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**R. H. SAPAT COLLEGE OF ENGINEERING, MANAGEMENT STUDIES,  
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# **POTHOLE Detection System**

**PROJECT PHASE - II**

**Department of Electronics &  
Telecommunication Engineering  
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# ABSTRACT

- Road maintenance is a challenging task.
- Pothole are the primary cause of accidents.
- Identification and classification of potholes is very important.
- Hitting potholes cause damage to vehicles and puts passengers into danger.
- This can be possible using CNN algorithms using deep learning and object detection technique.
- Detecting potholes in Indian road help the autonomous vehicle to move smoothly without getting struck in the potholes.



# INTRODUCTION

- It is a depression in a road surface.
- Formed by traffic and bad weather.
- Potholes claimed, on average, 1,876 lives annually.
- Over 5,000 People Killed In Road Accidents Caused By Potholes In 2018-20.
- Metro cities has more number of potholes.
- Potholes causes Fatal Accidents, Damages on Vehicle Suspension, Traffic Collision, Financial Damages.



# INTRODUCTION

- Potholes can be detected using deep learning.
- Object Detection is a key software and a fundamental task for an autonomous driving.
- Pothole detection involves different processing methods such as image filtering, image segmentation and clustering techniques like edge detection.
- The result where evaluated based on the traditional performance measures - accuracy, sensitivity, specificity, and computational time.



# LITERATURE SURVEY

Sr. No.	Author Name	Paper Name	Conclusion
1.	Chi-Wei Kuan, Wen-Hui Chen, Yu-Chen Lin	Pothole Detection and Avoidance via Deep Learning on Edge Devices, International Automatic Control Conference (CACS), IEEE, 2020.	Described the dangers of potholes and suggested detection technologies using DQN as an agent, and trained it on CARLA driving simulator.
2.	Dharneeshkar J, Soban Dhakshana V, Aniruthan S A, Karthika R, Latha Parameswaran	Deep Learning based Detection of potholes in Indian roads using YOLO, International Conference on Inventive Computation Technologies (ICICT), IEEE, 2020.	Developed a pothole detection system based on deep learning using YOLO and advanced image processing.
3.	Dhwani Desai, Abhishek Soni, Dhruv Panchal, and Sachin Gajjar	Design, Development and Testing of Automatic Pothole Detection and Alert System, 16th India Council International Conference (INDICON), IEEE, 2019.	Introduced a system which automatically generates an alarm on handset after detection of pothole making use of stereo-visual camera and GPS.

# LITERATURE SURVEY

Sr. No.	Author Name	Paper Name	Conclusion
4.	Byeong-ho Kang and Su-il Choi	Pothole Detection System using 2D LiDAR and Camera, Ninth International Conference on Ubiquitous and Future Networks (ICUFN), IEEE, 2017.	Provides a way to detect pothole using LiDAR and Camera using edge extraction, object extraction and adaptive breakpoint detection.
5.	Sudarshan S Rode, Shonil Vijay, Prakhar Goyal, Purushottam Kulkarni, and Kavi Arya	Pothole Detection and Warning System: Infrastructure Support and System Design”, International Conference on Electronic Computer Technology, 2009.	Detected potholes using Wi-Fi and access point tracking.
6.	Roopak Rastogi, Uttam Kumar, Archit Kashyap, Shubham Jindal, Saurabh Pahwa	A Comparative Evaluation of the Deep Learning Algorithms for Pothole Detection”, 17th India Council International Conference (INDICON), IEEE, 2020.	Studied the evolution in the technologies used in pothole detection using SSD algorithm.

# PROBLEM STATEMENT

In India, potholes in the road are the major cause for serious to fatal accidents. Potholes not only leads to injuries to human body by harming spinal cord but also damages the vehicles by making it less efficient, damages wheels and reems, harms exhaust system of vehicles which pollutes environment. Hence potholes are required to be detected.

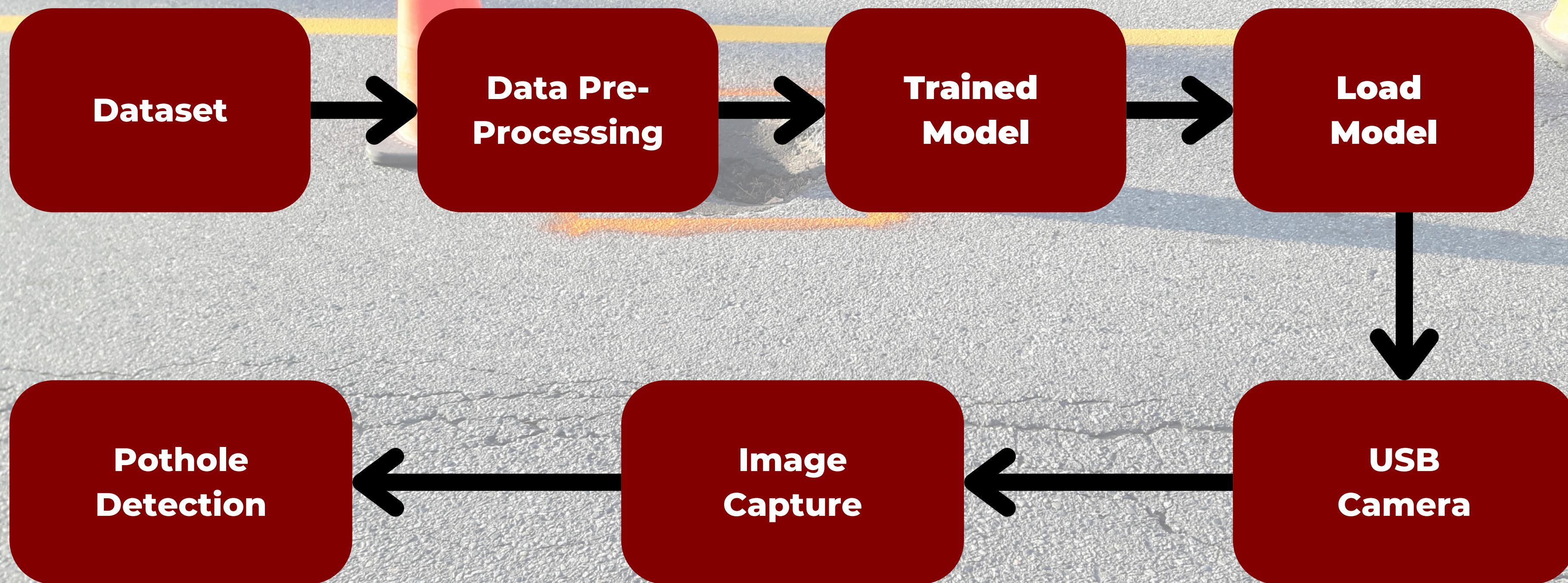


# OBJECTIVE

To develop a software-based image processing system which detects potholes using camera sensor based on machine learning algorithm.



# BLOCK DIAGRAM



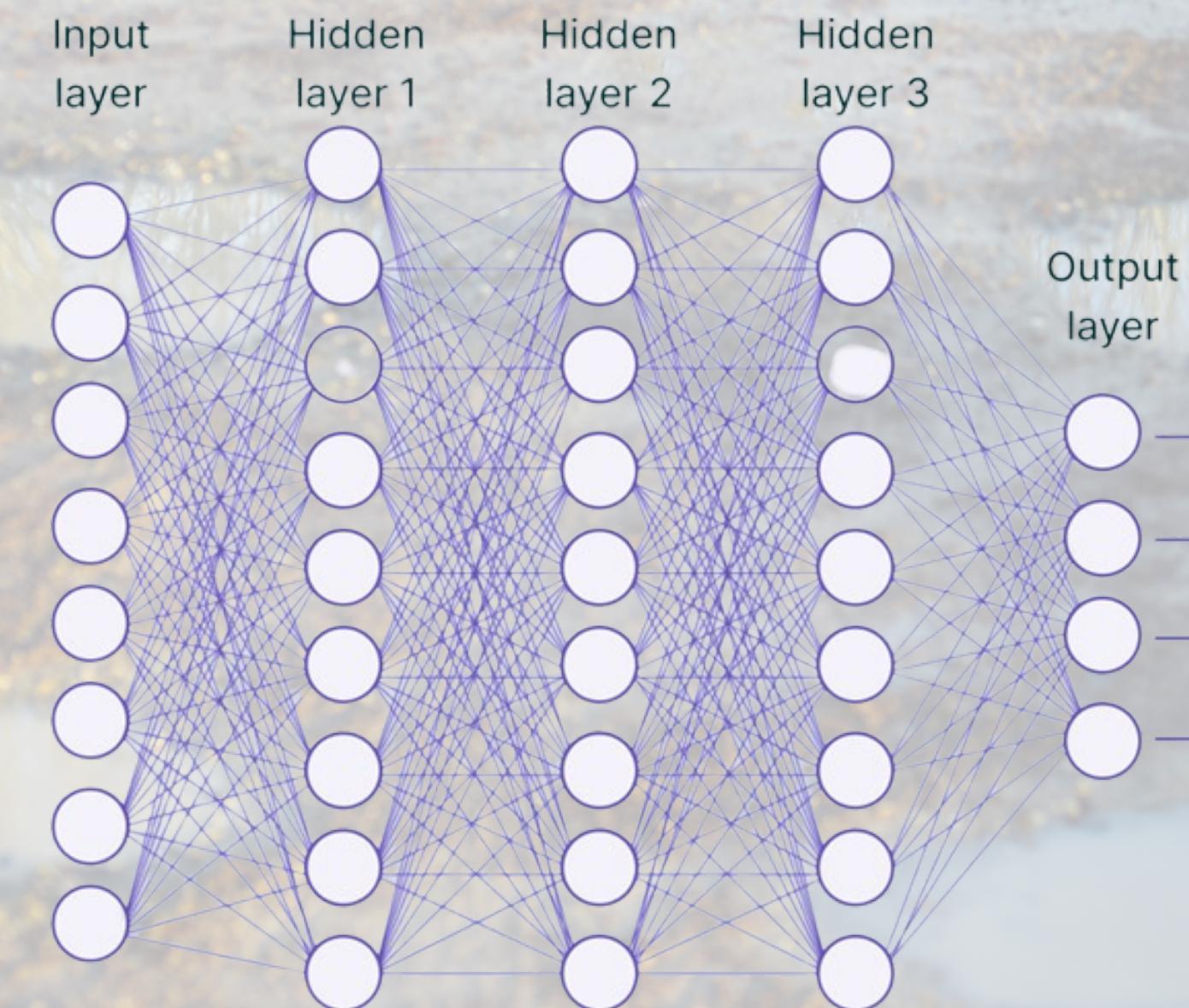
This study focused on identifying pothole and non-pothole events. Hence, it was a binary classification problem. The initial stage of the project involved the data collection and labelling of the pothole or non-pothole events. The input image will be taken by USB camera. These input image will be processed and split into two classified groups. By using these Methodology, potholes in the road will be detected.



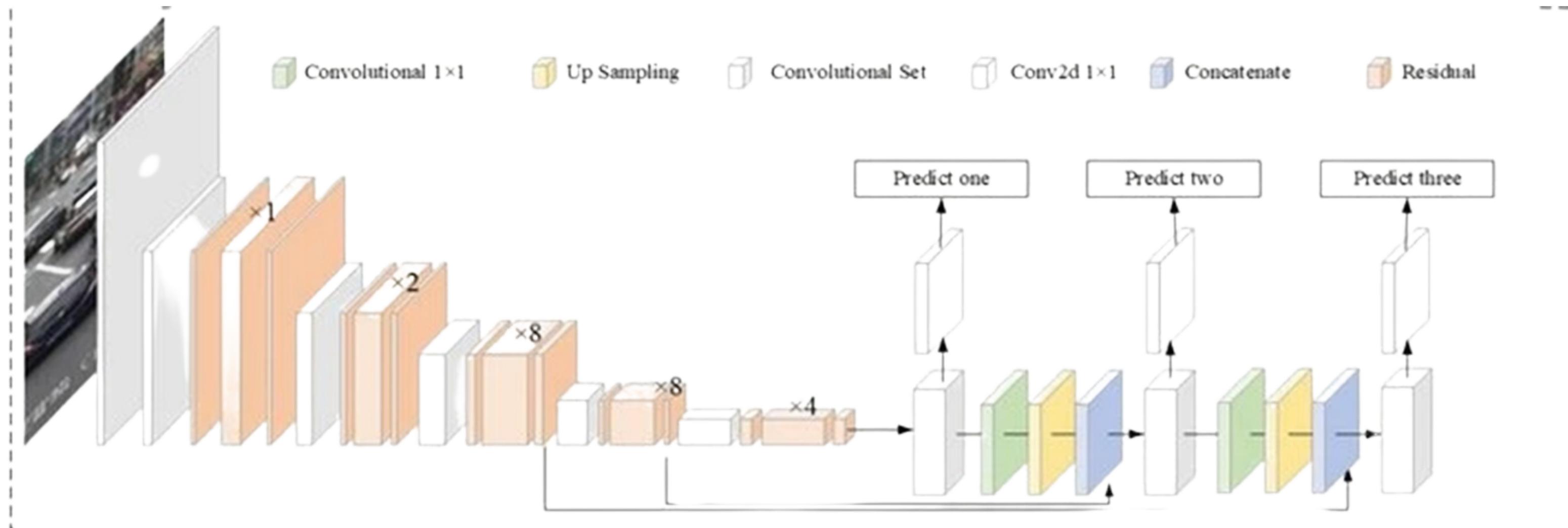
# METHODOLOGY



# CONVOLUTIONAL NEURAL NETWORK



# YOLO





## ADVANTAGES

- Help drivers to avoid accidents,
- Helps to avoid any vehicle damages, but also helps government to maintain roads.

## DISADVANTAGES

- It is expensive to detect potholes compared to other methods and hard to recognize when the potholes filled with water or dirt.

## ALGORITHM

- A convolutional neural network (CNN)-based model has been designed that takes as input- thermal images of potholes and non-pothole roads. After training the model on this data, the model predicts if the input image is of a pothole or non-pothole.

# HARDWARE USED

01

## USB Camera

USB Camera functions by plugging it to a computer through a USB cable. It is required for image inputs for the system.

02

## Hard Disk 160 GB

A hard disk of 160 GB and a RAM of memory 1 GB is required.

03

## Processor Core i3

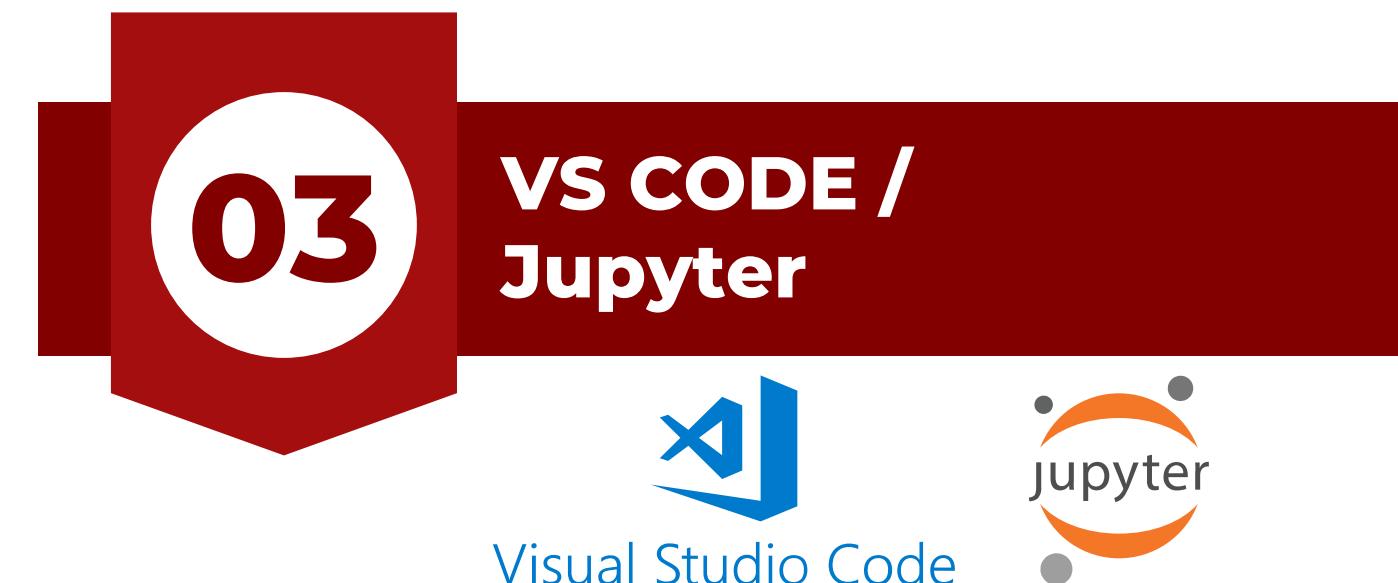
Developed and manufactured by Intel, Core i3 is a dual-core computer processor. It is required for image processing.

04

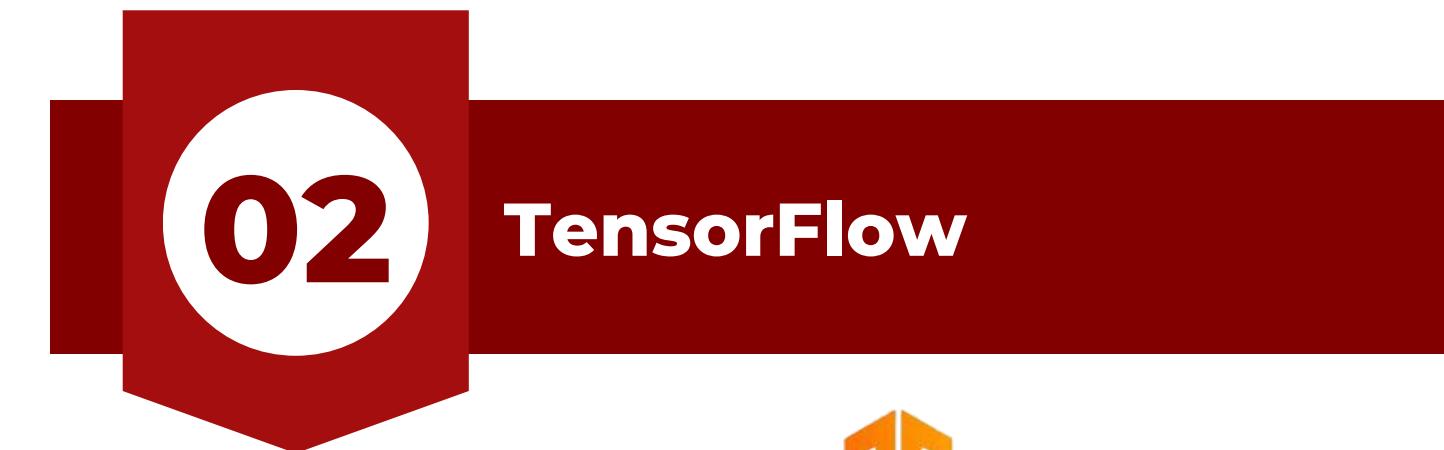
## Monitor

A monitor screen is required for displaying the result.

# SOFTWARE REQUIREMENT



# LIBRARY USED



# SETTING OF DATASET

## Set up Custom Dataset for YOLOv4

We'll use Roboflow to convert our dataset from any format to the YOLO Darknet format.

1. To do so, create a free [Roboflow account](#).
2. Upload your images and their annotations (in any format: VOC XML, COCO JSON, TensorFlow CSV, etc).
3. Apply preprocessing and augmentation steps you may like. We recommend at least `auto-orient` and a `resize` to 416x416. Generate your dataset.
4. Export your dataset in the **YOLO Darknet format**.
5. Copy your download link, and paste it below.

See our [blog post](#) for greater detail.

In this example, I used the open source [BCCD Dataset](#). (You can `fork` it to your Roboflow account to follow along.)



```
!wget https://moderncomputervision.s3.eu-west-2.amazonaws.com/Pothole.v1-raw.darknet.zip
!unzip -q Pothole.v1-raw.darknet.zip

--2022-11-22 08:12:17-- https://moderncomputervision.s3.eu-west-2.amazonaws.com/Pothole.v1-raw.darknet.zip
Resolving moderncomputervision.s3.eu-west-2.amazonaws.com (moderncomputervision.s3.eu-west-2.amazonaws.com)... 52.95.143.38
Connecting to moderncomputervision.s3.eu-west-2.amazonaws.com (moderncomputervision.s3.eu-west-2.amazonaws.com)|52.95.143.38|:443... connected.
HTTP request sent, awaiting response... 200 OK
Length: 48256609 (46M) [application/zip]
Saving to: 'Pothole.v1-raw.darknet.zip'

Pothole.v1-raw.dark 100%[=====] 46.02M 11.5MB/s   in 4.4s

2022-11-22 08:12:23 (10.4 MB/s) - 'Pothole.v1-raw.darknet.zip' saved [48256609/48256609]
```

# EXPECTED OUTPUT



# CONCLUSION

The pothole detection using artificial intelligence methods can help in better maintenance of the road conditions especially in developing countries where resources are limited.

For this purpose, the proposed system based on convolutional neural networks using thermal imaging does have the potential to compete with the existing techniques of pothole detection.

The proposed pothole detection system using CNN based ResNet model has achieved an accuracy of 97.08 which is the best ever reported in the literature so far. Moreover, this is the first time when thermal imaging has been used for the pothole detection which has several advantages over the other techniques such as more accurate, low cost, less complex.

Further, this work can be extended to detect the region of potholes after classifying an image as pothole and furthermore parameters can also be detected like the severity of potholes on the basis of which it can be figured out which area requires urgent repair work.

# REFERENCE

- [1] Chi-Wei Kuan, Wen-Hui Chen, Yu-Chen Lin, “Pothole Detection and Avoidance via Deep Learning on Edge Devices”, International Automatic Control Conference (CACS), IEEE, 2020.
- [2] Dharneeshkar J, Soban Dhakshana V, Aniruthan S A, Karthika R, Latha Parameswaran “Deep Learning based Detection of potholes in Indian roads using YOLO”, International Conference on Inventive Computation Technologies (ICICT), IEEE, 2020.
- [3] Dhwani Desai, Abhishek Soni, Dhruv Panchal, Sachin Gajjar, “Design, Development and Testing of Automatic Pothole Detection and Alert System”, 16th India Council International Conference (INDICON), IEEE, 2019.
- [4] Byeong-ho Kang, Su-il Choi, “Pothole Detection System using 2D LiDAR and Camera”, Ninth International Conference on Ubiquitous and Future Networks (ICUFN), IEEE, 2017.
- [5] Sudarshan S Rode, Shonil Vijay, Prakhar Goyal, Purushottam Kulkarni, Kavi Arya, “Pothole Detection and Warning System: Infrastructure Support and System Design”, International Conference on Electronic Computer Technology, 2009.
- [6] Roopak Rastogi, Uttam Kumar, Archit Kashyap, Shubham Jindal, Saurabh Pahwa, “A Comparative Evaluation of the Deep Learning Algorithms for Pothole Detection”, 17th India Council International Conference (INDICON), IEEE, 2020.

Image Sources: Google

<https://www.indiatimes.com/trending/social-relevance/over-5000-people-died-by-potholes-accidents-between-2018-2020-577821.html>



# Thank You

FOR YOUR ATTENTION

