IMAGE PROCESSING PROJECT (EE 610)

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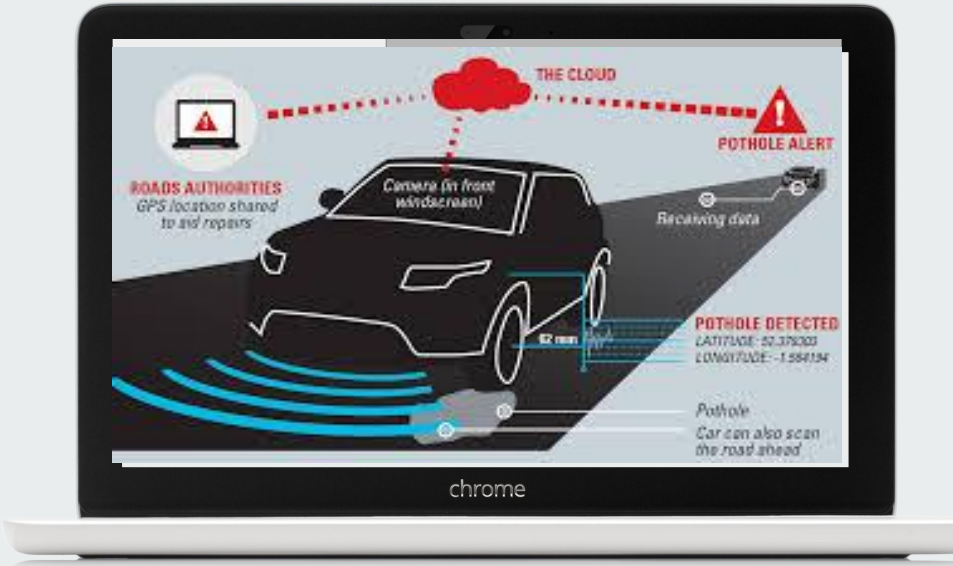
Project Wireframes

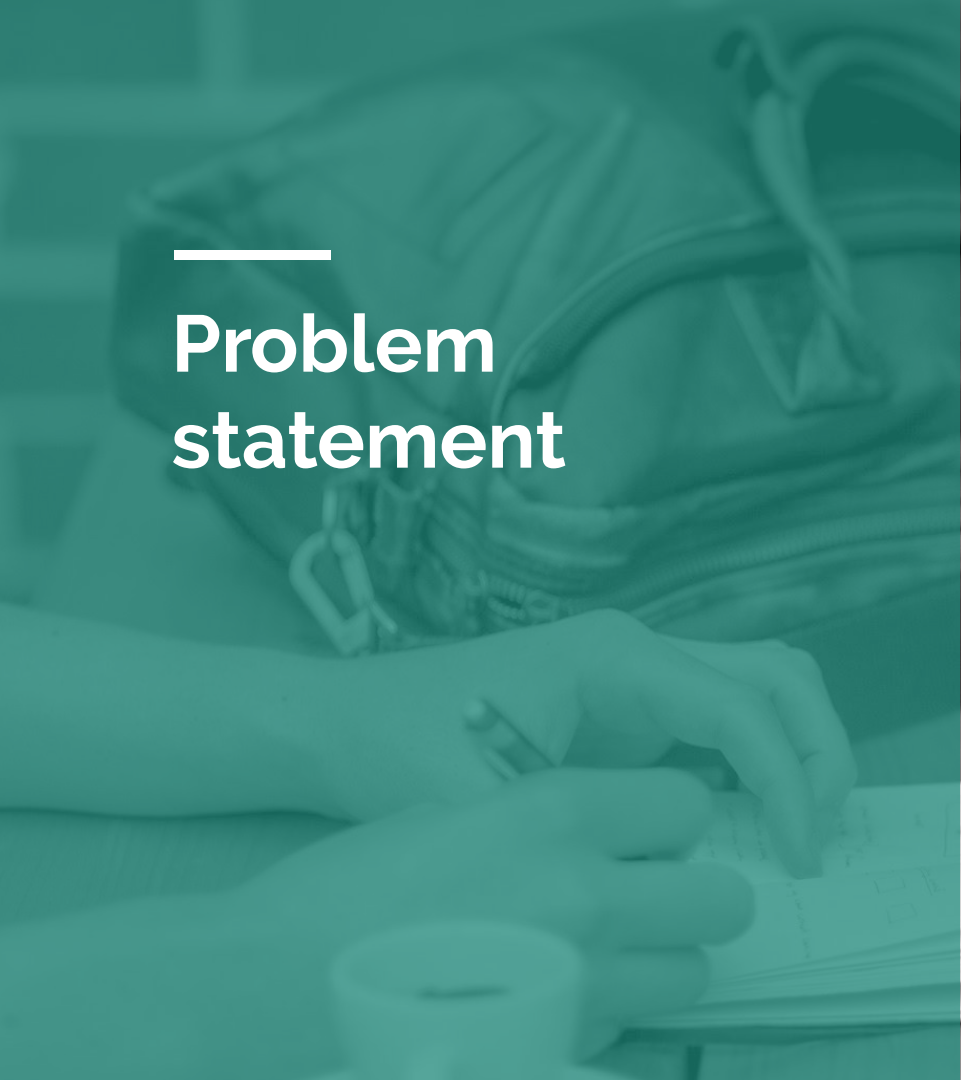
Pothole detection and avoidance system



Outline

The Problem

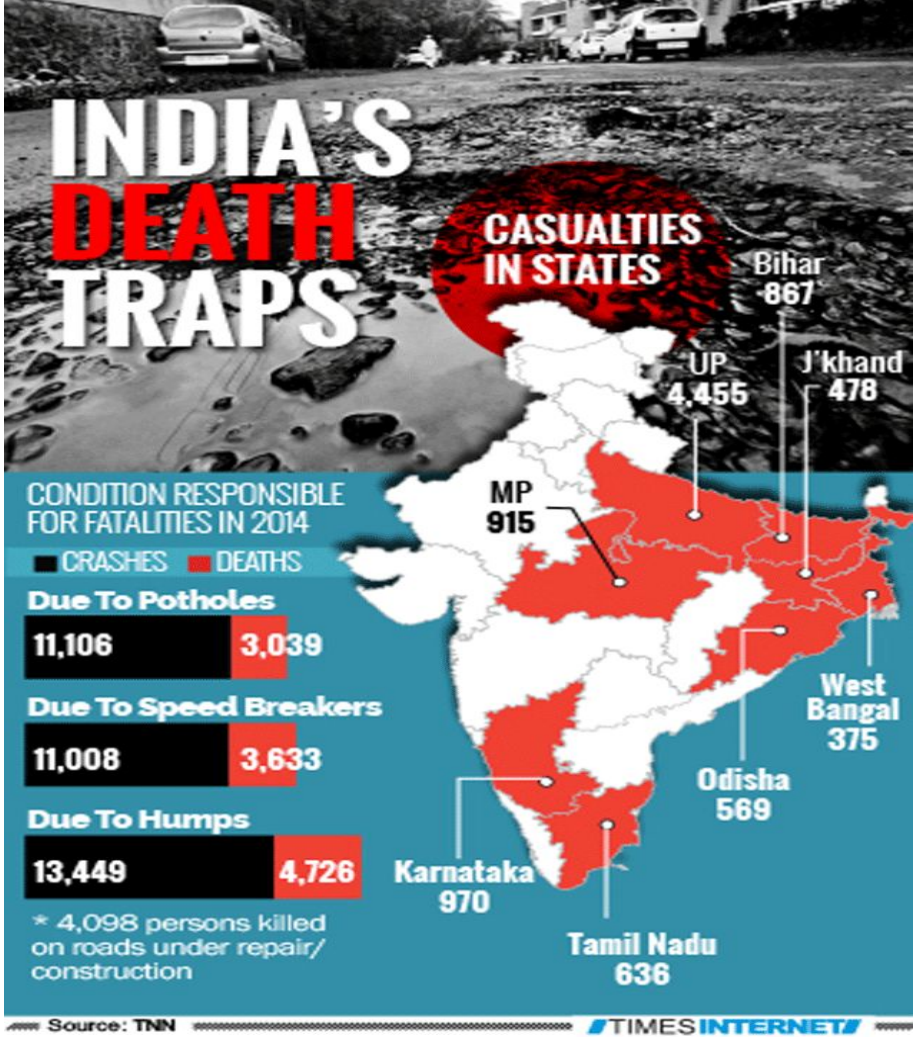
Potholes continue to be a major problem on roads, causing damage to vehicles and presenting a significant safety risk for drivers and cyclists.



Problem statement

POTHOLES present a serious safety risk to motorists. It is very important to get the information collect them and distribute it to other vehicles and warn the driver.So building a system in which the access point collects the information about the potholes in the vicinity of a wireless access point and distributes to other vehicles using a wireless broadcast

Supporting information



Solution description

A methodology which uses image-segmentation, thresholding and clustering to detect the potholes.

Proposed techiques

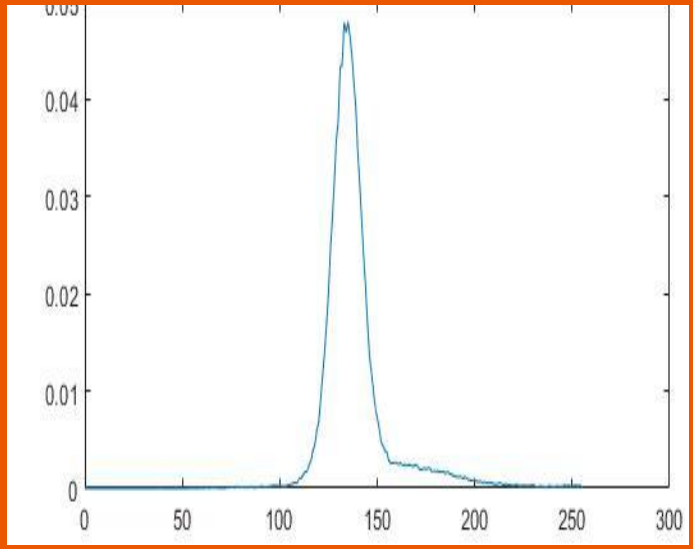
- ➔ THRESHOLDING BY OTSU'S METHOD
- ➔ DILATION (MORPHOLOGICAL OPERATION)
- ➔ CANNY EDGE DETECTION
- ➔ SEMANTIC SEGMENTATION

Thresholding by Otsu's method

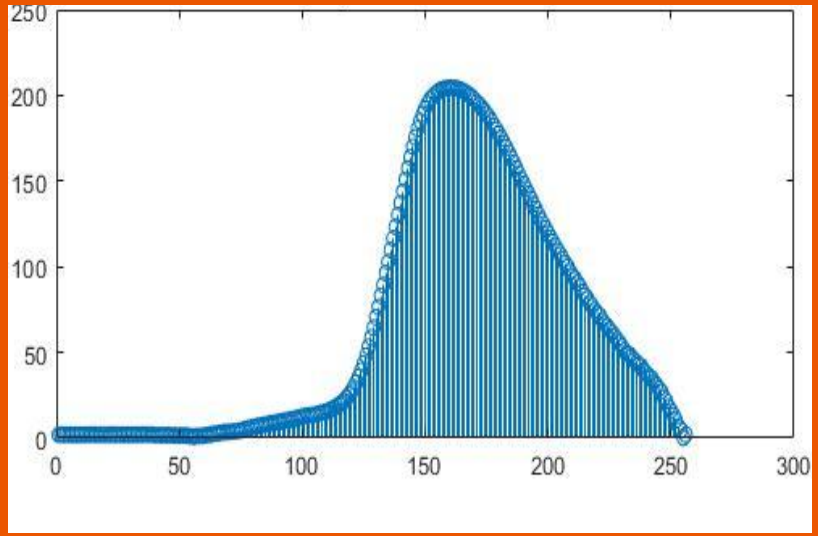
- ➔ Used to automatically perform clustering-based image thresholding or, the reduction of a gray level image to a binary image.
- ➔ It maximizes between class variance.
- ➔ It then calculates the optimum threshold separating the two classes so that their combined spread is minimal, or equivalently (because the sum of pairwise squared distances is constant), so that their inter-class variance is maximal.

Resized orignal image

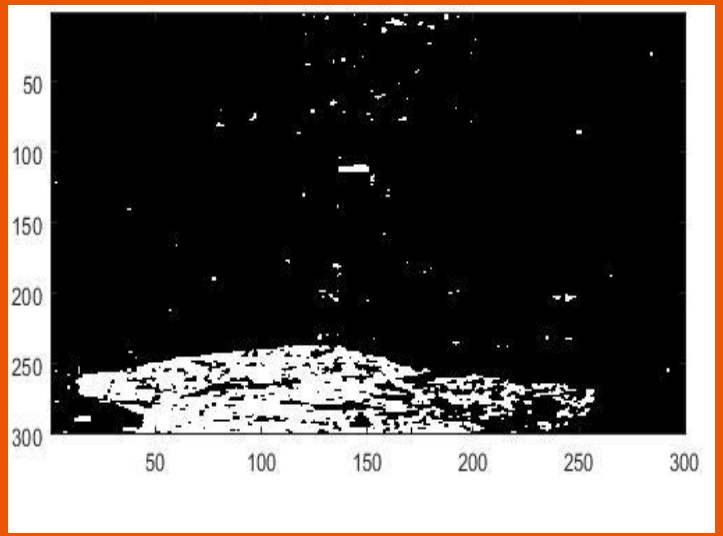
Histogram



Variance plot



Segmented image

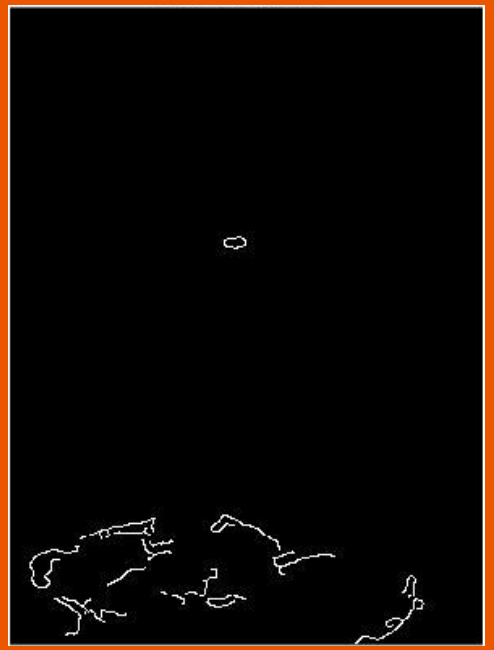


DILATION

- The dilation of an image f by a structuring element s (denoted fs) produces a new binary image $g = f \oplus s$ with ones in all locations (x,y) of a structuring element's origin at which that structuring element s hits the the input image f i.e. g(x,y) = 1 if s hits f and 0 otherwise,repeating for all pixel coordinates (x,y).
- Structuring element s.
- It adds a layer of pixels to both the inner and outer boundaries of regions.

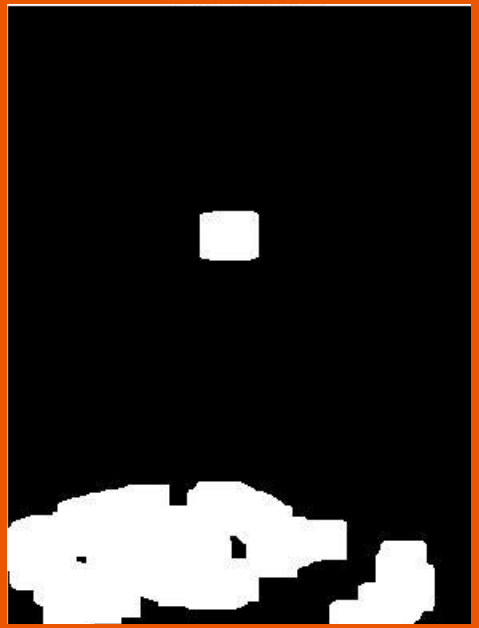
Original resized image

Edge detection



Resized orignal image

Dilated image



CANNY EDGE DETECTION

- ➔ It is a multi-stage algorithm.
- ➔ Noise Reduction Since edge detection is susceptible to noise in the image, first step is to remove the noise in the image.
- ➔ Finding Intensity Gradient of the Image
- ➔ Non-maximum Suppression
- ➔ Hysteresis Thresholding

Original image

Horizontal edges of potholes

Vertical edges of potholes

All edges of potholes

SEMANTIC SEGMENTATION

Train a Semantic Segmentation Network

The steps for training a semantic segmentation network are as follows:

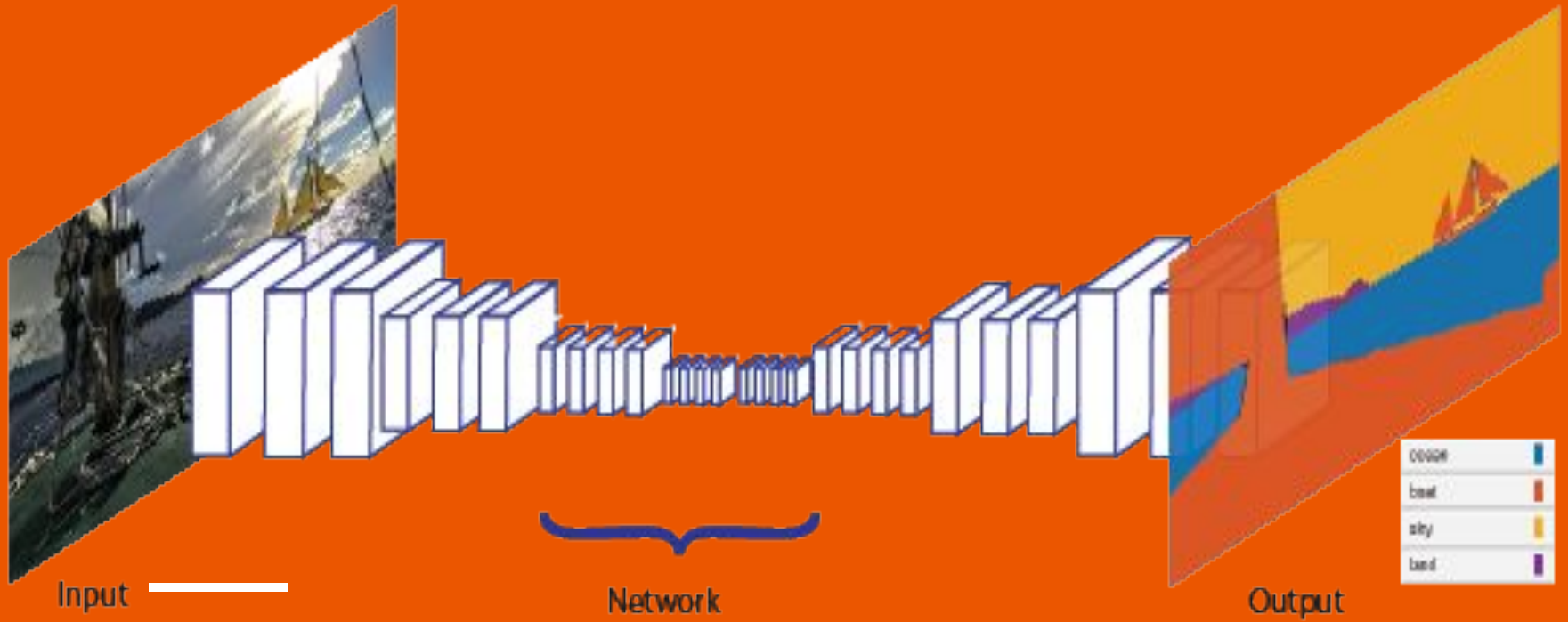
1.Analyze Training Data : Collection of images and its corresponding collection of pixel labeled images.

2.Create a Semantic Segmentation Network : Create a simple semantic segmentation network and learn about common layers found in many semantic segmentation networks.

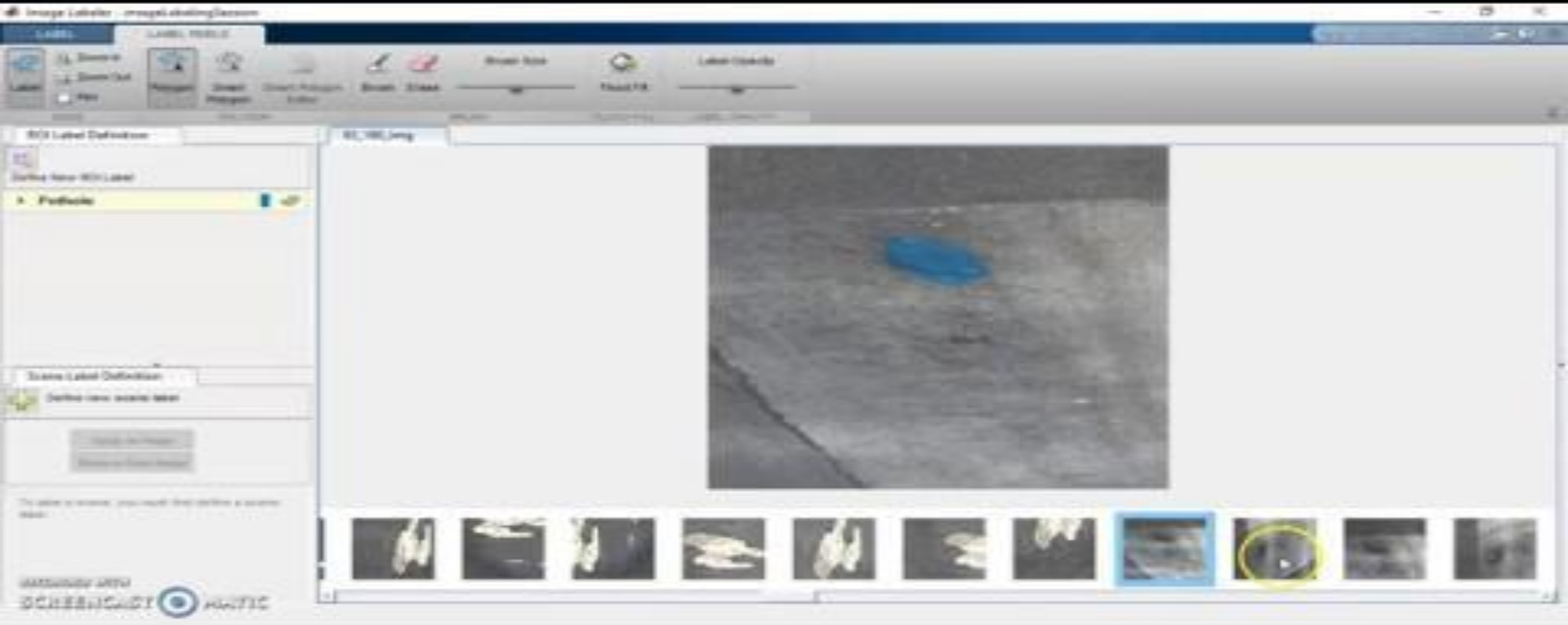
3. Train A Semantic Segmentation Network.

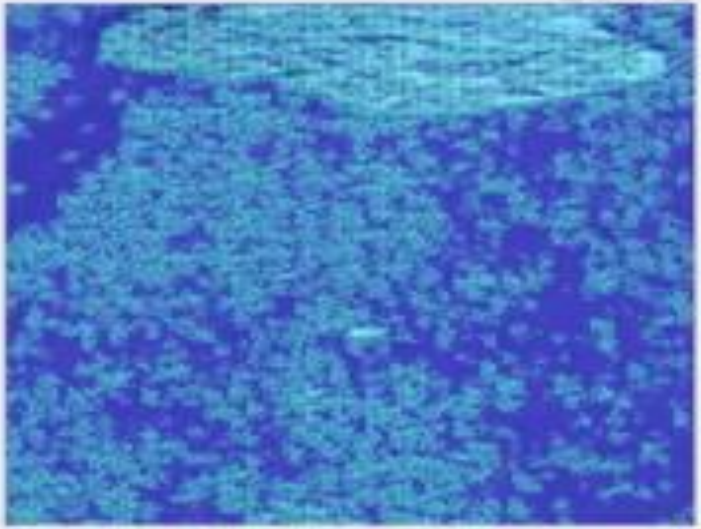
4. Evaluate and Inspect the Results of Semantic Segmentation : Import a test data set, run a pretrained semantic segmentation network, and evaluate and inspect semantic segmentation quality metrics for the predicted result.

Semantic segmentation transfer learning



source:https://in.mathworks.com/help/vision/ug/semantic-segmentation-basics.html





Conclusions

1. We have successfully detected the potholes using basic segmentation techniques. The best results were obtained by otsu's method.
2. Semantic segmentation network was able to detect major part of the pothole based on the training provided to it.
3. This is a theoretical proposal, it can be implemented in metropolitan cities.

Application

The driver behavior can be improved by either alerting him about the probable accident that may occur due to pothole and humps or controlling the vehicle itself.

References

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3. https://in.mathworks.com/help/vision/ug/semantic-segmentation-basics.html
4. Rajeshwari Madli,Santosh Hebbar, Praveenraj Pattar and Varaprasad Golla,"Automatic detection and notification of potholes and humps on roads to aid drivers", IEEE Sensors journal, vol.15, no.8, August 2015
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6. Taehyeong Kim, Seung-Ki Ryu, "Review and analysis of pothole detection methods" , journal of emerging trends in computing and information sciences,vol.5,no.8,august 2014

THANK YOU