Prevention of Forest Fire with AI

Nachiketa Hebbar
Vellore Institute of Technology, Vellore, India

***Abstract*—Every year forest fires destroy a huge area of forest cover, leaving largescale destruction of flora and fauna in its wake. Forest fires play a major role in driving thousands of species of wildlife to extinction year. Artificial intelligence helps us predict the future and using it in this domain can successfully help us predict forest fires and save the wildlife. Any fire essentially depends upon 3 factors which are the oxygen, temperature and humidity. This research aims at predicting the possibility of a forest fire taking place, given the oxygen, humidity and temperature content of a given place. A concept website that can be created to take inputs from the user and predicts the forest fire probability in real time, is also shown.**

I. INTRODUCTION

Forest or Wildlife fires are uncontrolled fires in area of combustible vegetation. Depending on the scale of fire it can be classified as bush fires, forest fires, etc.

They pose a huge risk to wildlife and it becomes pertinent that we come up with a solution to counter it .Now the main challenge that comes up here is to detect or predict a wildfire before it actually happens because once a forest fire gets started it becomes very difficult to put them out before they cause large scale irreversible damage.

Machine learning is learning from data to be able to predict the future.Hence, we are going to model some parameters crucial for any forest fire to take place and predict the possibility of a forest fire taking place based on that.

1.1. Principle of Wildfire detection

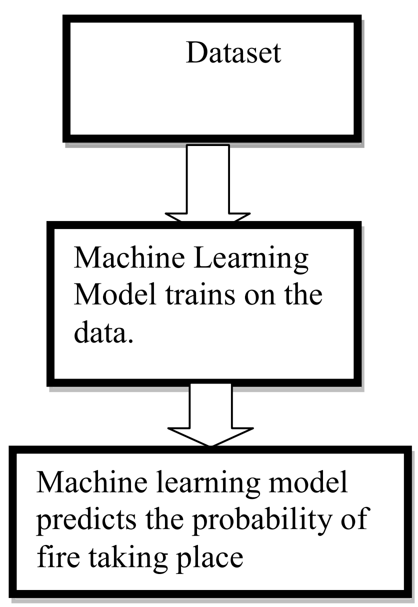
The detection of a wildfire is primarily dependent upon 3 factors

- *Oxygen Level:* For any fire take place, high oxygen content is required. So higher the oxygen more is the probability of a wildfire taking place
- *Temperature:* Obviously for a fire to take place, heat is favourable. Hence high temperature increases the probability of fire in any region.
- *Humidity:* Obviously Humid weather is unfavourable for a fire, whereas a dry weather is. Therefore, higher the humidity, lower the probability of a fire taking place.

II. ALTERNATIVE WORK GOING ON IN THE FIELD AND THEIR DRAWBACK

- *Camera Surveillance:* This approach uses drones or camera equipment to survey nearby forest cover for fires.However, the problem is, detection can only be done once a fire is actually started. It is also not economically feasible to cover large forest covers with cameras and drones.
- *Forest Fire Reservoirs:* This is simply creating water supplies near forest covers to extinguish fires early. This is system again only works after a fire takes place and does not help in detection of the forest fire
- *What our system proposes:* Machine learning models train on data. So, we take real life examples of forest fires that took place and collect the data **prior**to the fire taking place, which is publicly available. We have the inputs as oxygen, humidity, temperature and the output as 0 or 1 based on whether or not a fire took place. On creating a large enough dataset,we can create a trained machine learning model which can successfully predict the probability of a fire taking place in an area given the 3 parameters. Government can in that sense take necessary precautions for areas which high probability of a fire breaking out.

2.1 Data Flow Model



2.2 Development of Machine Learning Model

- Input: Oxygen, Humidity, Temperature Value
- Output: Probability of Fire Occurrence
- Dataset: Here is how a sample dataset will look like.

A	B	C	D	E
Area	Oxygen	Temperatu	Humidity	Fire Occu
Jharkand	40	45	20	1
Bangalore	50	30	10	1
Ecuador	10	20	70	(
Canada	60	45	70	1
Amazon	30	48	10	1
California	50	15	30	(
Australia	5	35	35	(

We use a dataset of 100 values for now , but as the scope of the project increases dataset size can also be increased to achieve higher accuracy.

2.3 Learning Algorithm

This particular problem comes under the category of Supervised Learning. We train our machine learning model using the following 3 learning models and compare the accuracies:

1. Linear Regression
2. Logistic Regression
3. Support Vector Machine

Here is a snippet of the Python code:

```
data=pd.read_csv("Forest_fire.csv")
data=np.array(data)
X=data[1:,1:-1]
y=data[1:,-1]
y=y.astype('int')
X=X.astype('int')
#print(X,y)
X_train,X_test,y_train,y_test=train_test_split(X,y,test_size=0.3,random_state=0)
log_reg=LogisticRegression()
lin_reg=LinearRegression()
svm_class = OneVsOneClassifier(SVC(random_state=0))
lin_reg.fit(X_train,y_train)

log_reg.fit(X_train,y_train)
svm_class.fit(X_train,y_train)
y_pred=lin_reg.predict(X_test)
print("Accuracy of")
print('\n Linear Regession:',lin_reg.score(X_test,y_test))
print('\n Logistic Regession:',log_reg.score(X_test,y_test))
print('\n Support Vector Regession:',svm_class.score(X_test,y_test))
```

The following output is obtained using the sklearn library in python:

```
prediction.py
Accuracy of

 Linear Regession: 0.8190223857065518

 Logistic Regession: 0.9166666666666666

 Support Vector Regession: 0.5833333333333334
```

Since we obtain the highest accuracy of Logistic Regression, we opt that model. A brief explanation about Logistic Regression is given:

Logistic Regression:

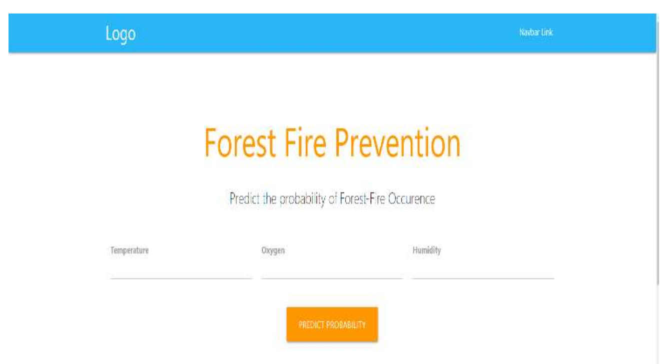
- This is a machine learning model that outputs the probability of a particular input instance belonging to a particular class.
- In this case output class are binary: 'Yes'(A forest fires likely to take place) , 'Not'(Forest fire unlikely to take place).
- Hence,we can obtain prioritized list of places with the places with most likely probability of a forest fire taking place at the top

2.3.1 Large Scale Application

- Once we get access to more data the machine learning model accuracy can be further increased**.**
- On a large scale this can be deployed by all forest authorities so that they have a prioritised list of places with places with maximum likelihood of a fire taking place at the top.
- This can be combined with web application to give a nice interface for forest authorities and this provides a way of smarter patrolling so that forests with greater likelihood of a fire taking place are given maximum patrolling and access to water supply

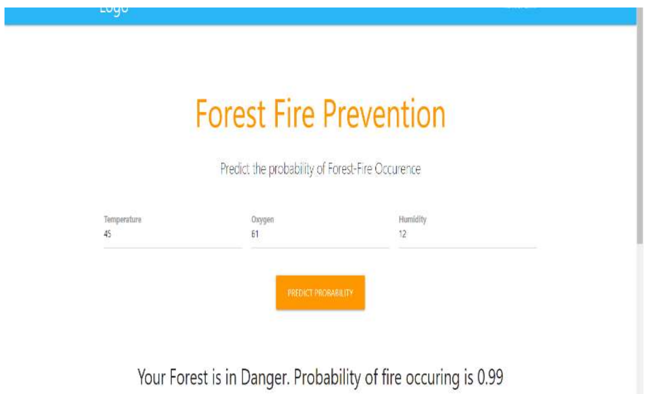
2.3.2 Web application

- When this concept is applied and integrated with web development, we can create a web application that simply takes 3 inputs from the user to get the forest fire probability.
- This can also be used by citizens which will allow citizens to patrol forests as well and alert higher authorities in case of a danger.
- Here is how a web application created using flask and html and css looks like:



Scenario 1: When input is cold weather, low oxygen content and high humidity(forest fire is not favourable)

Scenario 2:When input is hot weather, high oxygen content and low humidity.



III. CONCLUSION

Hence, we can see that machine learning can definitely help us predict the possibility of a forest fire taking place.After integration of this model with web or app development it can turn in into application of a large-scale use to prevent and detect wildfires all around the globe.

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