International Journal of Application or Innovation in Engineering & Management (IJAIEM)
Web Site: www.ijaiem.org Email: editor@ijaiem.org
Volume 6, Issue 7, July 2017 **ISSN 2319 - 4847**

Real-Time Anomaly Detection Approach for Intelligent Transportation System

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ABSTRACT

The importance of the road infrastructure for the society could be compared with the importance of blood vessels for humans. To ensure road surface quality, it should be monitored continuously and repaired as necessary. The optimal distribution of resources for road repairs is possible providing the availability of complete real-time data about the state of the roads. There was a lack of an automated system that will reduce human errors, successfully store and analyze the conditions of the roads. For that, the use of accelerometer is made to detect potholes on the roads. Also, there are different sensors that will assist the driver in driving including the driver's application.

Keywords—mobile sensing, potholes, accelerometers

1. INTRODUCTION

Now a day's android has taken over the world. Everybody is using Android, and it has become the widest spread mobile operating system in use today. The inclusion of an IDE like Eclipse along with a robust SDK that is given regular updates, Android certainly has made its mark on eager developers, amateurs and seasoned professionals alike. There are a large number of potholes in our country. The condition of roads is worsening day by day. Earlier approaches included complete or partial human intervention. There was a lack of an automated system that will reduce human errors and successfully capture the conditions of the roads.

For the detection of potholes, we are taking the input from the vehicles of the general public. For that, we are using an accelerometer to detect potholes on the road. When the vehicle is on a plain road, a threshold value will be set for the accelerometer and when a pothole or a bump is detected there will be the corresponding change in the values of the accelerometer, thus detecting anomalies in the road. The information will be sent to the server using Wi-Fi.

There will be alcohol sensors which will detect whether the driver is drunk. The alcohol sensors are sensitive to a particular range of gasses at room temperature. An alcohol sensor detects the attentiveness of alcohol gas in the air, and an analog voltage is an output reading. Also, there will be a Driver application which will come in use while driving. The Android device will be kept in the left pocket of the driver, and it will detect the movements of the leg, and accordingly, the Android device will go into silent mode, to avoid accidents while driving. If the driver is driving, then Phone becomes silent, and only emergency calls are received. [7]

2.Related Work

The paper, Real Time Pothole Detection using Android Smartphone's with Accelerometers", author Artis Mednis discuss The image processing way of detecting potholes by Automatic detection and characterization of cracks in road surfaces, which is used to detect and characterize the type of cracks and find the severity level of cracks, used to reduce errors in manual calculation. Road pavement images are converted into nonoverlapping image blocks, and then features of image blocks such as mean and standard deviation are obtained. [1]

The paper "Pothole Detection System Using a Black-box Camera", authors Youngtae Jo and Seungki Ryu describe the working of a new pothole detection system using a commercial black-box camera which detects the potholes over a large area and at a low cost. The algorithm works with embedded systems, and experimental results show that potholes can be detected in real-time. [2]

The paper "In-pavement wireless sensor network for vehicle classification", authors R. Bajwa, R. Rajbhopal and R. Kavaler describe Aging roads and poor road maintenance systems result in a large number of potholes, whose numbers increase over the time. Potholes jeopardize road safety and transportation efficiency. Moreover, they are often a contributing factor to car accidents. To address the problems associated with potholes, the locations and size of potholes must be determined quickly.[3]

The paper "Pothole Detection and Volume Estimation Using Stereoscopic Cameras", authors Margaret Velse Thekkethala, Reshma S, Sebin Jacob Varughese, Vaishnavi Mohan and Geevarghese Titus describe a method for automatic pothole detection in asphalt pavement images. Image of the pothole is first resized and then converted into gray-scale. The gray-scaled image is then histogram equalized. Thresholding and basic edge detection are performed after this. This methodology is implemented in MATLAB and tested on 24 pavement images. High detection accuracy and accurate depth of potholes are the advantages of this system. [4]

The paper "Fine particles, thin films and exchange anisotropy", authors I.S. Jacobs and C.P. Bean says pavement condition assessment is essential, for comprehensive and cheap condition surveying of municipal road networks papers deals with potholes recognition. [5]

We provide an improved method using vision tracking to track detected potholes. In current practice, visual pavement data is collected automatically by digital inspection vehicles, but due to high cost, the number of inspection vehicles is limited. Also, it is performed only for highways. Municipal roads, which represent a large part of country's road, are surveyed manually due to low budget. [6]

3.PROPOSED WORK

A. Design Considerations

To create an Android application that will detect pothole and update the value to the server.

To create an Android application that will read the temperature and fuel levels and also the alcohol level and update the values to the server.

To create an Android application that will only receive emergency calls and disconnect all the other calls and give a message to the user about missed calls.

B. Description of the Proposed System

Now a days good people and good roads both are becoming rare in this country. So to improve the condition of both, Android applications are being developed which will keep an eye on potholes and various parameters of the vehicle which can be made available. Now a days most of the owners rent their vehicles to third-party for business purpose. So it becomes difficult for them to keep check of their vehicle on the go.

The Vehicle Tracking application lets a person track a specific vehicle on the go and analyzes various values which are important from the safety of the vehicle and the first parameter being the temperature of the vehicle which after exceeding a particular value can lead to hazardous consequences. The user has to set a particular threshold temperature on the application and if the temperature measured exceeds the threshold value, then an alert will be generated on the application which is linked with a temperature sensor.

Refill of fuel is carried out on a frequent basis even when it is not required. The application checks the level of fuel on a regular basis when the application is in running state. This helps the owner for accurate analysis of the fuel consumption. The last parameter being the most important one which is ALCOHOL! Alcohol consumption is increasing day-by-day. This is a serious issue, but the more dangerous issue is "Drink and Drive". The application is linked with an alcohol sensor which detects the alcohol if consumed by the driver. If some content of alcohol is found, then ignition will not turn on preventing any disaster. All the three parameters temperature, level, and alcohol content are embedded in Vehicle Tracking application.

The user has to provide an IP Address of the server and mobile number for the purpose of alert generation. When the user is logged in, scaling factors need to be set for the purpose of accuracy. The application should now be paired with Bluetooth. After successful pairing, the tracking system is all set to start. When the user starts, all the values will be constantly updated, and all records will be stored on the server for analysis purpose. Thus, the application is the all-in-one tracking system for sure!

The Pothole Detection System consists of an accelerometer that will detect potholes. The accelerometer will be set to a default value. So when there is a significant change in the values, then it will be considered as a pothole. Whenever a pothole has detected the value that we will get will be less than the default value. Whenever a bump will be detected, then there will be an increase from the default values. There will be a Bluetooth facility to send the data to the server. The data will be constantly sent to the server. As the vehicle moves on the plain road, the value will be a default constant value, but when a pothole or a bump will be detected, then that value will be changed signifying an anomaly on the road. When another car comes behind the first car, then that car will receive the details of the anomaly ahead. The next cars should also have a Wi-Fi capability to receive the data. The cars should be in the range of the server to

get the details of the anomalies. Thus, in short, the Android device scans the accelerometer values, and the values collected from various sensors are filtered through ADC and send via Bluetooth to the device.

Cars have become a need rather than a luxury. Everyone buys a car according to his/her requirement, comfort, etc. The condition of roads is worsening day by day. Driving cars on such roads have become a tedious job. To make driving safe on such roads, we are developing a Driver Drow application which keeps the driver and passengers both in a safe condition. The application allows the driver to manage an emergency contact list and receive only such calls by stopping the car in a safe place. If a certain caller calls during the course of driving, a message is sent which may say "I'm driving, I'll call you later". Thus, the developed application prevents accidents and leads to a better and safe India!

4.SIMULATION RESULTS

Fig. 1 Welcome Screen

The fig. 1 shows the GUI of Vehicle Tracking System to track vehicles using Global Positioning System (GPS) in mobile phones. When we click the proceed button it shows following page:

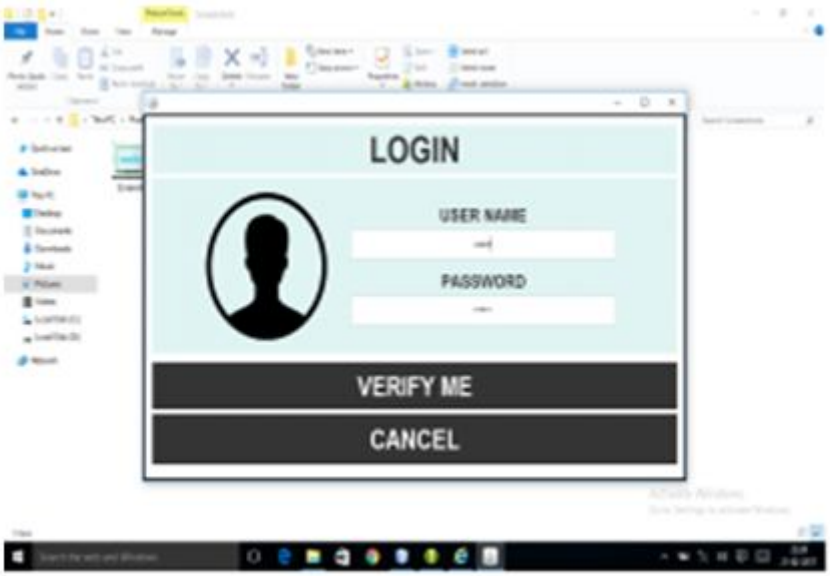

Fig. 2 Login Screen

In the fig. 2, the user needs to verify his Username and Password. If the user enters incorrect username and password, he cannot log in and track the vehicle. If the username and password entered are valid, he will be verified as an authentic user and can gain access to the information.

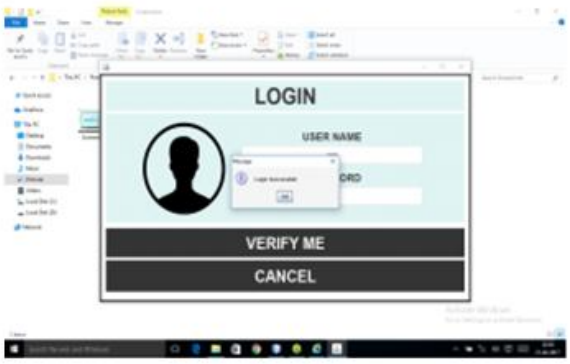

Fig. 3 Verification Message

The fig. 3, Shows the Login Successful message for a verified user.

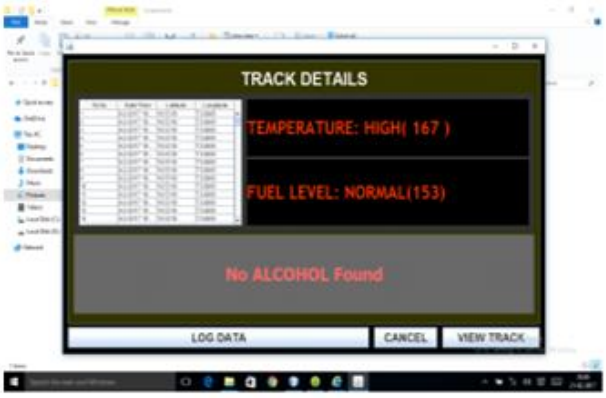

Fig. 4 Track Details

The fig. 4 contains all the information such as longitude and latitude of the vehicle with respect to date and time. Other details such as temperature sensing and fuel sensor values are also displayed inside Track details. Another important sensor, the alcohol sensor, detects if alcohol is found or not found. If a person is detected as drunk, then it will immediately turn on the buzzer. Thus, the developed application prevents accidents and leads to a better and safe India!

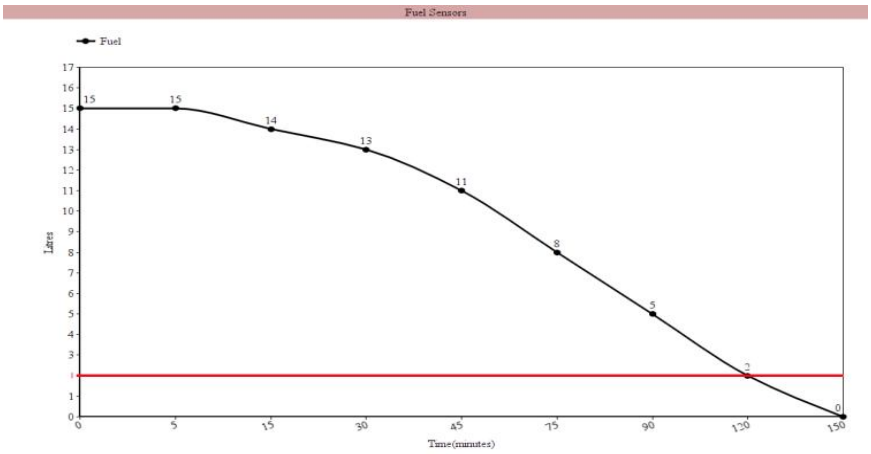

Fig. 5 Fuel Level Graph

	A	B
1	Time(days)	Litres
2	0	15
3	5	15
4	15	14
5	30	13
6	45	11
7	75	8
8	90	5
9	120	2
10	150	0

Fig. 6 Time v/s Fuel Level

In fig. 5 and fig. 6, we have taken into account the relation between Fuel level and time. We can clearly see that as the time increases, the fuel level decreases and if the fuel level goes below a certain level than a buzzer is sounded to tell us that the fuel level is too low. Hence we get a linear graph representing the increase in time decrease in fuel level.

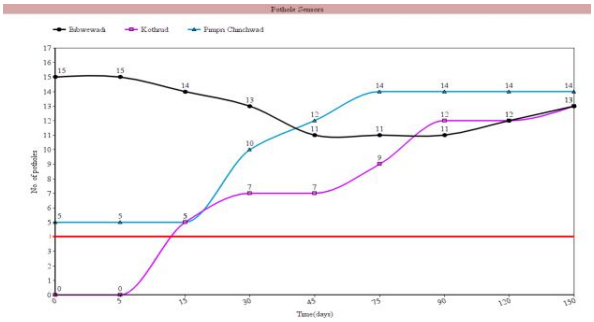

Fig. 7 Pothole Detection Graph

1	Time(days)	Bibwewadi	Kothrud	Pimpri Chinchwad
2	0	15	0	5
3	5	15	0	5
4	15	14	5	5
5	30	13	7	10
6	45	11	7	12
7	75	11	9	14
8	90	11	12	14
9	120	12	12	14
10	150	13	13	14

Fig. 8 Pothole Statistics

In fig.7 and fig. 8, we have taken into account the relation between a number of potholes and time around three places. As we can see the number of potholes are increasing as the time progresses, but sometimes the number decreases meaning that the potholes were filled. We found that the number of potholes in Bibwewadi was very high and was varying. In Kothrud, initially there were no potholes but gradually the number increased. Similarly, in Pimpri-Chinchwad, the number was less but gradually increased.

5.CONCLUSION

The system will detect potholes in real time. The system will use an Android OS based Smartphone with accelerometer sensor as the software/hardware platform. The system will have a calibration as different vehicles are likely to yield different sensor data. The system will also detect if the person has consumed alcohol and ensure the safety of the person. Also, the driver application will prevent the drivers' phone from ringing while the vehicle's engine is ignited.

Acknowledgment

I would like to thanks to all the teaching and non-teaching staff members of the department and my friends who helped me in gathering information and providing encouragement to me.

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