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Artificial Intelligence Powered Pothole Detection, Reporting and Management Solution

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Abstract:- Object Detection Potholes are a traffic hazard, endangering the safety of both automobiles and pedestrians. It is one of the leading causes of road accidents and the loss of lives and property in most developing countries. As a response, there is a need to collect and update data on current road conditions on a regular basis so that vehicles may be warned of other routes and the appropriate government department can take urgent action to remove potholes for the benefit of commuters. Using object identification algorithms on photos captured with a smartphone camera is a simple and effective technique to locate potholes on roadways. As a result, the goal of this research is to evaluate the performance of state-of-the-art neural network algorithms such as YOLO and Faster R-CNN with VGG16 and ResNet-18 architectures for rapid and accurate pothole identification. Furthermore, an updated YOLOv2 architecture is suggested to address the "pothole" and "regular road" class imbalance problem, and its performance is compared to that of existing object recognition algorithms utilising accuracy, recall, intersection over union, and frames processed per second (FPS). For real-time geotagged pothole recognition from images, this model can be used in autonomous cars. Pothole detecting software may also offer alternative environmentally friendly routes and assist commuters with low-light navigation.

Keywords:- *Autonomous Vehicle; Deep Learning Neural Network; CNN; YOLO Algoritham Object Detection; Image Processing .*

I. INTRODUCTION

A major problem being faced by municipalities around the world is maintaining the condition of roads be it summer, the monsoons (when it is at its worst) or any weather condition as a matter of fact. And although it's the responsibility of the authorities to make sure the roads are free of damage, at times they overlook the problem, and most times don't even know that the problem exists.

According to "Safety Resource Center", approximately 3 Billion US Dollars are spent by motorists for repair of blown tires, busted axles, and other damage to their vehicles. Over the past five years around 16 million drivers across the U.S. have suffered damage from potholes as per an article from "American Automobile Association (AAA)"

II. PROBLEM STATEMENT

Major Issue: A major problem being faced by municipalities all around the world be it any weather (summer, monsoons or winter) is to manage the conditions of the road, especially because of the rising number of potholes.

High Expenses
3 Billion US Dollars are spent by motorists for repair of blown tires, busted axles, and other damage to their vehicles.

Human Inconvenience and Casualties 16 million drivers across the U.S. have suffered damage from potholes as per an article from "American Automobile Association (AAA)".

Inshorts reported, potholes killed more people than terrorists reporting 14,926 deaths in road accidents.

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III. OBJECTIVE & GOAL

In articles covered by Guardian News & Media potholes took a deadly toll in 2017, claiming almost 10 lives daily. IndiaTimes stated that "Bereaved Father Mr. Dadarao" filled 600 Potholes in Mumbai in memory of son he lost in a road accident! Inshorts reported, potholes killed more people than terrorists reporting 14,926 deaths in road accidents.

When we look at the other side of the world, there is a similar situation as reported by American Automobile Association.

Keeping the roads in good condition along with tracking damages is a challenge with constant changes in weather, low budgets for the municipalities. Not to forget keeping the people informed is a task.

This project was aimed at solving the challenges mentioned.

IV. PRPOSED SYSTEM

The model is trained on top of Darkflow and built on top of pretrained weights which were obtained from Darknet. For crawling images relevant to our label ‘pothole’, images were crawled using the open source google image search package, along with using the serpapi image search tool.

After cloning the DarkFlow repository, to prepare the input files for DarkFlow we need to consider two things:

Firstly, we need an RGB image which is encoded as jpeg or png and secondly, we need a list of bounding boxes (xmin, ymin, xmax, ymax) for the image and the class of the object in the bounding box. Our class, in this case, is ‘pothole’. We then need to label our images with a tool like LabelImg to identify areas of interest with bounding boxes.

LabelImg is a graphical image annotation tool that is written in Python and uses Qt for the graphical interface. It supports Python 2 and 3. The annotations are saved as XML files in the Pascal VOC format We can split the data to train and test sets before running the training command.

V. PROCESS DESCRIPTION

The Citizen's App has been Divided into 5 Major Sections.

A. Create New Report:

The users can navigate to the add a new report screen either by clicking on the floating action button at the bottom right or from the drawer by pressing the hamburger icon in the app bar.

Here, users have the option to start their report by uploading an existing image of a pothole they clicked by browsing through the file system or by clicking a fresh photo using the inbuilt camera.

Once users have decided on the method for uploading, the image under consideration is validated by the python based deep learning model placed on the backend server to verify if the image uploaded contains one or more potholes.

If the media file contains one or more potholes, the users are presented with an option to share more details about their report.

If not, users are presented with a feedback screen for an invalid image and the option to contact support.

Assuming that the uploaded image is validated successfully, users are given the option to select a location (either current (presented after seeking permission)) or to enter a custom location.

After which users are asked to use a progress indicator to specify how severe the reported pothole(s) is(are) according to them.

Finally they are asked to give more details about their report through a required input text area component. Once the user has successfully submitted the report, they can now view the same using the My Complaints Screen.

B. My Complaints:

On signing into the app with their Google Accounts, users are presented with the My Complaints Screen.

Existing users who have at least one report created can manage the status of their report and add additional comments to it or reply to comments from authorities using this section of the App.

Users can click on any of the reports to view the detailed description for the report and monitor any notifications or to communicate with the authority through the chat section.

C. Route Navigation:

This screen presents the user with an option to enter the source and destination location.

After which a map is presented to the user based on the source and destination location entered by the user. A direction route is rendered on the map for the user.

It displays the route with the marked potholes on the path which were approved by the authorities. It uses Google's Maps API to build the route.

Custom markers for potholes with status approved ranging on severity are presented to the user on the route if they are close to the route.

It determines if a pothole is associated with a path using the 'is Location On Edge' library function provided by Google Maps.

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A legend explaining the different attributes of the map is presented to the user. Also, there is a street view renderer for the users. This screen can be used by any logged in user to monitor a route and the status for the different potholes on it and plan travel accordingly.

D. Profile:

This screen contains the basic details (avatar, name, email address of the user)It is then followed by a counter for reports with a status of either submitted, approved or completed.

Based on the above counters the user is assigned with a badge score indicating their contribution to the community. This score is a weighted average score based on the counters mentioned above. This score can later be used for rewarding the user.

Sign In Screen This screen contains the option to login using Google. This uses Google's OAuth 2.0 GAPI for logging in the user.

This also uses the Unsplash API for generating random backgrounds on the side. (When in desktop mode)

The app also uses local storage actively to maintain the session state every time in communication with GAPI.

OAuth2.0 Unsplash Logout Local Storage.

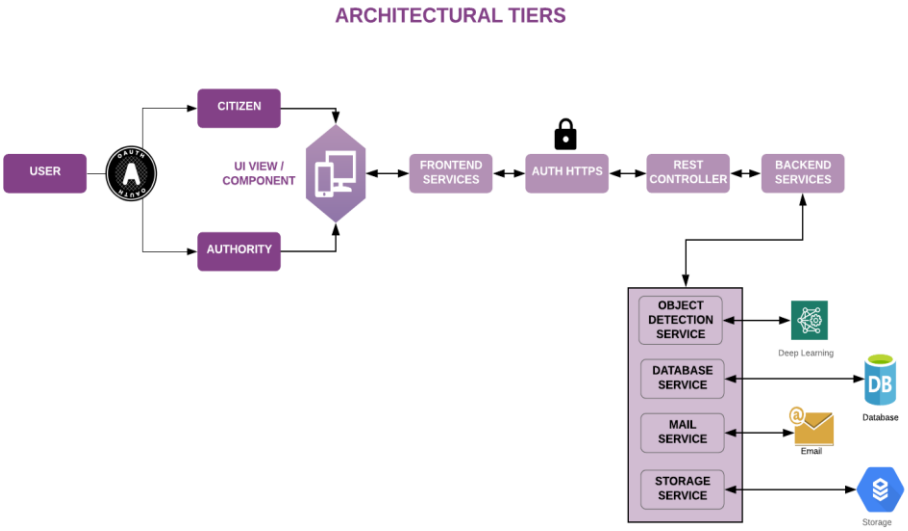

Fig. 1

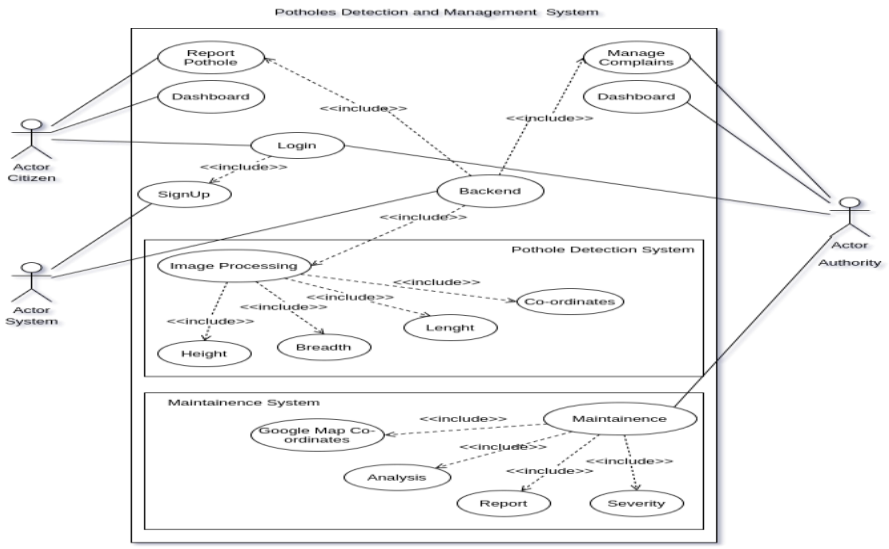

Fig. 2

VI. CONCLUSION

With this project one can now expect citizens to engage and take an active part in helping maintain the city infrastructure.

- An easy to use and sustainable solution is now available for government officials to manage and act on citizen issues with transparency and a streamlined process when it comes to reports related to potholes and maintaining city streets.

- The features like Heat Mapping, Route Navigation would better help the citizens and authorities to keep a track of their area.

- This project has the potential to solve the issue of pothole reporting, management and tracking with a lot of ease and with the addition of items mentioned in the future work, this statement will be further justified.

Looking forward to making more such contributions one step at a time.

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