DOI: 10.2507/36th.daaam.proceedings.016

COMPARISON OF DIFFERENT MOTION CAPTURE TECHNOLOGIES FOR GAIT ANALYSIS AND SUGGESTIONS FOR IMPLEMENTATION IN TOURISM APPLICATIONS

Antonio Maria Coruzzolo[1]*, Chiara Forgione[2],
Elia Balugani[1,2], Rita Gamberini[1,2] & Andrea Roversi[3]

[1] Department of Sciences and Methods for Engineering, University of Modena and Reggio Emilia, Via Amendola 2, Padiglione Morselli, 42122 Reggio Emilia, Italy

[2]Department of Biomedical, Metabolic and Neural Sciences, University of Modena and Reggio Emilia, Via Giuseppe Campi 287, 41125 – Modena, Italy

[3] En&Tech Interdepartmental Center of the University of Modena and Reggio Emilia, Piazzale Europa 1, 42124 Reggio Emilia, Italy

** Corresponding author*

This Publication has to be referred as: Coruzzolo, A[ntonio] M[aria]; Forgione, C[hiara]; Balugani, E[lia]; Gamberini, R[ita] & Roversi, A[ndrea] (2025). Comparison of Different Motion Capture Technologies for Gait Analysis and Suggestions for Implementation in Tourism Applications, Proceedings of the 36th DAAAM International Symposium, pp.0122-0130, B. Katalinic (Ed.), Published by DAAAM International, ISBN 978-3-902734-47-1, ISSN 1726-9679, Vienna, Austria
DOI: 10.2507/36th.daaam.proceedings.016

Abstract

In the framework of Industry 5.0, where human well-being, ergonomics, and human–machine interaction are increasingly emphasized, gait analysis offers valuable insights to improve working conditions, prevent injuries, and enhance human-cantered design. This study compares three motion capture (MoCap) technologies namely Azure Kinect (RGB-depth camera), AiQ Synertial G6 Suit (IMU-based wearable), and Vicon Vero (marker-based optical reference system) in order to evaluate their accuracy in gait detection. Eight volunteers performed standardized walking tasks, with kinematic analysed across the three systems. Results show that the choice of device depends on the application context: Azure Kinect is more suitable for rapid and cost-effective assessments, whereas the G6 Suit enables more in-depth analyses. Beyond ergonomics, this work highlights the potential of gait analysis in tourism environments, such as optimizing visitor flow in museums and heritage sites, improving accessibility for mobility-impaired tourists, and supporting smart tourism infrastructures through adaptive systems that respond to human movement. These suggestions open the door to innovative applications of MoCap in cultural and tourism contexts, where technology can contribute both to inclusivity and to enhanced visitor experiences.

Keywords: Motion Capture Technologies; Gait Analysis; Kinect; Vicon; Tourism

1. Introduction

In the framework of Industry 5.0, where human well-being, ergonomics, and human–machine interaction are central [1] [2], motion capture technologies have become increasingly relevant to improve working conditions, prevent injuries, and foster human-centred design [3] [4], [5]. At the same time, the tourism sector has experienced a technological revolution in the study of human mobility, enabled by GPS, mobile positioning, geocoded social media data, and Bluetooth tracking [6], [7]. These advances allow the collection of high-resolution space–time data over extended periods [8], which has transformed tourism research by offering insights into flows, accessibility, and destination management [9]. Despite these progresses, location-based tracking methods primarily capture where tourists move, but not how they move [10]. This limitation is significant because travel and movement are themselves part of the tourism experience [11] and should not be overlooked.

Literature on journey experiences shows that mobility contributes to sensory, affective, and social dimensions of tourism, shaping satisfaction and sustainability outcomes [12], [13], [14]. The “experience economy” perspective [15] and mobilities geographies [16] emphasize that displacement is not merely a transition between places, but an integral process that can enrich or constrain the tourist experience. This opens space for the application of motion capture (MoCap) technologies, which can complement geolocation data with kinematic and spatiotemporal variables. Unlike conventional tracking, MoCap technologies enables the detailed assessment of gait and posture, providing new ways to understand both physical performance and experiential quality based on visitors’ movement. MoCap applications in the manufacturing sector have increased during the last years but remain underexplored in other economic sectors as the tourist one [17], [18], [19].

In this study, we compare three systems: Azure Kinect (RGB-depth camera), AiQ Synertial G6 Suit (IMU-based wearable), and Vicon Vero (marker-based optical reference system) with an experiment that involved eight volunteers performed standardized walking tasks in a neutral space resembling an exposition site. The methods employed are discussed in Section 2, while the experiment and results obtained are discussed in Section 3 and Section 4 respectively. While Section 5 presents potential areas of MoCap technologies application in the tourism sector and Section 6 reports our conclusion and future research agenda.

2. Methods

The present study aims to compare different Motion Capture (MoCap) systems by analysing kinematic data. Specifically, two parameters were monitored:

1. Knee angles (right and left).
2. Hip angles (right and left).

These parameters were selected as they are representative indicators of gait analysis. The MoCap systems employed in this study are a gold standard marker-based system, used as the reference; a marker less system; and an Inertial Measurement Unit (IMU) based system.

2.1. Description of MoCap technologies

In this study, three different MoCap technologies were employed. First, the Vicon Vero v2.2, a marker-based optoelectronic system widely regarded as the gold standard in human motion analysis, was used as the reference method. The system enables highly accurate three-dimensional reconstruction of movement through multiple infrared cameras and 39 passive markers. Second, the Azure Kinect, a marker less system integrating RGB and infrared depth cameras with AI-based body tracking algorithms, was applied to capture motion without the need for physical markers. Finally, the AiQ Synertial G6 Suit, an inertial MoCap suit equipped with 19 IMU sensors, was used to record kinematic data real time. Data obtained with the Vicon system were considered the benchmark for evaluating the performance of the Kinect and the inertial suit.

2.2. Kinematic data processing

This paragraph presents an effective method for processing motion data from each device, aiming to facilitate their use in context such as scientific studies and in-depth analysis. To analyse kinematic data, it was necessary to define the body joints tracked by each technology. For the Vicon Vero system, the Plug-in Gait full-body model [20] was used, and the labelled skeleton template is shown in Figure 1. For Azure Kinect, the Body Tracking SDK [21] extracted the body joint hierarchy, as illustrated in Figure 2. For the AiQ Synertial G6 Suit, Syndash software was used [22] to record and process real-time data, generating a virtual skeleton displayed in Figure 3. Since the focus of this study was on knee and hip angles, a specific set of joints was selected for each systems to construct the vectors of interest, corresponding to the joint names in the respective system hierarchies (Table 1).

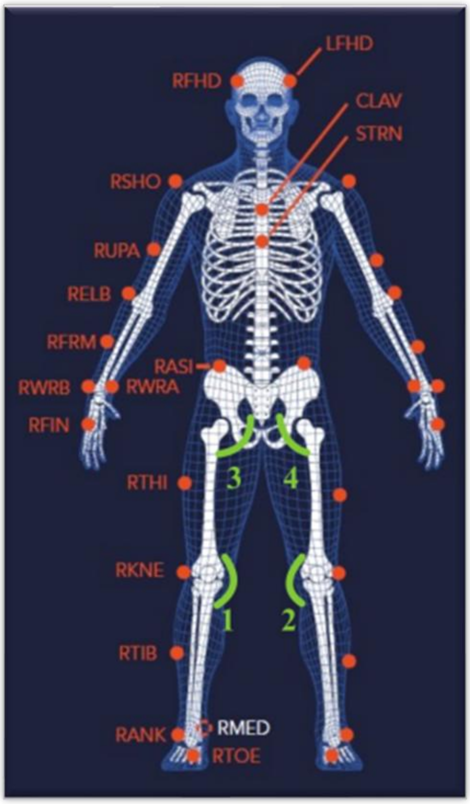

Fig. 1. Body joint hierarchy of Plug-in Gait full-body model [20].

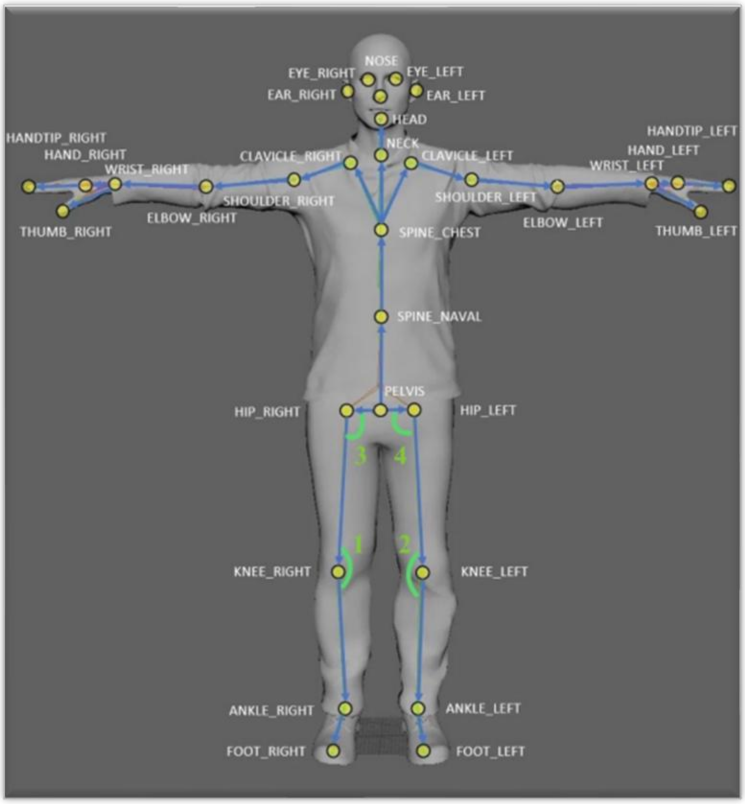

Fig. 2. Body joint hierarchy of Body Tracking SDK [21].

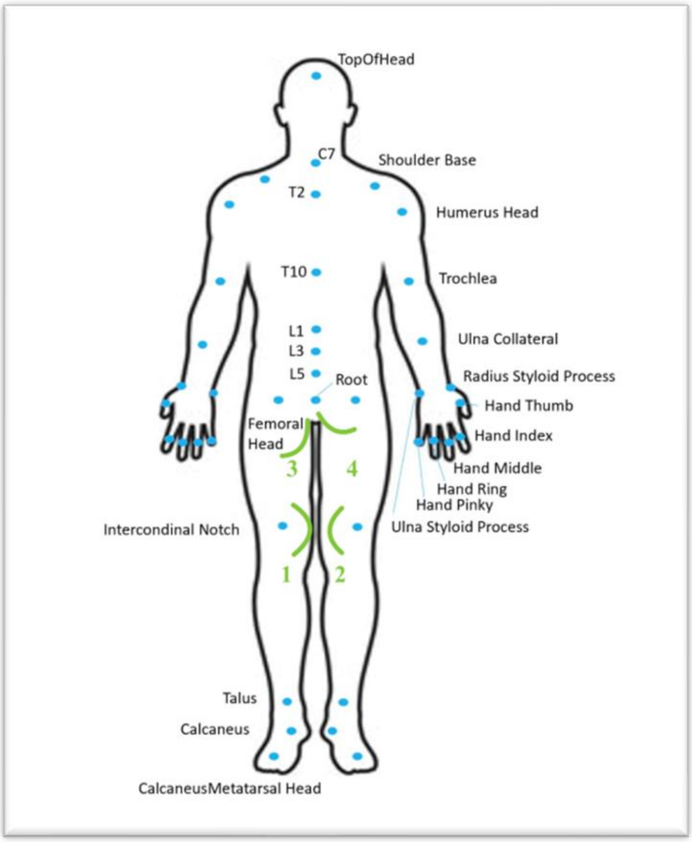

Fig. 3. Body joint hierarchy from Syndash [22].

Angle	Marker-based vectors	Markerless vector	IMU vectors
Right knee	RTHI – RKNEE and RKNEE – RTIB	HIP_RIGHT – KNEE_RIGHT and KNEE_RIGHT – ANKLE_RIGHT	Right Femoral Head – Right Intercondinal Notch and Right Intercondinal – Right Talus
Left knee	LTHI – LKNEE and LKNEE – LTIB	HIP_LEFT – KNEE_LEFT and KNEE_LEFT – ANKLE_LEFT	Left Femoral Head – Left Intercondinal Notch and Left Intercondinal – Left Talus
Right hip	RPSI – RASI and RASI – RTHIS	PELVIS – HIP_RIGHT and PELVIS – HIP_LEFT	Root – Right Femoral Head and Right Femoral Head – Right Intercondinal Notch
Left hip	LPSI – LASI and LASI – LTHIS	PELVIS – HIP_RIGHT and PELVIS – HIP_LEFT	Root – Left Femoral Head and Left Femoral Head – Left Intercondinal Notch

Table 1. Joints and vectors defined for the computation of knee and hip angles across the MoCap systems: marker-based (Vicon), markerless (Azure Kinect), and IMU-based (AiQ Synertial G6 Suit).

3. Experiments

To evaluate the effectiveness and accuracy of the Motion Capture systems under investigation, an experimental setup was established in a laboratory environment. Several walking trials were conducted with different subjects, while each system simultaneously recorded the movements. This design allowed for the assessment of each technology's functionality in a practical context, using cases that were as varied and representative as possible. The experimental setup included:

- 8 Vicon Vero v2.2 cameras and 39 body markers,
- 2 Azure Kinect cameras,
- An AiQ Synertial G6 Suit with 19 IMUs,
- 4 high-performance laptops.

Figure 4 illustrates the experimental setup.

Fig. 4. Experimental setup.

Seven participants took part in the experiment, specifically five males and two females. The participants' characteristics are reported in Table 2.

ID	Age	Weight (kg)	Height (cm)	Leg length (cm)	Knee width (cm)	Ankle width (cm)
1	22	83	183	97	10.5	7.5
2	22	76	190	102	10.5	7
3	22	81	194	107	11	7
4	27	67	171	105	11.5	7.5
5	34	69	176	104	11.5	8
6	29	92	185	106	11.5	7.5
7	35	58	160	100	10.5	6

Table 2. Demographic and anthropometric characteristics of study participants.

Each participant performed two walking trials of 120 seconds within the area shown in Figure 5, following the indicated path. The walking area and space resemble an exhibition space. At the beginning of each trial, participants performed a squat position to synchronize all systems acquisitions.

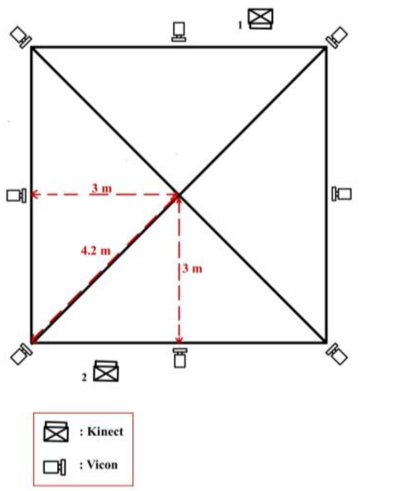

Fig. 5. Experimental walking area used in the study.

Following the preliminary analysis of the angular trend graphs, limitations were observed with the two Kinect devices. Specifically, the recording area, that was relatively wide and not a straight walkway, did not provide optimal conditions for accurate data capture with these systems. Consequently, four acquisitions were excluded from the analysis.

4. Results

During the experiment, seven subjects performed two walking trials of 120 seconds each. However, the Kinect did not provide accurate data for some acquisitions; therefore, from the total 14 recordings, only ten were analysed in this section. The results present a comparison of the three systems (Vicon marker-based, Azure Kinect markerless, and G6 Suit IMU) for the calculation of knee and hip angles during walking. Table 3 reports the mean values of the angles. The mean standard deviation is also included in the table as an indication of the oscillation range of each angle, thus reflecting specific characteristics of each subject's gait. Subsequently, data from Azure Kinect and G6 Suit were compared with the Vicon results by calculating the Root Mean Square Error (RMSE) and the Normalized Root Mean Square Error (NRMSE), which quantify the deviation of each system from the reference (Table 4).

System	Angle	Mean (°)	Mean Std. Dev. (°)
Vicon Vero	Left Knee	161.776	17.328
	Right Knee	156.242	18.113
	Left Hip	94.728	10.295
	Right Hip	99.504	10.403
Azure Kinect	Left Knee	154.593	15.407
	Right Knee	155.153	15.250
	Left Hip	99.796	7.291
	Right Hip	120.208	7.613
Synertial G6 Suit	Left Knee	153.661	23.762
	Right Knee	152.029	23.946
	Left Hip	88.066	7.482
	Right Hip	152.029	12.945

Table 3. Mean and standard deviation of joint angles across MoCap systems.

System	Angle	RMSE (°)	NMRSE
Azure Kinect	Left Knee	23.494	0.150
	Right Knee	23.787	0.152
	Left Hip	15.337	0.169
	Right Hip	20.129	0.181
Synertial G6 Suit	Left Knee	24.009	0.157
	Right Knee	23.495	0.167
	Left Hip	16.995	0.194
	Right Hip	13.872	0.144

Table 4. Root Mean Square Error (RMSE) and Normalized Mean Square Error (NRMSE) with respect to Vicon Vero.

Figure 6 presents a detailed analysis of flexion angles among the three systems. For knee flexion angles, all systems report values within the range approximately 145 to 175 degrees. The median values of both Kinects and the G6 Suit are comparable to those obtained with the Vicon Vero. Both Vicon and the Synertial G6 Suit show greater data dispersion, which can be explained by the higher number of data and the higher acquisition frequency compared to the Kinect systems. The lower amount of data acquired by the Kincts is mainly due to the larger monitored area; in practice, only about 50% of the data was used, whereas for the G6 Sut nearly 100% of the data was comparable with Vicon. For hip flexion angles, the measured range is 78 to 113 degrees, with a slight underestimation of the Kinect and G6 Suit values compared to the Vicon Vero, which appears more accurate in capturing hip movements. Nevertheless, both the Kinects and the G6 Suit demonstrated reliability in angle detection, as their overall measurements ranges were consistent with those of the Vicon Vero.

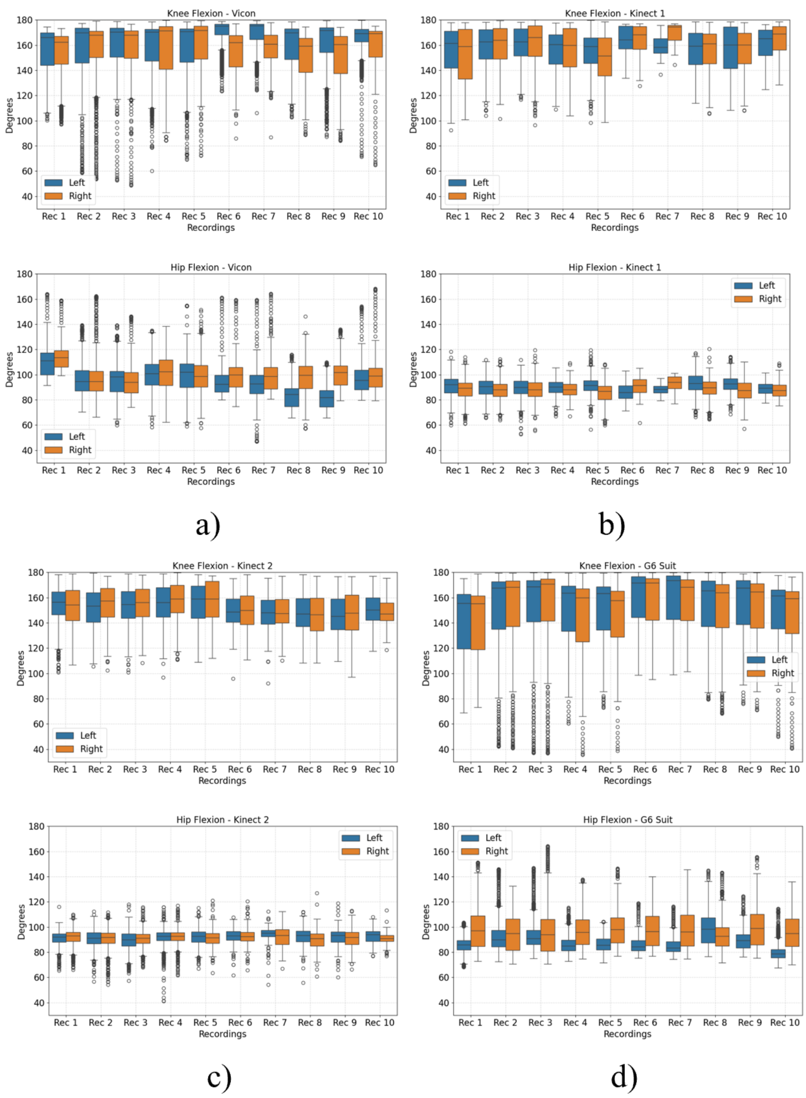

Fig. 6. Boxplots of analysed angles across 10 recordings for three technologies: a) Knee and hip flexion angles measured with Vicon Vero, b) Knee and hip flexion angles measured by the first Kinect, c) Knee and hip angles measured with the second Kinect, d) Knee and hip flexion angles measured with the Synertial G6 Suit.

5. Tourism applications suggestions

Our study focuses on the use of results collected regarding technologies experimented with in the tourism sector. The integration of these technologies enables various possible applications depending on their specific features. Motion capture technologies, for instance, can be employed either for a limited period of research or on a continuous basis with different purposes. In the case of limited use, they may support targeted studies involving a small sample, allowing precise adjustments to the structure and organization of the tourist site or in the redesign of an exhibition space. Continuous use, on the other hand, enables constant monitoring and the collection of large volumes of data, which can be leveraged to adapt and continuously improve the tourist experience. Our research, starting from the literature, has identified three main area of applications: accessibility, flow analysis, and interactivity.

5.1. Accessibility enhancement for people with impaired mobility

There has long been a growing interest in the tourism sector in promoting inclusive and accessible experiences. Investing in accessibility brings various benefits to stakeholders in tourism: it improves the image of destinations and tourism businesses; broadens the tourism market (with more than 1 billion people with disabilities worldwide [23]); contributes to a fairer and safer world for all; drives sustainable economic growth; and aligns with ESG, SDG, and ISD strategies adopted by companies and institutions [24], [25]. Accessible spaces are usually designed in advance by following conventional guidelines and hypothetical user journeys. However, real-world testing is rarely carried out, and systematic monitoring after implementation is almost never performed. The use of motion capture technology makes it possible to evaluate movement quality and monitor the real behaviour of people with reduced mobility within a given space. This would enable tourism experiences to become truly inclusive and accessible for individuals with motor disabilities or for older adults [26]. By collecting such data, it would be possible to identify personas that represent specific needs, allowing for the design of tailored pathways and support services. In this way, user journeys would be genuinely inclusive and accessible, as they would be based on real-world data rather than assumptions [27].

5.2. Attractiveness evaluation and tourists' flux design

The study of flows and the movement of people within a space makes it possible to identify areas of greatest interest. By using motion capture cameras, it is possible to measure the trajectories and walking speed of individuals or groups. These data provide indirect feedback on the level of interest in specific elements or zones, as it can be reasonably assumed that speed decreases in areas of higher interest, where visitors stop to observe, and increases in less engaging areas. For example, in museums, crowding often occurs around certain works of art, making circulation and enjoyment more difficult [28]. When aggregating this data, it becomes possible to understand the overall flow of tourists and to redesign and enhance the visitor experience by adapting pathways to better manage traffic and redistribute points of interest. In this way, the experience can be made engaging from beginning to end, while also reducing congestion and improving both quality and safety [29].

5.3. Interactive and immersive motion-based experiences

The inclusion of interactive digital elements in tourism experiences is becoming increasingly widespread, often associated with the use of touchscreens that provide information from an edutainment perspective. In the artistic domain, there are also works that interact with the public through sensors, changing and responding to external inputs processed by dedicated software, including artificial intelligence. These new opportunities enabled by creative applications of digital technologies make it possible to attract new tourism targets, such as young people and families with children, thereby broadening the audience's interest in cultural and tourism offerings [30]. In particular, the use of motion capture cameras allows the integration of visitors' movements into the experience as an integral part of the place they are visiting or of the artifacts and artworks they are observing. The reprocessing of movements captured by the cameras can be incorporated into virtual reality (VR) or augmented reality (AR) experiences. Especially in the case of AR, real elements of a tourist site can be combined with digital components that add an experiential layer through video, lights, and sounds [31]. This represents an opportunity to innovate traditional tourism and museum experiences, expanding their accessibility and appeal. At present, part of the authors of this research is engaged in an experimental project aimed at innovating a museum itinerary dedicated to the tenor Luciano Pavarotti, through the digitization of artifacts and their use within VR and AR experiences. The implementation of immersive digital experiences makes it possible to attract a new segment of younger visitors, who are not typically consumers of opera [32].

6. Conclusions

This study compared three motion capture technologies, Vicon Vero, Synertial G6 Suit, and Azure Kinect, for detecting knee and hip flexion during walking, with the aim of assessing their usability in real-world contexts and identifying suitable applications in the tourism sector. The Vicon Vero, a marker-based system, was used as the reference due to its well-established accuracy and high-quality data.

The Synertial G6 Suit, an IMU-based system, also demonstrated high accuracy; however, its applicability is limited to controlled environments, as the need to wear a full suit makes it impractical and intrusive in real-world or outdoor scenarios. The Azure Kinect, a marker less and low-cost solution, showed promising accuracy in the measurements. The main limitation, however, was the difficulty in data acquisition, likely due to the large, monitored area. Even with two Azure Kinect devices, coverage may not have been sufficient, highlighting the need to better define how many devices are required for different setups. Overall, our findings suggest that a low-cost, marker less system such as the Azure Kinect can achieve a meaningful level of accuracy without being invasive, making it particularly well-suited for application such as tourism or non-clinical motion analysis. Conversely, it remains unstable for applications requiring a high level of precision, such as medical diagnostics. Future work should therefore focus on determining the optimal number of Kinect sensors relative to the size and complexity of the monitored area. The practical implications of these findings are particularly relevant in tourism contexts. First, motion capture technologies can play a key role in enhancing accessibility for people with reduced mobility by monitoring real behaviours and identifying barriers in real time, leading to more inclusive and data-driven design of tourist spaces. Second, flow analysis based on movement trajectories can help managers understand visitor interests, reduce congestion, and optimize circulation within attractions such as museums and heritage sites. Finally, interactive and immersive applications enabled by motion capture, such as AR/VR experiences or responsive installations, offer opportunities to engage new audiences, particularly younger visitors, and expand the cultural offering of destinations.

Overall, while marker-based and wearable systems remain more suited to specialized research or clinical applications, markerless solutions like Azure Kinect provide an attractive balance of usability, affordability, and accuracy for tourism contexts. Future work should focus on identifying the optimal sensor configuration for large or complex environments and on piloting real-world applications in museums, exhibitions, and heritage sites to validate the added value of motion capture in fostering accessibility, flow management, and experiential innovation.

7. Acknowledgments

Project partially funded under the National Recovery and Resilience Plan (NRRP), Mission04 Component 2 Investment 1.5—NextGenerationEU, Call for tender n. 3277 dated 30 December2021. Award Number: 0001052 dated 23 June 2022.

8. References

[1] Lolli, F., Coruzzolo, A.M., Gonçalves Terra Neto, P., Afonso Sellitto, M., Gamberini, R. (2021). Key Enabling Technologies and Concepts for the Human-Centric Industrial Revolution. In: Human Factors and Wearable Technologies. AHFE International. https://doi.org/10.54941/ahfe1003625.

[2] Nakatova, H., Hricova, B., Badida, M. (2011). Use of Ergonomics in Design Selected Department Workspace in Engineering Company. In: Proceedings of the 22nd International DAAAM Symposium. pp. 1229–1230 (2011). https://doi.org/10.2507/22nd.daaam.proceedings.599.

[3] Bures, M. (2016). Time Demands of Virtual Ergonomic Modelling – Experimental Study. In: Proceedings of the 26th DAAAM International Symposium. pp. 0286–0291. https://doi.org/10.2507/26th.daaam.proceedings.039.

[4] Rybnikár, F., Kačerová, I., Hořejší, P., Šimon, M. (2022). Ergonomics Evaluation Using Motion Capture Technology—Literature Review. Applied Sciences. 13, 162 (2022). https://doi.org/10.3390/app13010162.

[5] Lolli, F., Coruzzolo, A.M., Forgione, C., Peron, M., Sgarbossa, F. (2024). Auto-AzKNIOSH: an automatic NIOSH evaluation with Azure Kinect coupled with task recognition. Ergonomics. 1–17. https://doi.org/10.1080/00140139.2024.2433027.

[6] Shoval, N., Isaacson, M., Chhetri, P. (2014). GPS, Smartphones, and the Future of Tourism Research. In: The Wiley Blackwell Companion to Tourism. pp. 251–261. Wiley. https://doi.org/10.1002/9781118474648.ch20.

[7] Shoval, N., Birenboim, A. (2019). Customization and augmentation of experiences through mobile technologies: A paradigm shift in the analysis of destination competitiveness. Tourism Economics. 25, 661–669. https://doi.org/10.1177/1354816618806428.

[8] Ahas, R., Miller, H.J., Witlox, F. (2014). From the Guest Editors: Mobility, Communication, and Urban Space. Journal of Urban Technology. 21, 1–7. https://doi.org/10.1080/10630732.2014.913420.

[9] Ahas, R., Aasa, A., Silm, S., Tiru, M. (2010). Daily rhythms of suburban commuters' movements in the Tallinn metropolitan area: Case study with mobile positioning data. Transp Res Part C Emerg Technol. 18, 45–54. https://doi.org/10.1016/j.trc.2009.04.011.

[10] Asakura, Y., Iryo, T. (2007). Analysis of tourist behaviour based on the tracking data collected using a mobile communication instrument. Transp Res Part A Policy Pract. 41, 684–690. https://doi.org/10.1016/j.tra.2006.07.003.

[11] Zakrisson, I., Zillinger, M. (2012). Emotions in motion: tourist experiences in time and space. Current Issues in Tourism. 15, 505–523 https://doi.org/10.1080/13683500.2011.615391.

[12] Scuttari, A. (2019). Cycling and Motorcycling Tourism. Springer International Publishing. https://doi.org/10.1007/978-3-030-17697-6.

[13] Larsen, J. (2001). Tourism Mobilities and the Travel Glance: Experiences of Being on the Move. Scandinavian Journal of Hospitality and Tourism. 1, 80–98. https://doi.org/10.1080/150222501317244010.

[14] Lohmann, G., Pearce, D.G. (2012). Tourism and Transport Relationships: The Suppliers' Perspective in Gateway Destinations in New Zealand. Asia Pacific Journal of Tourism Research. 17, 14–29. https://doi.org/10.1080/10941665.2011.613211.
[15] Pine, B.J., Gilmore, J.H. (2013). The experience economy: past, present and future. In: Handbook on the Experience Economy. Edward Elgar Publishing https://doi.org/10.4337/9781781004227.00007.
[16] Urry, John. (2010). Mobilities. Polity.
[17] Lolli, F., Maria Coruzzolo, A., Forgione, C., Gonçalves Terra Neto, P. (2023). Ergonomic Risk Reduction: A Height-Adjustable Mesh Truck for Picking Activities Evaluated With A Depth Camera. In: Ergonomics In Design. AHFE International.https://doi.org/10.54941/ahfe1003371.
[18] Lolli, F., Coruzzolo, A.M., Forgione, C., Peron, M., Sgarbossa, F. (2024). Semiautomatic rapid upper limb assessment methods: validation of AzKRULA. Int J Hum Factors Ergon. 11, 309–330 https://doi.org/10.1504/IJHFE.2024.143266.
[19] Di Natali, C., leggieri, S., Fanti, V., Forgione, C., Coruzzolo, A.M., Lolli, F., Caldwell, D.G. (2025). Pilot Test to Evaluate Ergonomic Risk of Industrial Exoskeleton with Semi-autonomous Method that Relies on AzKCLI and the Equivalent Weight. Springer Proceedings in Advanced Robotics. https://doi.org/10.1007/978-3-031-89471-8_21.
[20] Vicon Motion Systems Ltd UK: https://help.vicon.com/space/Nexus216/11607226/Full+body+modeling+with+Plug-in+Gait.
[21] Microsoft: Azure Kinect Body Tracking SDK | Microsoft Docs, https://docs.microsoft.com/it-it/azure/kinect-dk/body-sdk-download, last accessed 2021/07/30.
[22] AiQ Synertial: https://www.synertial.com/.
[23] WHO: https://www.who.int/news-room/fact-sheets/detail/disability-and-health.
[24] Kasimoglu, M. (2012). Visions for Global Tourism Industry - Creating and Sustaining Competitive Strategies. InTech. https://doi.org/10.5772/2278.
[25] UNWTO: https://tourism4sdgs.org/themes/accessible-tourism/.
[26] Yao, T., Jiang, B., Zhao, L., Chen, W., Sang, Y., Jia, Z., Wang, Z., Zhong, M. (2025). Research on Optimization of Indoor Layout of Homestay for Elderly Group Based on Gait Parameters and Spatial Risk Factors Under Background of Cultural and Tourism Integration. Buildings. 15, 2498. https://doi.org/10.3390/buildings15142498.
[27] Teixeira, P., Teixeira, L., Silva, S., Eusébio, C. (2025). Technology-based approaches for accessible tourism: Using personas to understand stakeholders' characteristics and motivations. Data Inf Manag. 100095. https://doi.org/10.1016/j.dim.2025.100095.
[28] Ferrato, A., Limongelli, C., Mezzini, M., Sansonetti, G. (2022). Using Deep Learning for Collecting Data about Museum Visitor Behavior. Applied Sciences. 12, 533. https://doi.org/10.3390/app12020533.
[29] Liu, S., Long, Y., Ge, J., Zhang, L.: Unveiling tourist movement patterns in micro-scenes: a novel framework combining computer vision and spatiotemporal clustering. Current Issues in Tourism. 1–26 (2025). https://doi.org/10.1080/13683500.2025.2526720.
[30] Zhang, L., Zou, L., Shi, M. (2024). Immersing and Perceiving in Tourism Scenarios: The Interaction Mechanism between Digital Technologies and Tourists. In: 2024 IEEE 24th International Conference on Software Quality, Reliability, and Security Companion (QRS-C). pp. 1292–1301. IEEE. https://doi.org/10.1109/QRS-C63300.2024.00168.
[31] Yu, J., Wang, Q., Chen, H. (2018). Application of kinect-based motion recognition algorithm in cultural tourism. In: ACM International Conference Proceeding Series. pp. 307–311. Association for Computing Machinery (2018). https://doi.org/10.1145/3301326.3301377.
[32] Progetto Atlante: https://www.progettoatlante.it/