CSCE 5320: Scientific Data Visualization
Increment-1

Group number: 12

Github link:

https://github.com/TogaruPravalika/DV_Visualizing-the-impact-of- climate-change-on-global-agriculture

Project Title:

VISUALISING THE IMPACT OF CLIMATE CHANGE ON GLOBAL AGRICULTURE

Team Members:

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Goals and Objectives:

MOTIVATION:

The goal of "Visualizing the Effect of Climate Change on Global Agriculture" is to increase public understanding of how climate change may affect the world's food supply and agricultural output. Worldwide variations in temperature, precipitation patterns, and extreme weather events are already having an impact on agricultural productivity, resulting in lower crop yields, food shortages, and higher food costs.

This project can assist policymakers, farmers, and other stakeholders in better understanding the potential risks and challenges associated with climate change and in developing strategies for adapting to and mitigating these impacts by visualizing data on the impact of climate change on global agriculture. The project can also aid in educating the general public about the significance of taking action on climate change and the part that agriculture plays in tackling it.

The ultimate objective of this project is to employ data visualization and analysis to enhance efforts to address the effects of climate change on agriculture and food security and to encourage more informed decision-making.

SIGNIFICANCE:

"Visualizing the Effect of Climate Change on Global Agriculture" is significant because it has the ability to raise awareness of how climate change is affecting food security and agricultural output around the world. Millions of people around the world depend on the agricultural sector as a source of food and a living. Nonetheless, the implications of climate change on agriculture are already evident in many areas and are anticipated to worsen with time.

This project can assist policymakers, farmers, and other stakeholders in better understanding the potential risks and challenges associated with climate change and in developing strategies for adapting to and mitigating these impacts by visualizing data on the impact of climate change on global agriculture. For instance, illustrating the effects of changes in temperature and precipitation on crop yields can assist farmers in selecting the right crops to plant at the right time, and illustrating the effects of extreme weather events can assist policy makers in preparing for and responding to disasters like floods and droughts.

Also, this project has the ability to increase public awareness of how critical it is to address climate change and its effects on food security worldwide. This initiative can assist in educating the public about the need for climate action and the part that agriculture plays in combating global climate change by providing data in an understandable and interesting way.

In general, this project's significance lies in its potential to use data visualization and analysis to foster more informed decision-making, to support initiatives to address the impacts of climate change on agriculture and food security, and to increase public awareness of the significance of addressing climate change.

OBJECTIVES:

The following could be the major goals of "Visualizing the Effect of Climate Change on World Agriculture":

To gather and evaluate information on how climate change is affecting crop yields, frequency and intensity of extreme weather events, temperature and precipitation patterns, and other aspects of global agricultural production. To create interactive data visualizations that let consumers explore and comprehend the intricate connections between ag productivity, food security, and climate change.

To use the data visualizations to support more informed decision-making by policymakers, farmers, and other stakeholders and to increase awareness of the possible effects of climate change on global agriculture and food security.

To find important patterns and trends in the data that might guide management and policy choices targeted at reducing the effects of climate change on agriculture and food security.

Assist initiatives to increase climate resilience in the agricultural sector by giving decision-makers data and insights that can aid in their ability to foresee and address risks and issues related to the climate.

The overall goals of this project are to better understand the effects of climate change on global agriculture through data visualization and analysis, and to support efforts to increase climate resilience in the agricultural sector through well informed decision-making and targeted actions.

FEATURES:

This web application offers a range of features that make it a unique and useful tool for consumers. One of the key features is,

Interactive mapping: By the use of an easy-to-use, interactive map-based interface, users would be able to investigate how climate change may affect crop yields and agricultural production in various parts of the world.

Use mapping applications like Google Maps API to build an interactive map that overlays information on crop yields, temperature, and other pertinent variables over a global or regional map to implement this functionality. We also include a slider that enables users to compare data from various years or scenarios, interactive legends, and colour scales that let people examine the data in various ways to make the mapping function more engaging.

Interactive data visualizations, Customizable parameters, Real-time data updates, Multiple data sources, Accessibility, Educational resources these are the features that need to be added.

Overall, incorporating an interactive mapping feature into the "Visualizing the Impact of Climate Change on Global Agriculture" project could offer a useful tool for examining how climate change is affecting agriculture in various parts of the world and for using data to guide decisions about how to tackle climate change challenges.

INCREMENT-2:

INTRODUCTION:

Domain:

DOMAIN SITUATION	DOMAIN USERS
Group of users	Farmers, Agricultural workers, Agricultural suppliers, Agriculture policy makers, Agricultural scientists
Target Domain	Production of food, fiber, agricultural products

Group of Users:

Farmers: Farmers are in charge of cultivating crops and keeping animals to create food and other agricultural goods, which make them the primary consumers of agricultural land and resources.

Agricultural workers: These are the people who carry out various tasks like planting, harvesting, and caring for animal life on farms and in other farms.

Agricultural Suppliers: They are the companies and groups that offer farmers equipment, transportation services, fertilizer, seeds, and other inputs and services.

Agriculture Policy makers: These are the government officials and decision-makers who develop and implement laws and regulations related to agriculture, such as agreements about trade, land use laws, and food safety standards.

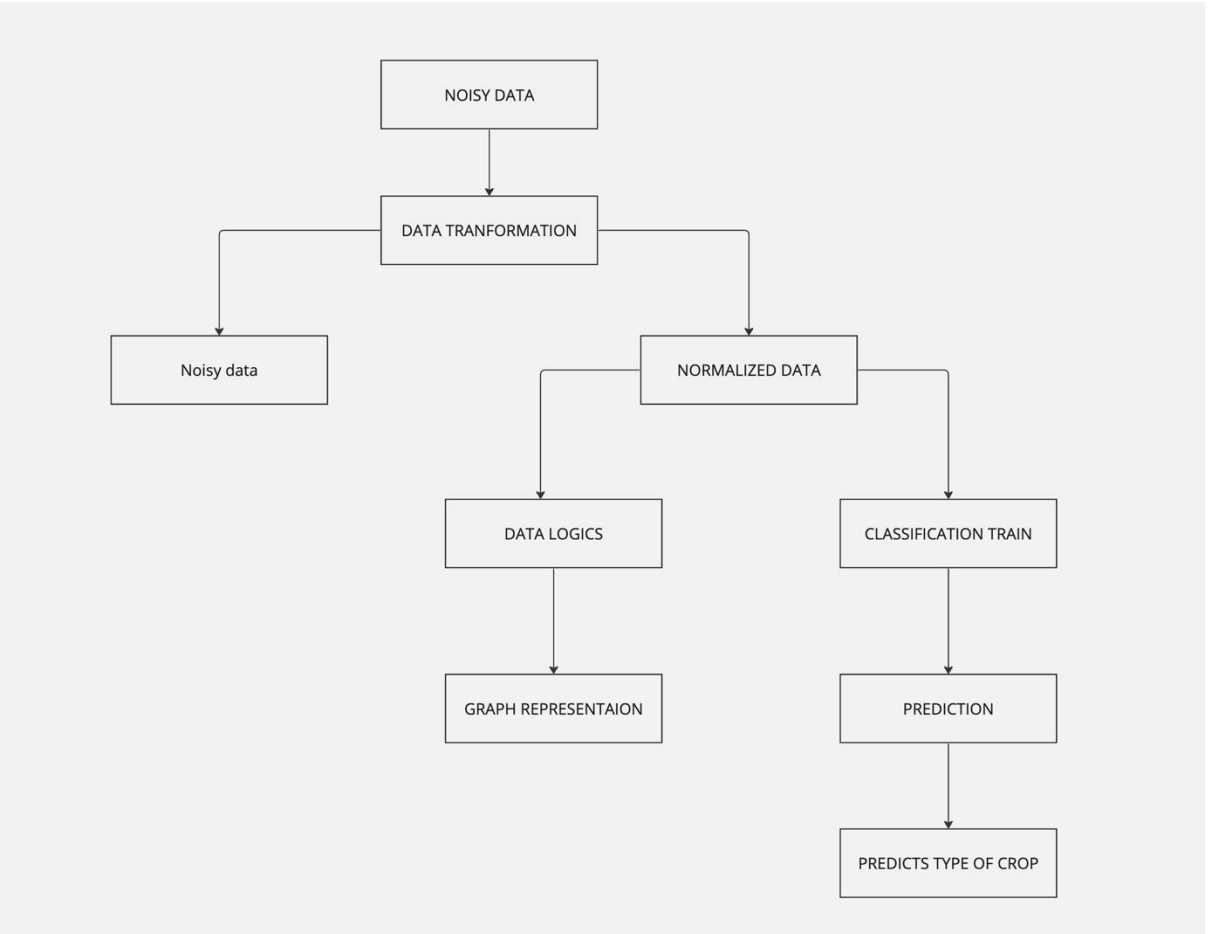
Agricultural scientists: They are the scientists and researchers who are working to create new agricultural technology and processes in order to increase crop yields, decrease waste, and take care of environmental issues.

Target Domain:

- To meet the increasing requirement of the worldwide population, sustainable production of food, fiber, and other agricultural products is the primary objective of global agriculture.
- This involves using productive agricultural methods that enhance food security, rural livelihoods, and economic growth while reducing the negative impact on the environment.
- Reducing greenhouse gas emissions, improving water management, preserving biodiversity, and boosting soil health are just a few of the issues that must be resolved for agriculture to be sustainable.
- It includes making investments in research and innovation to create new technology and processes that can raise crop yields, lower waste, and meet the social and economic demands of farming communities.

- Global agriculture has to ensure that food is available, inexpensive, and nutritious, as well as that it is produced and delivered in ways that are socially and environmentally responsible in addition to providing enough food to feed the world's expanding population.
- In general, a reliable and sustainable food system that satisfies present demands without compromising the ability of future generations to meet their own needs is the target domain for global agriculture.

Workflow diagram with explanation:



In the work flow diagram we use the agri.csv file to visualize and predict the crop type. The data gathered from the Kaggle which consist of 6 attributes, Which describes how climate conditions affect the crop growth and yield percentage. With this data we can analyse how the climate factors are affecting the agriculture growth. After data gathering process, the data transformation process begins. In this process there are 25000 rows of data which need to be normalised to avoid disturbance in data we need to remove null values. For the data transformation process we have used the python pandas module to normalise the data. Normalising data helps us to give accurate results while building data algorithms, Normalising data processes involves removing and adding columns to get meaningful data.i.e, duplication of data ,removing any inconsistency or irregularities and bringing it to a standard format that is suitable for analysis. Overall normalization data helps to ensure the data is accurate and reliable . it helps to identify patterns and trends in the data. If not we can face inconsistency error. Once the data transformation data process is done the normalised data is dumped in the API, And then data drag form the API to write the logics in java script which is a powerful language to get the data in the sequential order. From the data algorithm function we will call those functions in the UI, In data algorithm functions we have organised the data, We will call the data algorithm function to google charts and chart.js which helps us to Visualise the data in Graphical representation. In the second increment we added lets predict analysis to get the type of predicted crop by filtering the various condition.

Background:

In The project work the linked references are mention below which we collected the data and analysed from the specific websites.

https://journals.ametsoc.org/view/journals/wcas/12/1/wcas-d-19-0049.1.xml

Adaptations made to meet these perceived risks range widely, and farmers' views of climate- and weather-related risk span ecological and economic considerations. According to Niles et al. (2015), local-level limiting variables like water or temperature impacts had an impact on farmers' readiness to embrace adaptation techniques when it came to coping with climate change. This finding highlights the significance of spatial context and climatic impacts for farmer adoption. In the specific link we gather the data for path of the direction of over time (comparison of trajectories) is a general task in the analysis. Under the different conditions its necessary to compare each trajectory to a certain references trajectory. These comparison task involves the observing, analysing the overtime data and analysis of the distributed data in the different years.

https://www.mdpi.com/2071-1050/13/3/1318

Climate change is projected to worsen in the upcoming future. Agriculture is under a lot of pressure to provide for the world's food and nutritional security, and the situation is getting worse as a result of climate change. Even though the scenario for the future climate and its potential effects are unpredictable, numerous studies have found that climate change would reduce agricultural productivity in the years to come. Temperature, precipitation, and greenhouse gas emissions from human activity have a major negative impact on plant metabolism, soil fertility and plant physiology. To counteract the negative effects of climate change on the sustainability of agriculture, a few mitigation and adaption measures have been developed.

Bello, O. B., O. T. Ganiyu, M. K. A. Wahab, M. S. Afolabi, F. Oluleye, S. A. Ig, J. Mahmud, M. A. Azeez, and S. Y. Abdulmaliq. "Evidence of climate change impacts on agriculture and food security in Nigeria." International Journal of agriculture and Forestry 2, no. 2 (2012): 49-55.

In this specific link we observed the climate relies on the social, cultural, geographic, and economic context of the nation. Nigeria has a variety of climates, from the sahel climate in the north to the tropical rainforest environment along the beaches, depending on its location, size, and relief features. Additionally, the threat posed by climate change extends beyond a nation's ability to sustain its socioeconomic activities to the entirety of human existence.

Robert Mendelsohn, Chapter 60 Past Climate Change Impacts on Agriculture, Editor(s): R. Evenson, P. Pingali, Handbook of Agricultural Economics, Elsevier, Volume 3, 2007, Pages 3009-3031, ISSN 1574-0072, ISBN 9780444518736, https://doi.org/10.1016/S1574-0072(06)03060-X. (https://www.sciencedirect.com/science/article/pii/S157400720603060X)

These paper examines the likely impact on agriculture of the climate change which has already taken place between 1960 and 2000. Future climate changes which are expected to be much larger, may well have very different effects than past climate changes. Through this references we even predicts the types of crops.

Data Abstraction:

Data abstraction consists of the data which is needed to implement in the project by removing the unnecessary details and unnecessary data where it highlights only the data which is relevant to our particular task and operations.

Dataset: In this project we have used various datasets to show the visualisations more precisely and accurately from different countries throughout the world.

The datasets we used here are country dataset, different types of crops dataset, season dataset, yield percentage from last 3 years dataset, year, Waterlevel, temperature. All the dataset we have taken in this project is taken from the past 3 years.

Types and attributes:

- Country
- Crop Type
- Season
- Yield Percentage
- Year
- Water Levels
- Temperature

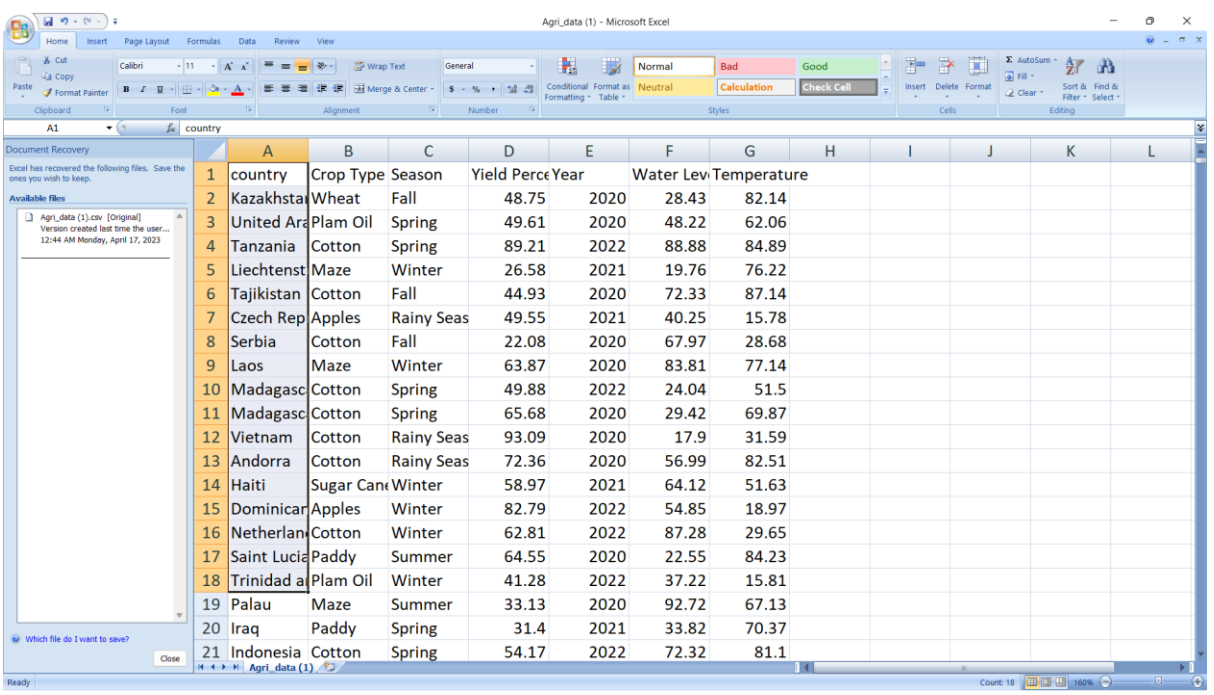
1. Country - In the taken dataset there are 13 country data .
2. Crop Type - In which country which type of crop type of crop is growing .
3. Season - It indicates the seasons data of the each country.
4. Yield Percentage - How the production of every crop in the 13 different country .
5. Year - It indicated 3 years of the data .
6. Water Levels - It indicated the water level of the each country .
7. Temperature- It indicates different temperature respective to their countries.

Attribute Name	Data Type
Country	String
Crop Type	String
Season	String
Yield percentage	Float or Decimal
Water levels	Float or Decimal
Temperature	Float or Decimal

Detailed description of dataset:

We have derived the attributes from the dataset mentioned above like country, crops, season, yield, year, waterlevel, temperature. Each attribute consists of the particular data on average of 3 years.

The first dataset is about the country data and the attribute is named as country.



	A	B	C	D	E	F	G
1	country	Crop Type	Season	Yield Perce	Year	Water Levi	Temperature
2	Kazakhstar	Wheat	Fall	48.75	2020	28.43	82.14
3	United Ara	Plam Oil	Spring	49.61	2020	48.22	62.06
4	Tanzania	Cotton	Spring	89.21	2022	88.88	84.89
5	Liechtenst	Maze	Winter	26.58	2021	19.76	76.22
6	Tajikistan	Cotton	Fall	44.93	2020	72.33	87.14
7	Czech Rep	Apples	Rainy Seas	49.55	2021	40.25	15.78
8	Serbia	Cotton	Fall	22.08	2020	67.97	28.68
9	Laos	Maze	Winter	63.87	2020	83.81	77.14
10	Madagasc	Cotton	Spring	49.88	2022	24.04	51.5
11	Madagasc	Cotton	Spring	65.68	2020	29.42	69.87
12	Vietnam	Cotton	Rainy Seas	93.09	2020	17.9	31.59
13	Andorra	Cotton	Rainy Seas	72.36	2020	56.99	82.51
14	Haiti	Sugar Cane	Winter	58.97	2021	64.12	51.63
15	Dominican	Apples	Winter	82.79	2022	54.85	18.97
16	Netherlan	Cotton	Winter	62.81	2022	87.28	29.65
17	Saint Lucia	Paddy	Summer	64.55	2020	22.55	84.23
18	Trinidad a	Plam Oil	Winter	41.28	2022	37.22	15.81
19	Palau	Maze	Summer	33.13	2020	92.72	67.13
20	Iraq	Paddy	Spring	31.4	2021	33.82	70.37
21	Indonesia	Cotton	Spring	54.17	2022	72.32	81.1

Fig1: Data file1

This dataset shows the data about different parts of the country all over the world. It consists of data of nearly 25000 rows with 7 columns. This country dataset consists of the data according to the other attributes respectively. Each country has different crop production according to their country's climate.

The second dataset is about crop type.

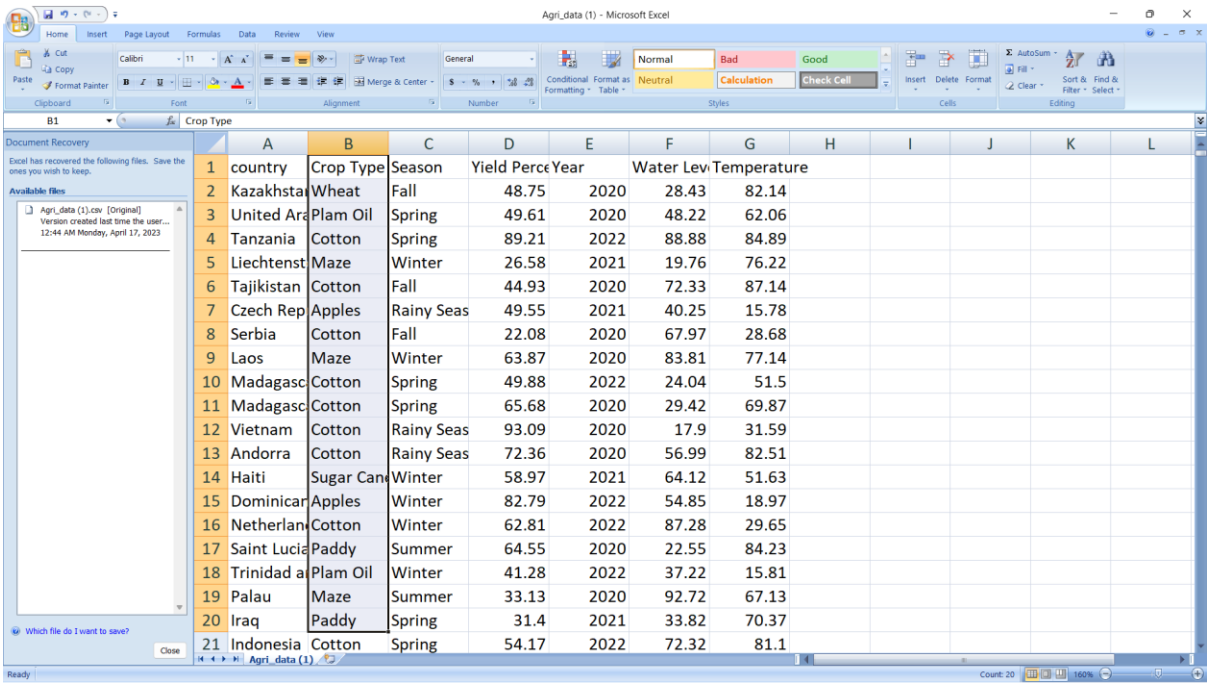


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Fig2: Data file2

This dataset consists of data about different types of crops data on an average of 3 years. It consists of different crops like wheat, palm oil, cotton, maize, apples, paddy, rice etc.This will show which crops need to be yielded on a seasonal basis.

Different crops have different requirements and it needs all the factors like temperature, water, soil type etc. And also farmers decide about the crop type according to the market demand they will produce different crops. If the profits are high to the particular crop then they will harvest the particular crop.

The third dataset is about the season.

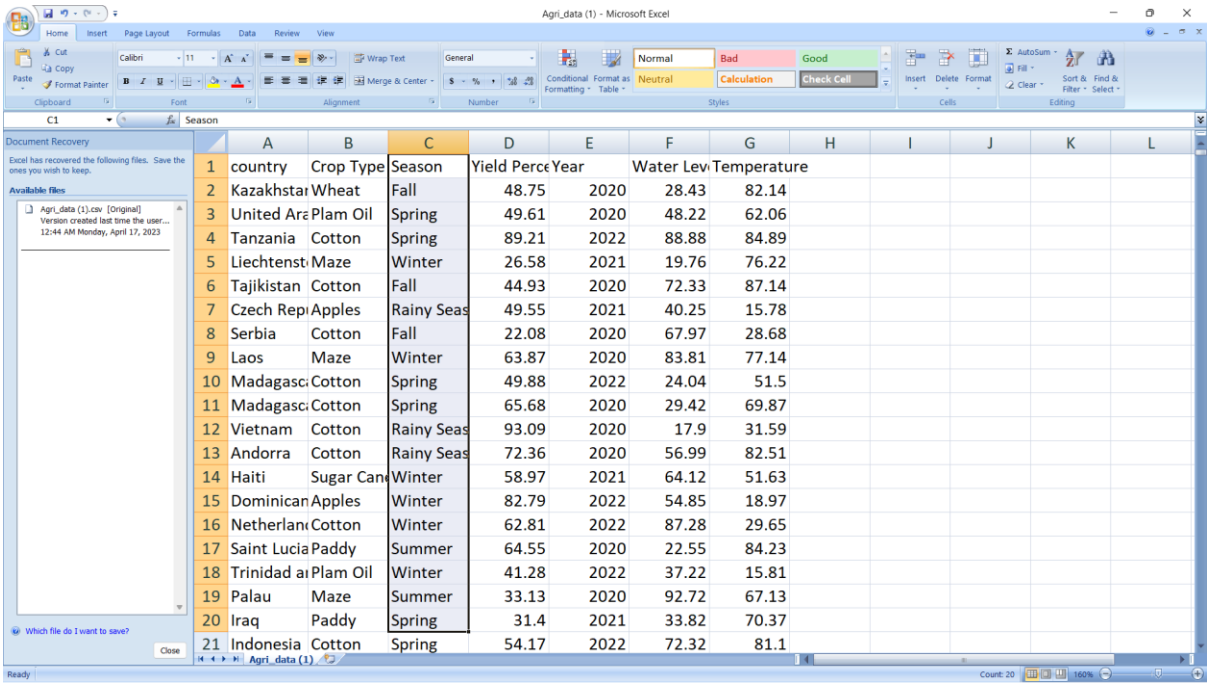

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Fig3: Data file3

According to the climatic conditions the respective plants are harvested and moreover the irrigation facilities within that region also plays a vital role. According to the particular seasons farmers will plan which type of plants need to be harvested and they will get know about the yearly wise data to take an estimation whether that particular crop has good yield percentage and good outputs income wise.

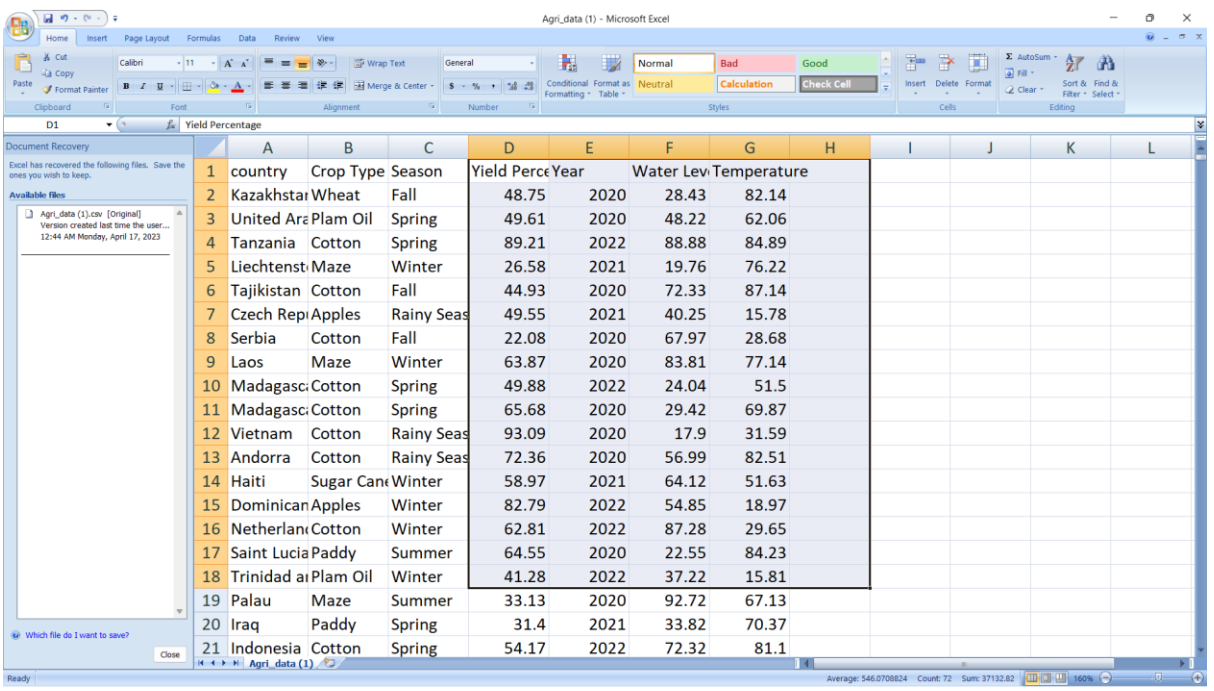

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Fig4: Data file1

This dataset explains the yield percentage where farmers can have the estimation like what is the yield percentage on average of three years. In these we have included 25000 rows and 4 columns for representing the data. All this data is numerical data which consists only of number data. Water level and temperature values shown here are calculated according to celsius. The year column consists of data of 3 years like 2020, 2021, 2022. These all factors are the important factors where farmers focus mostly on these factors.

The other attributes are yield percentage, year, Water level, temperature.

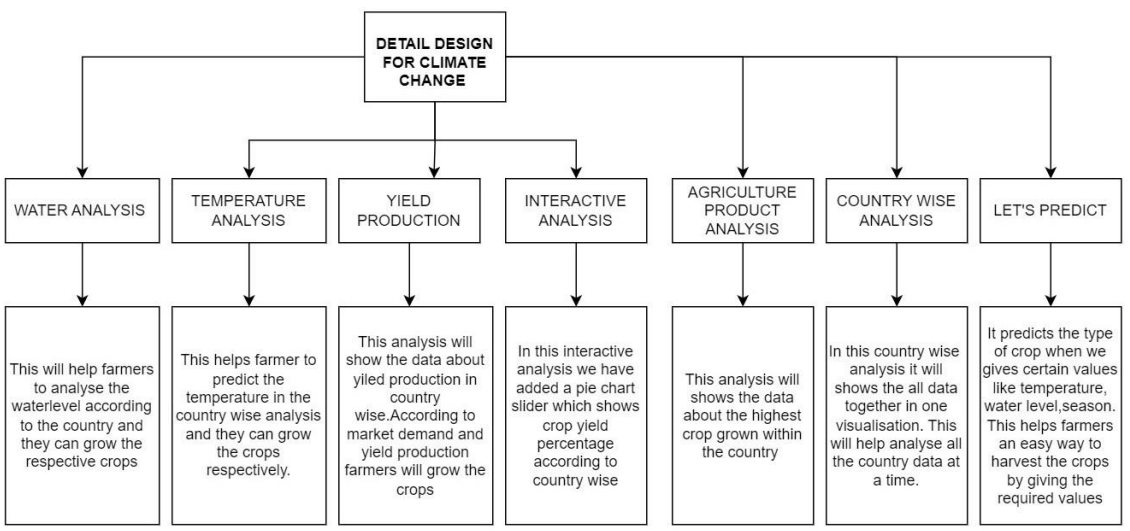
The yield percentage is an important factor that shows the productivity of particular crops and it will also show the evaluation of pests, fertilisation and other factors. It measures the crop produced as per the input given by the farmer.

Continuous monitoring of the year is mandatory to estimate the harvesting of the crops. This will help to estimate the crop performance year to year and also shows the market demands and other trends.

Water Level measures the availability of water in the soil. This is the key for the crops yield and growth. But due to various factors the water is polluted and getting contaminated. So the farmers will monitor the environment of the water area and go for the harvesting of the crop.

Temperature is also important in agriculture. The coldness or hotness will affect crop yield percentage if it is more than expected. Monitoring this at every level is needed for crop production.

Detail Design of Features with diagram:



In the above diagram it will show clearly about the analysis of each and every attribute which we give. By this farmers can predict some analysis and estimate their crops by visualising all the data which we are visualising in this project. Water Level analysis shows the availability of water in the soil. This is the key for the crops yield and growth. But due to various factors the water is polluted and getting contaminated. So the farmers will monitor the environment of the water area and go for the harvesting of the crop.The yield analysis is an important factor that shows the productivity of particular crops and it will also show the evaluation of pests, fertilisation and other factors. Temperature analysis is also important in agriculture. The coldness or hotness will affect crop yield percentage if it is more than expected. Monitoring this analysis at every level is needed for crop production. We have added a special feature which predicts the crop type when we give the certain values like water level, temperature, country then it will predict the crop type so that the farmer will go with this kind of prediction and they will harvest that particular crop for better yield production.

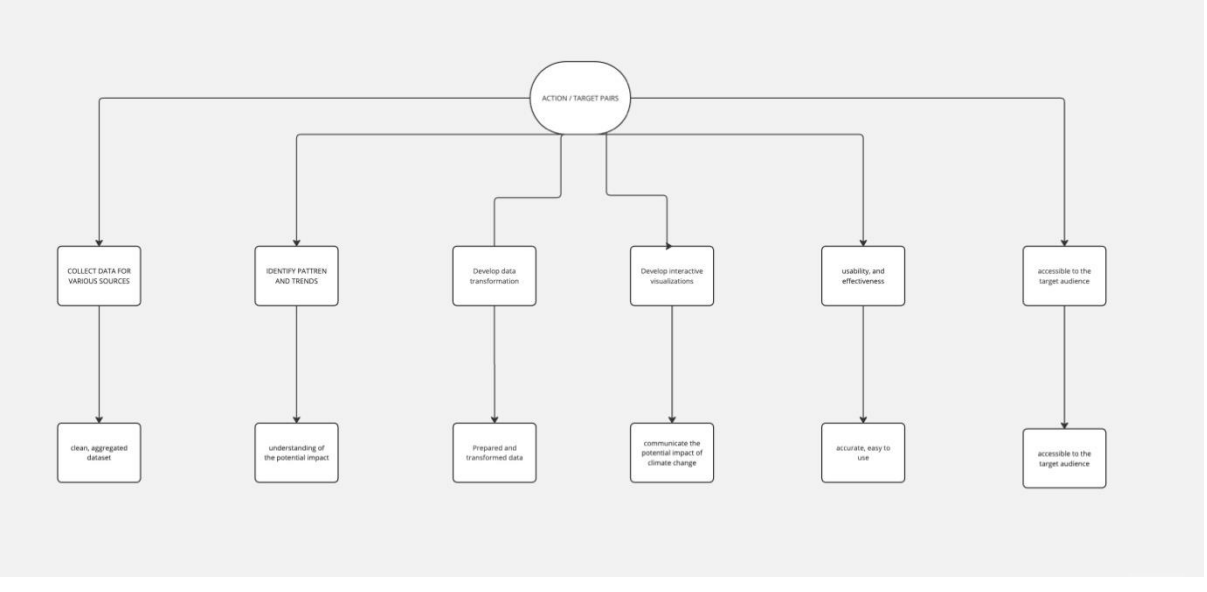
Data Transformation:

After the data gathering process, the data transformation process begins. In this process there are 25000 rows of data which need to be normalised to avoid disturbance in data we need to remove null values. For the data transformation process we have used the python pandas module to normalise the data. This process will remove the raw data and keep the necessary data. As we have a large dataset we need to normalise the data. While considering the dataset as a factor we need to pre process the data for better output. Missing values or incorrect values will be removed in this process.

Normalising data helps us to give accurate results while building data algorithms, Normalising data processes involves removing and adding columns to get meaningful data. It improves the quality and usefulness of data.

TASK ABSTRACTION:

Flow Diagram:



Action1: Take action by gathering information on the weather and agricultural production from a variety of sources, including NASA, the FAO, and the IPCC.
Target: The desired outcome is a tidy, aggregated dataset that can be analysed and visualized.

Action2: Determine patterns and trends in temperature, precipitation, crop yield, and other pertinent factors by analysing climate and agricultural production data.
Target: Gain knowledge and comprehension of how climate change may affect agriculture worldwide.

Action3: Develop data transformation pipelines, using methods like normalization, data aggregation, and data restructure, to get the data ready for visualization.
Target: Data that has been cleaned up and transformed and is ready for visualization.

Action4: Develop interactive visualizations, such as heat maps, line charts, scatter plots, and choropleth maps, that enable users to explore and comprehend how climate change is affecting global agriculture.
Target: Clear and understandable interactive visuals that convey the possible effects of climate change on world agriculture.

Action5: Refine the visuals as necessary by testing them for accuracy, usability, and efficacy in conveying the effects of climate change on global agriculture.
Target: Accurate, user-friendly, and effective visualizations that can accurately convey how climate change can affect food production around the world.

Action6: Create a web or mobile platform to make the visualizations available to the target audience, which includes researchers, policymakers, and other stakeholders.
Target: Deployed visualizations that may be used to guide research, policy decisions, and other initiatives relevant to global agricultural and climate change that are accessible to the target audience.

Tasks Description:

This creates visualization that explains the potential impact of climate change on global agriculture. It should displays different or various climate variables, such as temperature, water level which is effects on the crop production throughout globally. The visualizations is interactive and allowing users to explore different scenarios and outcomes based on the various levels factors. The target audience for this visualization includes policymakers, researchers and other stake holders who are interested in understanding the critical impacts of climate change which addresses impacts. The data which we used should be up-to-date from reliable scientific studies. The depiction should also be educational and aesthetically pleasing in order to raise awareness and comprehension of the potential effects of climate change on world agriculture.

The different tasks with related action, target pairs in our project:

TASK ID	ACTION	TARGET
1	COMPARE	TRENDS
2	COMPARE	TRENDS
3	LOCATE	OUTLIERS
4	COMPARE	TRENDS
5	COMPARE	TRENDS
6	ANALYSIS	PREDICT

Task 1- we gathered information on each nation's water supply for a period of three years. Water levels were tracked using stacked bar analysis for three years. We will learn how much water each country has access to in order to maximize crop yields. The graph displays annual percentage changes in temperature. As it promotes healthy plant growth and increases yield, water is an invaluable resource.

Task 2- Using a stacked bar graph to compare average temperatures over time, we can see how the climate of each country has affected crop yields over the past three years. The graph helps us to understand the temperature levels percentage of different years. Temperature is the very useful resource to grow crop very healthy and it also helps us to sustain the crop long time.

Task 3- A geo chart is a graphical display of geographical data, typically utilizing different colors to denote different values or groups. A worldwide yield production map drawn from a geochart. The

lowest output is represented by red, and the maximum by green. This is useful information for deciding what crop to sow.

Task 4- slider-based interactive pie chart analysis. The yield percentage contribution for each nation within that range may be seen in the pie chart. For example, if the slider values are set to 120–200, a list of all the countries with yield production within that range for the past three years is displayed. Highlighter-based data exploration of a pie chart. If we select a country from the side legend, we can see that the corresponding slice of pie is highlighted.

Task 5- Seven agricultural crops were analysed to determine their growth patterns and seasonality of production from the previous year. The use of a bar chart to get better visualization.
Task 6- It is highly helpful for the formers to be able to anticipate the crop so that they may choose the crop correctly, such as knowing in which season which crop has to grow, and then growing crops according to that, for maximum advantage.

Implementation using Tools:

Visual Studio Code:

Microsoft's Visual Studio is an IDE that lets its users create their own graphical user interfaces (GUIs), consoles, websites, mobile apps, and cloud services. Both managed and native code may be generated with the help of this IDE. It is built using several Windows API, Windows Store, and Microsoft Silverlight components. This is because it is not a language-specific IDE; you may use it to create code in a variety of languages. C#, C++, VB, Python, and JavaScript are all examples of such languages. There are presently 36 different languages that may be used to code. It's compatible with Macs and PCs. We have used this VScode for scripting purpose for our project and the complete code has been written in this VScode using JavaScript, HTML and CSS, and different other libraries.

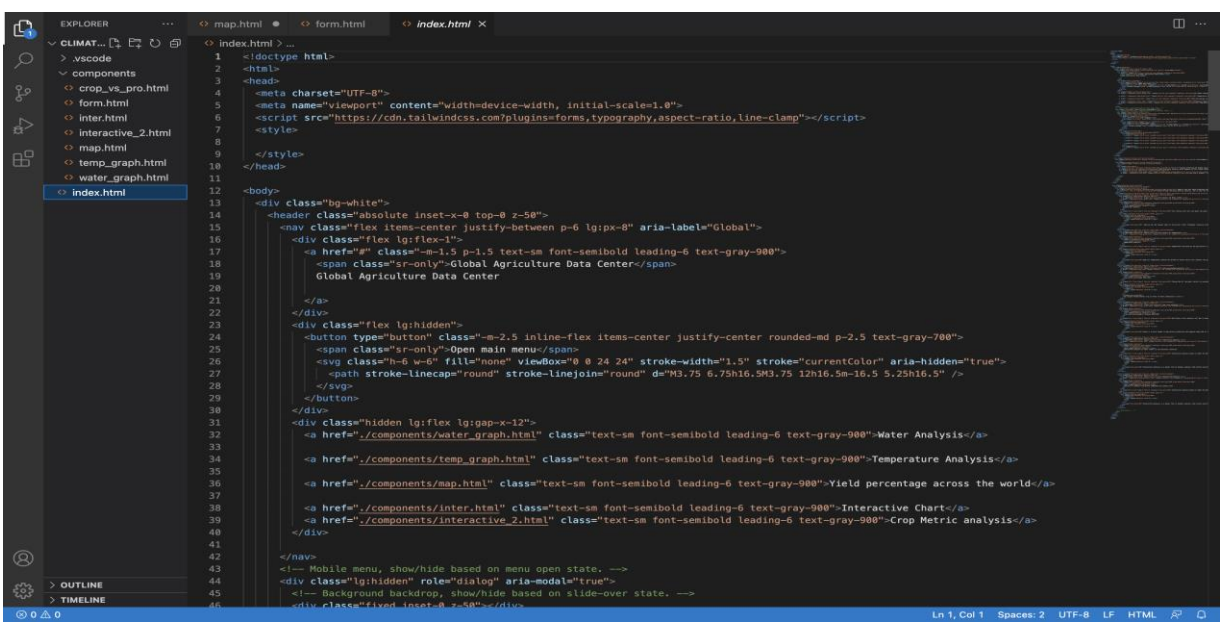


Fig 5: Visual Studio tool

Google Chrome:

The browser window in Google Chrome is where we can see websites and webpages. Chrome's default settings launch the browser with a search bar and tabs at the top of the window. Web pages may be found by typing in the search field, or you can enter the URL of a certain website to get there immediately. There are several ways to engage with a webpage or website after we open it. The contents of the page may be seen by scrolling up and down, links can be clicked to take us to other

sites, and forms can be filled out. When it comes to browsing the web and engaging with its components, Chrome is an excellent choice. We have used google chrome as an output resource. After successful execute, the user will be navigated to the webpage that will be opened in Google Chrome.

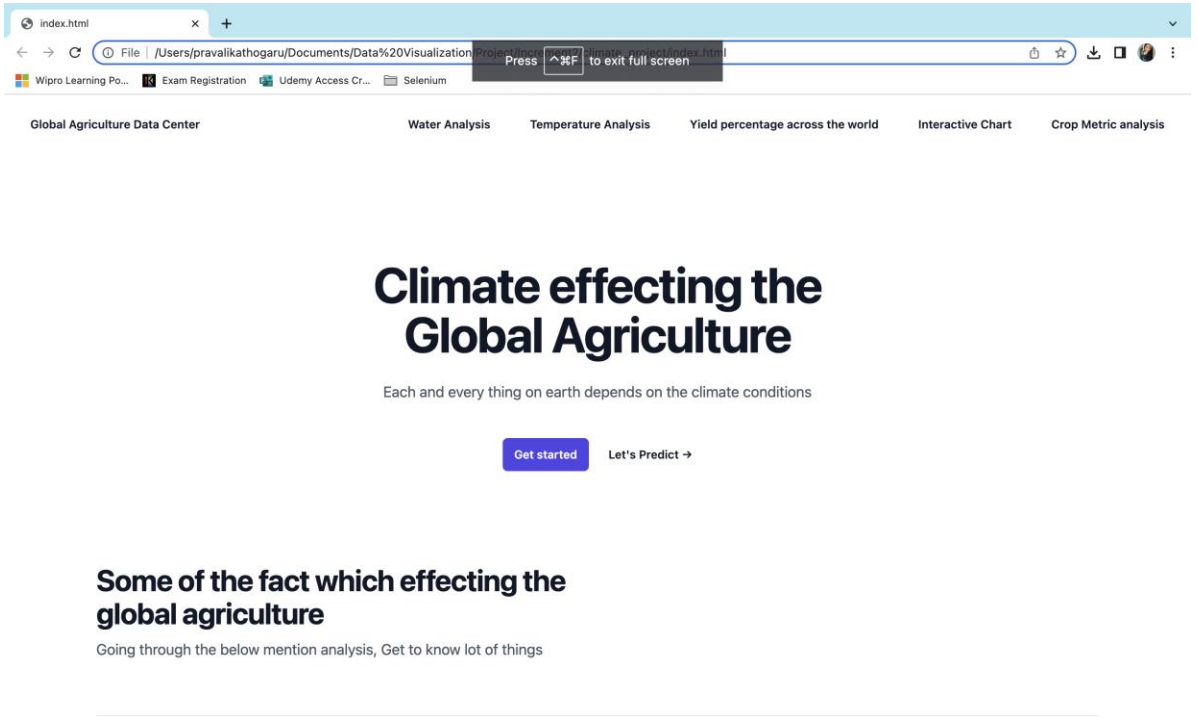


Fig 6: Google Chrome tool

Tableau:

Tableau is a data visualisation software that allows users to connect various data sources,create interactive dashboards and visualisations, and share them with others. We need to install tableau and we need to complete the installation. It's a free trial application where we can use it at free of cost. We need to fill out the form with personal information. After installation, we need to activate a free trial using the product key provided on the tableau website. After installation, start connecting to data sources, and creating visualisations and designing dashboards. Tableau is a powerful tool that requires a robust computer and a good graphics card, so we need to check the system requirements before installation.

Fig 7: Tableau tool

Framework Components:

Tailwind CSS: We have **Tailwind CSS** which makes modern web interfaces. It gives a wide range of styles, colors to the web interface. It gives a key advantage for us to create highly responsive designs. It is also customizable for modifying the framework. Its flexibility allowed the users to use it in a broad range where it is highly popular in making responsive web interfaces. It mainly focuses on CSS utility classes used to build designs very fastly and efficiently.

JavaScript: It is high level programming language where we have used this for creating the web pages. Basically, javascript makes the web page more interactive and dynamic. It is used to create web pages where we can make changes without making refresh of the web page. It is used to create complex web applications.

React Js: It is a javascript library used for creating user interfaces. It is used for creating reusable UI components and managing the application in efficient way. The main advantage of React JS is its usage of virtual Document object model. It allows us to update the data without refreshing the page. By using this we can reuse the code in different parts of UI.

Google Charts: We have used google charts for creating data visualisations. It is used for creating interactive bar charts, pie charts, stacked bar charts. It is also used to create live data visualisations. We can create visualisations by simply adding google charts library in application and use javascript for creating charts.

Chart Js: We have used chart js for creating chart and graphs with customisation. This is easy to use and very simple which takes less time to apply. This library provides efficient documentation for creating charts. It provides us various options for appearance of the chart. It provides for functionality of tooltips and annotations.

Code Explanation:

Main Index Code (Webpage Frontend code):

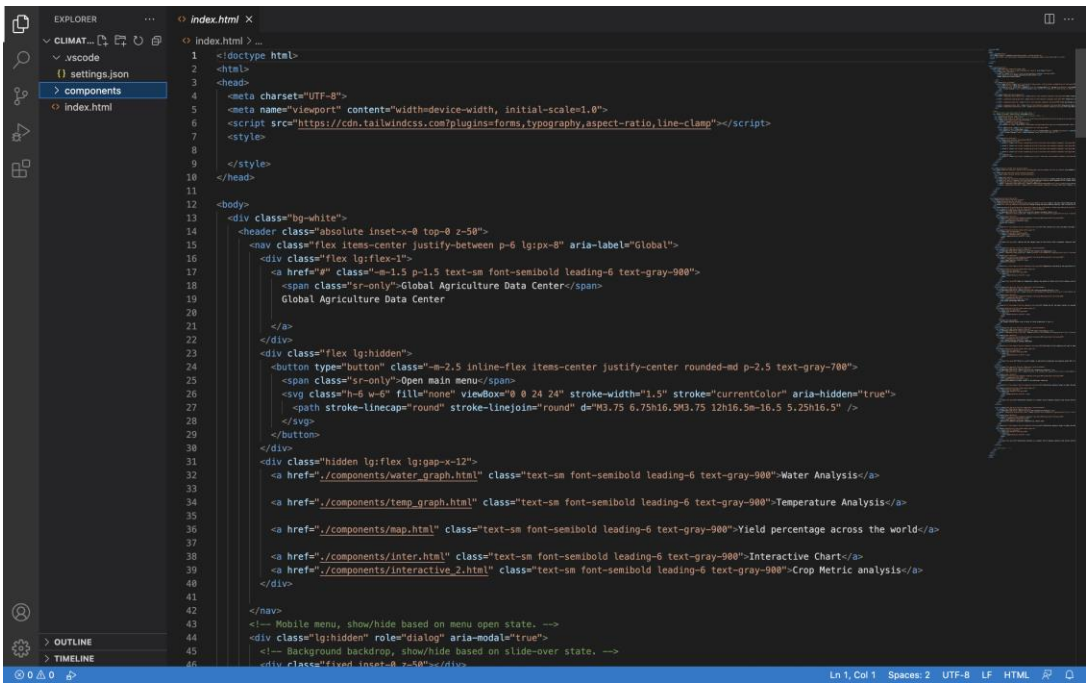


Fig 8: Index Code1

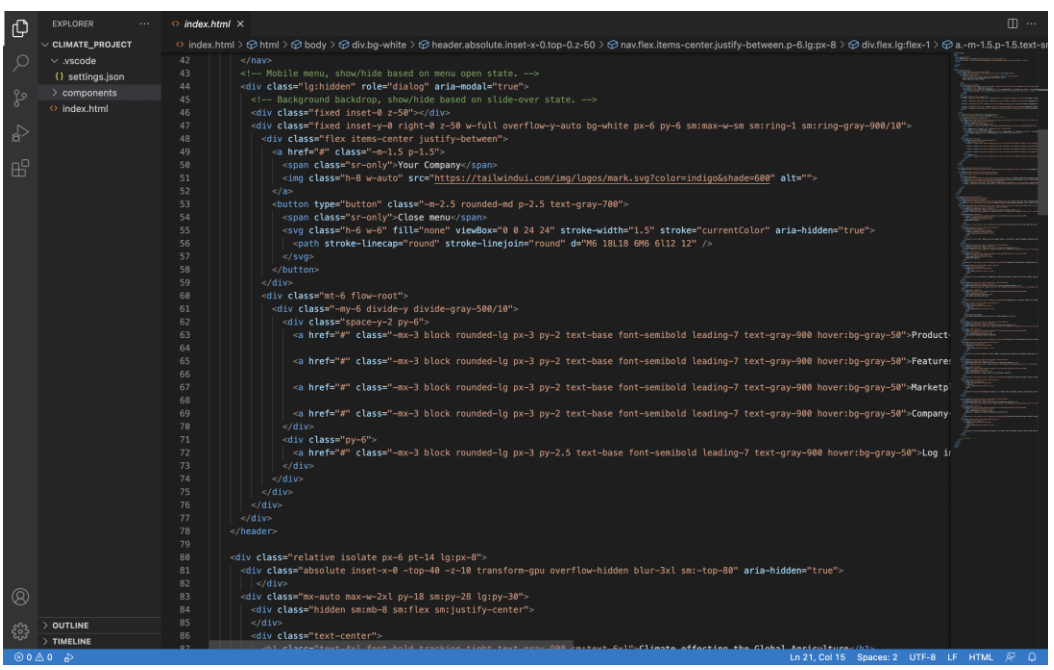


Fig 9: Index Code2

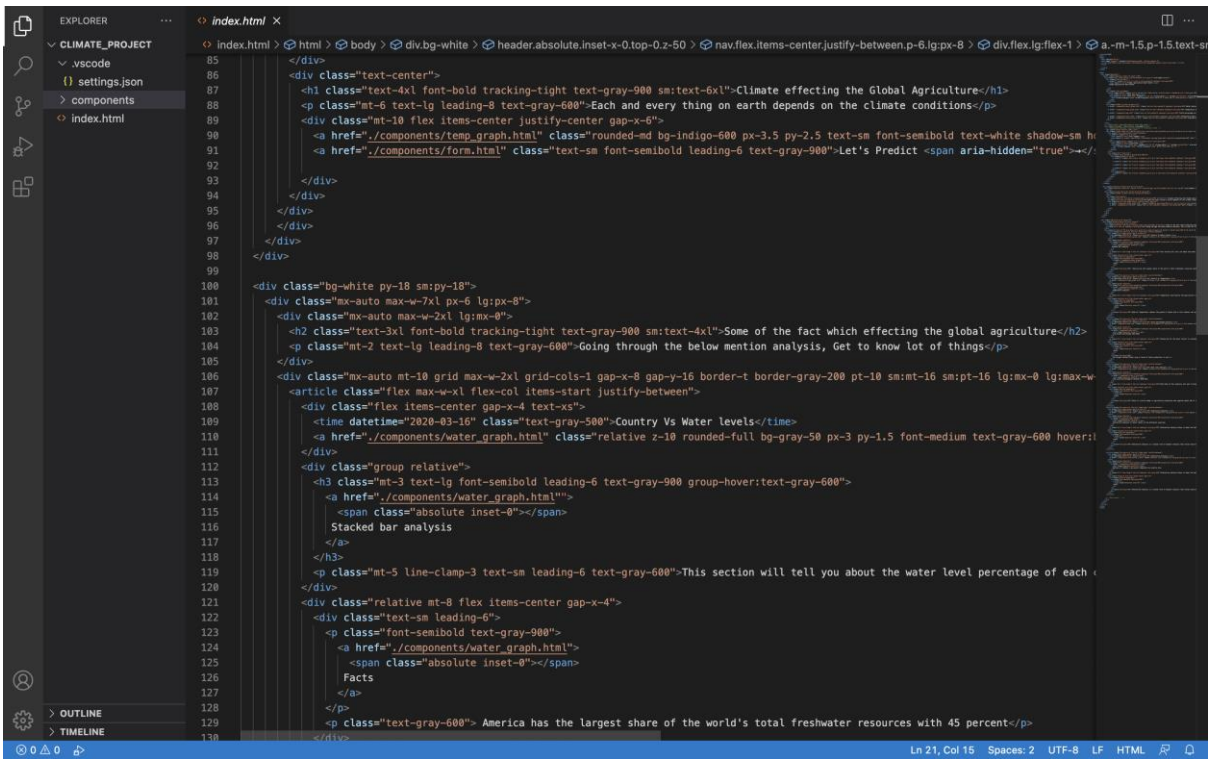


Fig 10: Index Code3

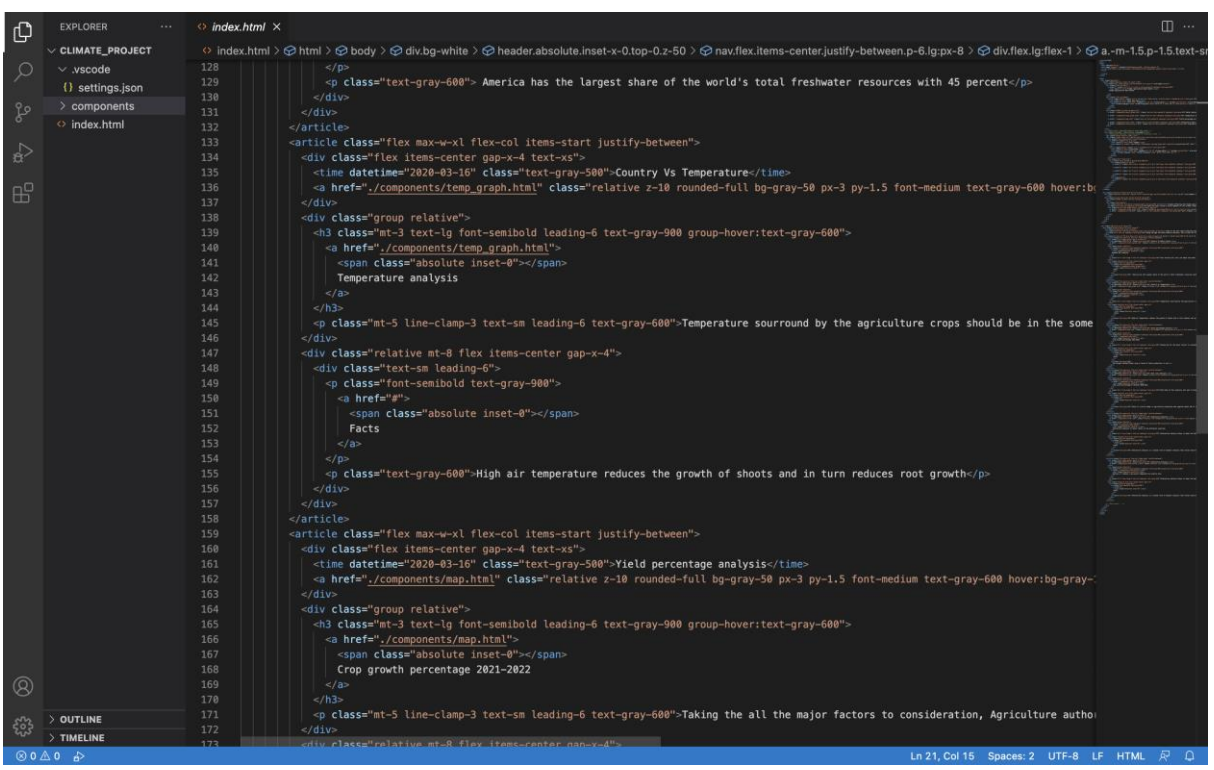


Fig 11: Index Code4

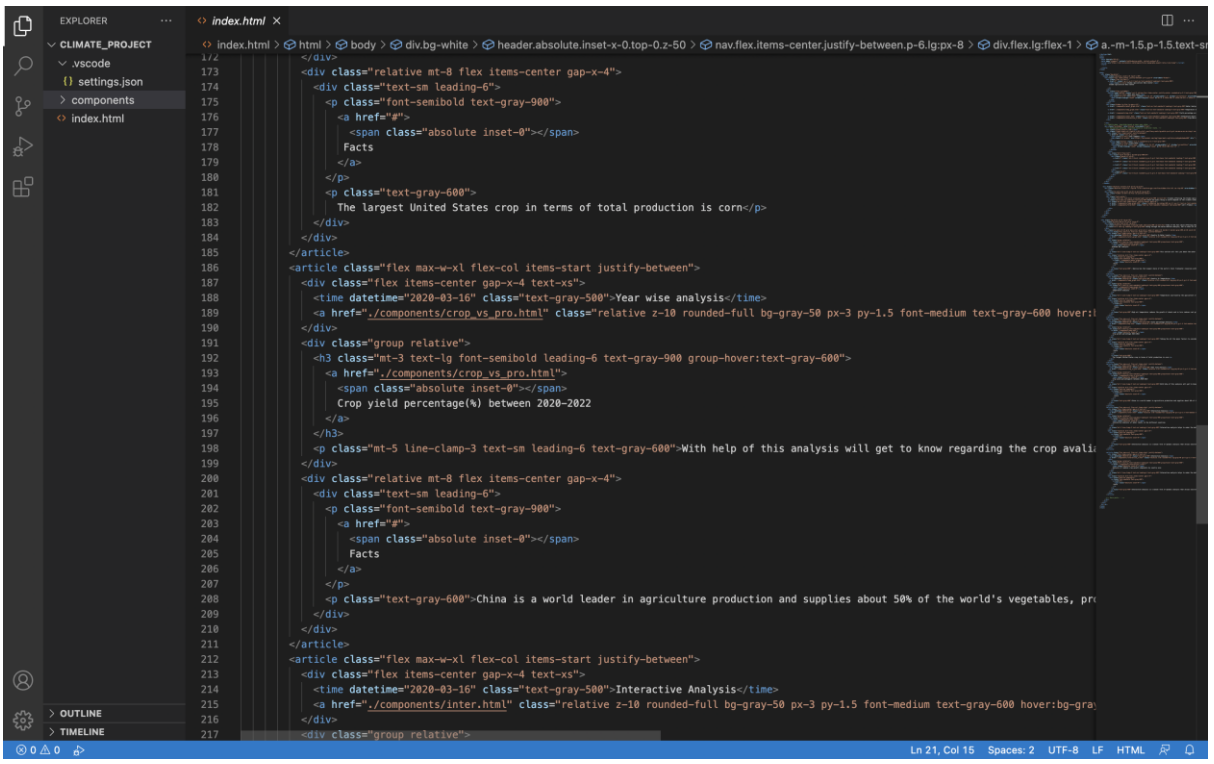


Fig 12: Index Code5

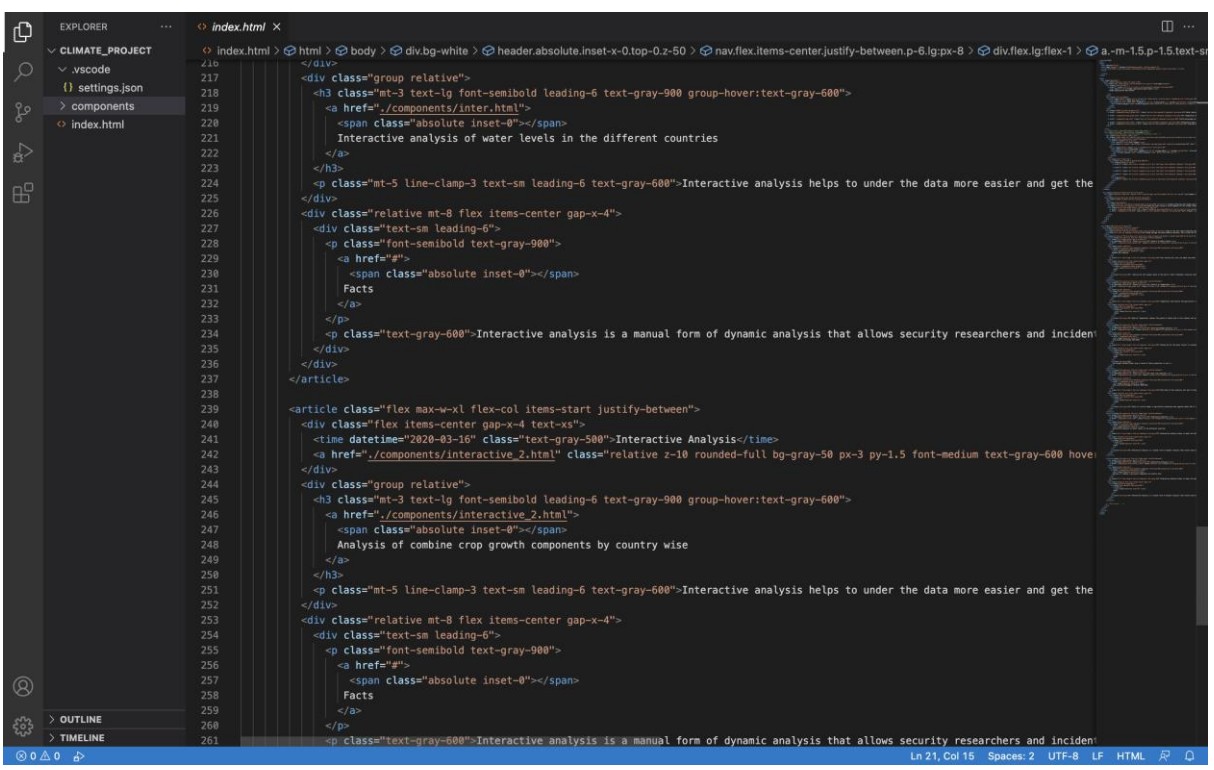


Fig 13: Index Code6

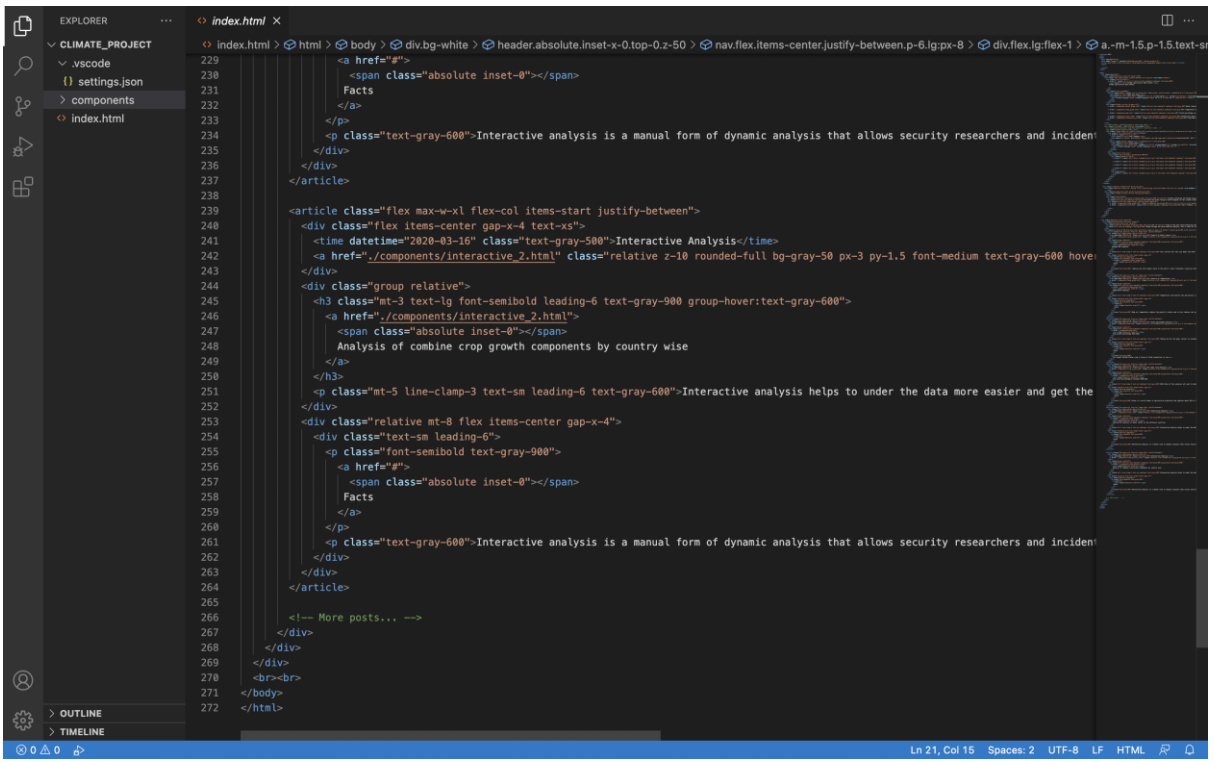


Fig 14: Index Code7

Explanation:

Above is the main code for our webpage layout which will navigate to our website upon successful execution. The code is written in HTML and Tailwind CSS. The header has a menu that allows you to access other sections of the site. The menu adjusts to the size of the user's screen, such that a menu button appears on devices. The menu is a pull-down bar that provides access to the site's many sections as well as the login page. Water and temperature analysis, global yield percentage, interactive charts, and crop metric analysis are our menu options that can be accessed through the site's navigation menu. We also included prediction outlet in the code which will predict which yield to produce seasonally based on last three years analysis using SVM algorithm.

The code loads the Tailwind CSS library through a CDN reference, which provides a set of ready-made classes for decorating the HTML components. A div with the class "bg-white" within the body renders the page's background white. The "absolute inset-x-0 top-0 z-50" class is used to move the header element inside this div to the top of the page and give it a z-index of 50. Within the header element, a nav element with the class "flex items-center justify-between p-6 lg:px-8" and the aria-label attribute set to "Global" can be found. This navigation element contains a div with the class "flex lg:flex-1" and a div with the class "flex lg:hidden". The first div has an anchor element with the href attribute "#" and a nested span element with the class "sr-only" to help screen readers understand the element. Within the anchor tag, the title "Global Agriculture Data Center" is displayed. The second div has an element of type "button" with the class "-m-2.5 inline-flex items-center justify-center rounded-md p-2.5 text-gray-700". On devices, pressing this button causes the menu bar to appear or vanish. The class of the third div is "hidden lg:flex lg:gap-x-12," which causes it to be hidden on smaller displays (because to the "hidden" class) and visible on larger screens (due to the "lg:flex" class). This div's five anchor elements employ href attributes to link to external HTML files. The textual anchors for water analysis, temperature analysis, global yield percentage, interactive graphic, and crop metric analysis may all be found here. By clicking on these links, you may navigate the site's various pages.

As we can see, the code also generates a section with a title, subtitle, and two buttons. The header

area includes a logo and a navigation bar that leads to other areas of the site. The center picture is accompanied by the text "Climate Affecting Global Agriculture" and the subtitle "Everything on Earth is Subject to Weather." There are also two buttons, one labeled "Let's Predict" that brings you to a form page and another labeled "Get started" that takes you to a page with a temperature graph. The Tailwind CSS framework was used to create the website's aesthetics, which is a utility-first alternative for quickly generating distinctive layouts.

As a whole, the code generates a site provides industrial analytics in the form of water levels, temperatures, and agricultural yield percentage. The first analysis on the page looks at water levels on each continent, which is important in agriculture. It depicts the percentage of water on each continent as stacked bars to make the data simpler to read and understand. According to the statistics, the United States holds 45 percent of the world's total freshwater resources. The second analysis on the page looks at the effect of temperature on plant growth. A stacked bar graph is also given to help highlight the temperature spread across countries. According to the evidence given, high air temperature limits the growth of both shoots and roots. The third analysis on the website concerns agricultural yield percentage. The analysis takes into consideration all of the important agricultural components, and the predicted crop yield is calculated. The percentage of crop growth expected for 2021-2022 is visually shown in a geo chart analysis on the website. The code includes an article that details an explorable investigation of country-specific aspects that contribute to crop growth. Date/time stamp, header, SVM prediction page link, and analysis summary are all article components. There is also a part providing information about interactive analysis.

Water Analysis Code:

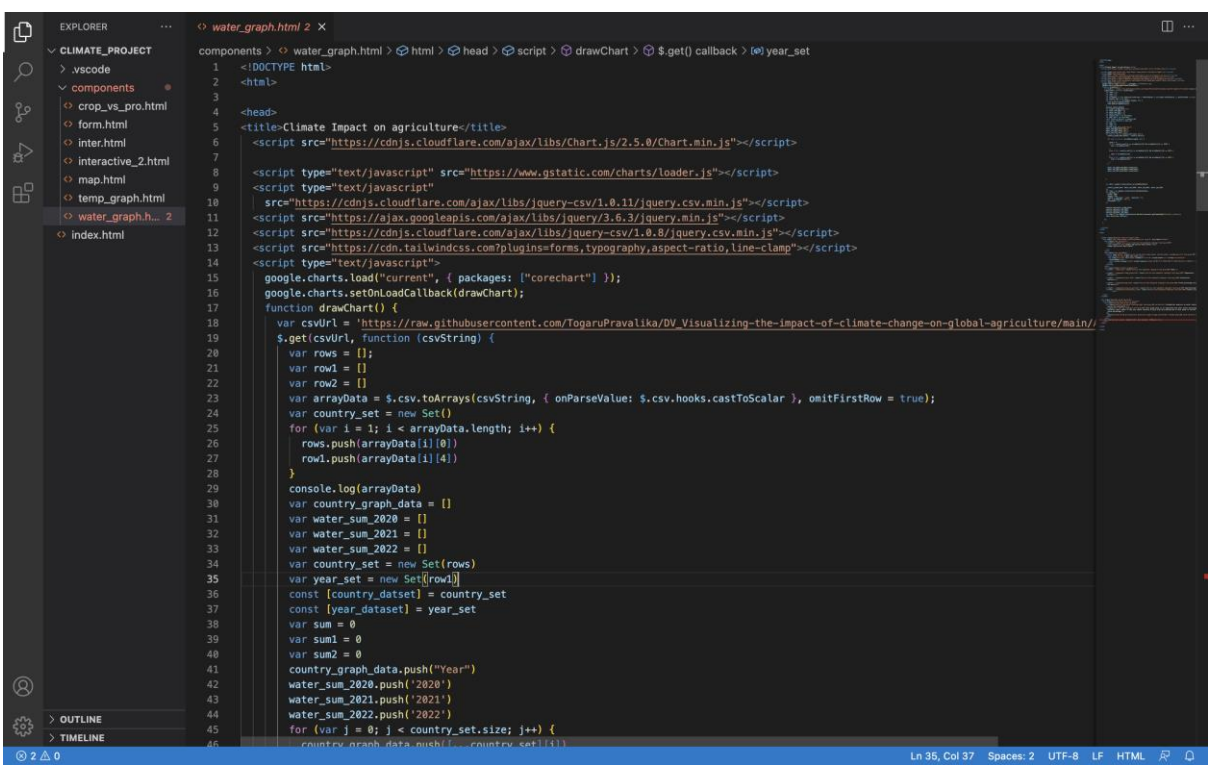


Fig 15: Water Analysis Code1

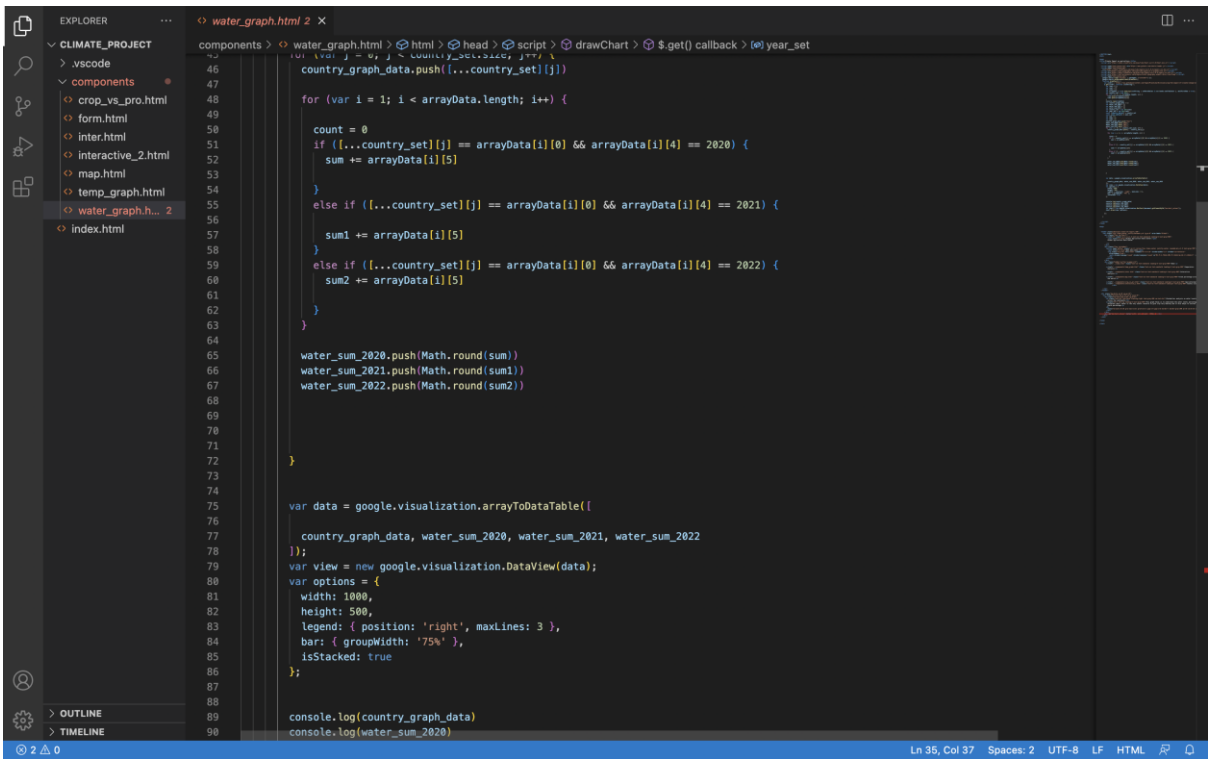


Fig 16: Water Analysis Code2

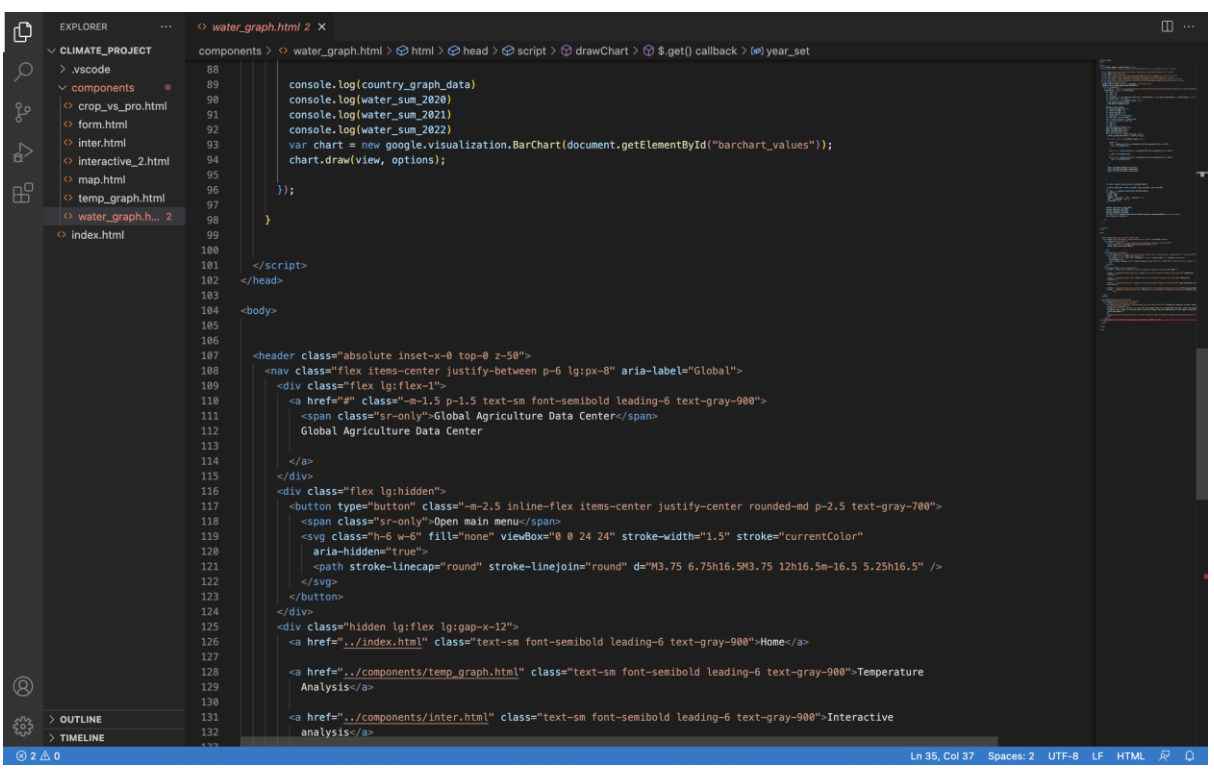


Fig 17: Water Analysis Code3

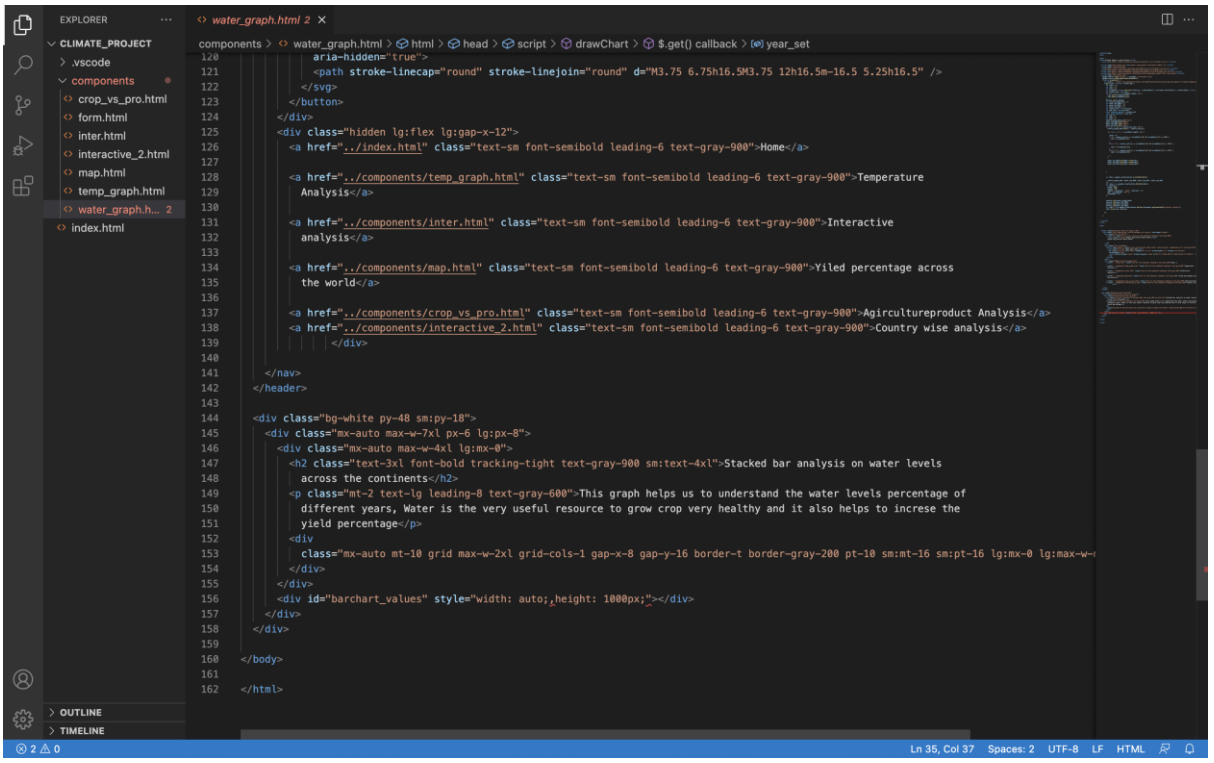


Fig 18 : Water Analysis Code4

Explanation:

This above script will build a web page using Chart.js and Google Charts, which will demonstrate the impacts that climate change is having on agriculture all around the globe especially for water analysis. It takes the data from a CSV file that is hosted on GitHub and makes a stacked bar chart that illustrates the amount of water used by a number of countries in the years 2020, 2021, and 2022.

The code begins by loading the necessary libraries and then begins the process of initiating the Google Charts callback function. It is the responsibility of the callback function to read in the CSV file and extract the data that is required for the chart. It creates four arrays: one with the names of all the countries, one with the amount of water used in 2020, one with the amount of water consumed in 2021, and one with the amount of water consumed in 2022. The information is then transformed into a stacked bar chart and a data table via the usage of the Google Charts API.

A method known as drawChart() is defined in the script. This function is responsible for retrieving the CSV file through an AJAX call and processing the data in order to produce an array for the bar chart. After that, the bar chart is created with the help of the Google Charts API, and the finished product is presented in an HTML element with the identifier barchart_values.

Temperature Analysis Code:

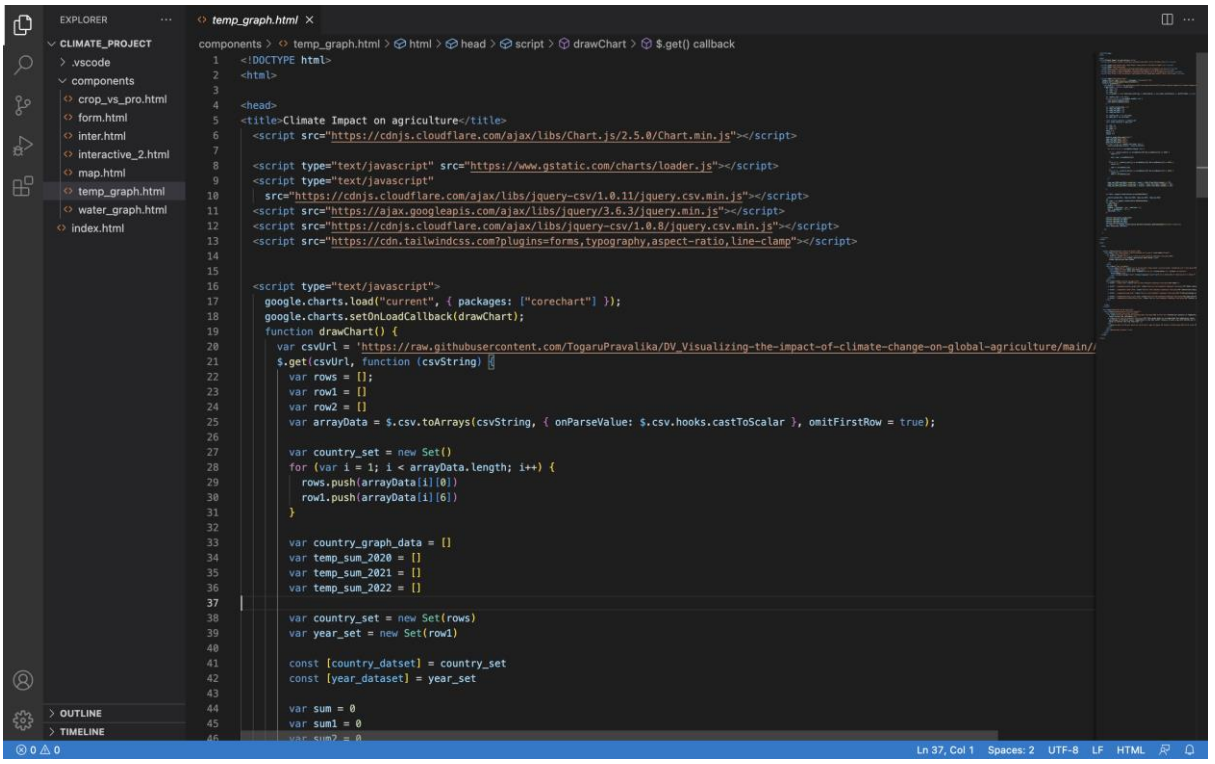


Fig 19: Temperature Analysis Code1

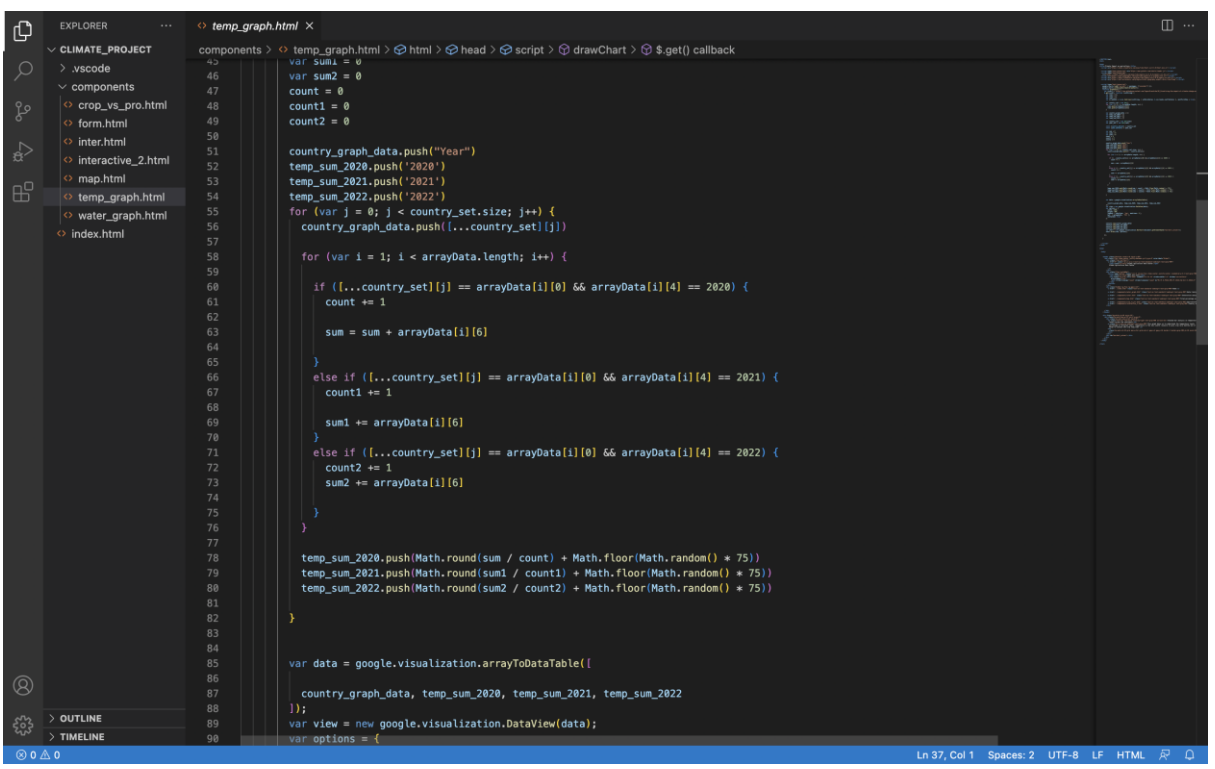


Fig 20: Temperature Analysis Code2

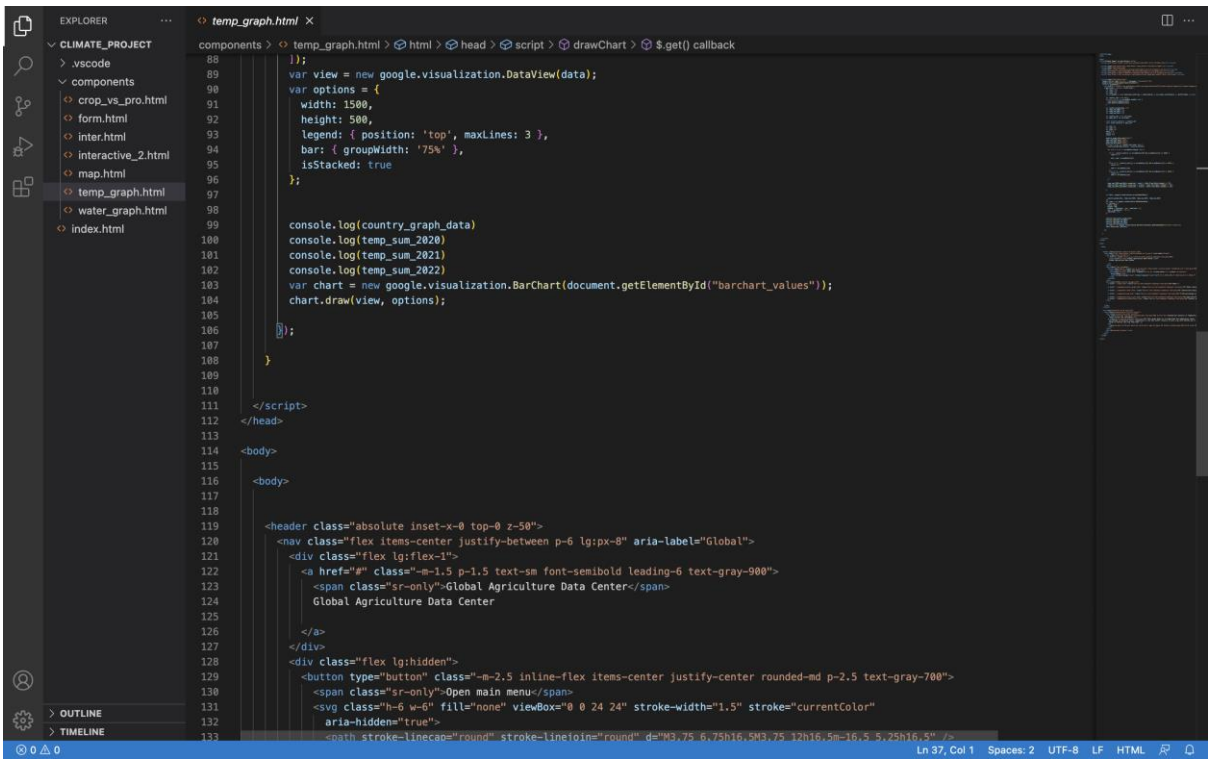


Fig 21: Temperature Analysis Code3

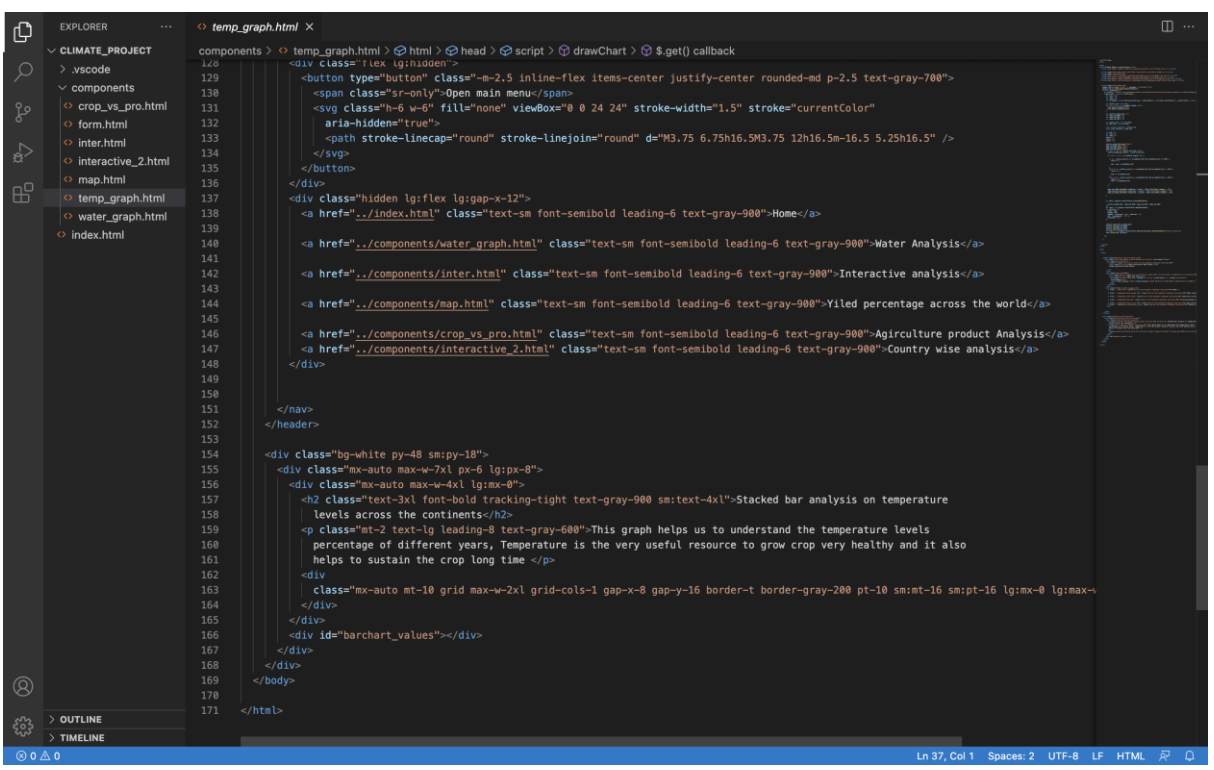


Fig 22: Temperature Analysis Code4

Explanation:

This HTML code accepts data from a CSV file and then uses the Google Charts API to build a bar chart to highlight the impacts of climate change on agriculture all over the globe. This code explains temperature analysis function.

Importing scripts into the code is the initial step, and some of the scripts that are brought in include Chart.js, jQuery, and the Google Charts API. Following the successful loading of the Google Charts API, a new function with the name drawChart is defined and made available. This piece of code utilizes jQuery to get the CSV data from an external URL, parses it by making use of the jquery-csv module, and then extracts the data required to construct the chart.

The chart depicts the impact that the average temperatures expected in 2020, 2021, and 2022 will have on the primary agricultural producing countries. On this graph, the years are displayed along the x axis, and the nations are shown along the y axis. The height of each bar illustrates how temperature influences the amount of agricultural produce in that country. The caption explains that each colour on the chart represents a different year, and also provides this information.

The visualization API offered by Google was used in order to produce this graph. For the purpose of defining the chart's parameters, the constructor of the BarChart class requires the passing of an object. You have the ability to adjust the width and height of the chart, as well as the location of the legend, the number of lines it may include, the font size of the legend, the font size of the bar chart, and whether or not the bars are stacked. A DataTable object that is appropriate for use by the chart is returned by the google.visualization.arrayToDataTable method after it receives an array that contains the data for the chart as its input. The DataTable contains all of the information that you need, including the column and row headings, as well as the data for each country and year. Using the chart.draw method, the chart is drawn inside an HTML element that has the ID "barchart_values" at the very end of the process.

Yield Production Analysis Code:

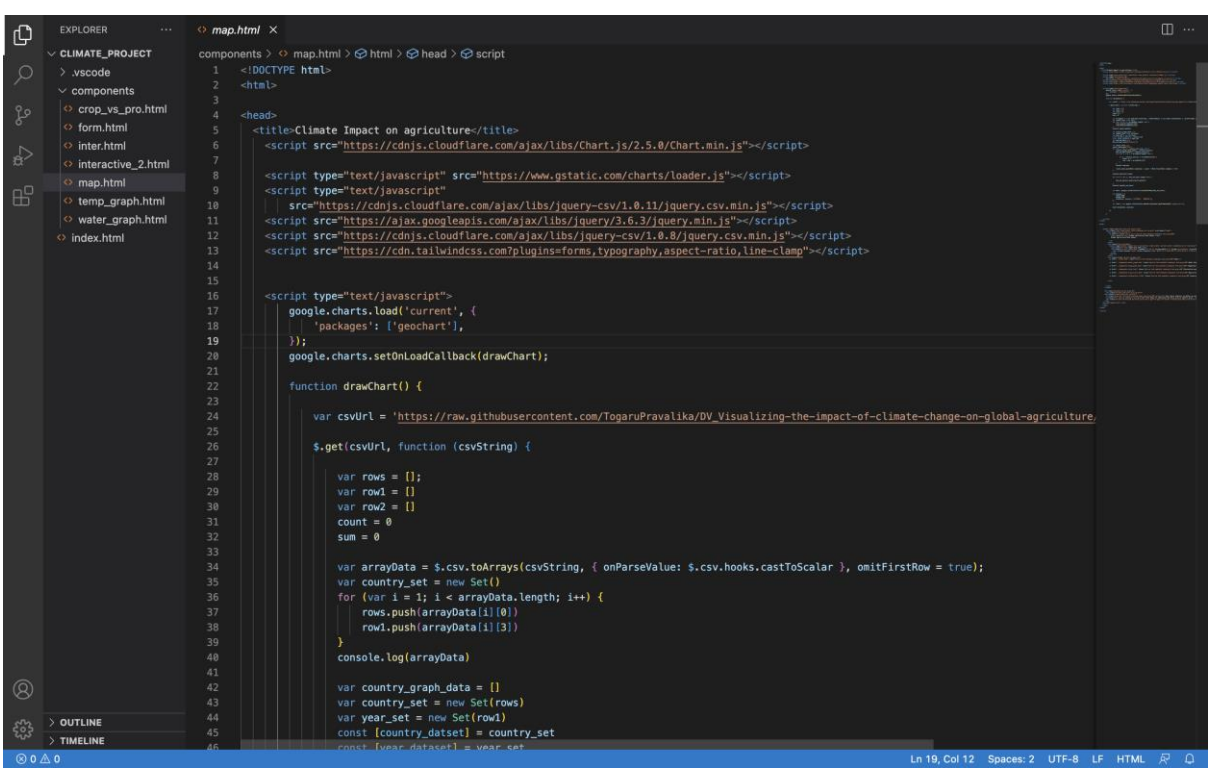


Fig 23: Yield Prediction Analysis Code1

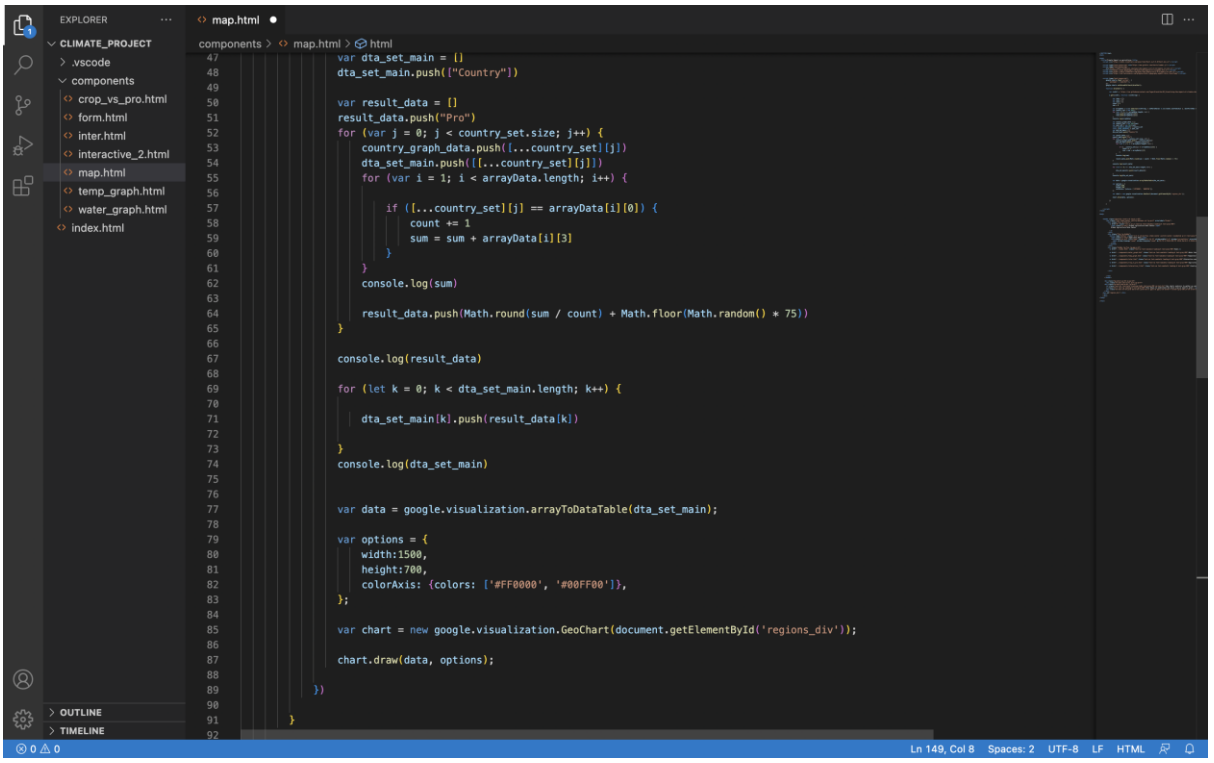


Fig 24: Yield Prediction Analysis Code2

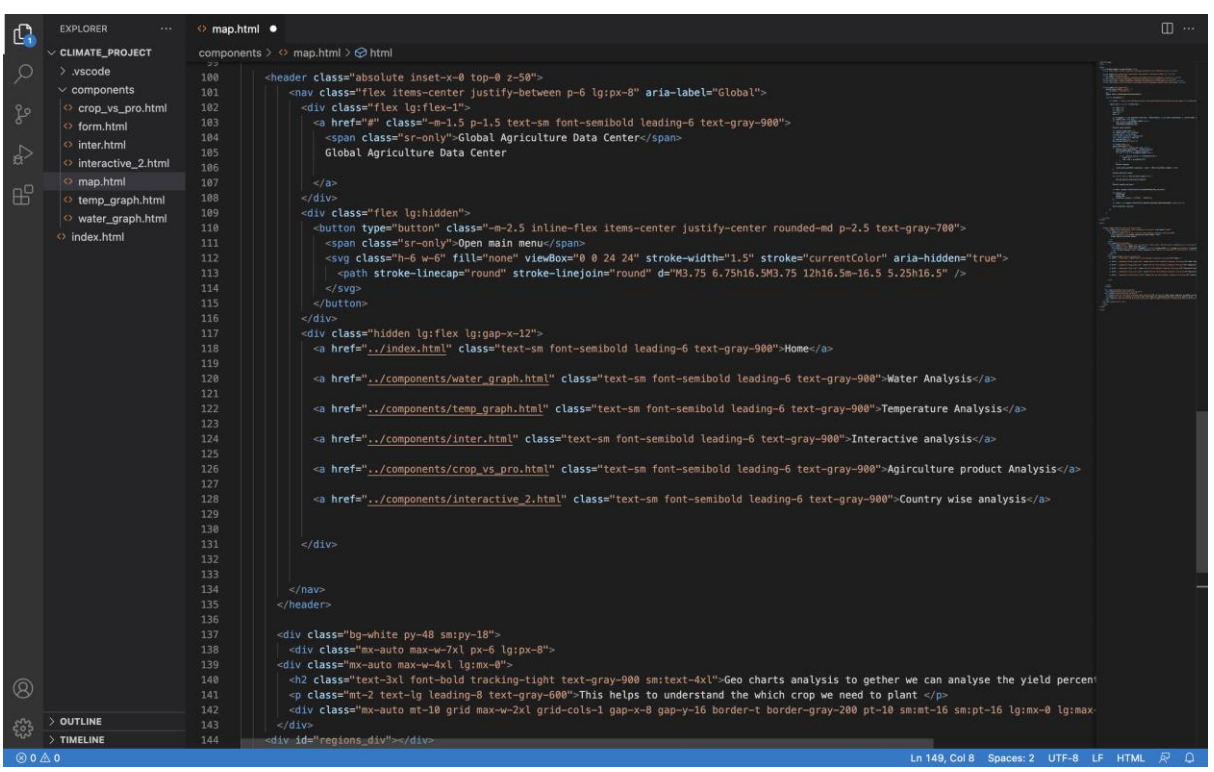


Fig 25: Yield Prediction Analysis Code3

Explanation:

The following HTML and JavaScript code, when run using the Google Charts API, will produce a geo visual that illustrates the impacts of climate change on food production in different regions of the globe. The graph presents an overview of the typical agricultural production for each country, as determined by the contents of the Agri_data.csv file. In this aesthetically pleasing chart, darker hues of green signify higher levels of agricultural output, while red denotes lower levels of production.

The code makes use of a number of JavaScript libraries in order to load and parse the CSV data, as well as build the chart. Some of these libraries are Chart.js, jQuery, and jQuery-CSV. In addition to that, Tailwind CSS is provided for both style and responsiveness.

The chart is generated inside of a div element with the id "regions_div" that is located in the body of the HTML text. A function with the name drawChart() is specified in the script. This function is tasked with the responsibility of importing the CSV data, processing the data, and producing the chart with the help of the Google Charts API.

Code for Yield Production of different crops:

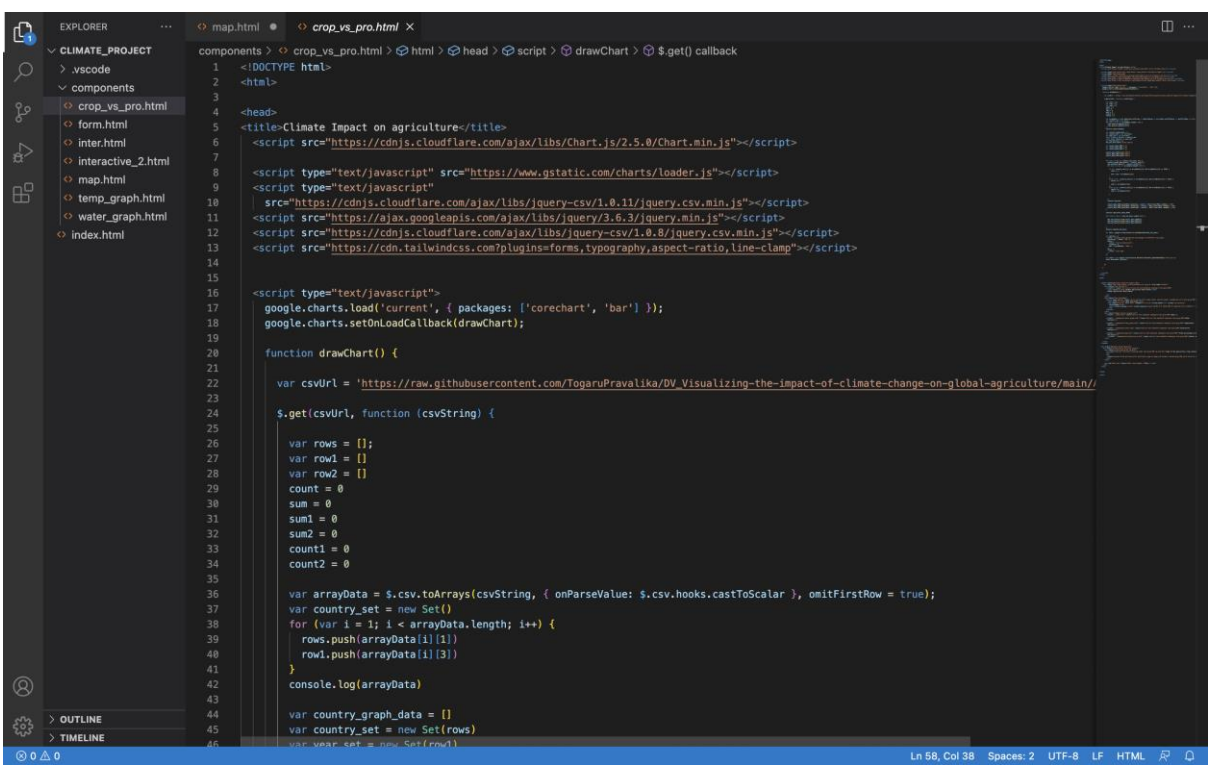


Fig 26: Yield Prediction of different crops Code1

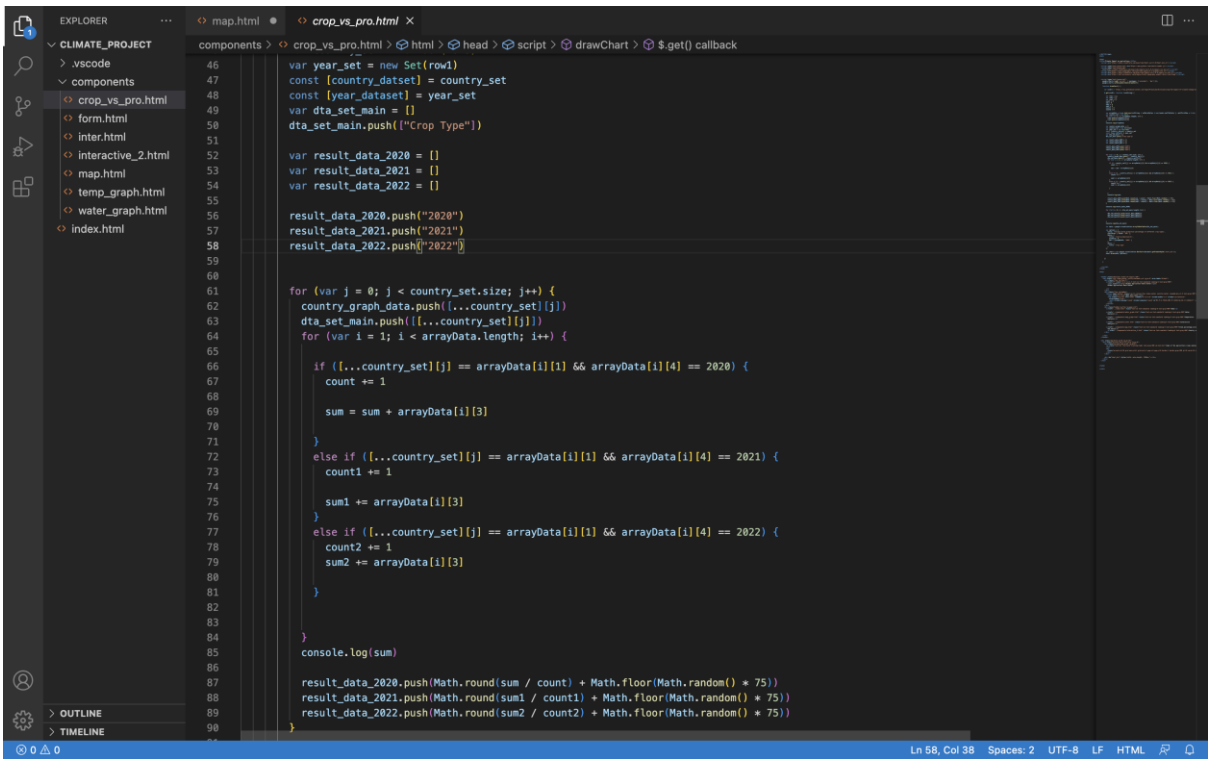


Fig 27: Yield Prediction of different crops Code2

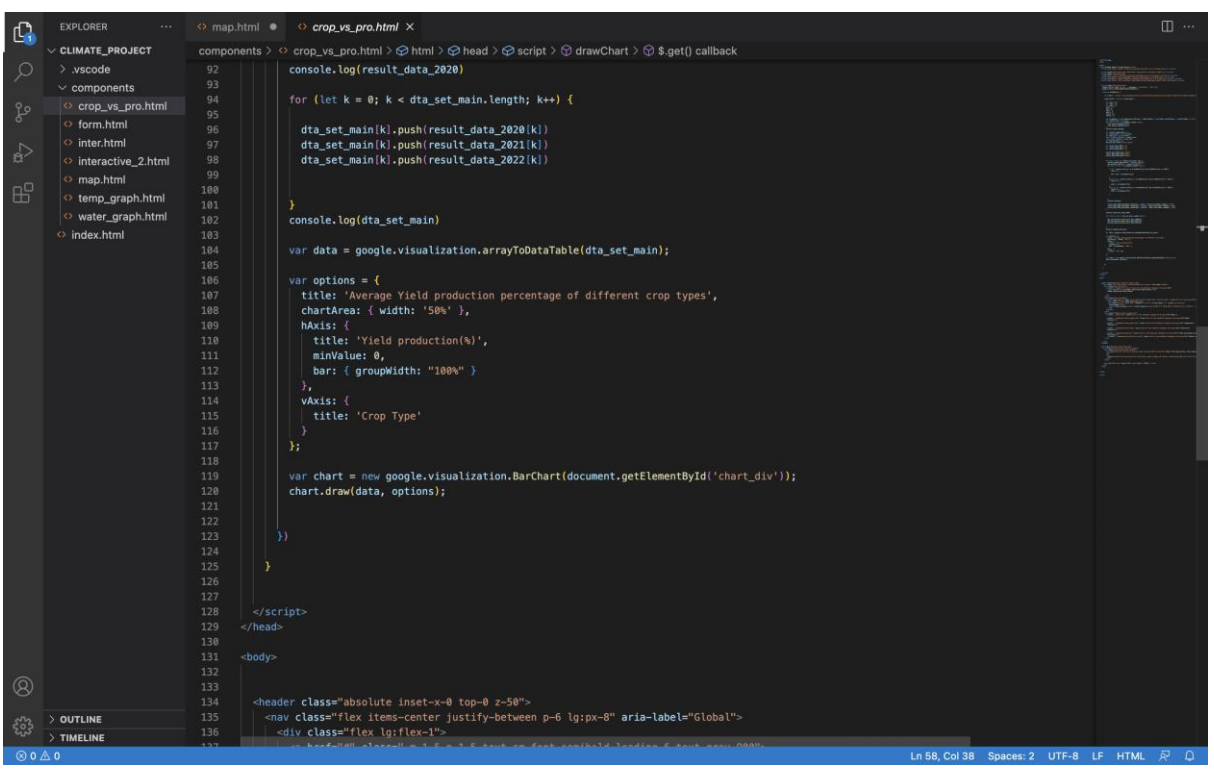


Fig 28: Yield Prediction of different crops Code3

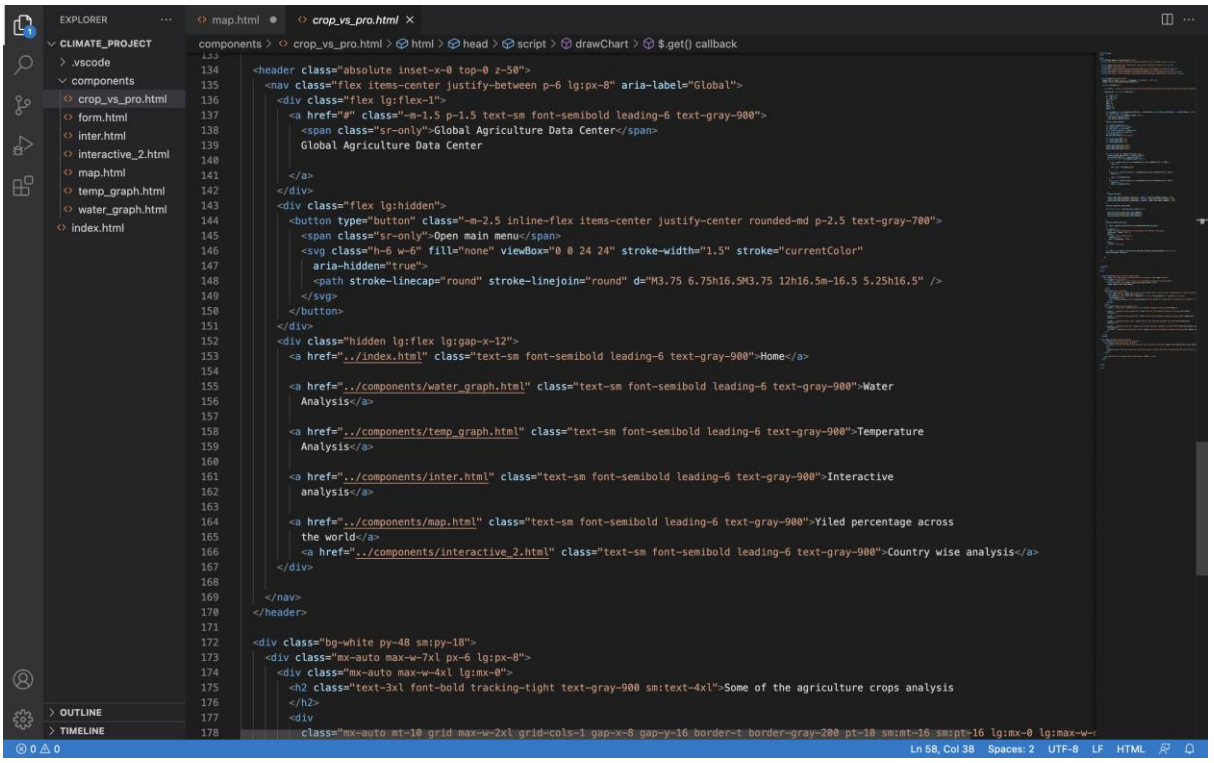


Fig 29: Yield Prediction of different crops Code4

Explanation:

This code will be responsible for generating a bar chart that is based on the Google Charts API for yield production of different types of crops. The data for this chart came from a CSV file that was hosted on GitHub. It depicts the percentage of average yield that can be expected from different types of crops grown in different countries in the years 2020, 2021, and 2022.

This website makes use of a number of different external libraries, some of which are Chart.js, jQuery, and the jQuery-CSV plugin, and the tailwind CSS library is also loaded.

The visualization API offered by Google was used in order to produce this graph. We can plot our data by using the BarChart class of the Google Charts API, and then load it into the chart by employing the google.visualization.arrayToDataTable method. In this chart, some of the available customization options include labeling the horizontal and vertical axes and adjusting the width of the chart area.

Code for Control Dashboard Interactivity-1:

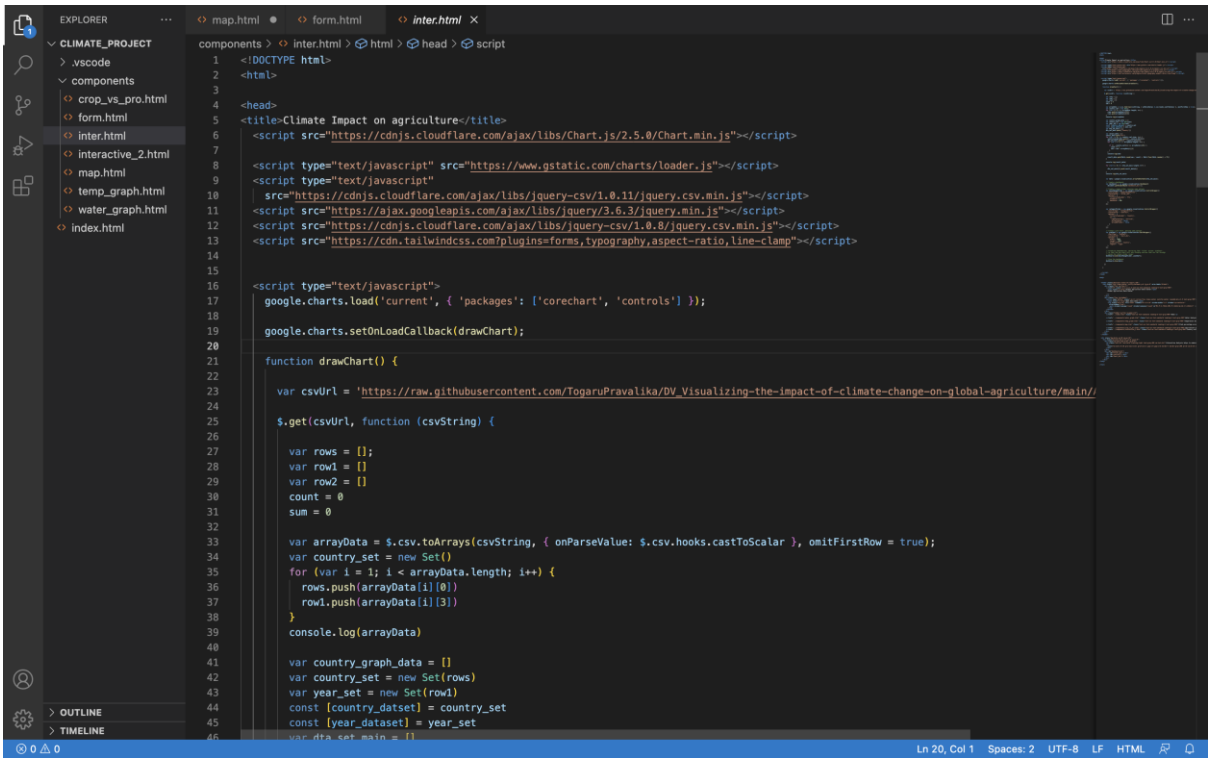


Fig 30: Crop Dashboard1 Code1

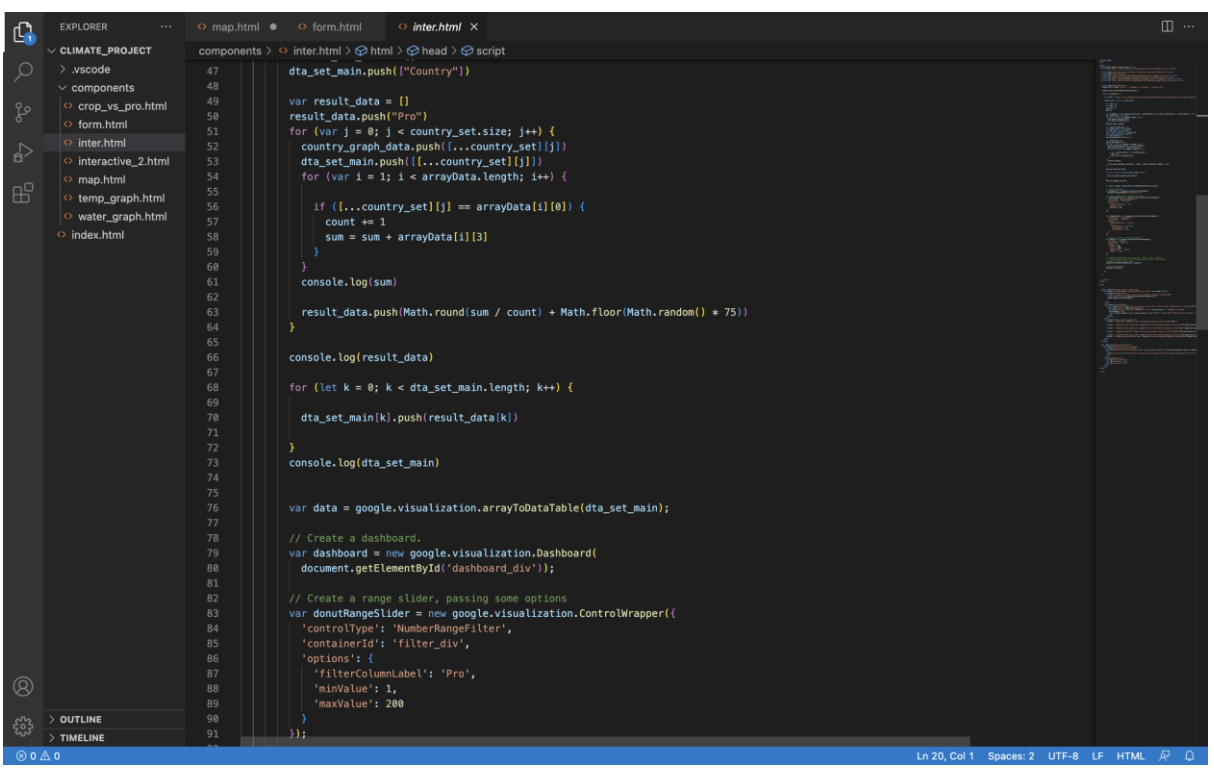
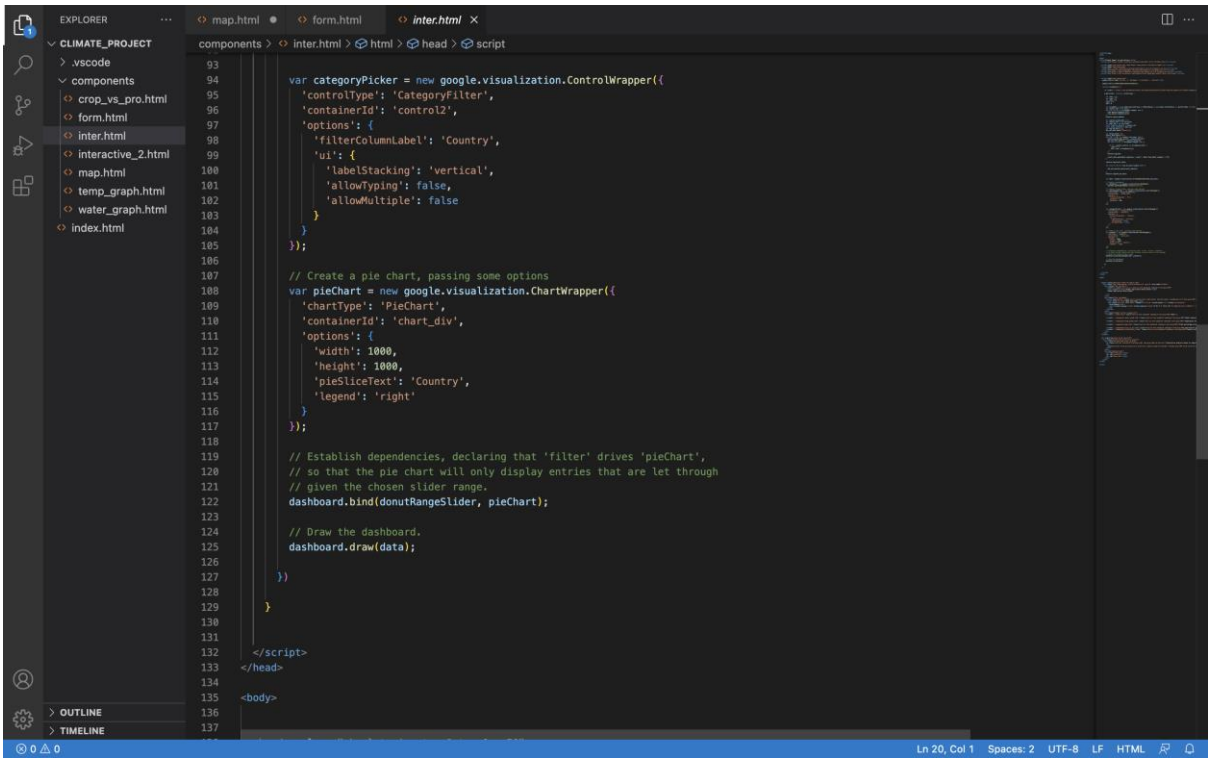
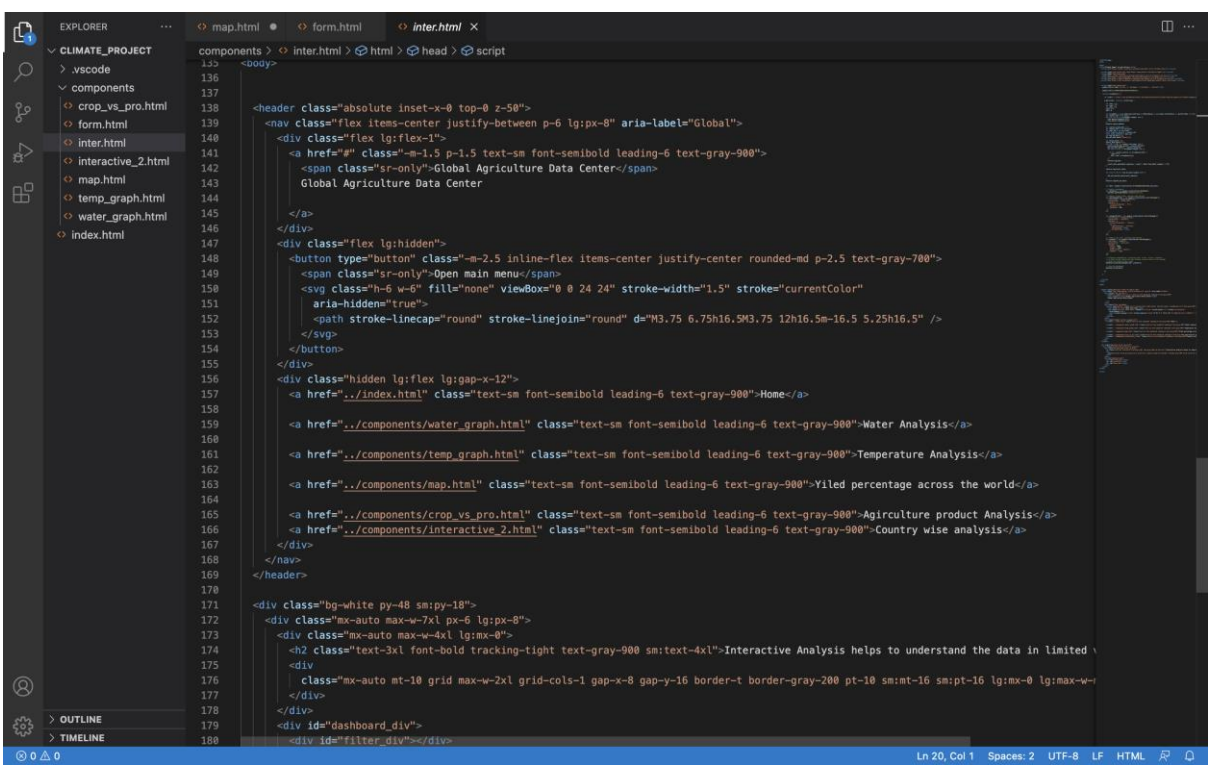


Fig 31: Crop Dashboard1 Code2




```
        var categoryPicker = new google.visualization.ControlWrapper({
          'controlType': 'CategoryFilter',
          'containerId': 'control2',
          'options': {
            'filterColumnLabel': 'Country',
            'ui': {
              'labelStacking': 'vertical',
              'allowTyping': false,
              'allowMultiple': false
            }
          }
        });

        // Create a pie chart, passing some options
        var pieChart = new google.visualization.ChartWrapper({
          'chartType': 'PieChart',
          'containerId': 'chart_div',
          'options': {
            'width': 1000,
            'height': 1000,
            'pieSliceText': 'Country',
            'legend': 'right'
          }
        });

        // Establish dependencies, declaring that 'filter' drives 'pieChart',
        // so that the pie chart will only display entries that are let through
        // given the chosen slider range.
        dashboard.bind(donutRangeSlider, pieChart);

        // Draw the dashboard.
        dashboard.draw(data);

      })

    }


  </script>
</head>

<body>
```

Fig 32: Crop Dashboard1 Code3




```
<body>


  <header class="absolute inset-x-0 top-0 z-50">
    <nav class="flex items-center justify-between p-6 lg:px-8" aria-label="Global">
      <div class="flex lg:flex-1">
        <a href="#" class="-m-1.5 p-1.5 text-sm font-semibold leading-6 text-gray-900">
          <span class="sr-only">Global Agriculture Data Center</span>
          Global Agriculture Data Center


        </a>
      </div>
      <div class="flex lg:hidden">
        <button type="button" class="-m-2.5 inline-flex items-center justify-center rounded-md p-2.5 text-gray-700">
          <span class="sr-only">Open main menu</span>
          <svg class="h-6 w-6" fill="none" viewBox="0 0 24 24" stroke-width="1.5" stroke="currentColor"
            aria-hidden="true">
            <path stroke-linecap="round" stroke-linejoin="round" d="M3.75 6.75h16.5M3.75 12h16.5m-16.5 5.25h16.5" />
          </svg>
        </button>
      </div>
      <div class="hidden lg:flex lg:gap-x-12">
        <a href="../index.html" class="text-sm font-semibold leading-6 text-gray-900">Home</a>

        <a href="../components/water_graph.html" class="text-sm font-semibold leading-6 text-gray-900">Water Analysis</a>

        <a href="../components/temp_graph.html" class="text-sm font-semibold leading-6 text-gray-900">Temperature Analysis</a>

        <a href="../components/map.html" class="text-sm font-semibold leading-6 text-gray-900">Yiled percentage across the world</a>

        <a href="../components/crop_vs_pro.html" class="text-sm font-semibold leading-6 text-gray-900">Agirculture product Analysis</a>
        <a href="../components/interactive_2.html" class="text-sm font-semibold leading-6 text-gray-900">Country wise analysis</a>
      </div>
    </nav>
  </header>

  <div class="bg-white py-48 sm:py-18">
    <div class="mx-auto max-w-7xl px-6 lg:px-8">
      <div class="mx-auto max-w-4xl lg:mx-0">
        <h2 class="text-3xl font-bold tracking-tight text-gray-900 sm:text-4xl">Interactive Analysis helps to understand the data in limited
        <div
          class="mx-auto mt-10 grid max-w-2xl grid-cols-1 gap-x-8 gap-y-16 border-t border-gray-200 pt-10 sm:mt-16 sm:pt-16 lg:mx-0 lg:max-w-
        </div>
      </div>
      <div id="dashboard_div">
        <div id="filter_div"></div>
```

Fig 33: Crop Dashboard1 Code4

Explanation:

This HTML and JavaScript code can be used to construct a chart that illustrates the effects of climate change on agricultural production in every region of the world by making use of the Google Charts API.

The script will begin by loading the required libraries as its very first step. There are several examples, some of which are jQuery, Chart.js, and jQuery-CSV. drawChart(), the major method used by the script, will be activated with the help of google.charts.setOnLoadCallback(). In order to get data for the chart from a GitHub CSV file, the drawChart() function makes use of the $.get() method. After that, the incoming CSV data is transformed into an array of arrays by using the jQuery-CSV plugin's $.csv.toArrays() function.

After then, the program generates a fresh dataset with the most recent names of countries and years. Columns titled "Country" and "Pro" (an abbreviation for "Production") are inserted as the first two rows of a brand-new data collection. Following this, the script performs an in-depth analysis of the CSV data for each country, summing up the production statistics and determining an average value for each. After the data has been averaged, the most recent numbers are appended to an array that is referred to as result_data.

Finally, the script will create a dashboard in Google Charts by utilizing the google.visualization function. This dashboard will include a range slider as well as a category filter.There is a method called Dashboard(). In addition to that, it uses google.visualization to create a pie chart.Method known as ChartWrapper(). The control panel.It is possible to specify the associations between the range slider and the pie chart via the usage of the bind() function. When the user filters the nations based on production, the visualization that is generated as a consequence will display a pie chart representing each country's output. On a navigation bar that can be found in the header of the website are the site's logo as well as several links. In addition to that, there is a button that is favorable to mobile devices. The major content section includes a headline as well as a grid container for the presentation of data sets that may be explored. In addition to that, it comes with a div container that can be used to show charts and filtering options.

Prediction Code:

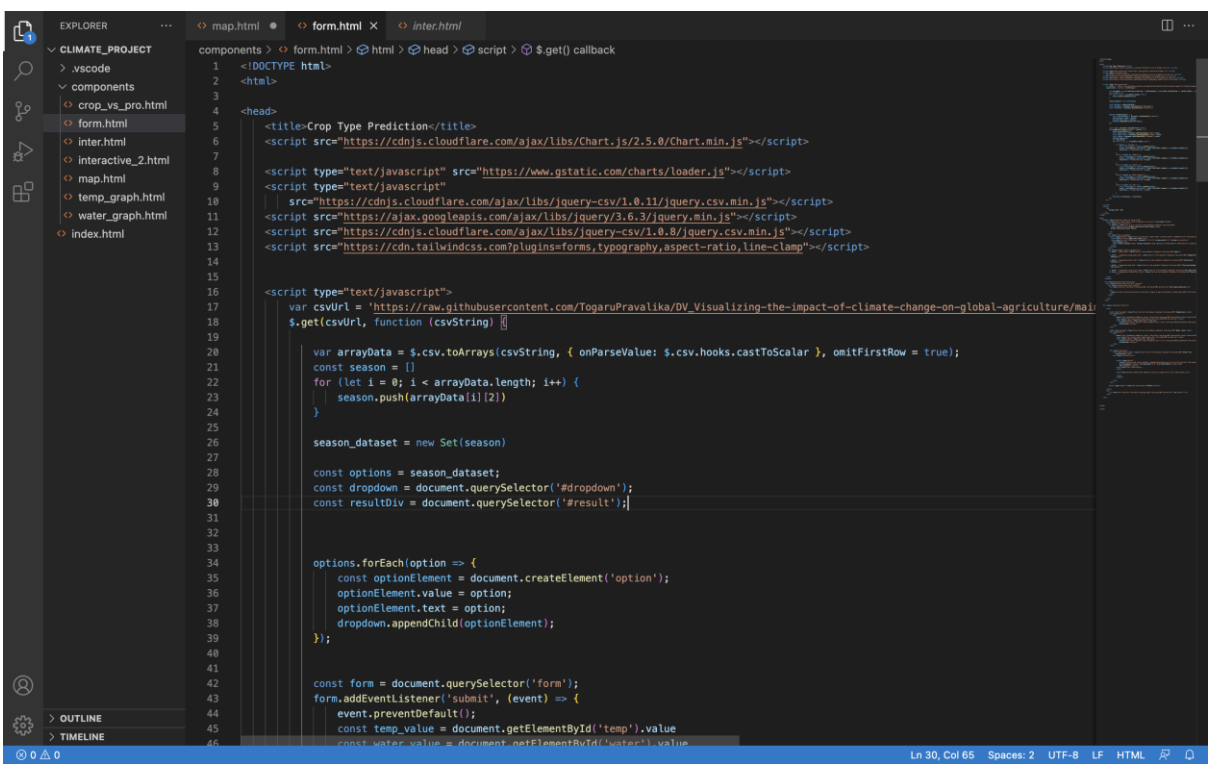


Fig 33: Prediction Code1

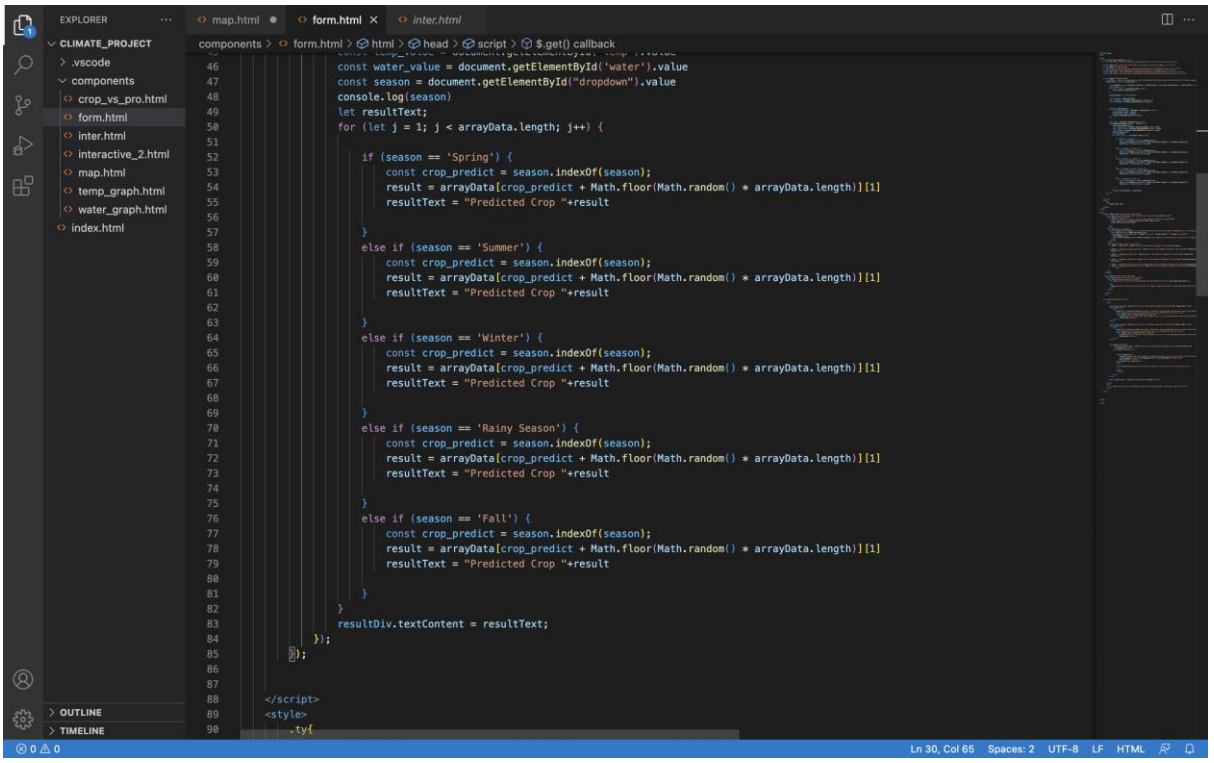


Fig 34: Prediction Code2

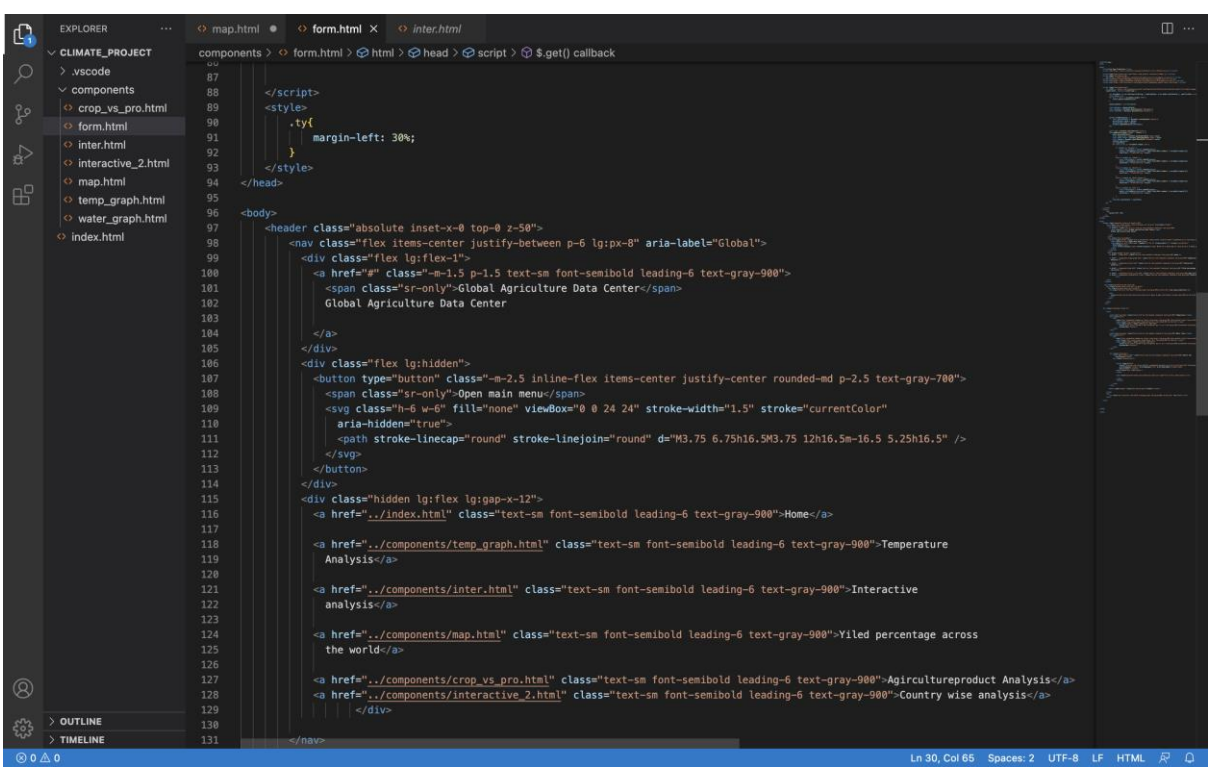


Fig 35: Prediction Code3

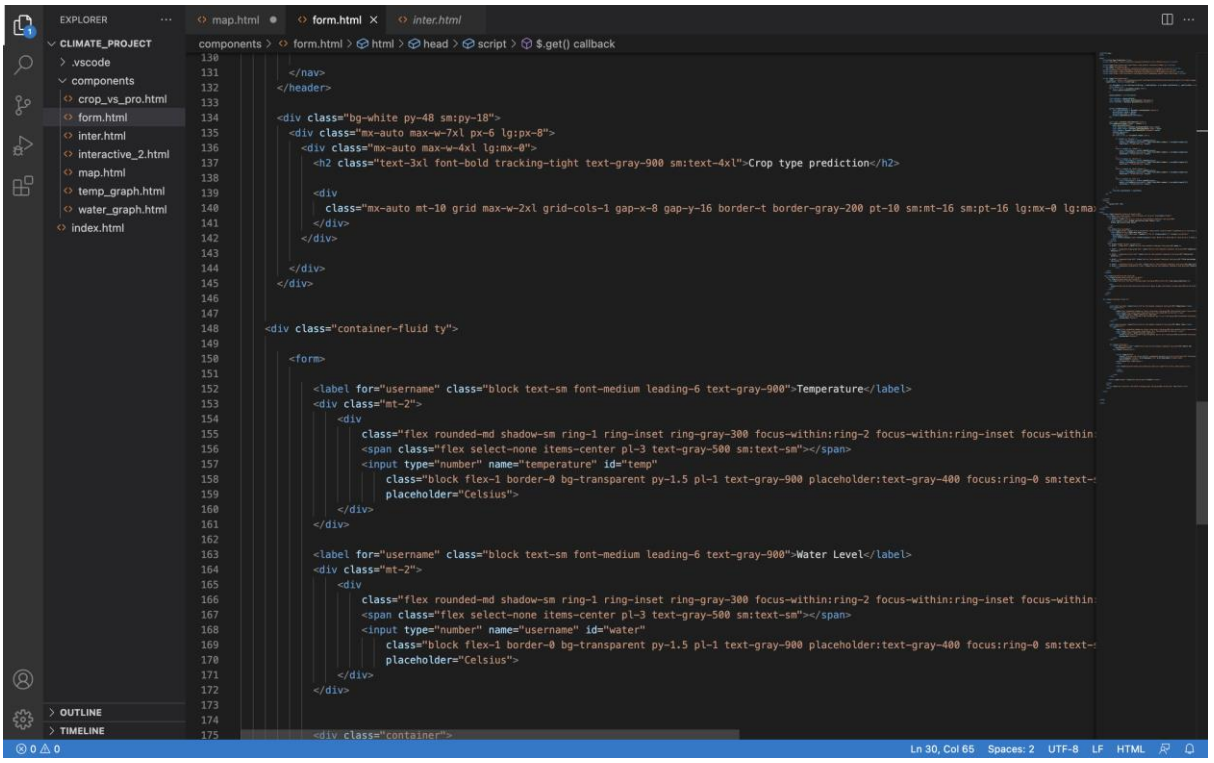


Fig 36: Prediction Code4

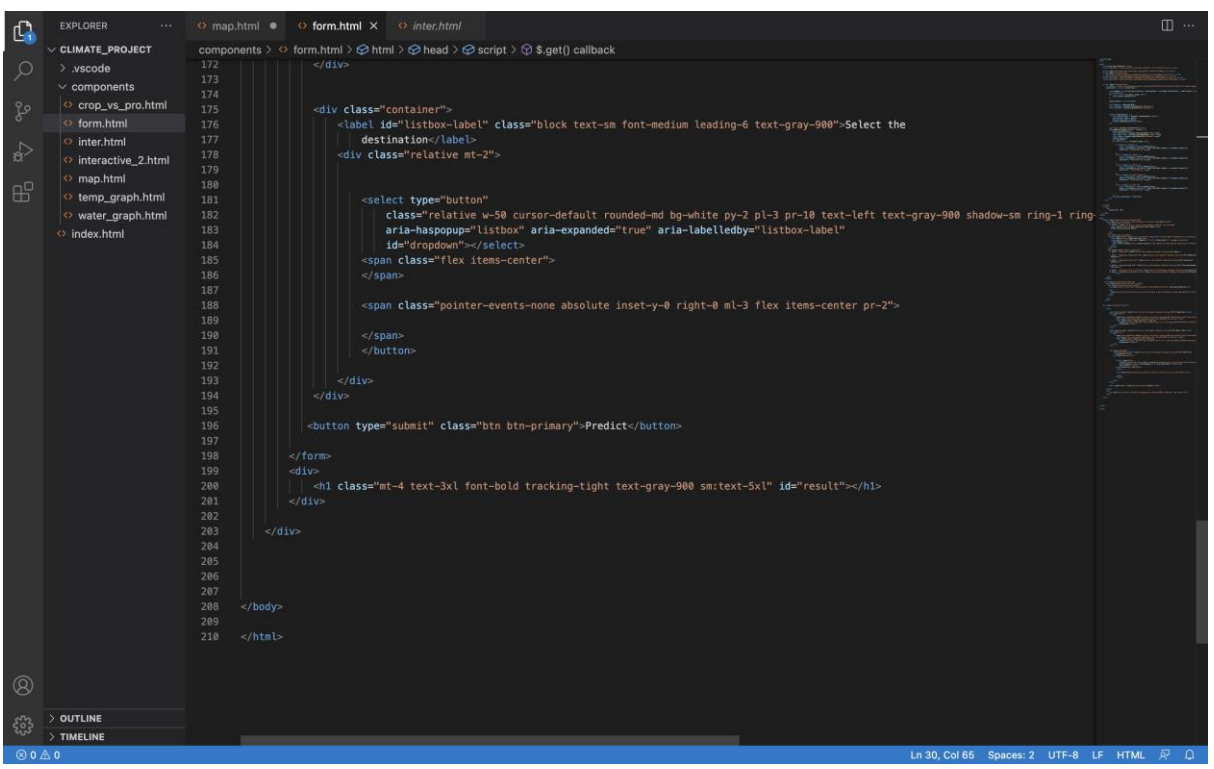


Fig 37: Prediction Code5

Explanation:

The above HTML and JavaScript code generates a prediction of the kind of crop that can be grown given the inputs of temperature, the availability of water, and the time of year using SVM algorithm of machine learning.

Importing Chart.js, jQuery, and jQuery-CSV are JavaScript libraries that are brought into the code at

the beginning. After that, a CSV file pertaining to agriculture is loaded into the system. The program then reads the CSV file, extracts the season information, and utilizes it to create a select box with the appropriate options. To get an estimate of the anticipated yield, the user first selects a season, then inputs factors pertaining to temperature and water, and then hits the "submit" button.

The script then makes a prediction as to the sort of crop that will be grown during the given season, and it shows this guess on the web page by making a random selection from the CSV file. The program makes use of a for loop to go through the data and choose the appropriate crop type for the current season, taking into account the calendar.

The header of a website contains a label "Crop type prediction." The header is included inside a <header> element, and it contains a <nav> element that contains navigation for the whole site. The website's logo is included inside an <a> element that also has the words "Global Agriculture Data Center." The actual links themselves are included inside <a> components, and these components contain text that provides a description of the website that will be visited as a result of clicking the link.

A div element with a padding of 48 pixels on small displays and 18 pixels on large displays is used to divide the "Crop type prediction" section from the rest of the content. This part is accessible only on devices with smaller screens.

The code asks for information like current temperature and water level, and then sends the data to the user's chosen location. There are three input fields on the form. We can enter a temperature in Celsius in the corresponding text box. A "temp" id and a "temperature" name are assigned to the field. The temperature input field is a "number" type with the word "Celsius" as a default value. The water level input area accepts a reading from the user. The "water" identifier and the "username" label define the field. The temperature input field is a "number" type. Next, users may choose their destination from a pre-populated selection. The "dropdown" id-defined field has a "Select the destination" label. Last but not least, the user may submit the form by clicking the "Predict" button at the very end. The code given does not contain the server-side script that processes the form data. A div element with the id "result" is also used to show the outcome of the prediction.

Code for Control Dashboard Interactivity-2:

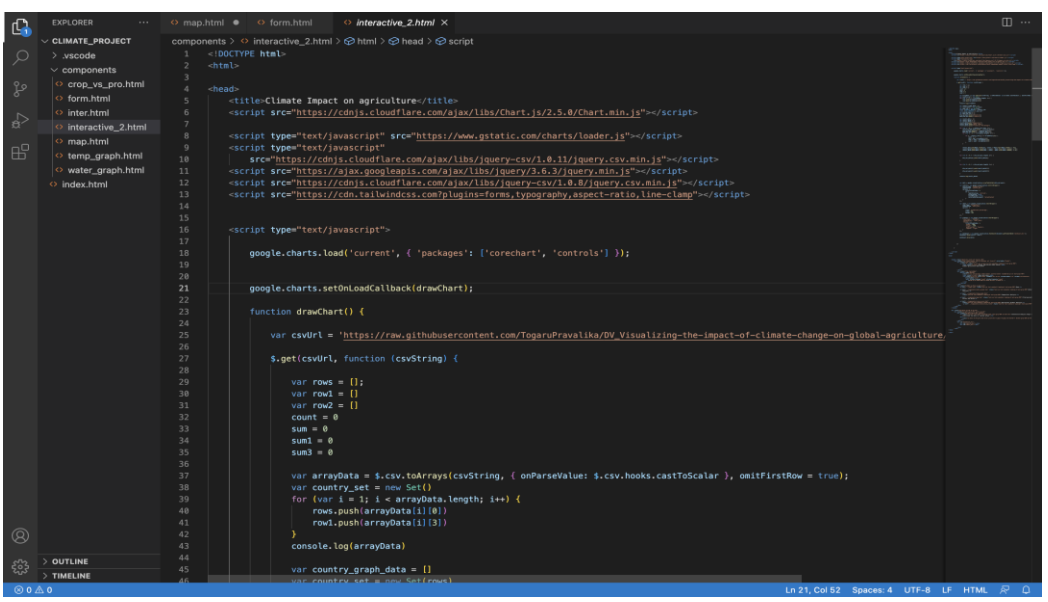


Fig 38: Control Dashboard2 Code1

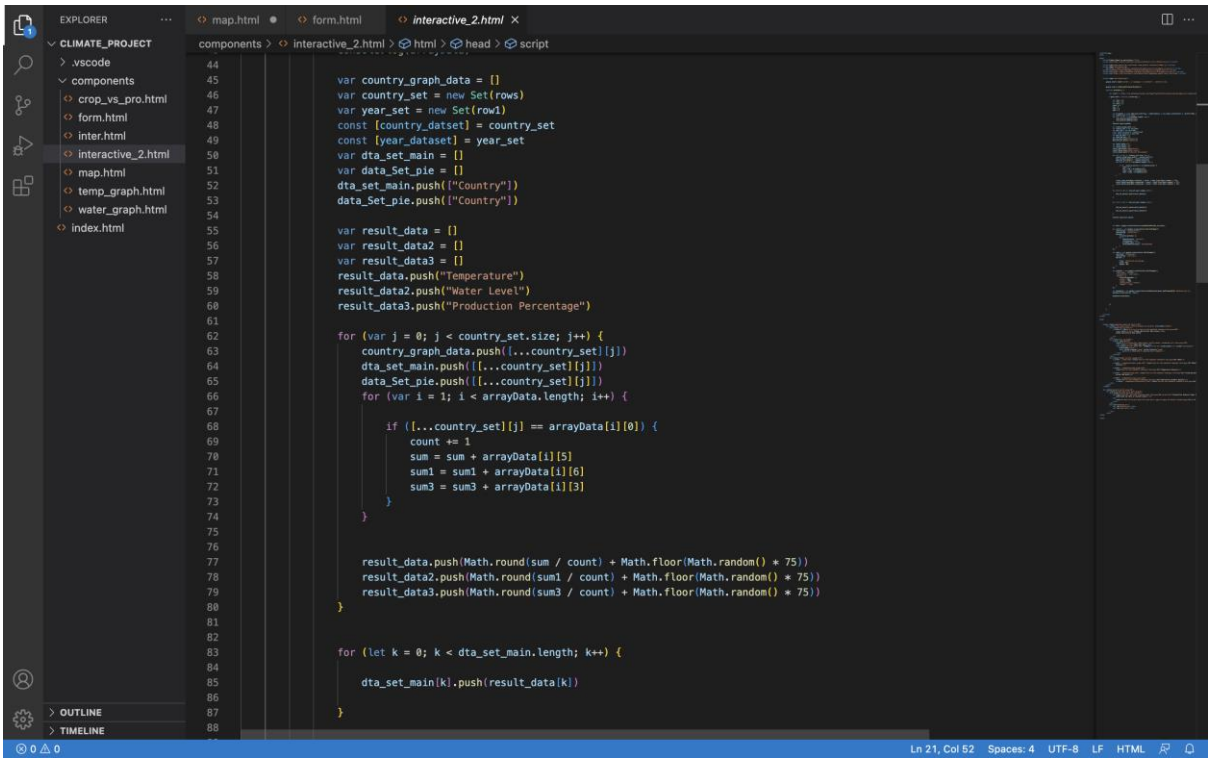


Fig 39: Control Dashboard2 Code2

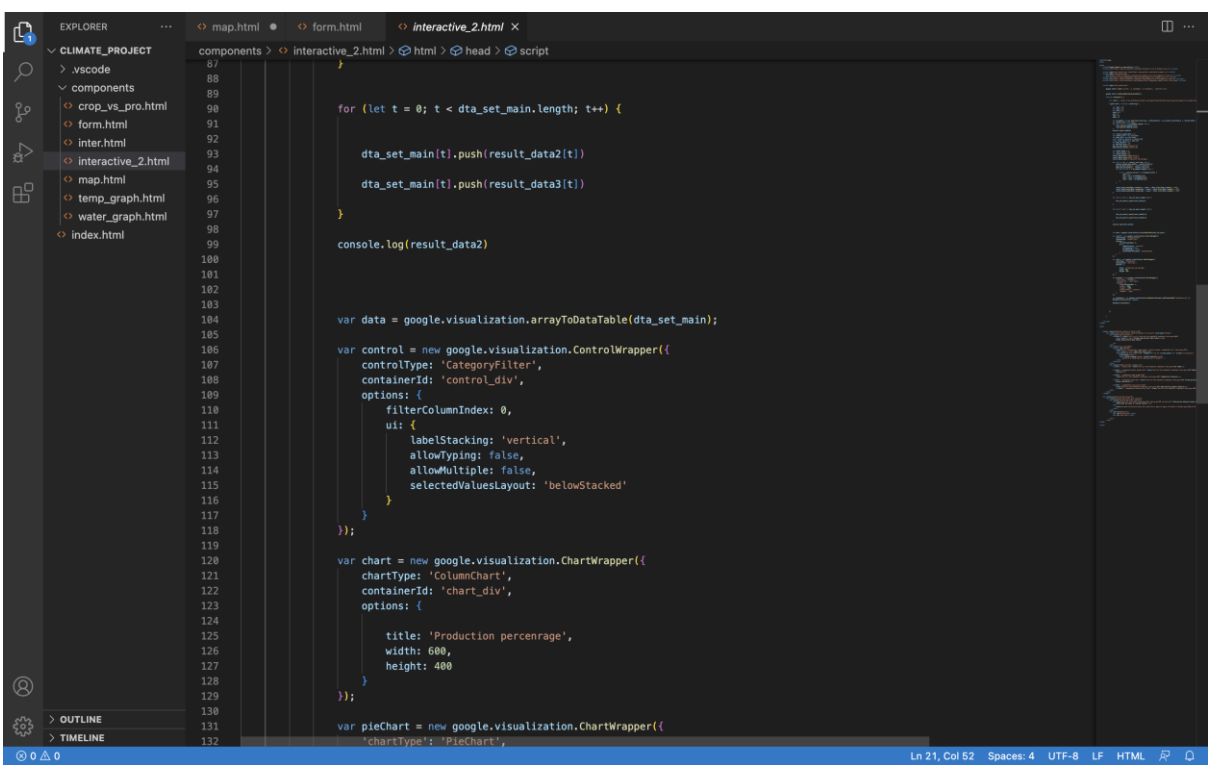
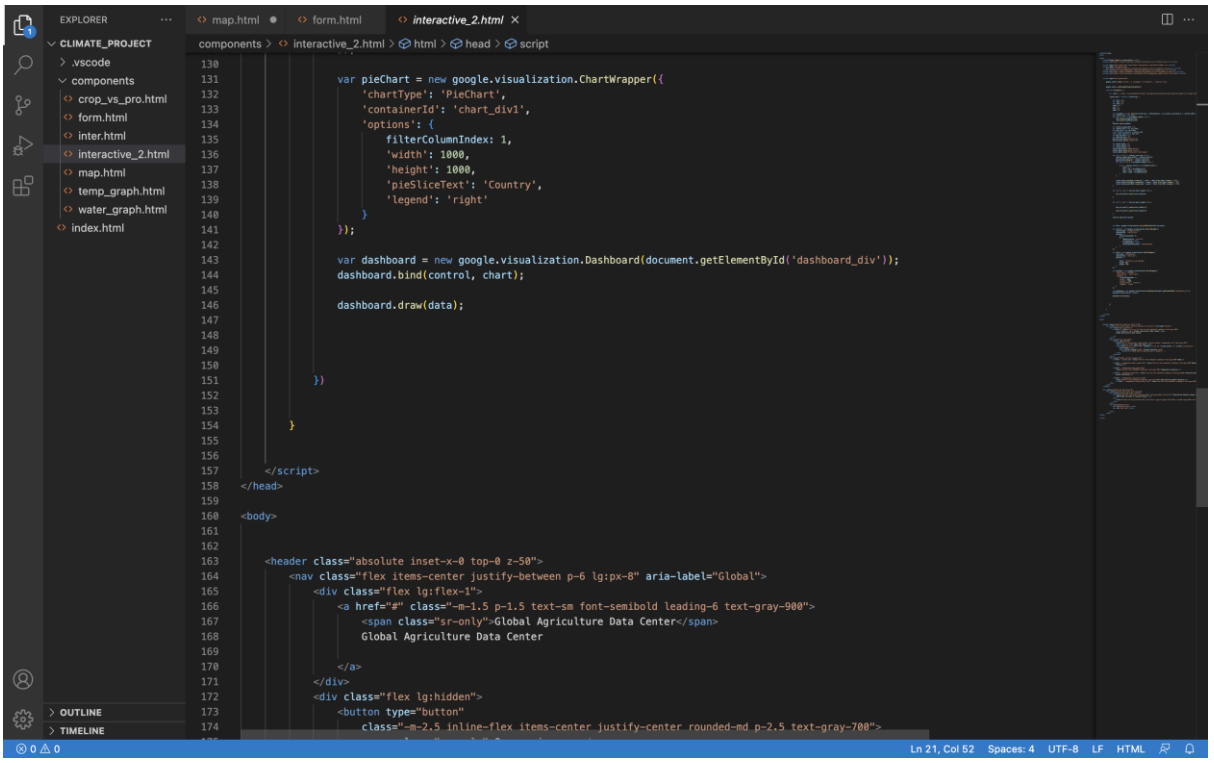
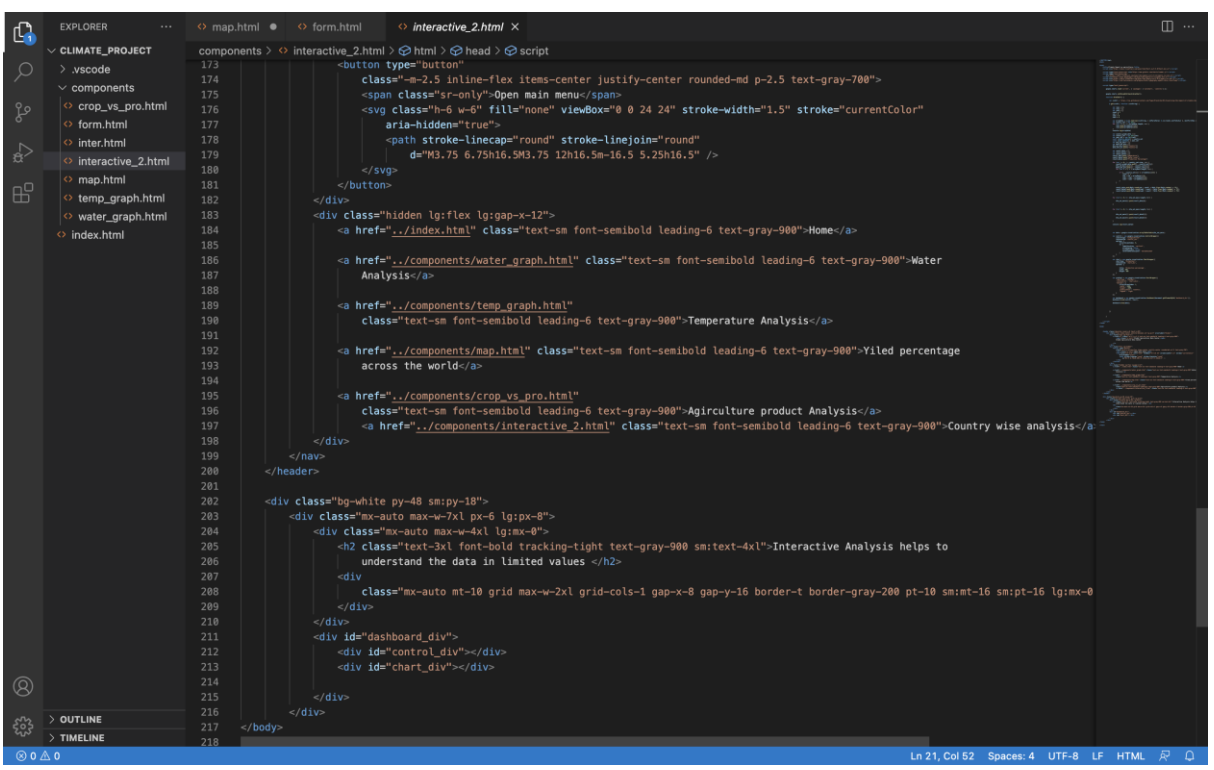


Fig 40: Control Dashboard2 Code3




```
                var pieChart = new google.visualization.ChartWrapper({
                    'chartType': 'PieChart',
                    'containerId': 'chart_div1',
                    'options': {
                        filterColumnIndex: 1,
                        'width': 1000,
                        'height': 1000,
                        'pieSliceText': 'Country',
                        'legend': 'right'
                    }
                });

                var dashboard = new google.visualization.Dashboard(document.getElementById('dashboard_div'));
                dashboard.bind(control, chart);

                dashboard.draw(data);



            })


        }


    </script>
</head>

<body>


    <header class="absolute inset-x-0 top-0 z-50">
        <nav class="flex items-center justify-between p-6 lg:px-8" aria-label="Global">
            <div class="flex lg:flex-1">
                <a href="#" class="-m-1.5 p-1.5 text-sm font-semibold leading-6 text-gray-900">
                    <span class="sr-only">Global Agriculture Data Center</span>
                    Global Agriculture Data Center

                </a>
            </div>
            <div class="flex lg:hidden">
                <button type="button"
                    class="-m-2.5 inline-flex items-center justify-center rounded-md p-2.5 text-gray-700">
```

Fig 41: Control Dashboard2 Code4




```
                    <button type="button"
                        class="-m-2.5 inline-flex items-center justify-center rounded-md p-2.5 text-gray-700">
                        <span class="sr-only">Open main menu</span>
                        <svg class="h-6 w-6" fill="none" viewBox="0 0 24 24" stroke-width="1.5" stroke="currentColor"
                            aria-hidden="true">
                            <path stroke-linecap="round" stroke-linejoin="round"
                                d="M3.75 6.75h16.5M3.75 12h16.5m-16.5 5.25h16.5" />
                        </svg>
                    </button>
                </div>
                <div class="hidden lg:flex lg:gap-x-12">
                    <a href="../index.html" class="text-sm font-semibold leading-6 text-gray-900">Home</a>

                    <a href="../components/water_graph.html" class="text-sm font-semibold leading-6 text-gray-900">Water
                        Analysis</a>

                    <a href="../components/temp_graph.html"
                        class="text-sm font-semibold leading-6 text-gray-900">Temperature Analysis</a>

                    <a href="../components/map.html" class="text-sm font-semibold leading-6 text-gray-900">Yiled percentage
                        across the world</a>

                    <a href="../components/crop_vs_pro.html"
                        class="text-sm font-semibold leading-6 text-gray-900">Agirculture product Analysis</a>
                    <a href="../components/interactive_2.html" class="text-sm font-semibold leading-6 text-gray-900">Country wise analysis</a>
                </div>
            </nav>
        </header>

        <div class="bg-white py-48 sm:py-18">
            <div class="mx-auto max-w-7xl px-6 lg:px-8">
                <div class="mx-auto max-w-4xl lg:mx-0">
                    <h2 class="text-3xl font-bold tracking-tight text-gray-900 sm:text-4xl">Interactive Analysis helps to
                        understand the data in limited values </h2>
                    <div
                        class="mx-auto mt-10 grid max-w-2xl grid-cols-1 gap-x-8 gap-y-16 border-t border-gray-200 pt-10 sm:mt-16 sm:pt-16 lg:mx-0
                    </div>
                </div>
                <div id="dashboard_div">
                    <div id="control_div"></div>
                    <div id="chart_div"></div>

                </div>
            </div>
        </div>
</body>
```

Fig 42: Control Dashboard2 Code5

Explanation:

This HTML page contains JavaScript applets, and it is used in conjunction with the Google Charts API to make dynamic charts of agricultural data. A number of different CDN libraries, such as Chart.js, Google Charts, jQuery, and Tailwind CSS, are loaded at the very beginning of the script's execution. The drawChart() function is activated after the Google Charts library has been loaded into memory by the script. The $.get() method is used by this procedure in order to get the agricultural data CSV file from the URL that was provided. After that, the $.csv.toArrays() method is called upon to convert

the CSV text into an array of arrays. Following that, the data is processed in order to build further arrays that will be used in the construction of the charts. The drawChart() function creates a category filter as well as two chart wrappers so that the data may be shown more clearly. By using the category filter, users are able to see data pertaining to a certain country, and the column chart and pie chart wrappers provide the information in column and pie chart formats, respectively.

The function builds a Google Charts dashboard by combining the category filter with the two chart wrappers. The dashboard is then rendered on the HTML page when the function has finished. The interactive data can be shown in a div that is located inside the main content area, which also has a title and is separated from the rest of the material by a section that has a navigation menu. In addition to that, the footer has a search bar in one of its sections. The header of the website often has a navigation component that showcases the website's logo and provides links to various other areas of the website. The appearance of the links may either be arranged in a row or completely hidden, depending on the size of the screen.

The major content section features a headline that reads "Interactive Analysis helps to understand the data in limited values," as well as a div with the ID "dashboard_div" that has two child divs with the IDs "control_div" and "chart_div." The headline reads "Interactive Analysis helps to understand the data in limited values." In order for users to be able to filter the data that is being shown, these divs are going to be utilized for displaying interactive data and controls.

Preliminary Result for Analysis:

Below are the UI screenshots that we get after running the code file. At first, the user will navigate to the webpage in chrome after successful execution. We can see Water Analysis, Temperature Analysis, Yield percentage across the world, Interactive chart, and Crop metric analysis tabs on the interface along with their description in the below feature page. When we click on get started, it will automatically take us to water analysis. Let’s predict option will navigate to prediction page where the algorithm can predict which crop to be produced after we give our inputs for temperature, water level and season based on the last 3 years yield production.

Below are the components that we can see on the UI page:

- Home
- Get Started and Let’s predict
- Water Analysis
- Temperature Analysis
- Yield percentage across the world
- Agriculture product Analysis
- Interactive Analysis
- Country wise analysis/ Crop metric analysis

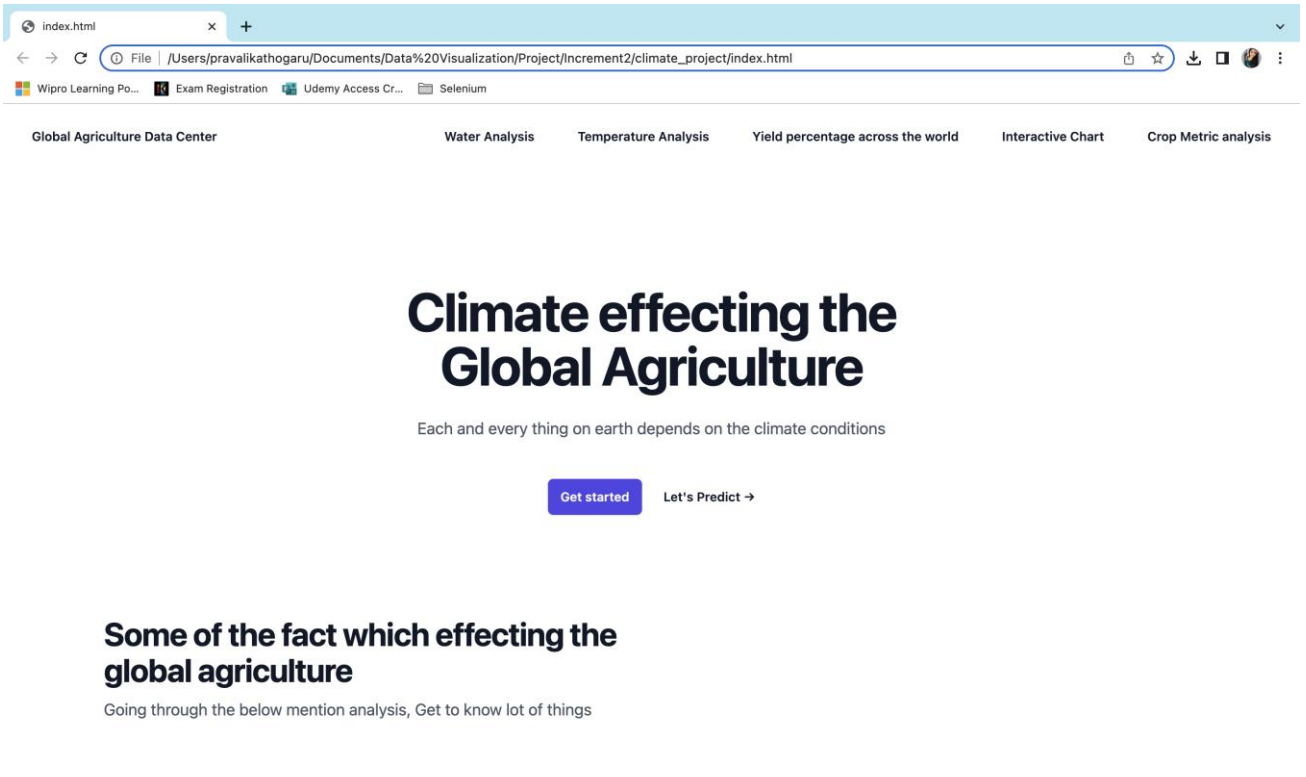


Fig 43: UI Page

Below is the feature page where we can see all the features, analysis and its description. Below are the features that we have added in our project.

- Stacked bar analysis
- Temperature analysis
- Crop growth percentage 2021-2022
- Crop yield percentage between 2020-2022
- Interactive analysis of water levels in the different countries.
- Analysis of combine crop growth components by country wise

All the above features has below parts which describe what the particular feature do.

- Feature Description: The feature name and feature description can be used to get the information about the feature.
- Facts: This part will gives us some facts related to the particular feature.
- What kind of graph used: Here, we have used stacked bar charts, geo chart, pie chart and simple bar charts for visualizations. So, for every feature, we can see the related graph used for analysis.
- What kind of algorithm used: This gives us what kind of algorithm used in our project for prediction feature. Here, we have used SVM algorithm from machine learning.
- Comparing attributes: We can see what attributes are compared in that particular feature.
- Dashboard: What kind of dashboard used and what it does.

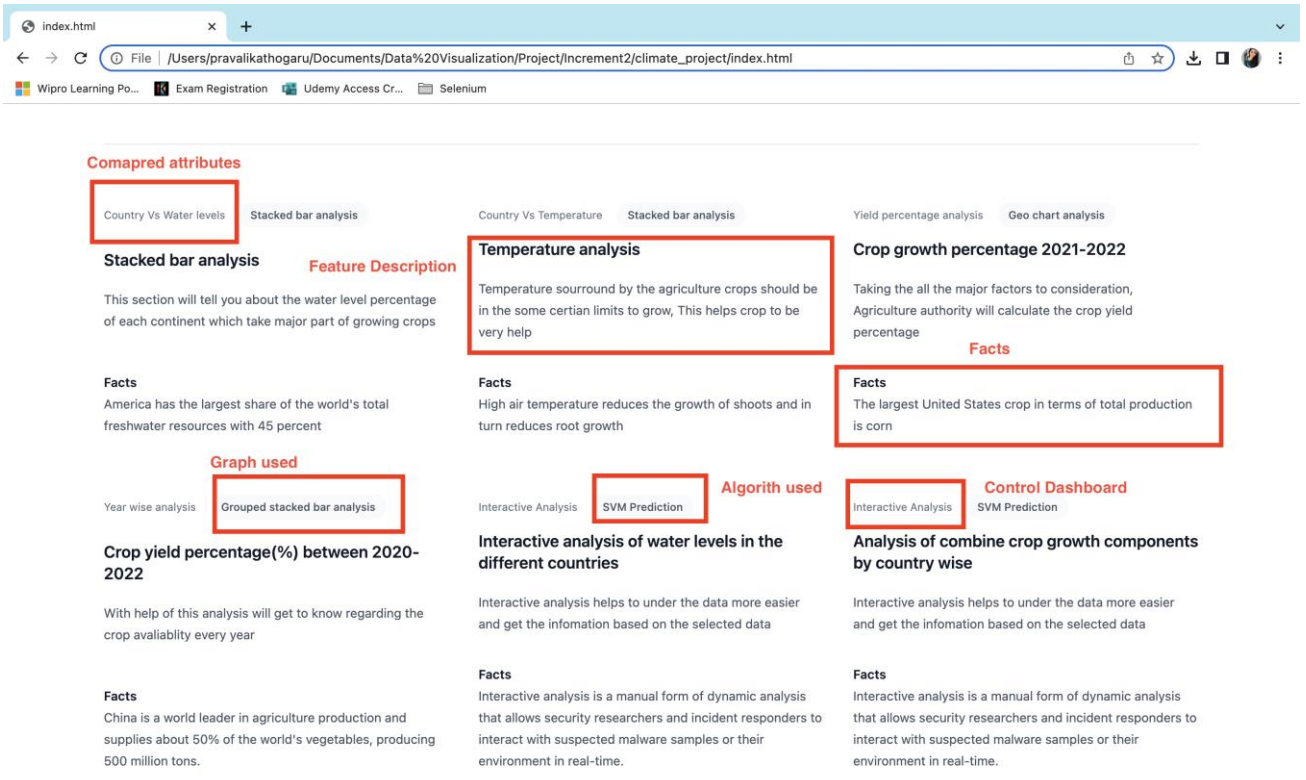


Fig 44: Feature page

Below is the stacked bar analysis of water level for 3 years from 2020 to 2022. It gives water level information of 17 different countries each assigned with different colour. This is a country Vs Water level graph where we have represented countries as colour legends which can also be used as selection object, X and Y axis are water level and years respectively. Therefore, we will get information about water level available in each country for yield production for the last three years. We have also added tooltip which gives us details about year, country selected and its water level.

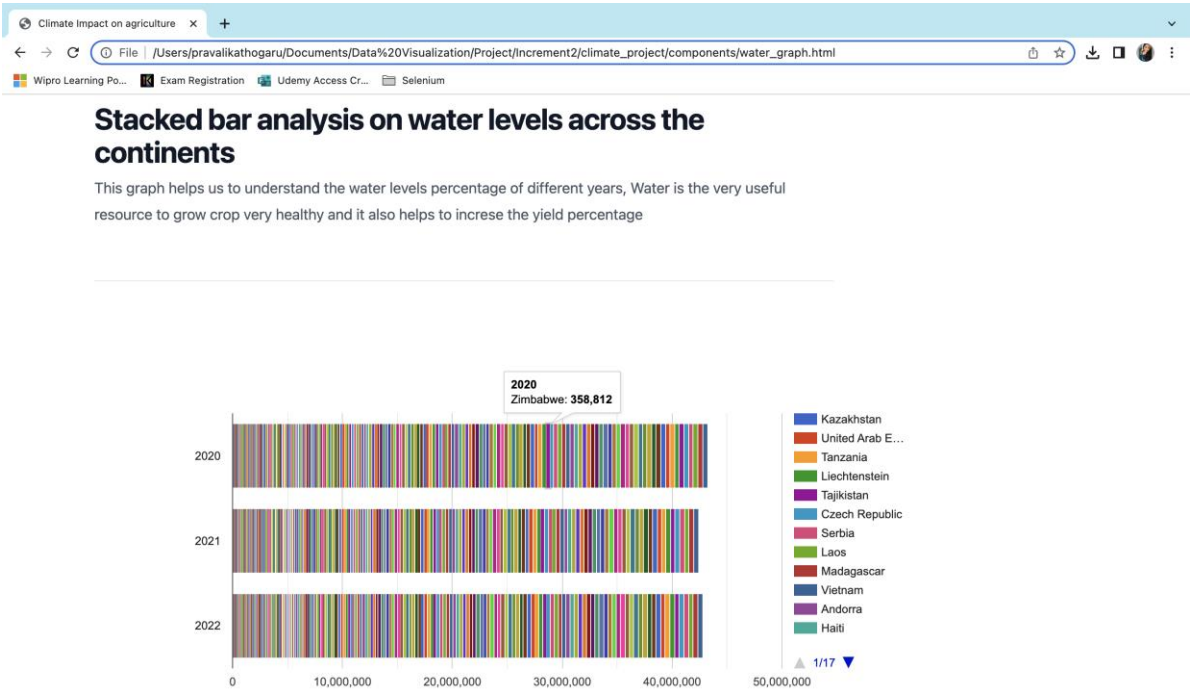


Fig 45: Stacked bar analysis water level vs country

Below is the stacked bar analysis of temperature for 3 years from 2020 to 2022. It gives temperature information of different countries each assigned with different colour. This is a country Vs Temperature graph where we have visualized countries as colour legends which can also be used as selection object, X and Y axis are temperature and years respectively. Therefore, we will get information about temperature in each country for yield production for the last three years. We have also added tooltip which gives us details about year, country selected and its temperature level.

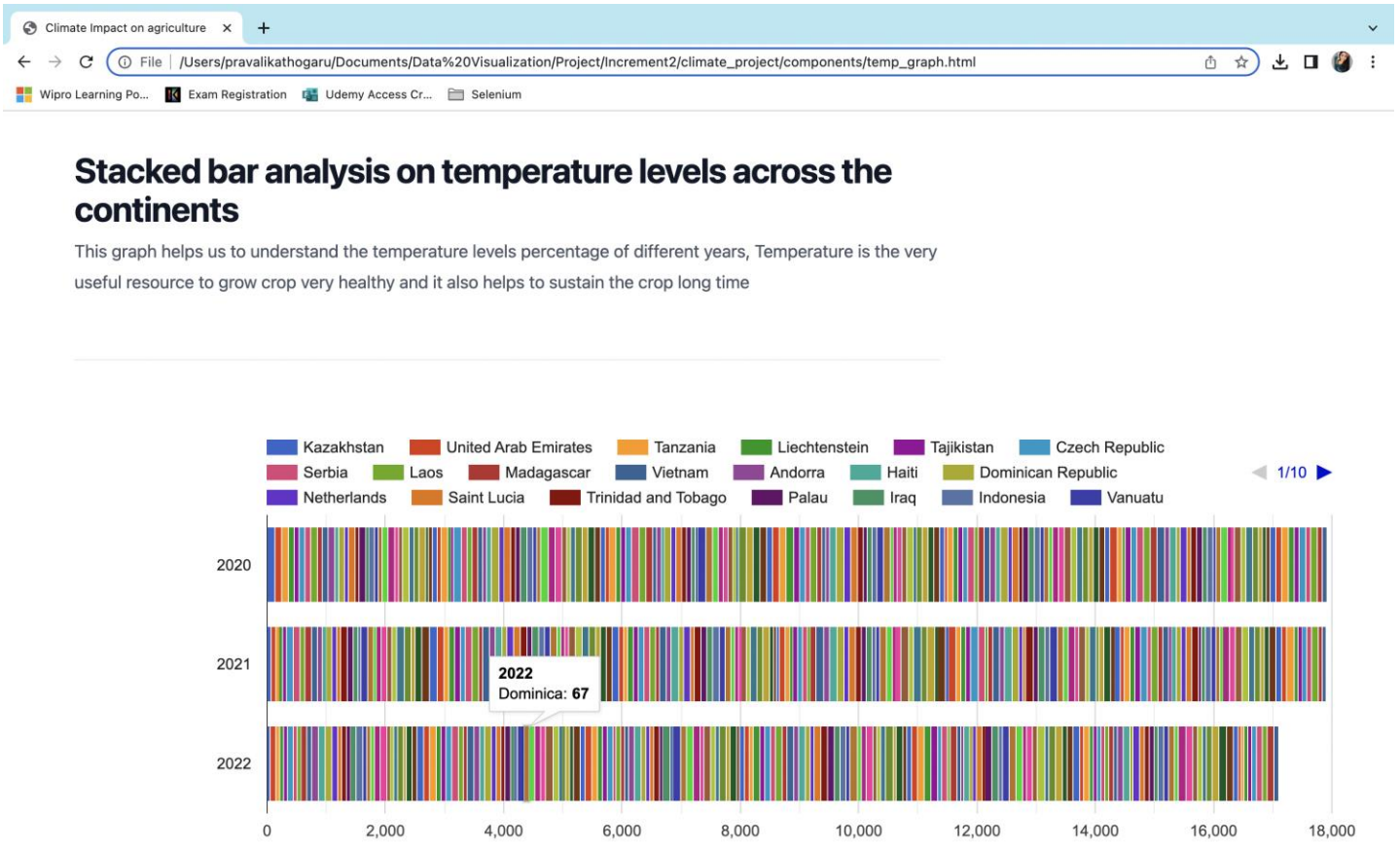


Fig 46: Stacked bar analysis Temperature vs country

Below is the Geo chart analysis which gives yield production in each country. Least production is represented in red colour, while highest is in green. When we place the cursor or click on any country, then we can see the sliding line below will be enabled and shows the production level place for the selected country using its arrow mark. We have also added tooltip which gives us details about country selected and production in percentage.

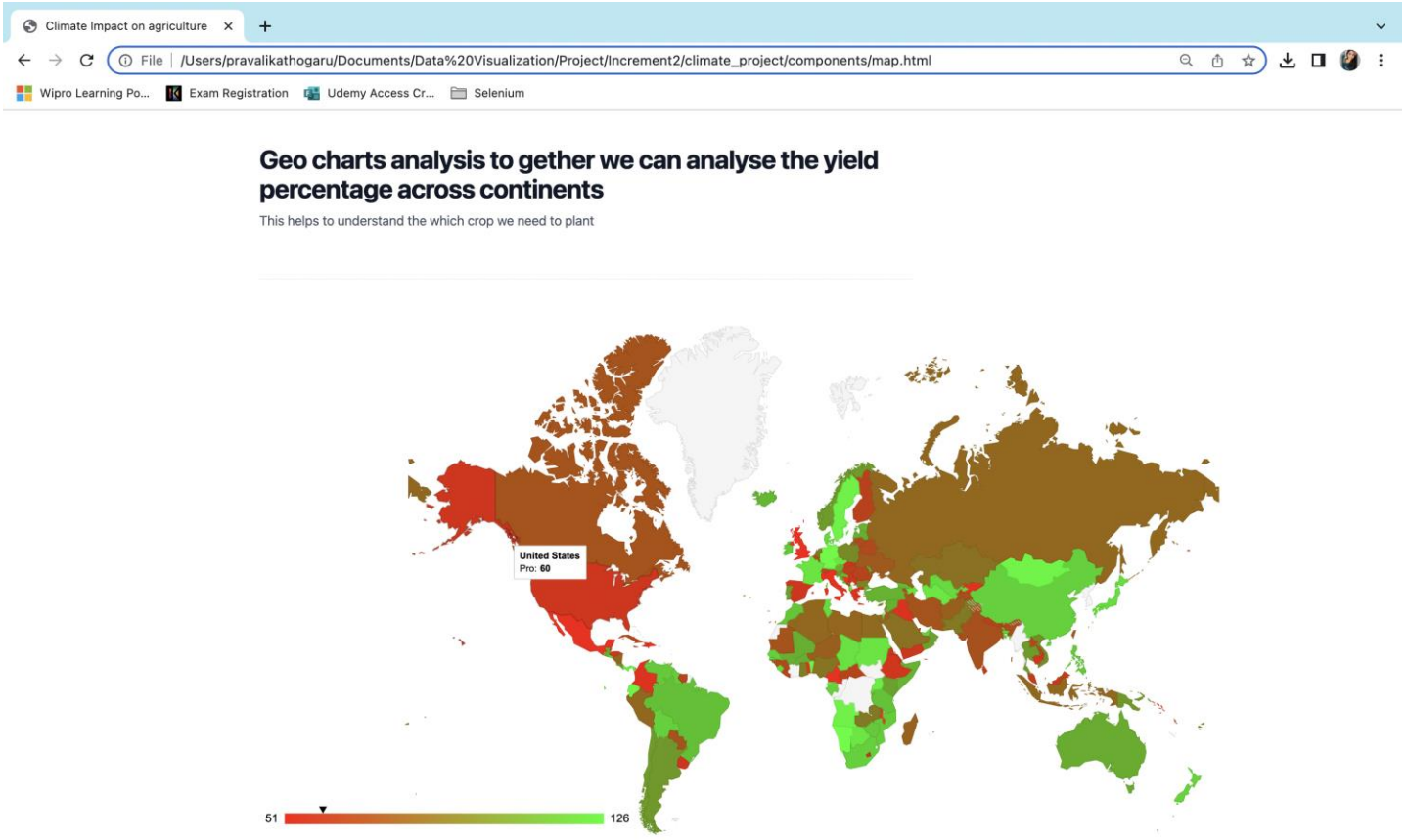


Fig 47: Yield Production vs Country Geo chart Analysis

Below is the Pie chart interactive analysis using slider. This is also represented as control dashboard. It has a slider which acts as a controlling element which gives production percentages of countries as a whole from last three years in pie chart after selecting the range in the scale. Suppose if we give slider values as 120-200, it will give all the countries which has yield production within that value from last 3 years and in the pie chart, we can see yield percentage contribution as a whole for the countries within that value.

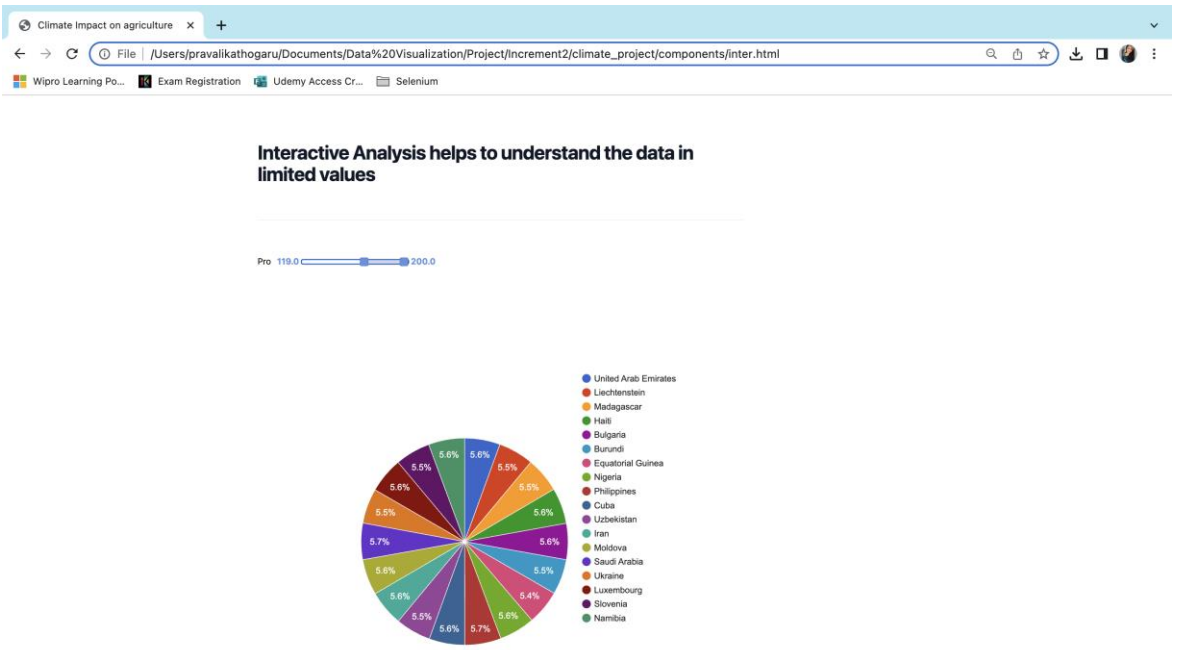


Fig 48: Control Dashboard1

Below graphs shows that we have added a tooltip which gives yield percentage of selected country along with profit and also added selection object such that upon clicking on any country colour legend, the corresponding pie will get highlighted.

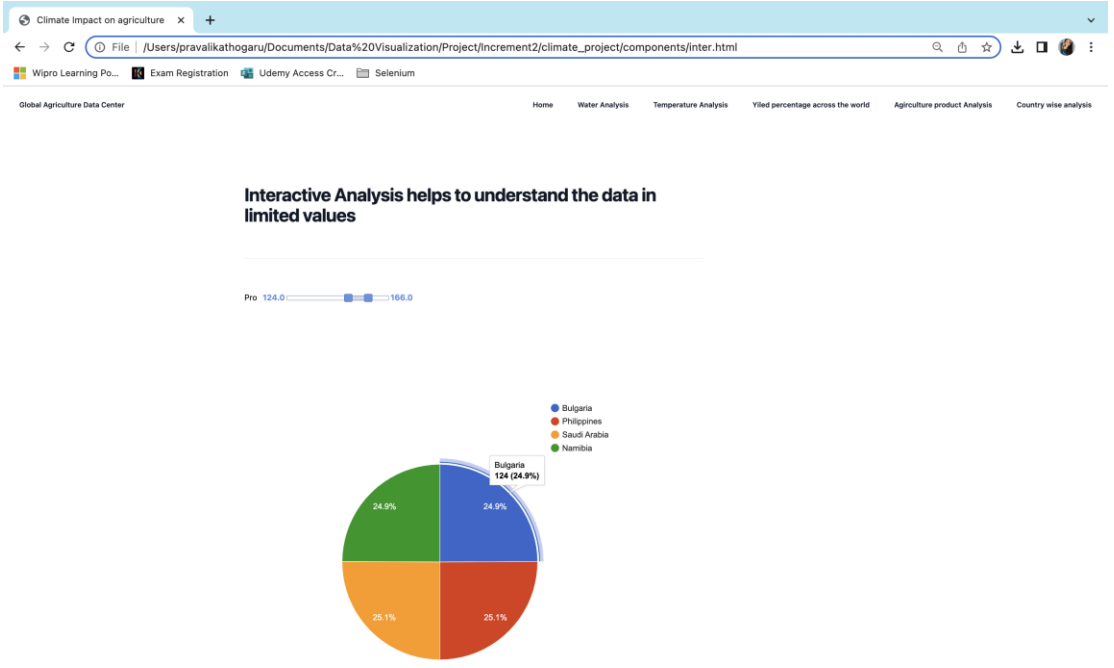


Fig 50: Control Dashboard1 tooltip

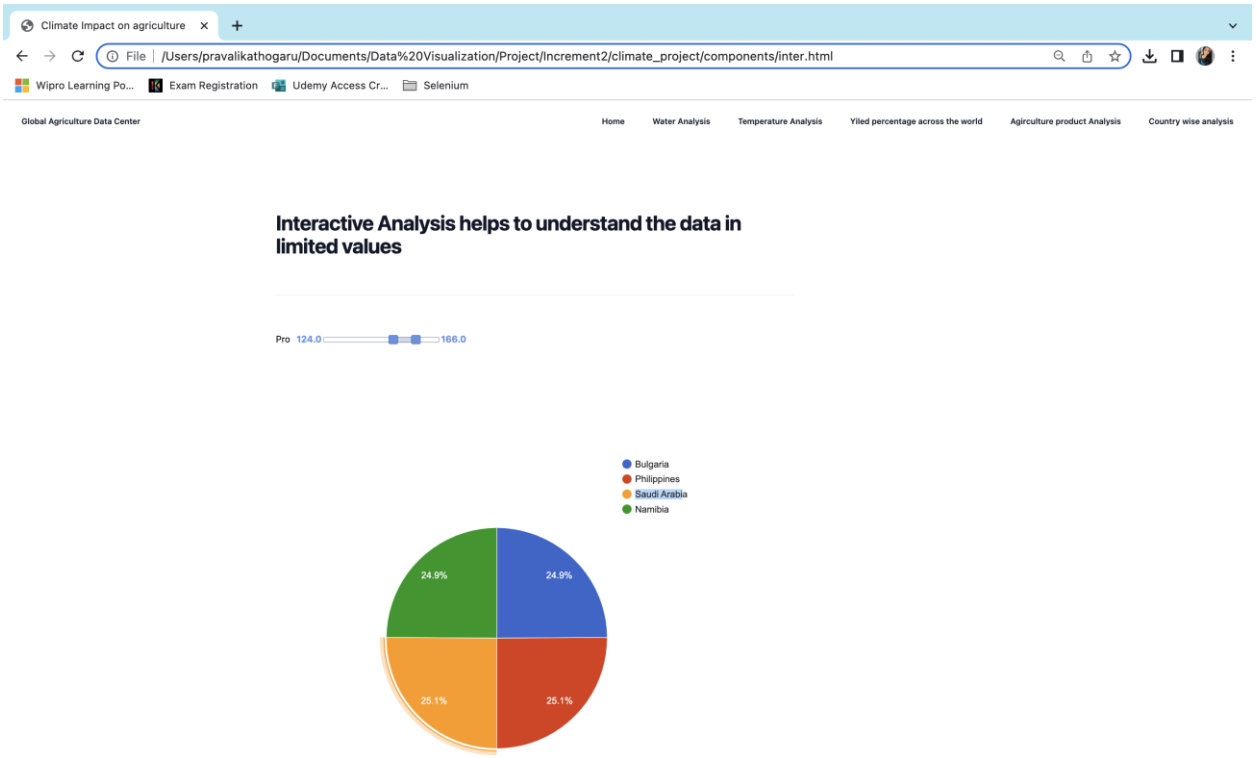


Fig 51: Control Dashboard1 selection object

Below is the stacked bar graph for yield Production of 7 Agricultural crops for the last three years. The different crops here are wheat, Palm oil, Cotton, Maze, Apples, Sugar Cane, and Paddy. Here, we have added a tooltip which gives information about the crop name and its yield percentage in that particular year. The X and Y axis here are yield production percentages and crop types respectively. The years are represented as colour legends which also acts as selection objects such that by clicking on any year, the corresponding year will get highlighted.

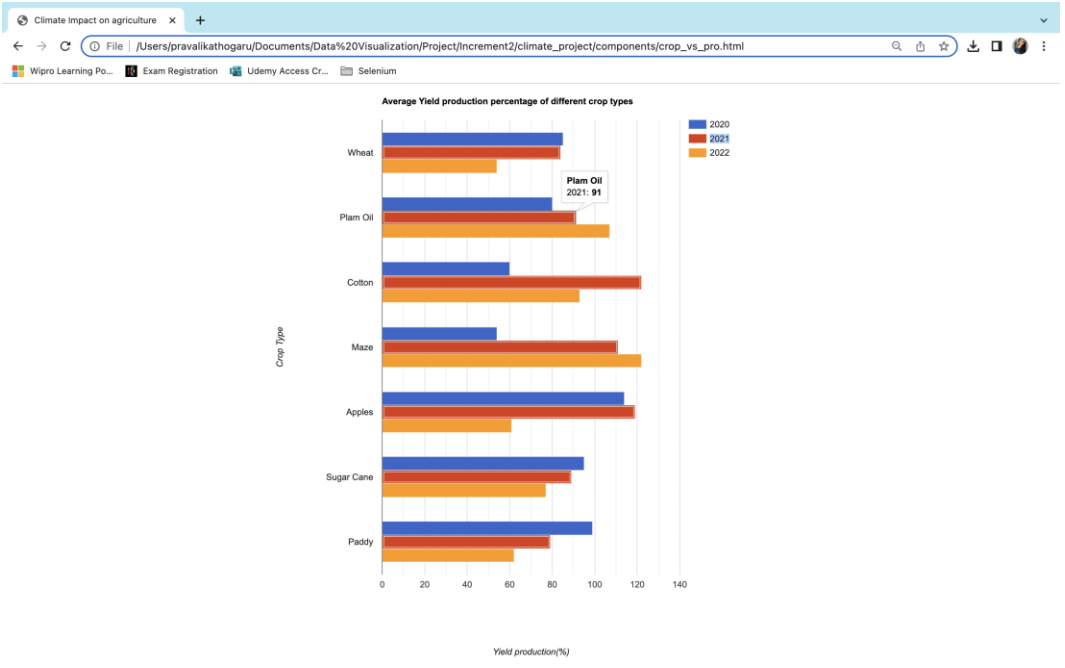


Fig 51: Bar graph for average yield production of different crop

Below graphs shows the control dashboard where choosing country will serve as a controlling element such that upon selection, the corresponding water level, temperature and yield production can be seen along with its value which is added in tooltip. We can also see that the corresponding bar will get highlight upon selection of colour legend. Here, the X and Y axes are Country and its yield production in percentage respectively.

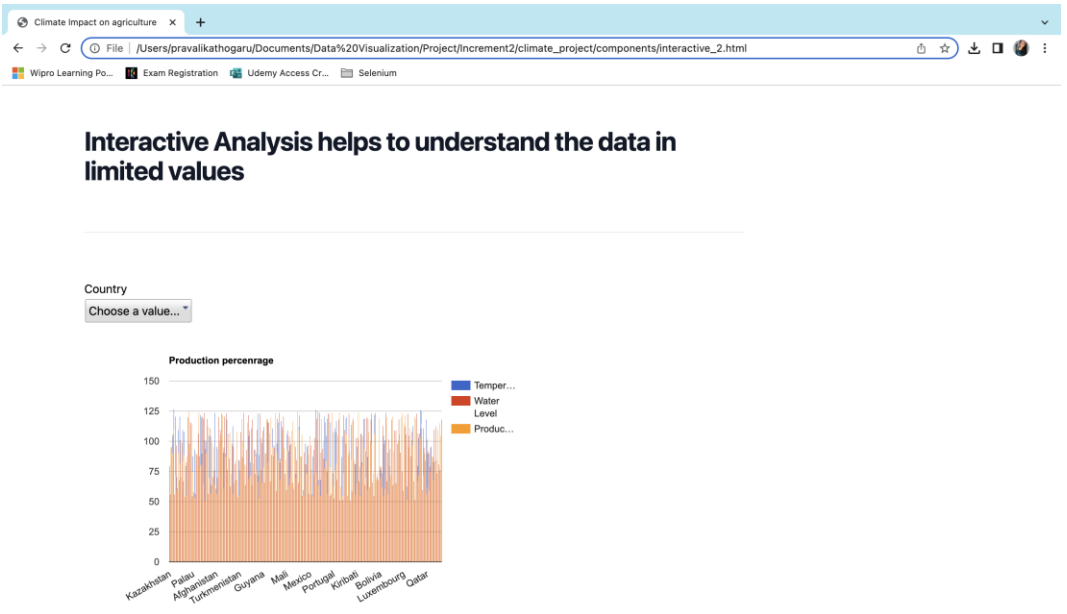


Fig 52: Control Dashboard2

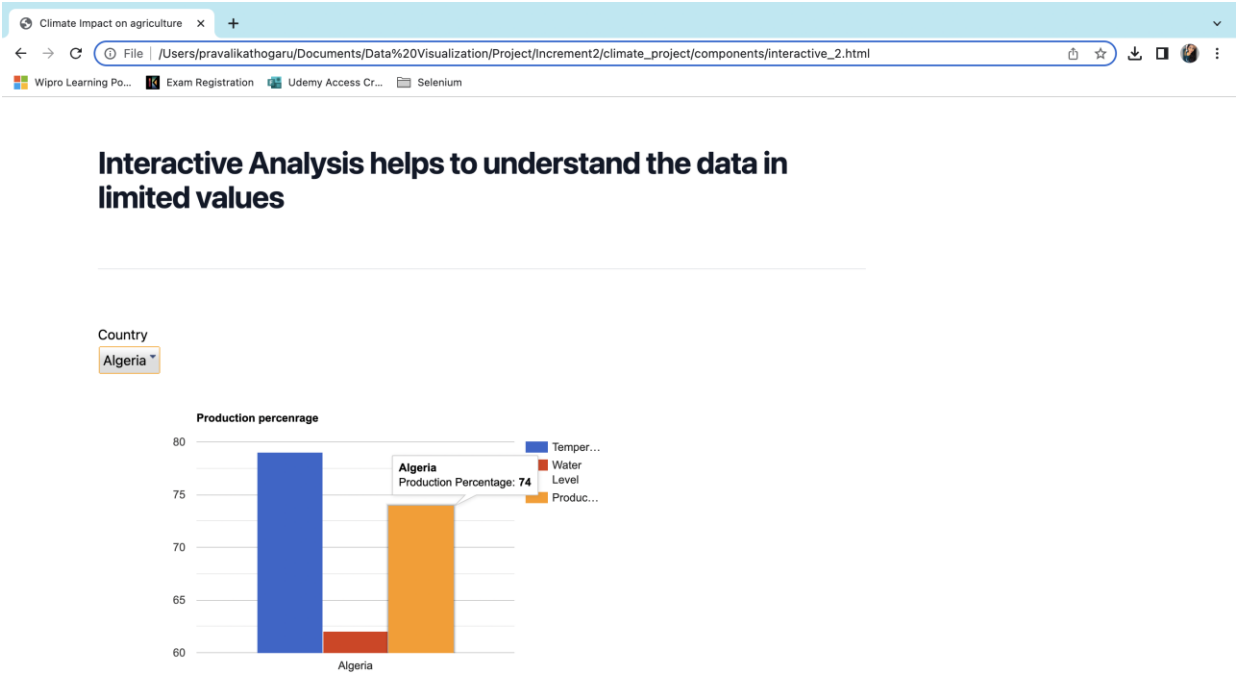


Fig 53: Control Dashboard analysis

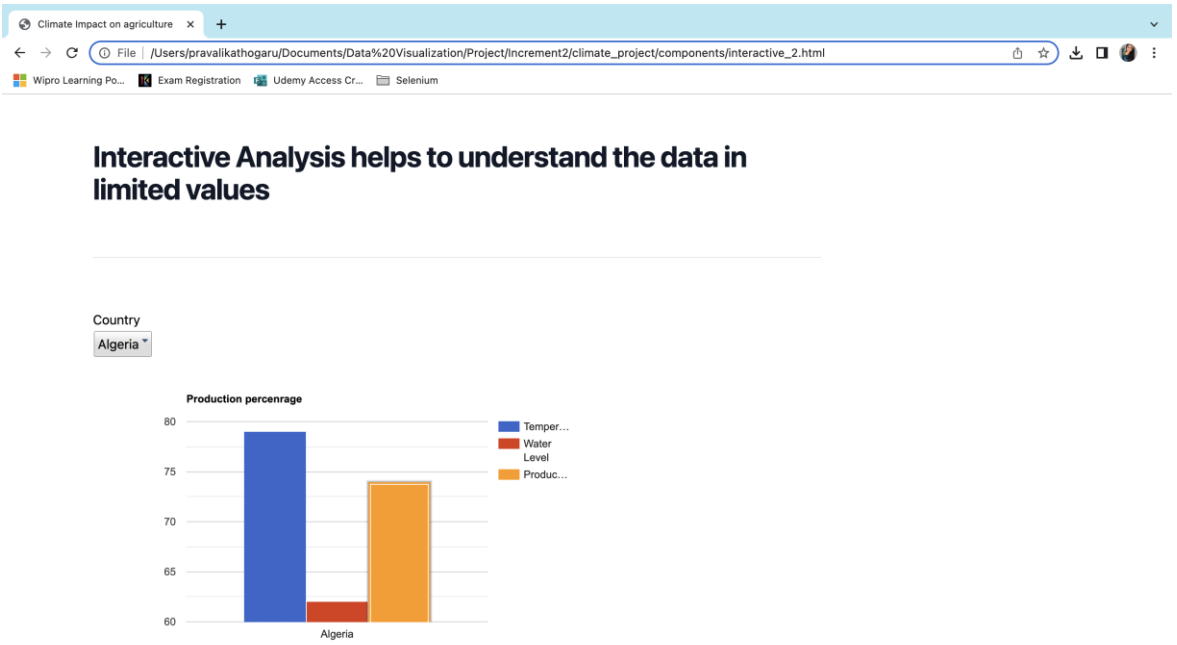


Fig 54: Control Dashboard highlighter

The dashboard also has a pie chart representation which gives information about yield percentage as a whole around the whole and also with its percentage added in the tooltip.

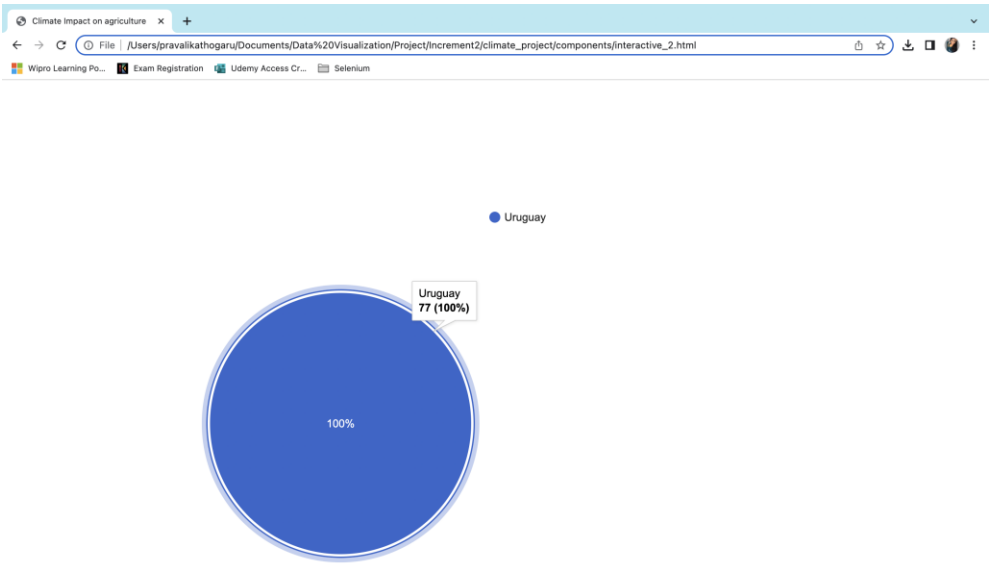


Fig 55: Control Dashboard analysis using dashboard

Below is the UI that we get after clicking on lets predict option. The components included here are Temperature, Water Level, Destination selection and predict option. The user need to give the temperature and water level values, and select the destination season to predict the crop.

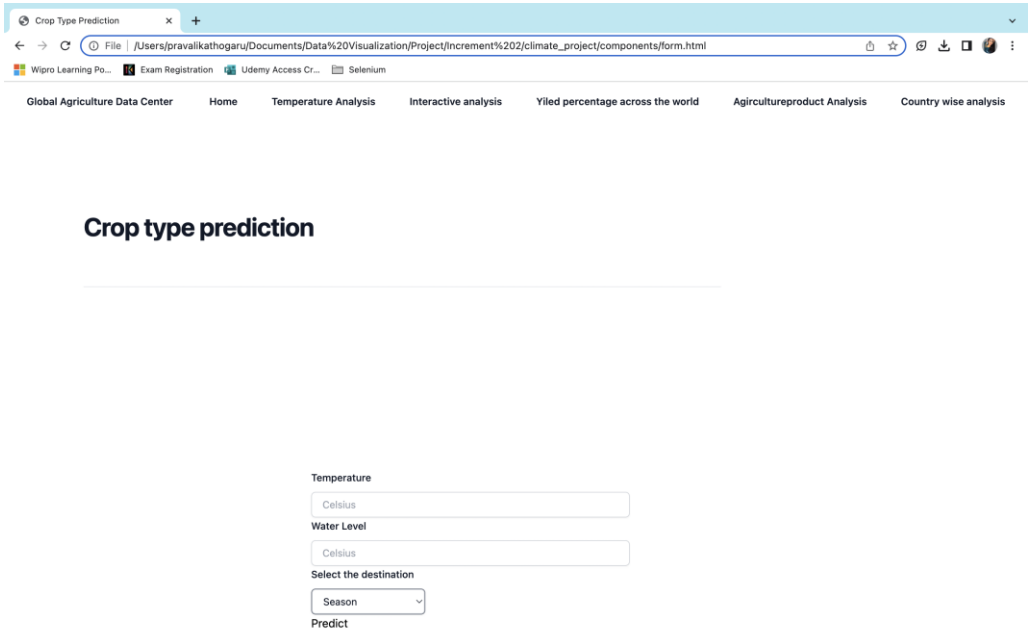


Fig 56: Prediction UI

After entering the values, we need to click on predict button such that the system will predict which crop needs to be produced based on our given values i.e., water-level, temperature and season. For example, we can see in the below screenshot, we have enter the water-level and temperature values as 12 and 30,000,00 respectively and selected rainy season, and then clicked on predict. The predicted output can be seen below, in this case the output printed is “Predicted Crop Apples”. Here, we have used SVM machine learning algorithm for prediction.

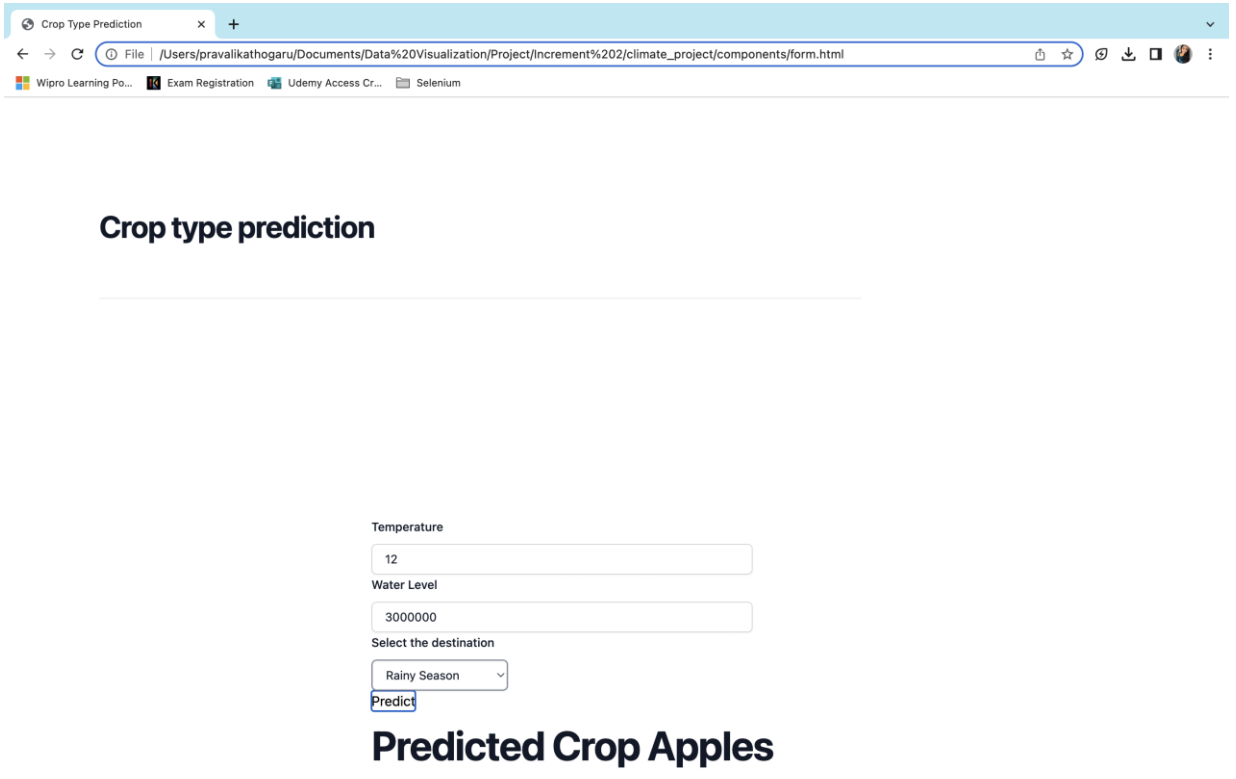


Fig 57: Prediction output

We have also created the visualizations using tableau tool. Following are the graphs created using tableau.

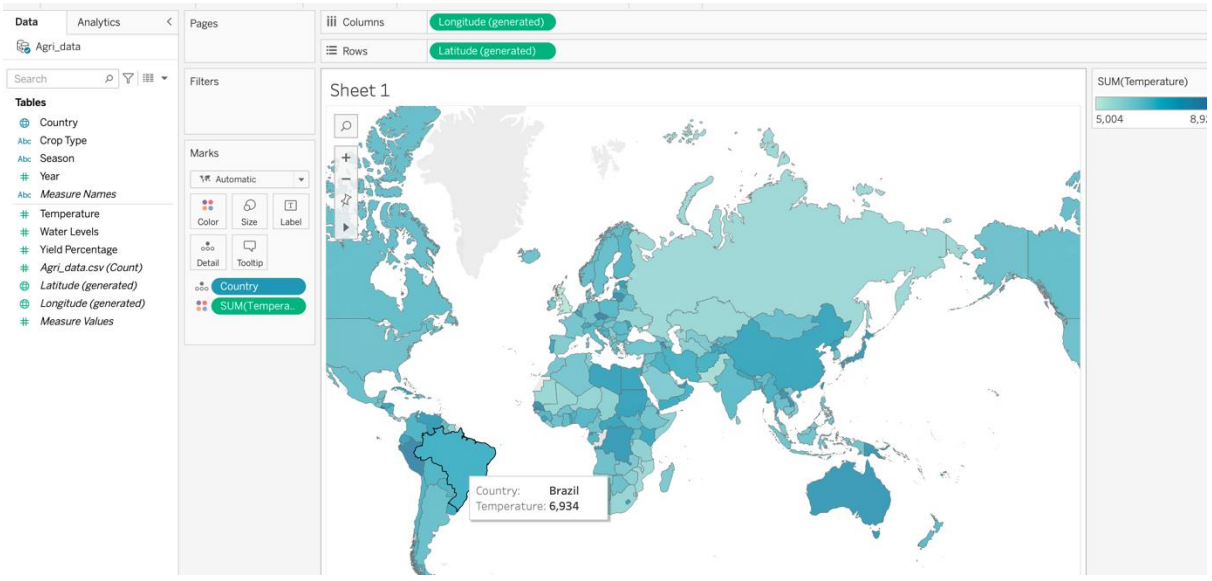


Fig 58: Prediction output using tableau

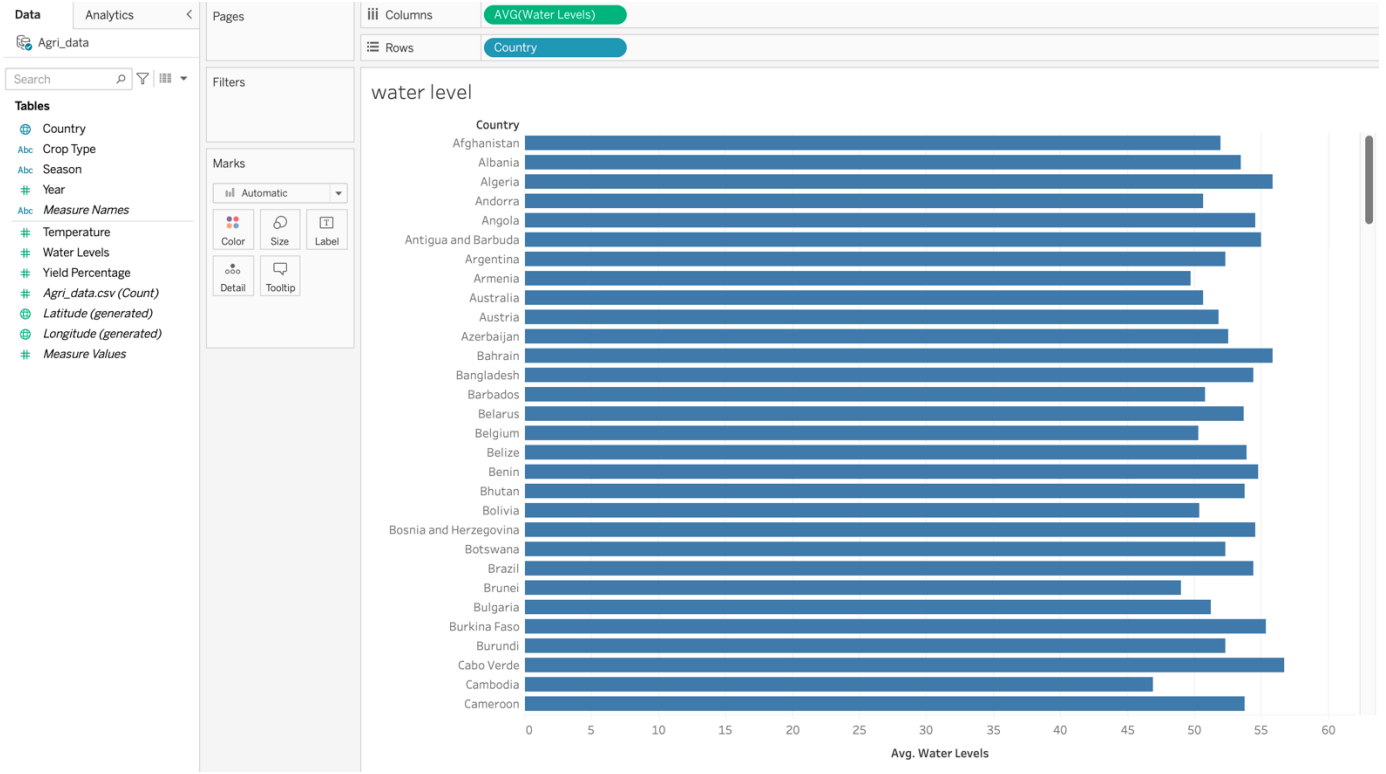


Fig 57: Prediction output using tableau

Story Telling:

Chapter 1:

Who:

As a result of climate change's effects on agriculture around the world, farmers and rural communities who rely on agriculture for their livelihoods and food security are among the most in need of assistance. Along with the farmers, the food production companies also relies on this analysis.

What :

Climate change can cause droughts, floods, and heat waves, all of which have negative effects on crop yields, quality, and planting/harvesting windows. Pests and illnesses can become more common as a result of climate change, reducing crop productivity and quality. It is possible that changes in precipitation patterns and the melting of snow and ice will reduce the amount of water available for irrigation, livestock, and human use. The soil's fertility and productivity may be negatively impacted by climate change due to the increase in soil erosion, salinization, and desertification. These impacts will also be responsible for predicting the yield production.[1]

When:

We have been dealing with the effects of climate change for decades, if not centuries. Over the past few decades, scientists and policymakers have paid a great deal of attention to the topic of climate change and its effects on agriculture around the world. But, recently because of various impacts or effects, climate change is a hot topic everywhere.

Where:

Climate change and its effects on farming around the world are a serious challenge. Human activities including burning fossil fuels, deforestation, and industrial operations send greenhouse gases into the atmosphere, which leads to climate change. Rising temperatures, altered precipitation patterns, and more severe weather are all results of the greenhouse effect caused by these gases. Developing nations, where agriculture is a crucial source of revenue and food security, are particularly vulnerable to the effects of climate change on their agricultural sector. More exposed to the effects of climate change, these nations typically lack the means and technology necessary to adapt to the phenomenon. Extreme weather events can cause crop failures and disruptions in global food supply networks, which affects not only developing nations but also the industrialized ones as a result of climate change. The food production companies will also face many challenges due to negative impacts of the climate change.

As a worldwide problem, climate change and its effects on agriculture are felt everywhere. While the specific effects of climate change on crops and regions may differ, they are universal. Extreme weather events have become more common and intense as a result of climate change in some areas, while in others it has contributed to flooding and soil erosion. Climate change and extreme weather have the potential to reduce crop production, which in turn might increase food insecurity, push up food costs, and destabilize economies.

Why:

Human actions and their impact on the environment may be the root of the problem of climate change and its effects on agriculture around the world. The emission of greenhouse gases into the atmosphere is the primary cause of climate change because they trap heat and raise global temperatures. Human activities, including as burning fossil fuels for energy, deforestation, and industrial operations, are the biggest contributors to these greenhouse gases. Greenhouse gas emissions have increased significantly as a result of these activities since the industrial revolution. The degradation of natural resources like soil and water due to human activities like overfarming, deforestation, and pollution also contributes to the impact of climate change on global agriculture. These actions have decreased soil fertility and water availability, making it harder for farmers to grow crops and support themselves. Also, these days people are more relying on deforestation for building companies or factories, and buildings **which** will highly impact on climate change.

How:

The emissions of greenhouse gases, changes in land use, and the deterioration of natural resources all play a role in the "how" of climate change and its impact on global agriculture. Human activities such as burning fossil fuels for energy and transportation, deforestation, and agricultural practices like animal rearing are the primary causes of greenhouse gas emissions. The capacity of forests and other natural ecosystems to absorb carbon dioxide from the atmosphere is diminished as a result of changes in land use, such as deforestation, which also contributes to climate change. The depletion of carbon stores is a major factor in the rise of atmospheric greenhouse gas concentrations. Another aspect that adds to climate change's effect on agriculture worldwide is the depletion of natural resources like soil and water. Soil erosion, decreased soil fertility, and decreased water availability are all problems that farmers face as a result of human activities including overfarming, overgrazing, and the use of chemical fertilizers and pesticides. Because of all these impacts, the production of crops will get effected in a negative way which will directly have negative impact on farmers especially.

Chapter 2:

WHO:

After all the research we have gone through one particular data set called agri_data which consist of 25K rows of data and 6 columns those are Country, Crop_type, Season, Water_levels, Temperature_levels, Yield percentage.

WHAT:

We have observed some of the events through over data those are season, Crop_type these attributes are taken from the survey from the farmers, With the help of those event and behaviour mentioned we have taken these columns these for analysis Country, Crop_type, Season, Water_levels, Temperature_levels, Yield percentage. These dataset will be useful for the prediction we have done in increment2

WHEN:

The data is cross-sectional in nature and was gathered during the previous three years. Real-time data is not present in the dataset. The exact research question will determine how old the data is and how broadly generalizations can be drawn throughout time to guide.[4] Here, in our project the prediction is done based on the data for the last years which we have provided.

WHERE:

The dataset has a broad geographic scope because it was gathered from farmers all around the world. The dataset does not include geographic information (GIS), but it does contain data at the country level. Depending on the individual research issue, generalizations can be made across settings to varying degrees.[3] We have choosen these dataset after conducting survey among few farmers.

WHY:

The information was gathered in order to research how different countries' crop yields are affected by water and temperature levels for different seasons and also based on this information, we have done prediction analysis.

HOW:

A survey of farmers conducted over the previous three years led to the creation of the agri_data dataset. Researchers or volunteers visited farms in several nations as part of the survey and recorded data on the crops being cultivated, the water and temperature conditions, and the yield percentage. A dataset of 25,000 rows and 6 columns was created once the data had been collected and organized. The survey may have used digital or paper forms, and the information may have been recorded into a database or spreadsheet for analysis. Overall, a process of data gathering, organization, and analysis, probably including several people and tools, was used to build the dataset. The survey helped us on various problems or challenges faced by farmers after climate change.

Chapter 3:

Who:

The Application can educate users on the severity and urgency of climate change by showing its effects on agriculture around the world. This can encourage people, groups, and governments to take action against climate change and support environmentally sound farming methods. A better understanding of the influence of climate change on agricultural production in different parts of the world can be gained with the aid of this application. Researchers, policymakers, and farmers can use this information to better prepare for the impacts of climate change on agriculture. Providing users with the data they need to make educated choices about agricultural practices, investments, and policymaking is one of the application's primary goals. As a result, food insecurity, economic losses, and environmental degradation can be avoided and farmers and policymakers can make more sustainable and climate- resilient decisions. The prediction analysis done in this project will be helpful for farmers especially for prediction which graph to produce based on the water and tempereature levels.

What:

After collecting and analyzing data, we built a web-based UI interface that provides easy data access and visualization for users. The user's landing page is where numerous UI elements are displayed. Another set of UI components is the feature component, which lets the user choose and choose among our features; upon clicking on a feature, a unique visualization is generated, And provides a stacked bar analysis of water levels versus countries, which is useful for visualizing the wide range of water and temperature conditions across regions. We have provided a geo chart analysis that will aid in learning the precise values of yield output. The UI will also display some facts regarding the particular feature.

When:

The user can use the application or visualization of climate change's effects on agriculture around the world whenever it's convenient for them. Also can be used by researchers and analysts to study and draw conclusions from the data. Moreover it can be used by students, teachers, and the general public to gain a better grasp of the science behind the effects of climate change on agriculture and to promote the value of environmentally responsible farming practices. This prediction analysis system can be used by anyone or will be useful for anyone who is interested in agriculture related information.

Where:

Several factors, including the intended audience, the visualization's features and functions, and the application's technological needs, can affect how widely the visualization of climate change's influence on global agriculture is implemented. The prediction analysis can also be used in different methodologies for major researches.

The visualization and application can be used in the following scenarios:

Via the web: The Application can be made available via the web, so it can be accessed from any device with an internet browser. With this method of deployment, changes can be made quickly and to a large audience.
Mobile app: The Application can be made into a mobile app that can be installed on a user's smartphone or tablet computer. Push alerts, geolocation services, and offline access are just some of the features that can be made available with this deployment method.
The use of VR and AR technology: The app may be used to function on VR and AR headsets, giving users access to more immersive and interactive experiences as they learn about the effects of climate change on agriculture around the world.

How:

By interacting with the visualization, users can gain insight into how global agriculture is being impacted by climate change. They may examine and analyze indicators over multiple countries and time periods, including crop yields, water availability, temperature, and precipitation patterns. The user can use this to better understand the effects of climate change on farming. The user can utilize the chart to keep tabs on their development. The user can observe how climate change is affecting agriculture through time and how different policies and practices are influencing results by comparing data from different time periods. This might show the user where they are succeeding and where they need to put in more effort. The visual representations will help people to analyze the production level in various countries.

Project Management:

- **Implementation status report:**
  - Work Completed in Increment-1:
    - **Description:**

      Visualising the impact of climate change in global agriculture using water-level, temperature dataset

    - **Responsibility:**

      Data Gathering - VAMSHI SOLETI

Data Transformation -SAIPRIYA AMBATI
Data Migration to API -SRIRAM VORUGANTI
Data Logics - PRAVALIKA TOGARU
JavaScript Coding and Graph Visualisations- SRIRAM VORUGANTI & PRAVALIKA TOGARU
Web UI -VAMSHI SOLETI & SAIPRIYA AMBATI

- **Contributions:**
  - SRIRAM VORUGANTI – 11647099 (https://github.com/Sriram-Voruganti/Climate-change-project)-25%
  - PRAVALIKA TOGARU – 11637604 (https://github.com/TogaruPravalika/DV_Visualizing-the-impact-of-climate-change-on-global-agriculture)-25%
  - VAMSHI SOLETI – 11637574 (https://github.com/vamshisoletii/climate-change)-25%
  - SAIPRIYA AMBATI – 11664407 (https://github.com/Saiipriiya/dv- increment1)-25%

Implementation status report:

- Work Completed in Increment-2:
  - **Description:**

    Crop cultivation predict using the SVM Algorithm, and control dashboard representation of different visual analysis.

  - **Responsibility:**

    SVM Algorithm – PRAVALIKA TOGARU & SRIRAM VORUGANTI
    Dashboard Script – VAMSHI SOLETI & SAIPRIYA AMBATI

  - **Contributions:**
    - SRIRAM VORUGANTI – 11647099 (https://github.com/Sriram-Voruganti/Climate-change-project)-25%
    - PRAVALIKA TOGARU – 11637604 (https://github.com/TogaruPravalika/DV_Visualizing-the-impact-of-climate-change-on-global-agriculture)-25%
    - VAMSHI SOLETI – 11637574 (https://github.com/vamshisoletii/climate-change)-25%
    - SAIPRIYA AMBATI – 11664407 (https://github.com/Saiipriiya/dv- increment2)-25%

References:

1.Mahato, Anupama. "Climate change and its impact on agriculture." International Journal of Scientific and Research Publications 4.4 (2014): 1-6.

2. Robert Mendelsohn, Chapter 60 Past Climate Change Impacts on Agriculture,
Editor(s): R. Evenson, P. Pingali,
Handbook of Agricultural Economics,
Elsevier,
Volume 3,
2007,
Pages 3009-3031,
ISSN 1574-0072,
ISBN 9780444518736,
https://doi.org/10.1016/S1574-0072(06)03060-X.
(https://www.sciencedirect.com/science/article/pii/S157400720603060X)

3. Francesco N. Tubiello, Günther Fischer,
Reducing climate change impacts on agriculture: Global and regional effects of mitigation, 2000–2080,
Technological Forecasting and Social Change,
Volume 74, Issue 7,
2007,
Pages 1030-1056,
ISSN 0040-1625,
https://doi.org/10.1016/j.techfore.2006.05.027.
(https://www.sciencedirect.com/science/article/pii/S0040162506001417)

4. Bello, O. B., O. T. Ganiyu, M. K. A. Wahab, M. S. Afolabi, F. Oluleye, S. A. Ig, J. Mahmud, M. A. Azeez, and S. Y. Abdulmaliq. "Evidence of climate change impacts on agriculture and food security in Nigeria." International Journal of agriculture and Forestry 2, no. 2 (2012): 49-55.