Rail defect diagnosis using smartphones and drones
by: Borna Tech.

Agenda

Introduction

Smartphone

Case Study

Analysis

Results

Future work

conclusion

Introduction

Condition monitoring of rail tracks is an important issue especially in terms of safety and maintenance. Most recent methods have been used for detecting track defects are either expensive or low in speed.

Safety

Life cycle

A good track maintenance scheduling not only provides the safety for railways but also increases tracks life cycle.

Smartphones

We had a research about developing an easy and low cost approach for detecting the defects may be identifiable with inexpensive equipment and actually do not need high accuracy equipment to be recognized.
We explore features of smartphones, as a low cost and easy to use device, and accuracy of its sensors on detecting anomalies.

Features of Smartphones

✓ Easy to use

The small size of smartphones, their sustainable computing power and their ability to send and recieve data changes them to a useful device.

✓ Low in cost

Due to their abilities, smartphones are almost an unexpensive device in compare with other similar devices.

✓ Available

Ubiquitous use of Smartphones in most societies make them an available device for every one in any condition.

Smartphones combine features of a cellphone such as ability of making calls and creating messages with mobile devices like personal digital assistants such as digital camera, GPS navigation and video games.
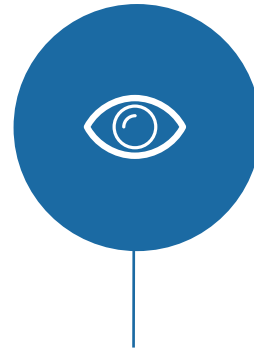Actually smartphones owe their abilities to the sensors embedded in them. These sensors are categorized to 3 types: Location Sensors,Ambient Sensor, Motion Sensor.
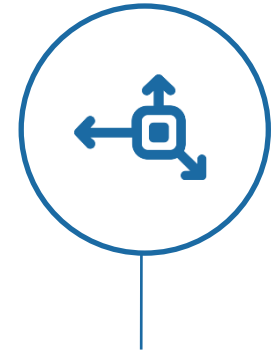
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Smartphone sensors categories

Location Sensors

GPS

Ambient Sensors

Microphone

Light sensor

Motion Sensors

Accelerometer

Gyroscope

Magnetometer

How did we work?

1

Applications

2 applications selected to collect GPS and accelerometer data on smartphones

2

Smartphones

Samsung Galaxy S6 edge and HTC One E8 used as devices for collecting data

3

Data collection

2 smartphones embedded in EM120 track recording car cabine.
GPS and acceleration data collected as the car moved

4

Analysis

EM120 data used as refrence data and data collected from smartphones compared with EM data to identify the relation between acceleration data and defects

Analysis

Acceleration data plotted on charts and as expected, significant peaks appeared in anomaly locations.
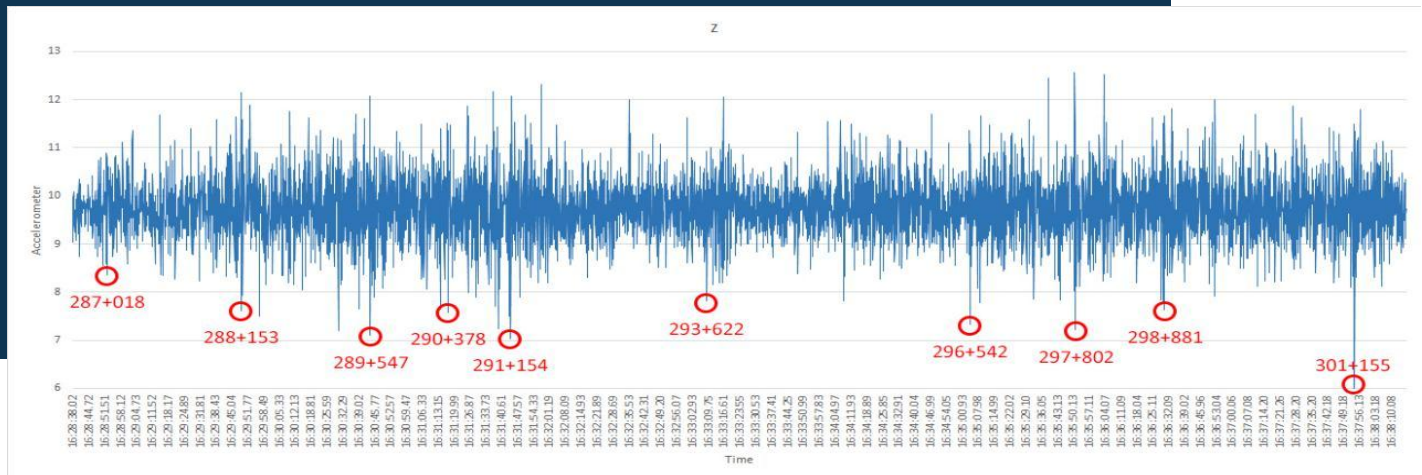
Example of acceleration data charts

Results

Results from analyzing acceleration signals collected from smartphones, show that track alignments result a significant vertical peak, so using peak detection algorithms could recognize the Track defects.

Future work
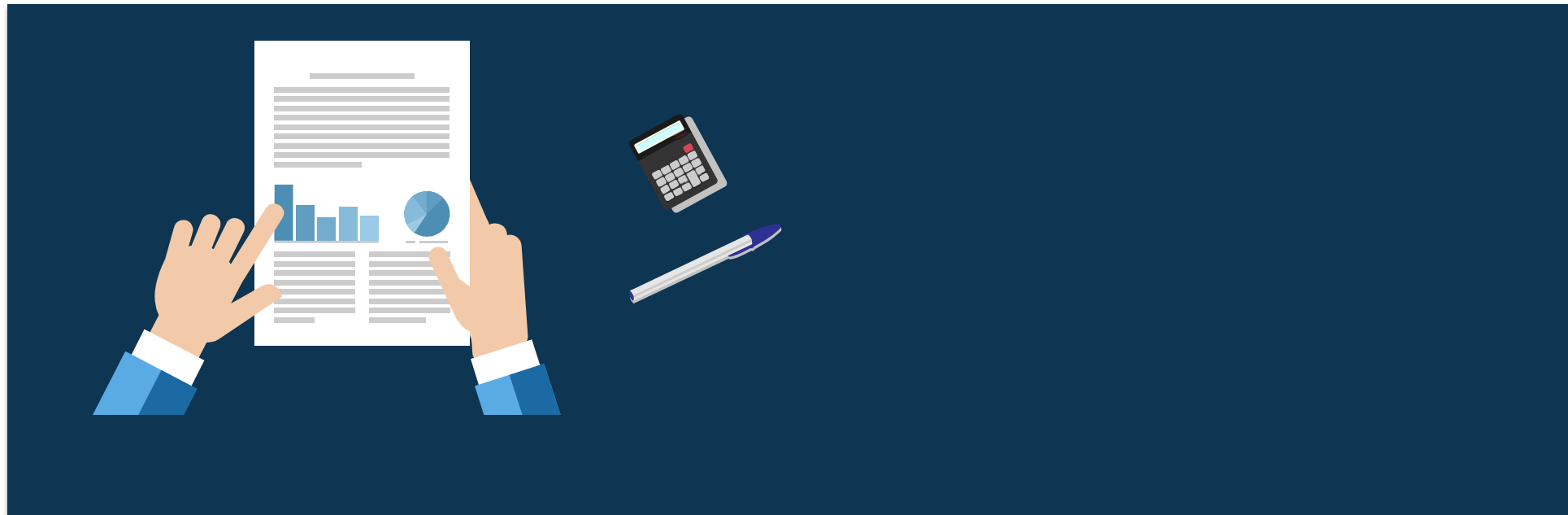
Smartphones features

Rail defects inspection is very important because of its efficent on safety and life cycle of railroads. The idea of using smartphones because of its features, introduced as a low cost, easy to use and available methode.

Using smartphones for track defect diagnosis

As we expected, smartphones have sufficant ability to diagnose some rail alignments using accelerometer sensor and GPS.

application

After proofing smartphones ability to defect some types of rail defects, the next step is to provide an application registring vibrations and locations of the defects and displaying the results on accessible formats.

sync smartphone and drones

The last stage of this idea is to sync smartphone with a drone moving above the vehicle so the visual inspection will be able.The vidoe camera on the drone will capture the rail track for data cheking and verification in case there is a need.

Application

Rail defects Recorder application!

Register defects

The application will be able to register vibrations of the vehicle. So the defects will be saved due to the algorithms given to the application.

Display defects type

This application will be categorize types of rail defects and their location.

Location of defects

Location of defects will be shown as the UTM (Universal transverse mercator) coordinates

Sync to other devices

The application will be able to sync to other devices for more inspections.

The last stage

What we need for the last stage:

Smartphones pre-installed with applications	Drone	GIS information from the railroad
As the application installed on smartphone, we will be able to sync it with other devices like a drone.	In this idea, we use drone to capture picturs from anomalies so we can use pictures for visual inspection or documentation of maintenance process.	GIS information will be used by drone to capture the exact location of the anomalies picture.

Methodology:

By using pre-installed smartphone, track defects and their locations would be registered by the application. The application will have the ability to be synced with drone so pictures of anomaly area could be captured and saved by drone camera. The pictures will be used for more detailed inspection and also documentation of maintenance operation process.

Conclusion

✓ By developing an application to detect,register and display the track alignments, we will be able to save lots of money and time and also increase the quality of maintenance process. Data will be easily collected and transfered to the computers to be used.

✓ The idea of using drones as a visual inspection method, will make a significant change in railroad maintenance scheduling due to its lower cost and higher speed. Visual inspection beside the recent methods will help to bring in more accuracy in railroad maintenance.
Using drone camera not only helps on a better visual inspection but also will help to document process of maintenance operation.

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