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ORIGINAL ARTICLE

K-HERO: An innovative tool for motor sciences

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ABSTRACT

The K-HERO represents a groundbreaking advancement in motor sciences due to its integration of advanced sensors, artificial intelligence, and analytical software. This innovative tool enables the precise collection of data on the kinetic and kinematic parameters of human movement, providing a detailed analysis of biomechanics. Its primary applications include rehabilitation, sports training, and scientific research. K-HERO allows for accurate assessment of physical performance, injury prevention, and the optimization of training programs, enhancing movement quality and the sustainability of physical activities.
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INTRODUCTION

In recent years, technological advancements have led to a significant transformation in the field of motor sciences, introducing innovative tools and devices capable of enhancing the understanding, assessment, and optimization of physical performance. The increasing availability of advanced technologies, including motion sensors, artificial intelligence, and real-time monitoring devices, has enabled the collection and analysis of data with unprecedented precision. This has had a profound impact across a wide range of applications, from rehabilitation and physical therapy to sports training, scientific research, and injury prevention.

Among the most promising innovations in this landscape, K-HERO by the company Drop emerges as a cutting-edge tool that combines inertial sensors, artificial intelligence, and advanced analytical software. K-HERO is designed to monitor and analyse human movement dynamics in real time, allowing for an accurate and detailed evaluation of biomechanical parameters. Its versatility makes it applicable to various contexts, including enhancing athletic performance, personalizing rehabilitation programs, and conducting in-depth biomechanical analysis in scientific research.

The objective of this article is to explore the technical features of K-HERO, analyse its applications in clinical, sports, and academic fields, and evaluate its potential impact on professional practice in motor sciences. The article will examine the tool's usage for measuring and analysing movements, as well as the benefits it offers for early diagnosis, injury prevention, athletic performance improvement, and rehabilitation. Furthermore, the discussion will address the added value that K-HERO represents for the educational sector, preparing future motor science professionals to engage with emerging technological frontiers and to meet the challenges of an ever-evolving market.

TECHNICAL DESCRIPTION

K-HERO is a device that combines advanced sensors, artificial intelligence, and analytical software to provide precise measurements of human movement dynamics. It features:

- *Inertial Sensors:* Detect accelerations, angular velocities, and spatial orientations.
- *Integrated Software:* Analyses the collected data and delivers detailed real-time reports.
- *Wireless Connectivity:* Allows integration with external devices such as smartphones, tablets, or computers.
- *Advanced Ergonomics:* Designed to adapt seamlessly to the human body without interfering with movement.

Its compact design and ease of use make K-HERO a versatile tool for a wide range of applications, from functional assessment to rehabilitation.

APPLICATIONS IN MOTOR SCIENCES

Rehabilitation and physiotherapy

K-HERO is widely used in rehabilitation, enabling healthcare professionals to monitor patients' motor recovery with high precision. Due to its ability to analyse movement biomechanics, the device is useful for:

- Assessing motor dysfunctions following injury.
- Monitoring progress during the recovery process.

- Personalizing rehabilitation programs based on objective data.

This data-driven approach enhances therapy effectiveness, shortens recovery times, and improves patients' quality of life.

Biomechanical analysis

A Strategic Ally in Movement Assessment Biomechanical analysis is a fundamental tool for understanding human movement in detail, offering an in-depth view of both motor capabilities and potential defects or imbalances. In this context, K-HERO proves to be an indispensable ally, capable of accurately and reliably measuring a wide range of biomechanical parameters, including:

Kinetic and kinematic parameters of movement

K-HERO records and analyses kinematic parameters such as speed, acceleration, and joint angles during movement. Additionally, it measures kinetic parameters, including forces and torque generated during physical activity. The accuracy of these measurements allows for a precise understanding of movement dynamics, helping to determine whether an athlete or patient performs movements correctly or exhibits alterations that could compromise performance or lead to injury.

Functional asymmetries and imbalances

One of K-HERO's most significant applications is its ability to detect functional asymmetries—differences in movement between the right and left sides of the body. This is particularly useful in both sports and rehabilitation contexts, as asymmetries can indicate compensatory mechanisms or muscular imbalances. Identifying and correcting these discrepancies is essential to prevent injuries and ensure optimal performance, especially in disciplines requiring symmetry and coordination.

Energy efficiency during physical activity

K-HERO not only measures movement quality but also analyses the subject's energy efficiency during exercise or physical tasks. This is crucial for optimizing performance, as it helps identify whether an athlete is expending more energy than necessary to execute a specific movement. Energy efficiency is a critical component in both sports, to enhance endurance and performance, and rehabilitation, to prevent the overloading of bodily structures during recovery.

Benefits of biomechanical analysis with k-hero

Performance Optimization: With precise measurements, coaches and industry professionals can design customized training programs focused on improving technique and enhancing physical performance. By analysing forces and movements, specific areas for improvement can be identified and progress monitored over time.

Injury prevention

Early detection of asymmetries or inefficient movements allows for preventive measures to avoid injuries. Incorrect or inefficient movements, if not properly identified, can accumulate over time, causing structural damage or premature wear. K-HERO helps reduce the risk of long-term injuries by improving the sustainability of physical activities.

Personalized rehabilitation

In rehabilitation settings, biomechanical analysis with K-HERO is essential for monitoring recovery and adapting treatment to individual patient needs. For instance, if a patient is recovering from an injury, K-HERO can assess whether the movement is symmetrical and functional, guiding the physical therapist in tailoring the rehabilitation program accordingly.

Sustainability of physical activities

Continuous monitoring of movement biomechanics enables optimization of exercise approaches, making activities less strenuous and more efficient. This not only enhances performance but also promotes longevity in active individuals, whether in sports or everyday contexts where physical activity is often performed sub optimally.

In summary, utilizing K-HERO for biomechanical analysis presents a valuable opportunity to significantly improve human movement quality. By collecting precise and detailed data, it is possible to intervene promptly to correct anomalies, enhance performance, and reduce the risk of injuries, ultimately leading to greater efficiency and long-term physical sustainability.

Sports training

K-HERO represents a highly valuable tool in the world of sports. It can be used to:

- Evaluate athletic performance in disciplines such as running, soccer, tennis, and more.
- Identify areas for technical improvement.
- Optimize workloads while reducing the risk of injury.

The detailed analysis provided by K-HERO allows coaches and athletes to personalize training programs, improve movement biomechanics, and achieve optimal results in less time. This positive impact not only enhances performance but also contributes to the longevity of an athlete's career.

Scientific research

Thanks to the precision of its measurements, K-HERO is particularly useful in academic and research settings. The data collected can be used for:

- Studies on the effectiveness of new training protocols.
- Comparative analyses of different rehabilitation approaches.
- In-depth investigations of movement-related pathologies.

The use of K-HERO in scientific contexts promotes the production of innovative knowledge and the adoption of evidence-based practices, accelerating progress in motor sciences.

Benefits and Innovation K-HERO represents a significant advancement over traditional movement analysis methods. Its main advantages include:

- Real-Time Measurements: The ability to obtain immediate feedback allows for timely and targeted interventions.
- Portability and Flexibility: Its compact, wireless design makes it usable in various environments, from laboratories to sports fields.
- Objective Data: The use of advanced technologies ensures precise and reproducible data collection.
- Adaptability: It can be adapted for various users, ranging from rehabilitation patients to professional athletes.

These features make it a particularly appreciated tool not only by professionals and researchers but also by athletes who can benefit from continuous and personalized monitoring.

POSITIVE IMPACT ON MOTOR SCIENCES

The introduction of K-HERO into motor sciences has a significant impact on various aspects:

- Improvement in Quality of Life: In rehabilitation settings, precise monitoring and personalized therapeutic interventions accelerate recovery and enhance overall patient well-being.
- Optimization of Athletic Performance: Athletes, through the data provided by K-HERO, can identify weaknesses and areas for improvement, refining techniques and maximizing performance.
- Injury Prevention: Movement analysis and the early identification of imbalances or biomechanical errors contribute to reducing the risk of injuries, ensuring greater safety during physical activities.
- Innovation in Training and Rehabilitation Protocols: The use of advanced technologies promotes the development of more effective and targeted approaches, redefining the standards of motor sciences.

Empirical evidence

A recent survey conducted at the University of Urbino involved students from the degree program in Motor Sciences, revealing significant data regarding interest in K-HERO. According to the results, 70% of the surveyed students expressed a willingness to work with this technological tool, identifying it as a key opportunity to enhance their professional skills and address the challenges of the field.

Respondents highlighted three main reasons behind their enthusiasm for K-HERO:

- Technological Innovation: Students emphasized that K-HERO's ability to offer precise measurements and detailed analyses represents a clear advantage over traditional methods of human movement assessment. Its use is seen as an opportunity to acquire skills aligned with the latest innovations in motor sciences.
- Application Versatility: Students recognized the potential of K-HERO in a variety of contexts, including rehabilitation, sports training, and scientific research. This flexibility makes it useful both for those pursuing a clinical career and for those aspiring to work with professional athletes.
- Workforce Preparation: The use of K-HERO is perceived as an added value in academic training, allowing students to enter the labour market with advanced skills and the ability to operate state-of-the-art technological tools. This aspect is particularly relevant in an increasingly competitive and data-driven job market.

Implications of the study

The findings reflect a growing interest among new generations in integrating innovative technologies into motor sciences. Seventy percent of respondents also emphasized that tools like K-HERO not only enhance professional approaches but also increase confidence in their ability to deliver personalized and effective interventions to future clients or patients.

Furthermore, the collected feedback highlights a trend toward greater use of advanced technologies in academic curricula, suggesting that educational institutions could benefit from incorporating tools like K-HERO into their study programs. This integration could contribute to training a new generation of highly skilled motor science professionals capable of meeting the demands of an evolving sector.

CONCLUSIONS

K-HERO represents a paradigmatic example of how technology can enhance motor sciences. Its versatility, combined with the accuracy of its measurements, makes it a valuable tool in various contexts: from rehabilitation to biomechanics, from sports training to scientific research. With tools like K-HERO, the future of motor sciences is increasingly oriented towards a data-driven, integrated approach, capable of significantly improving both quality of life and physical performance for individuals and athletes.

Moreover, the results of the initial applications suggest substantial potential for further developments. The survey conducted at the University of Urbino indicates that the majority of Motor Science students are interested in working with tools like K-HERO, signalling that new generations recognize the value of technological innovation.

The study on K-HERO will continue, exploring a practical comparison with the virtual reality system RIABLO. This research phase aims to identify the strengths and weaknesses of each approach, evaluating which technology best meets different needs in rehabilitation and motor performance enhancement. This comparison will provide further insights into the future use of advanced technologies in motor sciences, expanding opportunities for professionals and researchers in the field.

AUTHOR CONTRIBUTIONS

R.G.B conceptualized the study, designed the research methodology, and supervised the overall project. R.S conceptualized the study, designed the research methodology, and supervised the overall project. D.F. contributed equally to the study. M.S. contributed equally to the study. C.B. conceptualized the study, designed the research methodology, and supervised the overall project.

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No potential conflict of interest was reported by the authors.

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