



Real Time Pothole Detection with Deep Learning and Arduino

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ABSTRACT

For the transportation of goods and people, roads are crucial in our daily lives. So, in order to prevent large or minor road accidents, we must exercise extreme caution when engaging in any activity that could damage the roadways. The creation of potholes on the roads is one of the primary causes of these collisions. After the water has sunk into the ground beneath the footway, it causes these potholes by expanding and contracting. A real-time based system for identifying road damage is needed to prevent such incidents. Our project proposal outlines how to create a real-time pothole detecting system to prevent similar mishaps in the future.

Keywords:- Accident, Potholes, Machine Learning, Arduino, Kaggle CNN

1.OBJECTIVE

Objective of the program is to make the roads safe and smoother to drive.

2.INTRODUCTION

Road transportation is one of the most affordable and popular modes of transportation, both for passengers and for cargo. It is essential for our nation's social cohesion and economic growth as well. With a 4.5% proportion of India's GDP in 2005–2006, road transport has established a commanding position in the country's transport industry. In our nation, the road transport sector can convey around 87% of all passengers and 64% of all cargo. As the use of roads for transportation increases, so do road accidents. Numerous factors, such as a direct collision between two vehicles or deteriorated road conditions, might cause an accident. In our nation, poor road conditions were to blame for 67% of traffic accidents. In India, every single road and highway has a large or medium-sized pothole. These potholes may potentially result in tragic traffic collisions and life losses. To prevent this kind of catastrophe, the government has put road maintenance on a regular timetable and repaired potholes. However, there is a dearth of research pertaining to real-time pothole recognition and sending the caution message to the oncoming car to alert them that can be accessed online. In this document, we'll talk about a real-time pothole detecting system and show how it works to warn approaching drivers so that they may drive their cars safely.



DEADLY POTHOLES OF THE COUNTRY

ROAD ACCIDENT DEATHS MORE THAN FATALITIES CAUSED BY TERRORIST ATTACKS IN INDIA

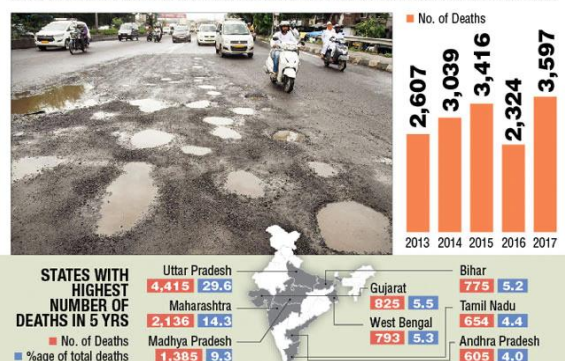
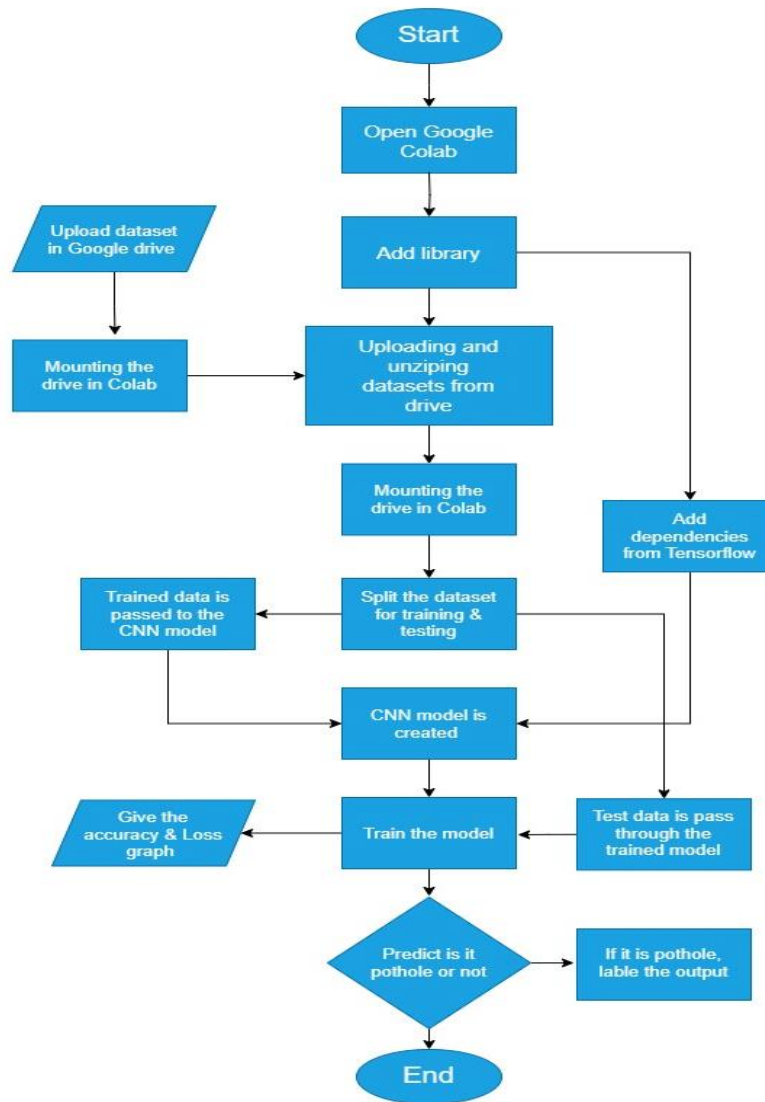


Figure 1: Potholes and accident statistics in India

3.EXPERIMENT

In this work, a dataset has been adapted for experimental work. This dataset consists of two different image sets i.e., normal roads and potholes. All the images of the dataset have been labelled. We have taken a dataset from Kaggle and trained the dataset using Python Machine learning. The dataset contains 352 normal road images and 329 pothole images. Then it is passed through a CNN model and calculate the accuracy and loss of our model. 3 dense layer of neurons are used and in those layers activation function "relu" is applied, we can also use sigmoid or softmax activation function. And for calculating the loss, binary-crossentropy function and "adam" optimizer is use to optimize the loss. We can also use the catagorical-crossentropy loss function. And then a prediction function is built to see how our model is predicting whether it is a pothole or not.

4.FLOW-CHART



5.DESRIPTION OF MODEL

Software Required: Google Colab, TensorFlow (Software library), Arduino IDE.

Hardware Required: We used Arduino uno and ESP32 Cam Module for capturing images.

Arduino: Arduino is an open-source electronics platform based on easy-to-use hardware and software. Arduino boards can read inputs - light on a sensor, a finger on a button, or a Twitter message - and turn it into an output - activating a motor, turning on an LED, publishing something online. You can tell your board what to do by sending a set of instructions to the microcontroller on the board. To do so you use the Arduino programming language (based on Wiring), and the Arduino Software (IDE), based on Processing.

ESP32 Cam: The ESP32-CAM is a small-sized, low-power camera module based on **ESP32**. It comes with an **OV2640 camera** and provides an onboard TF card slot. This board has **4MB PSRAM** which is used for buffering images from the camera into video streaming or other tasks and allows you to use higher quality in your pictures without crashing the ESP32. It also comes with an onboard LED for flash and several GPIOs to connect peripherals.

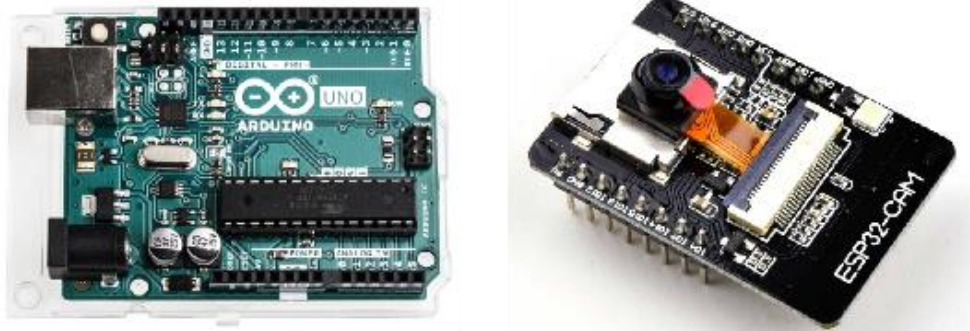


Fig 2: Arduino board and ESP32-CAM

Model Prototype: The figure, given below, is our prototype hardware model where we used Esp32 cam and TTL Serial converter instead of Arduino uno.

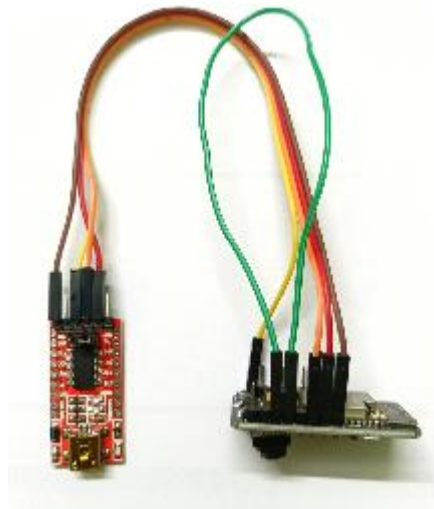


Fig 3: TTL serial converter and ESP32-CAM

Procedure: In this experiment we use deep learning model and developed a code to detect and classify pothole successfully. For that we use a previously created dataset and pass those through CNN layers for training our model.

In the below flowchart, there is a brief description about how our system will work.



Fig 4: Procedure of the experiment

7. Advantages and future scope

The system that is being proposed makes use of inexpensive, broadly deployable sensors. By collecting a lot of data on potholes and speed bumps, this project will enable the creation of density maps for the analysis of poorly built roads, which will further assist government organizations like BMC or commuters in avoiding a particularly bad patch of poor road with the aid of density maps of potholes on the servers. The sensors' shortcomings include a shorter range, lower precision, and a lack of direct analysis like image processing methods. The use of cameras or laser technology can improve the data collection's accuracy. We can also create an alarm system that can see potholes from a distance and alert the driver to slow down.

8. Conclusion

We discussed about potholes in this document, including their size, shape, and danger when they endanger the safety of the road. We have also discussed our approach for real-time pothole recognition and warning oncoming drivers in order to avert traffic accidents.

Our aim is to provide a better place for human to live by saving them from accidents happen on the roads. Our fast pothole detection system will be a massive insertion in road safely as it will detect potholes on the road and subsequently give output. Real-time pothole detection will be a key asset for our daily travelling life as most of the Indian roads are damped and not maintained properly.

9. References

- [1] YachaoYuan , Md. Saiful Islam , Yali Yuan , Shengjin Wang , Senior Member, IEEE, Thar Baker , Member, IEEE, and Lutz Maria Kolbe EcRD: Edge-Cloud Computing Framework for Smart Road Damage Detection and Warning IEEE INTERNET OF THINGS JOURNAL, VOL. 8, NO. 16, AUGUST 15, 2021
- [2] Aditya Anand¹, Rushiraj Gawande, Prathamesh Jadhav, Rima Shahapurkar, Anjali Devi, and NikhilKumar, INTELLIGENT VEHICLE SPEED CONTROLLING AND POTHOLE DETECTION SYSTEM , E3S Web of Conferences 170, 0 (2020)
- [3] Joseph S. 2017 ROLE OF ULTRASONIC SENSOR IN AUTOMATIC POTHOLE AND HUMP DETECTION SYSTEM, International Journal of Scientific & Engineering Research 8 260-265
- [4] pothole and object detection with respect to the speed of a vehicle using sensors in Arduino UNO board May2021,7(3)Sayan Ghosh, Abhishek Singha, SanchariMajumdar, Shweta Kumari, SubhrakantiSamanta,IJ IJARIIIT, Paper ID: V7I3-1369 (v7i3- 1470) ISSN: 2454-132X
- [5] M. Colin, F. Palhol, and A. Leuxe, "Adaptation of transport infrastructures and networks to climate change," Transp. Res. Procedia, vol. 14, pp. 86–95, Jan. 2016.
- [6] K. Gopalakrishnan, "Deep learning in data-driven pavement image analysis and automated distress detection: A review," Data, vol. 3,no.3,p.28,2018