

POTHOLE SCOUT

Pothole Detection using Deep Learning



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1.

ABSTRACT

OVERVIEW

ABSTRACT

- ▷ Potholes in roads constitute a major problem for citizens
- ▷ Municipal Bodies are responsible to maintain roads
- ▷ Solution is to Automate Detection of Potholes
- ▷ Camera inside car and a Deep Learning Model to detect Potholes
- ▷ An cross-functional app to serve Citizens & Municipal Authorities
- ▷ Municipal body will be provided with data plotted on Map

2.

PROBLEM STATEMENT

APPROACH

PROBLEM STATEMENT

- ▷ Potholes are caused due to internal factors like pavement corrosion, rainfall or poor construction of roads
- ▷ Potholes are inflicting major effects such as engine damage, traffic coagulations and accidents.
- ▷ Traditional method involve public awareness, manual inspection of roads etc

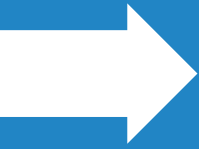
PROBLEM STATEMENT

- ▷ Our method is an automated system which records the information of pothole using a camera installed on the dashboard of car
- ▷ And providing live data to Municipal about the condition of roads along with location for maintenance.
- ▷ Citizens should also be able to contribute in finding potholes in places where the car may or may not have scanned.

3.

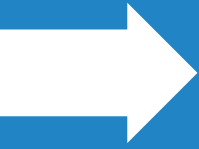
INTRODUCTION

ABOUT



15,000

Deaths in the last 5 years.



25,000

Injured in the last three years.



26,934

Potholes detected in 2018.

INTRODUCTION

- ▷ Road surface monitoring is essential for municipal corporations for quick detection and maintenance of potholes
- ▷ Road transport play an important role to deliver heavy goods and services which are efficient in terms of cost
- ▷ Potholes have huge economic impacts and are causing trouble in daily routine
- ▷ Use of high end detectors and sensors have high repair cost

4. LITERATURE REVIEW

RESEARCH

LITERATURE REVIEW

- ▷ The various Object Detection Frameworks were studied
- ▷ A review on NoSql Database-Google's Firebase
- ▷ A study on Deep Learning

5. EXISTING SYSTEM

IMPLEMENTED

EXISTING SYSTEM

- ▷ Automobile Manufacturers like Tesla, Ford
- ▷ CarVi, a device for detecting Pothole



6.

PROPOSED SYSTEM

INITIATED

PROPOSED SYSTEM

- ▷ Our Proposed System aims to work with Municipal Body of City.
- ▷ The system works on capturing live video feed using camera of an android device.
- ▷ A Deep Learning Model designed to detect the potholes works in the background.
- ▷ Based on the discovery of data about potholes, a patch of road is judged.

PROPOSED SYSTEM

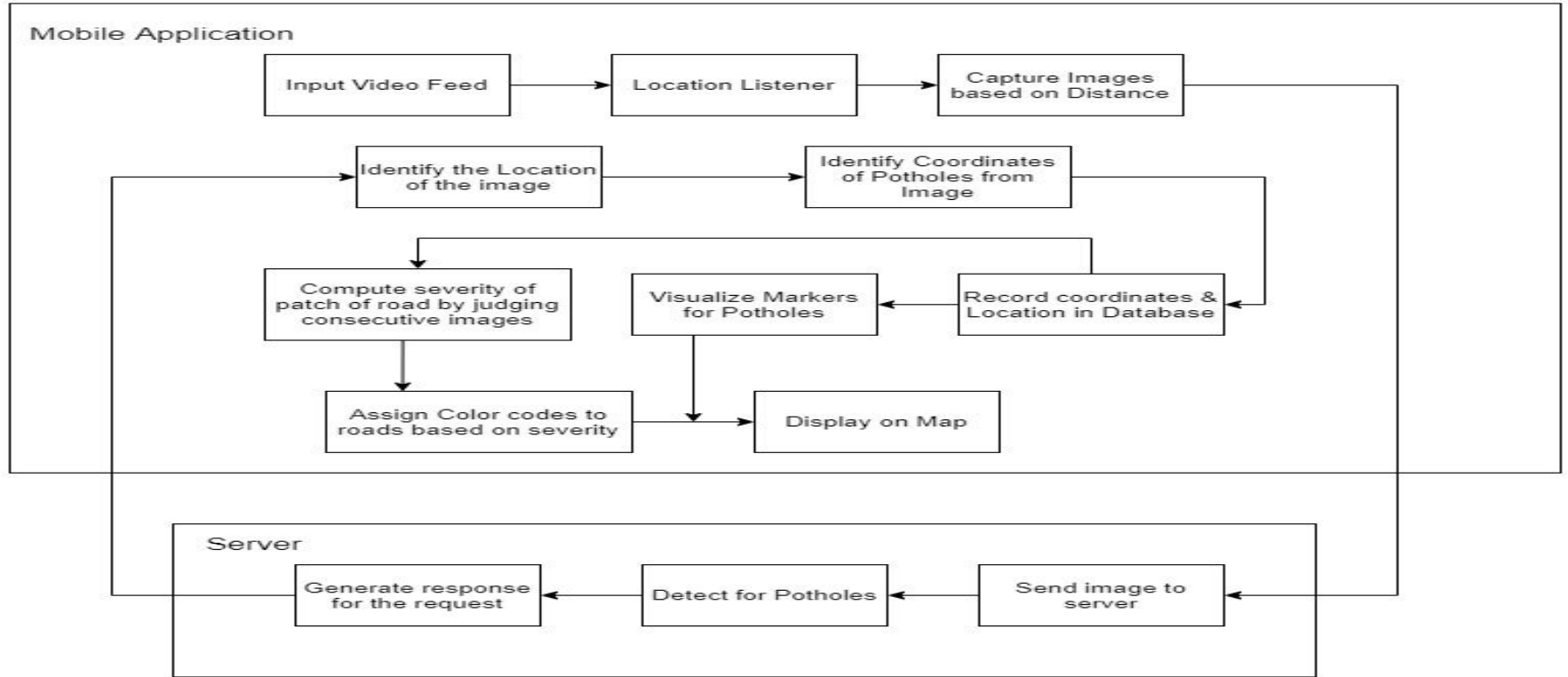
- ▶ Similar to the way Google Maps colors the road based on the traffic intensity, our final aim is to use the same concept but to represent how vulnerable the road or street actually is.
- ▶ The images captured will be stored and analyzed over the cloud and can be made available to the required cooperation
- ▶ The system focuses on maintenance of roads by Municipal Body to avoid possible risks of accidents happening every year.

7.

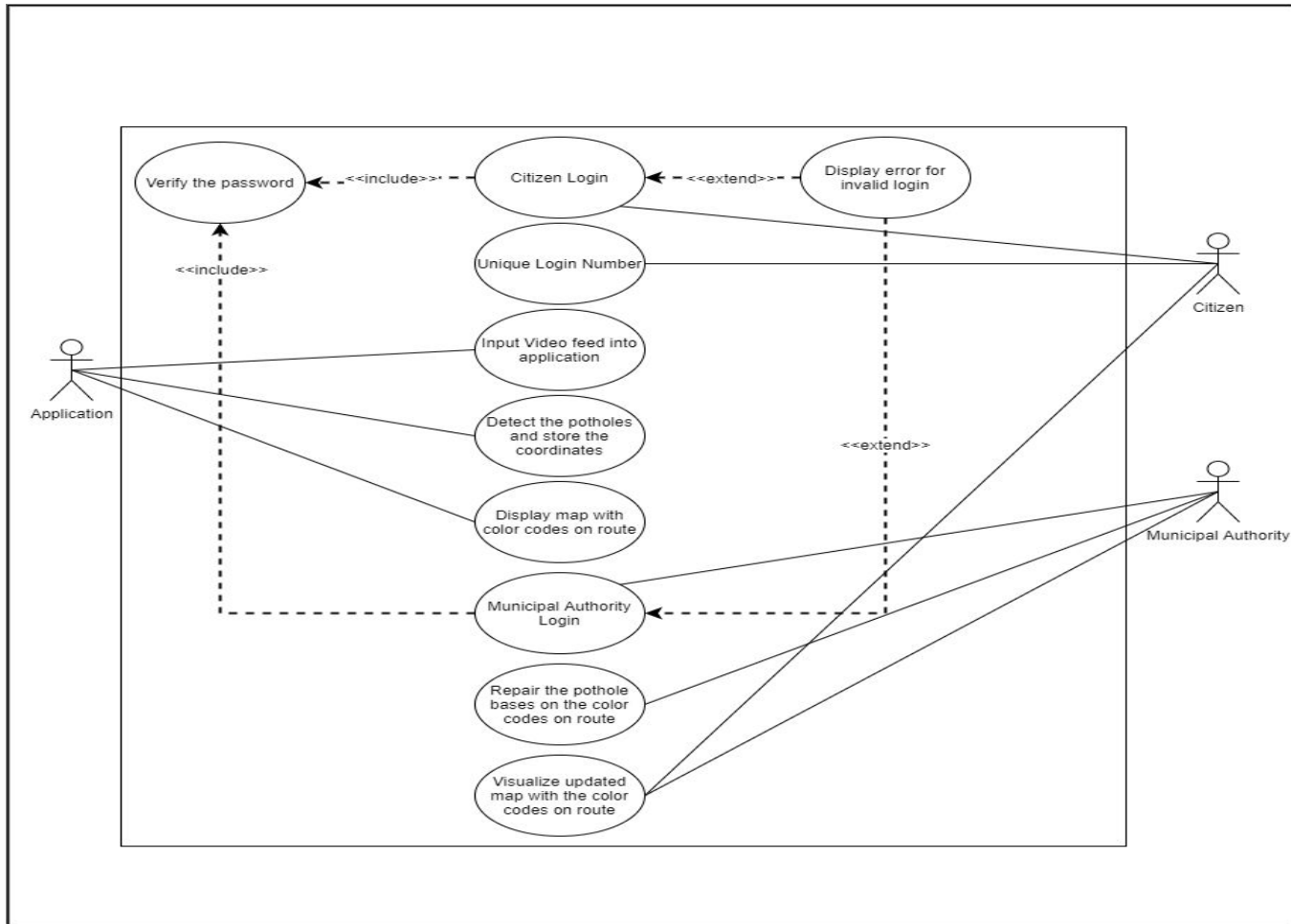
DESIGN OF THE SYSTEM

LAYOUT

BLOCK DIAGRAM



USE CASE



8.

DATASET & TRAINING THE MODEL

ANALYSIS

About the Dataset

- ▶ YOLO model requires at least 1,500 images for every class to be detected
- ▶ The dataset called Nienbar Pothole is obtained from kaggle
- ▶ Since our project is focused on one class i.e pothole hence 1,500 images are used for training and 350 images to test the model
- ▶ Using python and OpenCV the resolution of images are removed for constant part of image like dashboard and sky
- ▶ Web scraping tool in python like selenium around 1000 images were obtained

Description of Dataset

- ▷ The dataset is divided into 2 categories
- ▷ Positive class: Pothole and Negative class: No pothole
- ▷ YOLO doesn't require partition of images into categories hence a ratio of 70:30 images were taken into the dataset

Analysis on Dataset Using Python

IMAGES BEFORE AND AFTER CROPPING



Analysis on Dataset Using Python

Working On Labelling



Training

- ▷ Trained with Google Colab
- ▷ Used YOLOv3 Framework for training a Pothole Detection Model
- ▷ Accuracy offered was 42 %
- ▷ Trained with tiny YOLOv3 to make it compatible with Mobile App
- ▷ Faced an issue with compatibility of tiny YOLOv3 with Mobile App
- ▷ Came up with another solution to overcome this issue
- ▷ Added new images to the training set
- ▷ Accuracy boosted upto 54 %

9. SERVER

SERVER



- ▷ A Flask web application which caters to API requests
- ▷ Web Application deployed to Server
- ▷ Image is sent as request
- ▷ The coordinates of detected pothole is sent as response
- ▷ The Pothole Detection Model is integrated to respond to the API requests
- ▷ A GPU is required for detecting potholes

10.

MOBILE APPLICATION

MOBILE APPLICATION

- ▶ Flutter, a cross-platform framework for mobile SDK
- ▶ The mobile application has 3 parts
 - Authentication
 - Storage
 - Features



MOBILE APPLICATION - Authentication

- ▷ Separate Authentication for Citizen and Municipal
- ▷ Different functionalities for both the parties
- ▷ Authentication handled by Firebase
- ▷ Citizen can Sign up with email, Gmail ID, and can sign in anonymously.
- ▷ Municipal can Sign in with email
- ▷ State Management of the app handled



Firebase Authentication

MOBILE APPLICATION - Storage

- ▶ Firebase, a cloud storage solution is used for our application
- ▶ Citizen and Municipal Authority information can be stored into a realtime database
- ▶ NoSql feature of firebase helps to structure the data by defining rules for security as well as flexibility
- ▶ The information related to Maps such as coordinates, area of pothole are stored



MOBILE APPLICATION - Features



- ▶ Citizens can take appropriate photos of potholes which will help decrease the load of the authorities
- ▶ The citizen can generate markers on maps
- ▶ Municipal Authorities can scan the roads with the application which will capture frames from video for detection
- ▶ The municipal can generate colored roads on maps
- ▶ Both Municipal authority and citizens can view the maps which can be further used to analyze which part of the road needs attention

11. DEMO

12.

CONCLUSION AND FUTURE SCOPE

INTERPRETATION

CONCLUSION

- ▷ The proposed idea automates the inspection with the help of mobile application, vigil citizens and municipal authorities
- ▷ A combination of Computer Vision and Machine Learning to detect the potholes which supports the mobile application
- ▷ The end result is shown on a map with the help of markers which denote the potholes and colored roads which depict the severity of the condition of the road.

FUTURE SCOPE

- ▷ The future work can be extended by integrating our pothole detection system to the users travelling by road.
- ▷ This can help in identifying potholes more easily which reduces the burden for the municipal bodies.
- ▷ A notification system can be developed to aid the drivers with the information of any particular roads having potholes.

Thank You!!

Any questions?