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CITY CLEANLINESS DETECTION USING GEO-TAGGED STREET IMAGES

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Abstract:- Advancement in mobile, cloud technologies and IoT has made the world even smaller and connected like never before. It has become a challenge and an opportunity for cities to leverage these growing technologies to solve real city administration problems. Cities are in the transformation state to become state of the art smart-city using these technologies. This paper is about the automation of street cleanliness assessment in near real- time. It answers the question of how can we assess the status of streets more efficiently and effectively. In order to address the problem, this paper proposes a multiple-level assessment service system on how the cleanliness status of streets is collected using mobile stations, connected via city network, analysed in the cloud and presented to city administrators online or on mobile. The real applications show the usability and feasibility of our system. This also gives opportunities to city residents to participate and contribute towards making the city a better place.

Keywords- *Smart City, Street Cleaning, Litter Detection, Machine Learning, Cloud Computing, Dashboards*.

I INTRODUCTION

The project will include Geo Tracking of regions with high waste index detected using computer vision and Deep Learning image classification algorithms with help of geo tagged images captured by drones or mobile vehicles of the local areas coupled with development of business models for collection and utilization of single use plastics and various other industrial wastes. Due to littering and inefficient garbage disposal practices engaged in by citizens, it becomes a tough task for sanitation workers to determine which areas require attention and waste pickup. With the Swachh Bharat App, the government attempted to resolve this problem. Due to geo tagging requirements in this app, adoption is low. With the drone connectivity and intelligent algorithms, optimal search patterns for every area can be developed.

Using this sweep-search technique, areas that require help can be located. Depending on the Waste Quantity Index of the area, appropriate heat maps are generated. These heat maps enable authorities to take necessary action efficiently. Furthermore, an algorithm is developed to use inputs such as single use plastic item sale, date of sale, time of sale and location of sale and provide output with a probable area in heat- map form that will show the most likely position of the disposed item. This data is displayed in a very simplified and readable form so as to enable authorities to plan further activities of waste management rapidly.

II LITERATURE REVIEW:

This paper proposes a novel urban street cleanliness assessment approach using mobile edge computing and deep learning. First, the high-resolution cameras installed on vehicles collect the street images. Mobile edge servers are used to store and extract street image information temporarily. Second, these processed street data is transmitted to the cloud data center for analysis through city networks. At the same time, Faster Region-Convolutional Neural Network (Faster R-CNN) is used to identify the street garbage categories and count the amount of garbage. Finally, the results are incorporated into the street cleanliness calculation framework to ultimately visualize the street cleanliness levels, which provides convenience for city managers to arrange clean-up personnel.

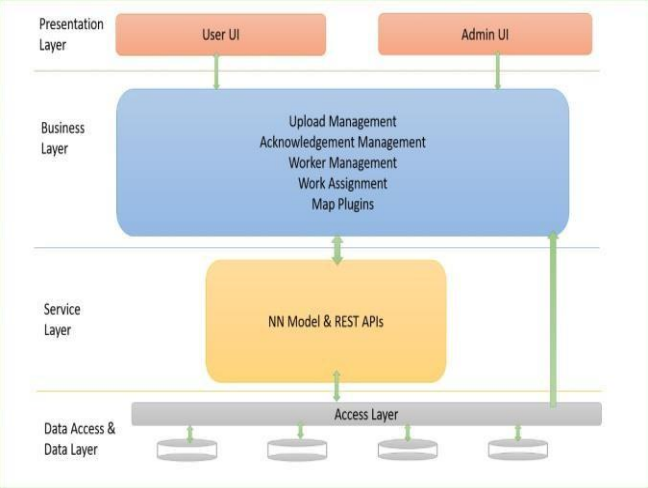
A novel framework with multiple local trained models exploiting the similarity of local images so that the proposed models learn better street image classification for each geographical region. This paper also presents a case study of street cleanliness classification using a large real-world geo-tagged image dataset obtained from Los Angeles Sanitation Department.

A solution of the optimization garbage removal problem in the large cities is suggested. In this paper a description of system architecture to find time-optimal dynamic route for garbage trucks within "Smart Clean City" project is given. A formal mathematical model of the task of dynamic optimal route and formal the optimization criterion for time-optimal garbage collection of all waste from landfills is proposed.

In this work, we introduce a Region Proposal Network (RPN) that shares full- image convolutional features with the detection network, thus enabling nearly cost-free region proposals. An RPN is a fully convolutional network that simultaneously predicts object bounds and objectless scores at each position. The RPN is trained end-to-end to generate high- quality region proposals, which are used by Fast R-CNN for detection.

Method:

• System Design: -



Data Layer: This layer is the layer where the data collection takes place in the form of images from streets. This data along with location coordinate is sent to cloud for processing.

Service Layer: This is the layer where the images are processed using analytical tools, created or fed the training model. Results from this layer fed to the end user database for visualization and reporting.

User Layer: This is the layer where reports are generated based on the Cloud processing. These results are visualized for city and community. A map view can see the street cleanliness level. Analytics shows various statistics on different sections of the city, management, and feedback of the system.

•High-Level System Layers:

The approach is composed of different layers in order to have more flexibility and scalability. Each layer has a different component and functions; which are maintained independently to minimize the impact on the entire system. Lower layer contributes to the layer above. Upper layers depend on lower layers. High availability is set to be achieved by using a **clustered approach in the cloud.**

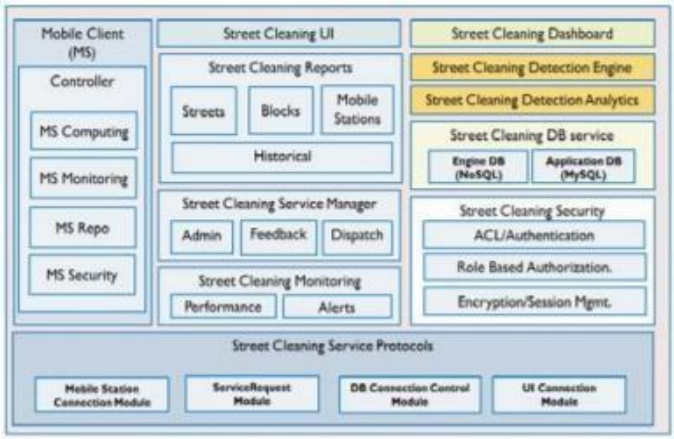


Fig.2 High-level Architecture

Edge Service or Mobile Station – This is the set of services run and managed on Mobile stations, which also serves as the client to cloud system. These are trucks or special vehicles, which connect to cloud service and updates continuously with latest updates. They have a local controller to manage edge service and have their own computer, repository, security and communication protocols for cloud connection. There is also a mobile app where the users can communicate with the cloud. This layer is heavily dependent on the network and needs to maintain a persistent connection with the cloud in order to have a real or near real-time communication.

Cloud Service or Server Side – This service includes various sub service and is composed of many modules or layers, which interact with clients and with each other and are running continuously. UI and Dashboards are setups for city administrators and other city officials. Part of it would be visible to public. Reporting and Analytics to reflect the assessment of the streets, blocks, zip codes, and city as a whole. It has management functionality for admin to manage the system. Various backend service like database and monitoring runs to monitor the system. It also has a detection engine, which is a machine learning based analytical engine

running visual recognition algorithm to classify the images for cleanliness levels. These services designed to be highly available and visible to city admins and truck drivers and other users.

III METHODOLOGY: -

Region Division Ideal for Indian Localities: Each city/state/region is divided into smaller localities and smaller subregions are formed and for each subregion different CNN models are trained with tuning then according to the specific region.

Training Models: Locally trained models are generated and then these models are used to create a structure in which each geotagged image is redirected to a specific geotagged model. Optimally, we can create locally trained models for each locality using Grid or Quadtree. Each Locally trained model is made using CNN GoogleNet which has Least error rate of 43% compared to AlexNet and BerkleyNet.

Visualization: Once the system is trained and tested with maximum accuracy the detected levels of cleanliness can then be used further to map the hotspots of cleanliness on the map by using basic visualization techniques. These hotspots can be used to trigger the authorities about localities with high waste index. So once the user uploads a geotagged street image, with the help of that image the locality will get classified into cleanliness level.

IV EXPECTED RESULT: -

Project Expectations: The project is expected to be implemented by local sanitation authorities. Due to implementation, maintaining the cleanliness of the city will become rapid. Also, the data produced by the project can be used for further research work.

Environment Impact: A positive and rapid effect in the betterment of the environment is expected.

V CONCLUSION:

System "Smart Clean City" allows to optimizing garbage collection by building the optimal route of taking away the garbage from the area of the garbage containers and provides effective management of this process. In the paper there is presented one optimization criteria by the time to empty all filled garbage containers. Obviously dynamic nature of chosen mathematical model suggests other criteria. One of the most important of which is the "uniformity" of the garbage trucks loading that imposes additional restrictions on the algorithm for calculate routes. The advantage of the proposed system is the integration of information on the status of containers for garbage on special area with traffic situation in real time. kinds of waste images, the wrong classifications, the reduced waste, the images into the database indicate that this technique is not enough to carry out the classification in a system the real scale. For those cases, classifications based on descriptors could be helpful.

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