# BIG DATA VISUALIZATION IN DIGITAL MARKETPLACES – A SYSTEMATIC REVIEW AND FUTURE DIRECTIONS

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**Abstract**

ABSTRACT As the digital landscape continues to evolve, digital marketplaces have become critical platforms for businesses to connect with customers and thrive in the highly competitive market. Amidst this growing complexity and influx of data, the role of big data visualization has emerged as a powerful tool for extracting meaningful insights and could also help with predictive analysis in digital marketplaces. Digital marketplaces have revolutionized the way businesses operate, creating vast streams of data generated by various transactions, customer interactions, and market dynamics. Navigating this data deluge presents a challenge, as businesses strive to uncover valuable insights that can inform strategic decision-making. Big data visualization has emerged as a powerful approach to transforming complex data into visually appealing representations that enable better understanding, analysis, and utilization of information in digital marketplaces. This paper explores the significance of big data visualization in the context of digital marketplaces. It highlights the growing importance of visualization techniques to unlock the hidden potential of massive datasets and facilitate data-driven decision-making. By employing innovative visualization tools and technologies, businesses can gain a comprehensive view of their marketplace, identify patterns, and extract actionable insights to optimize their operations. Additionally, the paper highlights the benefits of big data visualization for stakeholders involved in digital marketplaces. It emphasizes how visualization empowers decision-makers to identify emerging trends, understand customer behavior, and make data-informed strategic choices. Moreover, it addresses the collaborative aspect of visualization, enabling teams to share insights, foster innovation, and drive performance improvements across the marketplace ecosystem. This paper offers a multidisciplinary overview of the research problems and developments in big data and the tools and strategies used for its display. The primary goal is to give creative solutions for problems relating to the present state of big data visualization and highlight obstacles in visualization approaches for existing big data. Complex data visualization design projects frequently require collaboration between individuals with various visualization-related talents. For instance, many teams combine designers who produce fresh visualization concepts with engineers who put the resultant visualization software into practice. The authors pinpoint gaps that present difficulties for designer-developer teams trying to produce new data visualizations. Data for this study came from papers published between 2010 and 2022 and obtain using a comprehensive literature procedure (12 years). For this study, several publications from a variety of sources are utilized using the specified inclusion, exclusion, and quality criteria. The focus is primarily on the research regarding big data visualization in the context of digital marketplaces and the methods used for data visualization. The current study compiles and arranges the published literature on big data visualization in digital marketplaces that is currently available. The findings of this study indicate that there has been a rise in the number of papers published annually and that there are several studies on big data in digital marketplaces. The study will aid academics in understanding the research that is now accessible on big data in digital marketplaces and will ultimately be utilized as support in other investigations

**Keywords:** Big Data, Visualization, Data Visualization Tools, Digital Marketplace, and Systematic Literature Review

## 1 Introduction

In today's digitally connected world, online marketplaces have experienced a remarkable surge in popularity. These platforms bring together buyers and sellers from across the globe, facilitating transactions, and offering a wide array of products and services. Behind the scenes of these bustling digital marketplaces lies a hidden treasure trove of data, known as Big Data. The utilization of Big Data has revolutionized the way these platforms operate, enabling businesses to make data-driven decisions, enhance customer experiences, and unlock valuable insights that drive growth and success.

Big Data refers to vast volumes of structured and unstructured data that are generated at an unprecedented pace. These data sets are characterized by their variety, velocity, and

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volume, making them challenging to process and analyze using traditional methods. However, digital marketplaces have harnessed the power of Big Data to gain a competitive edge and meet the ever-evolving demands of the modern consumer. Data is now an essential component of social interactions, history, politics, science, economics, and corporate organizations. Social media platforms like Facebook, Twitter, and Instagram, where users regularly create a massive flood of diverse data (music, photographs, text, etc.), are blatant examples of this tendency [64].

In the realm of digital marketplaces, Big Data plays a pivotal role in numerous aspects of operations, ranging from inventory management to pricing strategies, personalized recommendations, fraud detection, and customer engagement. By leveraging the vast amounts of data generated by users' interactions, transactions, and behaviors, these platforms can gain deep insights into consumer preferences, market trends, and supply chain dynamics. Massive amounts of data are produced daily by businesses and social media platforms, and these data are typically represented in formats that are consistent with illogical databases: weblogs, text files, or machine code, such as geospatial data that may be gathered in different stores even outside of a business or organization [65,66,73-81]. One of the primary advantages of utilizing Big Data in digital marketplaces is the ability to enhance customer experiences. Through advanced analytics and machine learning algorithms, platforms can analyze vast amounts of customer data to create personalized recommendations, tailored marketing campaigns, and targeted promotions. This level of personalization not only increases customer satisfaction but also boosts sales and customer loyalty.

Moreover, Big Data enables digital marketplaces to optimize their pricing strategies. By analyzing historical sales data, competitor prices, and market trends, platforms can dynamically adjust prices to maximize revenue and maintain a competitive edge. These data-driven pricing strategies can lead to improved profitability, increased market share, and improved customer satisfaction. Furthermore, the application of Big Data in digital marketplaces enables effective fraud detection and prevention. By analyzing patterns and anomalies in transactional data, platforms can identify suspicious activities and potential fraud attempts in real-time[68,70]. This proactive approach helps protect both buyers and sellers, ensuring a secure and trustworthy environment for conducting business. In conclusion, Big Data has revolutionized the way digital marketplaces operate, allowing businesses to leverage vast amounts of data to make informed decisions, enhance customer experiences, and drive growth. The utilization of Big Data enables platforms to optimize pricing strategies, provide personalized recommendations, and detect fraudulent activities. As the digital marketplace landscape continues to evolve, the importance of Big Data analytics will only grow, empowering businesses to stay competitive and meet the ever-increasing expectations of the modern consumer.

The following are the main contributions of this research: To highlight the research work done from January 2010 till January 2022 in the field of visualization of big data in digital marketplaces To present a summary of the techniques used for the visualization of data in digital marketplaces To highlight the benefits of visualizations in the field of digital marketplaces with an indication of the limit of power

The paper's organization is as follows; Section 2 shows the detailed process of the research used to conduct the systematic literature review. Results, discussions, and answers to the research questions are presented in Section 3. The limitations and conclusion of the present research work are given in Section 4.

## 2 Research Method

The methodology for the research topic involves a structured approach to gather, analyze, and synthesize relevant literature and empirical evidence. Initially, a comprehensive search was conducted across electronic databases including, IEEE Xplore, Science Direct, Scopus, and Google Scholar, utilizing keywords such as "big data visualization," "digital marketplaces," "data analytics," "Digital AND "Visualizing marketplace big data" "OR" data visualization "OR" big data visualization "OR" Digital marketplaces data visualization". Selection criteria were established to include studies based on relevance, publication date, language, research methodology, and scope. Following the selection process, a systematic framework for data extraction was implemented to gather pertinent information such as research objectives, methodologies, key findings, visualization techniques, and proposed future directions from the selected literature. Quality assessment tools were employed to evaluate the rigor and credibility of the included studies, ensuring the validity and reliability of the systematic review. Thematic analysis techniques was then applied to identify common themes, patterns, and trends across the synthesized literature, while also pinpointing gaps and limitations that warrant further investigation.

Furthermore, the documentation and reporting phase adhered to established guidelines such as PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) to ensure transparency and reproducibility. By following these methodological steps, the systematic review aims to provide a comprehensive overview of the current state of research on big data visualization in digital marketplaces, offering insights into future research directions and practical implications for stakeholders in the field.

## 3 Research Questions

The following are the key research questions identified for conducting the proposed study:

RQ 1. What research has been done from January 2010 till January 2022 in the field of visualization of big data in Digital Marketplaces?

RQ 2. What techniques are used for the visualization of data in Digital Marketplaces?

RQ 3. What are the benefits of visualizations in Digital Marketplaces?

## 4 Search Strategy

A well-formulated search process devises it promising to thoroughly execute the resources available to identify all the associated existing studies that meet the defined search criteria. To maintain the standard of systematic literature review and conduct this study a proper search process has been done to identify the related materials which are published in the given well-reputed libraries. The proposed study uses keywords related to digital marketplaces' big data visualization based on the research questions. The following are the libraries that were used for the search process of the defined keywords for the related studies to the proposed research;

a. ScienceDirect
b. Taylor and Francis Online
c. IEEE Explore

## 5 Search String

Initially, we decided to choose the libraries and appropriate keywords related to the present research. The scope of the searched terms was defined to be in the range of the current research. The keywords defined include ("Digital) AND ("Visualizing marketplace big data" "OR" data visualization "OR" big data visualization "OR" Digital marketplaces data visualization".

The formulation and confirmation of the key search phrases then took place through the use of the information and detail gleaned from the sources based on the keywords. Then, these terms were adjusted because different sources have different search syntax. Figure 2 displays the details of the phrase that was searched for as well as the results. Journal articles, book chapters, books, conference proceedings, and other online resources are among the information gathered from many sources. Table 3 displays the complete list of the articles received. While Figure 2 shows the original, filtered by title, filtered by abstract, and filtered by content. The phases of the search are depicted in Fig 3.

## 6 Publication Inclusion and Exclusion Criteria

Numerous journal articles, books, conferences, seminars, and other published resources were discovered throughout the search process. The pre-defined keywords were manually searched in each of the aforementioned libraries. The Endnote reference management program was used to manage the necessary references and bibliographic data [71]. The bibliographic data in the Endnote library consists of the author's name, the title of the article, the name of the conference or journal, the year the piece was published, and the page numbers of that particular article. Figure 2 depicts the specifics of the general search procedure carried out by the specified keywords in the available libraries. The initial search, inclusion and exclusion, and filters by title, abstract, and full text are all included in this.

The authors decided to include the paper with the following inclusion criteria shown in Table 1. The authors decided to exclude the papers with the following exclusion criteria shown in Table 2. Figure 4 shows the initial results obtained from the search process of the proposed research. The study selection process in the proposed research was performed in different stages. Initially, the authors reviewed the articles' titles based on the defined criteria of inclusion and exclusion. The exclusion criteria were used to exclude the papers that weren't pertinent. Following that, the articles were screened by reading the abstracts, which led to the exclusion of several publications that were irrelevant to the stated research topics. The list of papers that were chosen based on the inclusion criteria is shown in Table 3. Only the papers that met the specified inclusion and exclusion criteria were chosen during the procedure [72]. Table 3 lists the chosen papers, titles, and citations. According to the trend in Table 4, there is a year-by-year increase in research and articles, indicating the field's growing importance and applicability. The quantity of papers in the chosen year range is shown in Figure 5.

*Table 1. Overview of the Inclusion Criteria.*

| Table 1. Inclusion Criteria |
| --- |
| The papers were published between Jan 2010 – Jan 2022 |
| The full content of the article is available |
| The papers were in English |
| The paper gives details about the use and application of Big Data Visualisation in Digital marketplaces. |
| The article exists in the databases defined in the search Strategy |
| The paper provides the background which is used to answer the research questions. |

*Table 2. Overview of the Exclusion Criteria.*

| Table 2. Exclusion Criteria |
| --- |
| The papers were not in the range of Jan 2010 – Jan 2022 |
| The full content of the article is not available |
| Several same versions of the paper |
| Not in English |
| Not existing in the databases defined in the search Strategy |
| Not associated with the defined research questions. |

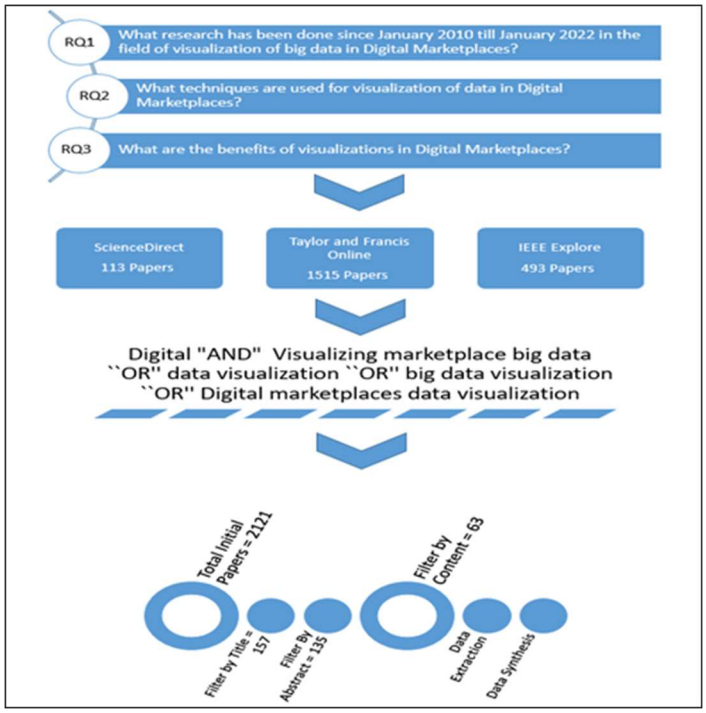



Figure 1: Protocol phases designed to carry out SLR

## 7 Systematic Literature Review

Critically analyzing the graphical presentation of big datasets that are generated from accumulative business transactions, digital marketplace reports, and publications in the digital marketplace [ 57]. Cota et al [62] highlighted electing perfect graphic visual static representation of visualized crucial big datasets that allows users interactive tool to control from the frontend of interaction, to keep track and relate the logic of extracted information [62]. As stated by scholars, visualization of dataset representation should be such that would produce an instinctive inner sense of understanding of specific datasets' behavior [63]. In 2016, Leung et al. [63] outlined on PyramidViz visualization accompanied by association rule mining that offers a hierarchical layout of informative datasets. Big data visualization tools evaluate the final report of taken datasets to boost business, government, and educational performances, and transactions, eliminate mistakes, and assist in a bright future [7, 51, 57]. Big data Visualization tools accordingly present descriptive information, digital materials, administrative information, and statistical data, where users can easily assume evaluated reports on the vigorous in-flows of generated datasets [8, 30, 40]. The most recent approach to visualizing big datasets formulated from mathematical models [20, 57]; namely Euclidean distances, correlation coefficient, using conditional probabilities, Gaussian functions, and applying eigenvalue decomposition to find distance represented datasets along with K-nearest neighbor (KNN) algorithms [20]. Mohammed et al. [31] examined big data visualization tools like Tableau, Qlikview, Sisense, Domo, Microsoft Power BI, Klipfolio, Plotly, Chartio, Geckoboard, Datawrapper, Infogram, Chart Blocks, D3.js, Google Charts, Fusion Charts, Chart.js, Grafana, Chartist.js, Sigmajs, Polymaps in various domains concerning the respective task.

Data is a vital component of any industry from educational to service industries which supports making wise choices within the continuous processes of industries in the digital platform [5, 6, 7, 40, 51, 14].

The rapid integration of datasets within digital transformation requires respective appropriate big data visualization tools to learn the linking patterns in taken datasets from various fields and domains [30, 51, 57, 14]. Islam and Jin [43] highlighted categories of visualizations like chartsBlock, Google Charts, Infogram, and Datawrapper to visualize hidden patterns and movements and chances for later scrutiny [43]. Visualizing big datasets enables data to be utilized most efficiently, swiftly outlines reports, and enables users to absorb information seamlessly [44]. In 2021, Ishika and Mittal [44] reviewed approaches to information visualization of massive datasets. To represent digestible reports, Ishika and Mittal highlighted tree maps, circle packing, parallel coordinates, and stream graph methods [44]. According to [1,15,40], projected multiples of applications and tools to collect information for visualization of data in the learning process within an open digital platform. Namely of multiple information sources for big data visualization purposes is enterprise content management system, online analytical processing tools like IBM Cognos, Oracle OLAP, and Oracle Essbase, enterprise architecture tool, decision tree techniques, neural network techniques, Na¨ıve Bayes techniques, K- Nearest neighbor techniques within educational data mining tool [1, 15] for efficiently providing

Table 3. Evaluation of common visualization tools.

| Name | Usage | Software category | Visualization structure | O.S. | License | Scalability | Extensibility |
|---|---|---|---|---|---|---|---|
| **Tableau** | Presentation | Desktop App., cloud hosted | Various Charts, graphs and maps | Windows 7 or later, OSX 10.10 or later | Commercial and Academic license | Hadoop and cloud | DBs Drivers, API for Matlab, R, Python and Javascript |
| **Infogram** | Presentation | Desktop App., cloud hosted | Charts, maps, images and even videos | Windows 7 or later, OSX 10.10 or later | Commercial and educational license | Cloud | API for Matlab, R, Python and Javascript |
| **QlikView** | Presentation | Desktop App., cloud hosted | Various Charts, graphs and maps | Windows 7 or later, OSX | Commercial | Hadoop and cloud | API for Matlab, R, Python and Javascript |
| **Plottly** | Presentation + Developers | Web tool, JavaScript and Python library | Charts, plot and maps | Web Based | Commercial and Community | Cloud | API for Matlab, R, Python and Javascript |
| **Power BI** | Developers | Desktop App., cloud hosted | Various Charts, graphs and maps | Windows 7 or later, OSX 10.10 or later | Free, Pro, and Premium Per User | Cloud and Hadoop | DBs Drivers, API for Matlab, R, Python and Javascript |
| **Ember-charts** | Developers | JavaScript library | Charts | Web Based | Open-source | Cloud | - |
| **Google charts** | Developers | JavaScript library | Charts, tree map, timeline and gauge | Web Based | Open-source | - | e Chart Tools Datasource protocol |
| **Fusion Charts** | Developers | JavaScript library | Charts | Web Based | Commercial | - | - |
| **Chart.js** | Developers | JavaScript library | Charts | Web Based | Open-source | - | - |
| **Leaflet** | Developers | JavaScript library | Map | Web Based | Open-source | - | Extensive plugin repository |

with the valuable data for further interpretation by users along with various digital applications and devices. In the digital marketplace, big data visualization intuitionally [1] brings awareness of updated organization tasks and involved or taken transactions and that further improves in reasoning abilities of users. Big data visualization represents explicit knowledge for the viewers on a cloud-based platform to make inferences critically using tact knowledge [1] along with learning algorithms and analytical algorithms. Hybrid information infrastructure enables an understanding of the concepts for the learner and academic coordinator at a faster pace [1,15] within real-time data analytics. Big educational data visualization provides a new direction for learners, businesses, academics, and professors to learn and understand specific fields' transactions [7]. The daily production of educational data within the Internet of Things, social media platforms, learning management systems, massive open online courses, open courseware, and open educational resources [7, 15] promotes an easy and flexible way for learners to continue with education [7]. Ang et al. [7] revised techniques of visualizing educational data that is through distributed architecture, five-layered architectures, cloud-based architecture, big data architecture, and logging architecture for education that evaluates the learner's pace of learning in the digital marketplace within predictive analytics and learning analytics [7]. Meanwhile, Dai et al. examined smart big educational data which is being generated from the Internet of Things by applying the visualization software CiteSpace [13] to configure which application is best to enhance e-learning in the digital marketplace with reliability and that provides useable, useful usability. Moscoso-Zea et al. also examined descriptive analytics that focuses on historical and present datasets for visualization and reviewed the decision support system and conceptual blueprint of the institute [15] to enrich judgments, evaluations, and smooth control of systems in the e-learning platform. Consequently, educational institutes produce students data and educational-related resources big datasets from educational management information systems in the digital platform [16]. Feng et.al [16] indicated analytical discipline for big educational data visualization from educational management information systems [16] to control, monitor, and boost e-learning for academicians and learners. The pace and patterns of acquiring skills in the digital marketplace are studied using process techniques within clustering algorithms and support vector machine algorithms [16] to improve the usability of the system for both learners and administrators. The clinical complex report is publically accessible from a cloud-based platform to easily understand the course of symptoms through the Multiple Imputation Visualization-Aided Validation Index techniques in the digital marketplace [2]. It searches similar patterns of clinical data sets on the web and groups them accordingly using unsupervised clustering learning algorithms [2]. The web-generated clinical data set visualization [2], enables the public to justify and take precautionary measures of incurring similar

symptoms early on. It is the holistic treatments given to patients from different generated treatment effects data sets [2] for patients to become responsible for health issues. The patient applies tact knowledge from visualized reports to make assumptions without having background knowledge on different health-related issues [2]. According to the scholar, designing the various big data visualization tools concerning its task is the one of most challenging tasks to map with intuition reasoning [1, 2]. The web-generated clinical report data visualization aims to improve statistical formulation and reliability of data within Multiple Imputation Fuzzy grouping and authentication methods [2]. Globally, every second the academician publishes quality scientific or art articles, literature, conference papers, magazines, books, and business reports with digital databases and libraries [3]. Vigorously, researchers

Table 4: Techniques of visualizing data by researchers.

| | |
|---|---|
| **Five-layered Architectures** | Cloud-based architecture, big data architecture, and logging architecture |
| **Internet of Things** | Visualization software CiteSpace |
| **Descriptive Analytics** | Decision support system and conceptual blueprint of institute |
| **Analytical Discipline** | Big educational data visualization |

need to look into the massive generated scholarly data [3] to acquire knowledge in specified fields based on officially acceptable findings. The Big data on the writer, main terms, reference, and summary is considered for visualization using rule-based metadata extraction [3]. Researchers are vigilantly well-informed of specialist details from structured semantic profile visualization tools [3]. Systematically, enables a researcher to simulate real-time interconnection of concepts using programming visualization tools with Java scripts; D3.js, Chart.js, FusionChart, FlotChart, ZingChart and Gephi, Nodebox3, Ggplot2, Processing, JpGraph also applying non-programming visualization tool like Tableau, ICharts, Infogram, Raw Graphs, Visualize Free to visualize scholar datasets [3]. The motive is to extract the proficiency of content aligned with real-life task solutions across wide disciplines [3]. The big dataset on body scan reports along with advice and monitoring provided electronically to long distances patients through mobile devices where the body scan reports are generated from computed tomography scans and magnetic resonance imaging machines [4]. For body scan reports visualization, [4] indicated a lightweight progressive transmission algorithm that supports a full-scale report with reliability and further promotes mHealth in the digital marketplace [4]. The projected big data visualization tool [4] upholds a healthy lifestyle that supports health-related issues electronically and maintains generated body scan reports datasets confidentially over the on-demand availability of the internet [4]. Nazir et al. [6] applied a holistic approach to analyze Digital Marketplaces' big data retrieval under digital transformation that further assist academicians and practitioners in diagnosing any recent heart disorders or cardiovascular system along with data mining algorithms that determine meaningful patterns of reports. [6]. Thus counsel the heart patient accordingly through the health information system (HIS) to minimize mistakes, leftovers, and care costs [6]. Meanwhile, structured, semi-structured, and unstructured large volume of data from various sources uses advanced analytical techniques for quickly reaching conclusion and forecasting upcoming consequences along with predictive analytics algorithms and artificial neural networks algorithms [5]. In this digital age, various Businesses, Government agencies, and Educational institutes' daily transactions and sensitive information are placed on cloud-based platforms. For instance, a loss of data occurs while transferring to the cloud platform, leading to misconduct intentionally or unintentionally. While big data analytics examines rising crime datasets in the digital marketplace which enables investigators to study the pattern of linked cases, determine the primary cause of misconduct, and place control on possible upcoming crimes in a specific country or location [5]. According to scholars, placing data security measures in the digital marketplace is a major concern of study [5, 7]. Henceforth, lengthy datasets generate from Internet of Things (IoT) applications in the digital marketplace [8]. The authors [8] reviewed various data analytics like real-time analytics, off-line analytics, memory-level analytics, business intelligence analytics, and massive analytics concerning the Internet of Things applications that further empower new strategies in the digital marketplace. Marjani et al. [8] highlighted that visualization of the increasing dataset from the Internet of Things applications is quite difficult to achieve accurate outcomes. Consequently, the Internet of Things big datasets visualization tools generates poor results in terms of clarity [8] along with real-time interactive charts and pie charts, scatterplots, line graph, and bar charts that are very critical for processing and submitting a graphical presentation for assumptions. Since the integration of data sciences, [9] restructured courses for colleges and institutes to digital platforms within data analysis and visualization tools to improve the pace of learning amongst learners and facilitators.

As stated by [10], enormous smart meter data, digital image, and video data are generated from smart grid applications within Lambda architecture in the digital marketplace to maintain the continuous and quality distribution of power within smart grid applications in the digital marketplace. The real-time visualization of smart grid application usage of power data using the Hadoop tool for spark connection to Tableau and Matlab software along with data mining clustering K-means algorithms [10]. Sqed et al. [11] examined big-time usage of the two-way flow of energy and data produced from real-time automatic payment systems, real-time consumer appliances along with Internet of Things devices. The tracking and tracing of smart grid data based on occurrence, state, customer operational, business, and signal task analytics [11]. Willingness of reaching their destination on time, Bangkok residents opt for a mathematical model of transportation system which assists in real-time taxi pick-up that is generating trip time, distance, and speed data [12]. The real-time trace of movement services examined by PANICHPAPIBOON et al. [12] using the satellite-based radio navigation system. The on-demand trip, time, distance, and speed data are visualized using a visual curve fitting to forecast upcoming wanted trips, the most well-known place that the visitor visit in Bangkok [12]. The best-fit approach model improves taxi facilities and infrastructure of

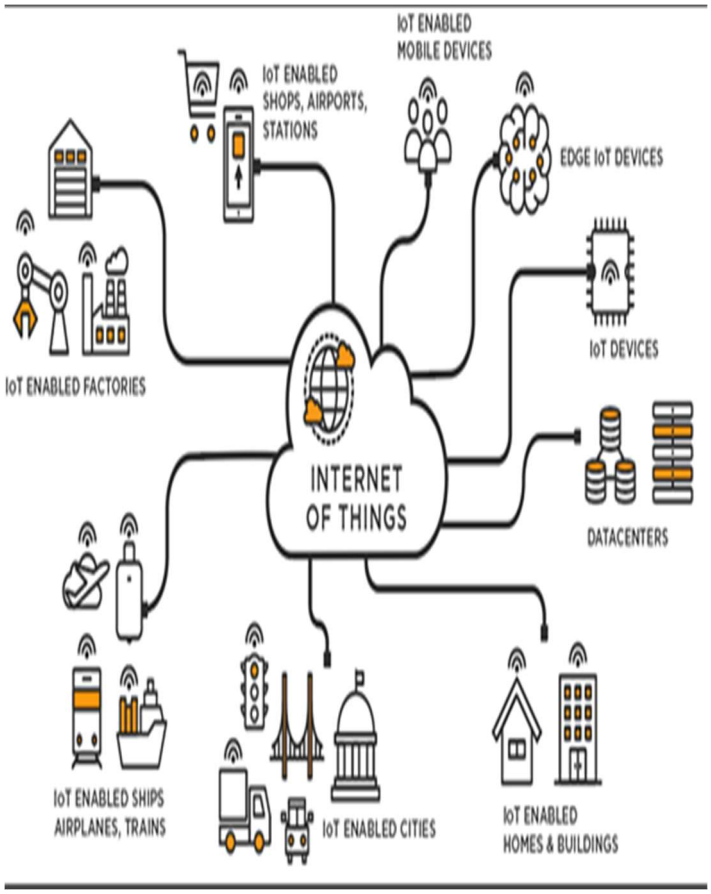



Figure 2: The illustration by Business Tech Michigan Ross shows various points of connection of the IOT.

places [12] to bring growth in economic development and gross domestic product in Bangkok. In 2018 Liao et al. examined open source code and software projects code big dataset that is generated in GitHub for software development on demand over digital platform [17]. Liao et al. reviewed the version control and Git;s big dataset visualization using the GiLA GitHub label analyzer to track source code matters in terms of recognizing the most used labels, determining maximum vigorous and expert users around each label, the time frame in which source code matters arises along with TL-IV Analysis Model [17], as a result to master and design clean software development source codes. Henceforth the authors [17] proposed C-SFS visualization, stacked Flow Visualization, and applied Sunburst Visualization techniques to trace source code matters in GitHub. The upcoming study [17] focuses on timeframe verification in organizing, preserving, and implementing the available source code dataset in web and cloud-based platforms [17]. The availability of source code in cloud-based platforms needs to be critically utilized in terms of constructing, handling, testing, and assimilating within version control systems [19]. In 2014 Liu et al. [19] tested large collections of source code datasets by applying Team Watch as the big data visualization tool for control version in software development [19] from GitHub, Git, GitLab, Apache Subversion, CVS, Mercurial, and Montone in the digital marketplace. Liu et. al [19] intend to create history attentiveness on the control version system of source code by using Seesoft, Evospace, COOP/Orm, BSCW, Xia, Augur, and Rationalizer [19] to increase competence levels and to create smooth learning for software developers in designing specific application in the digital marketplace. In everyday use of applications for prediction or evaluation in digital platforms for specific tasks, predictive analytics generates unlabeled datasets from given label datasets within Artificial intelligence [18]. In 2020 Hartono, [18] proposed new hierarchical neural network techniques for visualizing big unsupervised and supervised datasets for better presentation of predictive reports. Hartono outlined the future directions for using the novel approach of applying a soft-supervised topological autoencoder to improve the learning abilities of the learner in an e-learning platform along with a user-friendly presentation [18]. Cyber-related datasets generate every second in the Cyber marketplace between two connected nodes [21]. Jiang et al. in 2022 [21] reviewed cyber data visualization on network security analysis and malware analysis visualization to create cyber scenarios alertness and to protect business computer information systems, business computer networks, and infrastructure from offensive cyber threats or cyber risks in the digital marketplace. Lex et al. proposed on Upset techniques for general inter-linked dataset visualization which supports detecting the linkage of represented datasets within the Euler and Venn Diagram for multiple domains [22]. As stated by Kuhail et al. [23] that software developers in the digital marketplace visualize advanced programming datasets with statistical graphs by using the Uvis visualization tool that offers user interactions [23]. The graphical presentation of programming datasets efficiently improves developers' programming skills [23]. The continuous existence of events taken as well as endless three-dimensional events' relative location and path is being examined by He et al. [24] in the study of sciences, organisms, environment, living organisms, forecasting the weather, climate change, biodiversity, curing of diseases, the pace of movements. He et al. [24] recommended analytical reasoning for a multidisciplinary field that offers interactive user interfaces by using Spatiotemporal trajectory visualization techniques [24] for the duration, location, and direction of events' datasets. The motive of interactive visualization techniques is to understand an actual event's conditional behavior based on its changing value which is depending on occurrences and circumstances to make fair logistics on multidisciplinary' s event occurrences [24]. In online forum discussions, detecting unethical common interest interaction with transactions, the application's dataset is dissecting task in analytical reasoning to understand the complex user interaction. [25]. Shi et al. [25] proposed visualization techniques for a daily user to derive transaction datasets by using tracing and observing methods, investigation, and controlling movements, applying tacit knowledge, scrutinizing human-computer interaction, and refinement and identification methods to visualize in terms

of graphs, charts, manuscript, physical feathers of areas of event and symbols [25]. Visualizing the usage pattern of unethical user interaction, assist in placing controls on online network access and services from cyberattacks and defamation in internet-based social media platform [25]. Windhager et al. [26] 2019 proposed InforVis visualization techniques for the heritage of tangible and intangible heritage datasets of specific cultures in software-based online infrastructure [26]. The visualizing techniques used to preserve one's culture in digital transformation for today's generation that is to maintain integrity, manifestations of human social and professional behavior, find the linkage of one's tangible and intangible cultural heritage dataset to the other, and proficiently transform valuable skills from one generation to other [26]. Wiktorski et al. [27] studied dataset behavior on genetic utility, however, recommended physical activity monitoring datasets visualization approach within the UCI machine learning repository in the digital marketplaces field for effective results in the diagnosis process [27]. In the digital marketplaces field of visualization, Ma et al. [28] 2021 proposed K-means clustering segmentation visualization techniques to improve the decision-making process in diagnosing digital marketplaces report dataset patterns [28] in three-dimensional vision. The segmentation rule in visualizing digital marketplaces dataset reports is in terms of observing and extracting tissue's color, image, texture, and edges [28]. Zhiyuan et al. [29], 2017 reviewed the pace of movement data within Shanghai, China by using Echart.js and D3.js as the visualization tool to maintain travel feasibility, travel time, and travel convenience [29]. The travel datasets visualize in terms of connections of two nodes, which direction, particular areas, and final destination [29]. The automated system generates a continuous flow of traffic event datasets, mainly on the traveling details of travelers in Shanghai, China [29]. Liang et al. [31] proposed high-dimensional data visualization using k-means clustering algorithms, multi-source diverse visualization, time series visualization, predictive analytical system, and extensibility system to uncover the correlated patterns in specific datasets in various disciplines [31]. AN et al. [32] applied D3.js visualization techniques on film big datasets for film ranking and evaluation purposes. The film's big datasets are generated on search engines along with Python language [32]. For evolving film industries, Hu et al. [34] proposed a film expert evaluation system for visualizing film big datasets [34]. The film expert evaluation system enables producers and fans to refine ideas dynamically for later film production [34]. Ahmed et al. [33] proposed a web-based visualization platform for personal datasets generated on web-based and mobile-based applications. The web-based visualization platform provides easy access to users for task analysis of data in the form of graphical presentation [33] along with JQuery and JavaScript. Wei [35] proposed 3D electric power datasets visualization on real-time power consumption within the statistical parameters [35]. The 3D electric power visualization empowers healthy growth within digital transformation that evaluates actual time spent within the human-computer interaction process [35]. Atta et al. [36] applied real-time analysis and outlined the structure of "Spatial-Crowd" datasets that are generated on events taking place based on social media platforms [36]. Visualizing the bulk of transactions on social media platforms with real-time analysis improves seamless interaction with applications and prevents cyber deception in the digital marketplace [36]. According to Min et al. [37], big datasets proliferates within innovative technologies. The onward modes of visualizing big data in China turn to apply 3D visualization, information visualization, and research visualization in practice with echart, python, gi, Hadoop, OpenGL, and Matlab [37]. Henceforth develop big data visualization methods along with Neural Networks, Cluster Analysis, Complex Networks, and Regression Analysis algorithms [37]. Sergeevich et al. [38] proposed programs that have access to the internet linked through hypertext transfer protocol for visualizing real-time big datasets in the digital marketplace along with Advanced Data Extraction Infrastructure (ADEI) [38]. Exponentially growth in technology and data, Erraissi et al. [39] outlined big data meta-model visualizations layers to hierarchically visualize the compositional and structural datasets pattern for assumptions [39]. Raghav et al. [40] highlighted aspects of big data visualization in terms of enabling users to understand the specific course of action in different layouts with respective interactive details [40]. Hirve et al. [41] highlighted conventional visualization techniques which give the ability to understand and make an assumption based on datasets patterns generated from real-world and computer-generated content also based on stimulated-generated datasets [41]. Galletta et al. [42] examined health-related services datasets over the internet within MonogoDB by applying Geo-JSON for clear visualization of long distances in patients' digital marketplace reports [42] along with a decision support system. Big data visualization for telemedicine offers configurable services with available resources, and previous and current real-time data and maintains engagements with collaborative tools [42]. Internet content delivers ubiquitous access to information to mobile devices [45]. In 2019, Grujic´ et al. [45] examined massive telecommunication data visualization using high-level, general-purpose programming language and Quantum Geographic information system along with Application programming interfaces [45]. The stand-alone Python Quantum Geographic Information system maintains data integrity and trust components in the visualization of mobile data [45]. Fahad and Yahya highlighted visualizing structured and unstructured datasets within scientific methods, processes, and algorithms to extract and extrapolate knowledge and make insight assumptions [46]. The practice of visualizing meaningful noisy, structured, and unstructured datasets by using structured, object-oriented, and functional programming language and free software environment for statistical computing and graphics [46]. The graphical representation of extracted datasets in the form of a Bar, line chart, Box plot, Heat map, Histogram, map visualization,

Mosaic plots, and Scatter plot to diversely analyze clean visualization and assist in monitoring and forecasting structured and unstructured datasets [46, 82 - 93]. In 2022, Wang reviewed airlines' big data visualization by using high-level, general-purpose programming language including structured, object-oriented, and functional programming language to detect and trace patterns for inter-related components in flight datasets that lead to postponement of flights in the United States [47]. Leung et al. [48] highlighted visualizing Covid-19 datasets by applying sophisticated tools to scrutinize Covid-19 datasets along with visual representations of the most recent updates on infected Covid-19 countries, number of life losses, and recoveries. The visual analytics tools provide a deep understanding of global pandemic scenarios globally along with charts, graphs, and maps and which countries need more digital marketplace care attention urgently [48]. Nazir et al. [49] reviewed disorders of the heart and the cardiovascular system dataset visualization within the healthcare information system and electronic digital marketplaces record which assists practitioners in diagnosing heart-related issues. In the future looking forward to applying advanced practices to evaluate on digital marketplace big datasets [49]. Soklakova et al. [50], in 2016 highlighted on visualizing education big data by using data-driven document JavaScript along with hypertext markup language, scalable vector graphics, and cascading style sheet [50]. The D3.js enables users to control outlined education datasets with clicks and scrolls in web browsers to improve in real-time teaching and learning process for tertiary institutes [50]. Menon et al. [52], in 2021 proposed a declarative statistical visualization library within a high-level, general-purpose programming language along with GitHub for visualizing smart healthcare datasets and applied a concurrent neutral network for extrapolation. Remotely enables practitioner and patients to collaborate, control, and evaluates effectively visualized health-related datasets' hidden patterns [52]. Allaymoun et al. [53] proposed an online tool for the visualization of sales big datasets. Visualizing customizable informative and statistical reports of sales datasets over Google Data Studio as the means of cost-cutting enables businesses to determine which product or service needs more attention in the supply and demand market chain [53]. Akhir et al. [54] 2018 proposed an E-Latihan System for data visualization for evaluation form management system [54] along with a psychometric response scale. The e-Latihan system visualizes operational organizational datasets for making a wise decision in the continuous process of business transaction which brings more fecundity besides brief statements of reports [54]. Ji and Gan [55], in 2020 reviewed on visualization of scholarly publications that report original experimental and academic work in the ordinary and community real-life consequences. Ji and Gan, highlighted Citespace, CitNetExplorer, Gephi, ScienceScape, SciMAT, and VOSviewer as the visualization tools to detect the relationship between scientific literature and to forecast upcoming applications and user behavior based on previous study patterns [55]. Desai et al. [56] highlighted computational expert mechanisms to visualize educational datasets [56]. The rule-based inferences system extracts large scales of educational datasets in a highly declarative way with control approaches to make extrapolation of informed content [56]. According to Chandrasekar et al. [58], selecting the perfect fit of visualization tool like ggplot2 that best meet needs as required is a challenging task for organizations and individuals [58]. Nevertheless, Chandrasekar et al. [58] declared an open-source data visualization package that is free, easy to use, and displays general visual properties to make inferences [58].

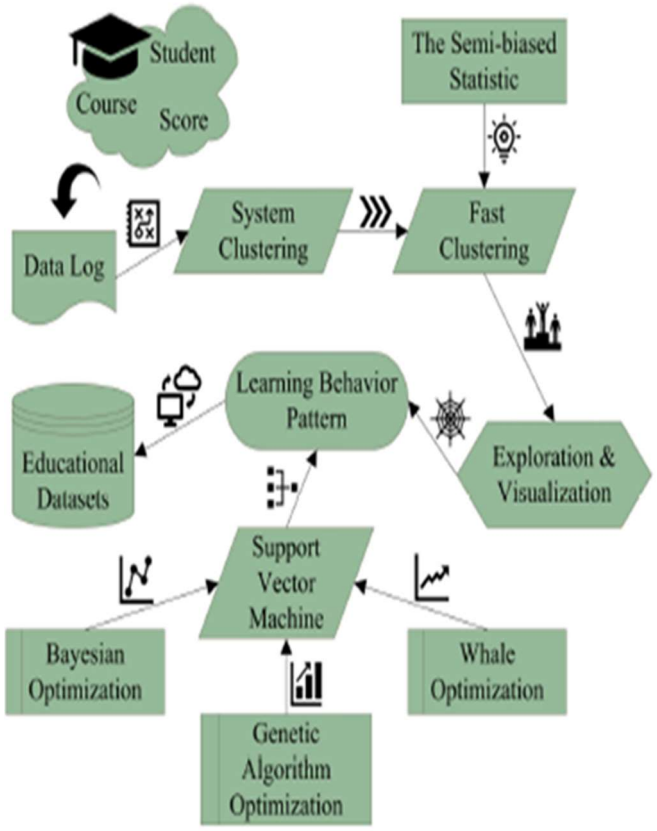



Figure 3: Educational process mining framework

According to a study by [59] visualizing datasets that are being generated over the Internet of Things is very crucial where cybercriminals can have unauthorized access to datasets. Khalid et al. [59] highlighted Decanter AI to evaluate Internet of Things datasets within semi-supervised machine learning techniques to maintain clean transactions of visualization [59]. Ordonez-Ante et al. [60] addressed on visualization of cyberbullying, cyberattacks, and cyber security threat datasets over online social media platforms [60]. Further on [60] indicated strategies of using structured design software tools within cluster computing with multiple processors and using an unbounded stream of events processing with computational application to maintain contextual state in visualizing misuse of

social media datasets at minimal delays [60]. Barik et al. [61] encompassed all aspects of proliferated moving information visualization. To match the correlation of objects, events, time, allocation, and other factors, Barkit et al. [61] suggested and reviewed White box GAT, ArcMap, GeoMesa, HadoopViz, and GRASS GIS, as the visualization tool for geospatial respective datasets [61].

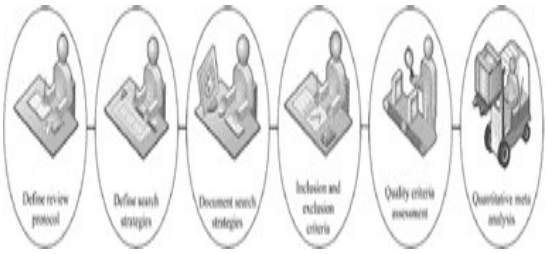



Figure 4: The figure shows the steps followed in the SLR.

## 8 F. Data Extraction

The relevant data were extracted from each of the included papers based on the review, assessment, and defined research questions. The significant data extracted is shown in different figures and tables and are briefly given as follows; • Table 3 shows all of the finally selected papers, with their titles, reference, and year of publication. • Table 4 provides a year-wise breakup of publications selected in which the number of publications is mentioned against each year. • Table 5 shows the answers to the research questions. This table shows show the details of each question and their answer with brief descriptions.

## 9 Data Synthesis

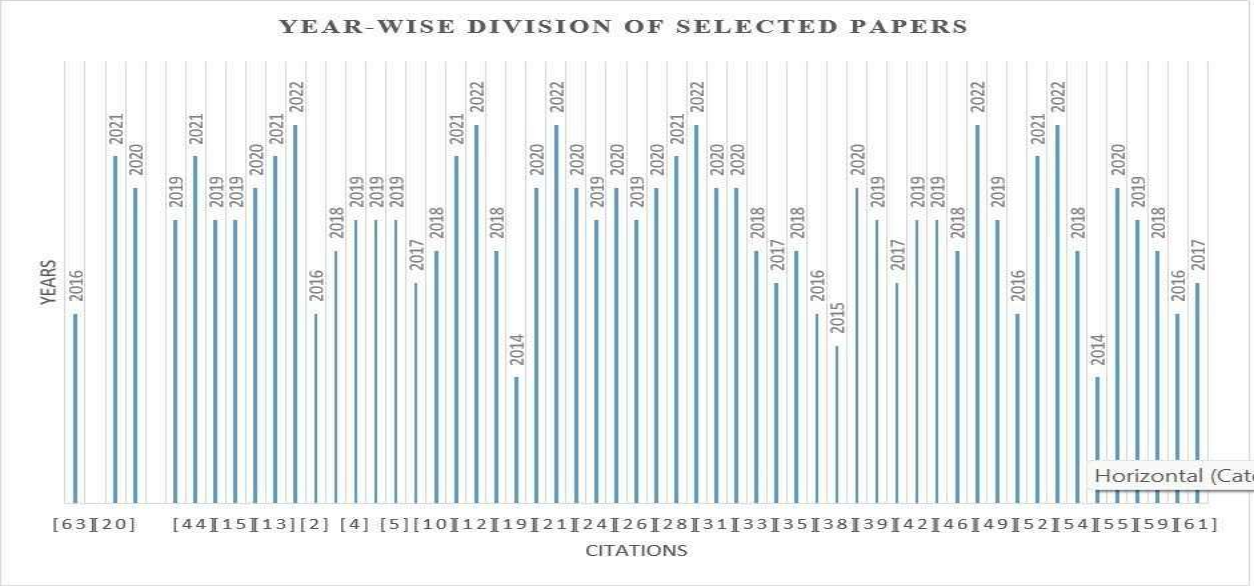
The main reviewer assisted the secondary reviewer in the data synthesis process. As a consequence, the 63-paper sample was used to produce the data extraction. These were read by the primary reviewer to compile a list of categories into which to group the success elements. The inclusion and exclusion criteria as well as the filtering procedure based on the keywords for articles are shown in Figure 2. Their names appropriately titled all of the articles and each library folder was thoroughly examined at the beginning. The duplicate papers were eliminated by examining the titles of the papers in each folder. The first selection and filtering procedure was done manually for all of the libraries, and 157 articles were found. The publications that were retrieved were then manually reviewed by abstract, and 135 articles in all were included. Finally, 63 articles were chosen after these articles underwent another manual content filtering. Each document had to be individually verified during the inclusion and exclusion

Table 3. Details of Selected Papers are listed in this table.

| S.N0 | Citation | Title | Year |
|---|---|---|---|
| 1 | [63] | PyramidViz: Visual Analytics and Big Data Visualization of Frequent Patterns | 2016 |
| 2 | [20] | Straightforward working principles behind modern data visualization approaches | 2021 |
| 3 | [31] | Data Visualization System based on Big Data Analysis", International Conference on Robots and Intelligent System | 2020 |
| 4 | [43] | An Overview of Data Visualization | 2019 |
| 5 | [44] | Big Data Analysis for Data Visualization A Review | 2021 |
| 7 | [15] | Visual analytics: A comprehensive overview | 2019 |
| 8 | [7] | Big Educational Data &; Analytics: Survey, architecture, and Challenges | 2020 |
| 9 | [13] | A comparative study of Chinese and foreign research on the Internet of Things in education: Bibliometric Analysis and visualization | 2021 |
| 10 | [16] | Exploration and visualization of learning behavior patterns from the perspective of educational process mining | 2022 |
| 11 | [2] | A New MI-Based Visualization Aided Validation Index for Mining Big Longitudinal Web Trial Data | 2016 |
| 12 | [3] | A Survey of Scholarly Data Visualization | 2018 |
| 13 | [4] | An IoT-Based Framework of Webvr Visualization for Digital Marketplaces Big Data in Connected Health | 2019 |
| 14 | [6] | Big Data Features, Applications, and Analytics in Digital Marketplaces—A Systematic Literature Review | 2019 |
| 15 | [5] | Big Data Analytics and Mining for Effective Visualization and Trends Forecasting of Crime Data | 2019 |
| 16 | [8] | Big IoT Data Analytics: Architecture, Opportunities, and Open Research Challenges | 2017 |
| 17 | [10] | Data Lake Lambda Architecture for Smart Grids Big Data Analytics | 2018 |
| 18 | [11] | Smart Grid Big Data Analytics: Survey of Technologies, Techniques, and Applications | 2021 |
| 19 | [12] | Big data analysis on Urban mobility: Case of Bangkok | 2022 |
| 20 | [17] | Exploring the characteristics of issue-related behaviors in GitHub using visualization techniques | 2018 |
| 21 | [19] | Source code revision history visualization tools: Do they work and what would it take to put them to work? | 2014 |
| 22 | [18] | Mixing autoencoder with a classifier: Conceptual Data Visualization | 2020 |
| 21 | [21] | Systematic literature review on cyber situational awareness visualizations | 2022 |
| 22 | [23] | UVIS: A Formula-based end-user tool for Data Visualization | 2020 |
| 23 | [24] | Variable-based spatiotemporal trajectory data visualization illustrated | 2019 |
| 24 | [25] | Visual analytics of anomalous user behaviors: A survey | 2020 |
| 25 | [26] | Visualization of Cultural Heritage Collection Data: State of the Art and Future Challenges | 2019 |
| 26 | [27] | Visualization of Generic Utility of Sequential Patterns | 2020 |
| 27 | [28] | Visualization of Digital marketplaces Volume Data Based on Improved K-Means Clustering and Segmentation Rules | 2021 |
| 28 | [29] | Application of Big Data Visualization in Passenger Flow Analysis of Shanghai Metro Network | 2022 |
| 29 | [31] | Data Visualization System Based on Big Data Analysis | 2020 |
| 30 | [32] | Film Big Data Visualization Based on D3.js | 2020 |
| 31 | [33] | Generic Data Visualization Platform | 2018 |
| 32 | [34] | Overview of Data Visualization and Film Expert Evaluation System | 2017 |
| 33 | [35] | Research on 3D Electronic Power Big Data Visualization | 2018 |
| 34 | [36] | Spatial-Crowd: A Big Data Framework for Efficient Data Visualization | 2016 |
| 35 | [38] | Web-Application For Real-Time Big Data Visualization Of Complex Physical Experiments | 2015 |
| 36 | [37] | The Trend, Hotspots, Frontier, and Path of Big Data Visualization Research in China: Based on the Knowledge Graph Analysis of Citespace5.5.R2 | 2020 |
| 37 | [39] | A Big Data visualization layer meta-model proposition | 2019 |
| 38 | [41] | An approach toward Data Visualization based on AR principles | 2017 |
| 39 | [42] | An innovative methodology for big data visualization for telemedicine | 2019 |
| 40 | [45] | Mobile phone data visualization using Python QGIS API | 2019 |

| | | | |
|---|---|---|---|
| 41 | [46] | Big Data Visualization: Allotting by R and Python with GUI tools | 2018 |
| 42 | [47] | Big Data Visualization and analysis of various factors contributing to airline delays in the United States | 2022 |
| 43 | [49] | Big Data Visualization in Digital Marketplaces—a systematic review and future directions | 2019 |
| 44 | [50] | Big Data Visualization in Smart Cyber University," 2016 IEEE East-West Design & Test Symposium (EWDTS) | 2016 |
| 45 | [52] | Data Visualization and predictive analysis for Smart Healthcare: Tool for a Hospital | 2021 |
| 46 | [53] | Data Visualization and statistical graphics in big data analysis by Google Data Studio – sales case study | 2022 |
| 47 | [54] | Data Visualization for evaluation from the management system | 2018 |
| 48 | [56] | Data Visualization in educational datasets using a rule-based inference system | 2014 |
| 49 | [55] | Data visualization for making sense of scientific literature | 2020 |
| 50 | [58] | Deriving big data insights using data visualization techniques | 2019 |
| 51 | [59] | Exploratory Study for Data Visualization in the Internet of Things | 2018 |
| 52 | [60] | Interactive querying and data visualization for abuse detection in social network sites | 2016 |
| 53 | [61] | Investigation into the efficacy of geospatial big data visualization tools | 2017 |

Table 4: Year-wise division of selected papers




| Table 5: Description of the answers to the questions defined in | Method | Description | RQ1 | RQ2 | RQ3 |
|---|---|---|---|---|---|

| the proposed study itation | | | | | |
|---|---|---|---|---|---|
| [1] | hybrid information infrastructure, business intelligence. Educational data mining | The authors proposed visualizing, optimizing, creating, distributing, and scaling, the company's daily transactional and related resources datasets. Applied data mining algorithms to study the patterns of datasets in visualization processes. | □ | □ | □ |
| [2] | MI-based Visualization | The papers emphasize on visualization of clinical datasets which is being generated over the network. Applied MI-based Visualization aided validation index (MIVOOS) to study and evaluate the patterns of clinical report datasets. Future work aims to improve the response rate of clinical datasets' visualization. | □ | □ | □ |
| [3] | scientific visualization, information visualization, and visual analytics | The paper highlights aspects of visualization and its respective tools within a wide variety of literature generated over digital platforms. | □ | □ | □ |
| [4] | lightweight progressive transmission algorithm | The paper outlined on visualization of body scan datasets reports within digital transformation. | □ | □ | □ |
| [5] | Big Data Analytics and Mining | The authors focus on the visualization of crime datasets generated over a web-based platform. Applied state of art machine learning ad neutral algorithms in visualizing crime datasets. | □ | □ | □ |
| [6] | Analytics in Digital Marketplaces | The author emphasizes on visualization of Digital Marketplaces datasets. Applied data mining algorithms in visualizing and diagnosing Digital Marketplaces datasets in digital platforms. | □ | □ | □ |
| [7] | predict analytics and learning analytics | The authors focus on systematics analysis to visualize educational datasets and henceforth proposed advanced approaches to conclusions within specialized software systems. The paper also outlined future research on confidentiality and ethical issues of educational big datasets. | □ | □ | □ |
| [8] | Big IoT Data Analytics | The authors highlight on visualization of IoTs generated datasets. Applied interactive data visualization tools in visualizing IoT datasets. | □ | □ | □ |
| [10] | Tableau and Matlab software | The authors reviewed on visualization of datasets that are being generated from smart grid applications. Applied data mining clustering K-means algorithms in visualizing smart grid applications generated datasets. | □ | □ | □ |
| [11] | Smart grid data analytics | The paper focuses on visualizing the consumption of energy datasets that are being generated over the online platform. | □ | □ | □ |
| [12] | statistical analysis | The authors reviewed on visualization of movement datasets that are being generated over a satellite-based radio navigation system. Applied visual curve fitting for predicting the next trip of dedicated customers to Bangkok, China. | □ | □ | □ |
| | | visualization techniques along with K-mean clustering algorithms. | | | |
| [29] | Echart.js and D3.js | The authors highlighted on visualization of the pace of movement datasets that are being generated from an automatic operational system. | □ | □ | □ |
| [30] | Construction strategy of data visualization | The authors revised on series of construction strategies for data visualization over the online platform. | □ | □ | |
| [31] | high-dimensional data visualization | The authors proposed visual observation visualization techniques of specific datasets along with vector quantization. | □ | □ | □ |
| [32] | D3.js visualization techniques | The paper focuses on highlighting film datasets visualization techniques with general-purpose programming language. | □ | □ | □ |
| [33] | Web-based visualization platform | The authors intend to highlight on visualization of web-generated datasets with pre-written Javascript code, HTML, and CSS. | □ | □ | □ |
| [34] | film expert evaluation system | The authors intend to highlight on visualization of film datasets generated over a cloud-based platform within the film expert evaluation system. | □ | □ | □ |
| [35] | 3D electric power datasets visualization | The authors highlighted on visualization of energy consumption datasets using 3D electric power datasets. | □ | □ | □ |
| [36] | real-time analysis | The authors highlighted on visualization of social media-generated datasets using logic and mathematics to visualize and understand datasets patterns. | □ | □ | □ |

processes, which was exceedingly difficult. These 63 papers were managed in MS Word 2016 together with their citations. The procedure of creating the references was carried out manually because, in most cases, information is lost while getting citations from the internet. These details could take the form of the author's name, the year, the article's title, the location of publication, the page number, etc. The stated research questions in the suggested procedure for the literature review process were then applied to the chosen articles.

## 10 Results and Discussions

SLR is an established protocol used to study specific research systematically. The current research is an endeavor to study the visualization of big data in Digital Marketplaces. This section briefly describes the answers to the research questions defined below:

RQ 1. What research has been done from January 2010 till January 2022 in the visualization of big data in Digital Marketplaces? RQ 2. What techniques are used for the visualization of data in Digital Marketplaces? RQ 3. What are the benefits of visualizations in Digital Marketplaces?

Table 5 shows the description of answers for the questions defined in the section above.

In real life, processing and analyzing big data presents several difficulties. The fact that computers now represent all data visually makes it challenging to extract, see, and understand data. These activities take time, and the outcomes are not always accurate or satisfactory. Understanding human perception and finite cognition challenges is crucial for solving the visualization problems mentioned in this article. The area of design may then offer more effective and practical methods to exploit big data. Conclusion: By taking into account basic cognitive psychology principles and executing the most natural interaction with displayed virtual objects, the data visualization technique may be enhanced. Expanding it with features to eliminate blind spots and vision-reduced areas will significantly improve recognition times. Visualizing the data can considerably improve the average user's comprehension of the preselected information. The progress of visual data representation and imagery perception in the modern world is evident. Additionally, visualization software has been widely used and accessible to the general population. The authors have emphasized the extra complexity that data inherently adds to the design process based on existing literature. Adapting to late-stage data changes, foreseeing edge situations, articulating data-dependent interactions, conveying data mappings, and maintaining data mapping integrity are just a few of the data-related issues that might arise. These indicate several chances to develop tools with unique data-related capabilities

| | | | | | |
|---|---|---|---|---|---|
| [37] | 3D visualization, information visualization, and research visualization | The authors highlighted on visualization of specific datasets that are being generated over digital platforms using graphic content patterns, abstraction visualization, and applying exploratory analysis process. | □ | □ | □ |
| [38] | Advanced-Data Extraction Infrastructure | The authors intend to outline on visualization of real-time generated datasets using a dynamic web interface in the visualization process. | □ | □ | □ |
| [39] | big data metamodel visualizations layers | The authors intend to outline on visualization of relative information and SQL databases using metamodel visualization layers. | □ | □ | □ |
| [41] | conventional visualization techniques | The papers focus on highlighting on visualization of real-world datasets that are being generated on digital platforms using pie charts, line charts, bar charts, area charts, graphs, maps, heat maps, etc. | □ | □ | □ |
| [42] | Geo-JSON | The authors highlighted on visualization of heath-related datasets over the internet using an open standard geospatial data interchange format with a NoSQL database program. | □ | □ | □ |
| [43] | Tableau, Infogram, ChartBlocks, Datawrapper, Google Charts | The authors highlighted the Pros and Cons of data visualization tools, which would assist in selecting the perfect tool for visualizing the datasets in the digital marketplace. | □ | □ | |
| [44] | Treemap, circle packing, parallel coordinates, and stream graph method | The paper reviewed various visualization tools to visualize real-world generated datasets. | □ | □ | □ |
| [46] | R and python | The authors intend to highlight on visualization of quantitative datasets and qualitative datasets using R and Python programming languages. | □ | □ | □ |
| [47] | Big data Visualization and analysis | The authors studied on visualization of flight transaction datasets using Python programming language. | □ | □ | □ |
| [49] | Systematic Literature Review on cardiovascular system dataset visualization | The authors highlighted on visualization of heart-related datasets within a healthcare information system. Systematically analyzed 53 scientific-related literature. | □ | □ | □ |
| [50] | D3.js | The authors highlight on visualization of educational datasets along with HTML, SVG, and CSS. | □ | □ | □ |
| [52] | The declarative statistical visualization library | The authors proposed visualization of health-related datasets using a declarative statistical visualization library with Python programming language. | □ | □ | □ |
| [53] | visual analytics tool | The authors proposed visualization of sales datasets using interactive visual analytical tools within Google data studio. | □ | □ | □ |
| [54] | E-Latihan System | The authors proposed visualization of organizational operational datasets using the E-Latihan System. | □ | □ | □ |
| [55] | Big data Visualization tools | The authors proposed visualization of scholarly datasets using respective visualized tools. | □ | □ | □ |
| [56] | computational expert mechanism | The authors highlight on visualization of educational datasets using the computational expert mechanism. Applied rule-based inferences system to visualize educational datasets. | □ | □ | □ |
| [58] | open source data visualization package | The authors highlighted on visualization of datasets using an open-source data visualization package. | □ | □ | □ |
| [59] | Decanter AI | The authors highlighted on visualization of Internet of Things datasets along with machine learning technology algorithms. | □ | □ | □ |
| [60] | visual analytics tool | The authors intend to outline the visualization of cyber threat, and bullying datasets using visual analytics tools. | □ | □ | □ |
| [61] | Geospatial Data Visualization | The authors highlighted on visualization of geospatial datasets that are being generated over digital platforms for better use. | □ | □ | □ |
| [63] | PyramidViz | The authors intend to highlight an interactive visual interface tool to support analytical reasoning. Applied a set of trapezoidal and triangular pattern blocks within machine learning models to evaluate informative datasets patterns for deep understanding in visualization. | □ | □ | □ |

that directly assist the visualization design process. The development of these more potent tools could improve the robustness, effectiveness, and accessibility of the design process for individuals in various design positions.

Heterogeneous data exacerbate problems with data integration and big data processes. Since they demand a lot of data processing and storage space, both of them are crucial and challenging to display and analyze in large databases. The study on large data analysis for data visualization is reviewed in this publication. Additionally, it contrasts the outcomes based on various algorithms and techniques. As a result, the difficulties and techniques of the suggested approaches in related studies employing virtual reality based on big data visualization found a way to observe and analyze a variety of complicated data structures. Although several visualization strategies have been put out, some particular scholarly visualization methods are urged to be enhanced. For instance, the depiction of academic institutions has received very little attention. Another issue is that scholarly data can include a lot of information. It's still important to figure out how to use visualization tools to harvest meaningful information. The complexity of the network structure is also becoming more complicated; thus the efficacy has to be improved. How to effectively mix visualization methods with academic data analysis is another difficulty.

Visualization ideas and methodologies for academic data visual analysis are not effectively integrated into practice. These visualization techniques' data processing abilities must also be upgraded. Generally, academics obtain scholarly datasets from many online scholarly data portals. The dataset may be quite large, and researchers must pre-process this heterogeneous data (data merging, data partitioning, deleting unknown characteristics in the dataset, etc.) to match the data-input criteria of various visualization approaches.

Scholarly big data opens up new possibilities and problems for scholarly data analysis. Researchers have understood the need of using visualization tools on various datasets to better understand science. Thus, academic data visualization is

critical in resolving the issues that arise from large-volume, multivariate, and high-value data. It seems logical to focus more on this subject. In this survey work, we explore the developing field of academic data visualization to bring fresh insights. We showcase cutting-edge scholarly data visualization methodologies, with an emphasis on visualization tools and analytic systems.

Meanwhile, academic data analytic methods are being created to compile visual analyses of multivariate data from multiple perspectives (e.g., citation relationship, co-citation relationship, and co-authorship). As a result, by presenting details of the issue, this work offers a significant addition to research on academic data visualization. Despite becoming the focus of current research, several technologies still require improvement. One of the primary issues is figuring out how to efficiently combine information from complicated scholarly sources. Another problem is determining how to best mix various display approaches with analytical processing. Future research looking into these issues would be very important.

Through the findings of this systematic review, future researchers will be able to better understand current data visualization techniques and Visualize data using data science tools to Identify seasonal trends, correlation, and forecasting of customer behaviors.

## 11 IV. CONCLUSIONS

Creating graphics, diagrams, or animations to convey a message from the insight observed depends heavily on data visualization. Data visualization is the process of extracting crucial information from the data and plotting it to make decision-making simpler. This research provides a thorough report of the available literature on data visualization in the context of digital marketplaces to aid decision-makers. This research uses the SLR protocol and the data was collected from the research published from January 2010 to January 2022. Initially, a total of 1412 titles were found. Separate folders were maintained for the libraries. Each folder of the library was checked manually and their titles properly named all of the articles. The duplication of these publications was done by checking the titles in each folder. The inclusion and exclusion process was performed manually for all of the libraries by the titles and 157 articles were included. These 157 articles were then reviewed manually by abstract, and 135 articles were included. Finally, these 135 articles were reviewed by content, and 63 articles were selected. The process of exclusion and inclusion was very tricky as each of the papers was checked manually. These 63 papers along with their references were managed in MS Word. The literature on big data visualization in digital marketplaces that have been published is compiled and organized in this study. A restriction on this research was the use of only three of the libraries that were often cited. To prevent the hassle of duplicate entries and access to all of the publications, it was also decided not to use Google Scholar's keyword search function. Furthermore, because there is a lot of published research in the field, a small set of keywords was used in the search, primarily (”Digital) AND (”Visualizing marketplace big data” ”OR” data visualization ”OR” big data visualization ”OR” data visualization ”OR” Digital marketplaces data visualization” to get only related results. The suggested research will aid in the researchers' understanding of the existing research studies on the topic of big data visualization in digital marketplaces. It may eventually be utilized as support in further investigations. The findings of the suggested study indicate that there has been an increase in publications every year on big data visualization in digital marketplaces.

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