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Application of Remote Sensing and GIS for Road Monitoring

Digambar R. Ghayal*1, Dr. Karbhari V. Kale2
*1Department of CSIT, Dr. BAM University, Aurangabad, Maharashtra, India
Ghayaldigambar55@gmail.com1
2Department of CSIT, Dr. BAM University, Aurangabad, Maharashtra, India

ABSTRACT

Smartphones have turned into a chief piece of human advancement. Expanding ubiquity, registering fitness, and accessibility of various sensors have opened better approaches to use these brilliant gadgets. Notwithstanding cell phones and tablets, another critical part of current society is the street organize. Since countless utilizations streets consistently, crumbling remains an issue in numerous spots. Securing of data without contacting the real protest is viewed as the meaning of remote sensing .We manage the cell phone to catch the awful surface directions utilizing the GIS geolocations idea for the Aurangabad city. The point of this paper is to give a calculation to street surface quality identification and a gadget application for accelerometer information gathering. As accelerometer contains the worldwide x, y, z co-ordinates with GIS geolocations to catch the present area from where we ought to consistently watch pathway and once the speeding up information of the z-axis increments with the indicated threshold value. We bring up this as a pothole in transit and store that information real time to the database. The algorithm utilizes accelerometer information, gathered from various streets thinking about the use of Aurangabad city, with a specific end goal to prepare a classifier for road surface quality location. The accelerometer information is gathered with the previously mentioned Android application, which is created due to this paper. The general aftereffect of this paper is a proof of thought that can be utilized to recognize, classify and order the surface nature of roads that are classified into three streets.

Keywords : GIS, Remote Sensing, road surface quality, accelerometer, geolocations, ionic3, G-sensor

I. INTRODUCTION

Roads are imperative for the simple development of products and substances, people and other mobile things. A decent street organize helps and quickens the financial advancement of any nation, through trade, tourism and other business improvements. Roads arrange in most Indian districts are not doing so good; street conditions in the investigation area are poor at present [1].

A database on road systems (network), past spatial appropriation of a road and their conceivable connects to the roads of part of the spots; towns or even nations can be made and refreshed utilizing RS and GIS. Cell phone plays a crucial role in a road to makes the things happened.

The past actualized technique for road monitoring is by physical examination; this is exhausting, exercise in futility and expensive and requires much workforce and materials. It additionally contains peril to the checking group, and so on. For whatever length of time that roads are constructed, this past-actualized conventional technique can never again reasonably serve the coveted motivation (agenda). In this manner, it winds up important to acquaint current procedure and innovations with monitoring our streets. Thus, the examination or selection of GIS and RS for road monitoring as a superior alternative, utilizing for Aurangabad city as a contextual analysis [1].

Cell phones (smartphones) and tablets have turned into a critical part of present-day society. As of late, the cell phone advertising has seen generous increments in the number of shipments everywhere throughout the world [2]. Most recent couple of years and has as of late outperformed work area web utilization out of the blue overall [3]. The prevalence of smartphones, combined with their expanding processing power, implies that smartphones are playing out an undeniably extensive variety of capacities. Applications on versatile stages, for example, Google Android and Apple iOS, can likewise exploit gadgets' interior sensors, which opens up better approaches to use these smart devices. Sensors can be utilized for various assignments, for example, identifying the introduction of the device or for more complex issues, for example, human action recognition [4].

Roads require frequent visits oversight to discover and settle anomalies (oddities) as quickly as time permits to shield them from deteriorating further. Notwithstanding typical wear and tear, factors, for example, poor road construction quality, high traffic condition, poor drainage, weak sub-level and vast varieties in temperature can add to the creation of potholes, cracks and different anomalies, which essentially bring down the typical road quality and ride solace of pavement asphalt streets [5]. Investigating roads physically or by utilizing uncommon committed equipment can likewise be tedious (time-consuming). In this manner, building up a more open and effective road quality identification solution, that can feature dangerous zones, would be useful to both the road administrators and street user.

A cross-stage (cross-platform) smartphones application, running an information gathering application (Road Surface Data Collector starting now and into the foreseeable future), and a bicycle used to gather acceleration data of various streets. The acceleration information is gathered in 2-second length time-based windows in three, logically more awful classes: smooth, bumpy and rough, individually, in and around the city of Aurangabad. The assembled information records comprise of acceleration information and related GPS-co-ordinates.

Due to these segments, this paper gives a proof of idea arrangement, which could be a reason for a future arrangement. That comprises a smartphone information accumulation application and server-side detection algorithm. The software application arrangement could be utilized by both the street user and the administrators to record acceleration information and see the nature of different streets to either reviews or maintenances or decide routes that give a smooth driving experience to the road user.

II. RELATED WORK

This section gives an overview of a portion of the related work regarding the matter of road quality recognition utilizing accelerometer information. The overview separated into two subsections those will centres around centres around the information accumulation setups and strategies, the outcomes that those procedures yielded.

A. Area Of Study

Proposed Road monitoring application is for Urban Area of Aurangabad city, which is situated with Geo-coordinates 19.88°, N 75.32°E [18]. Our application is for Urban Areas at Aurangabad city as a Case Study. The application we can Literature with two stages i.e. existing frameworks review and current Different advances (technologies). We will first begin with the information accumulation process as starting for the task.

B. Data collection

The information accumulation process is a basic advance in this segment. Diverse techniques have been utilized in past work; in any case, all work incorporates the gathering of accelerometer information, somehow. This subchapter plans to give an overview of the procedures used to gather this information. Tonde et al. [6] utilized a cross-stage device smartphone with a settled introduction to gathering the acceleration data. An accumulation was done at a frequency rate of 100 Hz. From the smartphone, information was transferred to a personal computer. Information records were then physically checked to just choose those road segments that give complete datasets. By and large, four classifications of road quality were recognized.

1. Existing Systems

In Aurangabad city, there is no framework, which would really make the things, occurred for street monitoring. From the daily papers, we really get the data that there were pothole, awful road condition. Hence, city enterprise needs to deal with those things, which they get from daily papers. This procedure comprises of paper specialist contact with Municipal Corporation about the news, they take a criticism from that point and following day news goes to the daily paper a status of what occurred with the posted news. The posted newsperson is any typical individual. Whatsapp number from the daily paper with detail data will enough for the expert for investigation for facilitating request in the event that they found the condition is critical.

2. Current Systems

There are different ways of detecting systems for pothole detection. A portion of these acquisitions of information by utilizing accelerometers strategies. This segment contains a review of pothole detection algorithm executed in such accelerometer-based systems. The suitability for execution of these frameworks on stages with restricted equipment and programming assets, for example, Android-based PDA, is considered.

Pothole Patrol framework [7] created at Massachusetts Institute of Technology is utilizing a particular equipment/programming stage – Linux controlled Soekris 4801 installed PCs with outside accelerometers (examining rate 380Hz) and an outer GPS. The pothole detection algorithm depends on the unadulterated machine-learning approach utilizing X and Z-axis acceleration and the vehicle speed data as input information. The algorithm comprises five sequential filters: speed, high-pass, z-peak, xz-ratio and speed versus z proportion. Each filter is connected while a rejecter of at least one occasion composes not identified with potholes, for example, entryway hammers or railroad intersections (crossing). The extra preparing process is executed for ideal tuning of the last three filters.

Nericell [8] and TrafficSense [9] frameworks created at Microsoft Research India are utilizing Windows Mobile OS controlled smartphones as equipment/programming stage with a variety of outer sensors, for example, accelerometers (testing rate 310Hz), amplifiers and GPS. Their algorithm for pothole detection z-sus (for speeds <25km/h) and z-peak (for speeds ≥ 25km/h) depend on straightforward threshold based heuristics. Extra algorithm virtual reorientation utilized to remunerate self-assertive introduction of the advanced mobile phone while driving in the vehicle.

A framework created at National Taiwan University [10] is utilizing bike-based mobile phones HTC Diamond as an equipment stage with worked in accelerometers (testing rate ≤ 25Hz) and outer GPS. Their approach for pothole detection depends on supervised and unsupervised machine learning strategies. Client-side errands (task) incorporate separating, division and highlighting feature extraction. Server-side errands utilize two learning models - support vector machine and a smooth street display. Street variation from the norm discovery is performed utilizing histograms of a succession of triaxial and mostly acceleration data segment with various windows sizes speaking to information from 0.1 to 2.0 seconds of time required in driving.

BusNet [11] framework procured at the University of Colombo is utilizing Crossbow MICAz bits and different sensor boards including GPS and accelerometer as an equipment stage. This method does not have constant information (real-time data processing) handling usefulness. The information gathered locally and put away for transmission over the remote system to accumulation hubs situated at the transport stations for later handling. The pothole detection depends on detecting acceleration and utilized to begin the information accumulation to spare (save) the restricted storage room.

Algorithm-based Simple threshold, for example, z-sus, z-peak and so on are best for use on Android/iOS based advanced mobile phones. Nevertheless, the accessible equipment and programming assets on this devices stage are prepared to do more mind-boggling calculations with better pothole/street quality detection parameters. Our algorithm for street quality detection is particularly from the earlier work in two unique perspectives: 1) proposed arrangement accept further developed and heuristic continuous occasion (real time) detection utilizing restricted equipment and programming assets; 2) focus on potholes/bumps as one particular occasion compose expect better usage of accessible sensor information.

III. TECHNICAL REQUIREMENTS

The following technical requirements were chosen as a basis for road quality detection systems:

- The framework ought to have the capacity to discover/recognize occasions (potholes for our situation in real time) progressively. Accumulation of raw information for disconnected (offline) post-preparing named an extra-preferred standpoint.
- The framework should utilize a nonspecific Android OS based mobile phone (for our situation) however; we can actualize it with on iOS gadget also with accelerometer sensors as the equipment/programming gadget stage. Versatility in different stages is delegated an extra advantage.
- The framework ought to have the capacity to execute on various mobile phone models with various parameters. Amid the venture usage ventures to the arrangement of the negligible cell phone, parameters ought to be figured and portrayed.
- The framework running on a cell phone ought to have the capacity to play out its local correspondence assignments at a sufficient quality level. The usage of all assets for pothole identification is not adequate.
- The framework ought to have the capacity to distinguish occasions while driving in a various four-wheel vehicle, Two-wheel vehicles.
- The framework ought to have a self-alignment or adjustment usefulness, as a few vehicles are probably going to yield different sensor information when confronting a pothole. This usefulness ought to be founded on signal pattern particular to the specific vehicle composes.

IV. OUR APPROACH

Street Surface Data Collector is a mobile phone application, customized in ionic 3 programming dialect and intended to keep running on cell phones or tablets with Android form 4.0.3 or more noteworthy. This variant of Android was picked on the grounds that as per official information assembled from Google Play Store visits, it covers an expansive level of the dynamic Android gadgets while yet giving adequate highlights to this present application's motivation [12]. Notwithstanding, something critical to note is that the rendition of

Road Surface Data Collector utilized and portrayed in this paper was constructed particularly with the end goal of this paper and was tried and utilized on a solitary cell phone and thusly serves just as a proof of idea and not as definite programming.

Information Collector depends intensely on the Android sensor system, by utilizing the gravity and linear acceleration sensors, which are available from the structure. Contingent upon the gadget models and producer of the gadget, these sensors can be either programming based or equipment based. Programming based (software based) sensors are gotten from one or a few equipment sensors while equipment based sensors get their information specifically from the equipment sensor (hardware sensors). Movement sensors like the gravity sensor and a linear acceleration sensor can give designers data that can be extremely valuable for certain particular errands. A gravity sensor estimates acceleration that is because of gravity while barring all other, which can be utilized to ascertain the gadget's introduction in connection to Earth. A linear acceleration sensor gives the contrary impact by giving increasing acceleration information, from which the power of gravity has been avoided. This can be utilized for assignments, for example, movement detection. [13, 14].

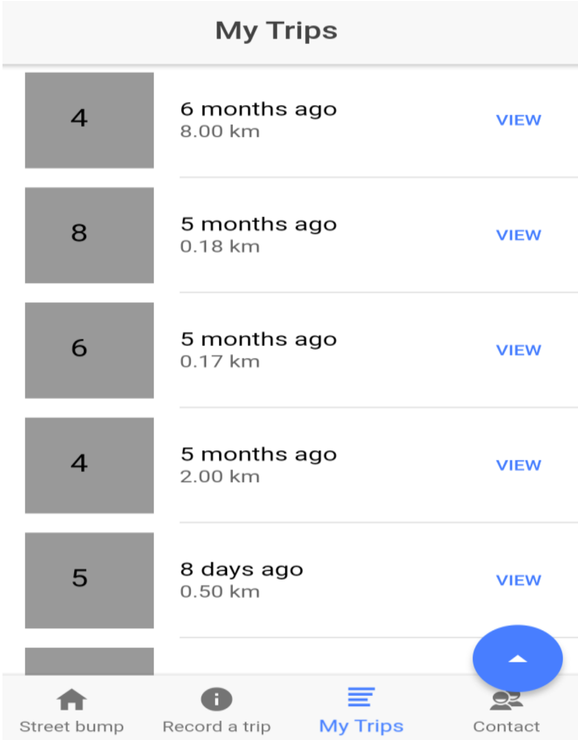

Figure 1. Recording of trip screen

On account of linear acceleration sensor and gravity, for the most part, require the gadget to have a gyroscope sensor and can in this way be inaccessible except if the gadget has one, which is the situation with the AOSP usage of the linear acceleration sensor and gravity. In any case, it additionally must be noticed that Android cell phone and tablet makers can give their own particular sensor usage and in this manner the accessibility and setup for the linear acceleration, sensor and other related sensors.

In the investigation of gravity sensors and a linear acceleration sensor, they normally require the gadget to have a gyroscope sensor. Hence, in this way, it will be inaccessible except if the gadget has one, which is the situation with the AOSP usage of the gravity and linear acceleration sensor. In any case, it likewise must be noticed that Android cell phone and tablet producers can give their own particular sensor executions and in this manner, the accessibility and design for the gravity, linear acceleration sensor and different sensors can vary crosswise over various gadgets. [15].

From fig, 1 is the screen to record the road monitoring of places, places are start and end positions with GIS geolocations as initiatives. Once the administrator of the app starts the trip, device captures his current location from where he started the journey. Once it starts geolocations, it is continuously watching with device acceleration sensor and G-sensor for gravity with accelerated data.

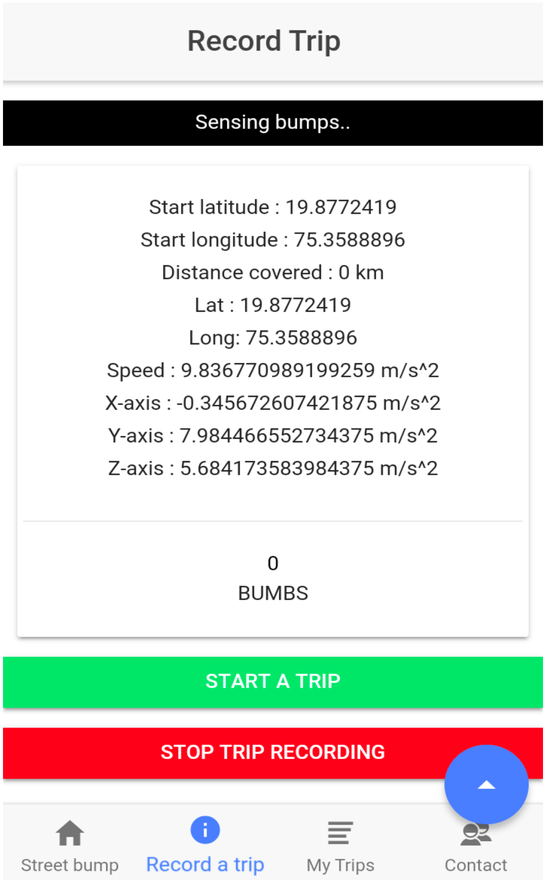

Figure 2. Recorded All Trip

Geolocation is calculated based on [16].

```
<manifest ... >
<uses-permission
android:name="android.permission.ACCESS
_FINE_LOCATION" />
  <!-- Needed only if your app targets
Android 5.0 (API level 21) or higher. -->
  <uses-feature
android:name="android.hardware.location.gp
s" />
</manifest>
```

Figure 3. Manifest XML file to set permissions

this.geolocation.getCurrentPosition() -- an ionic package where initiate with getCurrentPosition method will retrieve the current location of the use , we save this location for processing.

Where:

- ACCESS_FINE_LOCATION: It gets permission for both Network and GPS Providers.
- ACCESS_COARSE_LOCATION: Android application uses a network location provider.
- INTERNET: permission is required to use network provider [18][19].

Google maps API [17], has used to bring up the areas of pothole in Google maps, this API helpful to convey the pothole remove with haversine recipe and in addition to ascertain the acceleration information with current watch position of lat ,long qualities and old lat, long qualities and figure the separation from source to goal.

In our paper, we utilized the 'Haversine' equation for separate estimation for spherical estimations. It is utilized to process the considerable hover between stick focuses that is, the most limited separation over the circular earth's surface [20] [17].

Haversine formula:

$a = \sin^2(\Delta\varphi/2) + \cos\varphi 1 \cdot \cos\varphi 2 \cdot \sin^2(\Delta\lambda/2)$

$c = 2 \cdot \text{atan2}(\sqrt{a}, \sqrt{(1-a)})$

$d = R \cdot c$

Where

Φ is latitude, R is earth's radius, (mean radius = 6371000 meters),

λ is longitude; the angles should be in radians to pass to trig functions!

```
var R = 6371; // km
var φ1 = lat1.toRadians();
var φ2 = lat2.toRadians();
var Δφ = (lat2-lat1).toRadians();
var Δλ = (lon2-lon1).toRadians();
```

In this paper, we calculate the shortest distance between user old locations and is current location and continuously watching this location in Km.

Watch position:

this.geolocation.watchPosition();

watch.subscribe((data) => { // data.coords.latitude // data.coords.longitude });

We set 200 milliseconds of interval continuously watch the location from source to destination, watchPosition methods subscribe the coordinates and our motivation is to get the bad road condition monitoring and get the geo-coordinates.

A Speed of vehicle:

The speed of a vehicle here calculated based on the RMS values of the last accelerated 3-Axis values

Road monitoring detection algorithm (pseudo code):

Start

RoadMonitoringFunction () {

Start position()

: this.geolocation.getCurrentLocation().subscribe(position=> {

Position.coords.latitude ,

position.coords.longitude.

***Callback** : watchPosition() function inside*

})

***WatchPosition()** : this.geolocation.watchPosition().subscribe((pos) => {*

this.watchLocation = pos;

***Callback** : accelarationData() //call acceleration function to get accelerated data*

Callback: calculateDistance(startlatitude, startlongitude, currentlatitude, currentlongitude)

})

accelarationData():

this.deviceMotion.watchAcceleration({frequency:200}).subscribe((acceleration: DeviceMotionAccelerationData) => {

***acceleration . x , acceleration.y,acceleration.z** ;*

// using this we are getting the deviceMotion accelerated data , and we used the accelerated z axis data ,with a threshold of 9.8 m/s^2. We are recording this location using watch-position and saved to database.

})

calculate Distance() :

R = 6371 km ,

$a = \sin^2(\Delta\varphi/2) + \cos \varphi 1 \cdot \cos \varphi 2 \cdot \sin^2(\Delta\lambda/2)$

$c = 2 \cdot \mathrm{atan2}(\sqrt{a}, \sqrt{(1-a)})$

Return d = R · c [17]

}

End

From fig 2. we get the results of a trip of a number of potholes we get on locations, we consider Aurangabad city as a case study to implement this.

The result of fig b: the first result with the number of pothole data with distance travelled in km and time when data is collected, this is automated device based process. When clicked on view button it will give us detail information about mapped bump locations on Google maps.

V. CONCLUSION & FUTURE SCOPE

Because of this paper, a mobile phone application (Road Surface Data Collector) for linear acceleration gathering, was produced. The application makes utilization of the Android (in the event of the Android gadget) Sensor structure with a specific end goal to access the magnetometer, gravity and linear accelerometer sensors. In view of the contribution from a magnetometer and a G-sensor, a change steps, that permits the cell phone telephone to be in any introduction amid information gathering, as portrayed and actualized. The application was utilized to gather gadget speeding up (acceleration) information on various streets in and around the city of Aurangabad for long portions.

As an auxiliary part, an algorithm for road checking surface quality detection algorithm was developed using all the aspect of a project. It executes regulated learning (supervised learning) techniques with a specific end goal to anticipate the nature of street sections based on future aspects.

In upcoming time, we can consider the speed factor for better change like now we settled the 30km/hr. + threshold endeavour to anticipate the awful street surface/pothole. In the following area, we additionally going to order the sorts of a road from the information we get amid the gathering utilizing distinctive machine learning techniques.

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