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Railway Safety and Security using Image Processing and IOT

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Abstract: ***The railways have become the primary form of transportation because of their capability and speed. Even a small improvement in this sector will aid the overall development of a nation. There are various reasons for abnormalities that occur on railway tracks which result in breakdowns and accidents. The poor maintenance of the railway tracks will also result in accidents. The important aspect we are considering in this paper is to avoid the crowd of passengers in each compartment considering the Covid-19 situation. Other aspects are avoiding accidents in foggy conditions, obstacles in front of railways, due to track faults. Comparative studies of different methods used in these aspects of railways are made and the best which gives better accuracy is considered for Implementation.***
Keywords: IOT, Image Processing, Railways, Fault.

I. INTRODUCTION

Railways are the principal mode of transportation for freight and passengers in India. Railways also make it possible to conduct many activities like business, sight- seeing, and pilgrimage along with transportation of goods over longer distances[2].
Safety on and in the vicinity of the railways is of greatest importance. The safety of the passengers, the employees working on the trains, stations and tracks, the users of level crossings and the residents in the vicinity of the railway. To give an indication of the relationships between the most important railway safety issues and existing and new policy designed to achieve permanent railway safety improvements. Railways are the principal mode of transportation for freight and passengers in India. Railways also make it possible to conduct many activities like business, sightseeing, and pilgrimage along with transportation of goods over longer distances. The focus is to make improvements in the safety of transport on the railways, safety of work on and around the railways and safety of life around the railways. Improvement in the railway tracks, better obstacles detection, signal detection in foggy situations, improvise approach towards traffic signal detection and for this pandemic situation.

II. LITERATURE SURVEY

In this survey various papers were referred and compared the methods and found the best method in terms of Performance and accuracy. The railway network is used by the majority of the population, it is essential to maintain the safety of the system by periodically monitoring the system. To reduce the rail accidents due to fog, faults in tracks, to reduce delays in trains, to maintain the social distance, we are focusing on specific passenger counts. It will be helpful to loco pilots , passengers and workers on and around the railways and stations. The railway system utilizes technologies of machine learning and computer vision to detect and send an alert. These methods constitute a major part of image processing and classification algorithms. Machine learning is widely used and has become an integral part of all systems. A novel scheme for efficient image-based traffic light detection is proposed. In this paper, Gaussian filtering is used to preprocess images to reduce noises and then the classic Harris algorithm is employed to detect, locate and connect corner points to acquire a number of frame areas. Then, invalid frame areas are removed based on thresholding techniques. Finally, the valid frame areas are transformed into HSV color space to identify the colors of traffic lights and the figures displayed in traffic screens are further read by template matching. The advantage of CNN compared to previous methods is that it automatically detects the important features without any human supervision. F-CNN is also computationally efficient[5]. The papers studied for object detection are Image Processing based Real Time Obstacle Detection and Alert System for Trains to detect obstacles from a distance and alert TCMS system to stop the train. In this method,most frequent railway crossings and fixing an overhead camera at the scene, which can monitor the crossing. This feed will be fed into a SSD object detection algorithm that will detect an object in the feed. Existing Obstacle and Derailment Detector (ODD) detects obstacles only after an obstacle is being struck and damage is made[1]. Moving camera background subtraction for obstacle detection on railway track provides the method of moving camera background subtraction which is used for forward obstacle detection from a train frontal view camera. It does not work in various lighting conditions, seasons, and weathers. It sometimes failed to detect obstacles[3].

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III. SCOPE OF PRESENT WORK

The scope of the system is to develop a system with four modules. Each of the modules is used to avoid accidents in foggy conditions, obstacle detection, faulty track detection and passenger count to induce social distancing.

IV. PROPOSED SYSTEM

In this system, we have developed a Railway security system as in Fig[1]. which provides safety and security to users. There are four modules developed using existing algorithms which are good in terms of performance and accuracy. The first module is obstacle detection which is implemented using Single shot detection (YOLO) method, second module is traffic signal detection using K-clustering method and OPENCV library, third module is passenger count in compartment in trains considering the present covid-19 situation, only reserved number of passengers should be there and last module is Track Fault Detection which detects track is healthy or faulty.

System Architecture

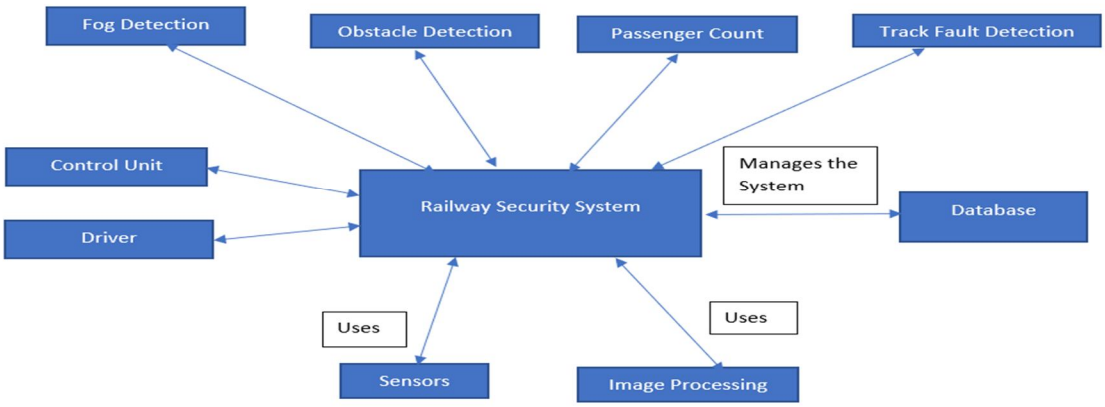


Fig. 1 System Architecture

A. Algorithms

1) Effective Obstacle detection in front of railway System:

a) Choose a dataset
b) Import Libraries
c) Resize frame to speed up processing time.
d) Reshape the frame to be a list of pixels.
e) Take a reading and compare it with Threshold value
f) Apply SSD(YOLO) Algorithm
g) Creating Rectangular Boxes around detected obstacle
h) Repeat the Step.

The output of module 1 is shown in Fig[2] and fig[3].

2) Effective traffic light detection in foggy condition

a) Method 1: FCNN

- Import tensorflow and matplotlib
- Input to given model
- Expand the training dataset
- Train model with dataset
- Perform prediction and show output
- Termination

The output of module 2 is shown in Fig[4] .

b) Method 2: Opencv

- Capturing video through webcam.
- Convert the image Frame in BGR(RGB color space) to HSV(hue-saturation-value
- Set range for red ,yellow and green colour
- Passing image frame to cv2.putText() method in OpenCv
- Show output imshow() method
- Termination.

The output of module 2 is shown in fig[5] .

c) Method 3: k-means cluster

- First take the input image.
- Resize image to speed up processing time
- Reshape the image to be a list of pixels
- Cluster the pixels and assign labels
- Count labels to find most popular (colors)/dence
- Plot in form of Pie chart

The output of module 2 is shown in Fig[6],fig[7] .

3) Effective Counting Passenger from Compartment :
a) Capture the image through the camera.
b) Do the foreground analysis.
c) Take the readings from image processing as an input .
d) Compare input values with threshold values.
e) Apply the merging and splitting strategy.
f) Finding the number of people who are coming in or going.
g) Send a message of people count to the next station through the gsm module.

The output of module 3 is shown in Fig[8].

4) Effective Track Fault Detection :
a) Method 1: IOT

- Capture the image through the camera.
- Compare it with data sets such as healthy track or faulty track.
- Take the readings from image processing, ultrasonic sensor , as an input .
- Compare sensor readings with threshold value.
- Exceed the threshold value , track the location through GPS.
- Send an alert to the control unit through the GSM module for real time monitoring of faults.

The output of module 4 is shown in Fig[9] and fig[10].

b) Method 2: Convolution Neural Network

- Choose a dataset
- Import Libraries
- Designing the model
- Generate images to train the model
- Visual representation of datagenerator
- Build the basic CNN model
- Compile the basic CNN model
- Fit the basic CNN model
- Predict the image as healthy or faulty

The output of module 4 is shown in Fig[11] and fig[12].

V. IMPLEMENTATION

These algorithms are implemented using simulation. Resources used for the first module are Python-3,OpenCV-python,Pycharm-IDE, COCO-Obstacle Detection Dataset.

For the second module Python 3.8 ,PyCharm edu is used.

Python OpenCV, Pycharm are used for Third module and for Fourth module Tinkercad , programming language python and Google colab are used. Tinkercad is a simulation tool for the Internet of things.

In module 4,CNN model was trained and tested with 600 images with a testing accuracy of 95%.

A. Module 1: Obstacle Detection

Method 1: SSD Algorithm(YoLo method)

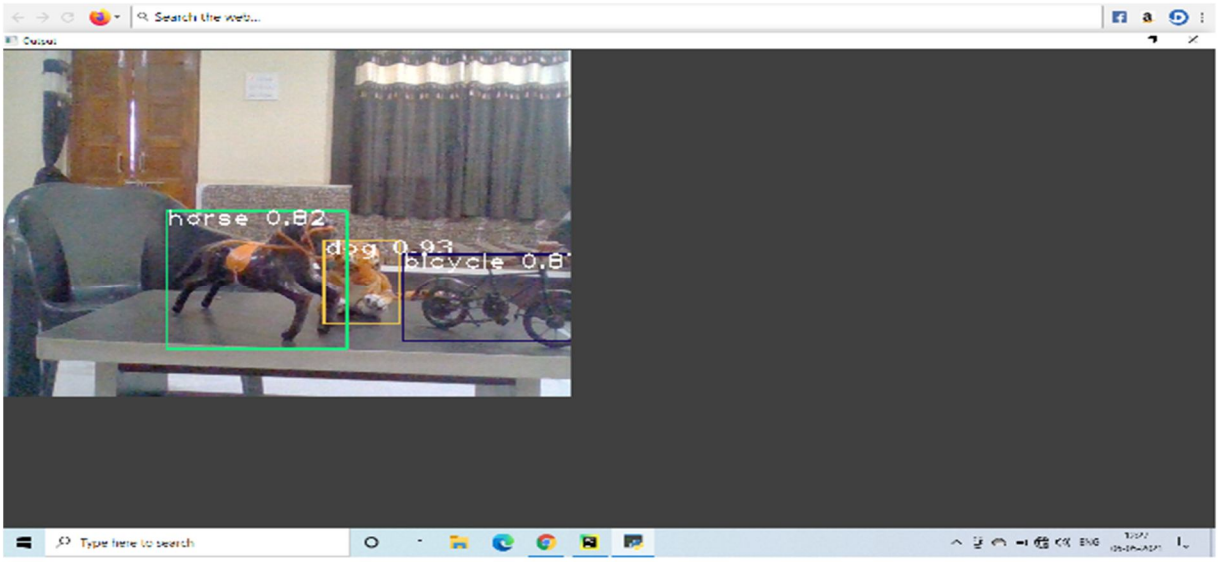


Fig .2

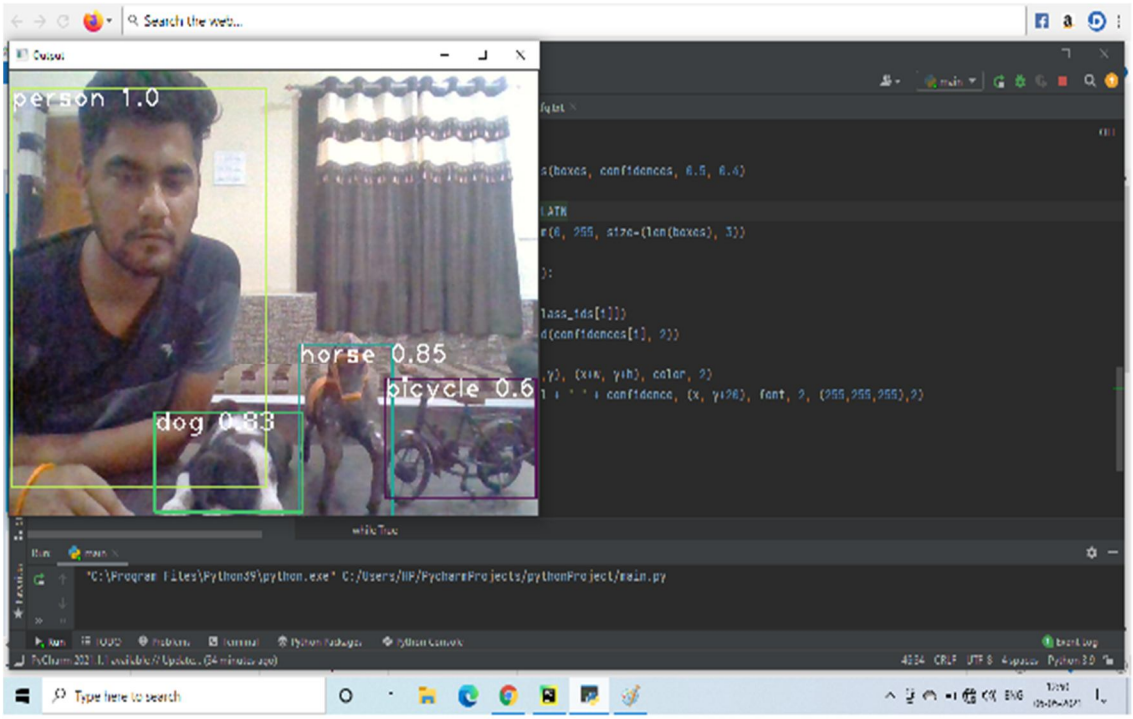
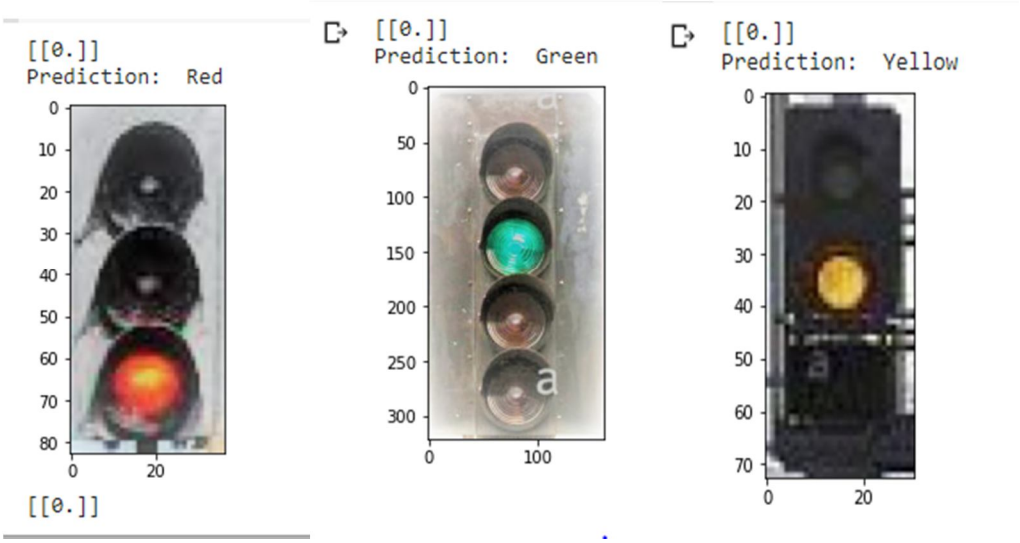


Fig.3

B. Module 2: Traffic Signal Detection in Foggy Condition

1) Method 1: FCNN



-Fig.4

2) Method 2: OpenCv

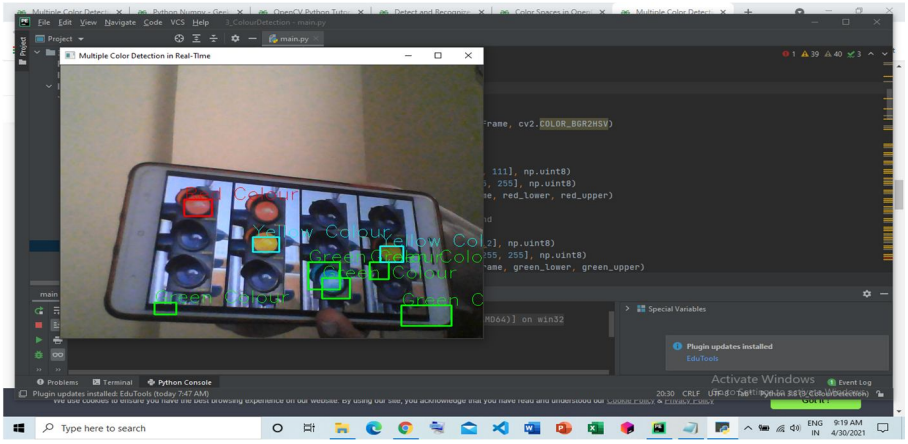


Fig.5

3) Method 3: K-cluster

Fig.6

Fig.7

C. Module 3: People Counting

1) Method 1: SSD Algorithm

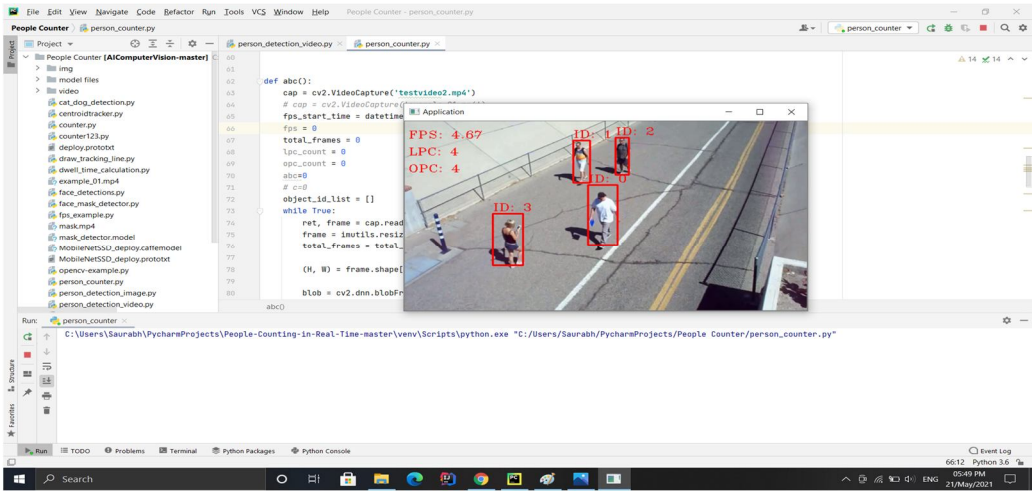


Fig.8

D. Module 4: Track Fault Detection

1) Method 1: IOT

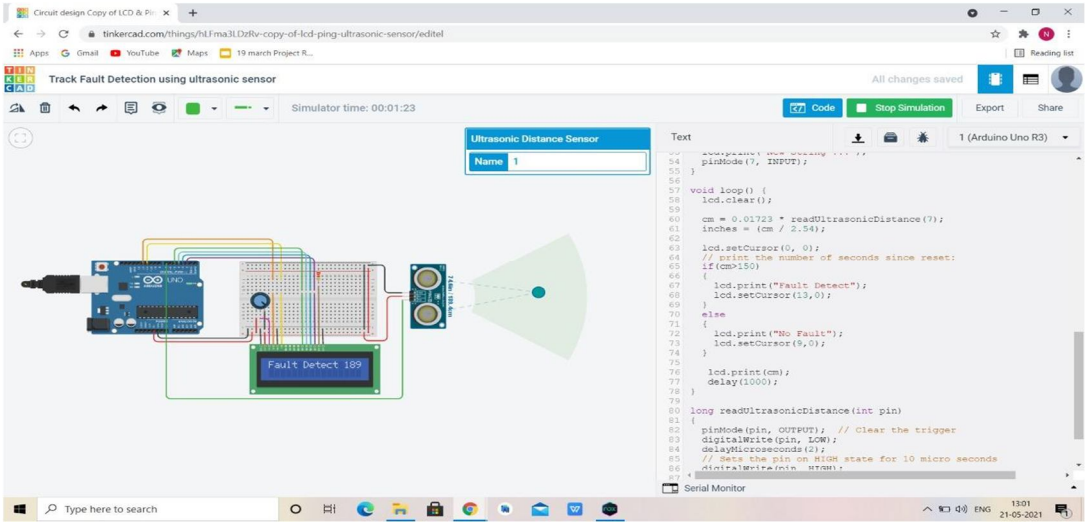


Fig.9

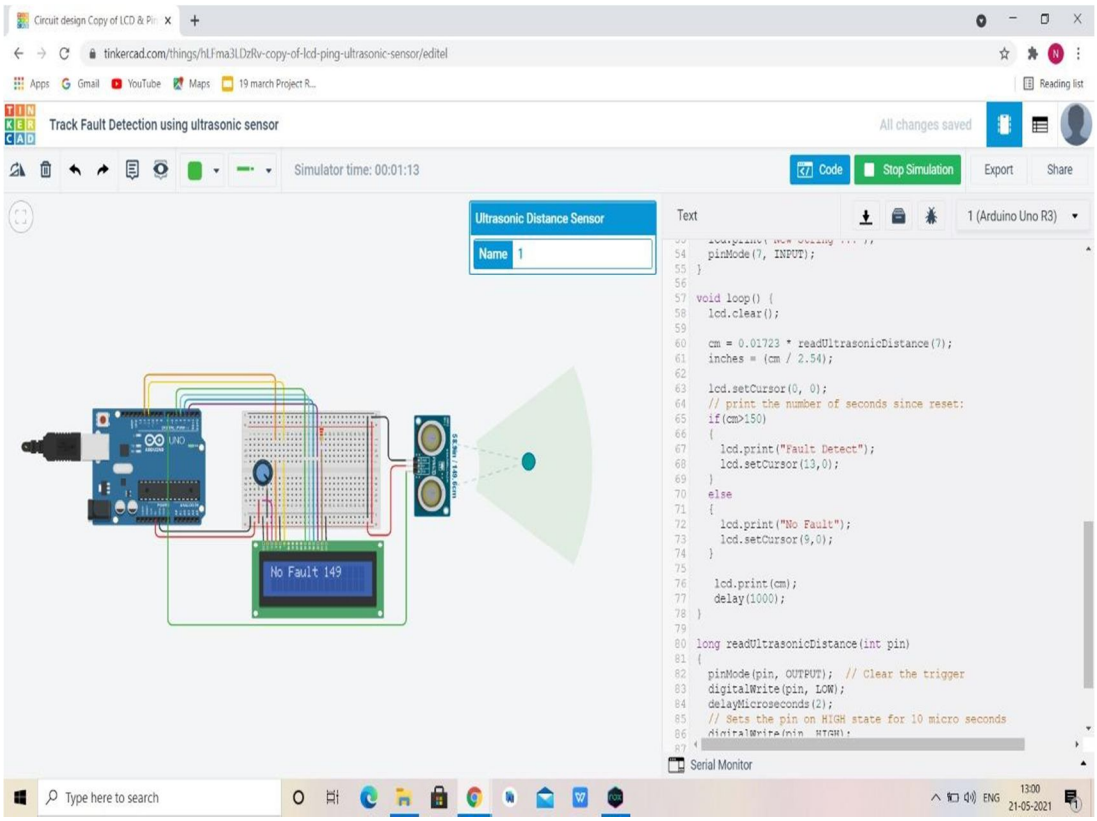


Fig.10

2) *Method 2:* CNN Algorithm

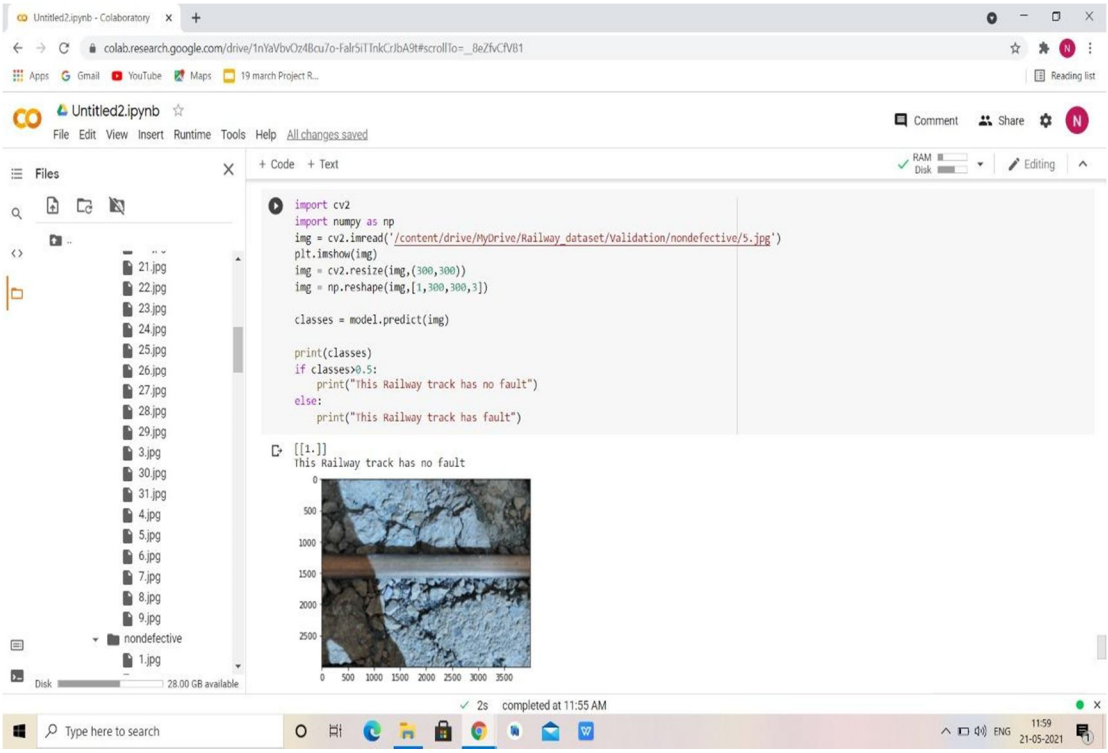


Fig.11

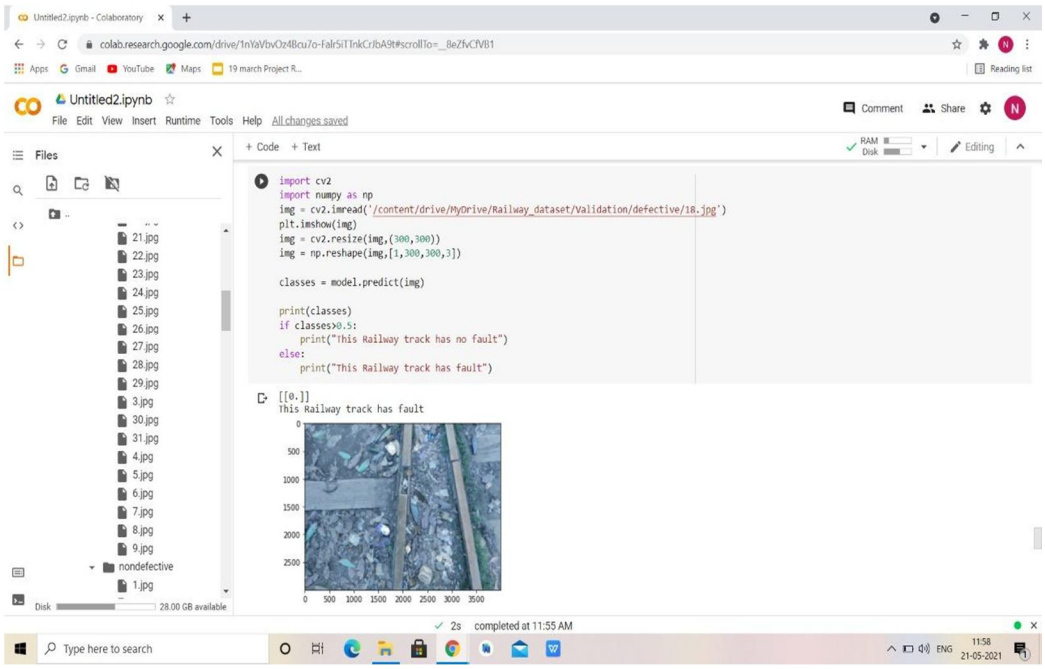


Fig.12

VI. CONCLUSION

To avoid delays of trains in a foggy situation we are going to use GPS tracking. By counting passenger count, we will try to maintain the number of passengers in each compartment by which we are going to follow the social distance. Through obstacle detection, we are trying to avoid the accidents of an animal as well as human beings by using a Single Shot Detector. Track fault detection is done using CNN model with accuracy of 95%.

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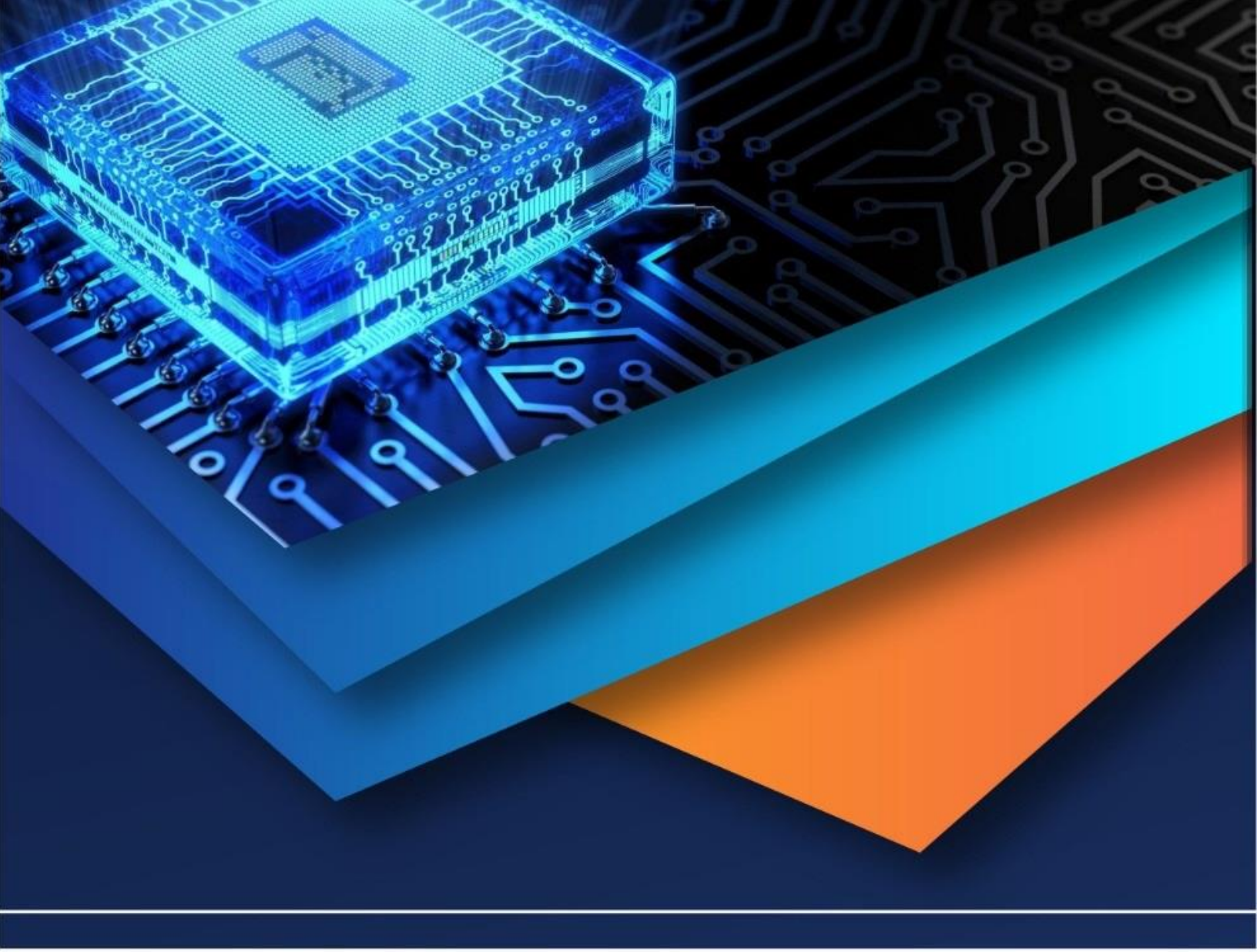

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