Wildfire Challenge – Team PSR

Application instance is deployed in H2O AI cloud and it can be accessed using the following URL.

**Instance ID**: 001f7563-5768-437e-8553-b6c00f296ed2

**URL**: <https://001f7563-5768-437e-8553-b6c00f296ed2.challenge.h2o.ai/>

# Description of the Solution

The H2O.ai Wildfire challenge focuses on a solution to be directly applied into numerous organizations that are working towards preventing and reducing the occurrences of wildfires (a.k.a. bushfires). The solution which is presented here can be used for predicting the severity of a wildfire on a specific geo-location based on the weather data of the relevant day.

Severity of a wildfire is ranging from values **0 to 5000+**. The higher the severity it represents a more critical wildfire. According to the severity, wildfire size can be categorized into following classes.

Table - Wildfire Size Categorization [1]

|  |  |  |
| --- | --- | --- |
| Severity Value | Class | Class Description |
| 0 | None | No fire hazard |
| 0.1 – 0.2499 | Class A | one-fourth acre or less |
| 0.25 – 9.99 | Class B | more than one-fourth acre, but less than 10 acres |
| 10 – 99.99 | Class C | 10 acres or more, but less than 100 acres |
| 100 – 299.99 | Class D | 100 acres or more, but less than 300 acres |
| 300 – 999.00 | Class E | 300 acres or more, but less than 1,000 acres |
| 1000 - 4999 | Class F | 1,000 acres or more, but less than 5,000 acres |
| 5000 and above | Class G | 5,000 acres or more |

## Inputs to the model

The prediction system accepts several inputs if the user needs to get predictions for a wildfire. Following image shows the user interface for inputting data which is required for the system (Model) to predict the severity parameter for the given geo-location.

Geo-Location can be viewed using the “**Mark on the Map**” or “**Converting Zip Code”** button and selecting the desired point using the graphical map of the region. After the point is selected, coordination data can be input to the system manually using Latitude & Longitude.

The system needs user to pick a date which the user wants the system to predict the wildfire on the desired geo-location. Ideally the above application can be modified to fetch the current date and time from the Internet thus the user doesn’t get to input the date. Main reason the application has designed in this way manner is due to complexity in updating weather data automatically. After the user interface provide necessary values to fetch the weather data from a pre-saved dataset which is not being automatically updated.

Table - Input Parameters for the Application by User

| Parameter | Description | Input Range |
| --- | --- | --- |
| Latitude | Latitude of the geo-location | 17.9397 to 70.3306 |
| Longitude | Longitude of the geo-location | -178.8026 to  -65.2569 |
| Zip code (Optional) | Text box which accepts zip codes in the United States – Value will be converted to geo-coordinates and used as the input parameters | Valid US zip codes only |
| Date | Date to fetch the weather data from pre-saved dataset | 07/01/2021 to 01/12/2021 |

Graphical user interface, website

Description automatically generated

Figure - User Interface of the Application

## Prediction from the System

As the user provides necessary values to the application, model which has been trained in the application fetches the relevant weather data. The application requires weather data for past 7 days from the user picked date. Application is defined to collect all the weather data into one row and then provide them into the model.

The model out is produced as the severity value which starting from zero and zero represents that there is no risk of a wildfire event considering the geo-location and weather data for past 7 days from the user picked date. If there is a severity value presented it can be further understood by referring above table (Table 1 - Wildfire Size Categorization [1].

A screenshot of a computer

Description automatically generated

Figure - Output from the Application (Severity)

## Features of the Application

Application user experience has been improved after the first submission was submitted on the H2O wildfire challenge. Following features are implemented and deployed in the H2O cloud instance.

### Zip/ Postal Code as the Geocode

App was initially developed where user must enter valid longitude and latitude to get predictions. A map which was shown in the bottom portion of the screen is used to select and pin the point where geo-coordinates were shown. Since this task is time consuming, a function to translate valid United States zip codes to relevant address and geo location was added.

Once the user input the zip code, app automatically inputs the longitude and latitude for the relevant text boxes and marks the geo-location on the map in the bottom half of the screen. Following figures represent the app functionality.

Graphical user interface, application

Description automatically generated

Figure - Zip code input

A screenshot of a computer

Description automatically generated with medium confidence

Figure - Zip Code translated to geo-location

### Prediction Location History

Once the users get the predictions from the application for a location, it is stored in the application and visualized on the map. This is allowing users to keep track of previous locations which they have looked on wildfire predictions.

Graphical user interface, text

Description automatically generated

Figure - Accessing history of predictions

Each location user enters is marked on the map with a **coloured marker** demarcating the wildfire severity with colours mentioned in the following table.

Map

Description automatically generated

Figure - Prediction history shown on the map

Table - Fire Class and Demarcation Colour

|  |  |  |
| --- | --- | --- |
| Severity Value | Class | Class Colour |
| 0 | None | Dark Green |
| 0.1 – 0.2499 | Class A | Green |
| 0.25 – 9.99 | Class B | Light Green |
| 10 – 99.99 | Class C | Orange |
| 100 – 299.99 | Class D | Pink |
| 300 – 999.00 | Class E | Light Red |
| 1000 - 4999 | Class F | Red |
| 5000 and above | Class G | Dark Red |

### Exception Handling

The application has following set of limitations and those limitations has been checked prior the prediction result is being fetched.

1. US region dataset has ONLY been used to train the ML model thus geo-points that can be entered are only within a limited area. (Latitude: 17.9397 to 70.3306 | Longitude: -178.8026 to -65.2569)
2. Automatic LIVE weather data acquisition function has not been implemented. Hence, valid dates which can be entered to the app is from 07.01.2021 to 01.12.2021

Graphical user interface

Description automatically generated

Figure - Empty input field error handler

Graphical user interface, website

Description automatically generated

Figure - Out of range geo-location error handler

Graphical user interface, website

Description automatically generated

Figure - Invalid Zip/ Postal Code input error handler

### Demo Video for New Users

Application is included with a demonstration video where the new users can view and understand the basic functionality of the application. It can be accessed through the application by clicking the “Demo” hyperlink or visiting following URL.

URL: <https://drive.google.com/file/d/1ku94g6s0lCYsipLuMcTtIOL06Sl435Ek/view?usp=sharing>

### Application Optimization

The database for storing weather data for the application was initially associated with Pickle files holding on locally. The pickle file was about 800 MBs and it was taking around 10-15 seconds to load with the application on the startup process. To increase the app’s performance the database was moved in to Firebase server which has allowed the main application to load almost instantaneously.

Graphical user interface, text, application

Description automatically generated

# References

|  |  |
| --- | --- |
| [1] | National Wildfire Coordinating Group, “Size Class of Fire,” [Online]. Available: https://www.nwcg.gov/term/glossary/size-class-of-fire. |