PROJECT REPORT

Emerging Methods For Early Detection Of Forest Fires

Submitted By

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EMERGING METHODS FOR EARLY DETECTION OF FOREST FIRE

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# INTRODUCTION

Forest fires are a major environmental issue, creating economic and ecological damage while endangering human lives. There are typically about 100,000 wildfires in the United States every year. Over 9 million acres of land have been destroyed due to treacherous wildfires. It is difficult to predict and detect Forest Fire in a sparsely populated forest area and it is more difficult if the prediction is done using ground-based methods like Camera or Video-Based approach. Satellites can be an important source of data prior to and also during the Fire due to its reliability and efficiency. The various real-time forest fire detection and prediction approaches, with the goal of informing the local fire authorities

# ProjectOverview

The idea is to create aand develop a system that can identify the effects of the forest fire and it can analyse the forest fire by advanced AI techniques and CNN Algorithm then the Prediction model is Checked and then the model is connected with Twilio account credentials of the Developer consisting of phone numbers of the persons in the surroundings of the people in the area of easy forest fire zone then an security sound alert system is developed to make a alert sound which is downloaded from internet then the entire model is deployed to the IBM Cloud account that we havecreated.

# Purpose

The forest fires destroys the wildlife habitat, damages the environment, affects the climate, spoils the biological properties of the soil, etc. So the forest fire detection is a major issue in the present decade. At the same time the forest fire have to be detected as fast as possible.

1. **LITERATURESURVEY**

# Existingproblem

Forest fires have been and still are serious problem for theEuropean Union and for all other countries in Europe. In the year 2000, the EU has established the European Forest Fire Information system (EFFIS) [1], which will soon become part of the European Emergency Management Service, maintainedby the Copernicus Earth Observation Programme [2]. This system provides valuable near real-time and also historical data on the forest fires in Europe, the Middle East and North Africa. Currently EFFIS is being used and supported with data by 25 EU member states and by numerous other countries. According to the annual report of EFFIS for 2016 [3], more than 54 000 forest fires have occurred all around Europe and they have led to nearly 376 thousand hectares of burnt areas.If we compare these values to the average values from the EFFIS reports for the period 2006-2015, the number of forest fires have decreased by 13327 or by nearly 20%. This decrease can be explained with the more severe actions and sanctions towards the arsonists and with the introduction of more advanced technical solutionsfor early detection of the fires. Even though their number is decreasing, the forest fires continue to be extremely devastating events and they have destroyed just 27 thousand hectares (or 6.6 %) less than the average burnt areas for the period 2006-2015, according to [3]. Confirmation for this are the devastating forest fires form 2018, which took place in the Attica region of Greece and ledto

more than 90 fatalities and to more than 200 injured people,as well as to the destruction to thousands of buildings [4]. Forest Fires can be divided into 4 categories in the forests of Hungary based on tree and other vegetation species: • underground burning, peat fire; • fire in undergrowth or dead fallen leaves; • fire in seedlings and saplings; • fire in trunks and shrouds.[5]

# References

* + 1. Official webpage of the European Forest Fire Information Systemat: <http://effis.jrc.ec.europa.eu/>
    2. Official webpage of the Copernicus Earth Observation Programmeat: [http://www.copernicus.eu](http://www.copernicus.eu/)
    3. Forest Fires in Europe, Middle East and North Africa 2016, JRC Science for policyreport, BN 978-92-79-71292-0, ISSN 1831-9424, doi:10.2760/17690, availabe at: <http://effis.jrc.ec.europa.eu/media/cms_page_media/40/Forest_fires_i> n\_Europe\_Middle\_east\_and\_North\_Africa\_2016\_final\_pdf\_JZU7HeL.pdf
    4. The 2018 Attica wildfires Wikipedia webpage availableat https://en.wikipedia.org/wiki/2018\_Attica\_wildfires
    5. RajmundKuti,”Characterstic of forest fire and its impact onenvironment”,(2016)

# Problem StatementDefinition

The user interacts with a web camera to read the video.

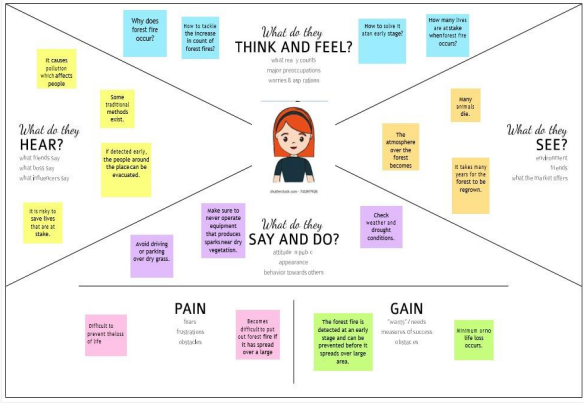
Once the input image from the video frame is sent to the model, if the fire is detected it is showcased on the console, and alerting sound will be generated and an alert message will be sent to the Authorities.

* DataCollection.
  + Collect the dataset or create thedataset.
* ImagePreprocessing.
  + Import ImageDataGeneratorLibrary.
  + Define the parameters /arguments for ImageDataGeneratorclass
  + Applying ImageDataGenerator on trainset and testset.
* Model Building
  + Import the model buildingLibraries
  + Initializing themodel
  + Adding CNNLayers
  + Adding HiddenLayer
  + Adding OutputLayer
  + Configure the LearningProcess
  + Training and testing themodel
  + Optimize theModel
  + Save theModel
* Video Streaming andalerting
  + OpenCV for videoprocessing
  + Creating an account in Twilioservice
  + Use Twilio API to sendmessages.

1. **IDEATION AND PROPOSEDSOLUTION**

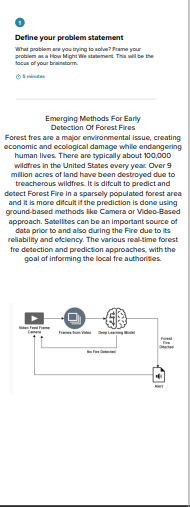
# Empathy MapCanvas

An empathy map canvas is a more in-depth version of the original empathy map, which helps identify and describe the user's needs and pain points.



# Ideation &Brainstorming

organizing the brainstorming session and prioritize the top 3 ideas based on the feasibility & importance.



Step-2: Brainstorm, Idea Listing and Grouping

An empathy map is a straightforward, simple-to-understand picture that summarises information about a user's actions and views. It is a helpful tool that enables teams to comprehend their users more fully. It's important to comprehend both the actual issue and the individual who is experiencing it in order to develop a workable solution. Participants learn to think about situations from the user's perspective, including goals and problems, through the exercise of constructing the map



step-Z: Idea Prioritization

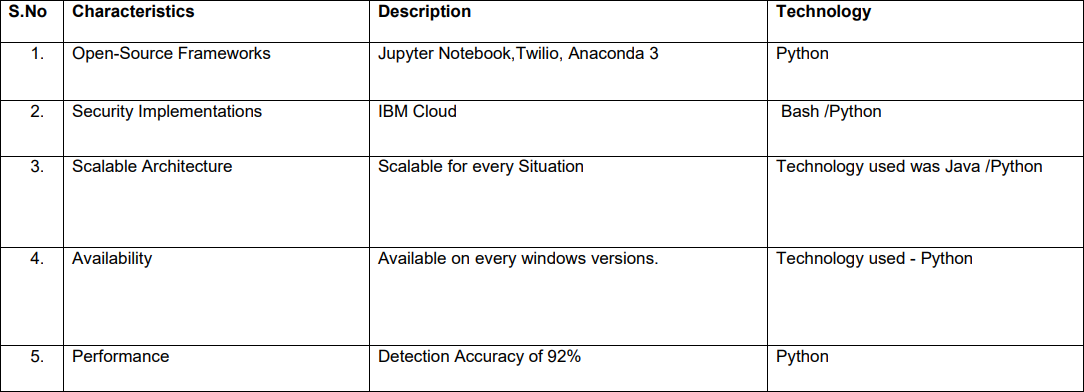
As mentioned, idea prioritization is just **a part of the idea management process**. Having a structured idea management process and a systematic way of gathering, evaluating and prioritizing new ideas takes time. To make it work, the entire idea management process should be integrated to the everyday ways of working



# Proposed Solution

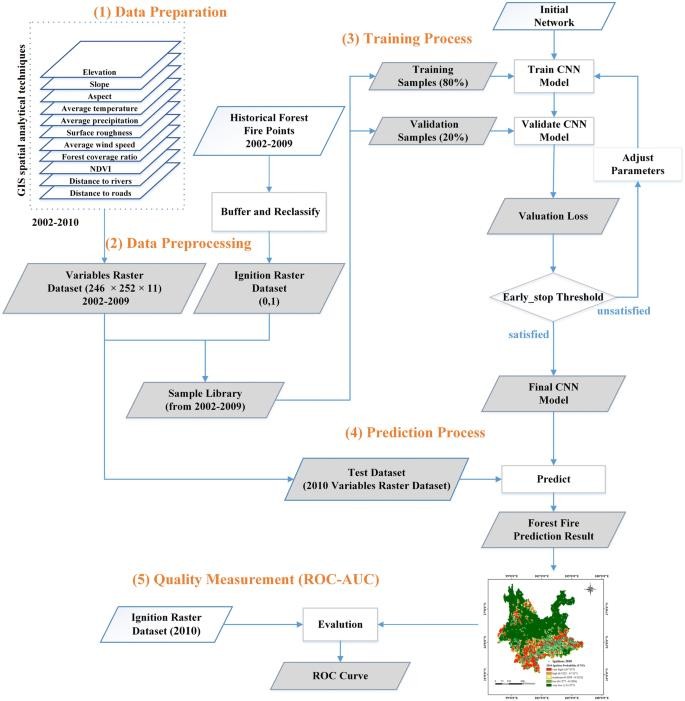
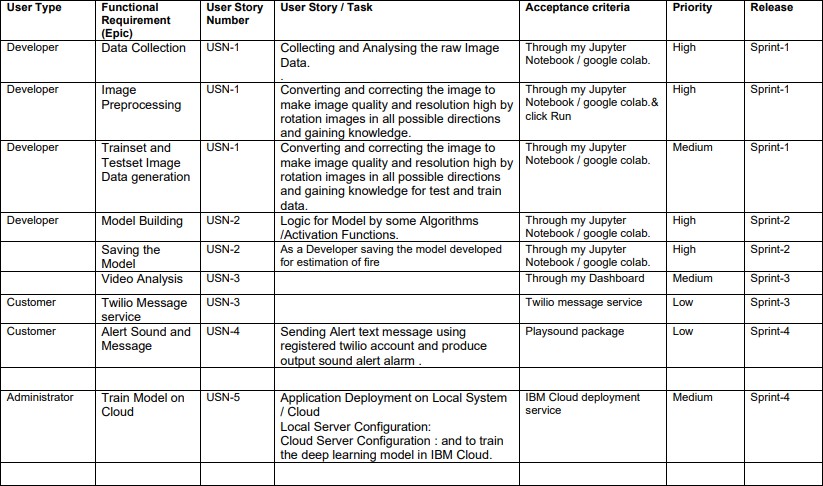
1. **REQUIREMENTANALYSIS**

# Functionalrequirement

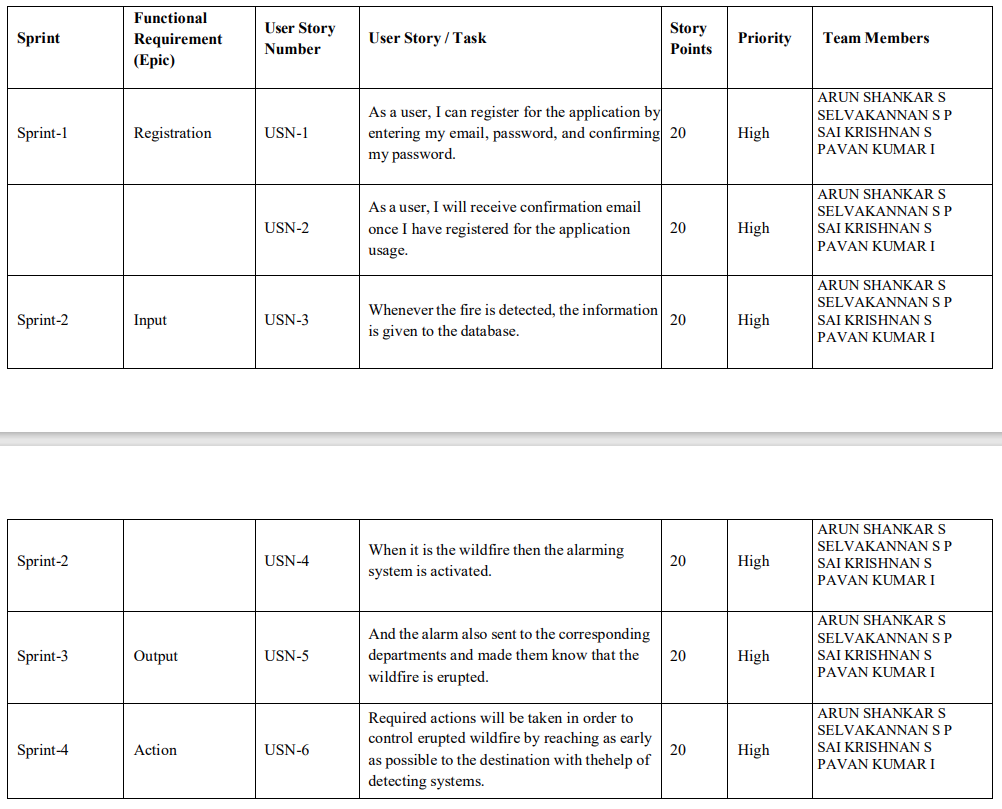
* 1. **Non-Functional requirements**

1. **PROJECTDESIGN**

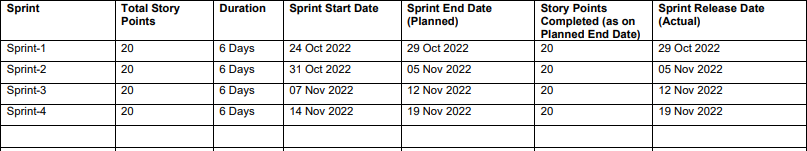
# Data Flow Diagrams

* 1. **Solution & TechnicalArchitecture**
  2. **UserStories**

1. **PROJECT PLANNING &SCHEDULING**
   1. **Sprint Planning &Estimation**



* 1. **Sprint DeliverySchedule**



The following table shows the sprint works assigned to the members along with the priority and story points assigned with the functional requirements with regards to user story.

# Reports fromJIRA

1. **CODING &SOLUTION**
   1. **Feature 1**

In Feature 1 module we have made data collection and Image preprocessing for and Model training.

*importing Required Libraries:*

import keras

from keras.preprocessing.image import ImageDataGenerator import matplotlib.pyplot as plt

import numpy as np batch\_size = 32

*image resizing and preprocessing :*

train\_datagen = ImageDataGenerator(

shear\_range=0.2, rotation\_range=180, zoom\_range=0.2, horizontal\_flip=True,

)

val\_datagen = ImageDataGenerator( rescale=1./255

)

train\_generator = train\_datagen.flow\_from\_directory( 'train\_set/',

target\_size=(150, 150), batch\_size=batch\_size, class\_mode='binary'

)

val\_generator = val\_datagen.flow\_from\_directory( 'test\_set/',

target\_size=(150, 150), batch\_size=batch\_size, class\_mode='binary'

)

*Creating the sequential model :*

from keras.models import Sequential from keras.layers import Convolution2D from keras.layers import MaxPooling2D from keras.layers import Activation from keras.layers importDropout

from keras.layers import Flatten from keras.layers import Dense

model=Sequential()

model.add(Convolution2D(32,(3,3),input\_shape=(150,150,3))) #*Convolutional 2D Layer*

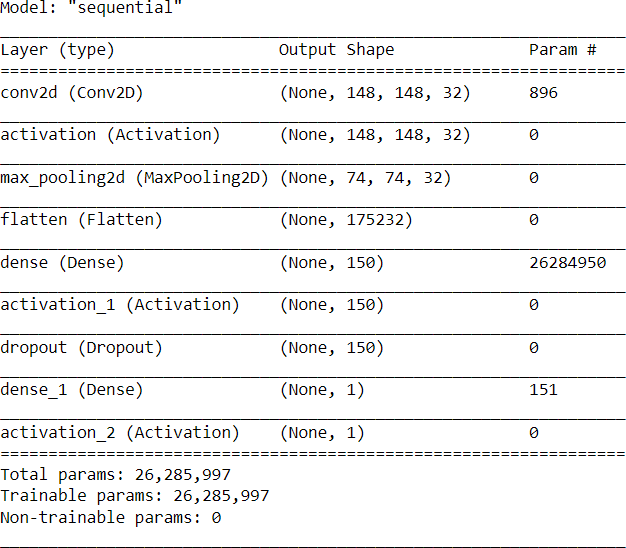
model.add(Activation('relu')) model.add(MaxPooling2D(pool\_size=(2,2))) *# MaxPooling Layer* model.add(Flatten()) #*Flatten Layer to make a array* model.add(Dense(150))

model.add(Activation('relu')) model.add(Dropout(0.5)) model.add(Dense(1)) model.add(Activation('sigmoid')) model.compile(

loss='binary\_crossentropy', optimizer='adam', metrics=['accuracy']

)

*Model summary :*

model.summary()

# Feature 2

from keras.models import load\_model from keras.preprocessing import image import numpy as np

import cv2

from PIL import Image, ImageOps model=load\_model("forest1.h5") from twilio.rest import Client from playsound import playsound model=load\_model('forest1.h5') video=cv2.VideoCapture(0) name=['forest','withfire']

account\_sid='ACca0e8bb11699d2957d67c979ca84b68a' auth\_token='bcb5f3850ef4b7ed263f60efc9acecdb'

client =Client(account\_sid,auth\_token) message=client.messages \

.create(

body='-------Forest Fire is detected,StayAlert!!! ',

from\_='+19457581434',to='+919943435141')

print(message.sid), print("Alert Message sent")

# TESTING

* 1. **Test Cases & User AcceptanceTesting**

*Testing with input video recording from userend:*

import cv2

import numpy as np

from keras.preprocessing import image from keras.models import load\_model from twilio.rest import Client

from playsound import playsound model=load\_model('forest1.h5') video=cv2.VideoCapture(0) name=['forest','with fire'] while(True):

ret,frame=video.read() cv2.imshow('frame',frame) cv2.imwrite('image.jpg',frame)

img=image.load\_img('image.jpg',target\_size=(64,64)) x=image.img\_to\_array(img) x=np.expand\_dims(x,axis=0)

pred=model.predict(x) index=np.argmax(pred) if index==0:

account\_sid='ACca0e8bb11699d2957d67c979ca84b68a' auth\_token='bcb5f3850ef4b7ed263f60efc9acecdb'

client =Client(account\_sid,auth\_token) message=client.messages \

.create(body='-------Fire is detected,StayAlert!!! ',

from\_='+19457581434',to='+919943435141')

print(message.sid) print('Fire detected') print("Alert Message sent!")

playsound('tornado-siren.mp3')

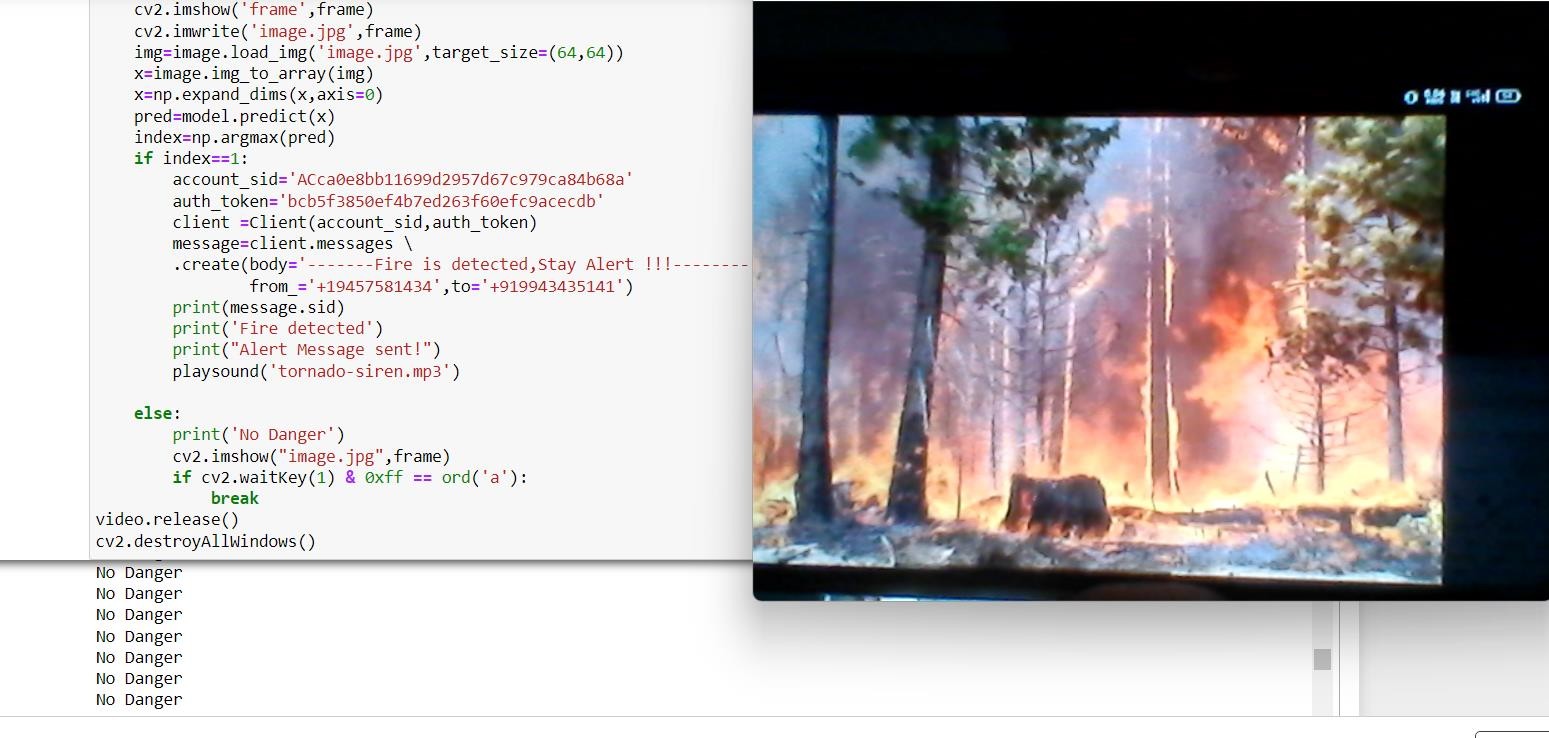
else:

print('No Danger') cv2.imshow("image.jpg",frame)

if cv2.waitKey(2) & 0xff == ord('a'): break

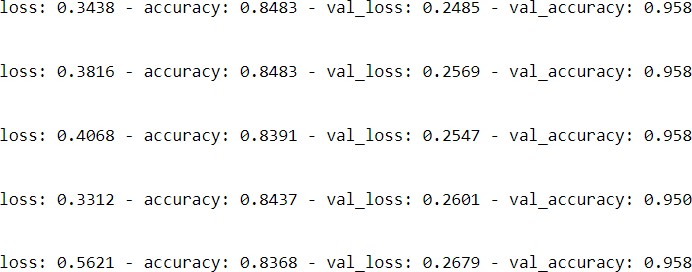
video.release() cv2.destroyAllWindows()

***output for user input video stream***



# RESULTS

* 1. **PerformanceMetrics**



1. **ADVANTAGES &DISADVANTAGES Advantages**

* Easily detect and Estimate the ForestFire.
* Most Accurate
* Flexible Model which can give maximizedoutcome
* No Specific Requirements needed to implement themodel

# Disadvanatges

* Training model is time consumingprocess.
* Error in Cv can cause damage tocamera
* Access of camera are prohibited due to personalissues

# CONCLUSION

Thus we have constructed a model that can can identify the effects of the forest fire and it can analyse the forest fire by advanced AI techniques and CNN Algorithm then the Prediction model is Checked and then the model is connected with Twilio account credentials of the Developer consisting of phone numbers of the persons in the surroundings of the people in the area of easy forest fire zone then an security sound alert system is developed to make a alert sound which is downloaded from internet then the entire model is deployed to the IBM Cloud account that we have created was made with the studies we have done.

# FUTURESCOPES

* It can be developed as a Web or AndroidApplication.
* In future Alternate Advanced technologies can beImplemented.
* The Identification and tracking system can be implemented ifpossible.

# 14.APPENDIX

GitHub & Project Demo Link

GitHub: https://github.com/IBM-EPBL/IBM-Project-14707-1659588977