Report on Various Road Quality Predictor Projects

Approaches discussed

=>Sensor based detection using smartphone vibration data

=>Object detection using deep learning(YOLO)

=>Vision based detection using convolutional neural network

Sensor based Pothole Detection using CNN

Link :https://www.mdpi.com/1424-8220/23/22/9023#sensors-23-09023-f001

Objective : Detection of Road potholes by applying CNN method based on road vibration data.

Source : MDPI Paper

Date Published : 7November, 2023 => Even though it was published back in 2023 it used a revolutionary approach by using mobile sensors and using the readings as an input to CNN.

Achievements

1) The main differentiating factor of this approach was that it didn't rely on the dashcam of cars which is not common till this day in India.
2) Smartphones were used as the primary device which has much larger penetration in India.
3)Extra cost for the dashcam was eliminated.
4)Commendable accuracy of 93.24%. In field study generated an accuracy of 80% to 87%.

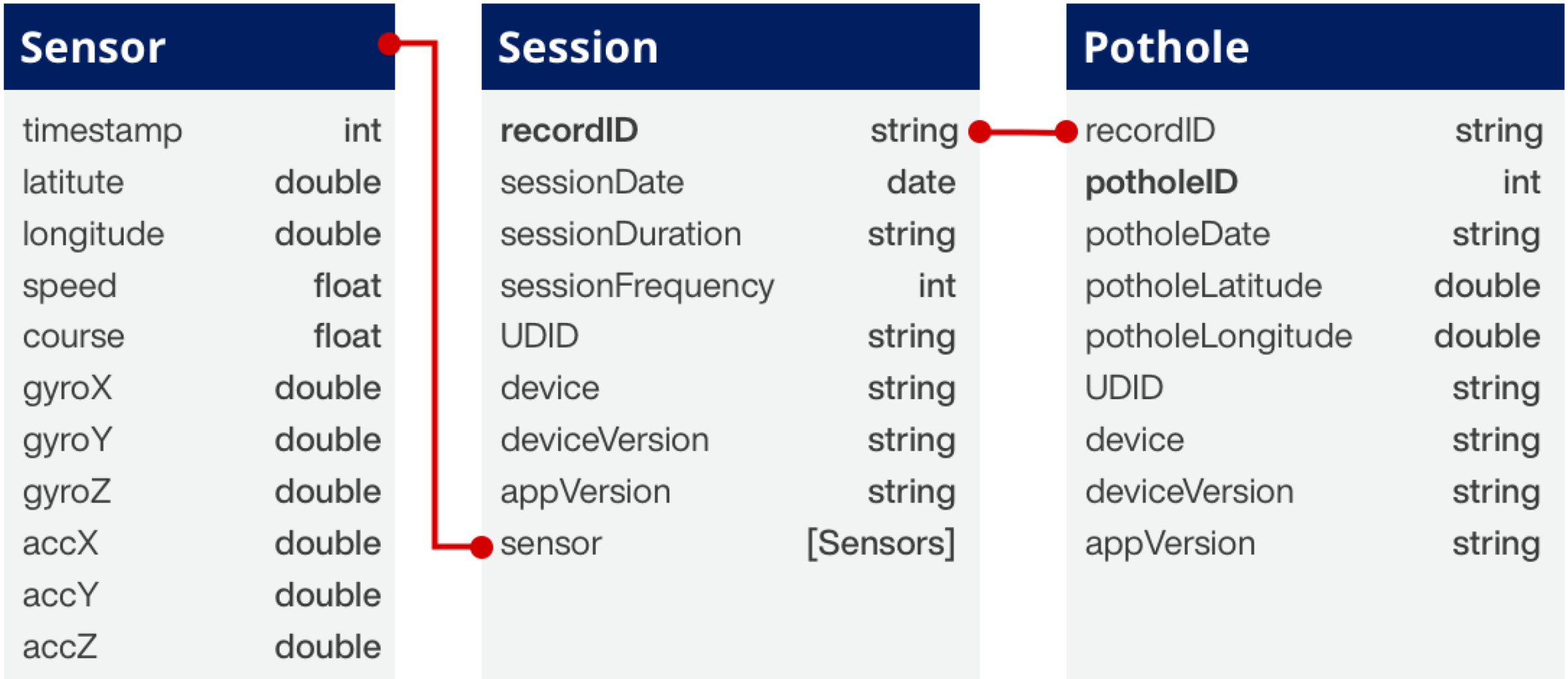
Dataset Preparation

1)For the dataset collection the motion sensors like accelerometer ,gyroscope and many others were used.

2)Detection is based on the road vibration data exceeding a predefined threshold value indicating surface irregularities(Dynamic threshold was used).

3)The vibration data from these sensors were continuously recorded ,all data were stored in a local database within the mobile device .For this purpose the "Realm database" (data directly on the phone and is fast for frequent writes) was used.

4)In the created database ,three tables of name sensor , pothole and session were designed to store road vibration data obtained from sensors.

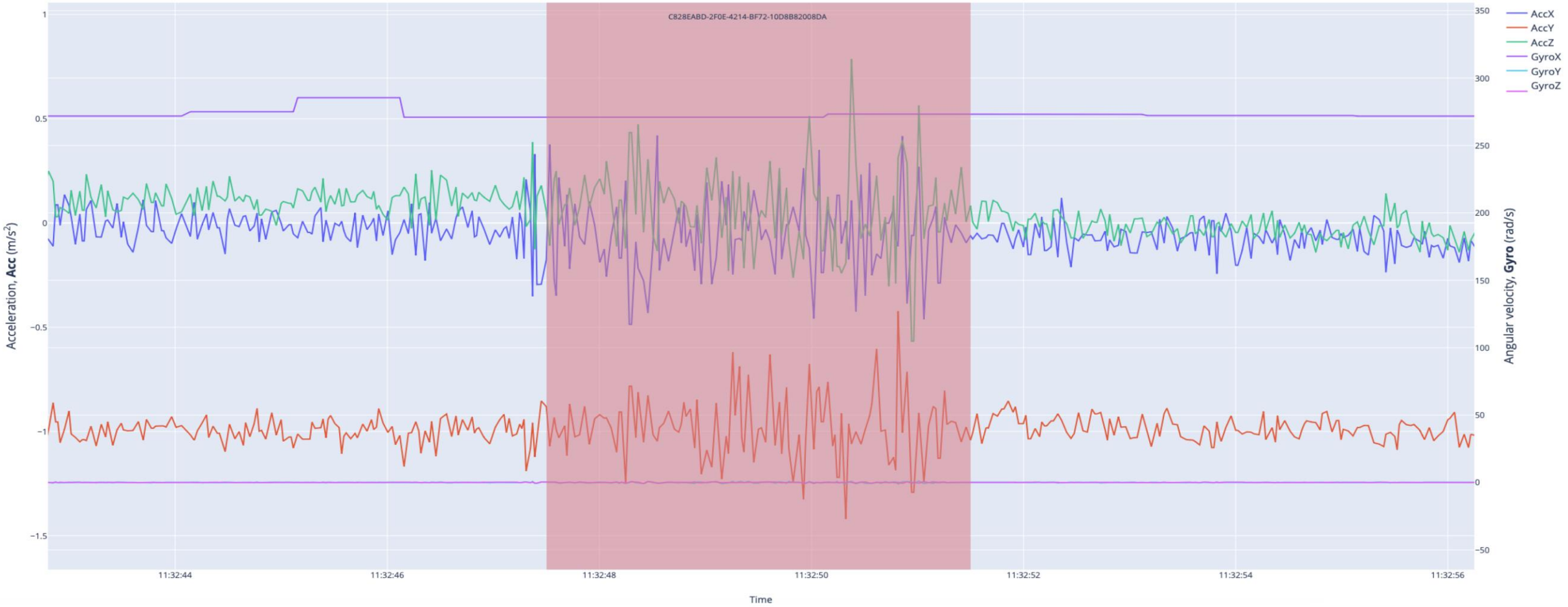

Sensor
timestamp int
latitute double
longitude double
speed float
course float
gyroX double
gyroY double
gyroZ double
accX double
accY double
accZ double
Session
recordID string
sessionDate date
sessionDuration string
sessionFrequency int
UDID string
device string
deviceVersion string
appVersion string
sensor [Sensors]
Pothole
recordID string
potholeID int
potholeDate string
potholeLatitude double
potholeLongitude double
UDID string
device string
deviceVersion string
appVersion string

5)During the data acquisition and model testing, the environmental conditions remained consistent: a dry day, on a dry asphalt road, and a maximum vehicle speed of 50 km/h, with the same driver. Both the training and testing of the CNN model were conducted under these environmental conditions.

Data Preparation

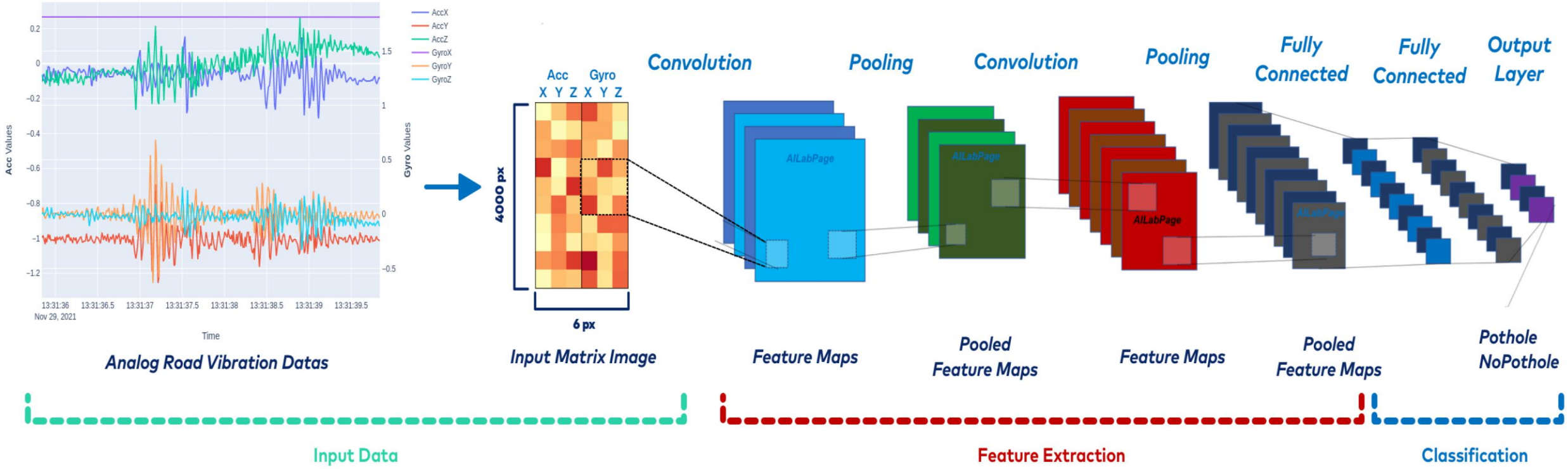
1)Google Colab was chosen due to its advantages in organizing and processing data in deep learning.

2)The road vibration data include attributes such as Timestamp, Latitude, Longitude, Acceleration (Acc(xyz)), and Angular Velocity (Gyro(xyz)), while the pothole data include attributes such as ‘PotholeID’, ‘PotholeLatitude’, and ‘PotholeLongitude’.



Road vibration data (acceleration Acc(xyz) and angular velocity Gyro(xyz) signals) and pothole region (red area).

Training and Validating of Convolutional Neural Network Model



Road vibration data were transformed into an input visual matrix for the CNN model

Different models with varying numbers of layers and parameter values were developed to detect road potholes using a CNN-based approach