An aerial, high-angle photograph of a city street intersection. A dark-colored sedan is stopped at a crosswalk. Several pedestrians are walking on the sidewalk. A traffic light pole and a street sign are visible. The scene is captured in a high-contrast, slightly desaturated style.

5G- ENABLED REMOTE ROAD FIXING VEHICLE WITH DEFECT IDENTIFICATION VIDEO/IMAGE ANALYTICS

Final phase



ITU AI/ML in 5G Challenge
Smart Transportation

AGENDA

- 1 **Description of the project**
- 2 **Requirements analysis & methodology**
- 3 **Evaluation setup & timeline**
- 4 **Demonstration**
- 5 **Team dynamic**
- 6 **Relevance with automotive industry**

WE ARE

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REGION INSIGHT



Various type of **transportation methods**, lead to different challenges.
Bicycle, Motor Cycle, Car, Tempo, Bus, Train, etc.



largest road network in The World with length around **4,320,000 kilometers**.

INDIA



4.3 m road accidents recorded across India in 2019.
where the **major cause** of road accidents (driver behavior, road condition, distraction, etc.)

PROBLEM STATEMENT



Road condition

one of the main causes of road safety level around all around the world. This project seeks to improve road condition by address an new techniques for road quality inspection process and instance fixing through emerging technologies.

Challenges in Indian roads



Potholes

India has one of the most pothole stricken road networks. In 2017, potholes killed 3,597 people in India.

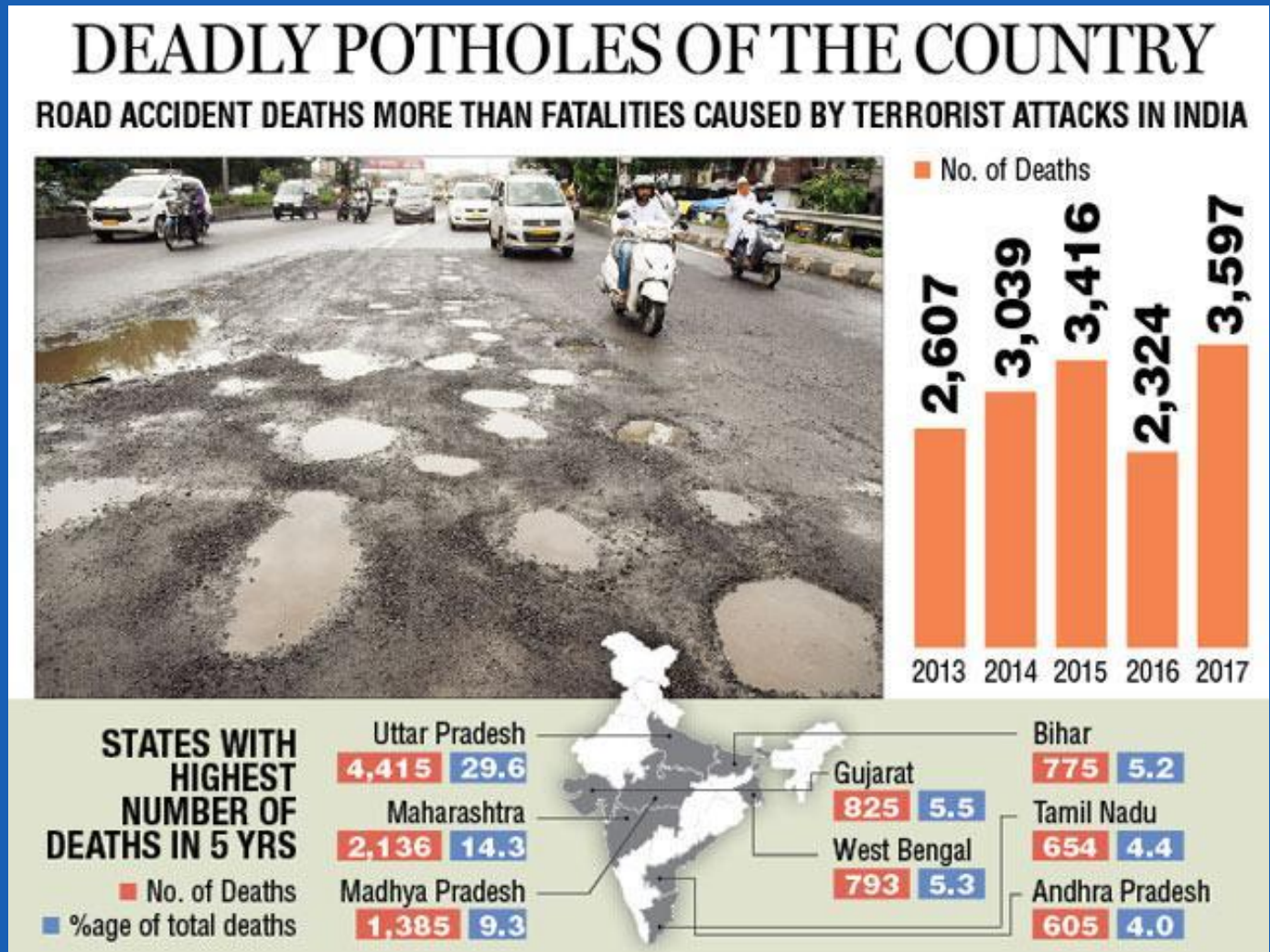


Lane marking

Newly surfaced roads with no lane markings are often seen by motorists as a green pass to speed and cut lanes. But most of roads have little or no markings and uneven signage.

Due to hitting a pothole - or taking the wrong measures to avoid one - can also lead to a crash resulting in injuries or worse. A blown tire or broken suspension part can cause you to lose control of your vehicle, as can a split-second decision to stomp on the brakes or suddenly swerve out of your lane to avoid a pothole.

Challenges in Indian roads



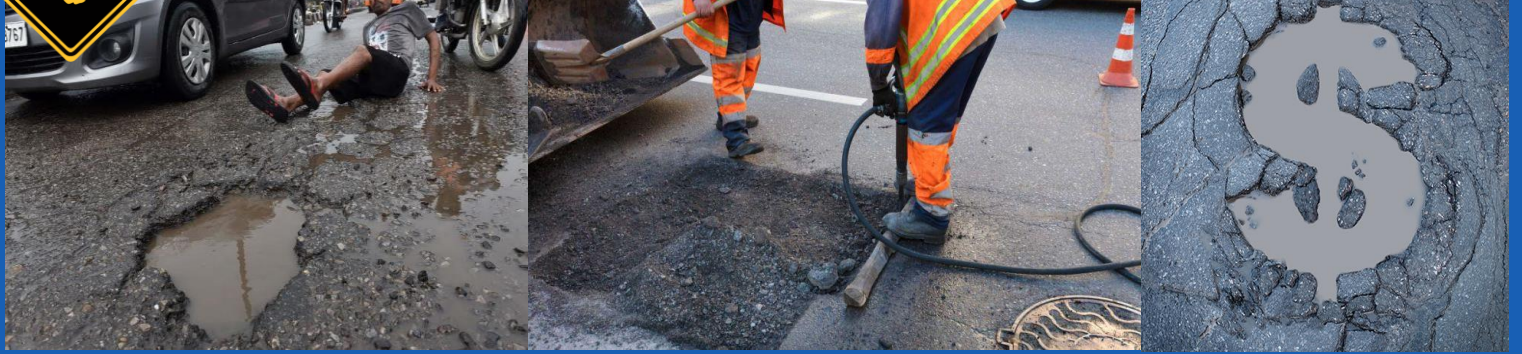
Potholes killed 3,597 across India in 2017, terror 803

Challenges in Indian roads

Cost of challenges



Manual inspection inefficient and reliant on experts



2.8

M Rs

Potholes are a major factor in causing axle & suspension failure, which counts for a third of mechanical issues on Mumbai roads and costs motorists an estimated **Rs.2.8 million** every year.

50

M Rs

Authorities currently pay out more than **Rs.50 million** in compensation claims due to poor roads.

A dark blue world map is visible in the background of the slide. The text is overlaid on the map.

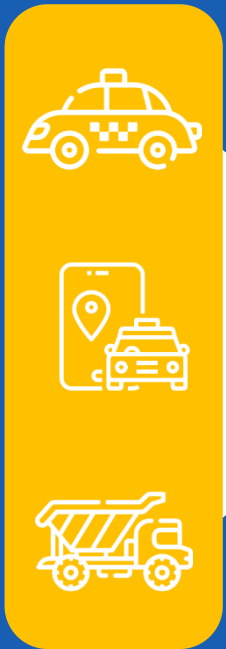
NEW METHODS & TECHNOLGY

Project aims

The project involves the AI to identify road condition and using 5G to enable the remote repair of roads with the goal of reducing manpower and the expertise needed to fix potholes and road lane painting.

SOLUTION AT GLANCE

ARCHITECTURE



Detection of road defects in real time



Data analytics
Through AI



**Remote vehicle control
Center** *owned/authorized by Gov*



Construction vehicle
With GPS and communication model

Send construction vehicle for identifies places

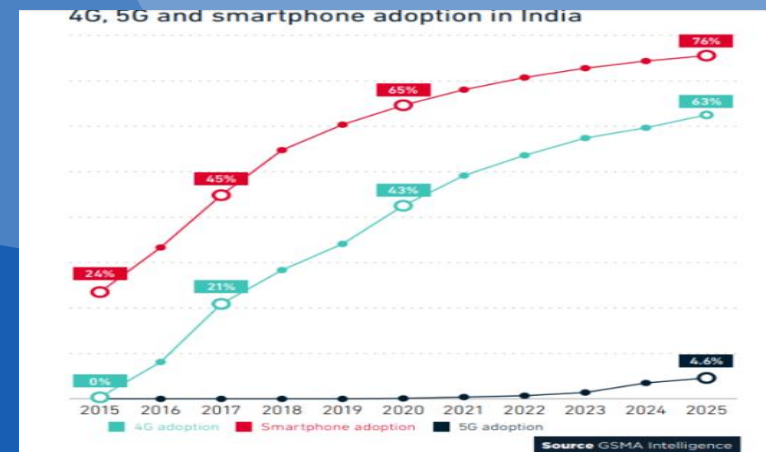
Image/ video Data sources
by different of users
Previous collaboration

SOLUTION AT GLANCE

Usability/Motivation



Over than 1 million trip per day leads to real
time monitoring



India 5G coverage plan

SOLUTION AT GLANCE

Challenges

01

New machines & vehicle support 5G network.

02

Real data availability to train the AI model.

03

New regulations for remote driving.

PROJECT MILESTONE

Timeline

Challenge selection and brainstorming

Idea generation and screening

1

2

System analysis and design

Business analysis

5

4

3 Concept development

5th Oct

First submission 6

5

4

3 Concept development

7

8

Start demo

stc_Saudi Arabia

15th Oct Final submission



HOW 5G AND AI IS BEING USED IN SOLUTION



5G



- I. High-definition video feeds from trucks can be sent back and distributed to the local control center via the 5G network and MEC for remote monitoring.
- II. Control the vehicle remotely as a result the 5G network's low latency.



AI



- I. To automate manual work of operators who search and select road defects from road laboratories video footage, like cracks, holes and patches.

END USER DETAILS



Cam on vehicle
to detect road defects in real time



Road condition report
to report road defects in real time



Vehicle control center
Remote driving machine for road fixing

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Team dynamic

6

Relevance with automotive industry

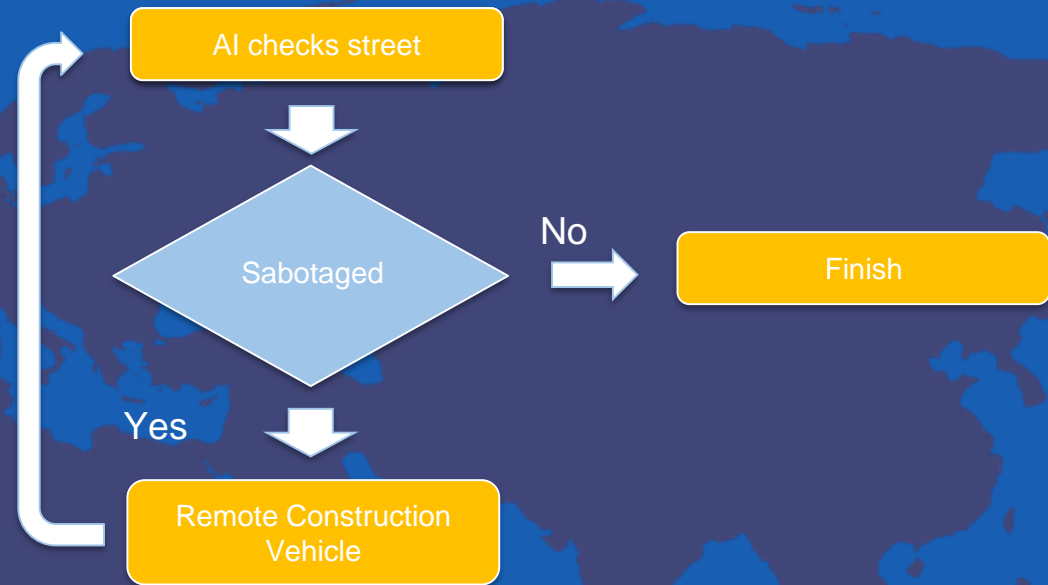
GOALS TO BE ACHIEVED

Project aims

- 1 Work efficiency
- 2 Visible road lane and good road condition
- 3 Low car accidents
- 4 Decrease human risk

Use case diagram/Flow chart

System Design and Data set

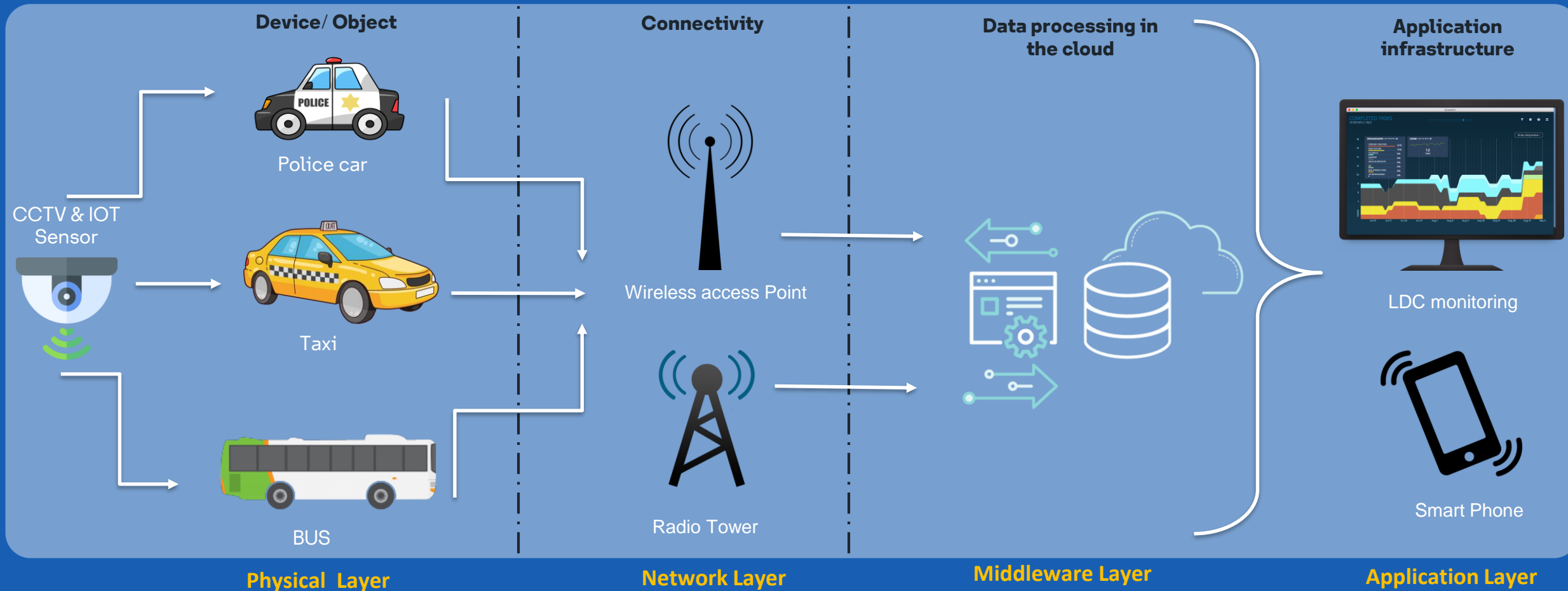


Berkeley DeepDrive



SOLUTION AT GLANCE

ARCHITECTURE



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Evaluation Setup & Timeline

Metrics to be used (Quantitative and Qualitative)

Quantitative

of covered roads

To measure the roads covering by setting the covering baseline and target

% of defects repaired

To measure the percentage of repairing the identified defects

of vehicles detect road defects in real time

To measure the efficiency of vehicles which will detect the defects and their ability to do the work

% of time consumed in defects repairing

To measure the real time per defect repairing

Qualitative

Road color/slop after repairing

To measure the overall work done in repairing defects and compare it with the ideal work

Customer satisfaction survey

To see what customers think of the work done and the solution impact

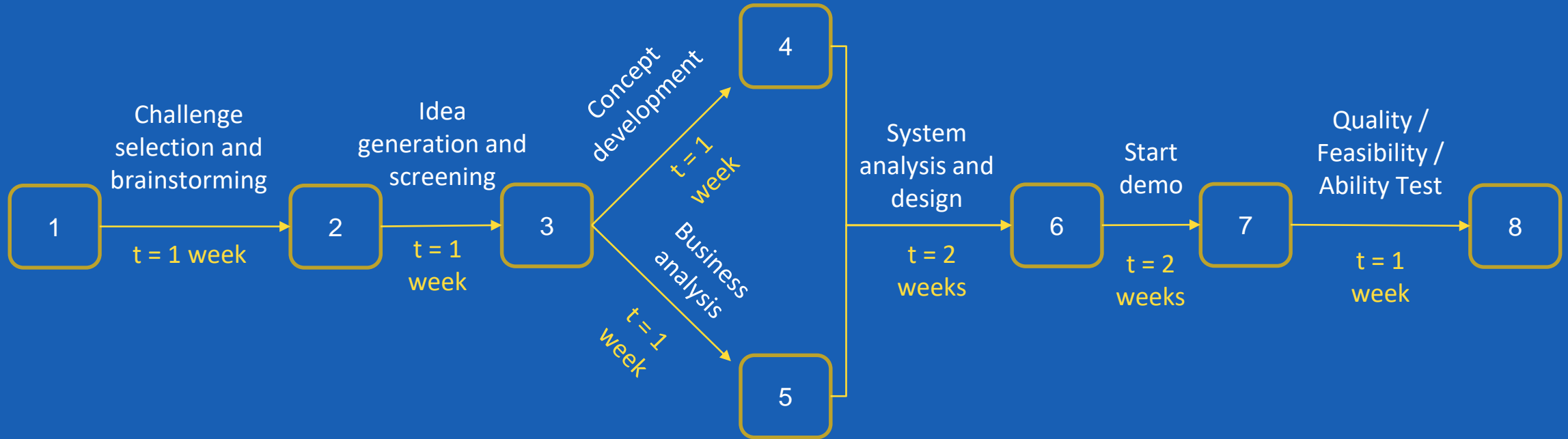
Focus groups

To see what customers think of the work done and the solution impact

Individual Interview

To see what customers think of the work done and the solution impact

Pert Chart



Solution Developed Type

The solution development type is an algorithm to use 5G and AI in repairing road defects while using control centers, remote driving vehicles, and cams using mobile app

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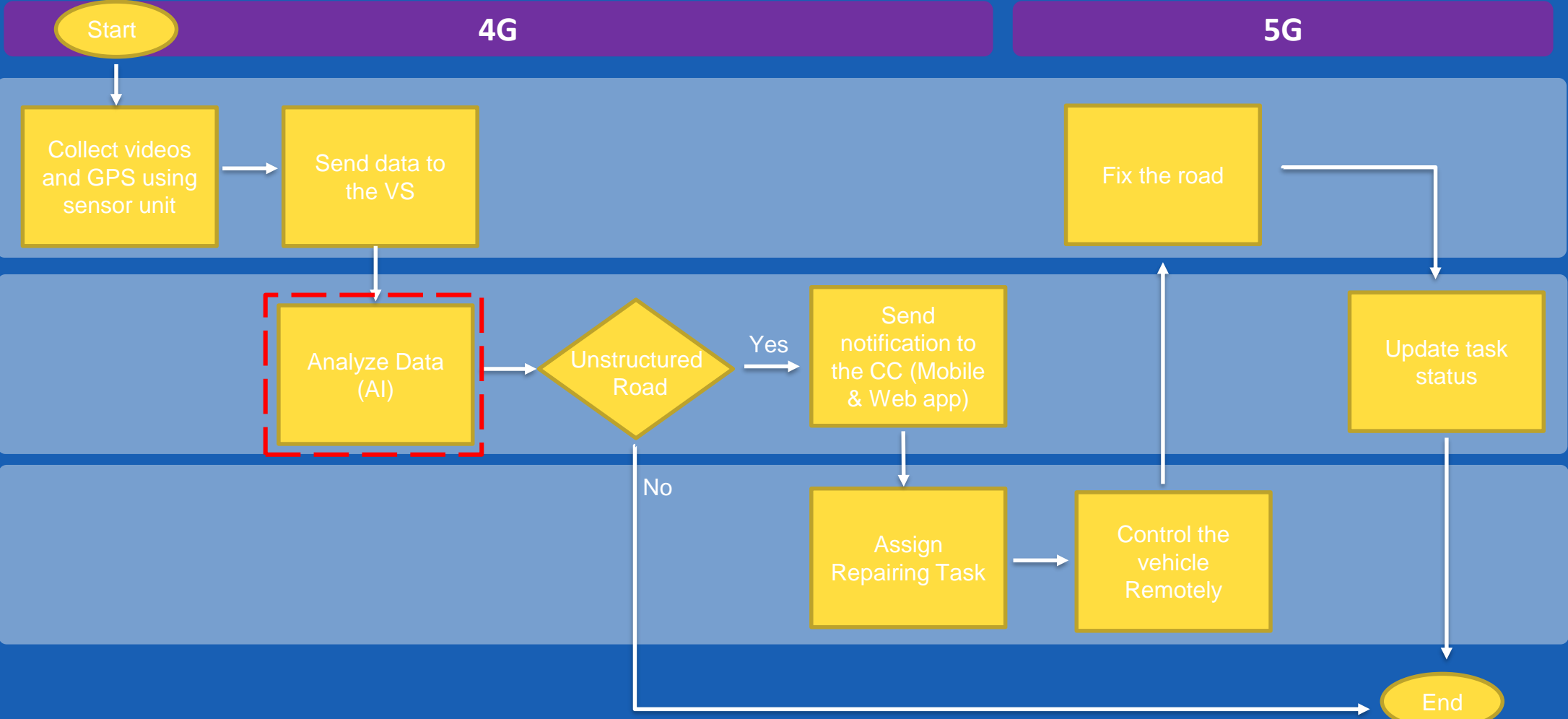
Team dynamic

6

Relevance with automotive industry

SOLUTION

Flowchart



Road



Virtual Server



Control Center

(AI)

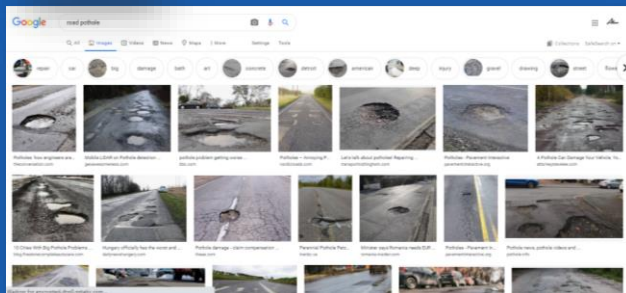
Analyze Data



Cloud AutoML



Batch Image Download
Full Screen Capture



Google Cloud Platform My First Project Search products and resources

Vision newuntitled_1602352398289 LABEL STATS EXPORT DATA

Dashboard IMPORT IMAGES TRAIN EVALUATE TEST & USE Object detection

Datasets All images 63 Labeled 63 Unlabeled 0 Filter labels Pothole 63 ADD NEW LABEL

Filter images Select all

Pothole(1) Pothole(3) Pothole(2) Pothole(1)

Images per page: 50 1 - 50 of many

Google Cloud Platform My First Project Search products and resources

Vision newuntitled_1602352398289 LABEL STATS EXPORT DATA

Dashboard IMPORT IMAGES TRAIN EVALUATE TEST & USE Object detection

Datasets Models TRAIN NEW MODEL

newuntitled_16023_20201011121248

Average precision at 0.5 IoU: 0.779

Precision: 68.75% Recall: 78.57%

* Using a score threshold of 0.508

Model ID: IOD3946791545901940736

Created: Oct 11, 2020, 12:10:09 AM

Data: 63 images

Model type: Cloud High Accuracy

Deployment state: Deployed to 1 node

SEE FULL EVALUATION

newuntitled_16023_20201010090729

Average precision at 0.5 IoU: 0.569

Precision: 60% Recall: 50%

* Using a score threshold of 0.298

Model ID: IOD5429883198100387200

Created: Oct 10, 2020, 9:05:05 PM

Data: 17 images

Model type: Cloud High Accuracy

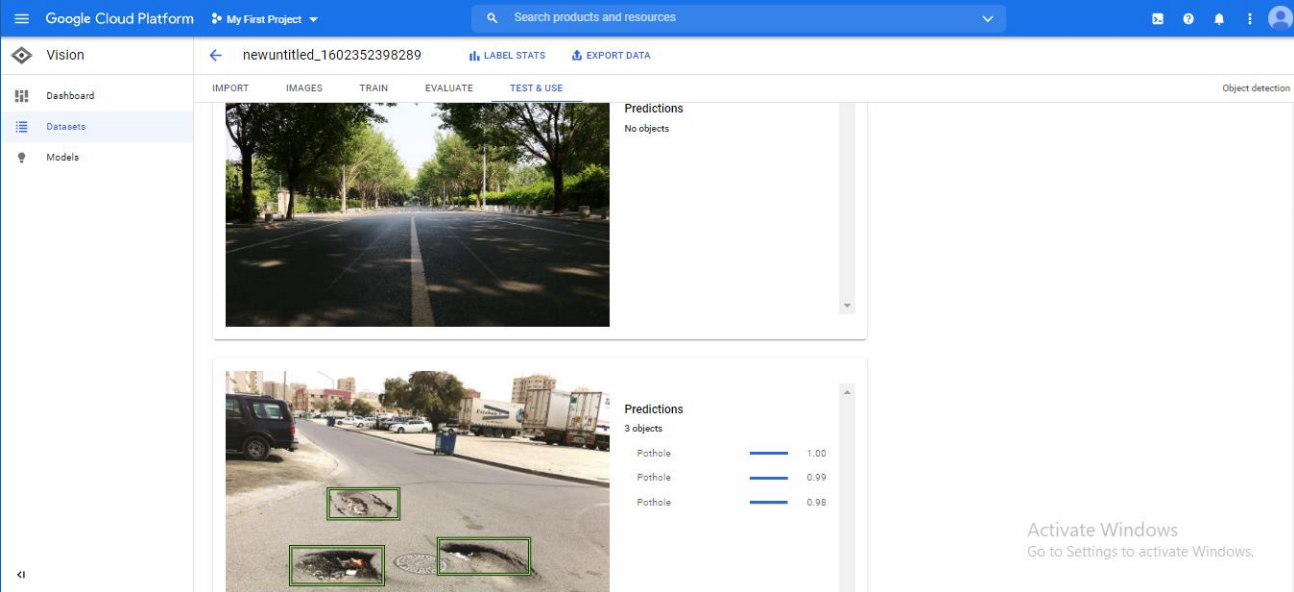
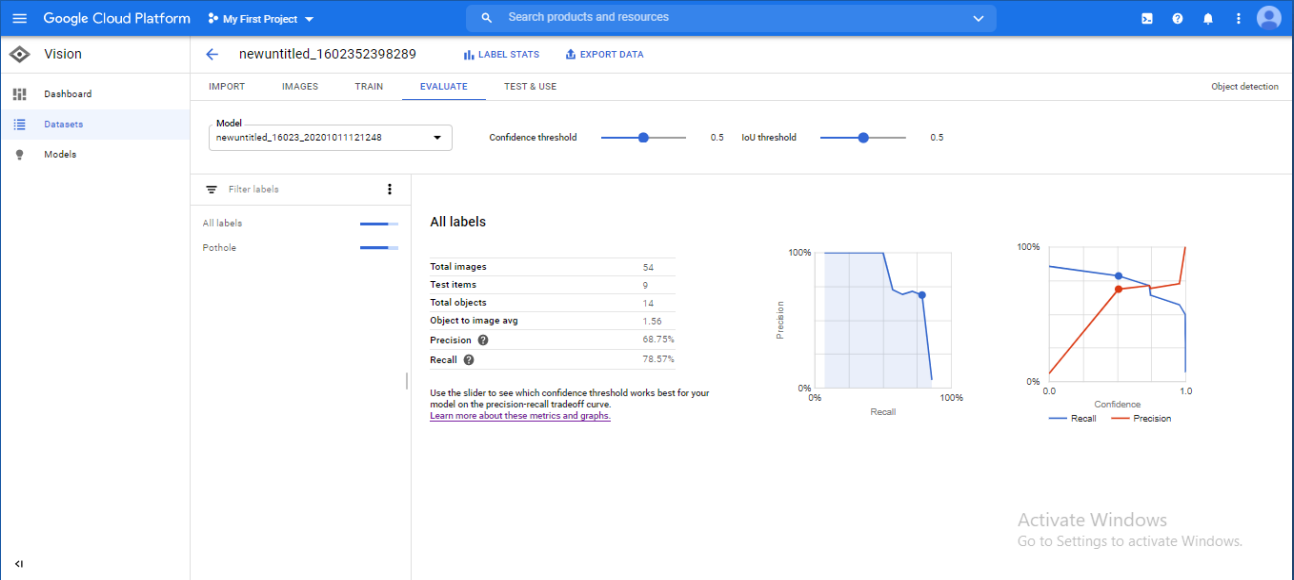
Deployment state: Not deployed

SEE FULL EVALUATION

Activate Windows Go to Settings to activate Windows.

(AI)

Analyze Data



(AI)

Analyze Data

The screenshot shows the Google Cloud Platform interface for a Vision project. The left sidebar contains 'Dashboard', 'Datasets', and 'Models'. The main area is titled 'newuntitled_1602352398289' and has tabs for 'IMPORT', 'IMAGES', 'TRAIN', 'EVALUATE', and 'TEST & USE'. The 'TEST & USE' tab is active, displaying an image of a road with a pothole. A green bounding box highlights the pothole, and a 'Predictions' panel on the right shows '1 object' with a confidence score of 0.94. Below the image, there are two options to 'Use your model': 'REST API' and 'Python'.

Google Cloud Platform My First Project Search products and resources

Vision newuntitled_1602352398289 LABEL STATS EXPORT DATA

IMPORT IMAGES TRAIN EVALUATE TEST & USE Object detection

Predictions
1 object
Pothole 0.94

Use your model

REST API Use a REST API to get predictions from this model through Google Cloud.

Python Use a Python client to get predictions from this model.

Activate Windows
Go to Settings to activate Windows.

This screenshot shows the 'REST API' section of the Google Cloud Vision API interface. It provides instructions on how to use a custom vision model. A 'request.json' file is shown with a JSON payload containing an image. Below the JSON, there is a terminal window showing the command to execute the request using curl. The background shows the same Vision API interface as the previous screenshot, but it is dimmed.

Free trial status: \$200.52 credit and 87 days remaining - with a full account, you'll get unlimited access to all of Google Cloud

Google Cloud Platform My First Project Search products and resources

Vision newuntitled_1602352398289 LABEL STATS EXPORT DATA

IMPORT IMAGES TRAIN EVALUATE TEST & USE Object detection

REST API

Use your custom model

You can now run predictions on images using your custom vision model. You will need a [service account](#).

request.json

```
{
  "payload": {
    "image": {
      "imageBytes": "YOUR_BASE64_ENCODED_IMAGE_BYTES"
    }
  }
}
```

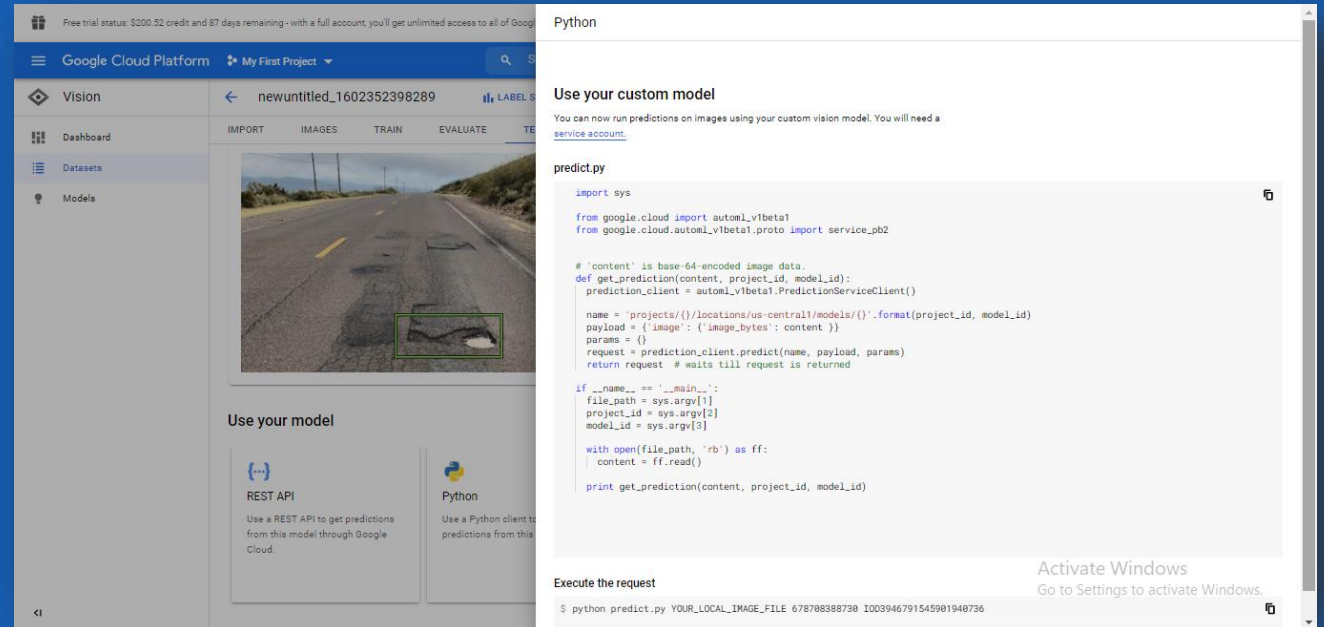
Execute the request

```
curl -X POST -H "Content-Type: application/json" \
-H "Authorization: Bearer $(gcloud auth application-default print-access-token)" \
https://automl.googleapis.com/v1beta1/projects/678706386730/locations/us-central1/models/IOD3946791545901940736/predict \
-d @request.json
```

Activate Windows
Go to Settings to activate Windows.

(AI)

Analyze Data



The screenshot shows the Google Cloud Platform Vision API interface. On the left, the 'Vision' dashboard is visible with options for 'Dashboard', 'Datasets', and 'Models'. The main area displays an image of a road with a pothole, which has been analyzed by the API. Below the image, there are two options to 'Use your model': 'REST API' and 'Python'. The 'Python' option is selected, and a code editor on the right shows a Python script named 'predict.py'. The script imports the necessary modules, defines a function to get predictions, and includes a main block to execute the prediction on a local image file. The terminal at the bottom shows the command to run the script, which successfully returns the prediction results.

```
Free trial status: $200.52 credit and 87 days remaining - with a full account, you'll get unlimited access to all of Google Cloud AI services.

Google Cloud Platform My First Project

Vision newuntitled_1602352398289 LABELS

Dashboard
Datasets
Models

IMPORT IMAGES TRAIN EVALUATE TEST

Use your model

REST API Use a REST API to get predictions from this model through Google Cloud.

Python Use a Python client to get predictions from this model through Google Cloud.

predict.py

import sys

from google.cloud import automl_v1beta1
from google.cloud.automl_v1beta1.proto import service_pb2

# 'content' is base-64-encoded image data.
def get_prediction(content, project_id, model_id):
    prediction_client = automl_v1beta1.PredictionServiceClient()

    name = 'projects/{}/locations/us-central1/models/{}'.format(project_id, model_id)
    payload = {'image': {'image_bytes': content }}
    params = {}
    request = prediction_client.predict(name, payload, params)
    return request # waits till request is returned

if __name__ == '__main__':
    file_path = sys.argv[1]
    project_id = sys.argv[2]
    model_id = sys.argv[3]

    with open(file_path, 'rb') as ff:
        content = ff.read()

    print get_prediction(content, project_id, model_id)

Execute the request $ python predict.py YOUR_LOCAL_IMAGE_FILE 678708388730 1003946791545901940736
```

```
import sys

from google.cloud import automl_v1beta1
from google.cloud.automl_v1beta1.proto import service_pb2

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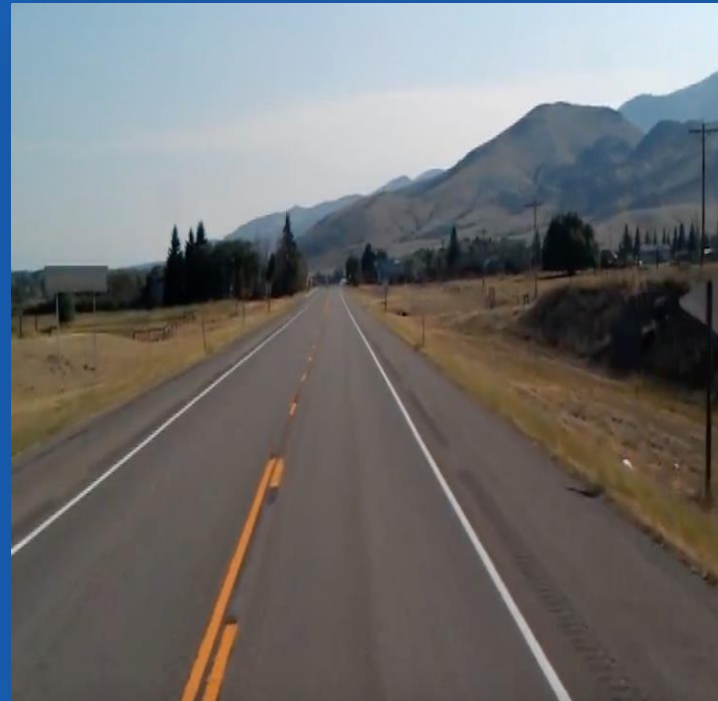
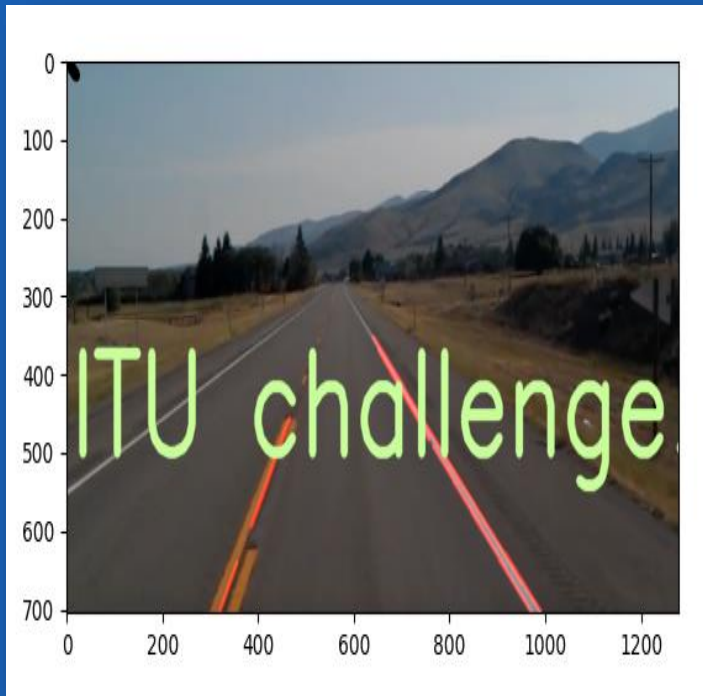
    with open(file_path, 'rb') as ff:
        content = ff.read()

    print get_prediction(content, project_id, model_id)
```

```
python predict.py YOUR_LOCAL_IMAGE_FILE 678708388730 1003946791545901940736
```

(AI)

Analyze Data



```
# Hello World program in Python

import matplotlib.pyplot as plt
import cv2
import numpy as np

def region_of_interest(img, vertices):
    mask = np.zeros_like(img)
    #channel_count = img.shape[2]
    match_mask_color = 255
    cv2.fillPoly(mask, vertices, match_mask_color)
    masked_image = cv2.bitwise_and(img, mask)
    return masked_image

def draw_the_lines(img, lines):
    img = np.copy(img)
    blank_image = np.zeros((img.shape[0], img.shape[1], 3), dtype=np.uint8)

    for line in lines:
        for x1, y1, x2, y2 in line:
            cv2.line(blank_image, (x1, y1), (x2, y2), (255, 0, 0), thickness=5)

    img = cv2.addWeighted(img, 0.8, blank_image, 1, 0.0)
    return img

image = cv2.imread('Road.png')
image = cv2.cvtColor(image, cv2.COLOR_BGR2RGB)

print(image.shape)
height = image.shape[0]
width = image.shape[1]

region_of_interest_vertices = [
    (0, height),
    (width / 2, height / 2),
    (width, height)
]

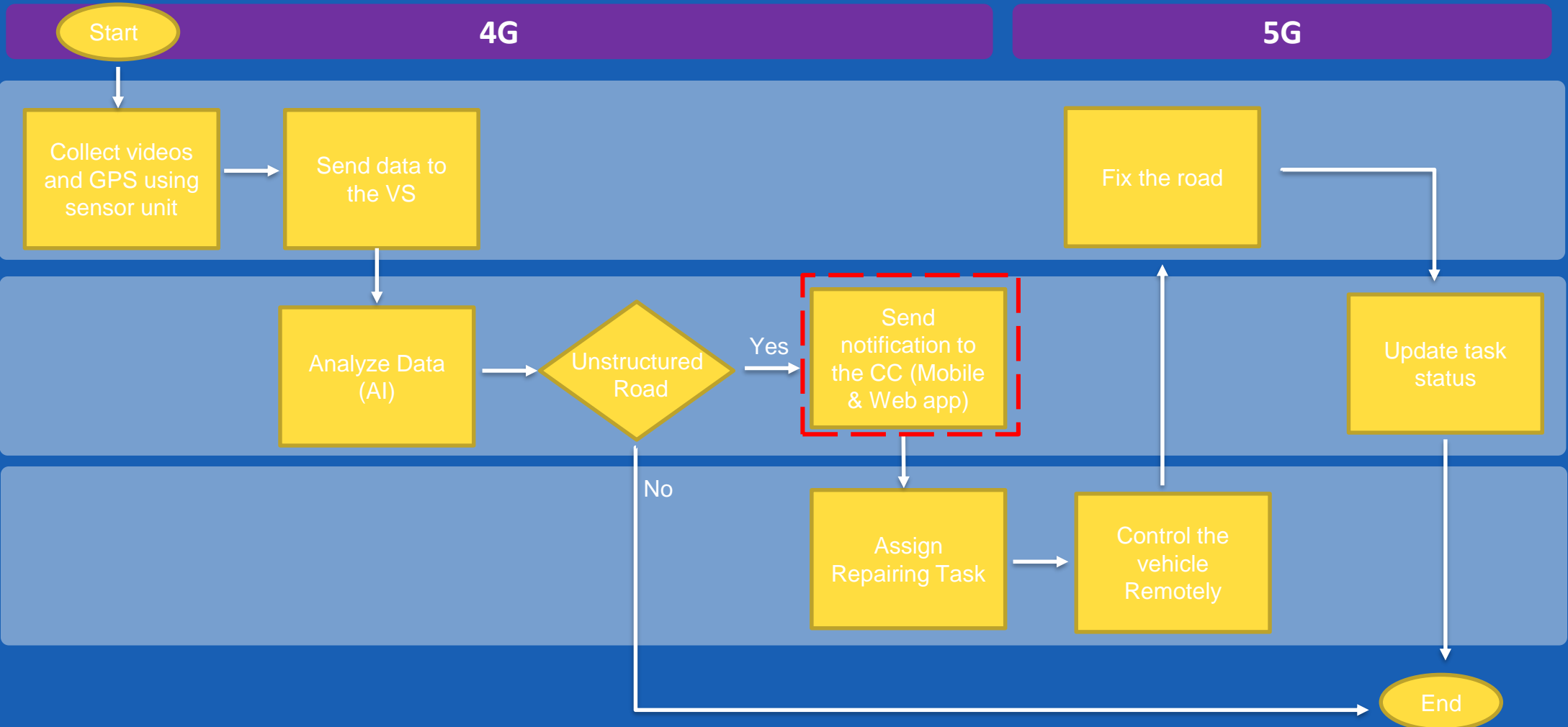
gray_image = cv2.cvtColor(image, cv2.COLOR_RGB2GRAY)
canny_image = cv2.Canny(gray_image, 100, 200)
cropped_image = region_of_interest(canny_image,
                                   np.array([region_of_interest_vertices], np.int32), )

lines = cv2.HoughLinesP(cropped_image,
                        rho=6,
                        theta=np.pi/60,
                        threshold=160,
                        lines=np.array([]),
                        minLineLength=40,
                        maxLineGap=25)

image_with_lines = draw_the_lines(image, lines)
cv2.line(image_with_lines, (0,0), (20,20), (0,0,0), 15)
font = cv2.FONT_HERSHEY_SIMPLEX
cv2.putText(image_with_lines, 'ITU challenge!', (10,500), font, 6, (200,255,155), 13, cv2.LINE_AA)
plt.imshow(image_with_lines)
plt.show()
print("Good job")
```

SOLUTION

Flowchart



Road



Virtual Server



Control Center



Welcome to The Remote Road Fixing Platform

Click Here To Start As a
[Road Detector](#)

Click Here To Start As a
[Controller](#)

Click Here To Start As a
[Road Fixer](#)



Road Detection Page

Automatically activate the
sensor unit

Manually activate the
sensor & send the date

Review the collected data
of sensor unit

It will be available as an application to detect defects from cameras and sensor units





Control Center

[Notification Center](#)[Data Review & Analytics](#)[Road Fixing Assignment](#)



Past Notifications

- Road X99 has 3 defects reported by sensor unit 5
- Road Fixer XY has been assigned to fix road AW12
- Road N15 has been fixed
-

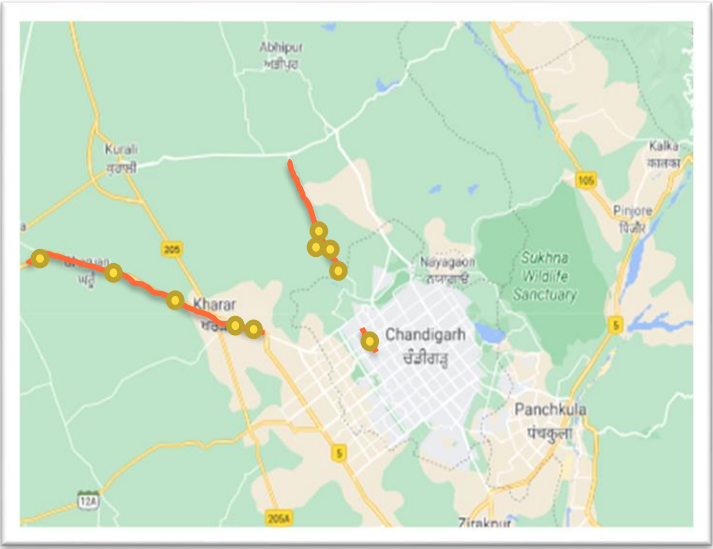
Today

- Road AB has 7 defects reported by sensor unit 2
- Road M99F has 4 defects reported by sensor unit 7
- Road 100 needs to fixer assignment
-

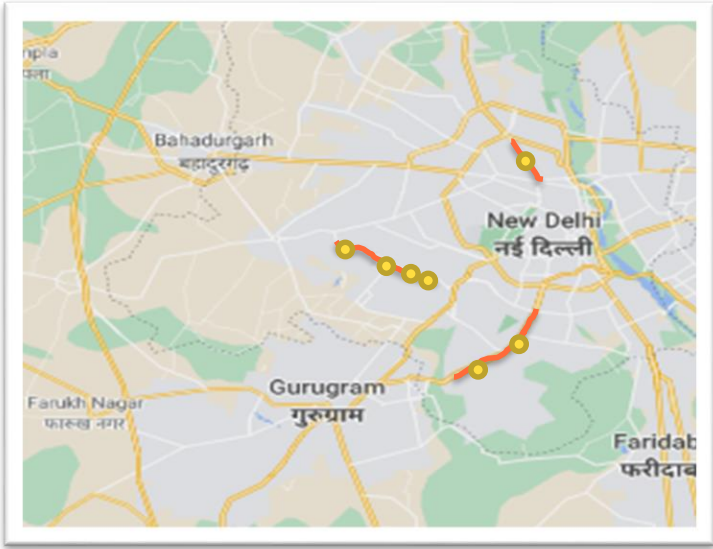
Future Notifications

- Road YYM needs to be checked
-

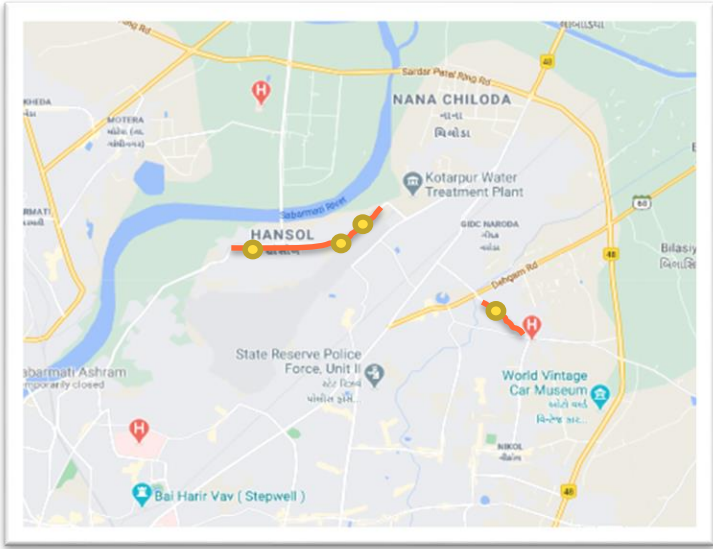
Chandigarh



New Delhi



Hyderabad



Defected Roads

Defects

Data Review & Analytics

Road Name	Sensor Unit Number	Number of Defects	Controller Name	Fixer Name
X1	1	12	AB	XX
Y1	2	4	MN	YY
Z1	1	7	BA	ZZ
M1	4	2	NA	MM



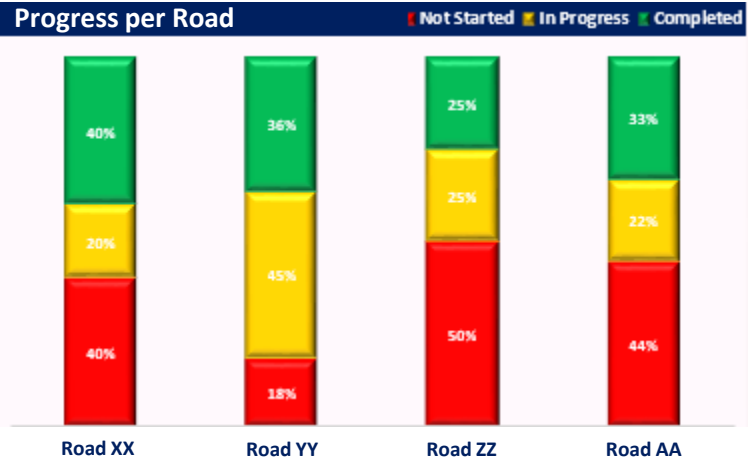
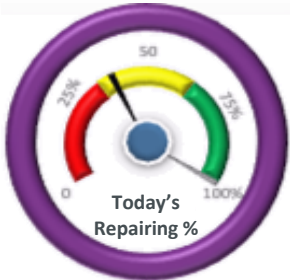
Occupied Road
Fixers



Total Reported
Defects



Occupied Sensor
Units



Road Fixing Assignment

Road Name	Sensor Unit Number	Number of Defects	Controller Name	Fixer Name
F1	1	5	AB	Click to Assign
G1	5	2	AB	Click to Assign
L1	3	9	AB	Click to Assign

- Norah
- Abdullah
- Abdulrahman
- Atheer



Road Fixing Task Details

Road

F1

Vehicle

M97



Defects

There are a total
of 4 defects

Start to drive the remote
fixing vehicle

Activate
Vehicle

Start Virtual
Driving

Report Issue



Activate
Alarms

Emergency
Stop

Repair

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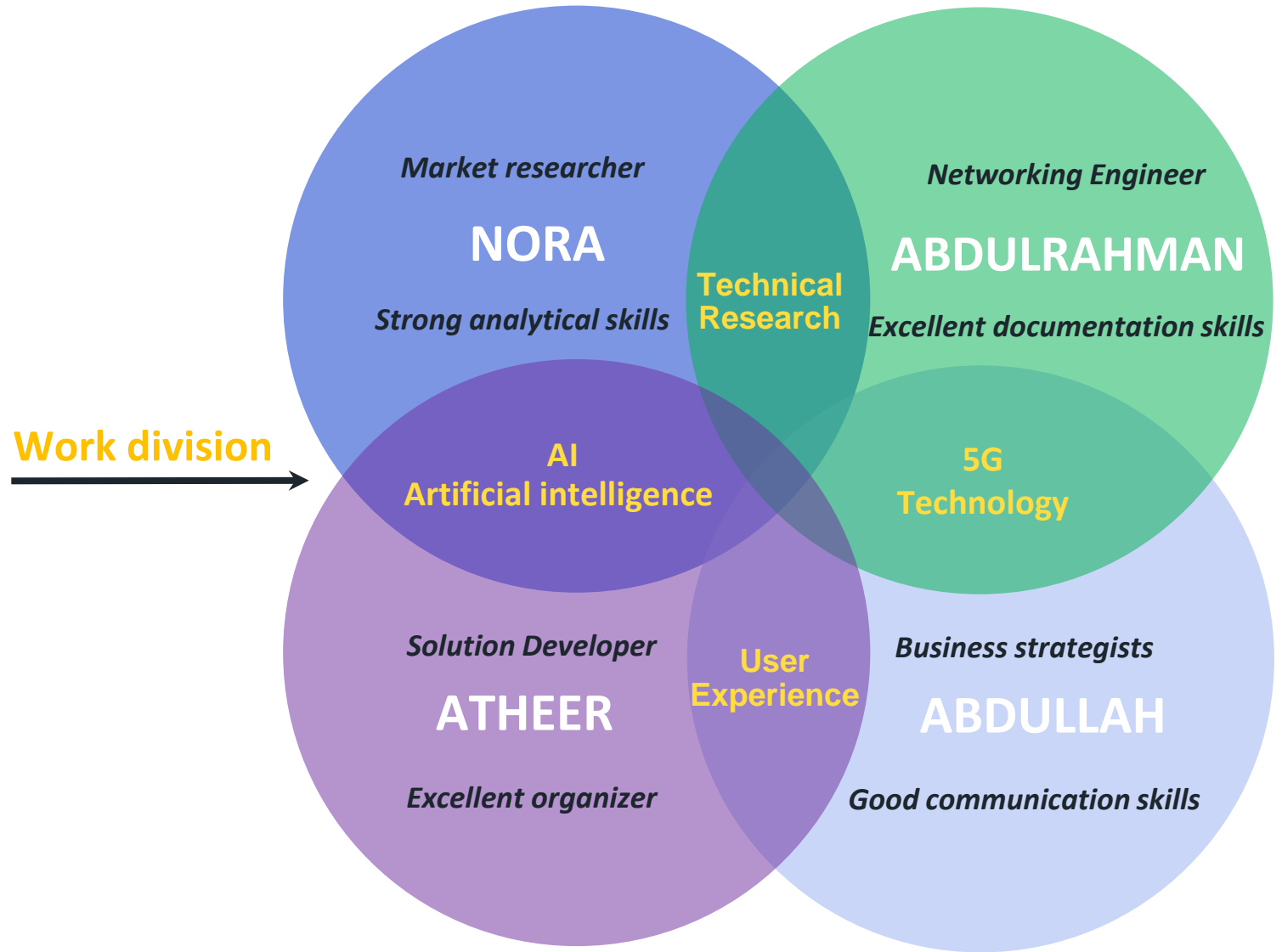
Relevance with automotive industry

TEAM DYNAMIC

NAME

Work division

Key strengths of team member

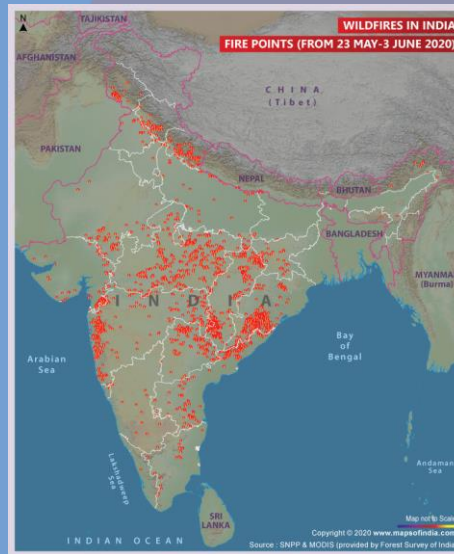


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Relevance with Indian automotive industry

How the solution can benefit in a large scale automotive Industry?



Map depicting wildfires in India
Fire points from 23 May -3 Jun2 2020



Remote-control and monitor
Fire Engine Truck
Commercial truck

END
THANK YOU



ITU AI/ML in 5G Challenge
Smart Transportation