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Pothole Detection and Warning System using IBM Bluemix Platform

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Abstract - *In today's world, there is an increase in road mishaps due to the irregularity maintained on roads, especially in countries like India. Especially in rainy season, the road becomes slippery and also potholes tend to take away the maximum road areas. The project aims to build pothole detection system, which will help to detect the irregularities. This will eventually help to avoid the road accidents. The project will be made using IBM bluemix platform. Also, the pollution can be detected, which will be helpful in knowing the pollution free roads. The standalone system will direct the user as for the safest path in accordance to the minimum number of potholes or the irregularities.*

The project is geared to meet the needs of the users who find it inconvenient with respect to the road issues. The ultimate scope of the project will be to build a general, easy to-use and versatile system that will detect the potholes and other irregularities and warn the user accordingly.

Key Words: Pothole Detection,Warnings and Notifications, IBM BlueMix Platform,Security, Management.

1.INTRODUCTION

Pothole detection system is the current call as there are lot of unfortunate road mishaps taking place due to the bad road conditions. Pothole detection refers to detecting the potholes on the road. This system also detects the other irregularities like slippery roads, differences in normal depths etc. The project mainly has Internet of Things and embedded system as the domain. And for storage, IBM bluemix cloud platform is introduced. IBM bluemix is a cloud platform as a service(PAAS) developed by IBM. It supports several programming languages and services as well as integrated devOps to build, run and manage applications on cloud. Bluemix supports several programming languages like java, node.js, php, swift, python, ruby on rails and can be extended to support other languages such as Scala. And talking about IOT, the Internet of Things (IoT) paradigm denotes the pervasive and ubiquitous interconnection of billions of embedded devices that can be uniquely identified, localized, and communicated. Sensor technologies have become pivotal to influence usage of IoT services. Nowadays, sensor embedded modern devices are being developed on a large scale. The main aim is to develop an application, in order to enable the users to detect the potholes on the road and also have a safe journey. In this, the user will also be able to find the best path. This would result in saving time while travelling. This application is basically for the safety of the people and also for the management so that it becomes easier for them to manage the roads which are not in good condition and take the desired action for the same.

2. RELATED WORK

In this paper [1], a stereo vision based pothole detection system is proposed. Stereo vision can provide information on the size of the pothole, without the need for using high cost specialized laser scanners. A disparity calculation algorithm, which is used for map generation which results in detection of potholes from the fitted quadratic road surface. The system produces the size, volume and position of the potholes which allows the pothole repair to be prioritized according to its severity. The quadratic road surface model allows for camera orientation variation, road drainage and up/down hill gradients. By putting the system on a vehicle that patrols the roads, it will be possible to continuously detect and evaluate potholes. It is important that the system can perform pothole detection in real-time to reduce data storage.

The paper describes [2],the 'The road condition monitoring using 3 axis accelerometer and GPS server'. In this, 3 axis accelerometers refer to the one having all the 3 i.e. x-axis, y- axis and z-axis. They present a low-cost vehicle-based solution, Road Condition Monitoring with Three-axis Accelerometers and GPS Sensors (RCM-TAGPS), by using a cheap three axis accelerometer and a GPS sensor embedded

in a vehicle to monitor the road condition. Pavement roughness is the important metric which is to be considered here. Pavement roughness simply means the irregularities in the pavement surface that adversely affect the ride quality of a vehicle. RCM-TAGPS consists of a set of sensor embedded vehicles for data collection and a central server for evaluating the pavement roughness levels.

The most important is the placement of the system. It is placed at the right side of the vehicle so that all the 3 axis can be evaluated with ease. The algorithms used here are data cleaning algorithm and pavement roughness level algorithm. In data cleaning algorithms, the raw data collected during survey is checked and unnecessary data is removed. After the evaluation by pavement roughness level algorithm, we come to know that when driving on smooth roads, the acceleration data are very smoothly with only small fluctuations, so that the overall road condition is outstanding. There are some instantaneous large pulses in the Z-axis acceleration on general roads. It might be aroused by small particles or other interferences on the road, and the overall road condition is considered to be good. The acceleration data gathered for potholes detected roads are with great fluctuations, and we deduce that the vehicles vibrated strongly when passing by these potholes. The road condition is unqualified in general.

In this paper [3], Smartphones have become the basic necessity of almost every individual. It can play quiet a big role in this internetwork era. The sensing, computing and communicating capabilities of smart phones bring new possibilities for creating smart applications, including in-car mobile applications for smart cities. Using the advanced capabilities of smart phones, we refer from this paper a framework with built-in multimodal sensor analysis capability, and enables easy and rapid development of signal and image processing-based smart mobile applications. We can infer that as part of study, a sample mobile application is also developed to demonstrate the applicability of the framework. In this study, a multimodal sensor analysis framework is developed for in-car mobile applications for performing analysis on real-time synchronized sensor values. The mobile application developed within this framework detects the potholes and speed bumps on the road, and successfully extracts the image and video section corresponding to this road segment automatically. This extracted section is prepared for further image processing. The detection is shared over a central application with other drivers, which provides a quick awareness about traffic events. This application is used for detecting defects on the road, such as potholes and speed bumps, and it automatically extracts the video section and the image of the corresponding road segment containing the defect. Upon such critical hazard detection, the application instantly informs nearby users about the incident.

In this paper [4], The acceleration sensor are used to identify potholes through changes in the vertical accelerometers readings and can also determine the variations in the car speed though change in horizontal acceleration. This is used in seven taxies running in the Boston area to build mobile network system called Pothole Patrol. In which each of the seven taxi needed running Linux, WiFi card for transmitting collected data, 3-axis accelerometer.

There are 3 general problem concerning the above system. First is the huge number of events such as unexpected swerves, doors being knocked, traffic jam. The second problem being the system can't identify between the pothole and bump in the road. The third problem is that the values reported by sensors depend on the car's speed and how the sensors are being mounted on the car.

Recently, the Jaguar and Land Rover automaker announced that they are researching a new connected vehicular technology, which allows a vehicle to spot dangerous potholes in the road and then share data in real time with other vehicles and road authorities.

3. TECHNICAL DETAILS

The objective of the project is safe driving and hence reduction of accidents. This also helps in finding the best path so that it becomes easier for the driver while travelling. It will also help the road management authority to maintain the roads. This system becomes handy for the user and hence easier to use anywhere and anytime.

The scope of the project is to develop a prototype application that includes i. A Mobile application for the driver. ii. Easy Potholes Detection. iii. A notification in the form of warnings generated. iv. Pollution Detection.

The pothole detection system is divided into three following subsystems. Firstly sensing subsystem which helps in sensing the potholes encountered by it, about which it did not have the prior information. Second is communication subsystem which helps in handling the information transfer between Wi-Fi Access Point and Mobile Node. Third subsystem is the localization subsystem which analyses the data received from Access Points and warns the driver regarding the occurrence of potholes.

3.1 Components Used

The proposed system offers a cost effective solution for detecting potholes and humps on roads and notifying drivers about their presence. Components used in the proposed work are as follows:

Embedded System: It consists of the ultrasonic sensor used to sense the potholes and roads. It is a type of active sensor which consists of transmitter and receiver. It helps in measuring the depth of potholes.

GPS Receiver: Global Positioning System (GPS) is a satellite navigation system which is used to capture the geographic location and time, irrespective of the weather conditions. It is maintained by the US Government and is freely available to anyone who has a GPS receiver.

3.2 Basic Architecture and Implementation

The architecture is as shown in fig below. It includes the sensor node, the GPS receiver and the manual recordings which sense all the data and then this whole data is gathered and is stored on the cloud. This data is updated as and when the new pothole is detected.

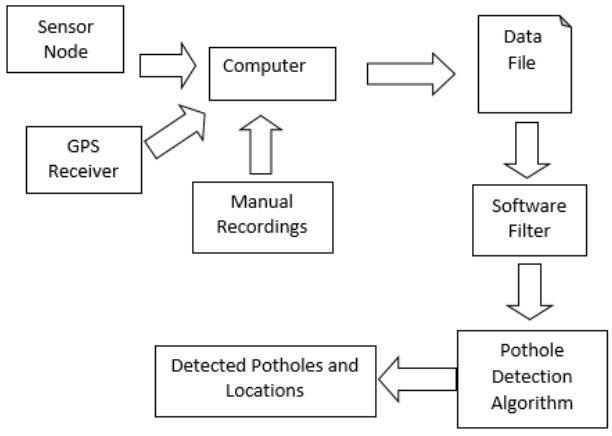

Fig -1: Architecture of the system

The working of the system is as shown in fig below. Firstly the end user registers himself/herself. Then when he required to use the system he can login through it as and when required. Then he/she would receive all the required data such as potholes on the road through which the user wants to travel. Simultaneously the updating of data will also take place as and when the car passes through the pothole. The user can log out after his work has been achieved.

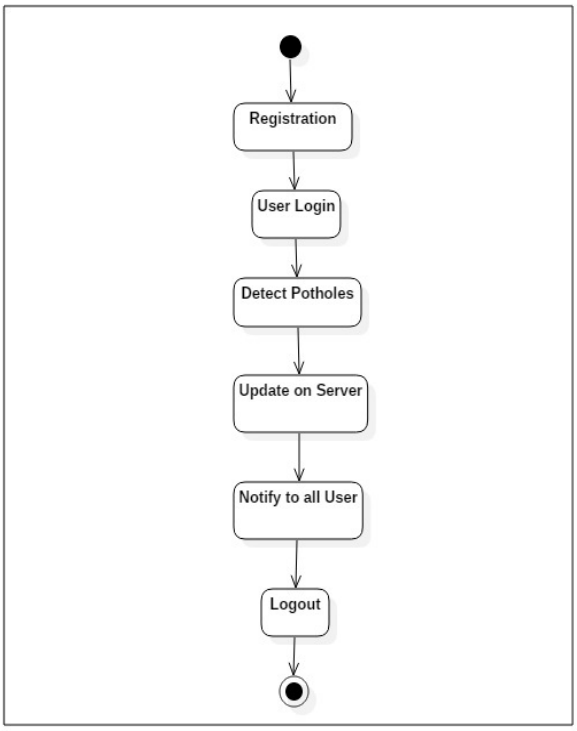

Fig -2: Workflow of the system

4. MATHEMATICAL MODEL

The mathematical representation of the proposed system focuses on the function of pothole detection.

Let 'S' be the solution perspective of the given problem statement such that –

S = {s, e, X, Y, Fs, DD, NDD, success, failure}

Where,

s: {start state of the system}

: {user registration/login}

e: {end state of the system}

:{pothole detection}

X: {input given to the system}

: {X1, X2, X3}

Where, X1 – user's name

X2 – user's mobile number

X3 – user's password

Y: {output obtained upon successful implementation of the system functionality}

: {potholes detected}

Fs: {functions used within the system}

: {F1, F2, F3, F4}

Where, F1 – preprocessing

F2 – detect potholes

F3 – update

F4 – notify

DD: {deterministic data}

NDD: {non-deterministic data}

success: {success state is when a desired category is returned for a tested document}

failure:{failure state is when a category other than desired category is returned}

5. CONCLUSIONS

This paper,automatic detection of potholes and humps and alerting vehicle drivers to evade potential accidents are the major purposes. The proposed approach is an economic solution for detection of potholes and humps, as it uses low cost ultrasonic sensors. The mobile application used in this system is an additional advantage as it provides timely alerts about potholes and humps. The solution works in all season and specially when potholes are filled with muddy water as alerts are generated using the information stored in the database. We feel that the solution provided in this paper can save many lives and ailing patients who suffer from tragic accidents.

The proposed system considers the presence of potholes and humps. However, it does not consider the fact that potholes or humps get repaired by concerned authorities periodically. This system can be further improved to consider the above fact and update server database accordingly.

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