Android Pothole Detection System Using Deep Learning

Pranav Prashant Kulkarni[1], Ketan Mandar Kulkarni[2], Vivek Rajkumar Nimbalkar[3], Prof S.P Jadhav[4]
[1,2,3]*Student, Dept. of Information Technology Sinhgad College of Engineering Vadgaon Bk, Pune, Maharashtra, India.*
[4]*Professor, Dept. of Information Technology Sinhgad College of Engineering Vadgaon Bk, Pune, Maharashtra, India.*

***Abstract*—This abstract discusses the challenges of maintaining road networks despite recent advancements in transportation technology. Potholes and other road defects are a common problem that can lead to accidents, traffic congestion, and expensive repairs. To address this issue, a proposed android pothole detection system that utilizes smartphone sensors and machine learning algorithms is introduced. The system can detect potholes using a smartphone camera and distinguish them from other road irregularities. It can also store and analyze data on road conditions, enabling authorities to prioritize maintenance and repairs. The proposed solution aims to crowdsource information from users and send it to relevant authorities using an Android application. The success of this solution depends on several factors, including the accuracy of the Deep Learning model, the quality of user-provided information, and the responsiveness of relevant authorities. The proposed android pothole detection system can offer several benefits, including reducing road accidents, lowering repair costs, and minimizing traffic congestion. Overall, utilizing technology for android pothole detection has the potential to revolutionize road maintenance and safety, providing safer and more efficient means of travel for everyone.**

***Index Terms*—android, crowdsource, Deep Learning, machine learning algorithms, pothole detection system, road maintenance, road safety, smartphone sensors.**

I. INTRODUCTION

Recent technological advancements have greatly improved transportation systems through the use of GPS and sensors in vehicles and on roads, as well as the potential development of autonomous vehicles. Despite these advancements, the maintenance and upkeep of road networks remain a significant challenge, especially in high traffic areas. Road defects such as potholes and cracks can lead to accidents, traffic congestion, and costly repairs if left unaddressed. The implementation of a pothole detection system can help mitigate these issues by detecting and reporting road defects in real-time. Such a system can also provide authorities with data on the frequency and severity of road defects, enabling them to prioritize repairs and allocate resources efficiently. Ultimately, the development of a pothole detection system is crucial for promoting safe and efficient transportation for everyone, by leveraging technology to address road defects effectively.

II. BACKGROUND

Road networks play a critical role in connecting communities and promoting economic growth. However, with regular use and various other factors, potholes and other road defects can arise, creating safety hazards and inconvenience for commuters. While traditional methods of pothole detection can be inaccurate and time-consuming, incorporating technology such as sensors and machine learning algorithms can provide real-time and precise information on the location and severity of potholes. An android-based pothole detection system that employs smartphone sensors and machine learning algorithms has the potential to revolutionize road maintenance and safety. The proposed system will use GPS sensors in smartphones to identify potholes and differentiate them from other road irregularities. Additionally, the system will be linked with a backend database that can store and analyze data on road conditions, allowing authorities to prioritize maintenance and repairs. This android pothole detection system can offer numerous benefits, including reducing road accidents, lowering repair costs, and minimizing traffic congestion. Its development has the potential to transform the transportation industry, providing safer and more efficient travel options for everyone.

III. LITERATURE SURVEY

- Report titled (2020) -A modern pothole detection technique using deep learning.

The utilization of inferior quality materials in the road drainage system in India has resulted in early road damage and the formation of potholes, making it difficult to detect and prevent accidents. As per the Ministry of Road Transport and Highways transport research wing's report, India witnesses around 4,64,910 accidents every year. To address this issue, a deep learning-based model that leverages images and videos to detect potholes early and minimize the probability of accidents has been proposed in this paper. The proposed model utilizes Transfer Learning, Faster Region-based Convolutional Neural Network (F-RCNN), and Inception-V2. While there are several pothole detection models that employ machine learning techniques with accelerometers, there are relatively few that depend solely on machine learning techniques utilizing images and videos for pothole detection. The findings of this research indicate that the proposed model outperforms other existing techniques for pothole detection.

Issue - The model's performance is significantly impacted when it is exposed to natural phenomena such as rainfall or snowfall.

Author - Abhishek kumar

- Report titled (2017) - An Early Warning System for Traffic and Road Safety Hazards Using Collaborative Crowd Sourcing

With an increase in the number of vehicles on roads, the road maintenance department is faced with the challenge of addressing the rising demand for timely repairs. It has become crucial to adopt a comprehensive approach to detect various road construction issues such as potholes, bumps, corrugations, waves, and defective street cuts. However, the absence of an improved real-time traffic alerts system makes efficiently maintaining city roads a daunting task. Hence, there is an urgent need for a more effective monitoring system that can identify and resolve road infrastructure issues. This study presents an analytical model of a system that can detect pavement deformities. The system utilizes a mobile application that utilizes the built-in accelerometer in smartphones to capture the accelerometer profile and pinpoint the location of pavement deformities. Additionally, the system considers the variations in accelerometer values in relation to the vehicle speed.

Issue - Merely relying on an accelerometer does not ensure accurate results, and this approach is ineffective when a person is not riding a vehicle.

Author - Pooja P.R & Balaji Hariharan

- Report titled (2021) -Deep Learning Approach to Detect Potholes in Real-Time using Smartphone.

The identification and prompt mapping of potholes play a critical role in preventing road accidents. At present, identifying damages on roadways requires a manual and labor-intensive process. This study proposes a system that combines deep learning algorithms and smartphone technology to detect potholes in real-time. The system involves a smartphone application that traces all potholes along the user's route. Simultaneously, the Single Shot Multi-box Detector (SSD), a deep learning object detection algorithm, operates in the background, utilizing the mobile camera to recognize potholes. Whenever an unrecognized pothole is detected by SSD, the coordinates are instantly updated in the database. Additionally, a Deep Feed Forward Neural Network model continuously examines accelerometer and gyroscope readings to detect unregistered potholes. The dual mechanism of camera-based and accelerometer-gyroscope based detection not only confirms detections but also delivers stable results even if one mechanism malfunctions. The pothole coordinates are shown on the map user interface within the same application. With a navigation feature as the front end and a two-pronged deep learning pothole detection algorithm as the back end, this system is an effective and economical solution for detecting potholes in real-time.

Issue - It is unnecessary to determine the area of individual potholes since there are often numerous potholes on a road, and this is an insufficient parameter. Contracts are typically issued to repair the entire road to address this issue.

Author - Shubham Kokate , Uday more

IV. METHODOLOGY

Our proposed solution seeks to tackle persistent road problems by harnessing the power of crowdsourcing. We plan to gather information from individuals who encounter these issues through an Android application and relay it to the relevant authorities. To accomplish this, we will employ a Deep Learning model that can identify potholes, gather data from users, and transmit it to the authorities. The diagram below outlines the stages involved in implementing this solution.

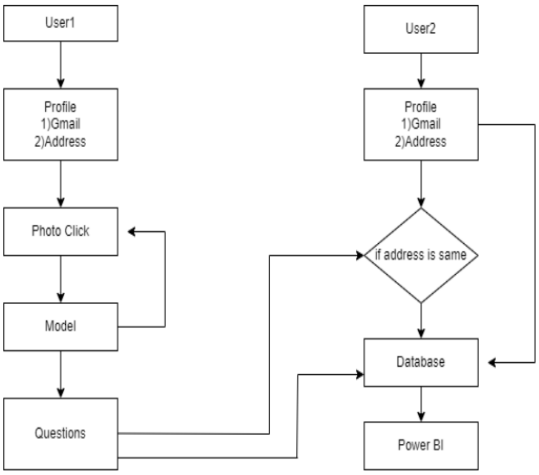

Fig 1.

Our proposed solution involves a multi-step process where User 1 uploads an image to detect a pothole. After detecting the pothole, User 1 is prompted with quick questions about the issue. Then, User 2 from the same neighborhood is asked about the challenges they have faced due to the pothole problem, along with others. All information collected is stored in a database and sent to the relevant authorities for analysis. This solution has the potential to enhance road maintenance and safety, reducing accidents and minimizing traffic congestion.

However, the Android pothole detection system may face various constraints, such as hardware limitations, battery life, data availability, network connectivity, privacy, security, cost, and legal compliance. Moreover, to ensure effectiveness, certain parameters, including geolocation, user feedback, database management, communication protocols, security, and user engagement, must be incorporated into the system.

The success of this solution depends on the Deep Learning model's accuracy, the quality of user-provided information, the responsiveness of relevant authorities, and user engagement. Therefore, appropriate parameters must be implemented to manage these factors and ensure the solution's effectiveness. Successful implementation can have a significant impact on frequent road users by improving road safety.

V. RESULTS & OUTPUT

To obtain accurate results for our research, we collected data from Android users, which was then stored in a Firebase database. This approach enabled us to gather a significant amount of data and analyze it effectively.

To train our model, we utilized various programming tools such as Python, TensorFlow, Keras, and other relevant libraries. These tools provided us with the necessary resources to develop an efficient and accurate deep learning model. The combination of data collection and advanced programming tools allowed us to create a robust system capable of detecting potholes and providing relevant information to authorities, ultimately enhancing road safety and improving the commuting experience for drivers and passengers alike.

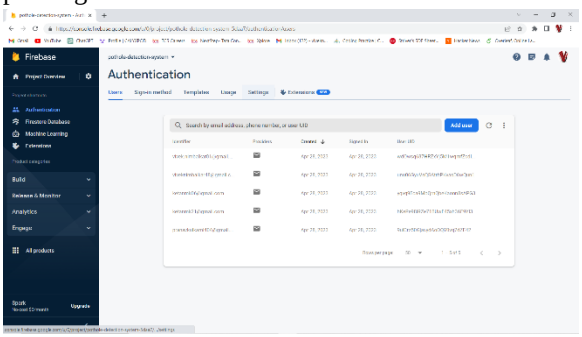

Fig 2:- Authenticated Users.

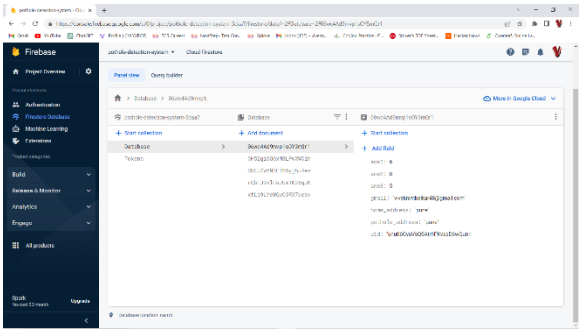

Fig 3:- Database.

Fig 4:- Registration Page

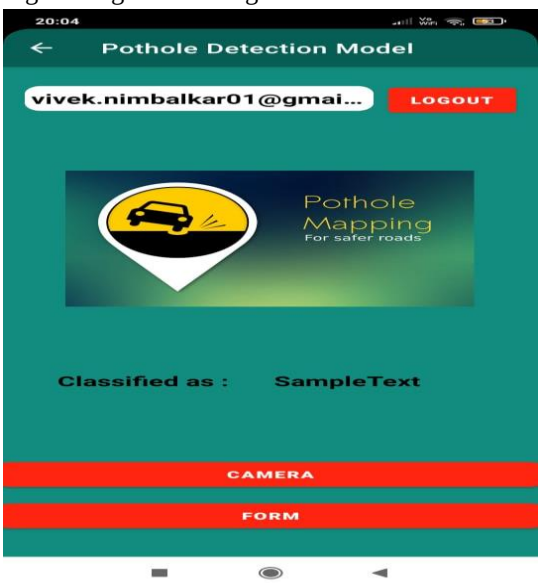

Fig 5:- Pothole Detection Model

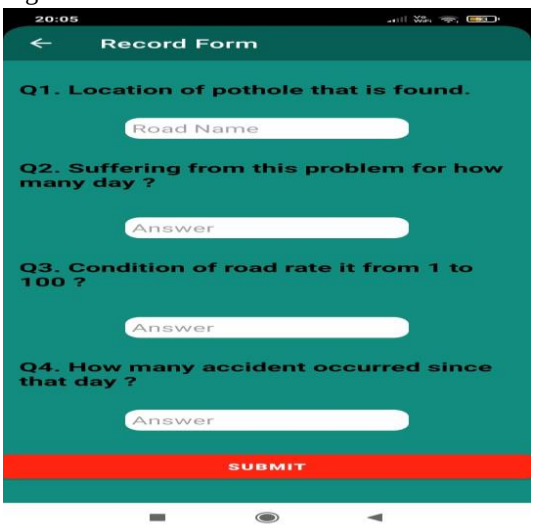

Fig 6:- Record Form

VI. CONCLUSION

Detecting potholes on roads is essential to ensure human safety and minimize vehicle damage. However, pothole detection presents many challenges due to varying sizes of potholes, diverse road construction materials, different traffic conditions, and changing weather scenarios. To address this issue, our research collected 1300 pothole images to test various object detection models. Our proposed architecture employs a smartphone camera to capture pothole images and provide authorities with sufficient information to take action with priority. This approach not only provides drivers and commuters with safe driving advisories but also addresses local issues that may arise.

Potholes on roads can cause significant damage to vehicles, leading to costly repairs and even accidents. Detecting potholes early and reporting them to authorities is crucial for maintaining road safety and preventing further damage. The proposed solution using object detection models and smartphone cameras can provide a cost-effective and efficient way to detect and report potholes to relevant authorities, enabling timely repairs and minimizing the risks associated with potholes. This approach has the potential to improve road infrastructure and enhance the commuting experience for people using the roads frequently.

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