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Scientometric Analysis of Cybersickness Through Mobile Devices: Research Trends and Development.

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ABSTRACT
This study uses scientometrics methods to look at the research on cybersickness, which is also called digital motion Sickness or simulated sickness, and how it related to mobile technology. In it, the trend's history is looed at, along with main sources, most important participant, collaboration trends, and new research hotspots. Data from the Scopus database was gathered using the words "cybersickness," "digital motion sickness" and "simulator sickness" in the title field. VOSviewer and RStudio were then used to look at the data. The results, which show a rising trend in papers, show that lecture motes in Computer Science (including its subseries in Artificial Intelligence and Bioinformatics) is the most useful source. Keshavarz, B. wrote 299 articles, making him Canada was the most productive university, and the United States was the most productive country for study. The paper also talks about how mobile technology is being used in more and more immersive settings. This has made cybersickness studies bigger and more difficult. This work is one of a kind because it uses a full scientimetric approach. It also gives useful information for further research in this growing and multidisciplinary area..
Keywords: Cybersickness, Digital motion sickness, Virtual reality sickness, Computer sickness and Mobile Technology.
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1. INTRODUCTION:

The beginning as more businesses use VR (Virtual Reality), AR (Augmented Reality), and MR (Mixed Reality), cybersickness has become a major concern. These technologies are used in different discipline. The study emphasized on different symptoms due to cybersickness which shows virtual technologies less easy, less motivating and less benefical (Lawson & Stanney, 2021). In the technological advancement, there is a need to understand the reasons, trends for technological progress as well as find out the ways to avoid cybersickness. (Khaitami et al., 2019). With the virtual reality technology people are addicted with doing same and signs are similar to regular motion sickness. (LaViola, 2000). There are various reason of cybersickness like visual and vestibular cues that don't match up. (Biswas, Mukharjee & Bhattacharya, 2024; Chandra, Jaimy & Reza, 2022). At the point we have to take the help from different methods related to neuroscience, psychology and so no. Cybersickness is more common in women than in males in both low- and high-sensory conflict games.

VR technology is increasingly used in diverse fields such as training, entertainment, healthcare, and education (Agic & Mandic, 2019; Monteiro & et. al., 2022). However, cybersickness can negatively impact user experience, influencing perceived presence and enjoyment (Wang & Suh, 2019; Doty & et. al., 2024). One study found that personalized models significantly improve prediction accuracy, which can lead to tailored cybersickness reduction techniques. To counter this, researchers are exploring methods to predict and reduce cybersickness, including personalized approaches that consider individual factors like age and gender (Tasnim & et. al., 2024). In order to develop a one-of-a-kind deep learning strategy for real–time cybersickness diagnosis, Yalcin et al. (2024) utilized a four layered bidirectional long short-term memory network that demonstrated a 91.1% F1-score. Research Conducted on augmented reality applications, such as railway inspections, has shed light on unusual factors that contribute to cybersickness. These factors include latacy and interaction frequency, both of which are distinct from virtual reality contexts (Duan et al.,2024).

The Evolution, trends, and significant discoveries in cybersickness research can be better understood by the application of scientrometrics analysis, which offers vital insights. Scientific methods contribute to the process of mapping the knowledge structure of this discipline (Haghani, (2023). Through scientometric analysis the study wants to explore publishing trends, history of cybersickeness, prevalent study themes reveal growth and association among the various fields, new ideas developed during study and future directions through research. The main focus of the study is to provide clear picture of current status of cybersickness and different future directions which will support in both perspective academic and workers.

Literature Review

On the same research area another study by Yang, Kasabov, and Cakmak in 2022 was a thorough review of machine learning methods and systems for the study of cybersickness caused by virtual reality. The study looked at 26 studies that used biometric and neurophysiological data from wearable devices to find people who were cybersickness. Amanda and et. Al. (2025) emphasized on

virtual reality simulations which supports the medical professionals in inducing cybersickness. The study examined the relationship between cybersickness and the degree of physical movement in VR simulations. Breves and Dodel (2021) conducted two experiments for cybersickness and media devices mobility on 360° commercials. The first experiment was conducted in participants' living room to compare the effect of 360° commercials using a head mounted display resulted higher spatial presence and product evaluation. On the other side second experiment conducted to analyse the impact of 360° commercials with mobile or static devices.

Cybersickness through Eclectic or Mobile Devices

Our ways of gaining access to digital content, talking with one another, and amusing ourselves have been fundamentally altered as a result of the proliferation of mobile devices, which includes smartphones and tablets, in recent years. In tandem with this rapid proliferation, a syndrome known as cybersickness, which is sometimes compared to motion sickness, has garnered increased scientific attention. Although cybersickness is typically associated with virtual reality (VR) and augmented reality (AR) environments, it is becoming increasingly elements such as augmented reality applications, screens that are axposed for extended periods of time, and interactions that are motion-based. In order to gain an understanding of cybersickness on mobile devices, it is necessary to investigate its causes, symptoms, and effects, as well as the potential treatment that can alleviate the experience.

In mobile devices, cybersickness can develop in a variety of settings, such as when users interacts with high-refresh -rate displays, use motion-based control, or spend a significant amount of time using augmented reality applications. This phenomena is especially relevant in light of the fact that mobile devices are increasingly incorporating immersive features, which blur the line between traditional screens and virtual environments.

The goal of the study that is show being conducted is to improve our understanding of individual vulnerability, develop predictive models, and establish guidelines for safe immersive mobile experiences. There is the potential for cybersickness to be alleviated with the implementation of display technology advancements such as increase refresh rates and eye-tracking.

Objectives of the study

Understand the growth and evolution of cybersickness research in the context of mobile technologies.

Analyze key contributors including most productive authors, institutions and countries.

Explore thematic patterns and keyword co-occurrence to reveal dominant research areas.

Methodology

The primary collection of the Scopus database provided the researcher with the scholarly publications relevant to the study. As the title, we looked for string-specific keyword on march 11, 2025. These keywords included cybersickness, visually induced motion sickness, virtual reality sickness, digital motion sickness, and simulator sickness. There were paper from conferences, books, book chapters, reviews, and more that ware searched. The language of the papers wasn't important. Peer-reviewed journals and pieces from them. From 1968 to 2024, we got 800 articles from 357 different sources. We used a screening process to get rid of duplicate publications and make sure everything was right. After the results were saved as a CSV file, the researcher used google sheets and RStudio to do Scientometric analysis on the data. For showing the data, Tableau and VOSviewer version 11619 were used. These software programs were picked because they have a good name in the business and can do complex analyses. These technologies can handle big visualize data in complex ways, analyse trends, and look into networks. A lot of study has shown that VOSviewer and Biblioshiny can be trusted and used in scientrometrics studies, which proves that this methods choice is sound. A full analysis is also made possible by including different types of publications, such as conference papers, book chapters, and peer-reviewed articles. This way not only helps us understand where cybersickness research is at now, but it also follows the best practices for scientrometric research that have been talked about in academic circles. While Table 1 offers comprehensive details about the main elements and facets of the inquiry, Figure 1 offers a visual depiction of the approach used in this study.

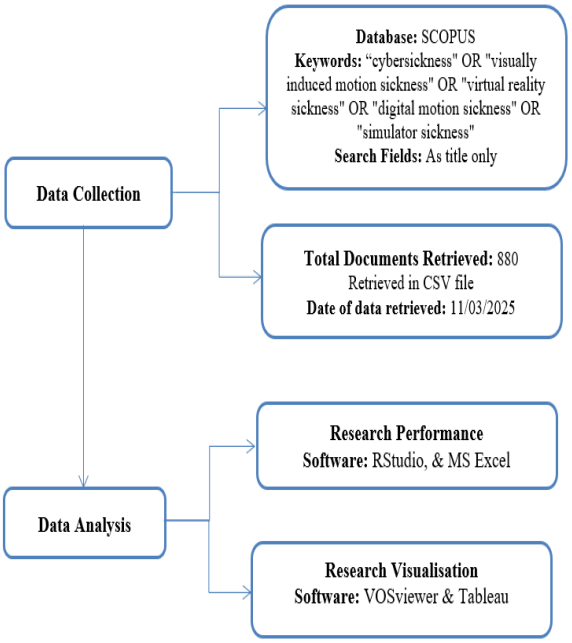

Figure 1: Methodology Phase

Table 1: Publications Characteristics

Description	Results
MAIN INFORMATION ABOUT DATA	
Timespan	1968:2024
Sources (Journals, Books, etc)	357
Documents	880
Annual Growth Rate %	8.79
Document Average Age	8.16
Average citations per doc	31.15
References	25294
DOCUMENT CONTENTS	
Keywords Plus (ID)	3640
Author's Keywords (DE)	1384
AUTHORS	
Authors	2145
Authors of single-authored docs	26
AUTHORS COLLABORATION	
Single-authored docs	33
Co-Authors per Doc	3.88
International co-authorships %	14.2
DOCUMENT TYPES	
Article	433
Conference paper	401
Review	21
Book chapter	7
Other	18

Data Analysis and Interpretation

Growth of research publications of Cybersickness over the time

Figure 1 shows the evolution of research articles on cybersickness throughout time, indicating a consistent increase in interest, especially within the last ten years. There were very few publications and sporadic scientific contributions between 1966 and the early 2000s. A slow between 2004 and 2014, there was a rise, with publication counts ranging from 10 to 22 annually. But in 2016, as virtual reality (VR) technology advanced quickly and head-mounted displays (HMDs) became more popular, there was a notable rise in research output. Publications increased at an exponential rate, peaking at 112 in 2024 after hitting 64 in 2018 and 88 in 2022. This dramatic increase indicates that cybersickness is emerging as a key area of study, most likely due to the extensive usage of virtual reality in teaching, gaming, healthcare, and human-computer interaction. The pattern suggests that the field will continue to attract attention and grow.

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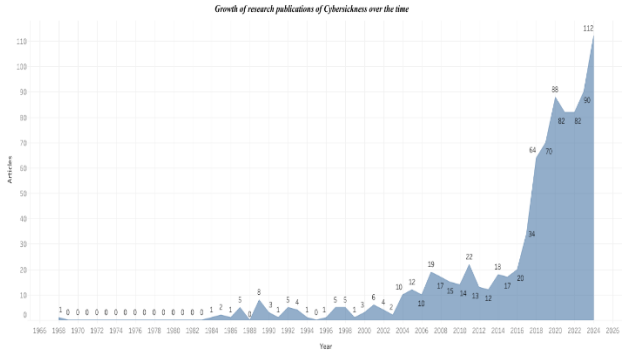

Figure 1: Growth of research publications of Cybersickness

Most productive authors

The table 1 presents the most productive authors in cybersickness studies, ranked by total publications (TP), average citations per publication (ACPP), and h-index. 'Keshavarz, B.' affiliated to Toronto Metropolitan University, Toronto leads with 34 publications, a moderate ACPP of 36.56, and the highest h-index of 19, indicating both their productivity and impact. 'Kennedy, R.S.', known for foundational work in simulator sickness, has 24 publications, but an exceptionally high ACPP of 239.54, reflecting the significant influence of his work despite fewer publications. Palmisano, S. (22 publications, ACPP 44.91, h-index 14) and Hecht, H. (14 publications, ACPP 40.43, h-index 11) also demonstrate strong citation impact. In contrast, Gilbert, S.B. and Dorneich, M.C. have relatively lower citation influence (ACPP ~8), suggesting a developing but less impactful research footprint. Quarles, J., So, R.H.Y., and Tohoku University researchers (Yoshizawa, M. & Yambe, T.) contribute significantly, but with varying citation impacts.

Table 1: The most productive authors

Name of authors	Affiliated to	TP	ACPP	h-index
Keshavarz, B.	Toronto Metropolitan University, Toronto	34	36.56	19
Kennedy, R.S.	RSK Assessments, Inc., Orlando, United States	24	239.54	13
Palmisano, S.	University of Wollongong, Wollongong, Australia	22	44.91	14
Gilbert, S.B.	Iowa State University, Ames, United States	15	8.07	07
Quarles, J.	Department of Computer Science, San Antonio, United States	15	19.93	10
Hecht, H.	Johannes Gutenberg-Universität Mainz, Mainz, Germany	14	40.43	11
Dorneich, M.C.	College of Engineering, Ames, United States	13	8.69	07
So, R.H.Y.	Hong Kong University of Science and Technology, Hong Kong	12	41.33	09

Yoshizawa, M.	Tohoku University, Sendai, Japan	11	7.27	05
Yambe, T.	Tohoku University, Sendai, Japan	11	7.27	05

Top 10 Subject areas

Figure 2 illustrates the diverse character of cybersickness research by distributing the total number of publications across subject areas with 557 papers, Computer science is the most popular discipline, which reflects the technical underpinnings of VR simulation and illness development. Engineering (358 publications) follows closely, emphasizing hardware advancements like head-mounted displays and motion tracking systems. Social Sciences (139) and Medicine (134) indicate a growing interest in the psychological and physiological impacts of cybersickness. Mathematics (123) plays a role, likely in modelling and algorithmic solutions for motion prediction and mitigation. Psychology (68) and Neuroscience (65) contribute to understanding cognitive and sensory responses, while Health Professions (40) explore VR applications in rehabilitation and therapy. Physics and Astronomy (37) and Materials Science (28) suggest involvement in display technologies and wearable VR materials. This distribution underscores the broad and interdisciplinary approach required to address cybersickness comprehensively.

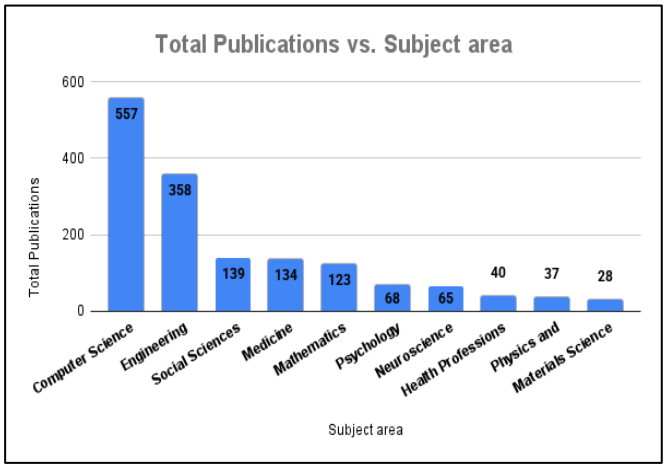

Figure 2: Distributed areas of research

Productive Source Title

The tabling of the most productive journals is based on the number of documents. The table 2 includes a variety of source (Journals) covering topics related to cybersickness or digital motion sickness. After the analysis, it can be see that the "Lecture Notes in Computer Science Including Subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics" stands out the most influential journal, with 46 publications, an average citation per publications and an h-index of 10. It also has a CiteScore 2023 of 2.6, indicating its average impact in the field. Other remarkable journal includes "Virtual Reality", which has 39 publications, an ACPP of 48.33, h-index of 18, and the CiteScore 2023 of 8.3, showing its strong impact. "Proceedings of the Human Factors and Ergonomics Society" follows with 34 publications, an ACPP of 22.97, and h-index of 13.

Table 2: The most productive source title

Source title	TP	ACPP	H-index	CiteScore 2023
Lecture Notes In Computer Science Including Subseries Lecture Notes In Artificial Intelligence And Lecture Notes In Bioinformatics	46	6.07	10	2.6
Virtual Reality	39	48.33	18	8.3
Proceedings of the Human Factors and Ergonomics Society	34	22.97	13	1.3
Displays	32	50.94	19	4.6
Frontiers in Virtual Reality	25	21.32	13	5.8
Aviation Space and Environmental Medicine	22	40.82	16	Discontinued
Applied Ergonomics	19	93.32	15	7.5
IEEE Transactions on Visualization and Computer Graphics	18	10.78	07	10.4
Experimental Brain Research	17	27.76	12	3.6
Proceedings of the ACM Symposium on Virtual Reality Software and Technology	14	12.50	07	Conference Proceedings

The most productive institutions

The table 3 showcases the most active institutions in cybersickness research, ranked by total publications (TP), average citations per publication (ACPP), and h-index. 'Toronto Metropolitan University (Canada)' leads with 24 publications, though with a moderate ACPP of 20.67 and an h-index of 11, suggesting steady but not highly cited work. 'University of Wollongong (Australia)' and 'University of Central Florida (USA)' follow closely with 22 and 20 publications, respectively, but have much higher citation impact (ACPP of 44.91 and 47.75), indicating influential research. 'Clemson University (USA)' has the highest ACPP among universities (49.31), reflecting the strong impact of its publications. 'Essex Corporation (USA)' stands out with an exceptionally high ACPP of 331.80, suggesting ground breaking contributions despite only 15 publications. 'Hong Kong University of Science and Technology' (33.94 ACPP) and 'Johannes Gutenberg-Universität Mainz' (39.44 ACPP) also show significant research influence. Institutions like 'KITE Research Institute (Canada)', 'The University of Texas at San Antonio', and 'Iowa State University' have moderate publications but relatively lower ACPPs, indicating ongoing contributions with less widespread citations.

Table 3: The most productive institutions

Name of Institutions	Country	TP	ACPP	h-index
Toronto Metropolitan University	Canada	24	20.67	11
University of Wollongong	Australia	22	44.91	14
University of Central Florida	USA	20	47.75	12
KITE Research Institute	Canada	20	11.25	08
The University of Texas at San Antonio	USA	17	18.35	10
Iowa State University	USA	16	13.88	07
Hong Kong University of Science and Technology	Hong Kong	16	33.94	11
Clemson University	USA	16	49.31	12
Johannes Gutenberg-Universität Mainz	Germany	16	39.44	12
Essex Corporation	USA	15	331.80	09

The most important research articles

The desirable objective of research is to advance society; if it has no bearing on society, it is pointless. An indication of how much attention a research output has received is provided by its Altmetric Attention Score. The score is a weighted count of the amount of attention that is selected for a research product and is generated by an automated algorithm (Elmore, 2018). Table 4 lists the most influential research publications according to their AAS score and the quantity of citations they have received. The table indicates that the paper "Simulator Sickness Questionnaire: An Enhanced Method for Quantifying Simulator Sickness," written by Kennedy, R.S., Lane, N.E., Berbaum, K.S. & et al. and published in "The International Journal of Aviation Psychology" in 1993, is ranked first with the highest citation count of 4319 and AA Score of 356. It is followed by "Review on Cybersickness in Applications and Visual Displays" and "Virtual reality sickness questionnaire (VRSQ): Motion sickness measurement index in a virtual reality environment," which have citation counts of 614 and 595 and AA scores of 14 and 03, respectively.

Table 4: Most influential research papers

Author Name	Title	Journal	Citations	AAS
Kennedy, R.S., Lane, N.E., Berbaum, K.S. & et. al. (1993).	Simulator Sickness Questionnaire: An Enhanced Method for Quantifying Simulator Sickness.	The International Journal of Aviation Psychology.	4319	356
Rebenitsch, L., & Owen, C. (2016).	Review on cybersickness in applications and visual displays.	Virtual Reality.	614	14
Kim, H.K., Park, J., Choi, Y., & et. al. (2018).	Virtual Reality sickness questionnaire (VRSQ): Motion sickness measurement index in a virtual reality environment.	Applied Ergonomics.	595	03
Weech, S., Kenny, S., & Barnett-Cowan, M. (2019).	Presence and cybersickness in virtual reality are negatively related: A review.	Frontiers in Psychology	532	33
Lin, J.J.-W., Duh, H.B.L., Parker, D.E., & et. al. (2002).	Effects of field of view on presence enjoyment, memory, and simulator sickness in a virtual environment.	Proceedings Virtual Reality Annual International Symposium.	431	04
Saredakis, D., Szpak, A., Birckhead, B. & et. al. (2020).	Factors associated with virtual reality sickness in head-mounted displays: A systematic review and meta-analysis.	Frontiers in Human Neuroscience	423	392
Brooks, J.O., Goodenough, R.R., Crisler, M.C., & et. al. (2010).	Simulator sickness during driving simulation studies.	Accident Analysis and Prevention.	327	03
Stanney, Kay M., Kennedy, Robert S., & Drexler, Julie M. (1997).	Cybersickness is not simulator sickness.	Proceedings of the Human Factor and Ergonomics Society.	305	347
Kim, Y.Y., Kim, H.J., Kim, E.N., & et. al. (2005).	Characteristic changes in the physiological components of cybersickness.	Psychophysiology.	304	03

Most contributed countries

The amount of a nation determines its level of development. Scientific knowledge and technical proficiency are the foundation of a country's overall development. Figure 3 displays the productivity of different nations according to the quantity of publications on cybersickness research. With 229 papers, the USA leads the area after analysis, demonstrating its robust research infrastructure and investment in VR motions and studies of human-computer interaction. This large volume of publications reflects the United States' recent concentration on research and development, which was probably fuelled by significant investments in science and technology. With 80 publications, Germany comes in second, demonstrating its long history of outstanding research and substantial support for universities and research centres. The Japan (75), Canada (75) and South Korea (67) follow as significant contributors, highlighting their active role in both theoretical and applied research. Data shows a global research effort, with North America, Europe, and Asia leading cybersickness investigations, driven by advancements in VR technology, healthcare applications, and human factors research.

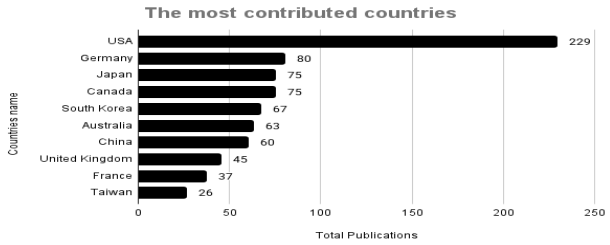

Figure 3: The most contributed countries

Figure 4 shows the scientific advancement over time using an overlay display between countries. The most recent advancement is shown in red, while the oldest advancement is shown in blue. The bare minimum of documents required for the visualization is country was set at five; 28 of the 81 countries had at least five papers.
A total of 14 clusters with 144 linkages and 219 link strengths were present. The United States of America (USA) is the most important collaborator based on the number of publications (229), followed by Germany (80), Japan (75), and Canada (75). The size of the node indicates the most contributing collaborator.

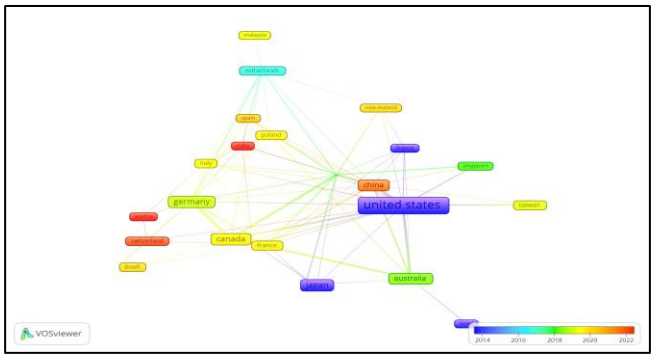

Figure 4: International collaboration network

Figure 5 shows a trend analysis of cybersickness-related study subjects throughout time. Key phrases related to the field are listed on the y-axis, while the x-axis depicts the years 2006–2024. The circles' sizes show the frequency of terms; larger circles signifying more instances in research articles. Early research (pre-2015) focused on foundational topics like "field of view," "heart rate," "visually-induced motion sickness," and "driving simulator," emphasizing physiological and environmental factors in VR sickness. Post-2015, there was a noticeable shift towards terms like "head-mounted display," "presence," "human factors," and "navigation," reflecting the technological advancements and user experience considerations. More recent studies (2020 onward) increasingly incorporate "deep learning," "machine learning," and "electroencephalography," indicating a growing interest in AI-driven solutions and biometric measurements for cybersickness detection. This trend suggests an evolving interdisciplinary approach combining human-computer interaction, neuroscience, and artificial intelligence to mitigate cybersickness in immersive environments.

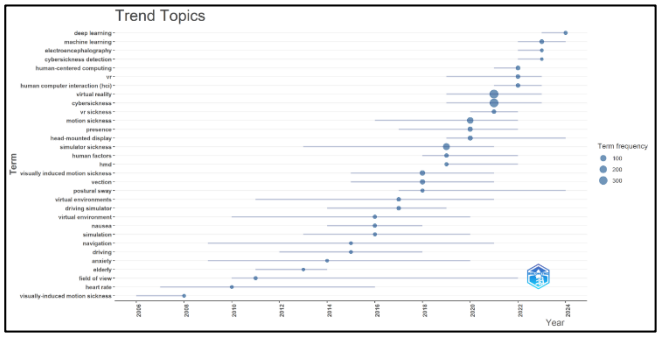

Figure 5: Trends reports of cybersickness research

Most occurred keywords

Most often used keywords Figure 6 shows the overlay depiction of the terms that were utilized throughout time. Of the 5,792 keywords, 390 met the criterion, which was set at a minimum of five occurrences of a particular keyword. Seven clusters, 17,195 linkages, and 55265 total link strengths were identified from the results. "Virtual reality," "simulator sickness," and "motion sickness" are the most common phrases represented by the larger nodes, suggesting their key position in the study domain. The color gradient, ranging from blue (older research) to red (recent research), shows the evolution of topics over time. Keywords like "helmet mounted displays," "head mounted displays," and "user interfaces" are closely linked to VR technology, while terms like "nausea," "pathophysiology," and "induced motions" highlight the physiological effects of cybersickness. Connections between "driving simulator," "computer simulation," and "ergonomics" suggest a strong focus on applied research. The distribution of terms across various clusters reveals interdisciplinary contributions from human-computer interaction, neuroscience, and ergonomics in understanding cybersickness.

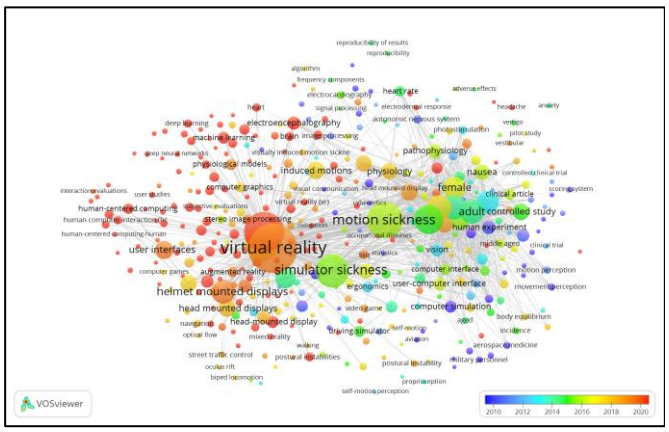

Figure 6: The most frequently used keywords

2. DISCUSSION AND FUTURE TRENDS

The Current study gives a full scientomtric review of the field of cybersickness research. It was possible to do this by carefully pulling data from the Scopus database and analysing it with Google Sheets and RStudio. The study looked at 880 works that come out between 1968 and 2024. New research on cybersickness shows that its fast growth is caused by improvements in virtual reality (VR) Technology and its wider use in many areas. A lot more papers have been written about head-mounted displays (HMDs), especially science 2016. This is in line with the growing use of HMDs in training, games, healthcare, and human-computer interaction. This rise shows that cybersickness is becoming more and more recognized as a major problem in immersive settings. The number of citations shows that important early studies, like the Simulator sickness Questionnaire, are still having an effect on the field, changing both theory and applied research. Notably, researcher like Kennedy, R. S., who have a high average number of citations per article (ACPP), show that early work is still very influential even though they have published less overall. Cybersickness study is interdisciplinary, as shown by the wide range of subjects that are contributing to it. Computer Science and Engineering are the most important because they are involved in making VR systems. Medicine, Psychology and Neuroscience, on the other hand, try to figure out how cybersickness affects the body and mind. Math, Physics and Material Science are all involved, which means that work is still being done to make computer models and VR hardware better. Institutional contributions include both academic and corporate, research. Universities have the most publications, but some institutions, like Essex Corporation, have high citation impact, chich means they have made groundbreaking contributions.

As shown by the growing interest in deep learning, machine learning, and biometric measurement, future study will likely focus on AI-driven solutions. The integration of electroencephalography (EEG) and physiological monitoring could provide real-time detection and mitigation of cybersickness, enhancing user experience. Moreover, the evolution of research keywords suggests a transition from basic physiological studies to applied human-computer interaction, presence, and navigation improvements. A key area of interest will be the optimization of HMDs, user interfaces, and motion tracking to minimize cybersickness symptoms. Due to significant investments in VR technology and human factors research, international collaboration shows that the United States leads the world in research output, followed by Germany, Japan, Canada, and South Korea. Global co-operation in this field suggests that it will continue to grow, with new contributions coming from a variety of places as VR uses spread. In the future, researchers may also look in to personalized adaptation methods, such as changing display settings. Depending on each person's susceptibility and using haptic feedback to improve immersion without making people feel uncomfortable.

3. CONCLUSION

Cybersickness research is growing quickly, which shows how important it is becoming as virtual reality technology moves to more areas of life. The analysis shows that the number of articles has been steadily rising, with a noticeable rise after 2016. This shows that cybersickness problems need to be addressed more and more. Some very important exports and groups have had a big impact on the field, and basic studies are still useful for gathering information. Cybersickness is a complicated issue that needs a multifaceted method to be solved. As a result, researchers from computer science, engineering, medicine, psychology, and neuroscience are all working on it. Cybersickness needs to be fixed for VR to be used and adopted by more people. Reducing cybersickness will be crucial to guaranteeing a smooth and comfortable user experience as immersive environments are increasingly included into professional training, gaming, healthcare, and education. In order to overcome these obstacles and create a more accessible and immersive virtual future, ongoing research and technical innovation will be essential.

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