AUTOMATIC COMPLAINT MANAGEMENT FOR PUBLIC SERVICES IN SMART CITY

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Abstract: In 21st century people have freedom to live and aim to make smart city. If city affect from any hazard. Hazard is a situation or thing that has the potential to cause harm to people, property or the environment and it is condition with the potential to cause injury, illness, or death of personnel, damage to or loss of equipment or property or mission degradation if any people survive in hazard area. So people have to compliant regarding civil problems to particular responsible authority. In this system deep learning concept is used. In the proposed system the user capture the image and send to the server. On the server side convolutional neural network algorithm is applied to classify the images. Classified images are sent to their respective departments. To work on that complaint nowadays mobile and information technology have become an integral part of our lives. A new area where mobile is useful for gathering civil complaints and their locations information as they are not readily accessible at any point. This paper is proposing simple and cost effective solution for civil complaints reporting by providing android application for individual user and organizational web portal for particular civil department. The proposed system gives solution to all these problems. Using smartphone the authorized person can complaint about his/her problem in his/her area.

Introduction:

In India we don't have any direct and efficient communication between the government bodies and the public for solving civil problems. In the proposed system public can post the petitions or complaints through android application and get them solved in a specified time. This system is very effective for complaint tracking.

It works in three modules:

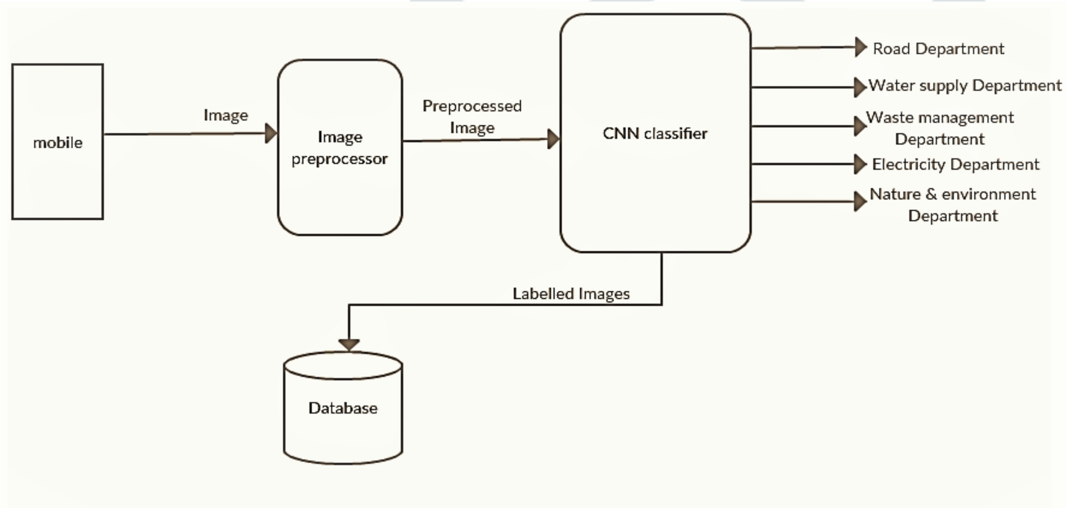
1. Android application
2. Pre-processing
3. CNN

Users can see the status of the previous complaints and according to the quality of the service user gives feedback to the system. If that department is not capable to solve the complaint in the specified time constraint then user can give alert notification to department that complaint is not resolved.

This process uses CNN model for classification of images. Deep Learning models, with their multi-level structures, are very helpful in extracting complicated information from input images. A CNN consists of an input and an output layer, as well as multiple hidden layers. The hidden layers of a CNN typically consist of convolution layers, pooling layers, fully connected layers and rectified unit layer. In traditional Machine learning techniques, most of the applied features need to be identified by a domain expert in order to reduce the complexity of the data and make patterns more visible to learning algorithms to work. The biggest advantage of Deep Learning algorithms is that they try to learn high-level features from data in an incremental manner. This eliminates the need of domain expertise and hard core feature extraction. Deep Learning requires high-end machines contrary to traditional Machine Learning algorithms. In implementing CNN for image classification, researchers have to collect such a large-scale data as that contains more than one million images for network training because of the need for learning a large number of parameters involved in the network, which, however, is not a trivial task. One simple way to deal with the situation is to apply the CNN model that has been trained based on a large-scale image data which is called transfer learning.

Convolution layer contains entire set of filters in each layer (e.g. 12 filters), and each of them will produce a separate 2-dimensional activation map. Convolution layer is used to classify images. For example, if image contains water wastage due to broken pipeline, then it will automatically get transferred to water department. This is initial stage for classifying image. It will divide entire image into pixels to study what image is all about. It it probably the only deep learning algorithm that is leverage the huge amounts of training data that comes from various datasets. Therefore CNN is applied to learn features and to them classify into various departments.

The current system in most countries provides some or all of these ways for citizens to register their complaints: email, helpline number, short messaging service and online complaint registration portal. However, all of these methods require the complainant to describe the location of the complaint manually. With the widespread availability of cell phones and cameras that have GPS capabilities, it is possible for images being uploaded to the Internet today to have GPS coordinates associated with them. Using this feature we can detect exact location of area from where image has been captured. GPS location gets automatically attached to the image so that there is no need of adding separate location details. The complaint is registered via a mobile application. Global Positioning System (GPS) sensor present in smart mobile devices is used to determine the exact location of the complaint. The area of the complaint is automatically detected, and the complaint gets automatically registered.



System Architecture

Literature Survey:

There are many image classification methods, but it remains unclear which methods are most helpful for analysing and intelligently identifying images. Images can be classified using image processing, machine learning, deep learning, etc. Two types of classification are supervised classification and unsupervised classification.

Image processing involves some basic operations namely image restoration / rectification, image enhancement, image classification, images fusion etc.

Deep learning is most advance technique in this field. Deep Learning has emerged as a new area in machine learning and is applied to a number of signal and image applications.

Theoretical results suggest that, in order to learn the kind of complicated functions that can represent high-level abstractions (e.g. for vision, language, and other AI-level tasks), one needs deep architectures. Deep architectures are composed of multiple levels of non-linear operations, such as neural nets with many hidden layers or complicated propositional formulae re-using many sub-formulae. The depth of an architecture is the depth of the circuit that represents this function. It is a broad subject and involves processes that are mathematically complex.

Reference article on deep learning referred is: Yann LeCun, Yoshua Bengio & Geoffrey Hinton, Deep learning, and NATURE—vol 521 — 28 may 2015

In this article, it is stated that, Deep learning allows computational models that are composed of multiple processing layers to learn representations of data with multiple levels of abstraction. These methods have dramatically improved the state-of-the-art in speech recognition, visual object recognition, object detection and many other domains such as drug discovery and genomics.

Second article which we have referred is: Peng Liu, Hui Zhang, and Kie B. Eom, Active Deep Learning for Classification of Hyperspectral Images

In this article, it is stated that, It is expensive getting good labelled samples in hyperspectral images for remote sensing applications. An active learning algorithm based on a weighted incremental dictionary learning is proposed for such applications. The proposed algorithm selects training samples that maximize two selection criteria, namely representative and uncertainty. This algorithm trains a deep network efficiently by actively selecting training samples at each iteration. The proposed algorithm is applied for the classification of hyperspectral images, and compared with other classification algorithms employing active learning.

Base paper: Ardhendu Bandhu, Sanjiban Sekhar Roy, Classifying multi-category images using Deep Learning: A Convolutional Neural Network Model

This paper presents an image classification model using a convolutional neural network with Tensor Flow. Tensor Flow is a popular open source library for machine learning and deep neural networks. In this paper they are using CNN for the image recognition of Cat and Dog only. We are building our application to work for PMC application in which we are going to take various images related to different government departments. We are categorizing images which will be sent to different departments based on the category of image.

Different departments of PMC are as follows:

1. Road Department

2. Water supply and pumping Department

3. Solid waste management Department

4. Electricity Department

We are building Android Application for the ease of user which is not the part of this paper. In our application, user just needs to capture image of complaint and needs to upload or send it to server.

Proposed System

A. Data Pre-processing

In the proposed system, the images are pre-processed before applying CNN algorithm. Digital image processing is the use of computer algorithms to perform image processing on digital images. As a subfield of digital signal processing, digital image processing has many advantages over analogue image processing. It allows a much wider range of algorithms to be applied to the input data—the aim of digital image processing is to improve the image data (features) by suppressing unwanted distortions and/or enhancement of some important image features so that our AI-Computer Vision models can benefit from this improved data to work on.

Here image pre-processing is done with following steps:

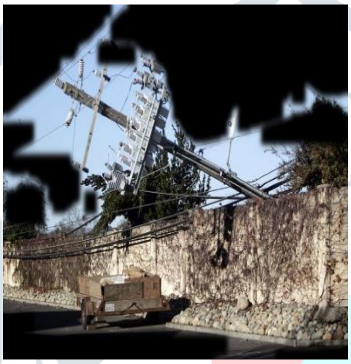
1. Image Resize: - Some images are captured by a camera and some images are downloaded from the internet and fed to our CNN algorithm. As they vary in size we have established a base size for all images which is 200*200 pixel. It will also reduce the size of data, which will help in training the images at a faster pace.

2. Image Masking: - Masking involves setting some of the pixel values in an image to zero, or some other "background" value. We are using image masking to highlight only the affected area and ignore the background.

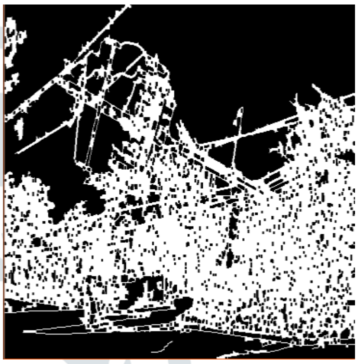
3. Image Grayscaling: - A Grayscale image is one in which the value of each pixel is a single sample representing only an amount of light, that is, it carries only intensity information. Grayscale images, a kind of black-and-white or gray monochrome, are composed exclusively of shades of gray. The contrast ranges from black at the weakest intensity to white at the strongest. It is done as a beforehand step to image thresholding.

4. Image Thresholding: - Image thresholding is a simple, yet effective, way of partitioning an image into a foreground and background. This image analysis technique is a type of image segmentation that isolates objects by converting grayscale images into binary images. Here thresholding is applied to detect edges.

Original Image



Masked Image



Thresholding of Grayscale Image

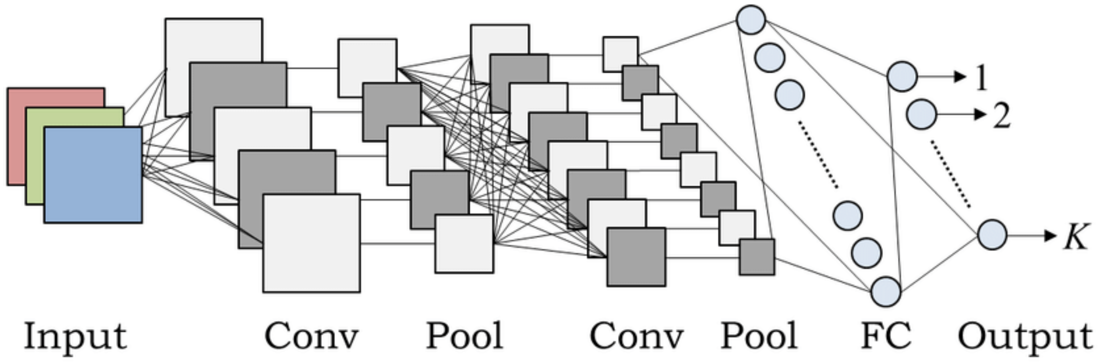
B. Methodology and Implementation

As mentioned earlier, input for CNN network is the images of affected area. The basic components of CNN algorithm are as follows:-

1. Convolutional Layer (Convnet) :- Convnet is the first layer to extract features from an input image. Convnet preserves the relationship between pixels by learning image features using small squares of input data. The input of first Convnet is passed as input to next Convnet and so on. The activation function used in this layer is ReLU. ReLU stands for Rectified Linear Unit for a non-linear operation. The output is $f(x) = \max(0,x)$. ReLU's purpose is to introduce non-linearity in our ConvNet. Since, the real world data would want our ConvNet to learn would be non-negative linear values. Performance wise ReLU is better than tanh and sigmoid activation function.

2. Pooling Layer :- The sampling process is equivalent to fuzzy filtering. The pooling layer has the effect of the secondary feature extraction, it can reduce the dimensions of the feature maps and increase the robustness of feature extraction. It is placed between two Convolutional layers. Pooling used here is max pooling. Max pooling take the largest element from the rectified feature map.

3. Fully-Connected Layer : - The classifier used here consists of two fully-connected layers. They take all neurons in the previous layer and connect them to every single neuron of current layer. There is no spatial information preserved in fully-connected layers. The last fully-connected layer is followed by an output layer. Softmax regression is used because it generates a well-performed probability distribution of the outputs. Dropout regularization is also used with fully connected layer to avoid overfitting. Dropout is a technique where randomly selected neurons are ignored during training. This means that their contribution to the activation of downstream neurons is temporally removed on the forward pass and any weight updates are not applied to the neuron on the backward pass.



Convolutional Layer Architecture

C. Result and evaluation:

1. Dataset :- For the proposed system, the dataset was not redily available. Collecting the sufficient amout of dataset was very crucial task. Dataset was collected from followng sources:-

I. Manually taking images from local areas
II. Internet by searching a particular category and downloading images

The previous count of dataset was about 1200 images which were not enough to train our CNN module. Accuracy was very low. Then more 100 images were added which was again insufficient to get desirable accuracy. Then the final dataset count is increased to total 4877 images which included:-

1. Road Department – 1470 images
2. Water supply and pumping Department – 943 images
3. Solid waste management Department – 1073 images
4. Electricity Department – 1391 images

The accuracy obtained through final dataset is about 93 percent.

Image classification has been carried since past but the accuracy of classifying images was not that much impressive. After the introduction of deep networks, accuracy for image classification enhanced to a peak level. We used a convolutional neural network as our deep architecture and with that we applied the Tensor Flow deep learning library. The experimental setup was done on Pycharm, which is a scientific python development environment. It is essential that the accuracy of models should be examined in terms of testing data rather than with the training data. Time for training the data, depends on the number of iterations we assigned to the model. Here in the current work, separate convolutional neural network was developed using the Tensor Flow model, to enhance the performance of the convolutional neural network.As the number of iterations is increased our training accuracy also increases but our training time also increases.

Conclusion:

Result of the project from studies indicate that Convolutional Neural Network is a popular learning technique for current visual recognition task. Like all deep learning techniques, CNN is very dependent on the size and quality of the training data. CNN is able to classify images accurately and quickly. It provides high efficiency as there is very less involvement of manpower. The automatic Global Positioning System helps to reduce the errors in tracking a particular place. The theory of CNN is still being developed and researchers are working to endow it with properties such as active attention and online memory, allowing CNNs to evaluate new items that are vastly different from what they are trained on.

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