

# EVALUATION OF ROAD CONDITION USING ANDROID SENSORS AND CLOUD COMPUTING

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**Abstract** - Nowadays every smart-phone is integrated with Many useful sensors. The sensors are originally designed to make the user interface and applications more convenient and Appealing. These sensors are potentially useful for many other Applications in different fields. The smart-phone sensor like accelerometer, GPS and gyroscope are used to estimate road Roughness condition. These sensors are used to collect vibration data. Using this data condition of road is evaluated. The smartphones are placed at more realistic locations and under realistic manner inside a moving vehicle to collect the data which is useful to evaluate its relationship with the actual road roughness. One of the major problems in developing countries is maintenance of roads. Well maintained roads contribute to a major portion of the countries economy. Identification of road anomalies such as potholes and bumps, help drivers to avoid accidents, vehicle damages and it also help authorities to maintain roads. In this paper, we discuss the previous pothole detection methods that has been developed and proposes a cost effective solution to identify the potholes and bumps on roads. In our system, mobile phone sensors are used to identify the potholes and bumps. The proposed system captures the geographical location of the potholes and bumps using GPS sensor in the Mobile phone. The sensed-data is send to the cloud storage for further processing. This serves as a valuable source of information for the government authorities and vehicle drivers. An android and web application can be used to display the road condition in the map.

**Key Words:** Road Quality System, Cloud computing, Pothole detection, Bump detection, Smart-phone, Android, Accelerometer, Web portal, GPS sensor

## 1. INTRODUCTION

Road condition these days serves as a vital role in Traffic management, accident prevention and vehicle maintenance, hence keeping a close check on the road orientation and anomalies has to be given utmost attention. This needs to be done so that drivers can avoid or be aware of the bumps and potholes ahead by using this information. Road condition can be defined using various metrics such as irregularity which may be in the form of surface bumpiness, potholes, damages and so forth. Presence of such anomalies on roads have adverse

Effects on the safety of the driver as well as condition of the vehicle. India, being the the second most populous Country the World and a fast growing economy, has a gigantic network of roads all over the country. Roads are the

dominant means of transportation in India today. Almost 90 percent of countries passenger traffic and 65 percent of its freight is carried by roadways. However, majority of the roads in the country are not in a good condition and hence risk of accidents and mishaps increases heavily. No matter what part of the country you

Travel in, driving is a breath-holding, multi-mirror involving, Potentially life threatening affair. Such condition of roads is A supporting factor for traffic congestion and accidents. Also, presence of speed breakers which is supposed to make the traffic better, is making it worse due to the fact that they are very poorly and unevenly constructed. Hence the whole purpose of constructing speed breakers is completely changed.

## 2. PROBLEM STATEMENT

Roads being a vital part of our lives makes a huge difference in the performance of our daily activities. After actual construction of roads they are subjected to different adverse conditions such as natural calamities, change in weather, vigorous rolling of wheels etc. This affects the quality of driving as well as the traffic flow. With the availability of information regarding the road conditions, drivers can be aware about any anomalies that are present on the road. It is desirable to have a mechanism for detecting the condition of roads and get them repaired as soon as possible. Anomalies such as road bumps and potholes need to be monitored and repaired immediately. The roughness of roads may cause discomforting rides, extra fuel consumption, unexpected vehicle maintenance costs and most importantly safety. Maintenance of road infrastructure and its management is very important to keep them in good condition so that it does not affect the safety as well as the finances of the road user.

## 3. OBJECTIVE

The main objective of this system is to design the system to know about the road quality. Nowadays we all use Google maps and its application for navigation during travelling, but these applications couldn't able to tell you any roads condition or its complexity. Road Quality Management System using android phone proposes to utilize the GPS system of phone and different sensors like accelerometer, magnetometer, etc. of android phone, so we could analyze the road and can upload this information of that road on central server so every application user can use this information during traveling.

#### 4. SOCIAL IMPACT

India is the second largest country with huge number of population and vehicles. In India most of the communications are being dependent on road transport only. Often the road accidents may occur due to Reckless Driving and improper road conditions. Government of India has taken necessary steps to maintain the road conditions. Even though the technology has improved a lot there will not be of accuracy. Due to heavy rain the road conditions are being damaged easily. Road monitoring can also help to predict the estimated arrival time from one place to another. This paper presents a detailed survey of methods for detecting road conditions. Form the survey, it is noted that the most commonly used sensors accelerometer and GPS. Smartphone sensors are gaining importance in this field as they are cost effective and also increase scalability. Analyzing form the research activities, it is certain that this area will gain more importance in recent future.

#### 5. LITERATURE SURVEY

Following is a systematic representation of the related work that enrich our system. In previous studies the use of cloud computing is not very commonly used. Our system mainly focuses on detecting anomalies such as road bumps and potholes using mobile sensors and cloud computing.

1) Arun Kumar G [1] proposes a system that make the use of accelerometer to get the deviation readings of the roads .Use of GPS sensors is done in order to find the exact co-ordinates of the potholes or bumps. No specialized algorithms are used in order to analyze the data. Use of a centralized server and a web application is used for the same.

2) In [2] authors, Dimpal V. Mahajan, proposed “Estimation of road roughness condition by using sensors in smartphones”. This system uses three axis accelerometer sensors, GPS devices and magnetometer in order to measure the vibration as well as location of the anomaly. Means algorithm is used in order to cluster and analyze data. Standard deviation is used for the mathematical calculations and finding the deviation.

3) Authors, Azza Allouch, Anis Koubaa, Tarek Abbes, and Adel Ammar, proposed [4]”Road Sense: Smart phone Application to Estimate Road Conditions using machine learning .A systematic approach is followed

Including data fetching, data preprocessing and predictive analysis. Sensors such as three axis accelerometer and gyroscope are used. Algorithms such as SVM, C4.5 decision tree, naive Bayes are used out of which SVM provides the most accurate results.

#### 6. MODULES

1) ANDROID APPLICATION: The android application serves as the main user interface .It makes use of the mobile phone

sensors to collect data. It combines Google map for proper visualization.

2) CLOUD: The data that is fetched using the sensors in collaboration with the smart-phone, is stored in the cloud. We make use of amazon web services (AWS) for analyzing and storing the data.

3) WEB APPLICATION: The web application is an interface that enables users and the administrator to fetch the record history of the trips.

#### 7. SYSTEM ARCHITECTURE

The basic system architecture of our project contains 4 tasks sensing, storing, analyzing and retrieving the data. In the first task, we acquire the data from the mobile phone sensors. The second task is to send the sensed data to the Cloud storage. The third task is to analyze the cloud data to predict the road conditions. The fourth task is to retrieve the data and display the condition of the road as the markers in the map.



Fig -1: System Architecture

**1) Sensing:** In the broadest definition, a sensor is an object whose purpose is to detect events or changes in its environment and sends the information to the computer. Today sensors are used in everyday objects. Our mobile phone contains so many sensors. We had used the accelerometer and GPS sensors in the mobile phone to detect the pothole and to find out the current location and speed of the vehicle. We can detect the potholes by observing the accelerometer data patterns. If we identified the pothole, immediately we access the location of the pothole by using the GPS sensor in the mobile phone. We can also find the speed of the vehicle by using the GPS values. Fig shows the flow chart for sensing the data sets from the mobile phone.

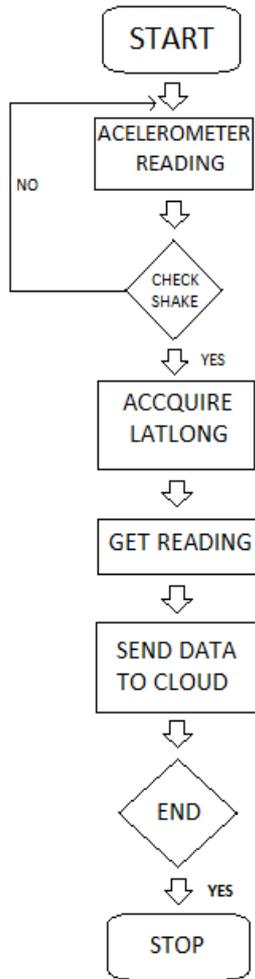


Fig -2: Sensing Flow Chart

**2) Storing:** Storing is the second task performed after all the data sets are sensed from the mobile devices. In this subsystem, the user send the sensed data to the cloud storage. This can be said as the backbone of the system. This subsystem collects the data from different vehicles and Co-ordinates the data.

**3) Analyzing:** Analyzing is the third task that is done after all the data sets are send to the cloud storage. Here the sensed data are compared to the other values that are already available in the cloud storage. Based on the comparison the quality of the road is predicted by the web application. This subsystem is responsible for determining the road conditions and adds the result into database. Other main function of this subsystem is to provide data to the user as per user’s requirements. It collects all the data send by the different mobiles. The centralized web application is running on the cloud to analyze the data before it gets stored in the database.

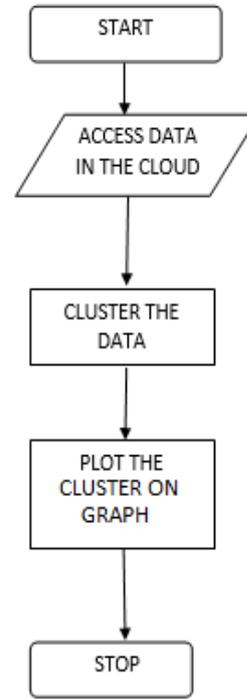


Fig -3: Analyzing Data Flow Chart

**4) Retrieving:** Retrieving is the fourth task, here the datasets present in the public cloud are accessed first. The location of the potholes are plotted as markers based on the latitude and longitude values present in the cloud storage. This module provides the user interface for showing where the potholes are located. A web application is used for showing the plotted map to the user. The user can easily view these data from any Device.

**8. METHODOLOGY**

To ensure road surface quality it should be monitored continuously and repaired as necessary. The optimal distribution of resources for road repairs depends on the availability of comprehensive and objective real time data about the state of the roads. Participatory sensing is a promising approach for such data collection. This system presents the development of a cost-effective, sensor system using commercially available off the-shelf devices for autonomous data acquisition of road surface conditions. This system is a easy-to-use sensor system that is relatively inexpensive, which could be easily mounted on vehicles, to perform periodic pavement data collection, and maintains data in a cloud.

**9. ALGORITHM**

$$E = \sum_{i=1}^k \sum_{x \in C_i} |x - m_i|^2$$

Fig -4: K-means Clustering algorithm

K-means clustering is popular for cluster analysis data mining. K-means clustering aims to partition and observations into k cluster in which each observations with the nearest mean, serving as a prototype of a cluster. In our project k-means algorithm is used to check which route has large number of potholes and bumps. So that user will come to know about road conditions in abstract form. This will also help admin to decide which road needs repairing immediately and priorities them accordingly.

## 10. COMPONENTS

**1) Accelerometer Sensor:** An Accelerometer Sensor is a device that measures Proper Acceleration. Proper acceleration is not the same as coordinate acceleration. Accelerometers have multiple applications in industry and science. Highly sensitive accelerometers are components of inertial navigation systems for aircraft and missiles. Accelerometers are used to detect and monitor vibration in rotating machinery. Accelerometers are used in drones for flight stabilization. Coordinated accelerometers can be used to measure differences in proper acceleration, particularly gravity, over their separation in space; i.e.

Gradient of the gravitational field. This gravity is useful Because absolute gravity is a weak effect and depends on local density of the Earth which is quite variable. Single and multi-axis models of accelerometer are available to detect magnitude and direction of the proper acceleration, as a vector quantity, and can be used to sense orientation, coordinate acceleration, vibration, shock, and falling in a resistive medium. Micro Machined accelerometers are increasingly present in portable electronic devices and video game controllers, to detect the position of the device or provide for game input. In our system, accelerometer plays an important role in detecting the potholes and bumps. Characterization of potholes and bumps in the roads can be done using the readings of the accelerometer. Sudden change in the accelerometer values will indicate the presence of the pothole in that location.

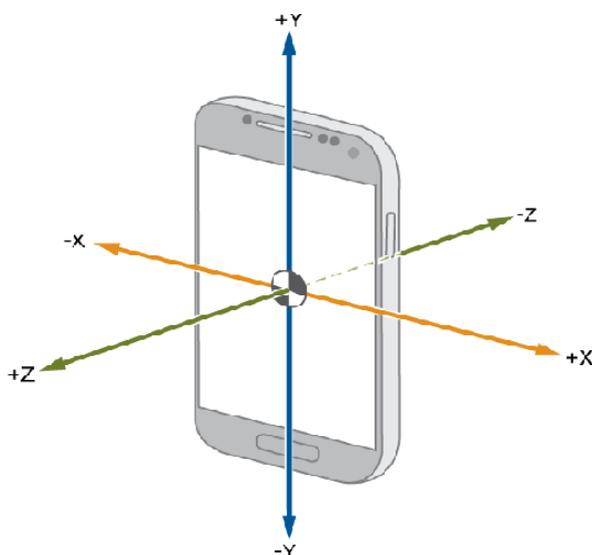


Fig -4: Accelerometer alignment in mobile phone

**2) GPS Sensor:** A GPS sensor was added to the data acquisition system to record the location of defects and the speed of the vehicle. If the accelerometer sensor detects the potholes or the bumps in the road, then immediately the Geo-location and speed of the vehicle has to be calculated from the GPS sensors. The Geo location data will contains the coordinates of the potholes or bumps. The speed of the vehicle will be used for analyzing the data for efficient working of our system. GPS accuracy in our deployment is important if potholes are to be properly located and multiple detections combined to report a single pothole. Accuracy is the tendency of your measurements to agree with the true values. Precision is the degree to which your measurements pin down an actual value.

## 11. APPLICATIONS

1) This system can be used by the car drivers for trip management .In other words it can help them to choose a road with less anomalies which in return can make their trip more convenient and effective.

2) Taking into consideration the social aspect, the proposed system can help reduce the frequency of accidents and also ensure a smoother flow of traffic .This will reduce the extra time that people have to spend in traffic jams as well as make sure that the ambulances reach the hospital on time.

3) For road maintenance, this system can serve as a direct platform for various agencies from where they can easily retrieve data about the road anomalies and can accordingly take suitable measures to fix them.

## 12. ADVANTAGES

1) There is no need to carry additional hardware devices or sensors as it makes use of mobile devices that are (usually) carried all the time. Having to carry a separate sensor and hardware system makes the job tedious.

2) As the proposed system makes use of cloud computing, the data can be retrieved anytime from anywhere by a simple process of logging in. No extra expenses of local database is required. Local database usage can take up a whole lot of RAM space of the mobile phone whereas cloud storage can be expanded as and when required.

3) Cloud usage enables multiple users to access the data at the same time that makes the system even more efficient.

## 13. CONCLUSION

Hence we can conclude that the proposed system aims at providing a fully functional model that detects the condition of roads. This assists the users in trip management as well as helps road maintenance organizations to take appropriate measures to resolve the anomalies. The system makes use of smart-phone sensors for fetching the data whereas analysis and visualization of data is done using cloud computing and Google maps. The concerning authorities can directly fetch

the data from the web application and take preventive measures accordingly.

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