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Procedia Computer Science 87 (2016) 316 – 321

Procedia Computer Science

2016 International Conference on Recent Trends in Computer Science and Engineering

CrowdSourcing based Online Petitioning System for Pothole Detection using Android Platform

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Abstract

To make city smarter every citizen is given an opportunity to selectively connect to the governing bodies in their location for sharing public views and issues that contributes to the general well being of the city. With this objective, this paper proposes an online petitioning system using smart phone that works on crowdsourcing process and image processing algorithms to inform about the pothole damages in the roads to the concerned authorities to take necessary actions. We show that the process involved in crowdsourcing such as data collection, data selection and data assessment can be applied to identify the potholes in the roads without redundancy. Further, we have tested our system for different types of input images and the detection accuracy is found to be better than normal image processing approach.

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Peer-review under responsibility of the Organizing Committee of ICRTCSE 2016

Keywords: Petitioning; CrowdSourcing; Potholes; Image Processing

1. Introduction

Road environment and infrastructure are very important for citizen's road safety and economic growth of a country. In India, roads are often damaged by weathering and traffic. Traffic contributes to road damage by cumulative vehicle passages and due to heavy vehicles going over the road tearing it up. The other important reason is due to rains: very short but heavy thunderstorms in which huge volumes of water fall very quickly causes lots of potholes and even once repaired these potholes are continually washed open again by the water volumes. Pothole detection and repair is important because unless it is repaired quickly, it can cause accidents to the people and slow down vehicle movements resulting in heavy traffic, damaging wheels and tyres of the vehicles thus impacting people's safety and hindering economic activities.

Road Accident Report (2014) by road transport and highways ministry of India [1] reported that 11,398 people have died due to potholes, humps and badly designed speed-breakers. Out of 11,398, the potholes had caused a total of 11,106 crashes that resulted in deaths of 3,039 people.

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Peer-review under responsibility of the Organizing Committee of ICRTCSE 2016
doi:10.1016/j.procs.2016.05.167

In the manual petitioning system, common people either affected by road damage or for general social cause, file a written petition and inform the government officials responsible for infrastructure maintenance, either in person or by post. The other way is complaining through phones over toll-free helplines, where there is limited chance for getting the line as very few lines are shared by entire people of the city. Hence forth, all these approaches are time-consuming, makes the official unable to judge the validity of the information and the depth of road damage. Online based petitioning system [2] relieves the user from communicating in person or by post. But still the problem of validity of information and intensiveness is not conveyed.

There are many methods for pothole detection, finding out the severity of the damages and also systems for informing to the drivers the possibilities of accidents beforehand. Pothole detection can be performed based on vibration based, 3D reconstruction and vision based analysis. In the vibration based approach, vehicles fitted with onboard accelerometer which measures the vertical and horizontal acceleration based on the road surface conditions [3]. Vision based approach [4] use laser scanning and stereo-vision. But this approach requires high computations and expensive. Image processing algorithms [5] are also used to identify the potholes and cracks in the captured image.

A pothole detection and warning system [6] has been implemented using Access Point that are present in the road side, informs about the road condition in the vicinity to the driver via wifi present in the vehicle. Thus the driver is warned using alarms, visual methods or it slows down the braking system of the vehicle. A vehicle based system capable of detecting the potholes [7], shares the information with the nearby vehicles through inter-vehicular communication via Zigbee transceivers to reduce the probability of accidents.

A new approach called participatory sensing which uses onboard accelerometer sensors and GPS of Android phone [8] to provide the road conditions and location of potholes. In our approach, we use android phone for online petitioning system to file petitions to authority about the road condition using onboard camera and GPS of mobile phone. It guarantees the correctness of information and reveals the depth of damage to the respective officials to take action in proper precedence.

This paper demonstrates that with the help of technology how the pothole issues are communicated to the government efficiently. To achieve this objective, a crowdsourcing based online petitioning system is implemented in android platform that applies image processing techniques to intimate the respective officials about the road condition.

The rest of the paper is organized as follows. Section 2 describes the methodology of the proposed system. Section 3 elaborates the image processing algorithms used for detecting potholes. Sections 4 brief the performance of our system. Finally, Section 5 presents our conclusion and future directions.

2. Methodology

Fig. 1 shows the system architecture of the proposed android based petitioning system. The entire process of the system is built on the concept of crowdsourcing. Also, due to the ubiquitous nature of mobiles, we propose an android based cost effective system that can inform the authorities visually the intense of the damage with exact location to take the required action.

The system works as follows: The user who intends to file a petition about the potholes in the road should have the android application for road damage petitioning installed in his mobile. The Graphical User Interface for the mobile application is shown in Fig. 2. To avoid duplicate petitioning, there is an option where the user can view in Google Maps, if any petitions about the place have already been filed.

For a new petition, the user captures photo of the pothole road along with its location information via GPS as shown in Table 1 and uploads the image with GPS coordinates to an online server database of the authority.

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