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A Comprehensive Survey on Societal Applications of Data Analytics as a way Forward

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Abstract

Data represents a grouping of facts that have a defined size and value. It is processed into understandable information, logically correct, helpful for any operation to carry out, and something new with the help of the knowledge discovery process. The procedure to investigate, filter, extract, reshape, and visualize data to spot the masked knowledge and facts, data analysis is used. Data analysis has integrated with numerous areas such as the finance and commerce industry, health industry, marketing industry, governance, academics, and a bunch of other industries. And among these applications, most are affiliated with profit-intended industries as compared to societal benefit-cause industries. Therefore, this work is a detailed survey of recent papers which are published between 2017 to 2024 on various societal benefit causes applications affiliated to different domains. To the best of the authors' knowledge, the proportion of societal benefits causes applications reported are lower in numbers if compared with others. Supplementarily, an extensive study for societal applications where data analytics is applied remains uninvestigated. This paper presents a schematic literature survey of societal domains where data analytics is applied. From the literature, it can be said that blending data analytic technologies into the societal domains can help us in numerous matters. In this study, we also proposed a model to analyze the barriers and facilitators related to various societal applications.

Keywords

Data Analytics, Machine Learning, Social Application, Governmental Application, Agriculture and Environmental Application.

1. Introduction

Facts that are untreated, unrefined, and unfinished are processed into information. To get information from untreated, undefined, and unfinished facts numerous software and techniques were developed, which ensure the processing should get done automatically[1]. As a result, it gives rise to a flood of information. Due to the tsunami of information, it is becoming more complex and challenging for us to decide which piece of information is required

and which is not. So, the analysis of data is necessary so that by analyzing these pieces of knowledge, we can store the essential data and eliminate the unnecessary ones[2]. According to William Pollard, "Information is a source of learning. But unless it is organized, processed and available to the right people in a format for decision making, it is a burden, not a benefit". Data is defined as the assembling of facts and ordered in such a manner that a relevant segment of knowledge is generated. This generated knowledge can be used for further tasks to carry out as needed. The knowledge generated must be valid, novel, advantageous, and free from ambiguity[3]. The procedure of investigating, filtering, extracting, reshaping, and visualizing data to spot the masked knowledge and facts data analysis is used. Various statistical methods are employed to the data to get the hidden and undiscovered knowledge from it[2]. This process of encapsulating and assessing the data is known as data analysis. To discover the unseen knowledge businesses and organizations used to analyze their data[4]. To get the actual theme from the gathered data, it is needed to organize, interpret, and encapsulate it. Data analysis has integrated with numerous areas such as the finance and commerce industry, health industry, marketing industry, governance, academics, and a bunch of other industries. But most are affiliated with profit-intended industries as compared to societal benefit-cause industries. Societal benefit-cause applications are those applications that have societal causes and benefits.

This study is a detailed survey of papers which are reported between 2017-24 on numerous societal benefits and causes applications affiliated with several areas. The aim of this paper, while doing this comprehensive literature survey, is to find out the details of the non-profitable applications of data analytics and the purpose is to identify which are the ones that have been most tabbed by the research community. During the study, we observed that the reported research work related to non-profitable applications is lower in numbers. In addition to that, an extensive study for societal applications where data analytics is applied remains uninvestigated. Therefore in this paper, we present a schematic literature survey of societal applications where data analytics is applied for societal development. This work identifies the current research trends in the domain of various societal applications where data analytics techniques play an important role. To grasp the knowledge from scratch to recent progress, this paper focuses on recently published articles from 2017-24. This survey presents a summary of societal application i.e. social application, governmental application, and agriculture and environmental application but is not limited to this. Finally, as an outcome of this study, this survey summarizes the gaps and challenges that will help the researchers to carry forward the research in the domain of societal application of data analysis.

2. Background

The assembly of unpolished, unprocessed, untreated, and unproved knowledge is represented as data. This unprocessed knowledge is gathered, reshaped, and processed to get data that can be used as per requirement. It can be a digit, character, symbol, measurement, term, observation, or elucidation of things. Data can be represented in any form like audio, video, text, or picture. Figure 1 illustrates the process of conversion of untreated facts to data products.

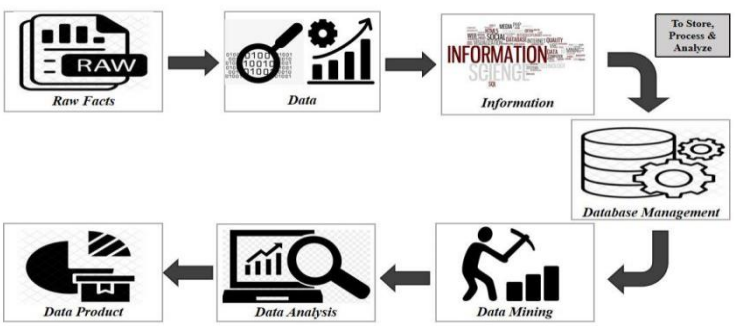

Figure. 1 Data to Data Product

Information confers to an organized and processed group of data when put together defines a logical meaning. Information is generated after data is processed, manipulated, and organized into a specific form that is understandable which is useful to get the solution to the question by intervening human knowledge. A piece of correct information is called knowledge. For decision making knowledge is required that is processed, interpreted, and analyzed. Database management is needed due to the growth in the volume of information to do further processing and analysis. Due to the tsunami of information, it is becoming more complex and challenging for us. Again due to the growth in volume and types of data, data mining is required for improved anticipation and intelligent decision-making tasks. From information, data mining is helpful to get the newer and unexplored pieces of knowledge[5]. It is used to generate more refined information from a huge collection of information by using various tools and techniques[6]. Since processing capability increases data are divided into various types and have different variants i.e. structured, unstructured, and semi-structured data[7,8]. The results after analyzing data we get from that are called data products. Based on the requirements the data is manipulated, inspected, and scrutinized by considering numerous circumstances to get valuable data product so that the end-user can be benefited.

2.1 Data Analysis

To deal with various kinds of data and get the undiscovered and potential knowledge from data, analysis of data is an essential task[8]. The data are highly organized and by putting in an unsophisticated algorithm one can easily and seamlessly do the operations like retrieving, storing, processing, and accessing refers to structured data. They are of a specific format so it will be untroubled to carry out any action. The data that has no specific structure or format and is heterogeneous is called unstructured data. Operations like retrieving, storing, processing, and accessing are more complicated than structured ones because of immense volume and variety. The data which are the combination of unstructured and structured data having some structure but not having the same formats are referred to as semi-structured data.

2.2 Data Analytic Algorithms

Numerous algorithms are there for data analytics which is mostly of statistical analysis type. They are the basis of data analysis and these statistical analyses have been automated by numerous data analysis tools for the conduction of analysis on data because one can not perform analysis on data directly. **Figure 2** is the depiction of numerous analytic algorithms broken down into 3 varieties i.e. supervised, unsupervised, and reinforcement learning. Based on the data, end product, and requirement we select the desired algorithm.

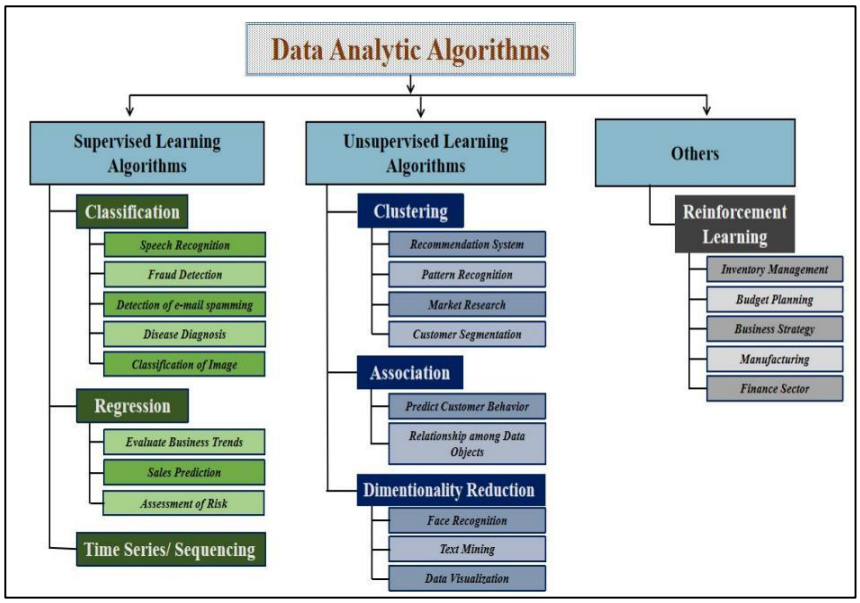

Figure. 2 Data Analytic Algorithm

2.2.1 Machine Learning

The data in machine learning(ML) can be linear and nonlinear categories. ML belongs to predictive analysis and the outcome it predicts with less intrusion from the human[9].

2.2.2 Deep Learning

Deep learning(DL) is a sub-section of ML that is more convenient for the textual, aural, and visual in terms of pictures and videos. DL can be unsupervised or supervised learning. The output it produces is more accurate and behaves like the human brain as it took inspiration from it[9].

2.2.3 Classification

To anticipate and assign the data points to any target group classification is used. It is generally used for speech recognition, detection of fraud, detection of e-mail spam, diagnosis of various illnesses, and classification of images[9].

2.2.4 Regression

To trace out the interrelation among variables or data objects regression analysis is used such as between independent data objects and a dependent data object. Regression is a kind of supervised learning method and is applied when there is a requirement for the prediction of the continuous dependent variable from independent variables. Regression is used for the prediction of sales, evaluating marketing trends and strategy, and for the assessment of risk[9].

2.2.5Association

To scrape out the reliance and link among data points association is used. It belongs to unsupervised learning method. The association is used to find out the relationship among data objects and also for customer behavior anticipation based on their searching and buying patterns[9].

2.2.6 Clustering

Clustering is a kind of unsupervised learning method that groups the data items depending on their similarity or dissimilarity. Dissimilar objects are kept in a different group, while similar ones are kept in one group. Clustering is used for the identification of patterns, recommendation systems, market research, and segmentation of customers[9].

2.2.7 Principal Component Analysis

It is a method used for the accomplishment of dimensionality reduction of datasets with minimum effect on the variance of the datasets. It keeps the important features and removes the redundant ones. For this, it transforms the variables of the actual dataset into a new set of variables termed principal components.

2.2.8 Time Series / Sequencing

Time series is an algorithm that improvised the prediction result of regression for continuous values, for example, the product sales report of a product, and sensor data over a while.

2.2.9 Text Mining

Text mining(TMN) is used to analyze the textual data and get the finer information from the text. TMN is the broader domain of analysis of textual unstructured data[10]. Many techniques like Named Entity Recognition, text classification, similarity among texts, summarization of text, and retrieval of information belong to text mining.

2.2.10 Gradient Boosting Algorithm

Gradient Boosting Algorithm is the combination of numerous weak algorithms that are used to create a better one for better accuracy, stability, and robustness. By combining various weak classifiers to get better output boosting use the ensemble technique.

3. Applications

Data analysis has many applications. In each place, we required data to be analyzed. The applications which are mentioned in this paper are real-time societal applications but are not limited to these. In this study, we have considered those applications which are having any societal cause and benefits to the society. We have categorized them into three different groups social, governmental, and agricultural and environmental applications as shown in **Figure 3**. There may be many more applications that are not being mentioned in the literature but are used currently by different organizations, and this paper highlights the ones that we come across in the literature.

Figure 3 is the depiction of various real-time societal applications of data analysis that we come across literature study. We categorize them into three different categories. First, the social application includes sanitation and nutrition facilities, smart health care and mental health care for everyone, anti-trafficking, women and child development, and Unemployment and employment of youth. Second, the governmental application includes e-governance,

smart cities, villages, and rural development, and the third is the agriculture and environmental application that consists of agriculture marketing, water management, precision farming, and smart farming.

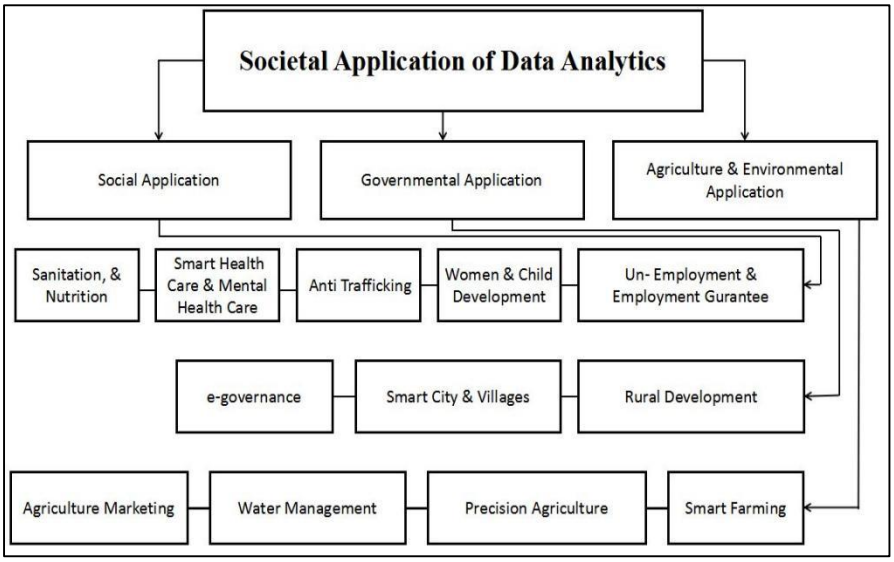

Figure. 3 Application of Data Analysis

3.1 Agriculture and Environmental Application

Wolfert, Sjaak, et al. discuss numerous applications of smart farming in Big Data and provide a conceptual framework for the same which leads to further development[11]. Pham, Xuan, and Martin Stack provide a brief description of the agriculture value chain and conventional agriculture. Also, describe the implications of data analytics in the agricultural domain[12]. Lioutas, Evagelos D., and Chrysanthi Charatsari. conclude that the use of big data in smart farming leads to a positive response from an economic and environmental perspective whereas it might be big for small farming and small for conveying global issues[1]. Kamilaris, Andreas, et al. provide an overview of various agricultural applications and usage of big data, its techniques, and its characteristics in a different layout, outline the problems, and propose solutions and tools and algorithms are discussed[4].

Goel, Raj Kumar, et al. analyzed various methods and models for ensuring food security like cropland monitoring, water dynamics anticipation, use of satellite images for forecast, disaster management, and further advancement can be done by integrating GIS, computer modeling, and multi-criteria decision analysis methods[13]. According to Su, Yan, and Xianping Wang with the help of big data will promote the growth of smart agriculture. They consider eggs and analyze the influencing factors and price fluctuations of egg prices [3]. Ansari, Nazneen, et al. developed a user friendly interface using data analytic techniques, Hadoop and Tableau, which is useful for farmers who were not aware of the latest technologies in smart farming[14]. Shankar, Sudha, et al. proposed a framework using data analytics methods in the agriculture sector which helps the farmers to choose the right crop and cultivate it so that it will help them to get monetary benefits and also to the stakeholders for better policy making strategy[15].

Sharma, Rohit, et al. proposed a framework by integrating numerous data analytic technologies with agriculture systems that help in smart farming in real time[16]. Ang, Kenneth Li-minn, et al. use hyperspectral data like spatial and spectral data from agriculture to find out the validation of ensemble ML and parallel discriminant analysis in the agriculture field[2]. Alfred, Rayner, et al. describe the benefits of applying machine learning in paddy rice farming and highlight the challenges. They proposed a framework for the same and concluded that machine learning will help for prediction, monitoring growth, and diseases[17]. Araújo, Sara Oleiro, et al. highlighted the existing application in agriculture 4.0, the way to achieve sustainable development through agriculture, the challenges,

and the way to achieve future smart agriculture[18]. Gohil, Jay, et al. describe the prominence of big data and how it affects the environment, highlight the challenges related to it, and propose a solution with the help of ML methods[19].

Shrivastava, Swapnil, and Supriya N. Pal. proposed a framework for the agriculture sector in the Indian context having functionalities like Market Intelligence, Food Supply Chain, and One Stop Mobile Application[20]. Lassoued, Rim, et al. describe the chances and barriers in agriculture by applying Big Data and how digital applications revolutionize people's jobs and skills[21]. Garbero, Alessandra, et al. list down the information about food systems that are funded by the International Fund for Agricultural Development, having an application of text mining network analysis and LASSO regression, and are documented but not properly investigated within 1981-2019[22]. Wang, Hui. proposed by using data mining techniques agricultural economic development is possible. For the growth of cities and countries the relation between urban-rural, the rural development plays a pivotal role where agriculture is the primary industry[23].

Vanshika, A., et al. Discussed various key indicators and the consequences associated with poor water quality. According to them blending various technologies like data analytics, Sensors, and IoT can help us to monitor and examine the quality in real time[24]. According to Huo, D., Malik, et al. the incorporation of IoT and smart agriculture can provide benefits in the agriculture domain. They also have provided a conceptual framework by blending IoT into the agriculture area[25]. Amini, M., & Rahmani, A. analyze the incorporation of machine learning and the agriculture domain. They have designed a machine learning based model to incorporate into agriculture and discussed the problems faced during the process[26]. Purcell, W., et al. Highlighted the major obstacles integrated with agriculture domains and provided a comprehensive review that indicates the integration of technologies in agriculture can help to overcome these obstacles[27]. Javaid, M., et al. Analyze the significance of incorporating AI in agriculture and discuss how AI can help the farmers in various ways which can lead to an increase in their production with less effort[28]. According to Pallathadka, Harikumar, et al. ML, AI, and deep learning are used for better production of the crop, better management of the supply chain, monitoring and predicting any kind of disease, and reduction of wastage of water in the healthcare and agriculture sectors[29]. According to Roberts, Daniel P., et al. for crop management and disease management geoinformatics techniques and computing infrastructure help to propose a framework that helps the scientists, policymakers, and the agricultural community to speed up development in sustainable feed which is much required in the future[30].

3.2 Governmental Application

Nunes, Simão AS, et al. highlight the factors and determinants that lead to the success of the smart city program and the cause-and-effect relation of these factors among themselves[31]. Agbozo, Ebenezer, and Kamen Spassov. provide an overview of big data analytics in e-governance services by considering the data generated from governance systems and e-applications[32]. The differentiation of e-governance services and facilities provided by Dubai, Saudia Arabia, and Oman is discussed by AlSayegh, Ahmed, et al.. The facilities of the e-governance system of Dubai are compared with several other cities but Dubai leads the transformation and application[33]. Kumar, Shiv, et al. describe the services provided by the government and some additional features to the existing ones such as Education, banking, insurance, health, notice board, inbox, and grievances which transform the traditional to automation style of technology[34].

Al-Dmour, H., et al.analyze the influence of application of data analytics in banks. They have investigated the same in the commercial banks in Jordan by measuring their performances by the TOE model[35]. Vasa, J., et al. highlight the importance of integration of data analytic technologies for the development of smart cities. Also, they have mentioned various parameters and automation using IoT[36]. Samuel, P., et al. discussed the significance of data analytic techniques in e-governance. They provided an overview of numerous data analytic method and their application in the governmental sector[37]. Bibri, S. E., et al. Discussed the significance of integration of AI, IoT, and Big data techniques with smart cities. They have also highlighted the challenges associated with them because of the coupling[38]. Gubareva, R., & Lopes, R. P. discussed various models for analyzing municipal data related to smart cities and found out that major models are related to machine learning methods. Also concludes that LSTM is the better model among them[39]. According to Malhotra, Charru, et al. the usage of big data and data

analytics in the governance field will be helpful to attain Global goals in India. These technologies help the e-governance system to perform effectively[40]. For the improvement in forest planning and development of smart cities, Marathe, Aboli, et al. suggested that the integration of GIS technology, data visualization, and ML can help to identify the foliage sparse areas and suggest mitigating measures[41].

For choosing the smart villages, Mishra, Brojo Kishore, et al. in their study integrate opinion mining, big data analysis, and the MapReduce method. Also recommended to use GPU in place of the Map-Reduce method can provide better and improved results[42]. Javed, Ahmad Sayed. discussed the pros and cons of incorporating technology into the governance system. And conclude that for better decision making and a faster way is possible timely access to information is very much crucial which is possible by incorporating governance with technology[43]. Peisker, Anu, and Soumya Dalai. proposed a framework that enhances rural development and supports rural communities by providing enhancement and providing support in various sectors of agriculture, banking, governance, and healthcare[44]. According to Elisa, N., Yang, L., Chao, F., et al. in e-governance systems, the government data is stored in a centralized location that can result in failure sometimes due to intruder attacks. This can be resolved by using Blockchain technology to store the data without depending upon the third-party application. They have proposed a methodology for the same to ensure the privacy and security of data[45]. Kim, Eun Sun, et al. use R&D data of 48,309 projects in Korea between 2013 to 2017 to find out their commercialization performance using cluster analysis and decision trees and for the improvement of R&D investment in enterprises they suggest applying Big Data analytics will be beneficial[46].

Cantuarias-Villessuzanne, Carmen, et al. developed a method by grouping 40 European cities by using the clustering technique to characterize and interpret their components using PCA. According to their findings, the analysis of smart cities' dynamic capabilities points out how to make cities sustainable[47]. Kim, Nammi, and Seungwoo Yang. developed a service indicator for smart cities, sustainable cities, and sustainable smart cities and identified the relationship between them[48]. Yoo, Yejin. propose to develop the smart Seoul portal with the help of four different mart city portals i.e. Barcelona, Amsterdam, Columbus, and Singapore, and evaluate their roles and main features which are transparent and citizens can also participate to eradicate urban issues and take decisions[49].

Liu, Lingyan. suggest applying ZiBee technology for the management of green cities and discuss the significance related to city management and the ZiBee technique[50]. Wan, Ling, and Xiaozhong Yu. discussed the study of the government-society joint venture mode and its feasibility, applicability, and significance of using this venture mode for the construction of smart city projects. Also discussed the implementation idea of government-society joint venture mode[51]. To delineate urban-rural boundaries by fusing night-time light and point-of-interest data with the help of wavelet transform. After that depict the same after and before data fusion by multi-resolution segmentation for the optimization of the internal spatial structure in rural and urban localities. Zhang, Jun, et al. found that with fusion the accuracy is better[52].

Yin, Jiadi, et al. integrate and characterize using decision-level integration and feature-level integration and analyzing Geospatial data and remote sensing data their differences and after that apply classification For better urban planning and sustainable development in China[53]. According to Ying, and Sun, with the increase in the demand for open access to government data in China for transparent and convenient service which leads to economic and societal development because people can access and understand various policies and measures[54]. According to Zhang, Jianan, and Shuoyi Zhu to upgrade the formation of intelligent society it is required to improve the association of government and various parts of society in China. Intelligent society is possible if the rural labour are being promoted from physical to intelligent labour[55].

3.3 Social Application

According to Jain, Monica., supplementary nutrition of children affects the physical growth of a child. According to her findings, it affects the physical of a girl child more as compared with a boy child[56]. Augsburg, Britta, and Paul Andres Rodriguez-Lesmes examine the effect of sanitation on child growth in Gwalior in a semi-urban area and their result shows that sanitation plays a crucial part in the growth of height during the first year of a child[57]. Renegade, N., S. Saravanan, and CM Naga Sudha. discussed big data, its characteristics, its application of Big da-

ta, storage systems, including its techniques, and its role in smart healthcare which provides safety to human life and provides a clinical recommendation. Also, discussed the challenges faced by big data and its relationship with IoT[58].

Kohli, Neha, et al. analyze the progress of food security, health, and nutrition in Odisha in the last 25years and conclude that there is a significant improvement in these areas, but some other areas like improving sanitation, addressing high levels of early marriage, especially among girls, and ensure both land rights and sustainable livelihoods[59]. Kumar, Neha, et al. came up with a framework to facilitate nutrition improvement which suggests participation in a program that is women-based will improve nutrition[60]. Fletcher, R., et al. developed a tool that is used to screen and detection of diseases and monitor nutritional status because the tools used for screening and detection of diseases are more prone to errors because of manual input and less knowledge of people who operate these devices. So developed a tool that is used to measure height, weight, oxygen level, blood pressure, and upper arm circumference which is used for nutrition measurement of a child[61].

Gupta, Shalu, and Pooja Tripathi discussed the poor rural healthcare facilities and how rural people are unaware of the facilities. It also, discussed how Big Data analytics will help in this field so that rural people can benefit by gaining access to their medical and other data and informing them if any illness is there[62]. Hore, Sirshendu, and Tanmay Bhattacharya proposed a model to find out the child sex ratio by using multi class sentiment classifier instead of a binary classifier, and the opinion was taken over a certain period from Twitter data, other social media data can be taken into consideration[63]. Ogbo, Felix Akpojene, et al. use multi-variate multinomial logistic regression to find out the barriers and enablers for Antenatal care service for women in India. According to them, the barriers are socioeconomic and health policy interventions, and also there is a requirement to upgrade education, health education, and social services[64].

To improve infant and young child feeding operations, Dhami, Mansi Vijaybhai, et al. surveyed published work between 2001 to 2020. As the factors associated with them are multifactorial and largely modifiable improvement is needed in the policies at the national and sub-national level[65]. For global seasonal weight loss, and diet food interest Park, Myung-Bae, et al. apply data analytics in the data of Google and Naver search engines from 2004 to 2008 to tackle global health issues[66]. Song, Malin, et al. presented all the initiatives having goals to achieve sustainability and societal improvement and focused on the development of human health and natural resource management and concluded that new approaches are required to bridge the gap and ensure environmental and economic development[67]. To achieve women's empowerment and predict the forthcoming expenditure that is required to achieve the determined goal Tanwar, Harshita, and Misha Kakkar in their paper used linear regression and the ARIMA model and concluded that these two models used for prediction give accurate results[68]. Pratap, Maheshwar, et al. proposed a framework based on formal banking and its impact on NREGA employment[69].

Malik, Garima, et al. proposed a tool named E-alive having aims to educate people about the current statistics of motherly and infant health management. The tool is used to categorize the educational condition of the state, groups, and individual and also can be useful for calculating awareness factors and the complete birth rate can be anticipated. In this study, they cover two governmental policies, i.e. Swadhar Scheme and Janani Suraksha Yojana[70]. To check if the involvement of Big Data analytics can be useful in predicting and correctly forecasting unemployment in Italy every month Naccarato, Alessia, et al. used two models the ARIMA and VAR model. The ARIMA model used the youth unemployment rate and the VAR model integrated the unemployment rate and the Google Trends query share[71]. According to Ahmed, Hamed MS, and Yimer Ayalew Ahmed, bad governance schemes, restricted access, and support to accounting, business aid, information and infrastructure, and lack of education and training are the major barriers for small and medium-scale organizations in Ethiopia[72]. Katris and Christos used a vector auto-regression model to find out whether and how the unemployment rate in Greece is affected by the COVID-19 situation and compared it with ARIMA and ANN models[73]. Bal-Domańska, Beata analyzes the interconnections between the jobless problem of youth and economic affairs[74].

Mohan, Anandan, et al. evaluate compliance measure and that of factors linked with intravenous iron sucrose treatment for moderate anemia among pregnant women attending health facilities of Kancheepuram a district in Tamil Nadu[75]. To scale up of dietary diversity of reproductive age women by ensuring food and nutrition security at the household and individual levels, Vijay, Jyoti, and Kamalesh Kumar Patel use logistic regression[76]. Masavah, Vincent, et al. analyze the individual’s choice by focusing on social structure, an individual agency, the

degree of empowerment, and the development outcomes so that employment opportunities by accessing open government data of South Africa[77].

Pesquera Alonso, Carlos, et al. in their study discussed numerous viewpoints of youth guarantee and by using regression analysis tested whether it should be viewed as successful or as a collapse[78]. Mulero, Rodrigo, and Alfredo García-Hiernaux forecasts of the Spanish unemployment, monthly series. PCA and Forward Stepwise Selection are used and result in a significant increase in predictive accuracy[79]. Burns, Courtney Julia, et al. discussed barriers and hindrances in improving trafficking i.e. police corruption, insufficient enforcement of national law, discrimination toward trafficking victims, inadequate funding, and lack of government involvement[80]. Cederbaum, Julie A., et al. examine that grandparent and maternal cannabis use can influence next-generation adolescents' behavior and attitude by using a theory-driven path model and a mediational theory[81].

Marimbire, B., et al. used a machine learning model for anticipating criminal activity that can help us in finding criminal behavior[82]. Kiganda, C., & Akcayol, M. A. used deep learning models for the anticipation of COVID-19 cases in various regions. The output suggested that using the LSTM method in their proposed approach provides a better accurate outcome[83]. Neto, Cristiana, et al. in their study try to find out if there is any relation between mental illness and unemployment. By using data mining techniques they predict if any individual has any risk of unemployment based on a questionnaire[84]. Awotunde, Joseph Bamidele, et al. to control, manage, and identify COVID-19 and reduce the effect on health associated with it. So big data analytics is used for the analysis of health-related data for public health betterment[85]. According to Marshall, Vanessa, et al. veterans Health Administration initiatives provide quality healthcare services to women. In this study, they also discussed the roadblock and blueprint for the refinement of women veterans' access[86].

4. Proposed Approach

A comprehensive study is required for in-depth understanding to grasp the knowledge from scratch to recent progress. From the literature, we can say that there were improvements in various fields that led to achieving a sustainable lifestyle by incorporating techniques with them, but there are so many areas that are left behind; where improvement is required for the growth of the country. **Figure 4** denotes the proposed approach where various data analysis techniques like regression, classification, neural network, data mining, opinion mining, MapReduce technique, time series analysis techniques, or integrating various data analysis techniques with other technologies like IoT, AI, GIS can be applied in various societal application as discussed above for the improvement in the society. The data for various societal applications can be collected from various sources like publicly available sources (Internet, Government Publications), private sources(Organizations, medical, etc.), questionnaires, focus groups, interviews, surveys, experiments, observations, oral investigation, feedback, and newspaper. This proposed methodology can be applied to find out the barriers and facilitators for various societal applications.

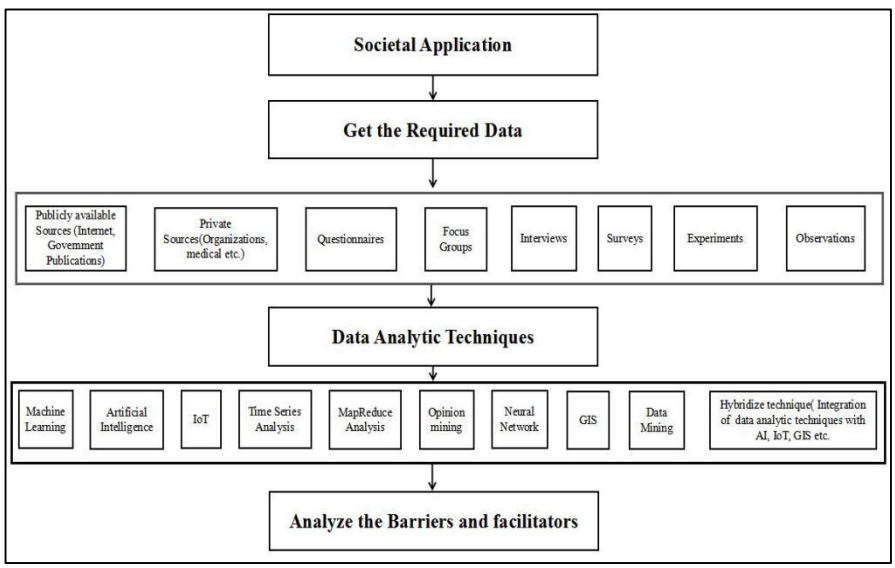

Figure. 4 Proposed Approach

5. Discussion

Different organizations are using many more societal applications that are not mentioned in the literature. This study has highlighted the ones that we come across in the literature and categorized them into three categories that are social applications, governmental applications, and agriculture and environmental applications. The social application consists of sanitation and nutrition facilities, smart health care and mental health care for everyone, anti-trafficking, women and child development, and Unemployment and employment of youth. Second, the governmental application includes e-governance, smart cities, villages, and rural development, and the third is the agriculture and environmental application that consists of agriculture marketing, water management, precision farming, and smart farming.

In this study, we consider papers ranging from the year 2015 to 2024. **Figure 5** is the pictorial representation of the published work from the year 2015 to 2017 in which we represent the number of published work percentage out of 29 papers in agriculture and environmental applications, 31 papers in governance applications, and 40 papers in societal applications which comes out to be 17%, 16%, and 67% respectively.

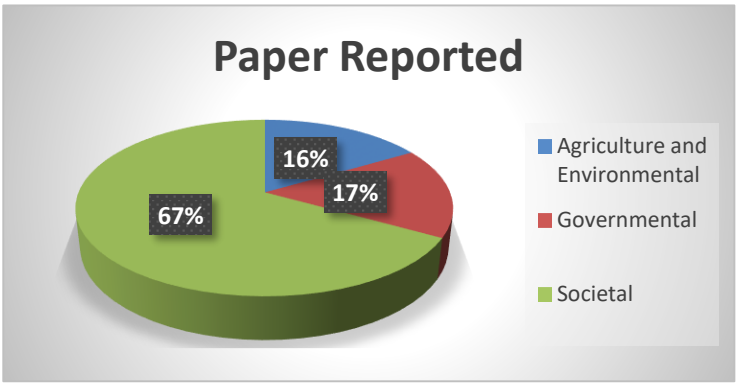

Figure 5. Pictorial representation of published work in the year 2015-2017

Figure 6 is the pictorial representation of the published work in the year 2018 in which we represent the number of published work percentage out of 29 papers in agriculture and environmental applications, 31 papers in governance applications, and 40 papers in societal applications which comes out to be 17%, 33%, and 50% respectively. In the year 2018, there is an advancement in the area of governance applications which lead to decrement in % of societal applications.

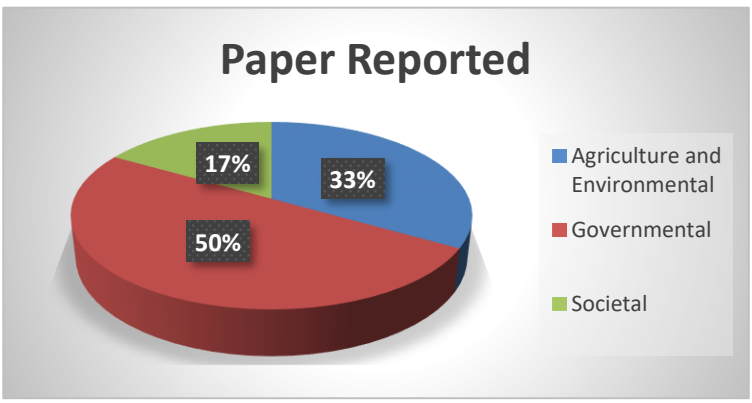

Figure 6. Pictorial representation of published work in the year 2018

Figure 7 is the pictorial representation of the published work in the year 2019 in which we represent the number of published work percentage out of 29 papers in agriculture and environmental applications, 31 papers in governance applications, and 40 papers in societal applications which comes out to be 14%, 28%, and 58% respectively. In the year 2019, there is again advancement in the area of societal applications and decrement in % of agricultural and environmental applications and governance applications.

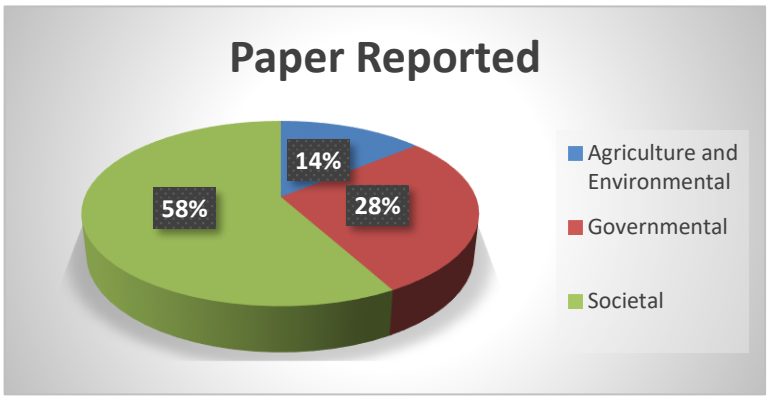

Figure 7. Pictorial representation of published work in the year 2019

Figure 8 is the pictorial representation of the published work in the year 2020 in which we represent the number of published work percentage out of 29 papers in agriculture and environmental applications, 31 papers in governance applications, and 40 papers in societal applications which comes out to be 50%, 25%, and 25% respectively. In the year 2020, there is again advancement in the area of agricultural and environmental applications and decrement in the % applications, societal, and governance applications.

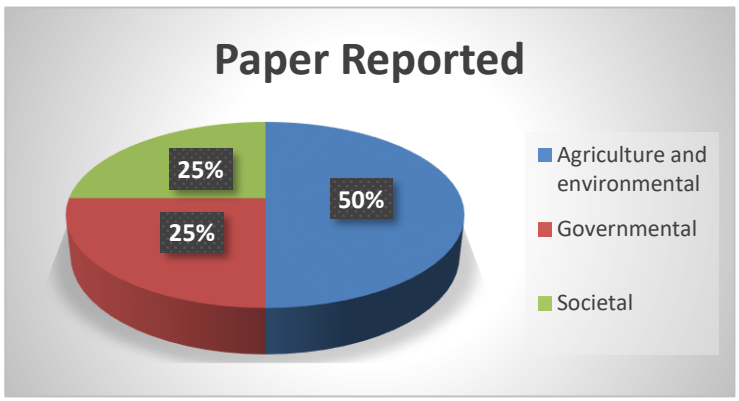

Figure 8. Pictorial representation of published work in the year 2020

Figure 9 is the pictorial representation of the published work in the year 2021 in which we represent the number of published work percentage out of 29 papers in agriculture and environmental applications, 31 papers in governance applications, and 40 papers in societal applications which comes out to be 33%, 27%, and 40% respectively. In the year 2021, there is again decrement in the area of agricultural and environmental applications and an advancement in the % applications, societal and governance applications.

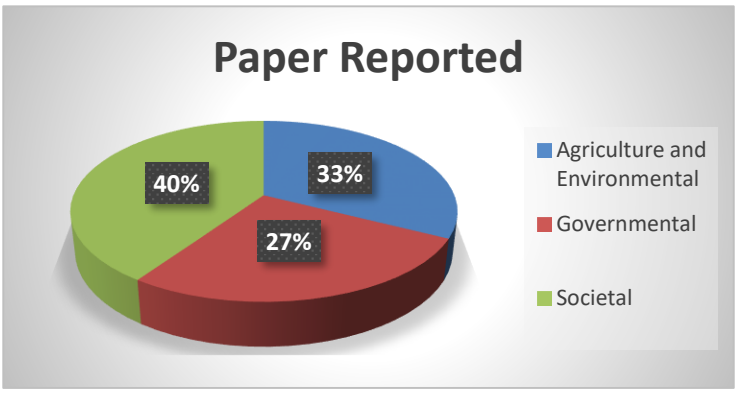

Figure 9. Pictorial representation of published work in the year 2021

Figure 10 is the pictorial representation of the published work from the year 2022 to 2024 in which we represent the number of published work percentage out of 29 papers in agriculture and environmental applications, 31 papers in governance applications, and 40 papers in societal applications which comes out to be 42%, 42%, and 16% respectively. In these years, there is again decrement in the area of societal applications and advancement in others.

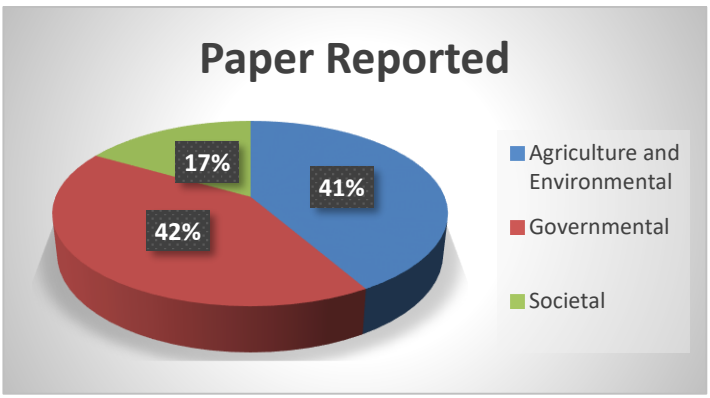

Figure 10. Pictorial representation of published work from 2022 to 2024

Figure 11 is the pictorial representation of the published work from the year 2015 to 2024. In the years from 2015 to 2024, the overall score of agriculture and environmental application and governance application is comparatively less than societal application. **Table 1** is the depiction of the reported papers from 2015 to 2024 on various societal applications belonging to the above-mentioned domains.

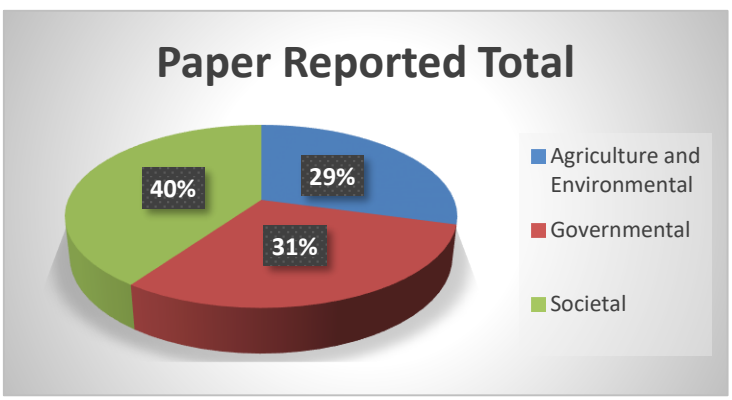

Figure 11. Pictorial representation of published work from year 2015 to 2024

Table 1. Depiction of the result of published papers from 2015 to 2024

Societal Applications	Agriculture and Environmental Applications	Governmental Applications	Social Applications
Total(%)	29	31	40
Number of Papers	24	25	33

The research gaps are defined as follows.

- Agriculture and the environment play a vital role in sustainable growth. Due to the lack of technology used in these areas and due to the lack of data available in agriculture and environmental domain, development in these areas is less.
- Similarly, in governmental applications, there is also an unavailability of data that is needed for research to be carried out. It might be because of security issues related to the data of the government sector. In some cases, government organizations do not share their data to maintain the privacy of people.
- And the same problem happens in the case of societal application. We are required to gain access to information related to the societal domain from time to time so that it is possible to scrutinize the hurdles and roadblocks along with the promoter that can be helpful with the integration of technologies in these areas. For example, data associated with women and children's development for their overall development as well as their nutrition improvement as a whole improvement of their health, youths' data to eradicate unemployment, is required on a timely basis to analyze the barriers and facilitators which again is needed for overall societal development.
- Around the globe, several schemes are introduced at national and international levels for the benefit of people around the country so that the growth of the country can be possible. In India, there are several schemes for youth employment, child and maternity nutrition programs, villages and rural development, smart city development, e-governance, and many more.

Data analysis techniques like regression, classification, neural network, data mining, opinion mining, MapReduce technique, time series analysis techniques, or integrating various data analysis techniques with other technologies like IoT, AI, and GIS with societal application can lead to improvement in society. We have cited some of the reported papers in this study. From the literature, we can also conclude that the data analysis technique plays an important role, and we can use these technologies for societal benefits. Still, there is a scope for improvement in the various societal domains because some schemes were introduced for the benefit and development of people but failed to achieve the goal set before.

Integration of data analysis in the societal application is too vast because the emerging data analysis paradigms and societal applications are two broad domains; hence fusing them will open the door for many new studies and research. This survey lacks all possible combinations among the emerging data analytics techniques and societal applications. This survey is also limited to the cited papers published within a period but shows that there are significant improvements in these applications by incorporating data analytic techniques into it. In addition to that, it is required to explore hybrid machine learning models, the fusion of machine learning models with each other, and with other analytic technologies in detail.

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