

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 1 - 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 2 - 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

Defense Against WildFire
Get to know whether you need a firetruck today.

Wildfire prediction for a location in North American territory can be obtained by entering relevant longitude and latitude in following fields. Date entry is used to obtain prediction result for entered date. (Note: for development purposes dates in the range of 07/01/2021 to 01/12/2021 will only be accepted)

Latitude *
Add a value in between 17.9397 and 70.3306

Longitude *
Add a value in between -178.8026 and -65.2569

Pick a Date
Thu Jan 07 2021

Predict

Know the Geolocation?

Postal/Zip Code *
Only in USA Region

Convert Zip Code

– OR –

Mark on the Map

Figure 1 - 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).

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Latitude *
Add a value in between 17.9397 and 70.3306

Longitude *
Add a value in between -178.8026 and -65.2569

Pick a Date
Thu Jan 07 2021

Predict

Selected Point...
Latitude: 42.5531
Longitude: -115.4004
Date: 2021-07-13
Severity: 148.25866414/3628

Show History

Know the Geolocation?
Postal/Zip Code *
Only in USA Region
Convert Zip Code
- OR -
Mark on the Map

Severity Value	Class	Class Description
0	None	No fire hazard
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5000 and above	Class G	5,000 acres or more

Figure 2 - 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.

Know the Geolocation?

Postal/Zip Code *

Convert Zip Code

– OR –

Mark on the Map

Figure 3 - Zip code input

H2O Wave

d8b45847-191f-48c6-b818-c3e262871d12.challenge.h2o.ai

Defense Against WildFire
Get to know whether you need a firetruck today.

Refresh History About Demo

Wildfire prediction for a location in North American territory can be obtained by entering relevant longitude and latitude in following fields. Date entry is used to obtain prediction result for entered date. (Note: for development purposes dates in the range of 07/01/2021 to 01/12/2021 will only be accepted)

Latitude *

Longitude *

Pick a Date

Predict Clear

Know the Geolocation?

Postal/Zip Code *

Convert Zip Code

Address: South Hero

– OR –

Mark on the Map

This is the point you have selected.

South Hero

Asia North Europe Asia

Figure 4 - 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.

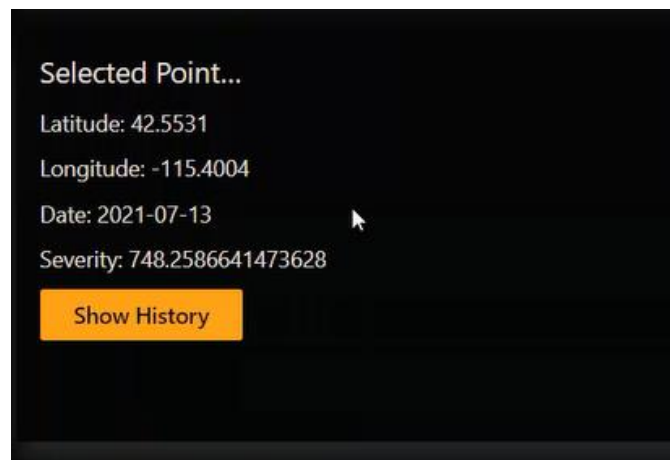


Figure 5 - Accessing history of predictions

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

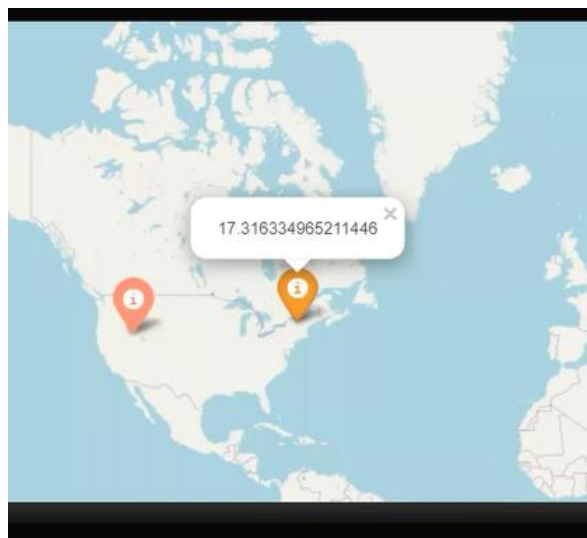


Figure 6 - Prediction history shown on the map

Table 3 - 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

The screenshot shows a web application titled "Defense Against WildFire" with the tagline "Get to know whether you need a firetruck today." The interface is dark-themed. At the top right, there are buttons for "Refresh", "History", "About", and "Demo". The main form area has three input fields: "Latitude" (with a hint "Add a value in between 17.9397 and 70.3306"), "Longitude" (with a hint "Add a value in between -178.8026 and -65.2569"), and "Pick a Date" (showing "Thu Jan 07 2021"). A "Predict" button is below these fields. To the right, there's a section "Know the Geolocation?" with a "Postal/Zip Code" input field (hint: "Only in USA Region"), a "Convert Zip Code" button, and a "Mark on the Map" button. At the bottom, a red error banner displays the message "ERROR! Fill all blank areas".

Figure 7 - Empty input field error handler

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Pick a Date
Thu Jan 07 2021

Predict

Know the Geolocation?

Postal/Zip Code *
Only in USA Region

Convert Zip Code

– OR –

Mark on the Map

ERROR! Geolocations are out of range

Figure 8 - Out of range geo-location error handler

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Pick a Date
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Predict

Know the Geolocation?

Postal/Zip Code *
Only in USA Region

Convert Zip Code

– OR –

Mark on the Map

ERROR! Enter geolocations in valid format

Figure 9 - 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/1ku94g6s0lCYsipLuMcTtIOL06SI435Ek/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.

