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Immersive Application in Library: An Analysis of the Use of VR, AR, MR Technologies and Provided Functionality based on Systematic Literature Review

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Abstract: This study aims to recognize the primary forms of immersive technologies and applications in libraries and provide information on the employed methods, technologies, equipment, and software solutions by conducting a systematic literature review aligned with the PRISMA guidelines. The study focuses on Virtual Reality, Augmented Reality, and Mixed Reality Technologies, highlighting their functionalities within Library & Information Science. To collect the relevant data, the researchers used Google Scholar with a specific query syntax. The study identified 63 immersive services across 38 SAs, with the Virtual Tour being the most prominent among 12 SAs. Navigation and VR Content follow as significant services, alongside services like Gravbox, Sandbox, and AR Learning Trail. Overall, this study identifies, reviews, and analyzes various studies of immersive technologies in the library context.

Keywords: Immersive Application, Virtual Reality, Augmented Reality, Mixed Reality, Systematic Literature Review

Introduction

Interactive, participative, experiential learning is essential to enhance the expertise and joy of the learner. Libraries have transformed from mere book storage to dynamic spaces for knowledge acquisition. Despite predictions of their decline, libraries have adapted by embracing modern technologies and immersive services. This nascent technology has seen adoption across sectors such as Medicine, Defence, Gaming, Tourism, and Architecture, all of which have accrued significant benefits. Likewise, Libraries and Information centres globally are integrating such services to cater to the needs & requirements of the patrons. The central focus of this systematic literature review is to explore the extent to which libraries worldwide have adopted immersive technology, while examining the research literature on its applications in library settings. This paper presented a systematic literature review (SLR) of immersive technology, focusing on Virtual Reality, Augmented Reality, and Mixed Reality. Utilizing the Google Scholar Database, the investigator employed specific query terms such as "Virtual Reality," "Augmented Reality," "Mixed Reality," "Immersive Technology," "Data Visualisation," and "Libraries." From 715 results, 38 relevant articles were identified and analyzed based on services and equipment related to AR, VR, and MR.

Literature review

Vasileios Komianos (2022) discusses the application of immersive technologies such as Virtual Reality (VR), Augmented Reality (AR), and Mixed Reality (MR) in museums. The research includes a systematic literature review following PRISMA guidelines, revealing insights into methodologies, technologies, equipment, and software used to create immersive experiences in cultural settings. The study emphasizes the enhancement of communication, visitor engagement, and the promotion of deeper learning experiences facilitated by these

technologies. It evaluates various implementations within museums and cultural institutions, categorizing the primary types and their practical usage. The findings were significant for understanding the transformative impact these technologies have on visitor engagement and educational outcomes in museums.

Samrat Guha Roy et.al (2022) in their research paper "Building Immersive Library Environment to Access Virtual Reality Content – A Proposed Framework Model," identify numerous serious factors impacting user satisfaction levels. The analysis identified internet connectivity and phone calibration as two important challenges affecting content delivery in WebAR services. Moreover, the data showed that the factor of 'content delivery' had a direct correlation with user satisfaction.

"A Systematic Review of Virtual Reality-Based Education Research Using Latent Dirichlet Allocation: Focus on Topic Modelling Technique," by (Kim and Im,2022), examined research in virtual reality-based education over the past three decades (1992–2022) and found that the research was distinctly categorized into four periods: 1992–2011, 2012–2016, 2017–2019, and 2020–2022. Overall, the study findings revealed different topics on virtual realities such as "virtual reality for training and learning," "virtual reality in medical education," "virtual reality education platform," "virtual reality-based education in rehabilitation," and "virtual reality training and treatment in healthcare. "virtual reality for learning and teaching," "VR in medical education," "VR in education platform," and "VR-based education in rehabilitation".

Significance of the Study

Research is still on to find out the challenges associated with virtual reality-based systems in academic libraries, as well as the most recent developments and methods on the topic of AR, MR, VR technologies integration with regard to libraries. Through a systematic literature review (SLR), the primary goal of this work is to present the most recent findings about the use of immersive technology in libraries. This study seeks to identify gaps in current literature and to highlight effective practices and innovative ideas for future implementations. Moreover, future librarians will greatly benefit from having comprehensive knowledge of this topic. With this aim, the following research questions are put forth;

RQ1: Which immersive technologies and Trends are currently employed in libraries?

RQ2: Which immersive services are offered by the library?

RQ3: Which App or Software is procured by the library?

RQ4: Which facilities and equipment are available in the libraries?

Material and Method:

This study involves secondary data analysis involving web-based screening of the research papers published in the Google Scholar database. The data was downloaded from the Google Scholar database on 19th June 2024. Furthermore, data analysis tools such as MS Excel were used to analyze and investigate the collected data to answer the above-mentioned research questions. The present study used the Google Scholar database to select the scholarly literature. The requirements are a set of keywords to be searched in the Google Scholar database. The search results are the bibliographic list of the published articles that are further analysed to generate the final acceptable list for the study. The study uses phrase search with Boolean operators to retrieve the bibliographic information from the Google Scholar database. However, GUI filtration is not present in Google Scholar, so that part is performed manually by checking the bibliographic information. Query Syntax used was "Virtual Reality" or "Augmented Reality" or "Mixed Reality" or "Immersive Technology" or "Data Visualisation" or "Library Service". The logic of the query syntax is designed to retrieve all the documents having any of the words "Virtual Reality" or "Augmented Reality" or "Mixed Reality" or "Immersive Technology", or "Data Visualization" in the title or abstract, or keyword section of an article.

Screening Criteria:

To examine a paper, its content must be comprehensible, and 37 works whose content is not written in English (C3 – Criteria 3) are excluded as their relevance and their findings could not be judged with confidence. A total of 100 works were found to be duplicates (C1 – Criteria 1). A total of 200 works are not provided with access. These are paid based only on (C2 – Criteria 2)—a total number of 35 works not relevant to search syntax (C4 - Criteria 4). After removing duplicate, not accessible, and not comprehensible papers, 38 papers remain to be examined (Table I and Fig. 1). These 38 works are examined to ascertain if they are relevant to this review's subject. In order for a paper to be selected for review, a minimum set of criteria should be met. Table II shows the selected articles and the main technology category they belong to (their proper citation is given in the References section). Articles not meeting the inclusion criteria were eliminated. The data from these articles was extracted and coded in Microsoft Excel before being reviewed and scrutinized. The article analysis includes the equipment, software, and employed methods in the following subsections.

Criteria	**Total records**	**715**
C1	Removed duplicates	100
C2	No access provided	200
C3	Not available in English	37
C4	Not relevant	35
C5	Literature other than Research Article	305
C6	Full-text article analysed	38

Table 1: Article screening criteria

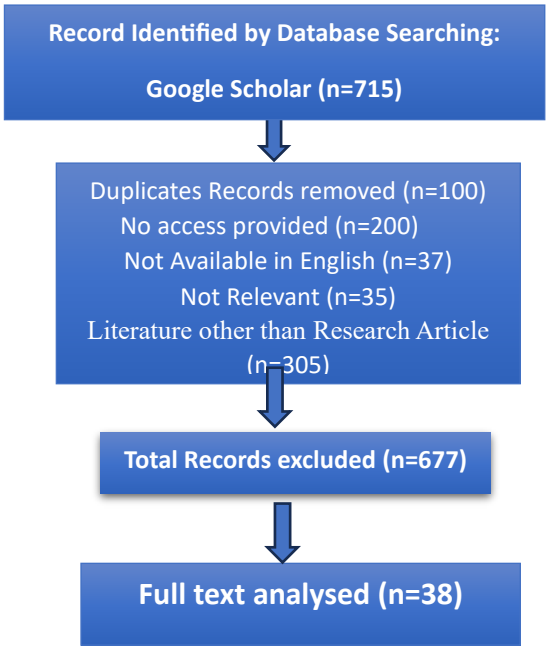

Fig. 1: Screening Process

Results And Discussion

Immersive technology and Trends currently employed in libraries

Information about the data sets gathered from 38 peer-reviewed research publications can be found in Table 2. It lists the titles of the research articles and presents details on the main aspects of the study, such as how virtual reality affects cutting-edge library systems and how challenging it is for university libraries to implement virtual reality. At this point, the included articles are analysed in order to answer our first research question. The research question is coded as [Q1]: Which immersive technologies (as well as the approaches, the hardware, and software solutions) are currently employed in libraries? The review analysis reveals and discusses various augmented reality (AR) applications and their implementation within library settings. It was revealed that S1, S2, S3, S5, S6, S13, S17, S19, S23, S25, S28, S31, S34, S35, S36, S37, S38, these 17 articles are focusing on Augmented Reality, which are discussed in the following paragraphs.

ID	Title	AR	VR	MR/XR	ID	Title	AR	VR	MR/XR
S1	Using virtual and augmented reality in the library.	✓		✓	S20	Virtual reality-based library user education program development.		✓	
S2	Facing reality: the growth of virtual reality and health sciences libraries.	✓	✓		S21	Virtual realities and academic libraries: A paradigm shift.		✓	
S3	Immersive services in libraries: perspectives and views of library professionals	✓	✓	✓	S22	Virtual reality as a tool for student orientation in distance education programs: A study of new library and information science students.		✓	
S4	Research on the application of virtual reality technology in information retrieval.		✓		S23	A Study on the Plan of Activation of the Library by Utilizing Virtual Reality and Augmented Reality.	✓	✓	✓
S5	Potential of augmented reality in the library.	✓			S24	Academic library services in virtual worlds: An examination of the potential for library services in immersive environments.		✓	
S6	Using augmented and virtual reality in information literacy instruction to reduce library anxiety in non-traditional and international students.	✓	✓		S25	AR, VR, and immersive technologies: The new mode of learning and the key enablers in enhancing library services.	✓	✓	
S7	Using virtual reality in medical education to teach empathy.		✓		S26	Virtual reality library services: A global vision for university libraries in Delta and Edo states, Nigeria.		✓	
S8	Strategies for inclusive and safe education using virtual reality: from the digital library perspective.		✓		S27	Virtual reality-based library user education program development.		✓	
S9	Application of virtual reality technology in library visual information retrieval.		✓		S28	Mobile Use–Scenarios for Digital Content and Digital Services–The Augmented Reality App “Ludwig II” of the Bavarian State Library.	✓		

S10	Exploring methodologies for designing a virtual reality library for children.		✓		S29	A virtual reality exploration of library services: Affordances and perceptions.		✓	
S11	Virtual reality: A survey of use at an academic library.		✓		S30	Exploiting virtual realities for library serial services for Nigerian disabled patrons.		✓	
S12	The Virtual Reality of the automated library circulation system as a practicum learning media.		✓		S31	Virtual and Augmented Reality Technologies in the Organization of Modern Library Media Space.	✓	✓	
S13	The feasibility of implementing augmented reality technology for delivering library services: a case study at the University of Bahrain.	✓			S32	Blurred Lines—between virtual reality games, research, and education.		✓	
S14	Scope of Metaverse Technology in the Central Library		✓		S33	Virtual Reality as an Educational Tool in University Libraries.		✓	
S15	Library in virtual reality: An innovative way for accessing, disseminating, and sharing information.		✓		S34	Digital content for libraries considering extended reality, physical interaction disabilities, universal design for learning, and user-centered design: a systematic review.	✓	✓	
S16	Using virtual reality to create real-world collaborations.		✓		S35	Is your library ready for the reality of virtual reality? what you need to know and why it belongs in your library.	✓	✓	✓
S17	Building Immersive Library Environment to Access Virtual Reality Content: Proposed Framework Model.	✓	✓	✓	S36	Augmented virtual reality and 360 spatial visualizations for supporting user-engaged design.	✓	✓	
S18	A comparative study of the sense of presence of traditional virtual reality and immersive environments.		✓		S37	Black, White, and Gray- The wicked problem of virtual reality in libraries	✓	✓	✓
S19	Augmented Reality Applications in modern-day library: A study.	✓			S38	Augmented Reality Navigation App and Metadata Icon Design for Children's Library	✓	✓	

Table 2: Selected research Articles on AR, VR, and MR services

S1 introduces the EON Experience portal, an interactive online library featuring 3D objects, avatars, scenes, and applications, used to showcase a library's art gallery via AR.S5 elaborates on AR application projects and implementations specifically designed for libraries, citing examples such as myLibraARy, ShelvAR, LibrARi, and SCARLET.S6 shifts focus to information literacy instruction methods currently under development by a library, discussing the implementation and initial feedback from a formative assessment involving a virtual tour of the ORU Library. S13 presents a study investigating researchers' behaviour and their intent to utilize mobile AR technology for accessing specialized library services, specifically current awareness services and selective dissemination services provided by the University of Brahmin. The article S19 revealed information detailing several applications of Augmented Reality (AR) technology, including Aurasma, Layer, Google Goggles, libARi,

and ShelvAR. Aurasma is characterized by its ability to create an "aura" around an image, making it suitable for applications such as generating content for posters and art gallery charts. Layer is identified as the first augmented reality browser, which empowers creators to incorporate multimedia files into AR experiences. Google Goggles is described as an image-identifying mobile application designed for visual-based searches. The application libARi is specifically noted for its use within libraries to assist users in locating books. ShelvAR is an Android application that functions by scanning coded tags, thereby accessing the information associated with them. Furthermore, "S19" also elaborates on various library projects, in addition to presenting these AR applications. "S20" shifts focus to a library user education program, outlining a three-step framework that includes basis-oriented education, information literacy education, and information technology education. This article provides a list of Virtual Reality (VR) services offered by North American public libraries and details the design of a user education program utilizing VR technology. Finally, "S28" highlights the development by the Bavarian State Library of a smartphone application named "Ludwig II—walking in the Footsteps of a Fairytale King." This app serves as a location-based multimedia service that employs augmented reality technology. The Ludwig II app is presented as offering cultural institutions, such as libraries, archives, and museums, extensive opportunities to deliver unique and engaging content to their users.

Exploring the Role of Virtual Reality in Library Services

Several studies examine the application of Virtual Reality (VR) in libraries. These research articles highlight the multifaceted applications and potential of Virtual Reality (VR) within library services and educational contexts. Several studies, including S2, emphasize the development of project-based VR services, particularly those submitted by librarians from prominent institutions. These projects frequently integrate gamification and evidence-based learning strategies. S4 details specific VR applications for libraries, such as Virtual Reality Reader Stations, Scene Construction, Information Resources Construction, and virtual visual exhibitions. Further exploring the educational aspect, S8 and S25 present VR applications for education and learning, leveraging the capabilities of digital libraries. In parallel, S9 and S36 focus on the role of digital libraries in providing VR visual information retrieval content. S10 specifically addresses the design of a VR system for children, aiming to serve as an alternative navigational tool to traditional web portal search mechanisms. Providing practical guidance, S11 presents a survey conducted at the Harold B. Lee Library at Brigham Young University. This survey aimed to assist other libraries in implementing VR services. The study identified five popular free VR applications: Google Earth, The Lab, Tiltbrush, Virtual Jerusalem, and 3D Organon VR Anatomy. It also indicated that the primary VR hardware utilized in this context includes HTC Vive, Google Card, and Oculus Rift. Shifting towards library operations, S12 examines the integration of virtual reality into library circulation systems, particularly focusing on self-service as a learning medium. Employing the System Development Life Cycle (SDLC) method, the study found that users perceived VR as capable of delivering a realistic experience for implementing RFID technology in self-service library circulation.S14 focuses on the scope of Metaverse Technology in central libraries, using Rajiv Gandhi University's library as a case study to detail virtual library implementation steps. The application of virtual reality (VR) technology within various library functionalities is a key focus in S15, enabling patrons to experience immersive, interactive, and deeply involved engagements with library resources. Five specific libraries are highlighted as exemplars of this integration: the Mediatheque De L'Ircan, the VILMA Library, the ULBRA Library, the CAVE-ETD Library, and the ARLib Library. S16 describes how library VR programs are identified as crucial for fostering opportunities for direct involvement in student and researcher projects. Methods employed to encourage experimentation with VR technology have included circulating equipment among academic departments, organizing VR competitions, and connecting VR applications with tangible, real-world scientific research initiatives. The Redcliffe Science Library is specifically mentioned for its VR services, particularly its lending operations. S17 presents a study involving a survey of 135 random users who explored immersive library experiences, leading to the proposal of a framework built upon the DELOS DL reference model, which integrates information delivery with academic and innovative activities. In S18, A comparative analysis was conducted between traditional virtual reality environments (TVRE) and Immersive Visualization Environments (IVE). Two primary types of IVE were examined: the CAVE system, characterized by projectors aimed at three to six walls of a cube-shaped room, and systems employing field-of-view stereoscopy. This comparison concluded that IVE systems offer a more significant and natural user experience than TVRE.

In the context of academic libraries, S21 presents Academic libraries' space utilization studies. space utilization studies are advised to consider the concerns of diverse user groups and integrate these considerations into library design. A related metadata study underscored the necessity of implementing virtual reality technologies in academic libraries. Regarding leadership, a literature review on leadership styles indicated that transformative leadership is the most effective approach for the successful implementation of virtual reality technologies.

In an educational application, a study S22 surveyed MLISc students to assess the utility of VR for student orientation in distance education. This research employed a pre-test/post-test experimental design. Students were allocated to either an experimental or a control group based on their residential state. The experimental group received a cardboard VR headset, similar to Google Cardboard, along with usage instructions, and was tasked with engaging in an interactive VR experience designed to introduce library services and library education as part of new student orientation. In contrast, the control group received a set of links containing equivalent information but presented in a static, non-immersive, and non-interactive format. The findings revealed that VR had a beneficial impact on student interest, resulted in a slight increase in scores, and reduced anxiety among participants. While there is no indication from this study whether VR would produce positive effects over a sustained period of time, S23 presents the plan of library activation using VR and AR. It elaborates on core AR and VR technologies, current trends, major activities, and utilization in the library.

This analysis synthesizes distinct studies concerning virtual worlds and immersive technologies in academic and library contexts. S24 examines virtual worlds as a platform for academic learning, specifically conducting a comparative analysis of Second Life, Active World, and Open Grid VR worlds. S25 centers on the application of Virtual Reality (VR) and Augmented Reality (AR) technologies in learning. It details the significance and benefits of these technologies, while also outlining the challenges associated with their adoption. Recommendations for implementation are provided, with a particular focus on libraries, identifying trained staff and the cost of equipment as primary factors influencing the application of VR technology in this domain. S26 offers a global vision for university libraries in Delta and Edo States, Nigeria, based on a study of 116 libraries across 15 universities. This research identified health-related issues and the cost of VR equipment as significant concerns. Furthermore, poor internet connectivity was highlighted as a major impediment to the full deployment and utilization of VR within Nigerian university libraries.S27present VR VR-based user education development. It provides the design of a user education program. It presents the study of 11 North American public libraries.S29 presents a virtual reality exploration of library services. It aims to explore whether the VRT format. The study provides important insights into the competitiveness of VR. S30 presents that Libraries in Nigeria can use virtual reality capabilities to provide uninterrupted serial services to disabled users. They can make an effort to obtain the appropriate VR goggles to access a designed serial book space with reference services capability that quickly responds to the queries of disabled users. The use of virtual reality (VR) would address many of the issues that disabled patrons confront in Nigeria today, since they have restricted access to library serial services. S31 presents a modern library media space using AR and VR technologies. Such space provides the opportunity to create VR content on their own. The case study of some university libraries is presented in S31.

The Role of Mixed Reality in Libraries

Mixed Reality is the blending of the real and virtual worlds to create new environments and visualizations. In these environments, physical and digital objects coexist and interact in real-time.S1 offers a rich multimedia experience by presenting 3D content, video with sound effects, and annotations. It utilizes Layer, an augmented reality platform, and the Aurasma augmented reality app to showcase the library's art gallery, aiming to enrich the user experience through the integration of physical and digital elements. S3 focuses on providing an optimal user experience through a comprehensive suite of interactive services and features. These include virtual tours, orientation assistance, data visualization, 3D galleries, and an "augmentarium" designed for augmented experiences. Additionally, S3 incorporates 3D printing capabilities and leverages various Mixed Reality (MR) and Virtual Reality (VR) headsets such as the MR-Hololens, VR-Oculus Go, Oculus Rift, HTC Vive, and Samsung Gear.S17 provides virtual tours and orientation services, and features CAVEs (Computer Assisted Virtual Environments), which are specialized immersive VR spaces. It prominently features Mixed Reality (MR)

technologies, including the MR-Hololens and Google Glass, alongside Virtual Reality (VR) headsets such as the Oculus Go, Oculus Rift, HTC Vive, and Samsung Gear.

Enhancing the Library Services with Immersive Technologies

This part focuses on delivering immersive experiences to users, particularly in virtual tours and orientations. The research question is coded as [Q2], which immersive services are offered by the library? The findings indicate that a total of 63 immersive services are presented across 38 selected articles (Table 30). Among these, the Virtual Tour service is the most frequently mentioned, appearing in a total of 12 SAs. Following this, Navigation and VR Content are identified as the second-largest categories of immersive services. Additionally, new emerging services are shown in 1 and 2 SAs. Table 3 explains the immersive services, which were elaborated earlier in SAs.

SL. No	Library Immersive Services	Total (SA)	%	SL. No	Library Immersive Services	Total (SA)	%
1.	3D content with Video, sound,effect,annotations	1	2.63	33.	Second life	1	2.63
2.	interactive content service.	1	2.63	34.	Projection Room	1	2.63
3.	virtual Tour	12	31.57	35.	CAVES	4	10.52
4.	Orientation	5	13.15	36.	Guided Tour	1	2.63
5.	Data visualization	1	2.63	37.	VR Literacy Education	1	2.63
6.	3D galleries	1	2.63	38.	Maker Space	2	5.26
7.	Augmentarium	1	2.63	39.	Borrowing Equipment	4	10.52
8.	3D printing	5	13.15	40.	VR Bibliographic Instruction Service	1	2.63
9.	3D display	3	7.89	41.	VR Reference Service	2	5.26
10.	Virtual Reality Reader Station	1	2.63	42.	VR Book	2	5.26
11.	Visual Information Retrial Service	5	13.15	43.	VR Station	1	2.63
12.	Library Online Roaming	1	2.63	44.	Immersive Reality book	1	2.63
13.	Virtual Exhibition	6	15.78	45.	AR Coloring book	1	2.63
14.	VR Content	7	18.42	46.	Information Delivery	1	2.63
15.	Navigation,	7	18.42	47.	Visualize and Exlore the Places	1	2.63
16.	Augmented Book	2	5.26	48.	Immersive Story telling Room	2	5.26
17.	AR Display	2	5.26	49.	AR Learning Trail	1	2.63
18.	Literature Walk	1	2.63	50.	AR Exhibition	1	2.63
19.	Multimedia Content by Map,	1	2.63	51.	3D Learning	1	2.63
20.	VR Based Information Literacy	1	2.63	52.	Virtual Reality Lounge	1	2.63

21.	AR based Information Literacy	1	2.63	53.	CAS	1	2.63
22.	Book Shelf Maintenance	1	2.63	54.	Location Based multimedia Service by AR	1	2.63
23.	IL Instruction	1	2.63	55.	VR based instructional Unit	1	2.63
24.	VR Lab	5	13.15	56.	Virtual Field trip	2	5.26
25.	Educational Gaming	6	15.78	57.	VR use for access of E - Resources	1	2.63
26.	Open Access Repository	1	2.63	58.	Library Lab	1	2.63
27.	OPAC	1	2.63	59.	book tour	1	2.63
28.	Shelf Detail Map	1	2.63	60.	Gravbox	1	2.63
29.	VRML	1	2.63	61.	sandbox	1	2.63
30.	VR Web Library Positioning system	1	2.63	62.	VR Chat	1	2.63
31.	Information Pop -up with VR	1	2.63	63.	AR Navigation	1	2.63
32.	Virtual Reality Library Automation	1	2.63				

Table 3: Immersive Services offered by libraries

(The percentage drawn based on 38 SAs)Total SAs x explained SAs / 100 = %

The research question is coded as [Q3] Which apps/software were procured by libraries? Finding reveals a total of 65 applications and software are detailed across 38 specific areas (SAs), with Aurasma and ShelvAR being the most popular among them. Additionally, Google Tilt Brush and Second Life are the emerging technologies in the field of Library & information science, as indicated in the fig.2. Table 4 provides information regarding the software products and apps that are reportedly used in each work for providing immersive services.

Sl. No.	Apps	Total (SA)	%	Sl. No.	Apps	Total (SA)	%
1.	Layer	2	5.26	34.	HoloLence App	1	2.63
2.	Aurasma	4	10.52	35.	ARchitect	1	2.63
3.	Second Life	3	7.89	36.	Land of Dinosaurs	1	2.63
4.	A-Frame	1	2.63	37.	Boulevard	1	2.63
5.	myLibARy(AR)	1	2.63	38.	Steam	1	2.63
6.	LibrARi(AR)	2	5.26	39.	Viveport	1	2.63
7.	ShelvAR	4	10.52	40.	The Lab	1	2.63
8.	King LudwigII	1	2.63	41.	Google Earth	1	2.63
9.	SCARLET	1	2.63	42.	Audio Factory	1	2.63

10.	3D Vista	1	2.63	43.	The Night Cafe	1	2.63
11.	Information Retrieval visualization tool Topic Map	1	2.63	44.	Raygun Commando and Quanero	1	2.63
12.	TouchGraph	1	2.63	45.	Palmyra	1	2.63
13.	Shelf detail Map	1	2.63	46.	Insight Heart	1	2.63
14.	VRML- Virtual Reality Modelling Language	1	2.63	47.	Second Life	2	5.26
15.	Google Earth	2	5.26	48.	Active World	1	2.63
16.	The Lab	1	2.63	49.	Openlife Grid	1	2.63
17.	Tiltbrush	1	2.63	50.	Moshi Monster- Color Alive	1	2.63
18.	Virtual Jerusalem	1	2.63	51.	Gaia Online	1	2.63
19.	3D organonVR Anatomy	1	2.63	52.	World of Warcraft	1	2.63
20.	ARLib	1	2.63	53.	Sims OnlineEverrQuest	1	2.63
21.	librARi	1	2.63	54.	Sim Online	1	2.63
22.	Blippar	1	2.63	55.	EverQuest	1	2.63
23.	Zappar	1	2.63	56.	Unity	2	5.26
24.	Google Goggles	1	2.63	57.	Unreal	2	5.26
25.	Librarian in Black	1	2.63	58.	Oculus Rift	1	2.63
26.	New York Public Library's Find the Future App	1	2.63	59.	Steam	1	2.63
27.	Smart Library App	1	2.63	60.	Google Tilt Brush	3	7.89
28.	Wolf Walk	1	2.63	61.	Gravbox	1	2.63
29.	Expendition Deventer	1	2.63	62.	Sandbox	1	2.63
30.	Timescape: Kolkata	1	2.63	63.	3D Blender	1	2.63
31.	3D Desain	1	2.63	64.	3D organon VR Anatomy	2	5.26
32.	3D Blender	1	2.63	65.	3D LIDAR	1	2.63
33.	Metaverse	1	2.63				

Table 4 : App/Softwares procured by libraries

(The percentage drawn based on 38 SAs) Total SAs x Explained SAs / 100 = %

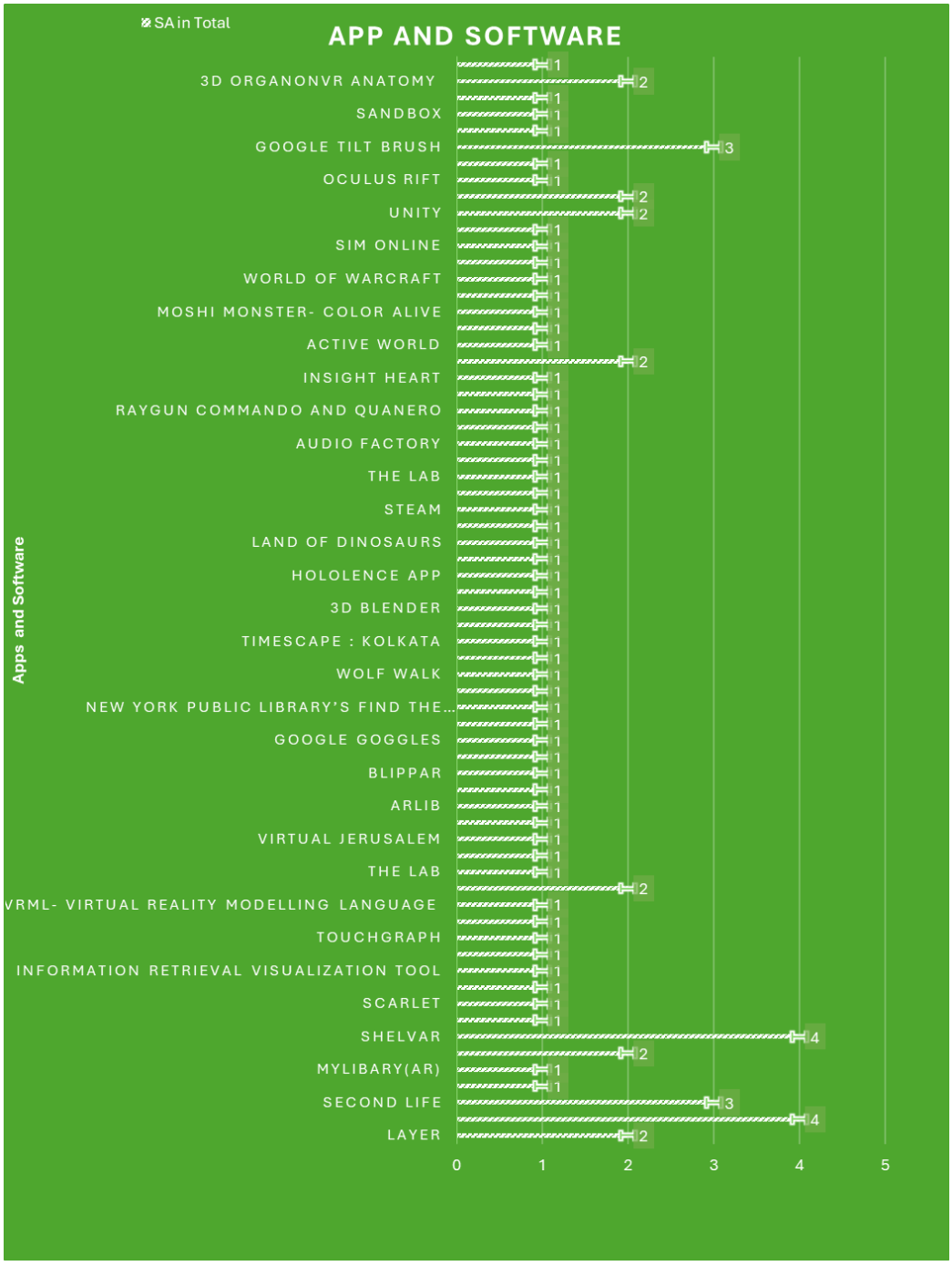

Fig. 2: Apps and Software

The research question is coded as [Q4] Which facility and equipment are available in libraries? The analysis is now focused on the employed equipment per solution. Table 5 presents the equipment used in the selected articles with a notion of the main technology (AR, VR, MR) in order to facilitate the identification of relationships among the technology and the employed equipment. In the next few paragraphs, a discussion on the used technologies is given below.

Sl. No.	Equipment	Total (SA)	%	Sl. No.	Equipment	Total (SA)	%
1.	AR-Meta Glasses	2	5.26	19.	HTC Vive	4	10.52
2.	MR-HoloLens	4	10.52	20.	MS HoloLens	1	2.63
3.	Google Glass	1	2.63	21.	AR Waze	1	2.63
4.	VR-Oculus Go,	2	5.26	22.	3D Printer	2	5.26
5.	Modelling Software-Auto CAT,3DS	1	2.63	23.	Samsung's Gear VR	3	7.89
6.	Headset	1	2.63	24.	Google Daydream View	1	2.63
7.	-VR Goggle	8	21	25.	Windows Mixed Reality	4	10.52
8.	HTC Vive	5	13.15	26.	Google cardboard	2	5.26
9.	Samsung Gear	3	7.89	27.	Valve Index	2	5.26
10.	Google Cardboard	1	2.63	28.	Samsung Odyssey+	1	2.63
11.	HP	1	2.63	29.	MR-HoloLens	1	2.63
12.	Acer	1	2.63	30.	Veer VR	2	5.26
13.	Magic Leap	1	2.63	31.	Blender	2	5.26
14.	Google Day dream	1	2.63	32.	Sony play Station	2	5.26
15.	RFID	5	13.15	33.	Spectra VR	2	5.26
16.	Oculus Go	3	7.89	34.	Lenovo Mirage Solo	1	2.63
17.	Oculus Quest	9	23.68	35.	Insignia VR Viewers	1	2.63
18.	Oculus Rift	17	44.73				

Table 5: Employed Equipment

(The percentage drawn based on 38 SAs) Total SAs x Explained SAs / 100 = %

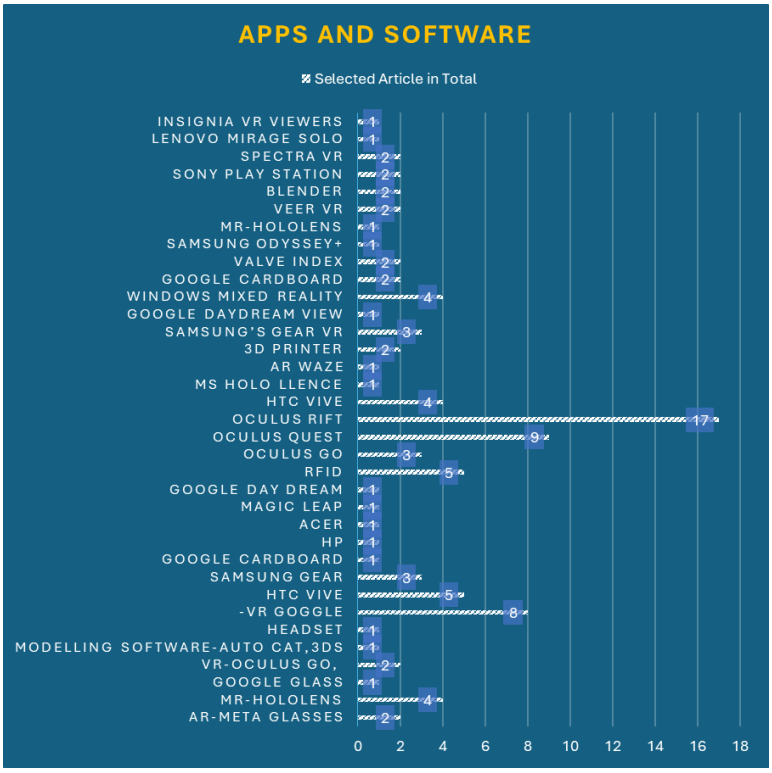

Fig. 3: Apps and Software

As depicted in fig.3 the Oculus Rift is the most popular Headset in SAs. 44.73 % selected articles have mentioned it. The Oculus Quest is the second most used headset device. Google Cardboard, HP, Acer, Magic Leap, Google Daydream, Samsung Odyssey+, Lenovo Mirage Solo, Insignia VR Viewers, etc, are the emerging headsets. The emerging new services are showing in total 1 and 2 SAs. A total of 65 apps and Software are elaborated in 38 SAs. The Aurasma and ShelvAR are the most popular apps shown in SAs. The graph is showing Google Tilt Brush and Second Life are growing technologies in the field of libraries.

Conclusion:

This systematic review study conducted SLR on a total of 38 research papers that were selected based on inclusion and exclusion criteria. The researcher formulated specific questions to address gaps in understanding current trends and technologies in the immersive sector. The study revealed a total of 63 immersive services were presented over 38 SAs. The Virtual Tour is the largest immersive service described among the 12 SAs. Navigation and VR Content are the second largest immersive services stated in SAs. Gravbox, Sandbox, and AR Learning Trail are some other notable services revealed through the study analysis. Overall, this analysis synthesizes distinct studies concerning virtual worlds and immersive technologies in academic and library contexts. This study also details the application of Virtual Reality (VR) in libraries to enhance user immersion and interaction with resources, citing several example libraries. VR initiatives offer opportunities for deeper engagement with student and researcher projects, supported by promotional strategies such as equipment tours and competitions. Studies suggest VR can improve student orientation by increasing interest and reducing anxiety, though long-term effects require further investigation. Comparative analyses indicate Immersive Visualization Environments (IVEs) may be superior to traditional VR setups. The implementation of VR in academic libraries is supported by user group needs and metadata, with transformative leadership identified as a key factor for successful adoption. The text also touches upon library space utilization and the integration of VR and Augmented Reality (AR) technologies. This review identifies immersive technologies and application paradigms commonly utilized in library settings. It also emphasizes the importance for future librarians to possess a thorough understanding of this area. The analysis indicates substantial opportunities for further exploration and offers guidelines for future research, particularly concerning interaction methods and the design of User Interfaces and User Experience within highly immersive and interactive library environments.

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Conflict of Interest:

The authors declare no conflicts of interest related to this study.

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