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Analysis and Visualization of Geospatial Data using WebGL API

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ABSTRACT

In this paper author has presented various geospatial raw data and visualized them in WebGL globe, this led to ease in analysis of the data. The raw data has various events such as data location in the form of latitude, longitude, magnitude etc. The data are collected from reliable resources such as SEDAC NASA (Socioeconomic Data and Application Centre), USGS, etc. The fields of data include earthquake events, volcanic activities over last 3 decades, and recent spread of the Covid-19 pandemic.

Keywords: GIS System; Data Analysis; WebGL Visualization; Seismology.

1. INTRODUCTION

Geospatial data is a subset of spatial data. A spatial data is a simple data which indicates the coordinate of the subject/object in a given system. Spatial data can have a wide range, it can be position of wind turbines in an area to churn out highest electrical energy, automobile engineers placing automobile parts to achieve maximum efficiency in their proposed concepts.Now, what separate Geospatial data from spatial data is the fact that geospatial data is indicated by or represented in relation to the geographic location, or in other words georeferenced. At the most basic level Geospatial data have at least data which can be validated on a Terrestrial Co-ordinates System that is latitude and longitude.

Terrestrial Co-ordinate System can be defined as perpendicular intersection of curved line on the spherical object such as planets creating a wireframe which is used to divide the planted into subdivision. The lines running east-west forming complete circles are known as latitudes and the lines running from north to south pole forming complete circles are known longitude. The major latitude the divides the planet into northern and southern hemisphere is known as equator.

Advanced technology has become the integral part of our life[1]. To satisfy the need of the society, almost in each work, we use the technology[2][3]. In current era computer science is major subject[4]. It has many real life applications such as cloud computing[5], artificial intelligence[6], remote monitoring[7], Wireless sensor network[8, 9, 10], internet of things[11, 12, 13], Neural network[14, 15], FSPP[16, 17, 18], NSPP[19, 20, 21, 22], TP[23, 24, 25], internet Security[26], uncertainty [27, 28, 29, 30, 31] and so on. Technology is the mode by which user can store, fetch, communicate and utilize the information[32]. So, all the organizations, industries and also every individual are using computer systems to preserve and share the information[33]. The internet security plays a major role in all computer related applications. The internet security appears in many real-life applications, e.g., home security, banking system, education sector, defence system, Railway, and so on. In this manuscript we discuss about the protection of authentication which is a part of internet security.

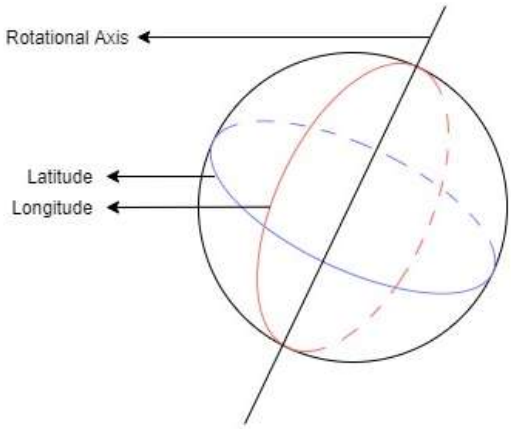

Fig.1 A general Terrestrial Coordinate system.

1.2 Data Visualization

Data Visualization means the visualization of raw data to yield information from it. In the age of internet every organisations, groups and users generate enormous amount of unstructured data. The data has increased dramatically in recent time of web. Organisations are trying hard to visualize, analyse and explore this new field to use it for the benefit of themselves. This field is crucial to scientific research[34].Data are coded records of observations of reality, are conventional annotations about what is detected in the study of the phenomena that occur in the real world.

Computers are used to process the big data. They are also responsible for analysing, developing and visualization of the result achieved into graphical representation.Data Visualization aim to build a graphical result to the corresponding available raw data, the result highlights the most significant element in the data set, key change or issue which leads to better understanding, establishing decision, relation or carving out the statistical trend from the data.Humans' spatial recognition abilities work best when a system responds to user-initiated actions in real-time. Data exploration, and user interfaces which are interactive and able to effectivelyrespond on changes to the data or view are most effective.The more attractive and clear a visualization is, the more can be Information can be obtained it[35].

Data Visualization is an enormous field and its application are vast. Data visualization is of many types like pie chart, line graph, scatter graph, bar chart etc[34]. There are several other complex data visualization types like time series visualization, network visualization, positional plotting, geospatial data visualization,3D data plotting, etc. Several Web Services such as AWS, Blogspot allow the combination data visualization in the monitoring section of their services. Another great but basic example of data visualization can be seen on website called Flight Connections[36]. They utilize network visualization along with the geospatial data visualization to represent the airports and flight routes around the word.

Fig. 2: Data visualization showing all the direct flight routes from Oslo, Norway.

2. APPLICATION

The main aim of data visualization is to communicate a cleaner and easily understandable information to the observer. This provides the significance of data. A data of general seismic activities happening daily are enormous and keeping in the fact that they are natural phenomenon, the data in just one month becomes humongous to record let alone the ability to study and observe them. Raw data generated by the companies are measured in petabytes-exabytes All these data were thought to be of no use but with the recent emergence of big data and big data analysis tools the humongous data is turning out be a gold mine for several organisations. If structured and analysed correctly, these data can easily be utilized in the favour of organization's interest.

Data Visualization has its application in every field ranging from public healthcare to sports event happening around the world. Data visualization is more than just representing numbers; it involves selecting and rethinking the numbers on which the visualization is based[37].Geospatial Data visualization utilizes Geospatial data and plot them relative to a co-ordinate system, A fascinating fact about geospatial data is that it does not acts as an constraint to the general data visualization but instead they add another dimension to the data, similar to adding time parameter in the data visualisation.Gourav Gupta and Inder Singh Gupta[38] have visualized earthquake and seismic activities around Indian subcontinent using big data tools. Utilizing Big data tools such as Hadoop hive allows collection of data somewhat easier also given the fact that bid data tools are able to manage loads of data without hassle.Geospatial data visualization is also helpful when the data is visualized have anonymity of the location.For example: The locations of tsunami darts in the oceans. Their position without visualization can only be expressed through the coordinate systems.

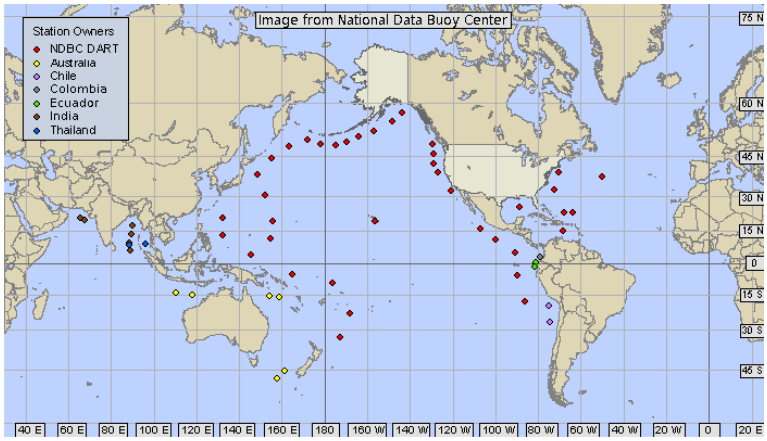

Fig. 3 Tsunami Darts location across Indian, Pacific and Atlantic Ocean[39].

3. PROPOSED METHODOLOGY

The Geospatial Data Visualization follows a similar pipeline to that of general data visualization. The pipeline can be demonstrated as follows:

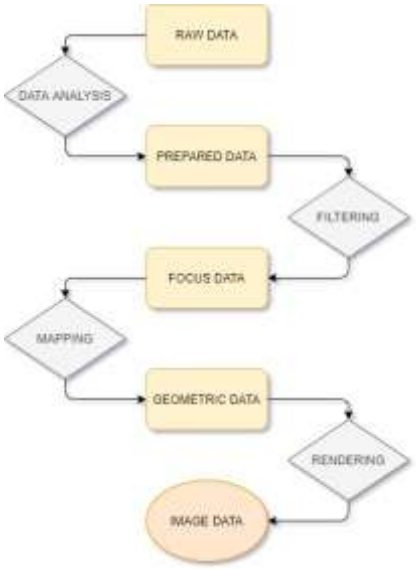

FIG.4: Pipeline diagram, Orange box being the data and grey being the process of refinements.

- **Raw Data:** Collection of unstructured data that does not convey any information directly.It also contains unnecessary data which will not provide any help in the long process.
- **Data Analysis:** This process includes analysing data from several resources and justifying its use.
- **Prepared Data:** This is a structured data which contains several information about events. Most of them are useful. Data can be too large and needs to be constrained by applying filters.
- **Filtering:** Here Data is Filtered according to the need. It can be filtered with several parameters such as location, time range etc.
- **Focus Data:** This is the ultimate Data set we want. It contains only those parameters and information which is required in the project. This data will be visualized on the final product.
- **Mapping:** This process leads to creation of mapped data. Here Focused Data is plotted against Terrestrial Co-ordinate system.
- **Geometric Data:**Once the Data is plotted against a location or region, we get geometric data. This data is still half baked and any errors and wrong information can be easily tweaked.
- **Rendering:** The last process is to render out the main information. Here the data is exported in a solid file or visualisation medium.
- **Image Data:** It's the end result we receive from in the form of image, interactive media, map, etc. This can be used as conclusion and reference for another project. It is the final product which will make the conveyance of the information easy

FIG.5: A Tabular structure of prepared data about Volcanic activities in last decades.

	A	D	E	F	G	H	I	J	K	L
1	Year	Name	Location	Country	Latitude	Longitude	Elevation (m)	Type	Agent	Deaths
2	2000	Miyake-jima	Izu Is-Japan	Japan	34.08	139.53	815	Stratovolcano		
3	2000	Semeru	Java	Indonesia	-8.108	112.92	3676	Stratovolcano	T	2
4	2000	Arenal	Costa Rica	Costa Rica	10.463	-84.703	1657	Stratovolcano	P	2
5	2000	Kilauea	Hawaiian Is	United States	19.425	-155.292	1222	Shield volcano	G	2
6	2000	Merapi	Java	Indonesia	-7.542	110.442	2947	Stratovolcano	A	1
7	2001	Etna	Italy	Italy	37.734	15.004	3350	Stratovolcano		1
8	2001	Etna	Italy	Italy	37.734	15.004	3350	Stratovolcano		
9	2001	Merapi	Java	Indonesia	-7.542	110.442	2947	Stratovolcano	P	2
10	2001	Stromboli	Italy	Italy	38.789	15.213	926	Stratovolcano	T	1
11	2002	Karangetang	Sangihe Is-Ind	Indonesia	2.78	125.48	1784	Stratovolcano	M	
12	2002	Nyiragongo	Africa-C	Congo, DRC	-1.52	29.25	3470	Stratovolcano		100
13	2002	Etna	Italy	Italy	37.734	15.004	3350	Stratovolcano		
14	2002	Reventador	Ecuador	Ecuador	-0.078	-77.656	3562	Stratovolcano	I	
15	2002	Stromboli	Italy	Italy	38.789	15.213	926	Stratovolcano		
16	2002	Semeru	Java	Indonesia	-8.108	112.92	3676	Stratovolcano	T	3
17	2003	Soufriere Hills	W Indies	Montserrat	16.72	-62.18	915	Stratovolcano		
18	2004	Egon	Lesser Sunda I	Indonesia	-8.67	122.45	1703	Stratovolcano	T	1
19	2004	Tengger Caldera	Java	Indonesia	-7.942	112.95	2329	Stratovolcano	T	2
20	2004	Manam	New Guinea-N	Papua New Gu	-4.1	145.061	1807	Stratovolcano	T	5
21	2005	Manam	New Guinea-N	Papua New Gu	-4.1	145.061	1807	Stratovolcano	T	1
22	2005	Santa Ana	El Salvador	El Salvador	13.853	-89.63	2365	Stratovolcano	A	2
23	2005	Karthala	Indian O-W	Comoros	-11.75	43.38	2361	Shield volcano		
24	2006	Raoul Island	Kermadec Is	New Zealand	-29.27	-177.92	516	Stratovolcano		1
25	2006	Soufriere Hills	W Indies	Montserrat	16.72	-62.18	915	Stratovolcano	P	
26	2006	Bulusan	Luzon-Philippi	Philippines	12.77	124.05	1565	Stratovolcano		1
27	2006	Merapi	Java	Indonesia	-7.542	110.442	2947	Stratovolcano		2

4. CHALLENGES

Data is often the documentary and informative basis, with reduced uncertainties, necessary to make decisions about very varied contents, from journalism to science.
While creating a project there are several challenges to overcome:

- Data is an uncertain term. It varies greatly from device to device and observer to observer.
- Data on several real phenomenon cannot be measured directly and the way of obtaining them is not uniform and they have to be estimated which is again cannot be deemed as a perfect data.
- Data about phenomenon happening in real-time change frequently with time. Sometime the Data about them change so frequently that accounting it becomes a fuss.
- Another easier method of obtaining data is from several educational and research website but still it arises a need to make certain about the authenticity of data.
- When data collection is done on smaller scale by using smaller in-house device a minor flaw can critically change the data.
- Data obtained from other sources may be accurate but can be result of analysis limited samples and not of the entire phenomenon.
- Selection of the interactive media for ultimate renders needs to be considered carefully.
- Big data, structured and unstructured, introduces a unique set of challenges for developing visualizations. This is due to the fact that we must take into account the speed, size, and diversity of the data. A new set of issues related to performance, operability, and degree of discrimination challenge large data visualization and analysis[40].
- Visualizing big data has some additional challenges; for example, visual analytics solutions themselves may not scale: we need to consider how to deal with information overload on the viewer if we show too many things at the same time[41].

5. RESULT

Fig. 6: Final render of the visualized data.

In the proposed case the data was collected from sources such as USGSand SEDAC NASA. The data is represented on an open platform WebGL project namely WebGL Globe and using JSON language for the implementation. WebGL is a JavaScript Web API which is used to create interactive media for webpages and web-applications. The data collected are in the form of major seismic activity happened in the past 3 decades, Country-wise spread of Covid-19 virus, etc.

6. CONCLUSION

Utilization of WebGL API in data creates an interactive output where the user can easily scroll around the globe to access the information. The Visualized data can easily be placed in any Web Page easily. The observer can easily pan around the global and communicate the information easily. The Future scope of improvements can include: Implementing touch capabilities in the project. The project currently has hover, pan and zoom capabilities.

7. REFERENCES

[1] M. BM and H. Mohapatra, "Human centric software engineering," International Journal of Innovations & Advancement in Computer Science (IJIACS), vol. 4, no. 7, pp. 86-95, 2015.
[2] H. Mohapatra, C Programming: Practice, Vols. ISBN: 1726820874, 9781726820875, Kindle, 2018.
[3] H. Mohapatra and A. Rath, Advancing generation Z employability through new forms of learning: quality assurance and recognition of alternative credentials, ResearchGate, 2020.
[4] H. Mohapatra and A. Rath, Fundamentals of software engineering: Designed to provide an insight into the software engineering concepts, BPB, 2020.
[5] V. Ande and H. Mohapatra, "SSO mechanism in distributed environment," International Journal of Innovations & Advancement in Computer Science, vol. 4, no. 6, pp. 133-136, 2015.
[6] H. Mohapatra, "Ground level survey on sambalpur in the perspective of smart water," EasyChair, vol. 1918, p. 6, 2019.
[7] H. Mohapatra, S. Panda, A. Rath, S. Edalatpanah and R. Kumar, "A tutorial on powershell pipeline and its loopholes," International Journal of Emerging Trends in Engineering Research, vol. 8, no. 4, 2020.
[8] H. Mohapatra and A. Rath, "Fault tolerance in WSN through PE-LEACH protocol," IET Wireless Sensor Systems, vol. 9, no. 6, pp. 358-365, 2019.
[9] H. Mohapatra, S. Debnath and A. Rath, "Energy management in wireless sensor network through EB-LEACH," International Journal of Research and Analytical Reviews (IJRAR), pp. 56-61, 2019.
[10] H. Mohapatra and A. Rath, "Fault-tolerant mechanism for wireless sensor network," IET Wireless Sensor Systems, vol. 10, no. 1, pp. 23-30, 2020.
[11] H. Mohapatra and A. Rath, "Detection and avoidance of water loss through municipality taps in india by using smart tap and ict," IET Wireless Sensor Systems, vol. 9, no. 6, pp. 447-457, 2019.
[12] M. Panda, P. Pradhan, H. Mohapatra and N. Barpanda, "Fault tolerant routing in heterogeneous environment," International Journal of Scientific & Technology Research, vol. 8, pp. 1009-1013, 2019.
[13] D. Swain, G. Ramkrishna, H. Mahapatra, P. Patra and P. Dhandrao, "A novel sorting technique to sort elements in ascending order," International Journal of Engineering and Advanced Technology, vol. 3.

[14] H. Mohapatra, "HCR using neural network," 2009.
[15] V. Nirgude, H. Mahapatra and S. Shivarkar, "Face recognition system using principal component analysis & linear discriminant analysis method simultaneously with 3d morphable model and neural network BPNN method," Global Journal of Advanced Engineering Technologies and Sciences, vol. 4, p. 1, 2017.
[16] R. Kumar, S. Edalatpanah, S. Jha, S. Gayen and R. Singh, "Shortest path problems using fuzzy weighted arc length," International Journal of Innovative Technology and Exploring Engineering, vol. 8, pp. 724-731, 2019.
[17] R. Kumar, S. Jha and R. Singh, "A different approach for solving the shortest path problem under mixed fuzzy environment," International Journal of fuzzy system Applications, vol. 9, no. 2, pp. 132-161, 2020.
[18] R. Kumar, S. Jha and R. Singh, "Shortest path problem in network with type-2 triangular fuzzy arc length," Journal of Applied Research on Industrial Engineering, vol. 4, pp. 1-7, 2017.
[19] S. Broumi, A. Dey, M. Talea, A. Bakali, F. Smarandache, D. Nagarajan, M. Lathamaheswari and R. Kumar, "Shortest path problem using Bellman algorithm under neutrosophic environment," Complex & Intelligent Systems, vol. 5, pp. 409--416, 2019.
[20] R. Kumar, S. Edalatpanah, S. Jha, S. Broumi, R. Singh and A. Dey, "A multi objective programming approach to solve integer valued neutrosophic shortest path problems," Neutrosophic Sets and Systems, vol. 24, pp. 134-149, 2019.
[21] R. Kumar, S. Edalatpanah, S. Jha and R. Singh, "A novel approach to solve gaussian valued neutrosophic shortest path problems," International Journal of Engineering and Advanced Technology, vol. 8, pp. 347-353, 2019.
[22] R. Kumar, S. Edaltpanah, S. Jha, S. Broumi and A. Dey, "Neutrosophic shortest path problem," Neutrosophic Sets and Systems, vol. 23, pp. 5-15, 2018.
[23] R. Kumar, S. Edalatpanah, S. Jha and R. Singh, "A Pythagorean fuzzy approach to the transportation problem," Complex and Intelligent System, vol. 5, pp. 255-263, 2019.
[24] J. Pratihar, R. Kumar, A. Dey and S. Broumi, "Transportation problem in neutrosophic environment," in Neutrosophic Graph Theory and Algorithms, F. Smarandache and S. Broumi, Eds., IGI-Global, 2019.
[25] J. Pratihar, S. E. R. Kumar and A. Dey, "Modified Vogel's Approximation Method algorithm for transportation problem under uncertain environment," Complex & Intelligent Systems (Communicated).
[26] J. Sakhnini, H. Karimipour, A. Dehghantanha, R. Parizi and G. Srivastava, "Security aspects of Internet of Things aided smart grids: A bibliometric survey," Internet of Things, pp. 100-111, 2019.
[27] S. Gayen, F. Smarandache, S. Jha and R. Kumar, "Interval-valued neutrosophic subgroup based on interval-valued triple t-norm," in Neutrosophic Sets in Decision Analysis and Operations Research, M. Abdel-Basset and F. Smarandache, Eds., IGI-Global, 2019, p. 300.
[28] S. Gayen, F. Smarandache, S. Jha, M. Singh, S. Broumi and R. Kumar, "Introduction to plithogenic subgroup," in Neutrosophic Graph Theory and Algoritm, F. Smarandache and S. Broumi, Eds., IGI-Global, 2020, pp. 209-233.
[29] S. Gayen, S. Jha, M. Singh and R. Kumar, "On a generalized notion of anti-fuzzy subgroup and some characterizations," International Journal of Engineering and Advanced Technology, vol. 8, pp. 385-390.
[30] S. Gayen, F. Smarandache, S. Jha, M. K. Singh, S. Broumi and R. Kumar, "Introduction to plithogenic hypersoft subgroup," Neutrosophic Sets and Systems, vol. 33, p. Accepted, 2020.
[31] S. Gayen, S. Jha and M. Singh, "On direct product of a fuzzy subgroup with an anti-fuzzy subgroup," International Journal of Recent Technology and Engineering, vol. 8, pp. 1105-1111, 2019.
[32] Behura and H. Mohapatra, "IoT Based Smart City with Vehicular Safety Monitoring," EasyChair, vol. 1535, 2019.
[33] H. Panda, H. Mohapatra and A. Rath, "WSN-Based Water Channelization: An Approach of Smart Water," Smart Cities—Opportunities and Challenges. Lecture Notes in Civil Engineering, vol. 58, pp. 157-166.
[34] Matthew and S. , "Data visualization," International Journal of Engineering Research And Advanced Technology (IJERAT), vol. 2, pp. 11-16, 2016.
[35] Goodman and A. A. , "New Thinking on, and with, Data Visualization," arXiv preprint arXiv:1805.11300.
[36] "Flight Connections," [Online]. Available: https://www.flightconnections.com/.
[37] J. Wolfie, "Teaching students to focus on the data in data visualization," Journal of Business and Technical Communication, vol. 29, pp. 344--359, 2015.
[38] G. Gupta and I. S. Gupta, "Earthquake Data Analysis and Visualization using Big Data Tool," in International Conference on "Computing for Sustainable Global Development, 2016, pp. 618--621.
[39] "National Weather Service," [Online]. Available: https://www.weather.gov/jetstream/dart_max.
[40] Li, X. and K. , "Advanced aggregate computation for large data visualization," in 5th Symposium on Large Data Analysis and Visualization (LDAV), IEEE, 2015, pp. 137--138}.
[41] J. Choo and H. Park, "Customizing computational methods for visual analytics with big data," IEEE Computer Graphics and Applications, vol. 33, pp. 22--28, 2013.