

Theory and Practice of Interactive Maps Based on Machine Learning Algorithm

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Abstract

This speculative proposes an approach towards enhancing the real time experience while using the Maps. It is an all-in-one for most of the information about a particular area, cities, states, countries, which include salient features like, 'Crime Report', 'Population Density', 'Covid Cases', 'Average Temperature Change', 'Climate Change', 'Sex Ratio'. The interactive maps assist us in conveying complicated information in a more straightforward manner. They help the user to have more engaging usage of application than regular static map. Interactive maps involve representing the maps which allows zoom in and zoom out, identifying the specific features by just hovering over the map without typing queries. The map also maintains high-definition picture quality while zooming in. This is used to produce a summary and various ways to use or visualize data source on the map. The GSI (Global Information System) is used in interactive mapping to display pinpoint data on a map. The many tiers of geographical information are layered on top of each other using a layering approach. Unlike static maps, interactive maps offer a lot of characteristics that help to display a vast quantity of complex data more effectively.

Keywords: *Geographical User Interfaces, Cartographic Interaction, Interactive Maps.*

1. Introduction

We cannot imagine where we would be without maps today (both literally and figuratively). Powerful maps guide us to explore the world, reach our daily destinations and help us explore and change our campaigns to implementation [1]. Visualized data to match Graphical. This makes it easier to understand and analyze data. It also includes a variety of static and dynamic data that helps us find all the useful data we need in one place. The creation of new interactive maps, as illustrated by EU, Metro Monitor and Carbon Map. These examples illustrate the potential for high quality international data, which has useful implications for understanding growth and inequality [2]. New opportunities to create interactive maps are taken up by educational research institutes, government institutions, policy think tanks and campaign organizations. This growing market for online cartographers takes place in line with the popularity of the online mapping theme with trends such as info-graphics and data journalism. The framework of this project is to greatly improve the data-based application that allows users to search for static and data journalism [3]. Flexible data based on their needs and the amount

of data that needs to be viewed. The user can view the data in the photo introduction where they can find useful information [4]. The following are some of these characteristics:

- The ability to add text boxes to data points that appear when they are clicked, providing for a brief review.
- Zoom functions that allow users to zoom in on precise details of a location or get a clear snapshot of a wider region.
- External supporting resources, such as pictures, video, or graphs, may well be connected to points on a map, and these changes would be made visible to users.

2. Related Work

The Watershed Watch Salmon Society built a real-time example of an interactive map to illustrate the dangers of salmon in the Fraser River in British Columbia [5]. The map itself demonstrates a variety of interactive map elements, like adding dynamic text, a pop-up box, and more [6]. Allows the user to choose which data set is displayed on the map by clicking; Create links to case studies and pop-up graphs in maps that show how things have changed through time; A sliding timeline that modifies the data displayed based on the time period selected [7]. The Nigerian Security Tracker, established by the Council on Foreign Relations and curated by Ralph Bunch, Senior Fellow for Africa Studies, is a simpler interactive map than the one above, but it is organized by state in Nigeria. Displays information on the number of deaths in an effective manner [8]. Kumar et. al proposed many buyer seller watermarking protocol [10-13]. The user can use the sliding scale to select the time period they want to see, and hovering the cursor over a state will show more information about that location as well as an external link to the data [14-15]. The maps' data is updated on a regular basis.

3. Proposed Method

Different map layers are used to clarify the nature and distribution of a problem, allowing for new insights and comparisons. It's simple to show how a problem affects various groups and geographical areas. Individual variables can be isolated and examined using the ability to choose which layers of information to display on an interactive map. Interactive maps can be utilized in the design, implementation, and evaluation of interventions because they provide evidence that can be used in planning, implementation, and evaluation decisions., "as well as a basis for justifying those judgments to funders and policymakers," says the report. They can indicate how programs and interventions have changed over time, indicating where and how they are performing and failing. Interactive maps are effective presenting tools. Most importantly, GIS maps aid policymakers, particularly elected officials, who often have little knowledge of the issues that drive their decisions. GIS maps can aid because they are so effective at describing situations in a given area. Policymakers gain a better understanding of issues, which leads to logical policies that address reality.

3.1 Objectives of Interactive Maps

- Users can design their own personalized maps
- Layering indicators to evaluate trends is simple.
- Zooming, hover-over pop-ups, and other features allow users to interact with the map data.

- Raw data and visualizations can be seen and downloaded by the user.
- Provides a live analytical tool that can be updated as needed.

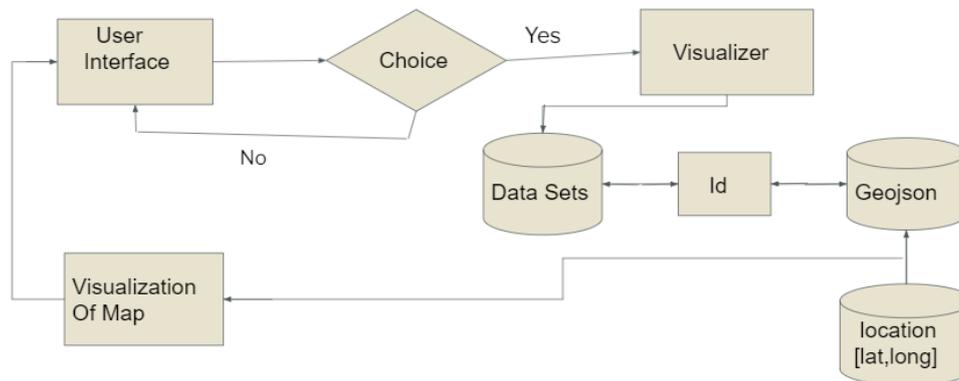


Figure 1. Architecture diagram of proposed approach

The above block diagram shows how the proposed system operates. The whole system can be summarized as below using the above block diagram. When a user tries to interact with a map and searches for an element or about any event data the code checks if the user is entering an existing aspect. If yes, the data is visualized and taken from data sets which verifies ID numbers and uses Geojson maps locating with coordinates where it is later visualized to map. Based on the above block diagram the proposed approach can be understood by user interface, visualizer, data sets, geojson data.

3.2 User Interface

The interfaces between the user and the computer are known as user interfaces. The user directs the computer's behavior through the interface. A subset of user interfaces is the Graphical User Interface (GUL). The input and output of the application are represented by visuals rather than words in these interfaces. "The application displays specific icons, buttons, dialogue boxes, and other items on the screen in its windows, and the user interacts with them largely by moving a pointer on the screen (frequently with the aid of a mouse) and selecting them. " By clicking the mouse button, you can select certain things. "The pointer is aimed towards them." Some basic criteria for UI design include striving for uniformity to remove unwanted UI distractions, delivering feedback to the user, avoiding or making faults easy to address, and so on. The user should be at the core of the GUI design. This means that at each level of the design process, the needs, wants, and restrictions of an interface's end user are given careful consideration. There are four types of GUI controls in a GUI:

- Input element
- Output element
- Selection element
- Verb element

The designers' thoughts and mental attitude are always imprinted in the GUI design. We can't always state that one user interface is superior than another because everybody performs different duties and has varied preferences when it comes to using an application. Color selection and combination, in particular, is a personal preference. As a result, one individual may enjoy the appearance of the GUI while the other does not.

3.3 Visualizer

Make data exploration simple: Data is only valuable if the users who are responsible for identifying patterns can make the most of it. When data is homogeneous, keeping track of KPIs to be tracked, understanding which variables require attention, and gleaning insights becomes onerous for analysts. Data can be shown in an interactive map in a way that makes it simple to identify, locate, alter, format, and effectively communicate information. Even inexperienced users can uncover correlations, trends, and outliers, making the decision-making process easier.

- Information presented in a clear and succinct manner: Interactive maps can provide information in linked groupings and with more clarity.
- Consolidate data to build a story: A user can better grasp a complex data collection if the data is presented in the form of a story. Users can plot data points, map pins, generate text hovers, pick and filter data pieces, and alter settings to shift views using interactive maps. Data is compacted on these maps, and just the relevant information is provided based on user preferences. A story is constructed based on the context of data, which may provide a bird's eye view or the most granular details.
- Real-time: Refreshing and presenting information in real-time takes only a few minutes. Decisions are well-informed, and appropriate actions may be taken in the event of a crisis, because information is updated on a frequent basis.
- Collaboration is simple: Because most interactive maps are cloud-based, numerous people can change or see them at the same time. There are no inconsistencies when viewing the maps because the information is updated in real-time.
- Derived correlation: Based on several data streams, they assist a user in identifying regions that require attention, identifying patterns, and determining dynamic correlations.
- Drive Processes: Interactive maps can aid in the decision-making process. They allow users to create KPIs and use color-coded data to represent each phase of the process in order to achieve these KPIs. Clustering Maps (customize view to indicate density), Heat maps (user browsing sessions), and many others are based on the current state (colors).
- Prescriptive Analytics: Because real-time data is available, some interactive maps can be programmed to suggest actions based on the present scenario.

3.4 Data Sets

Data sets acts as database for the data that are collected from different sources. This makes things simpler to connect the data to the visualizer and to store the data. For our project, we are using CSV files for storing data. We include various necessary rows and colors for existing data. To create an interactive map, we use both dynamic and static data sets. CSV (Comma Separated Values) is a common file format for storing tabular data in spreadsheets and databases. The tabular (number and text) data is stored in plain text in a CSV file. A data record might be found on each line of the file. The file format's word derives from the utilization of a comma as a field separator. Each record consists of one or more fields separated by commas.

3.5 Geojson Data

Geojson is a file format for describing ap data that is available to everybody. Geojson is the format used by Mapbox's web series and APIs to serve geospatial data. Geojson is a subset of JSON that can be parsed by JavaScript and most current software natively.

3.6 Data Visualization

The practice of attempting to interpret data by providing it in a visual medium is known as data visualization, in order to reveal patterns, trends, and connections that might otherwise go undetected. There seem to be a number of fantastic graphing packages in Python, with its own range of abilities. Python provides a great library for creating interactive, live, or highly customizable charts. Here are a few common plotting libraries to give you a quick overview.

- Matplotlib: low-level, with a lot of flexibility
- Pandas Visualization: a simple, Matplotlib-based interface.
- Seaborn: nice default styles, high-level interface
- ggplot: uses Grammar of Graphics and is based on R's ggplot2.
- Plotly: allows you to build interactive plots.

We use plotly for creating a user interactive interface which helps the use to especially navigate and understand the data in an unambiguous way. The program was written in the Python programming language. Python is an excellent language for data analysis, thanks to a thriving community of data-centric Python tools. One of these packages is Pandas, which makes importing and analyzing data a lot easier. Color is one of the most powerful data resources for visual acuity, and it's crucial if we're going to get the details right.

4. Result and Discussion

In this paper we have seen how the proposed system is implemented and how it works.

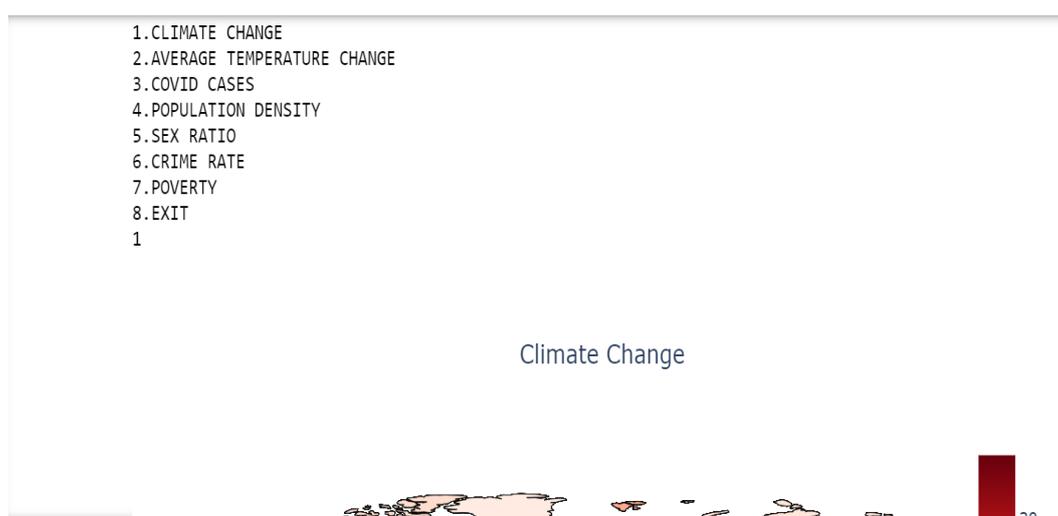


Figure 2. GUI of Interactive Maps Based on Machine Learning Algorithm

In figure 2 we notice that the above appears when we open the application. We used seven different aspects of data which can be visualized.

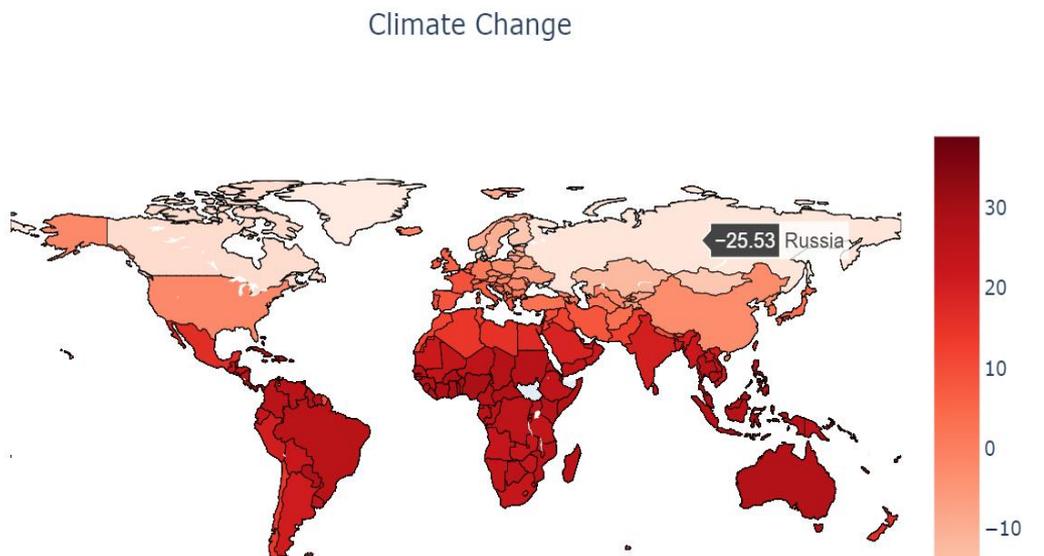


Figure 3. User selects Climate Change

Fig 3 shows a situation where the user selects an aspect called climate change. The user gets the visualized data in the above form. When a user moves the cursor through any region, the data pops up and shows the related information.

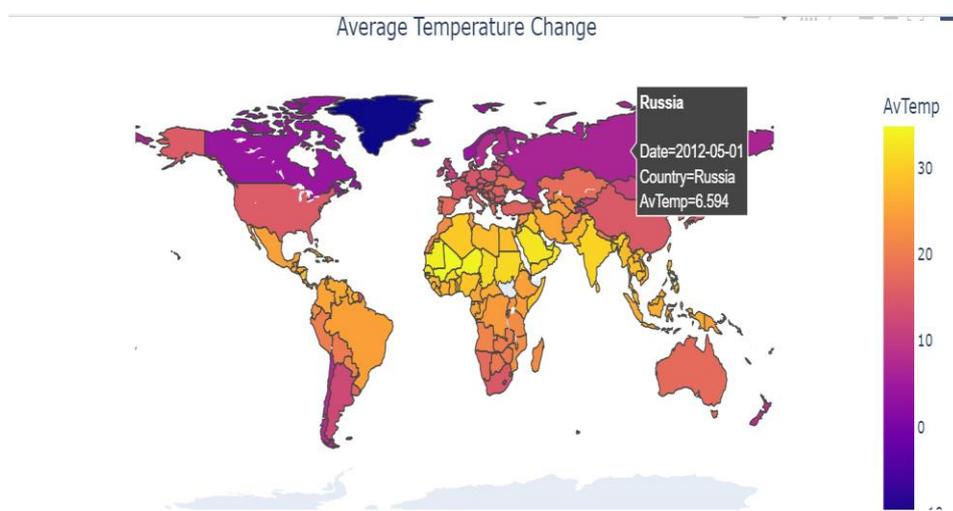


Figure 4. User selects Average Temperature Change

Fig 4 shows a situation where the user selects an aspect called average temperature change. The user gets the visualized data in the above form. When a user moves the cursor through any region, the data pops up and shows the related information.

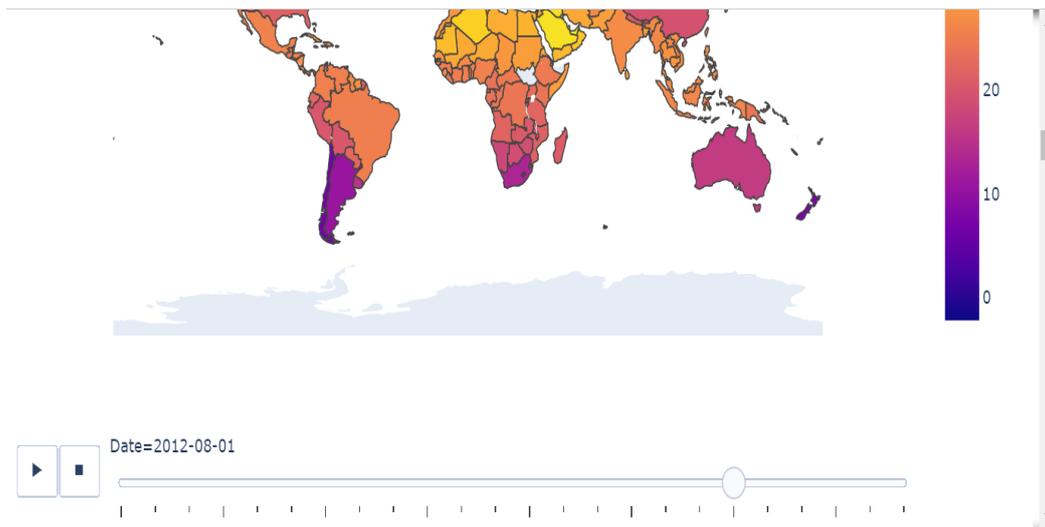


Figure 5. Range Scale

Fig 5 shows the range scale where user can drag the point according to the requirements that is year.

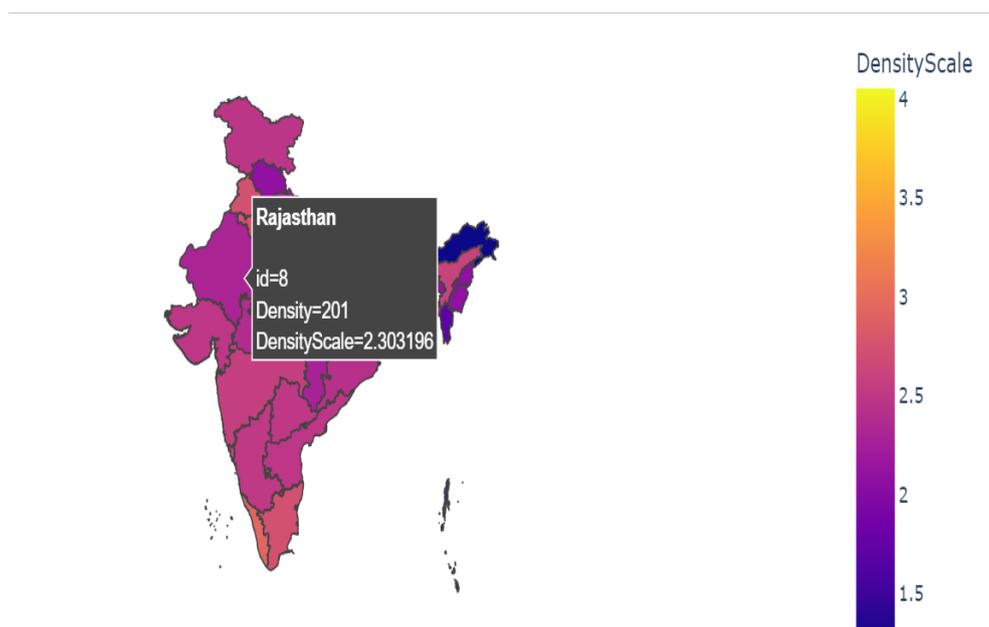


Figure 6. Population Density

Fig 6 shows a situation where the population density of India using choropleth representation and when the user moves the cursor through any region, the data pops up and shows the related information. The bar represents the hue scale and intensity of the information.

5. Conclusions

New interactive maps are being designed for the EU, Metro Monitor, and Carbon Map, to mention only few. These examples demonstrate the benefits that high-quality international data may provide, including important insights on growth and inequality. Although the amount of data collection and synthesis labor necessary to build global sub-national datasets remains large, costs are decreasing as open data principles extend globally, and chances for more international study are anticipated to grow. Academic research institutions, government agencies, policy think tanks, and campaign organizations are all taking use of new chances to generate interactive maps. This growing market for online cartographers coincides with the rise in popularity of online thematic mapping as a result of Infographics and data journalism are samples of recent trends. The element with interactive mapping appears to be terrific. The potential for interactive mapping on the web to expand the general public's access to spatial information to address everyday concerns in planning, resource management, and other sectors is substantial. It's quickly becoming a tool rather than a toy. Business apps must make it simpler for non-programmers to construct interactive mapping websites at the same time that it is now simplest to apply websites yourself. Python has made it possible to get back in touch with a genuine GIS on the internet. Creating a successful mapping website online necessitates the integration of knowledge from a variety of disciplines, including computer programming, cartography and GIS, and graphic design.

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