International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 05 Issue: 12 | Dec 2018 www.irjet.net p-ISSN: 2395-0072

A REVIEW PAPER ON EXISTING POTHOLE DETECTION METHODS

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Abstract - *Intelligent transportation framework (ITS) plans to enhance the transportation system and has turned out to be increasingly prevalent. Enhancing the security of traffic is one of the vital issues of ITS. One of the significant issues in developing nations is maintenance of streets and the potholes on the road which is the reason for serious harm in driver's safety. Therefore, drivers' safety might be improved with the established of pothole recognition methods. This paper outlines the different pothole detection methods that at present exists and their methods and their limitations.*

***Key Words*: Internet of Things, Pothole Detection, Intelligent System, Model, Potholes**

1. INTRODUCTION

India, being the second most populated country, has a detailed network of streets. Streets are the common mode for transportation in India bearing 90% of the country's traveler activity and about 65% of its cargo [14]. Be that as it may, most of the streets in India are narrow and congested with poor quality surface and the street maintenance needs are unsuitable.

Over the span of recent two decades, there has been a colossal increment in the vehicle populace. This increment in the number of vehicles has provoked issues like clog in rush hour and various accidents on street and the primary factor for this, is the inadequate condition of the streets. Intelligent transportation system is working in the region of traffic congestion control, which is of extraordinary significance now.

Potholes formed because of substantial downpours, ill-conceived drainage framework in urban areas and transportation of heavy vehicles, turn into a major purpose behind high-chance of mishaps and loss of human lives. As indicated by the review report "Road Accidents in India, 2017", by the Ministry of Road Transport and Highways, an aggregate of 1.47 lakh individuals had lost their lives because of road accidents. According to most recent figures by a few state governments, potholes across the nation has claimed 3,597 lives in 2017, an over half ascent in the toll than a year ago. Around 30 deaths happen day by day on streets because of potholes.

Fig 1: States of streets with Potholes

Figure 1 depicts the state of streets with unsafe potholes. To address the referenced issues, a cost-effective solution is required that encourages drivers to drive safely. With the different pothole detection methods proposed, it has been possible for drivers to avert the mishaps caused because of potholes

2. OVERVIEW OF THE EXISTENT POTHOLE DETECTION METHODS

Pothole detection being an interesting subject of research, specialists have been taking a shot at various pothole detection methods. Some of the pothole detection methods are referenced underneath.

2.1 Metrology and Visualization of Potholes using the Microsoft Kinect Sensor

Moazzam, et al [1] proposed an economical model to examine 3D pavement distress images. The computation cost is decreased by making utilization of a low-cost Kinetic sensor which gives the direct depth measurement. The sensor comprises of an IR camera and an RGB camera capturing depth images and RGB pictures which are examined under MATLAB environment by extracting the metrological and the characteristic features to establish the depth of the potholes.

2.2 A Research of Pavement Potholes Detection Based on 3-D Project Transformation

He Youquan, et al [2] developed a model making use of LED direct light and 2 Charge Coupled Device cameras to identify the 3D cross-section of potholes in pavement. It uses different advanced image processing techniques including

image pre-processing, binarization, thinning, error analysis & compensation and 3D re-construction to get the depths of potholes.

The constraint in this model is that the outcomes get influenced by LED light intensity and natural elements.

2.3 Potholes Detection Based on SVM in the Pavement Distress Image

Jin Lin, et al [3], proposed a model for pothole recognition based on Support Vector Machine which separate potholes from different deformities on road, like splits and cracks. The pictures are segmented by utilizing partial differential equations. To detect potholes, the SVM is trained with a collection of pavement images.

The constraint to this model is that the training model fails to detect the defects on pavement if the pictures are not properly enlightened.

2.4 Road Hazard Detection and Sharing with Multimodal Sensor Analysis on Smartphones

Faith Orhan, et al [4], put forward a work created on android platform to recognize road hazards which comprises of 3 components; Sensing, Analysis and Sharing. The sensing component gathers raw information from accelerometer and synchronizes with the interface for the ease of access. The data gathered from the sensors are used for creating analysis modules in the analysis component. For the sharing component: the framework which is developed is connected with the central application, from where it can directly communicate with others. For further processing, all the gathered information is stored at central repository.

Even though this method communicates traffic events with fellow drivers, the cost and complexity of implementation increases.

2.5 Real Time Pothole Detection using Android Smartphones with Accelerometers

Artis Mednis, et al [5] proposed a pothole detection model in real time making use of Android phones with accelerometers. Presently android OS based smart phones comes with accelerometers inbuilt which can detect the development and vibrations. The data from the accelerometer is used to identify potholes.

To recognize potholes, algorithms which are used are: 1) Z-sift, that estimates the acceleration amplitude at Z-hub. 2) Z-diff, that measures the difference between two amplitude values. 3) STDEV (Z) which is used to find the standard deviation of vertical axis acceleration and G-Zero.

2.6 An Efficient Algorithm for Pothole Detection using Stereo Vision

Zhen Zhang, et al [6] proposed a model where they made utilization of stereo camera pictures alongside a disparity calculation to distinguish potholes and also store the location co-ordinate of the pothole in the database.

2.7 A Mobile Sensor Network Based Road Surface Monitoring System

Mircea Strutu, et al [7] proposed a model which made use of accelerometers to detect deformities on the road surface. It also made utilization of GPS framework to recognize the correct area of the deformities. The pothole detection algorithm can run in moving vehicles, that are equipped with GPS, accelerometer, local computer and a wireless router. The gathered information is sent to the central database using the access points which can be utilized for further processing.

The constraint of this model is that setting this up turns out to be quite expensive.

2.8 Detection of potholes in autonomous vehicle

Sachin Bharadwaj, et al [8], proposed a model that makes use of a 2D vision-based approach to detect potholes. A properly mounted camera captures images of the road surface. To detect the presence of potholes, the captured images are process using MATLAB.

This model works under uniform lighting conditions only and it doesn't include any sort of warning system. It is constrained only to the reorganization of a pothole and does not give any guide to the driver to avoid mishaps because of potholes.

2.9 Pothole Detection and Warning System

Sudarshan S. Rode, et al [9], proposed a model in which, vehicles equipped with Wi-Fi, gather data about the road surface and forwards it to the Wi-Fi access point which then broadcasts this to other vehicles nearby as warnings.

This system is expensive as all vehicles should be then installed with Wi-Fi stations and additional number of access points have to be set up.

2.10 An Intelligent System to Detect, Avoid and Maintain Potholes: A Graph Theoretic Approach

Sandeep Venkatesh, et al [10] proposed a model to detect and avoid potholes making use of laser line striper alongside a camera. The system contains a central database where the location of the potholes is maintained. It sends warning alert to the adjacent vehicles about the presence of potholes utilizing Dedicated Short-Range Communication Protocol.

2.11 Pothole Detection and Inter vehicular Communication

Shambhu Hegde, et al [11], put forward an intelligent transport system which uses ultrasonic sensors to recognize the presence of potholes. Using Zigbee module, it sends a warning signal to the vehicles which are in the range of 100 metres. The Limitation to this the system is that it provides warnings only after detecting the potholes which does not viably assist drivers with avoiding the chance of accident.

2.12 Potholes and Pitfalls Spotte.

Prachi More, et al [12], put forward a system where vertical and horizontal accelerations experienced by a vehicle on its route are recorded with the help of sensors mounted on it. The installed GPS devices notes down the co-ordinates which are later processed to locate potholes along the same path. For experimenting, a Fire Bird V Robot which has a constant speed is used. It has a servo motor mounted on it, which turns 0-180 degrees alongside an IR Sharp sensor which check for fluctuation in constant speed. If variance is detected, it indicates the presence of a pothole.

The robot comes to a halt. The camera takes picture of the pothole while the co-ordinate of the pothole is recorded by the GPS device.

It is confined to gathering the information about potholes despite being a cost-effective solution.

2.13 Road Condition Monitoring Using On-board Three-axis Accelerometer and GPS Sensor

Kongyang Chen, et al [13] put forward a model which uses a GPS sensor and a 3-axis accelerometer for detecting potholes. The outputs from the 3-hub accelerometer and the GPS sensor are fed into a data cleaning algorithm. In the next part, to calculate the roughness of the potholes, the inputs for the algorithm are processed for Power Spectra Density which are then arranged into different levels.

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