IDEA PROPOSAL FORMAT

(Sample -- to be used ONLY for reference)

e-Yantra Ideas Competition 2019-20

Project Name: Pothole Management System using Image Processing and Geotagging

Introduction/Motivation:

Potholes have been the cause of death in many accident cases as reported in various newspapers like the Times of India, Hindustan Times etc. [1]. Every alternate day, especially during the monsoons we get to read about how due to such bad conditions of roads, lives are lost. Thus management of these potholes and road conditions has become the need of the hour.

The objective is to introduce a system that uses image processing techniques on pothole images to identify and determine the area of potholes and provides statistical information as well as a final geotagged image of an area with pothole location and information. The automated system would also aid in priority based complaint attendance, having the added benefit of efficient utilization of materials in an extremely economical way.

Market Research / Literature Survey:

Existing pothole detection methods [2] can be divided into vibration-based, 3D reconstruction-based and vision-based methods. Due to noise, distorted signal is generated in the case of vision based methods, requiring improvement of existing detection methods. Koch and Brilakis presented a supervised vision-based method for detecting potholes [3], segmenting image into defect and non-defect regions. The potential pothole shape is approximated according to the geometric characteristics of a defect region. This method assumes all images are shot from the same distance and angle. Images taken from varying heights, angles and proximity need to be considered.

Buza et al. [4] proposed unsupervised vision-based method consisting of image segmentation, shape extraction, identification and extraction. This method works on pictures taken from good perspectives with explicit focus on the road anomaly, which is not possible in real time scenarios.

Rajab et al. used curve fitting to specified points at the pothole border to measure the area of a pothole [5]. However, they required images to be acquired with necessary road marks and units of known length like metal rulers.

Hardware requirements:

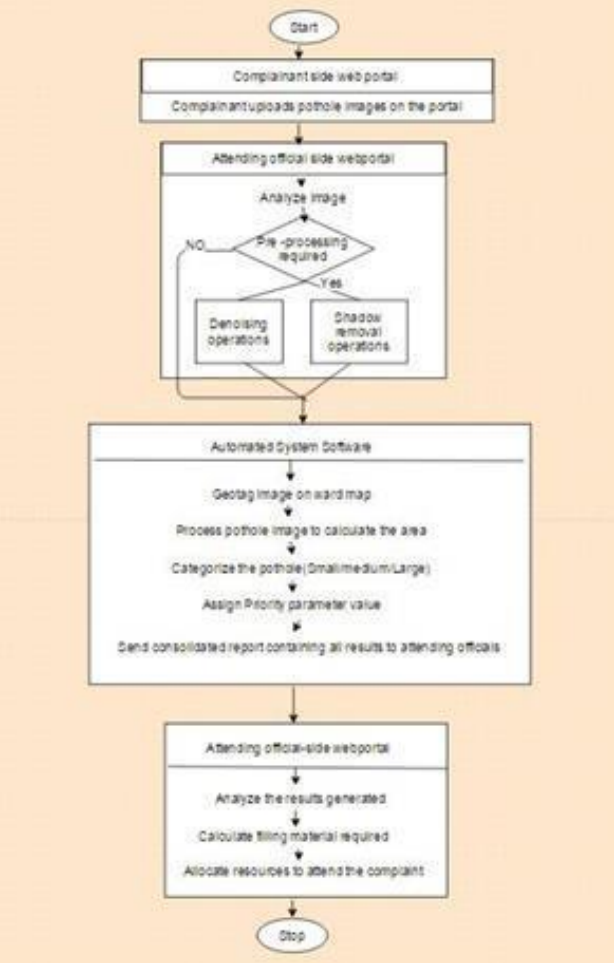
1. GPS enabled camera would be required to obtain latitude and longitude information of pothole images.

Software requirements:

1. Google Earth 7.1.5.1557 would be used for geotagging pothole images and their Information.
2. Matlab v2007 would be used for processing images.
3. For generation of statistical data, Microsoft Excel and Google Sheets shall be used.

Implementation:

Complainant will upload pothole image on the website portal. This image will be given as input to an automated system software that will geotag the image on the map, calculate the area, categorize the pothole and assign a priority parameter value to it. This information will be provided to the civil engineer of the concerned government body. The user interface for the civil engineer will include options for denoising, removing shadow and calculating the filling material required to attend to the complaint.



This system is broadly divided into three parts- Geotagging, Image Processing and verification of data acquired by a government body.

Geotagging: The map of the selected ward will be marked and its boundary will be defined using Google Earth [6], an open source software. Using the latitudinal and longitudinal information from the database, potholes will be geotagged onto the ward map. Description of the potholes will be added along with its image in the geotagged part. The tagged information is stored in a kmz or kml file that could be easily transferred via emails.

Image Processing: Problem arises when the complainant posts pothole images under varying ambient conditions, camera resolutions, angle of photography and proximity to the pothole while capturing the image. In images where the entire pothole is not captured, to obtain the total pothole area, 10% of the area calculated is added to it. Affine transforms are to be applied to images where the orientation is not in the top view. This system proposes a metric called priority parameter, defined as: Priority parameter(ρ)= abs{P(A)*P(D) - P(AD)} where,

abs{x} = absolute value of x

P(A) = probability of area category A

P(D) = probability of depth category D

P(AD) = probability of area category A and depth category D, area and depth being dependent variables. This serves as a tool to attend pothole complaints on priority basis.

MATLAB software will be used in the image processing section.Steps like converting image into black and white (binary) format,applying edge detection algorithms,using structure relation functions to mark out the target area and filling the area with a particular distinct color to separate it from other objects in the image will be followed in this particular sequence.

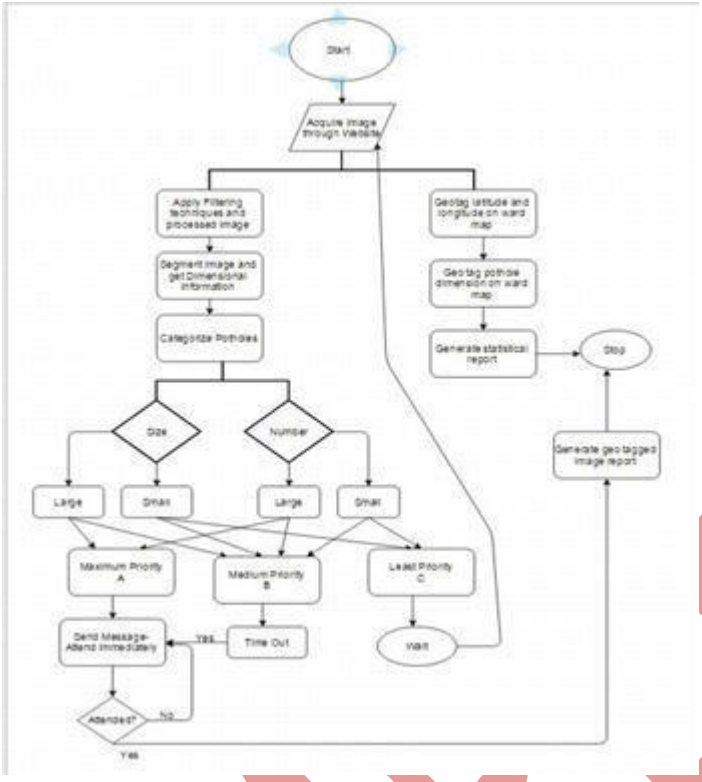
Verification of data: The third and final part of the system involves verification of data provided by BMC to determine the precision and accuracy of the proposed system. Also priority based pothole attendance report would be generated from this data.

Reports generated by the system will be of two types- geotag reports and statistical reports. Various graphs and pie charts will be created using analytical tools like Google Sheets to analyze the data that will help in determining the priority to be assigned to the repairing of the potholes and graphically visualizing the data that was present in the theoretical form.

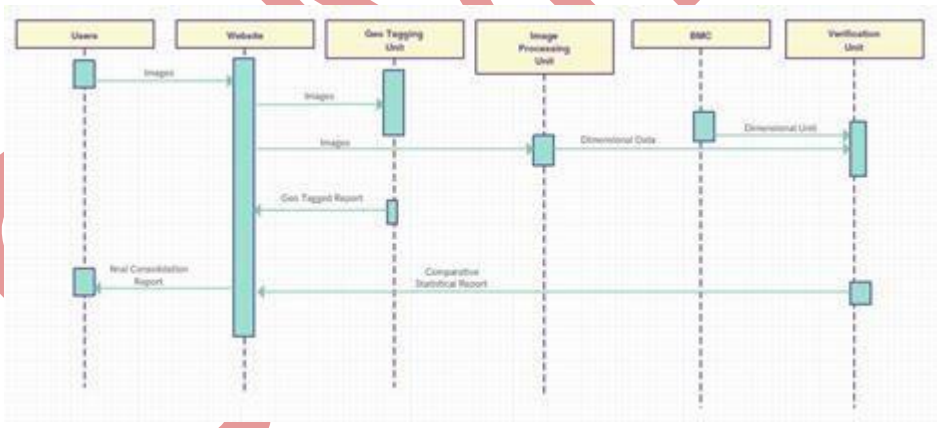
User Interface:

There will be separate web portals for complainants and attending officials. Complainant side web portal would provide facilities to upload complaints and check status. Web portal for the attending officials will provide functionalities like denoising, shadow removal option and calculate filling material required to attend the pothole complaint.

Flow Chart:



Sequence Diagram:



Feasibility:

The current process of pothole management has certain limitations regarding coverage of all the potholes in an area and consumption of a lot of manpower in conducting surveys to get information about the same. In order to automate this entire process and provide a more efficient and optimal solution, we decided to come up with the idea of a pothole management system using image processing and geotagging. Due to the automation applied, the probability and chances of getting optimal inferences increases.Problems like limitations in coverage of all

potholes in an area, manual calculations of material required to treat the potholes and manipulations in costs by contractors are dealt with in an efficient manner . Transfer of processing techniques from old paper-pen methods to completely automated methods guarantees correct and optimal results with the added advantage of less manpower consumption.

References:

[1] Newspaper articles:

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tholes-cause-death/1/486135.html

(d)http://timesofindia.indiatimes.com/india/Over-11000-people-killed-by-potholes-speed-breakers-last

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[2] Taehyeong Kim, Seung-Ki Ryu, "Review and Analysis of Pothole Detection Methods", Journal of

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[3] Christian Koch, Ioannis Brilakis, " Pothole detection in asphalt pavement images", Advanced

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[4] Emir Buza, Samir Omanovic, Alvin Huseinovic, " Pothole Detection with Image Processing and

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[5] Maher I. Rajab, Mohammad H. Alawi, Mohammed A. Saif, "Application of Image Processing to

Measure Road Distresses", WSEAS Transactions on Information Science & Applications, Issue 1,

Volume 5, January 2008, pp. 1-7

[6] Google Earth: https://drive.google.com/open?id=0B1Rifi8w3J6DMFFGeEhxX0lKQzA