS) DOI: http://dx.doi.org/10.1109/ICIAFS.2016.7946558	Q3	Based on research results, EyeVista demonstrates potential in helping athletes run fast to improve their performance and facilitate their mobility on the track.
A6	(Doughty, 2016)	SPAs (smart phone applications) – a new form of assistive technology	Journal of Assistive Technologies DOI: http://dx.doi.org/10.1108/17549451111149296	Q3	This paper describes how the special built-in features of modern smart phones can be used to open up the potential of these devices for use as assistive technologies in supporting the independence and Quality of Life of vulnerable people. It describes, through a number of relevant examples, how low-cost, downloadable applications enable the camera, the microphone, the accelerometer, the GPS receiver, and the touch-screen, to be used for specific assistive purposes.

Therefore, this data collection provided comprehensive information on various perspectives in the research literature discussing the extent to which technological advances in the implementation of aids can make a significant contribution to the increased mobility of persons with disabilities. The selected journal articles are presented in Table 1.

Study based on Journal Indexers

The detailed spread of the study based on the index of the journal related to the development of assistive running technology to improve mobility is presented in Figure 2. Figure 2 shows that the publication search on Google Scholar resulted in six final articles about running assistive technology to improve mobility. Most of them were indexed in Q1 (four articles) and Q3 (two articles). In Q2 and Q4, there was no relevant publication found. It might be a consideration for researchers to increase and deepen research on assistive walking technology to improve mobility.

Figure 2. Journal Articles Included in Inclusion Criteria

Study based on Year of Publication

The data in this systematic review study were published from 2014 to 2023. Details of the scope of the primary study from 2014 until 2023 are presented in Figure 3.

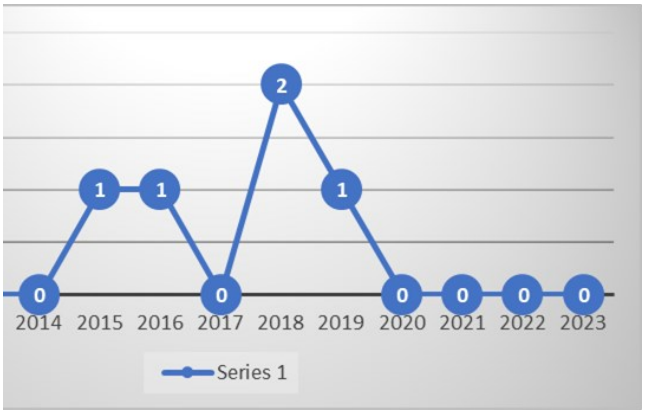

Figure 3. Details of The Scope of The Primary Study

From the picture above, it can be seen that the number of publication fluctuated during the period. Even though there is still little research regarding the development of assistive running technology to improve the mobility of the blind, the existence of a certain amount of research shows that research on the development of assistive running technology to increase the mobility of the blind is still gaining recognition among the researchers. The highest number of publications regarding the development of assistive technology to improve the mobility of blind individuals occurred in 2018 (2 articles each being included in the research inclusion criteria), while the lowest number of publication happened in 2012, 2013, 2014, 2017, 2020, 2021, 2022, and 2023 (there was no relevant article found).

DISCUSSION

Assistive technology is a general term that covers auxiliary, adaptive, and rehabilitation tools for individuals with disabilities and covers almost everything that may be used to compensate for a lack of certain abilities (Reed & Bowser, 2005). Assistive technology broadly outlines a set of tools, strategies, and services that are tailored to a person needs, abilities, and duties and also includes assessment of individual needs with disabilities, evaluation of individual functions in the individual customary environment and selection, planning, installation, adaptation, implementation, maintenance, improvement, and replacement of assistance technology services, and coordination with existing education and rehabilitation plans and programs for inclusive development (Dapa, 2022).

Mobility has become an important aspect of everyday life, while wearable technology has become a solution for increasing autonomy and participation in various activities. In the last two decades, assistive technology has undergone significant progress in the field of robotics. A systematic analysis based on existing literature provides insight into how new technologies can enhance the mobility of trainees, as well as the development of assistive running technology to enhance their mobility. In 2011, there was a successful entry into the article to be reviewed. The article by (Doughty, 2016) explains how the inherent features of modern smart phones can be exploited to enhance the potential of such devices as auxiliary technologies to support the independence and quality of life of vulnerable communities. By giving a number of relevant examples, this study shows how a low-cost downloadable application is able to activate cameras, microphones, accelerometers, GPS receivers, and touchscreens for specific help purposes. In the study of SPA as a new auxiliary technology, the problem formula identified is how smartphone applications can be transformed into a variety of auxiliaries that can improve the quality of life of individuals with a range of needs, including sensory disabilities, diabetes, mental health problems, epilepsy, or communication problems. Smartphone-based m-care services are likely to be offered in conjunction with home telecare services to extend user independence from home to outdoor environments.

Progress in research on aid technologies to enhance mobility was reflected in the study conducted by (Pieralisi et al., 2015). The aim of the research was to design and develop an electromagnetic guiding system to help athletes exercise in their physical activities. The system aims to overcome the constraints encountered by athletes during races, thereby improving their autonomy and performance. The proposed electromagnetic conductor system offers some potential benefits. First, this system helps athletes follow complex paths during races, thereby improving their performance. Second, it gives vibro-tactile warnings to athletes when they leave safe areas, encouraging them to return to the right path.

Third, testing involving volunteers shows the viability and usefulness of the system in real-life situations. The research includes the design and realization of an electromagnetic steering system consisting of a moving unit that creates two "electromagnetical walls" to limit the path, as well as a receiver unit worn by athletes that provides vibro-tactile warnings. The tests were conducted with the involvement of volunteers to ensure the validity and benefits of the system. The results show that the electromagnetic guidance system is effective in helping athletes follow complex paths and give vibrotactile warnings as they exit safe areas, motivating them to return to central positions. In conclusion, the research has successfully designed and implemented an electromagnetic guidance system that can improve the autonomy and performance of athletes during training or competition. Through testing with volunteers, the system has proven practical and beneficial in real-world contexts. This research has made a significant contribution to the development of innovative technologies that support athletes in their physical activity.

In 2016, there was a study conducted by (Peiris, 2016) entitled "EyeVista: An Assistive Wearable Device for Visually Impaired Sprint Athletes." The study aimed to develop a usable navigation assistant, called EyeVista, to facilitate fast-running athletes. EyeVista is a wearable jacket that uses computer vision techniques to help athletes avoid collisions and move on the relevant track. EyeVista aims to empower the athletes in the blind sprint by improving their performance and facilitating their mobility. It is hoped that these aids will allow athletes to move independently without the help of human guides, improving their safety and quality of life. The EyeVista system is designed using a single-board Raspberry Pi computer to process real-time images captured by the Raspberry Pi camera module. The system is used to navigate athletes on specified tracks and avoid collisions. The population targeted in this project is a fast-running athlete.

The EyeVista project has the potential to provide an efficient and promising solution for fast-running athletes. Through the use of computer vision technology and usable navigation aids, it is expected that the project will improve the independence and performance of athletes in their sports. The conclusions of this study involve the design and implementation of a Raspberry Pi-based real-time detection and tracking system. The system proved to be smart, economical, and efficient in leveraging vision-based applications. EyeVista devices are designed to meet the needs of users with high operational ease, portability, adaptability, and usability. Thus, it is expected that the system will enhance the confidence of the athletes by providing accurate information about the obstacles they will encounter, allowing them to move autonomously on the track without human guidance. EyeVista has the potential to be a better and more reliable human guide substitute, making it the "eye" of an athlete. Although the results of the experiment showed positive results, it must be acknowledged that there are still some limitations in the system that need to be overcome. The stability and optimality of the application remain a challenge, especially in the face of changes in brightness due to lighting. The EyeVista system is more suitable for use in stadiums with consistent lighting conditions. Despite providing the potential for improved autonomy, significant improvements in terms of ease of use, portability, and practicality are needed before they are widely accepted by the regulatory body and the blind community.

In the same year, in the study of (Hubicki et al., 2016), entitled “Walking and Running with Passive Compliance: Lessons from Engineering a Live Demonstration of the ATRIAS Biped,” there was the development of a tool to walk and run with a robot. The aim of the study was to prove that walking and running bipedally with a passive dynamics-based approach could be done strongly and stably. The research used the ATRIAS bipedal robot as a physical model for such an approach. The advantages of the research include the development of fast and sturdy walking and running abilities on bipedal robots, which can be applied in a variety of robotics and automation fields. This passive dynamics-based approach has the potential to produce more efficient and stable drivers in unstructured environments. The study used a passive dynamics-based approach using the natural stabilizing effects arising from mechanical compliance on the ATRIAS bipedal robot. The controller is designed to exploit the interaction between passive dynamics and actuation in order to produce strong drives. The development process involves rapid iterations, including additional designs and controller testing. The sample tested in this study is the ATRIAS bipedal robot.

The results show that ATRIAS is capable of run-

ning with resistance to strong human kicking, moving in various fields, and crossing surface altitude changes without requiring planning or visual feedback. The ATRIAS is also capable of accelerating from a standstill, transitioning to a walking mode in the air, and reaching a maximum speed of 2.5 m/s. The culmination of this research was seven live shows at the DARPA Robotics Challenge, where Atrias walked and ran with disturbance without falling in front of the audience. The study also notes important lessons learned during the development of these abilities.

In 2018, a research was conducted by (Mancini et al., 2018b) entitled "Mechatronic System to Help Visually Impaired Users During Walking and Running". There are advances in the technology of running aids for people with disabilities, namely developing a mechatronic system that can help the blind users when walking, jogging, and running in outdoor environments. This system aims to improve mobility and quality of life for people with disabilities.The benefit of this mechatronic system assistance is that it provides navigation to blind users so that they can move independently in complex environments. This system can assist users in recognizing paths or lines on specific runways and provide appropriate stimulations through haptic gloves. The research used a number of algorithms to send images and extract lines or paths that users had to follow. The embedded system began with the use of a small camera and a board to process images, as well as a haptic device consisting of two gloves equipped with motorized vibrations to direct the user on the right path.The population or sample studied in the research were blind users who carried out sports activities, such as jogging and soft running. The research analyzed the mobility needs of blind people when carrying out sports activities at all levels.The research results show that the mechatronic system as a whole is able to detect the right path and provide the right stimulation to the user via the haptic glove. This system is capable of operating at speeds above 10 km/hour. Based on this research, it can be concluded that the mechatronic system developed is able to assist blind users in walking, jogging, and running in outdoor environments. This system provides precise navigation assistance and can improve mobility and quality of life for people with disabilities.

In the study of (Zhu et al., 2019b) entitled " Running Guide: Design of a Marathon Navigation System for Visually Impaired People", a marathon navigation system was being designed to help runners run. The system aims to provide guidance and feedback to the runnetra runners so that they can follow the running route and finish the marathon with more independence and confidence. Using GPS location information and 3D spatial hearing feedback, as well as vibro-tactile feedback, the system can help the runners avoid obstacles and stay on a predefined virtual track. The marathon guide system is expected to assist the runner in following the marathon competition. The GPS position information, the 3D spatial hearing feedback and the vibrotactil feedback, can help a runner avoid obstacles and stay on a previously defined virtual running track. The study used a user-based design methodology by conducting research on people with visual impairments. GPS location information is used as input to create a virtual runway. Vibrotaktile feedback and 3D spatial audio are used as outputs to guide the runners to stay on the virtual track. Overall, the development of mobility support technology in running has produced a variety of innovative solutions. From electromagnetic guidance to marathon navigation systems, all research is aimed at improving the autonomy, performance, and safety of athletes, as well as making positive contributions to their mobility and quality of life.

The conclusions of the research show that more and more VIP participants are interested in participating in marathon competitions, but they have concerns about inaccurate track information, untimely feedback, imperfect obstacle avoidance systems, and the imperfection of portable assistance systems. Therefore, it is necessary to design an additional navigation system to address the various problems encountered by VIP participants. From a user perspective, the navigation systems developed are expected to effectively solve the problems encured by VIP participants in marathons, providing significant benefits for both VIP participants and the general public. The prototype has been made using the Raspberry Pi, although it has quite a significant weight as a wearable device. To enhance the comfort of the VIP runners, the plan is to integrate all the modules into a single circuit board, thus requiring only cable ports to connect the headset and bone conduction tactors. The next step of development would focus on improved detection of obstacles and slopes so the system could provide better support for VIP participants during participation in marathon competitions.

The research results from the six reviewed articles include software-based running aids for the wearer, including electromagnetic steering systems, mechatronic systems, voice navigation systems, ATRIAS bipedal robot software, smartphone apps (SPAs), and a navigation aid called EyeVista, a wearable jacket using computer vision techniques to help athletes avoid collisions and move on relevant tracks. Each supporting technology has its own advantages and challenges. Although advances in the aid technology have brought significant benefits, there are still challenges to overcome. From security issues to suitability for individual needs, this discussion also covers future opportunities to improve the efficiency and sustainability of aid technologies.

This literature review provides a comprehensive overview of the development of auxiliary technologies to enhance mobility. By understanding the evolution, category, excellence, challenges, impacts, and future opportunities, we can design better solutions to meet their mobility needs, support their independence, and improve their quality of life. Research by (Hiranya Peiris, 2016), entitled "EyeVista: An Assistive Wearable Device for Visually Impaired Sprint Athletes", revealed that the stability and optimumness of the application remained a challenge, especially in the face of changes in brightness due to lighting variations. The EyeVista system is more suitable for use in stadiums with consistent lighting conditions.

Assistive technology has played an important role in increasing the autonomy and participation of individuals in everyday life. With the help of technology, they can more easily explore the environment, access information, and participate in various social activities. In addition to improving physical mobility, assistive technology also provides psychosocial support. The sense of independence resulting from the use of this technology can have a positive impact on mental well-being. Meanwhile, a study by (Mancini Et Al., 2018b), entitled "Mechatronic System To Help Visually Impaired Users During Walking And Running", highlights the advantages of the mechatronic system in providing navigation assistance to blind users, enabling them to move independently in complex environments. The system helps the user recognize a track or line on a particular track and provides accurate stimulus through haptic gloves, proven to play an important role in helping the user master the ability to walk and run.

In general, these six studies contribute to the development of technology that helps improve the quality of life of athletes and individual runners during running and walking activities. Despite a significant progress, further research and sustainable improvement are still needed to ensure its wider and more effective application in society.

CONCLUSION

In this study, a special attention was given to the development of aid technology to improve the life quality of runners with disabilities. This research revealed that the use of smartphones as an affordable and versatile support tool had opened up new opportunities for individuals with various types of sensory disabilities, such as blind, diabetes, mental health problems, epilepsy, and communication barriers. In addition, significant advances had been apparent in the system development, such as electromagnetic guidance, computer-based vision devices, passive dynamics-based bipedal robots, and mechatronic systems with haptic feedback. All of which promised improved mobility and independence, especially for running athletes and individuals with visual impairment.

Nevertheless, the study also identified a number of challenges to overcome. This included the increased stability and security of technology, as well as the need for individual adaptation and the ability to adapt to a variety of environments. Increased research and development of auxiliary technology is seen as the key to overcome these barriers and ensure a wider and more effective application of future assistive technologies.

Overall, the results of this literature review confirm that assistive technology not only has the potential to enhance physical independence but also provides significant psychosocial benefits to individuals with disabilities. It is expected that this research will serve as a foundation for advanced research in assistive technology for blind runners, making greater positive contributions to their quality of life. This will enable them to engage more actively in various aspects of everyday life and their social interactions.

ACKNOWLEDGEMENT

Thank you to everyone who contributed to this article. Without your cooperation and dedication, this article would not have been possible. Hopefully, this article can provide positive values for readers. Thank you for your extraordinary cooperation and support.

CONFLICT OF INTEREST

The authors declared no conflict of interest.

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