Visualizing Time Series Data

September 10, 2020

Terrorism Analysis with Insights

A detailed summary of the project "Terrorism Analysis with Insights" has been provided. The project aims to let the user perform predictive analysis to find the trendline of each kind of Attacks that has occurred during a particular timeline. Visualization has been used to its extent to give clear patterns about the data and makes it easy for analysis.

[See project on GitHub]

By - Sahil Rahman

Introduction

Protective vehicles are less in numbers with the Army and are distributed uniformly across the area. Similarly, Explosive Detection Dogs (ED Dogs) are only less in the entire country. This project can be used as a Predictive Analysis tool to find the trendline of each kind of Attack (Bombing, Assassination, Etc.). This tool helps in finding the concentration of Attack type - Bombing in the area which would help in allocation of the resources. Visualizing the data gives clear patterns about the data and makes it easy for the analysis.

Data visualization is a graphical portrayal of data by utilizing visual components like outlines, diagrams, and maps. Data representation apparatuses give a free method to see and get patterns, exceptions, and examples in data. Time series diagram, additionally called time series chart or time series plot, is an information perception tool that shows data points at progressive timespans. Each point on the outline relates to both a period and an amount that is being estimated.

The project reflects the domain Data Analysis and Full Stack Development with Python, as the primary programming language. For the interactive dashboard, a productive Python framework "Dash" has been used, along with a Python library "Plotly".

Related Work

Time Series data is inescapable in the field of Data Science. Regardless of whether it is investigating business patterns, determining organization income or investigating client conduct, each information researcher is probably going to experience time series data eventually during their work.

Some of the existing projects that are utilizing the comparative techniques are given beneath:

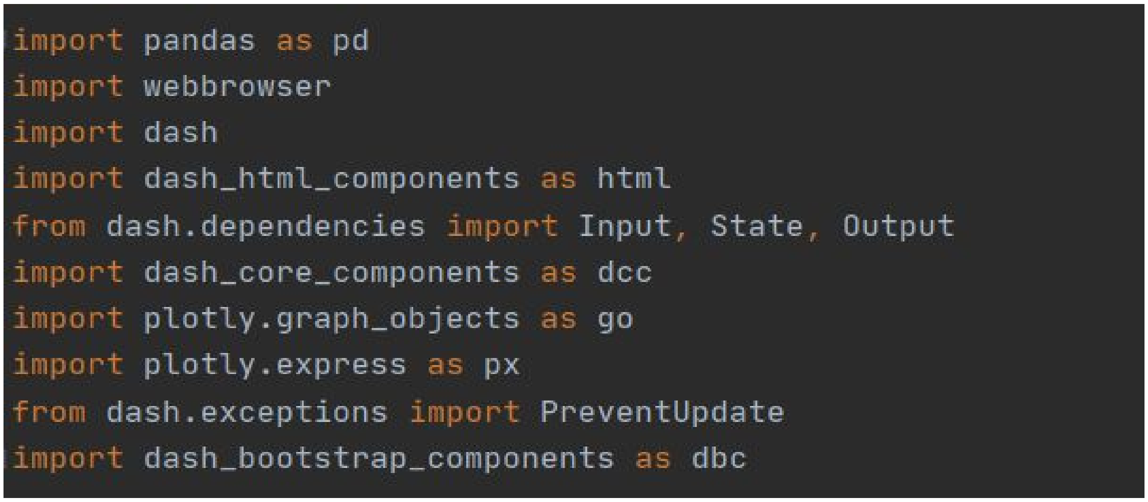
- **Crime and Drug use in New York City:** This project is used to investigate the time series interrelationships between crime, drug use, police, and arrests in New York City. Thus, in a time-series approach, one can be able to find a causal relationship between drug usage and property-related felonies.
- **Forecasting Methods:** In this project, open-source datasets have been taken into account that is publicly available and various methods/techniques of performing time series forecasting such as holt-winters method, Autoregressive integrated moving average method, exponential smoothing methods, have been discussed, and comparative study of the modern methods of performing forecasting using neural network-based models has also been highlighted.
- **Coronavirus Outbreak:** In this project, real-time time series methods are used to predict the forthcoming situations in different countries due to the Coronavirus Outbreak. The application takes certain parameters such as Active cases, Recovered cases, Number of death cases, etc., to perform the predictive analysis.

My Work

The project showcases a GUI (Graphical User Interface) with Python, as the primary programming language that uses a Python framework "Dash", along with a Python library "Plotly". The project provides plenty of handful of insights about the worldwide terrorist attacks ranging from the year 1970 to 2018. The interface contains two tabs named as "Map Tool" and "Chart Tool", respectively. Each tab contains two subtabs "World Map Tool" and "India Map Tool" for the "Map tool" tab and "World Chart Tool" and "India Chart Tool" for the "Chart Tool" tab. The purpose of each tab is to perform the visualization in the form of scattered plots of the dataset that has been provided. Next, we have various dropdowns that serve the purpose of filtering out the data according to the condition. With the help of these dropdowns, the user can filter out, and access visualizes pieces of information specifically. Next, we have a range slider that filters the provided condition within the given period of the time. Following up, we have added a graph section where the user can have a better sight of visualization for the filtered conditions. Last but not least, a modal or popup button has been provided that describes the overview of the application such as how to use the project, what the project is all about, what all tools have been used, Etc.

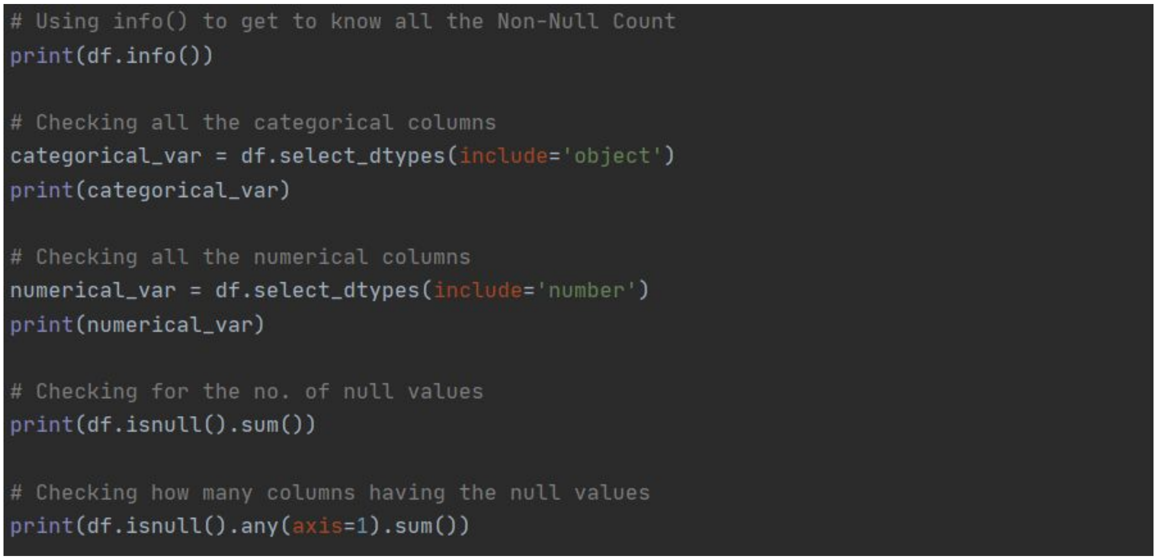
Implementation

- **Importing all the required packages:** Firstly, we have imported all the packages that we require for this project.



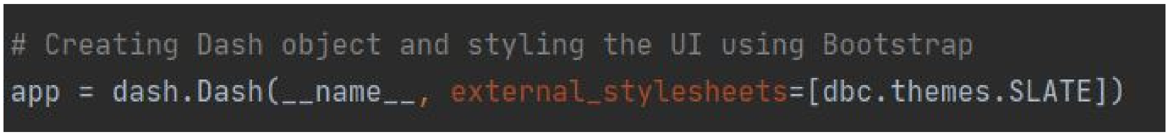
```
import pandas as pd
import webbrowser
import dash
import dash_html_components as html
from dash.dependencies import Input, State, Output
import dash_core_components as dcc
import plotly.graph_objects as go
import plotly.express as px
from dash.exceptions import PreventUpdate
import dash_bootstrap_components as dbc
```

- **Performing Exploratory Data Analysis on the given dataset:** The dataset provided is an unstructured dataset with the extension .xlsx, containing 1,90,000 records. To make the dataset structured, we have performed EDA and formed a new file fresh dataset in a .csv file.



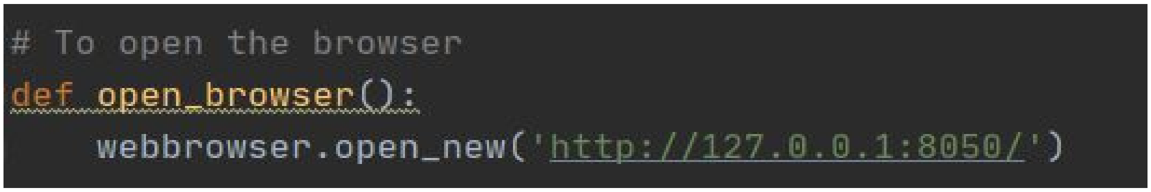
```
# Using info() to get to know all the Non-Null Count
print(df.info())

# Checking all the categorical columns
categorical_var = df.select_dtypes(include='object')
print(categorical_var)

# Checking all the numerical columns
numerical_var = df.select_dtypes(include='number')
print(numerical_var)

# Checking for the no. of null values
print(df.isnull().sum())

# Checking how many columns having the null values
print(df.isnull().any(axis=1).sum())
```

- **Create Dash object and use a Bootstrap template for the styling purpose:** We have used the "Dash " framework for creating the dashboard and use Bootstrap template "SLATE" for the styling purpose.



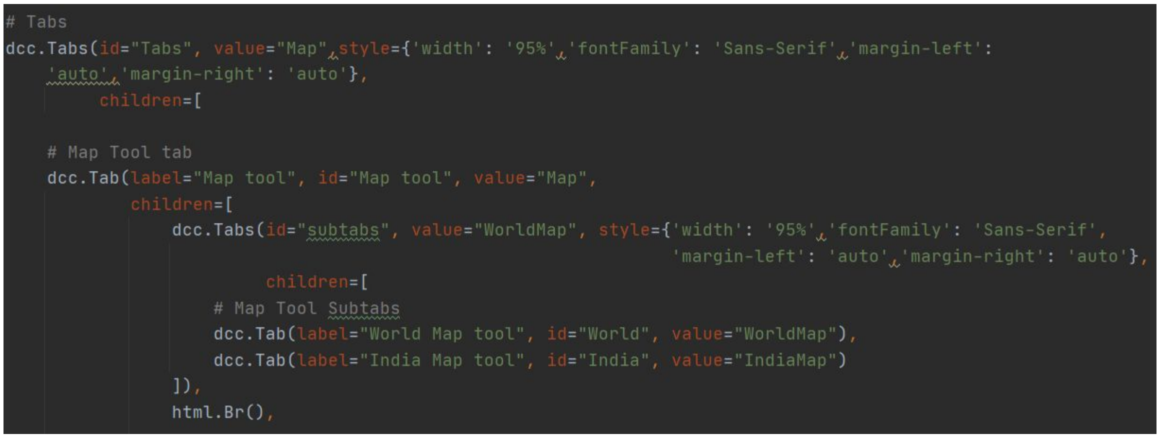
```
# Creating Dash object and styling the UI using Bootstrap
app = dash.Dash(__name__, external_stylesheets=[dbc.themes.SLATE])
```

- **Creating a function that opens the web-browser when the program runs:** I have used the webbrowser() package to let the browser open whenever the application comes into action.



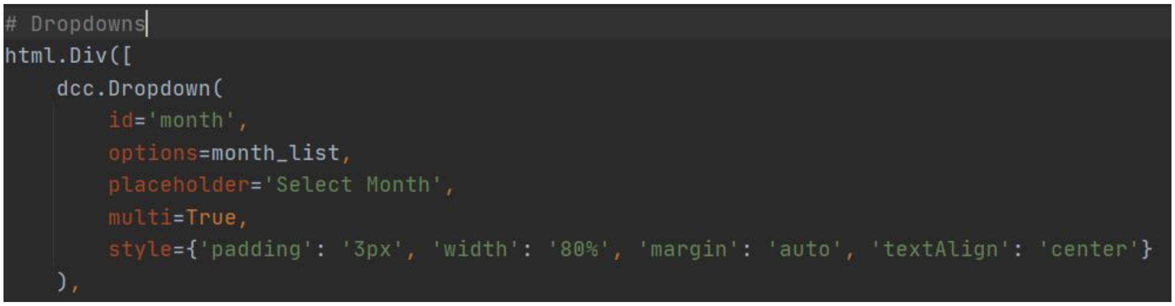
```
# To open the browser
def open_browser():
    webbrowser.open_new('http://127.0.0.1:8050/')
```

- **Creating Tabs and Subtabs:** Creating the "Map Tool" and "Chart Tool" section along with the sub-tabs for each section.



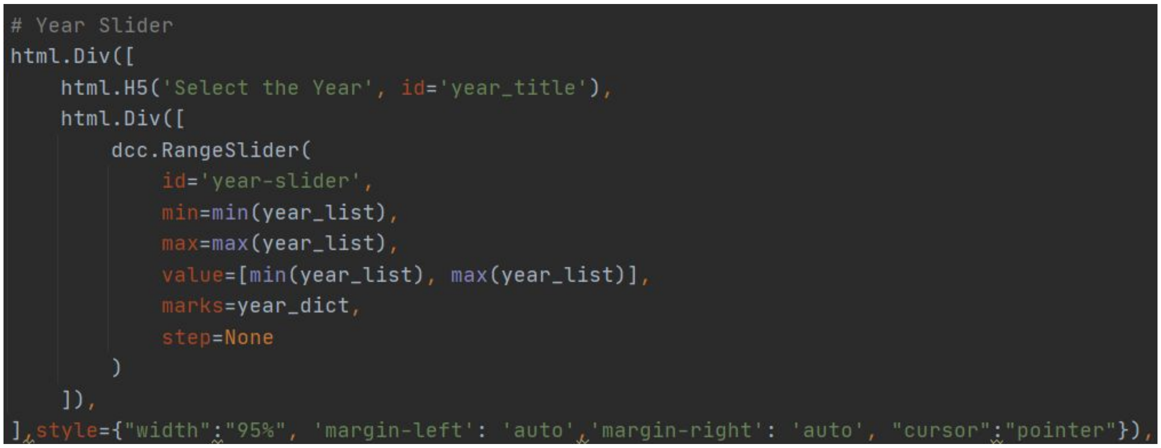
```
# Tabs
dcc.Tabs(id="Tabs", value="Map",style={'width': '95%','fontFamily': 'Sans-Serif','margin-left':
    'auto','margin-right': 'auto'},
         children=[

    # Map Tool tab
    dcc.Tab(label="Map tool", id="Map tool", value="Map",
            children=[
                dcc.Tabs(id="subtabs", value="WorldMap", style={'width': '95%','fontFamily': 'Sans-Serif',
                                                                'margin-left': 'auto','margin-right': 'auto'},
                         children=[
                    # Map Tool Subtabs
                    dcc.Tab(label="World Map tool", id="World", value="WorldMap"),
                    dcc.Tab(label="India Map tool", id="India", value="IndiaMap")
                ]),
                html.Br(),
```

- **Creating Dropdowns:** Dropdowns has been created that serves the purpose of filtering out the data according to the condition.



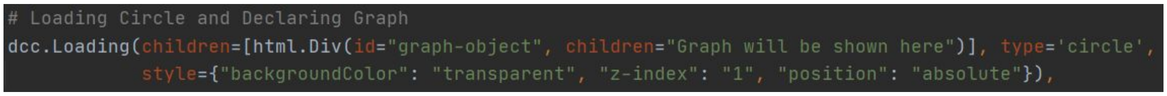
```
# Dropdowns
html.Div([
    dcc.Dropdown(
        id='month',
        options=month_list,
        placeholder='Select Month',
        multi=True,
        style={'padding': '3px', 'width': '80%', 'margin': 'auto', 'textAlign': 'center'}
    ),
```

- **Creating Range Slider:** I have used Range Slider to filter the provided condition within the given period of the time.



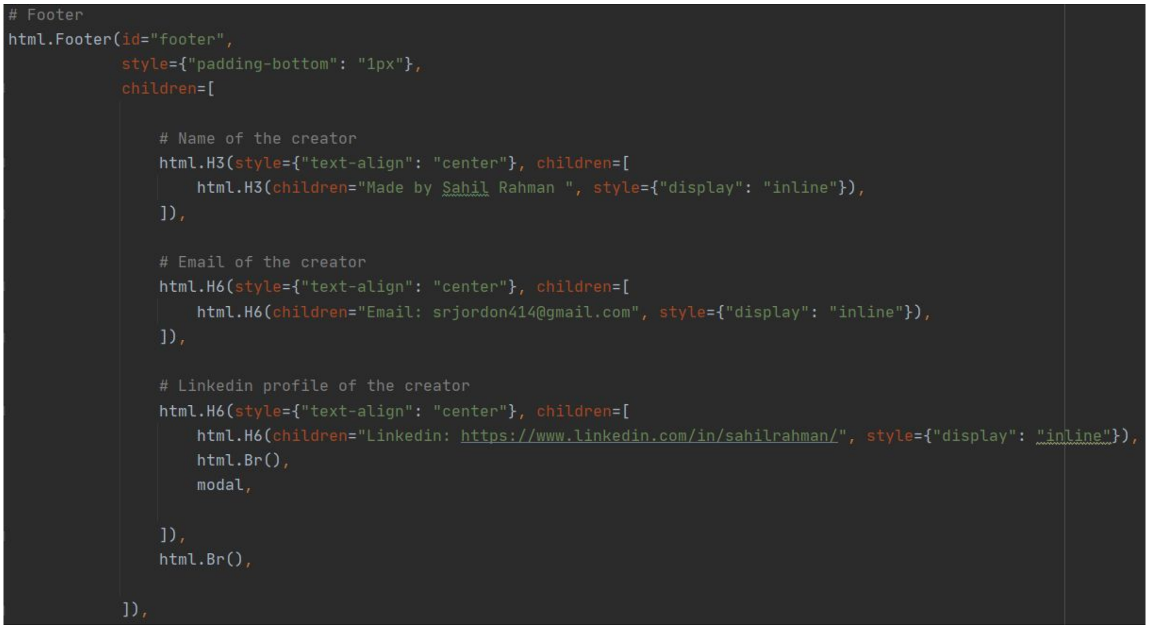
```
# Year Slider
html.Div([
    html.H5('Select the Year', id='year_title'),
    html.Div([
        dcc.RangeSlider(
            id='year-slider',
            min=min(year_list),
            max=max(year_list),
            value=[min(year_list), max(year_list)],
            marks=year_dict,
            step=None
        )
    ]),
],style={"width":"95%", 'margin-left': 'auto','margin-right': 'auto', "cursor":"pointer"}),
```

- **Adding Graph:** We have added a graph section where the user can have a better sight of visualization for the filtered conditions.



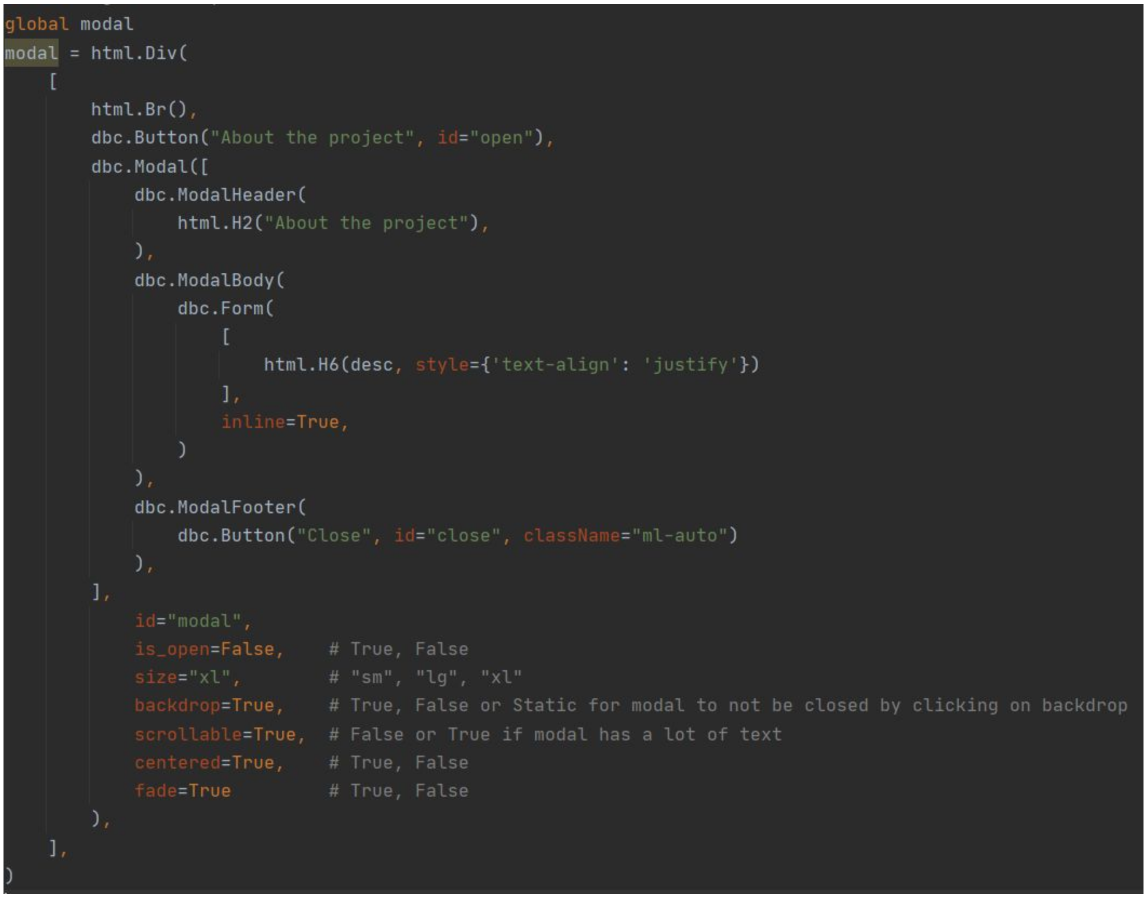
```
# Loading Circle and Declaring Graph
dcc.Loading(children=[html.Div(id="graph-object", children="Graph will be shown here")], type='circle',
            style={"backgroundColor": "transparent", "z-index": "1", "position": "absolute"}),
```

- **Adding Footer:** We have created a footer to store the information about the creator and Modal/Popup.



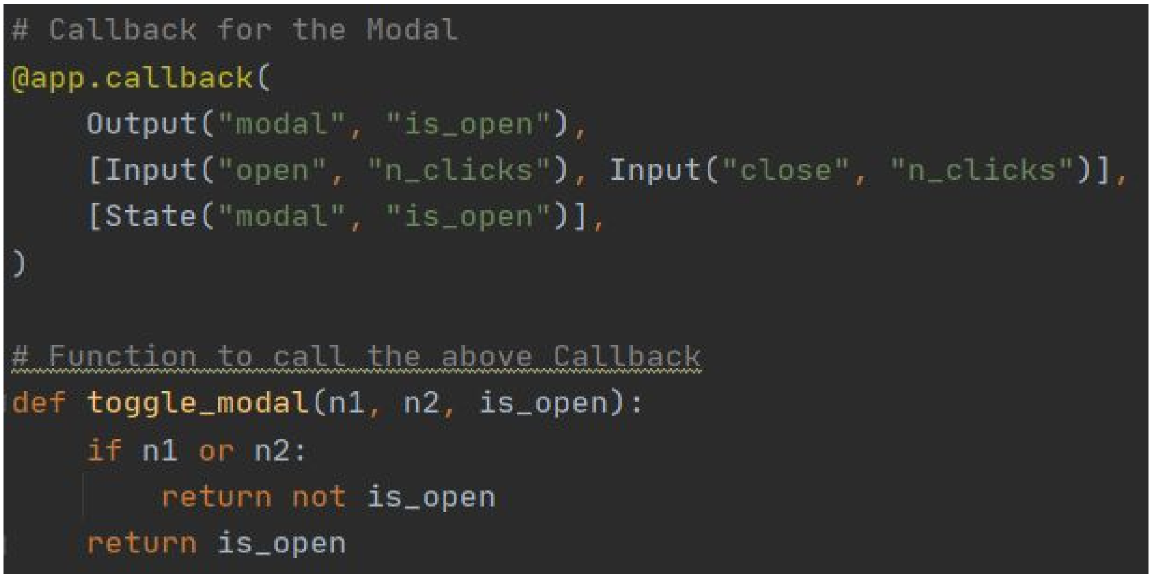
```
# Footer
html.Footer(id="footer",
            style={"padding-bottom": "1px"},
            children=[

                # Name of the creator
                html.H3(style={"text-align": "center"}, children=[
                    html.H3(children="Made by Sahil Rahman ", style={"display": "inline"}),
                ]),

                # Email of the creator
                html.H6(style={"text-align": "center"}, children=[
                    html.H6(children="Email: srjordon414@gmail.com", style={"display": "inline"}),
                ]),

                # Linkedin profile of the creator
                html.H6(style={"text-align": "center"}, children=[
                    html.H6(children="Linkedin: https://www.linkedin.com/in/sahilrahman/", style={"display": "inline"}),
                    html.Br(),
                    modal,

                ]),
                html.Br(),

            ]),
```

- **Making Modal/Popup:** I have added a modal or popup button that describes the overview of the application such as how to use the project, what the project is all about, what all tools have been used, Etc.



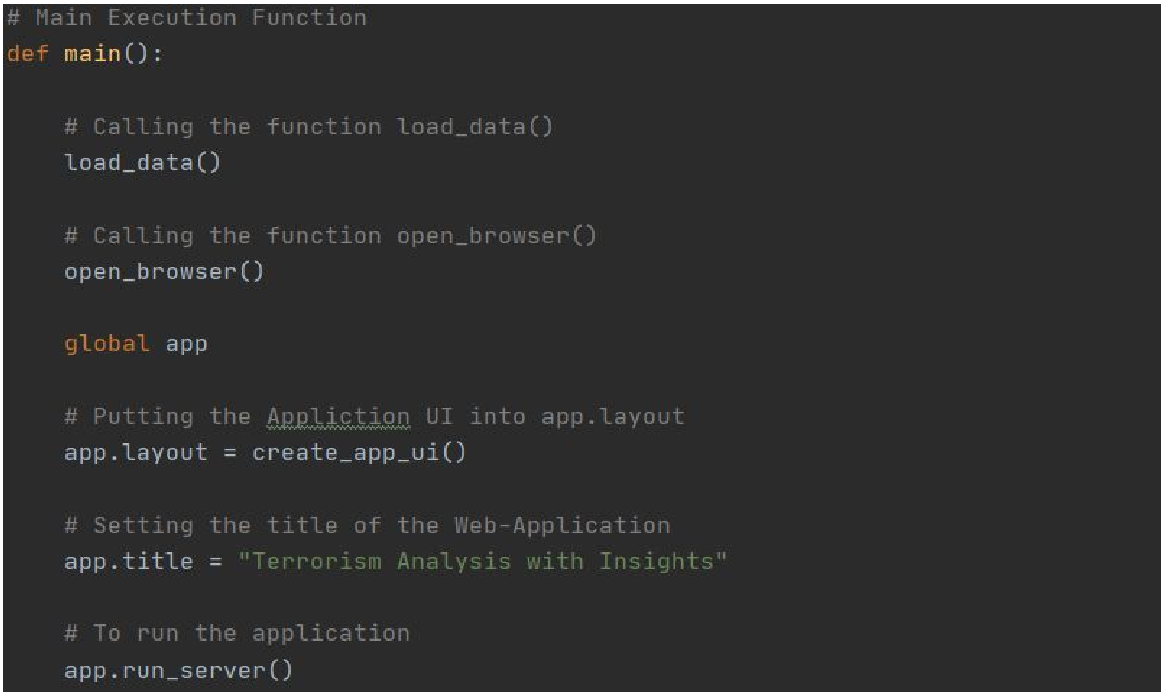
```
global modal
modal = html.Div(
    [
        html.Br(),
        dbc.Button("About the project", id="open"),
        dbc.Modal([
            dbc.ModalHeader(
                html.H2("About the project"),
            ),
            dbc.ModalBody(
                dbc.Form(
                    [
                        html.H6(desc, style={'text-align': 'justify'})
                    ],
                    inline=True,
                )
            ),
            dbc.ModalFooter(
                dbc.Button("Close", id="close", className="ml-auto")
            ),
        ],
            id="modal",
            is_open=False,    # True, False
            size="xl",        # "sm", "lg", "xl"
            backdrop=True,    # True, False or Static for modal to not be closed by clicking on backdrop
            scrollable=True,  # False or True if modal has a lot of text
            centered=True,    # True, False
            fade=True         # True, False
        ),
    ],
)
```

- **Creating callbacks to make our elements work:** Creating the functionality of each element in order to bring life to them.



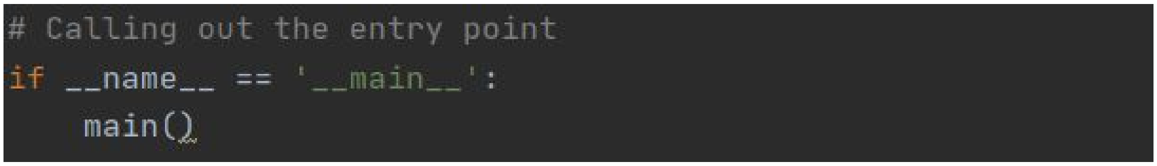
```
# Callback for the Modal
@app.callback(
    Output("modal", "is_open"),
    [Input("open", "n_clicks"), Input("close", "n_clicks")],
    [State("modal", "is_open")],
)

# Function to call the above Callback
def toggle_modal(n1, n2, is_open):
    if n1 or n2:
        return not is_open
    return is_open
```

- **Forming the main function:** Gathering all the functions into the main function section.



```
# Main Execution Function
def main():

    # Calling the function load_data()
    load_data()

    # Calling the function open_browser()
    open_browser()

    global app

    # Putting the Appliction UI into app.layout
    app.layout = create_app_ui()

    # Setting the title of the Web-Application
    app.title = "Terrorism Analysis with Insights"

    # To run the application
    app.run_server()
```

- **Calling the entry point:** Formed an entry point to run the application.

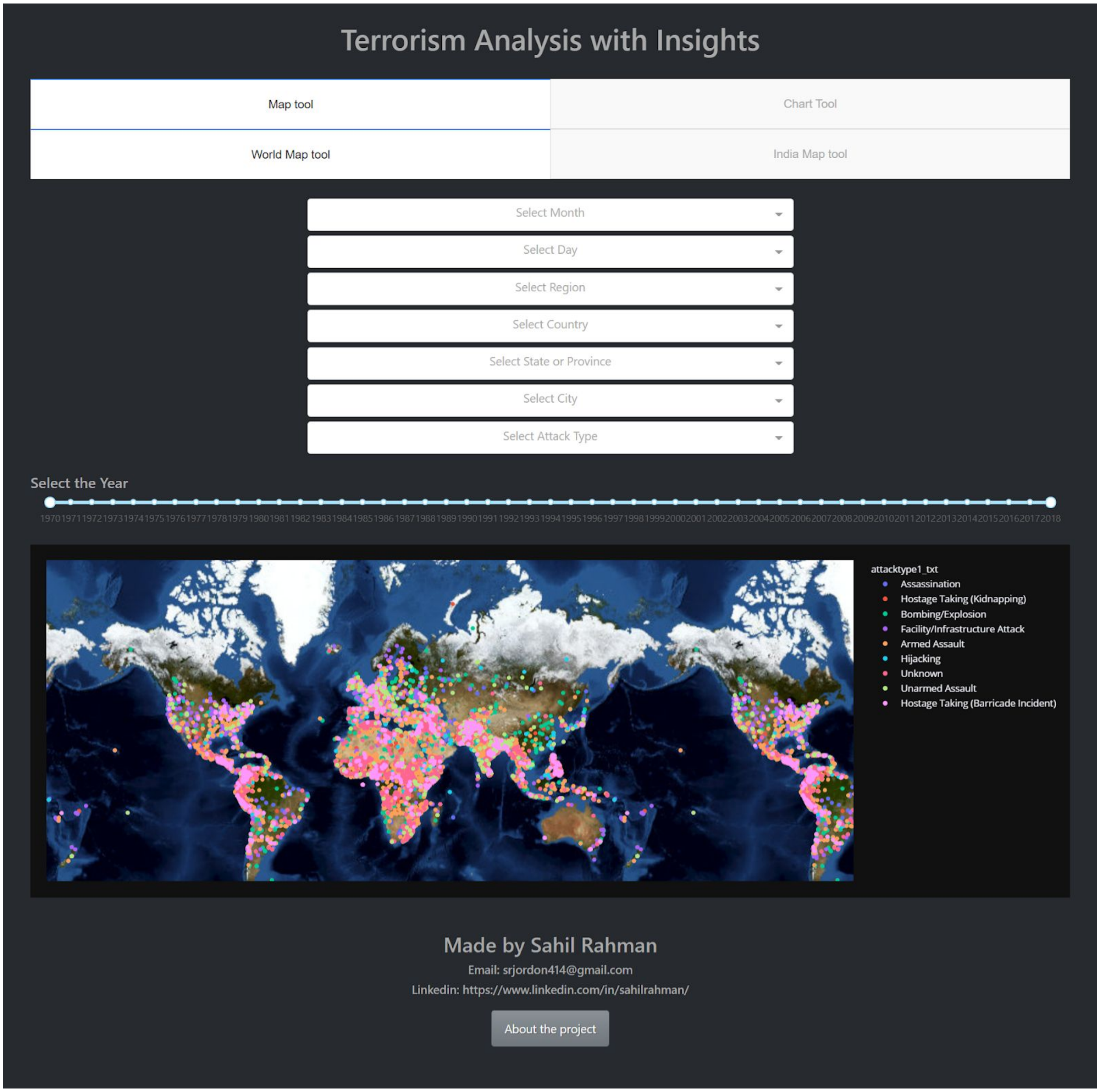


```
# Calling out the entry point
if __name__ == '__main__':
    main()
```

Results

The project has been successfully implemented and working fine. A glimpse of the UI of the project has been attached to have a better understanding of how the project looks when running on a live server.

1. Map Tool -> World Map Tool



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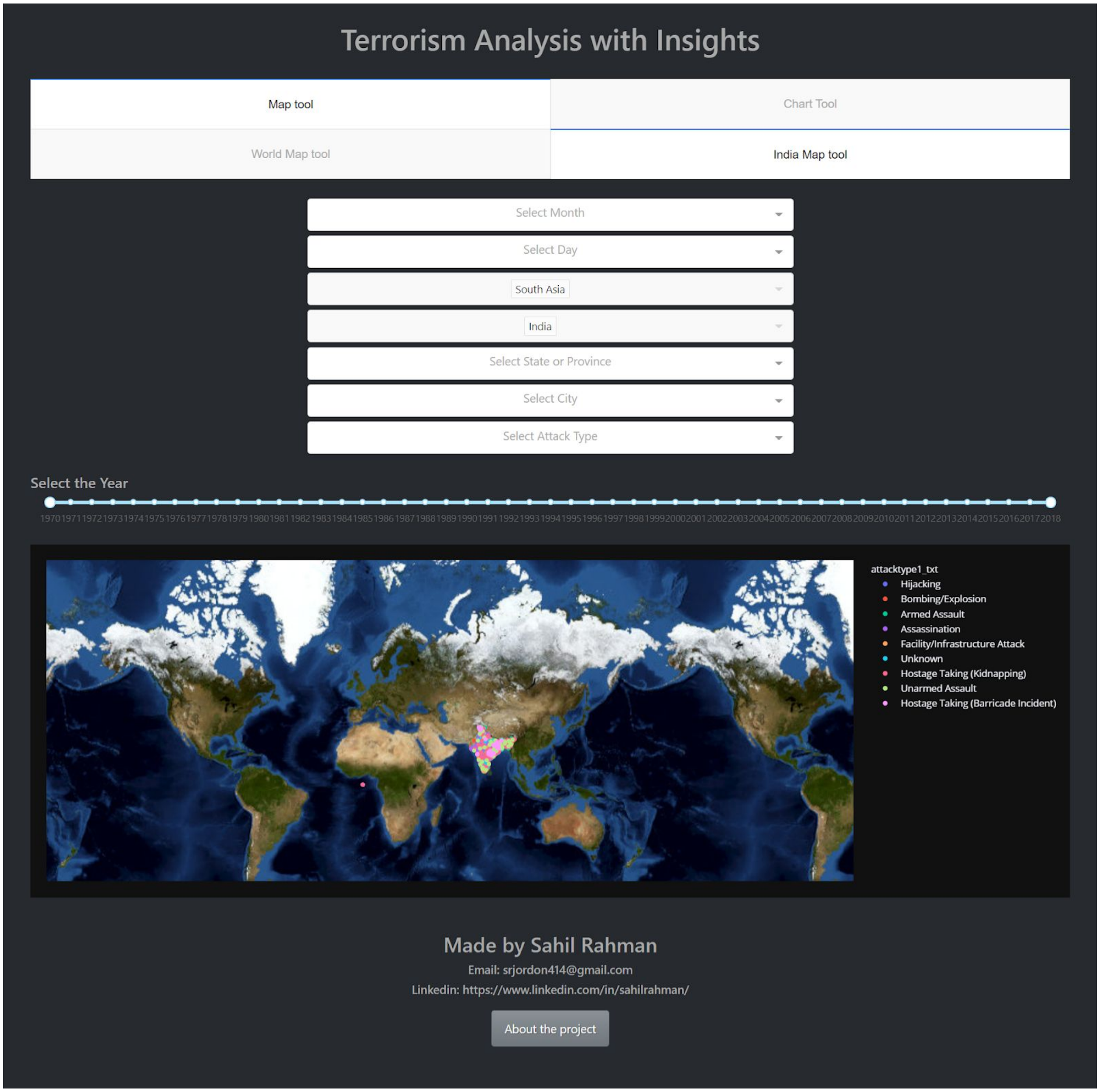
2. Map Tool -> India Map Tool



Terrorism Analysis with Insights

South Asia

India

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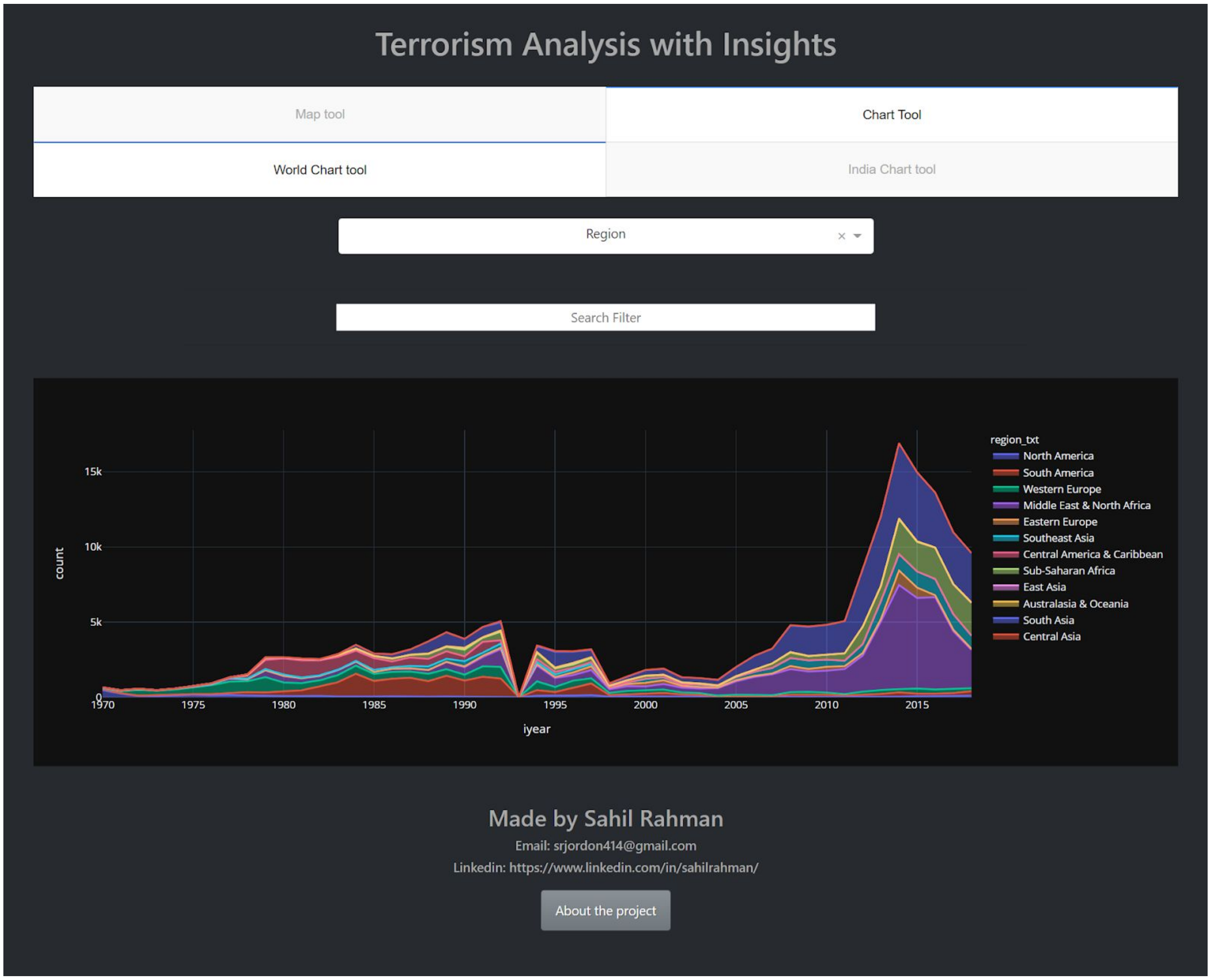
3. Chart Tool -> World Chart Tool



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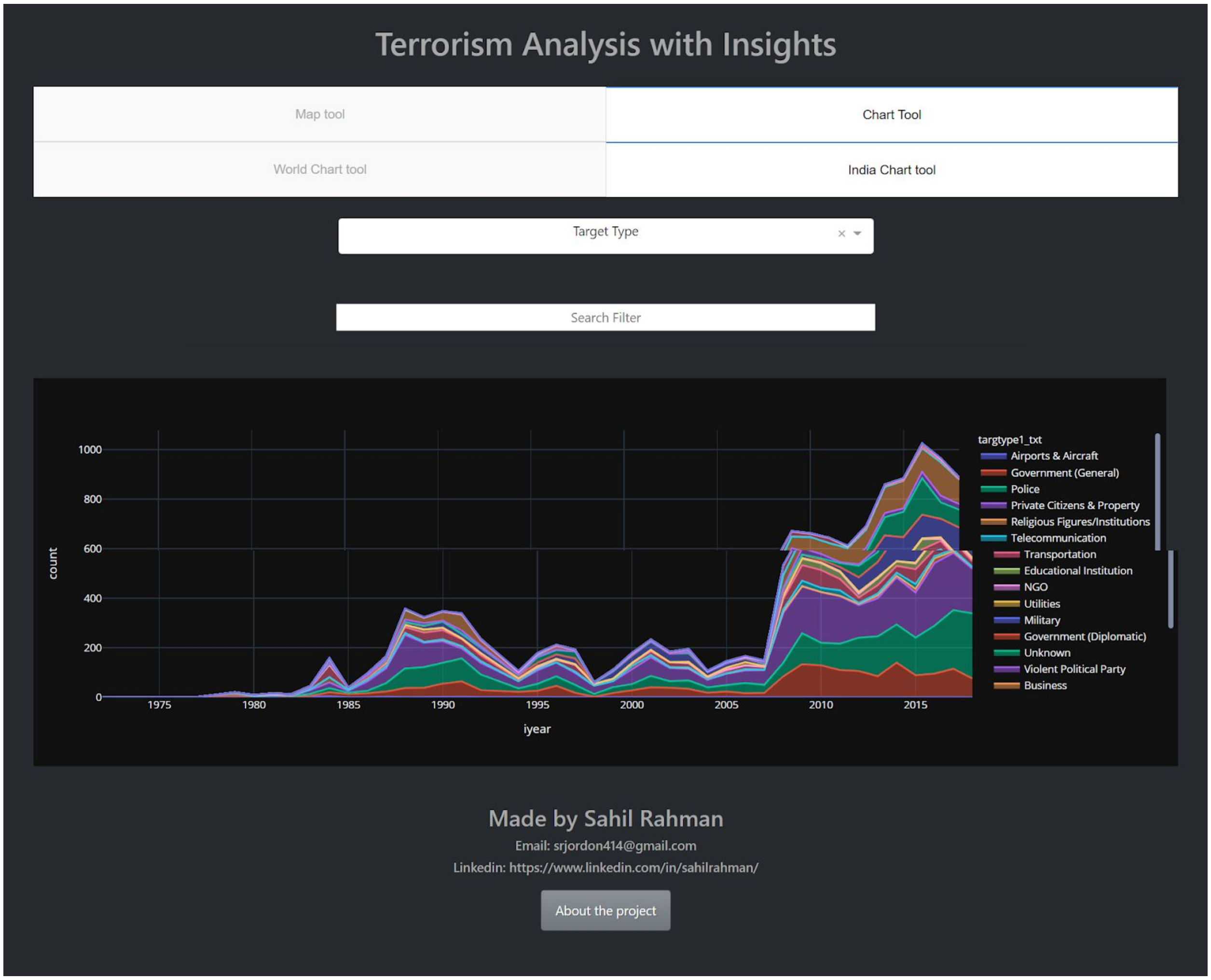
4. Chart Tool -> India Chart Tool



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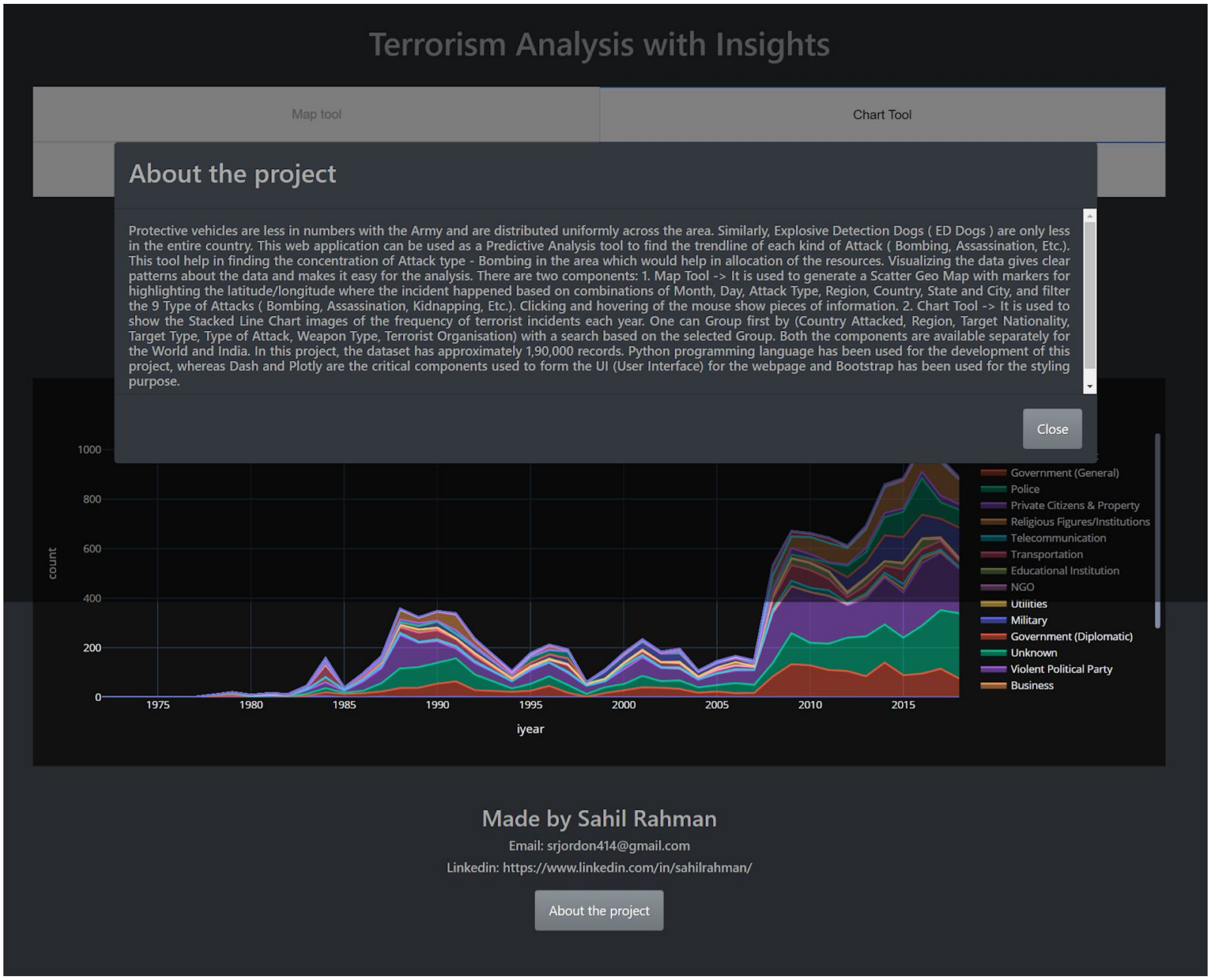
5. Modal/Popup



About the project

Protective vehicles are less in numbers with the Army and are distributed uniformly across the area. Similarly, Explosive Detection Dogs (ED Dogs) are only less in the entire country. This web application can be used as a Predictive Analysis tool to find the trendline of each kind of Attack (Bombing, Assassination, Etc.). This tool help in finding the concentration of Attack type - Bombing in the area which would help in allocation of the resources. Visualizing the data gives clear patterns about the data and makes it easy for the analysis. There are two components: 1. Map Tool -> It is used to generate a Scatter Geo Map with markers for highlighting the latitude/longitude where the incident happened based on combinations of Month, Day, Attack Type, Region, Country, State and City, and filter the 9 Type of Attacks (Bombing, Assassination, Kidnapping, Etc.). Clicking and hovering of the mouse show pieces of information. 2. Chart Tool -> It is used to show the Stacked Line Chart images of the frequency of terrorist incidents each year. One can Group first by (Country Attacked, Region, Target Nationality, Target Type, Type of Attack, Weapon Type, Terrorist Organisation) with a search based on the selected Group. Both the components are available separately for the World and India. In this project, the dataset has approximately 1,90,000 records. Python programming language has been used for the development of this project, whereas Dash and Plotly are the critical components used to form the UI (User Interface) for the webpage and Bootstrap has been used for the styling purpose.

Made by Sahil Rahman

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Software Improvements

Python programming language has been used for the development of this project, whereas Dash and Plotly are the critical components used to form the UI (User Interface) for the web page and Bootstrap has been used for the styling purpose.

IDLE: PyCharm Professional

Language: Python v3.8

Libraries: Plotly v4.10.0, Pandas v1.1.2, Time, Webbrowser

Framework: Dash v1.16.0

RAM: 4GB (8GB recommended)

OS: Windows, Mac OS, Linux

Browser: Google Chrome, Mozilla Firefox, Microsoft Edge, Opera

Conclusion and Future Work

In conclusion, I may say that the project required a lot of effort and time to get completed. The project meets the client's expectations and performs well enough to fulfill the task for what it has been developed. As the requirements vary, future enhancement and improvement can be carried out accordingly.

Acknowledgement

First and foremost, praises and thanks to God, the Almighty, for His showers of blessings throughout my project work to complete the project successfully.

I would like to express my deep and sincere gratitude to my project guide, Dr. Sylvester Fernandes, Co-Founder Forsk Technologies, for giving me the opportunity to do the project and providing invaluable guidance throughout this project. His dynamism, vision, sincerity and motivation have deeply inspired me. He has taught me the methodology to carry out the project and to present the project works as clearly as possible. It was a great privilege and honour to work and study under his guidance. I am incredibly grateful for what he has offered me. I would also like to thank him for his friendship, empathy, and a great sense of humour. I am extending my heartfelt thanks to him for their acceptance and patience during the discussion I had with him on project work and thesis preparation.

I am incredibly grateful to my parents for their love, prayers, caring, and sacrifices for educating and preparing me for my future. Also, I express my fellow mates for their support and valuable time they provided in order to complete this project successfully.

Finally, my thanks go to all the people who have supported me to complete the research work directly or indirectly.

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Galgotias University,
Greater Noida, UP

Reference

1. Plotly (Dash) - https://dash.plotly.com/
2. PyPi - https://pypi.org/project/dash/
3. Medium - https://medium.com/plotly/introducing-dash-5ecf7191b503
4. Datacamp - https://www.datacamp.com/community/tutorials/learn-build-dash-python
5. Data Science Tutorials (YouTube) - https://www.youtube.com/watch?v=Ma8tS4p27JI&list=PLH6mU1kedUy8fCzkTTJlwsf2EnV_UvOV-
6. Charming Data (YoutTube) - https://www.youtube.com/watch?v=UYH_dNSX1DM&list=PLh3I780jNsiSvpGtPucq4yusBXVt3SL2Q
7. Adriano Yoshino (YouTube) - https://www.youtube.com/watch?v=f2qUWgq7fb8

Biography

I am Sahil Rahman, a final year undergraduate student pursuing BTech Engineering in the field of Computer Science from Galgotias University, Greater Noida. I live in New Delhi, the capital of India. I have completed my schooling from New Delhi itself from The Frank Anthony Public School, Lajpat Nagar. During the duration of my course, I have cultivated a keen interest in the field of Data Science and Machine Learning. My passion for Data Science pushed me to do numerous Internships along with a handful of industrial projects. With so much experience in this field, I am confident enough to possess the right and accurate skills at collecting, analyzing, interpreting large datasets and performing data management tasks. I firmly believe that knowledge and experience are the two significant factors that enhance an individual's ability. Under the guidance of company's professionals, I can contribute to the company's success using my extensive analytical skills.

I am a hard worker, always ready to accept challenges. I am good at my academics well equipped with enough practical knowledge in diverse fields. Learning and improving new skills is my passion for which I can devote my 100%. Apart from academics, I am good at many things. I believe patience and time management are my biggest strengths which are absolutely essential. I have got good grasping skills. I have always tried my best to deliver the best to achieve the goal with full commitment, passion and hard work.