Pothole and Garbage Detection Using Support Vector Machine

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Abstract: - In the era of modern world, society has some basic needs like clean drinking water, adequate treatment and disposal of human excreta and pothole-free roads, etc. It has questioned the competency of concerned ruling authority. In the society there are volunteers who are urging to alter the case and report of these problems. Along with that people are also facing basic problem like vehicle accidents, fires, mechanical damages and many more. There is a provision for huge financial budget at each year for maintaining road by Municipal Corporation but due to the lack of supervision everything gets waste. Same thing is happening with sanitization; problems like surface waters, poor garbage management, pollution, etc. do appear. In this work we are proposing the machine learning based solution, which enables the citizens to report the issues like potholes or sanitation evidences by simple one click along with remainders and monitoring. Proposed work uses support vector machine classifier for classifying and reporting the images of the said evidences to the concerned authority.

Key Words :— ***Convolutional Neural Network, Support Vector Machine, Geographical Information System*.**

I. INTRODUCTION

Roads are the first medium of transport for human lives. Because the potholes are increasing day by day, people also are facing problem. Problems like vehicle accidents, fires, mechanical damages and lots of more only thanks to potholes. The large financial budget invested once a year for maintaining road by Municipal Corporation but because of improper supervision the results are improper. Same goes for sanitization; problems like surface waters, poor garbage management, pollution, etc. does appear. The solutions enable citizens to report potholes or sanitation problems by simple one clicks and therefore the technology will be sure of the remainder, the situation of the image would be automatically get fetched through the mobile or device itself, gets validated, a complaint to respective domain are transferred. The foremost issue a concerned section faces is that for each registered complaint, a government official must be on-site for verification. The citizen service solution automates the whole process by checking the authentication of the image so fetching the acceptable location. Major technology used for the method is convolution neural network which may be a deep learning exercise. Using multiple images helps us to search out depth, size, the dimension of pothole and volume for garbage.

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II. LITERATURE REVIEW

Several studies are reported within the literature for classification of pothole and garbage and also for calculating the depth of a pothole. The work is as follows: The convolutional neural network is initially introduced by LeCun in [1] and improved in [2]. They developed a multilayer artificial neural network referred to as LeNet-5 which may classify handwriting variety. Like another neural network, LeNet-5 has multiple layers and should be trained with the back-propagation algorithmic program [3]. However, thanks to the dearth of enormous training information and computing power at that point. LeNet-5 cannot perform well on lots of complicated problems, sort of a large-scale image and video classification. Since 2006, several ways are developed to beat the difficulties encountered in coaching deep neural networks. Krizhevsky propose a classic CNN design Alexnet [4] and show vital improvement upon previous ways on the image classification

task. With the success of Alexnet [4], many works are projected to boost its performance. ZFNet [5], VGGNet [6] and GoogleNet [7] are projected. TianmeiGuo, Jiwen Dong, HenjianLi, YunxingGao [7] introduced a straightforward convolution neural network comprising of relu[8] and dropout[9]. These gave the very best accuracy of 0.66% on MNIST dataset dataset also less computational cost. Analysis of various methods of learning ret set and different optimization algorithm for image classification is finished. [11] BishwajitPal, Dr.SamithaKhaiyum, Dr. Y. S. Kumaraswamy [12] advocate the subsequent proposition: Using the successive triangulation method the particular position of the depth pixel are often established using simple trigonometric functions. Also, these trigonometric functions is executed independently for each pixel. Hence the complete process is executed in parallel. The numbers of steps are finite which makes it predictable in terms of execution time. TPL isn't ready to proportion compared to sequential execution.

The most reason is that the modern operating systems are capable of distributing processing power to different cores whether or not the programming languages don't explicitly mention it. Whereas when TPL is employed the CPU cores are efficiently used, and performance is enhanced. The performance is far higher when the image size increases. In our test differing kinds of processors has shown different execution and performance difference, but one thing is clear that using TPL the performance will be increased. SaifaliNoorani, Prof.MilindFernandes[13] introduced a technique successfully developed waste, identification, and system.

The extracted textural features for all three networks provided an honest basis for the neural network classification. In ILSVRC-2012 competition, AlexNet had achieved a winning top-5 error rate of 15.3 percent while the GoogleNet features a Top-5 error rate as low as 6.67 percent. But networks above that's AlexNet, Berkeley model and GoogleNet show Top-5 error the speed of 49%, 50%, and 41%, hence stating that these networks haven't been trained for waste image database or the input images we've got fed to that. Mobilenets[14] a brand new class of efficient models for mobiles was introduced which reduced a good amount of computation cost, size and time. Depthwise separable convolution was the methodology introduced for image classification which consists of two layers depthwise convolution and pointwise convolution.

III. ALGORITHM

A. *Support Vector Machine*

Support Vector Machine is a classification and regression approach. SVM can easily handle multiple variables for regression technique. SVM constructs hyperplane and divides the class with it in multidimensional space. The idea of SVM is to obtain maximum hyperplane distance. I.e. Margin which divides the dataset into classes

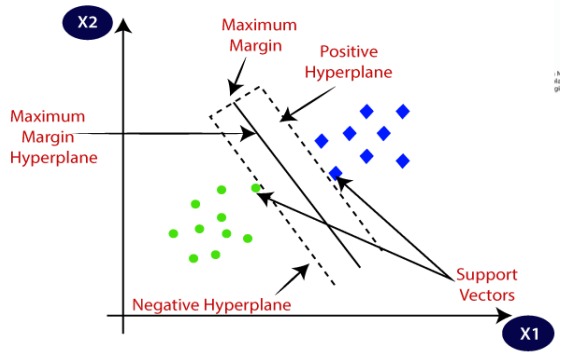

Fig.1. SVM Architecture

B. *Hyperplanes and Support Vectors*

- Data points are classify on the basis of Hyperplanes by using decision boundaries. Data points falling on any side of the hyperplane can be attributed to different classes. The dimension of the hyperplane depends upon the lot of various features. When the total number of input features are two (2), then hyperplane is just a line. But when the number of input features are three (3), then the hyperplane becomes a 2D plane. It hard to determine when the number of features exceeds 3.

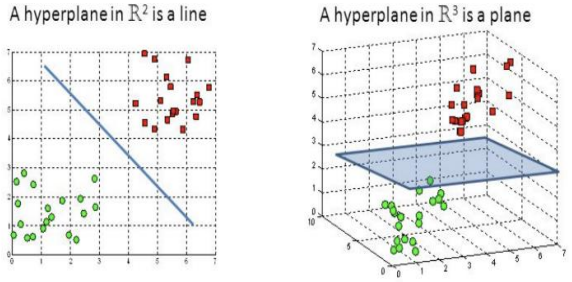

Fig.2. Hyperplanes

C. *Margin*

Support vectors (SV's) are data points which are closer to the hyperplane and affect the position and orientation of the hyperplane. By using these support vectors, we can basically

maximize the margin of the classifier. Deleting the support vectors affect the position of the hyperplane. Those are the points that help us build our SVM.

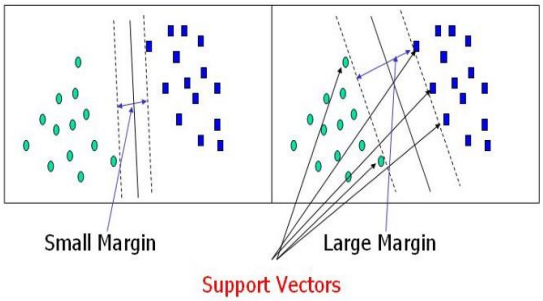

Fig.3. Margins

D. Cost Function and Gradient Update

In the SVM algorithm, we have to maximize the margin between the data points and the hyperplane, the loss function which helps maximize the margin is hinge loss.

$$c(x, y, f(x)) = \begin{cases} 0, & \text{if } y * f(x) \geq 1 \\ 1 - y * f(x), & \text{else} \end{cases}$$

$$c(x, y, f(x)) = (1 - y * f(x))_+$$

The cost remains 0 only if the predicted value as well as the actual value are of the same sign. And if not, calculate the loss value. A regularization parameter the cost function is also added.

We have trained a linear SVM classifier on the features extracted by the convolutional base. For training of classifier, a traditional machine learning approach is preferable. k-fold cross-validation will be used to estimate the error of the classifier.

E. Linear Support Vector Machine Model Performance Metrics

To measure the performance of the classifier, following parameters are taken into Consideration.

Accuracy = Number of Correct Predictions / Number of total Predictions

Accuracy= (TP+TN)/ (TP+TN+FP+FN)

Where TP = True Positives, TN = True Negatives,

FP = False Positives, and FN = False Negatives.

• True Positive (TP):

Reality: Road with Pothole

ML model predicted: Pothole

Number of TP results: 1

• False Positive (FP):

Reality: Pothole

ML model predicted: Pothole

Number of FP results: 00

• False Negative (FN):

Reality: Garbage

ML model predicted: No Garbage

Number of FN results: 02

• True Negative (TN):

Reality: Garbage

ML model predicted: Garbage

Number of TN results: 101

Therefore,

Accuracy = (1+101) / (1+101+0+2) = 0.98

• Precision: -It finds out proportion of positive identifications which was actually correct.

Precision=TP/ (TP+FP)

Therefore, Precision score= 1/ (1+0) = 1

• Recall: - It finds out proportion of actual positives were identified correctly. Recall=TP/(TP+FN)

Therefore, Recall score= 1/ (1+2) =0.33

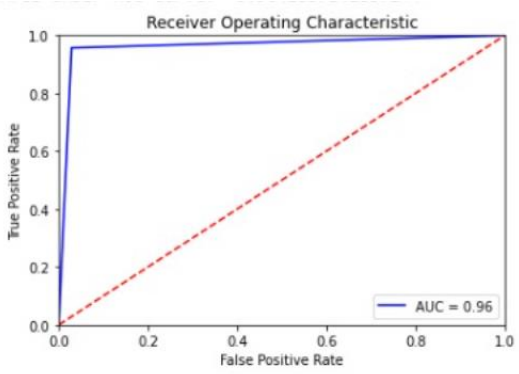

Fig.4. Receiver Operating Characteristics

IV. CONCLUSION

Machine learning based solution can enable the citizens to report the issues like potholes or sanitation evidences by simple one click along with remainders and monitoring. Support vector machine classifier is used for classifying and reporting the images of the said evidences to the concerned authority, so that concerned authority can implements the maintenance polies in transparent way and the society will get benefited.

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