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Vehicle Related Prevention Techniques: Pothole/Speedbreaker Detection and Antitheft System

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Abstract - *Pits are the most dangerous road conditions that prevent the safe, secure and reliable movement of people, goods and services. Roadblocks such as potholes affect the safety and comfort of many road users and passengers. Bad road network hinders the flow of goods and services and contributes to poor growth and economic development while good roads provide access to markets and facilitate the rapid and smooth movement of goods and services from manufacturers to consumers. Early detection and maintenance of pits helps to create a more efficient and reliable road network that facilitates the movement of people, goods and services. Transportation plays a major part in our daily lives. Every year, people are increasingly using a car, especially a two-wheeled motorcycle for their standard mode of transportation. Increasing motorcycle users, motorcycle theft is also rampant during the year. This paper contains a report of various pits and speed breaker recovery strategies for theft prevention strategies.*

Key Words: Street pothole, Speed breaker, machine learning, GSM, Theft prevention system, Micro-controller, yolov4.

1.INTRODUCTION

Traffic jams and accidents are mainly caused by poor road conditions. The most common form of stress on such roads is potholes, which can put safety at risk, and cause car crashes. Rehabilitating roads in common areas will ensure the safety of drivers and help to reduce vehicle damage. There are many methods available for digging holes using advanced machines and algorithms. Due to large data counts such processes are slow and time consuming. The world is developing in an independent environment at a fast pace and it has been an hour's need, especially in this current epidemic. The epidemic has disrupted the work of many sectors, one of which is road development and road maintenance. Creating a safe working environment for workers is a major concern for road maintenance during these difficult times. This can be achieved to some extent with the help of an independent system that aims to reduce human dependence. Today car theft rates are very high worldwide and the situation is worse in developing lands.

Therefore, the protection of vehicles with a smart, reliable, efficient and economical system is very important. Existing car safety technologies have many limitations which include a high level of false alarm, easy operation and high cost.

This paper looks at various algorithms and techniques for machine learning, in-depth learning, computer-assisted detection methods used for finding potholes and speed breakers as well as scaring drivers. Section 5 looks at how different anti-theft methods are used. Finally, Section 6 concludes our study by presenting many interesting results..

2. LITERATURE SURVEY

2.1 Real Time Pothole Detection Using Android Smartphones with Accelerometers:

The algorithm requires the determination of the position of the Z axis in the same way as in the previous method. [1] After analyzing the related work, the authors decided to use other techniques used to process the post. One of the strategies, which seemed promising to be used on the device-enclosed device, used a standard deviation of the vertical axis acceleration. The following is the use of visual data analysis tools and search for specific data patterns authors find that there are specific events that are characterized by certain measurement tuples. All three axis data in this tuple had values close to 0. Strong analysis of these data sets led to the first two conclusions: a) copies of such data can be obtained when the vehicle is temporarily crashed for free, for example, entering or exiting. pit; b) such tuple data can be analyzed without knowledge of the Z-axis position of the accelerometer. [2] The supervised machine learning algorithm usually requires a significant amount of data with a training label. Labeled data should introduce different types and characteristics of the defect, so that trained algorithms can be made more general to detect similar errors. In contrast, an unregulated machine learning algorithm does not require prior knowledge about errors. An unattended machine learning algorithm does not require prior knowledge. Based on the disability characteristics contained in the database, the algorithm can automatically categorize it into a predefined number of categories.

An unsupervised machine learning k-means algorithm was adopted, as this is one of the most well-developed and widely accessible clustering algorithms.

2.2 A Modern Pothole Detection Technique using Deep Learning:

The system will identify the pothole location and upload the same to the map (shown in the android app developed by us) [3] so that other users without a camera installed in their car can access the pothole monitoring using the app only. In this program, they have used CNN's popular and sophisticated structures such as Inception v1 (GoogLeNet), v2 implementation and finally selected v2 implementation in our system data test, the system shows excellent results. Setting up a portable computer and camera in the car. Based on region. Real-time detection of holes using the system in video-captured videos. Matching captured data with real street data. TensorFlow Object Obtaining API is a powerful tool that can quickly allow anyone to build and uninstall powerful image recognition systems. Provides many pre-trained models (trained in different databases) that can be used to build custom separators / detector / detector after fine adjustment. Selected model called "F-RCNN inception v2". Transfer Learning applies the acquired knowledge while solving one problem and applying it to a different but related problem.

2.3 An Anti-Theft System for Two Wheelers:

In this Paper, [4] the safety of all and all is an important part and the safety of two wheels or a bicycle is one of the most important components. We designed the safety of a two-wheeled microcontroller ESP8266, with a built-in Arduino board with a built-in Wi-Fi module. This Wi-Fi module can be accessed via an HTML webpage or Android app from a mobile device. This web page or Android app controls two-wheel arches, headlights and two-wheel drive indicators.
We use GSM and GPS technology. Two-Wheeler position is detected by a GPS module and this data is provided by a microcontroller hardware that sends messages to users' cell phones using the GSM module.

The owner of the system notification via SMS to the user whenever he tries to steal, which allows the user to control the car remotely via SMS and provides the inability to move the engine and alarm. Computer systems are designed to prevent theft of cars and fuel. Regarding attempted theft, the owner is alerted via SMS allowing the user to control the system remotely. The proposed project uses the Global Positioning system (GPS) and the Global mobile communication system (GSM). The system constantly monitors the GPS vehicle and sends the data on demand. In an attempt to steal, we have to send an SMS to the controller, and then the microcontroller pulls out the control signals to stop the engine. Then we have to reset the password and restart the car. To start two wheels, we have to open a web page or android app. Now, the owner should check the Wi-Fi connection, and when it is turned on press Open on the web page to re-ignite it Instead of Switching the two wheels with the key.

3. PROPOSED METHODOLOGY

The system only needs a smartphone and no other external hardware. The user puts the smartphone in a the owner of the cellphone stops in his car and opens the cell phone application. The app is simple and easy to use which will guide the user about using the app and provide feedback as well. Once you start scanning in real time it will ask permission to start the camera. After granting the required permissions, the camera will continue to operate and scan to detect potholes and speedbreaker in real time. The app works in offline mode so no internet connection is required and can work anywhere in your area.

To obtain the largest amount of training data was collected, covering approximately 2,26,000 images. This database was used to train various models such as YOLOv4, YOLOv5, EfficientDet, Resnet50. Whenever a traffic disturbance is detected, the user receives an audio notification indicating which obstacle is in front of the driver. Road crashes include 5 different stages that go like successive cracks, lateral crack, alligator crack, pothole and speed breaker.

The anti-theft program is integrated into the vehicle. It contains a switch that the user must start every time the car is kept in good condition [11]. If someone tries to steal or disturb a car, the system will start to make a loud noise until the switch is turned off. So to prevent the car from being stolen.

In summary, the app's front end will contain all the app details and the first recording option. The backend algorithm tries to detect the roadblock and alert the user.

4. METHODOLOGY AND IMPLEMENTATION OF POTHOLE AND SPEEDBREAKER DETECTION

The proposed pothole-based and speedbreaker method using the transfer learning method finds holes in videos / pictures in real time. The method uses common techniques such as "YOLOV4", "RESNET", "YOLOV5" described below. The main advantage of this method is the short training time with a simple training process and high accuracy.

4.1 Camera Based Pothole Detection

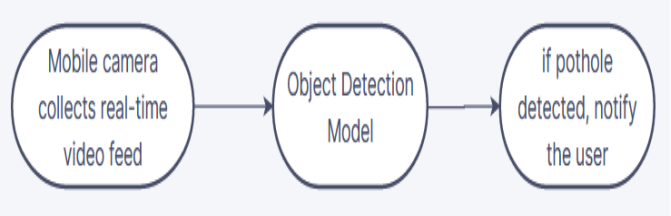

Fig.1 Flow of Camera-Based System

The continuous video server is taken from the camera running behind the android app and is split into photo frames. These images are transmitted as input to a trained object detection model, which detects that the image contains a pothole or other obstacle. When a pothole is detected the user is alerted by a sound that means the same.

4.2 Real-Time image acquisition:

The android app uses the smartphone camera in the background series. Camera feeds collected by the camera are divided into multiple photo frames and these images are transmitted to a professional object acquisition model: RESNET. The mobile app does not even need an internet connection and as a result is very likely. It is a model used in the mobile app.

4.3 YOLOV4:

YOLOv4 is a one-stop model for getting something advanced in YOLOv3 with a few bags of tricks and modules presented in the textbooks. The section section below describes the strategies and modules used. YOLOv4: Proper Speed and Accuracy of Object Detection. [7] YOLOv4 was built based on the latest research findings, using CSPDarknet53 as Backbone, SPP (Spatial pyramid pooling) and PAN (Path Aggregation Network) in the so-called "Neck", as well as the YOLOv3 " Head ".

4.4 YOLOV5:

YOLOv5 is a family of integrated scale acquisition model trained in COCO databases, and includes the simple operation of Test Time Augmentation (TTA), model integration, hyperparameter appearance, and export to ONNX, CoreML and TFLite. [8]

4.5 EFFICIENTDET:

EfficientDet is a type of object acquisition model, which uses several enhancements and spinal adjustments, such as the use of BiFPN, and an integrated measurement method that measures equally adjustment, depth and width of all lines, embedded networks and box / class predictions. networks at the same time.

4.6 RESNET:

The residual neural network (ResNet) is a virtual neural network (ANN). Remaining neural networks use skipping connections, or shortcuts to skip other layers. Typical ResNet models are used in excess of two or three layers containing non-linear content (ReLU) and standardized mass in between. [9]

In addition, TensorFlow Lite was used to reverse this the model has become a lightweight model in which it can be integrated Android apps for real-time discovery. Tensorflow lite with quanitzed and floating versions, both used in the app both have almost identical behavior.

4.7 Dataset and Annotations:

To train the RESNET model, a data set was created by to photograph more than 20000 Pothole images and speedbreaker. There are also some pictures with no holes and a speedbreaker so marking without restrictions. The holes in the images are defined using LabelImg which generates an XML file for each image. In addition, details of all images and XML files are converted to CSV format and later to TensorFlow RECORD format.

4.8 Data Preprocessing:

We have a pothole database that includes more than 20000 images. Each database contains two different sets, one was considered simple and the other is very complex which was separated from training and testing. The task of locating the pits is much easier if only the region in the road-containing images is cut off and used for visual purposes but it takes longer to capture 20000 images. We label all photos. In the task, we create a CSV file containing the name of the images, the path, the image. The first column in the annotation file contains an image format. The second a column contains the number of holes in that image and 4 consecutive columns show links of holes in the image. Image size is 3680 × 2760.

4.9 Training:

The training was performed on Google Colaboratory, a cloud service with a robust GPU for accelerating training speed.

Google Colaboratory specifications:

- 1xSingle core Hyperthreaded Xeon Processors @2.3Ghz i.e.(1 core, 2 threads)
- RAM: ~12 GB
- GPU: GeForce RTX 2060 having 2496 CUDA cores, 12GB GDDR5 VRAM.

4.10 Detection of pothole in image/video:

After processing the data, we created a video / pothole detection system so that the driver could receive an early warning about a pothole. In the program, we used 4 types of models. So all the trained models in the 5 classes mentioned above. After training, the testing process is done and some additional code is written to take video and find holes in the video and image (we actually need “holes in the videos”). System testing shows good performance but can be continuously improved. Section 4.10 shows the output of all models and 4.11 compares the same accuracy, showing the

result in the testing process. The output depicts the images from various algorithms thus giving different and unique output.

4.10 Output from Various Algorithms:

The model was trained in various algorithms such as YOLOV4 and its various versions, YOLOV5 and its various versions, EfficientDet, ResNet. Trained with photos, videos and real-time. The following output images show the object detection, type of block and its accuracy.

4.10.1 YOLOV4:

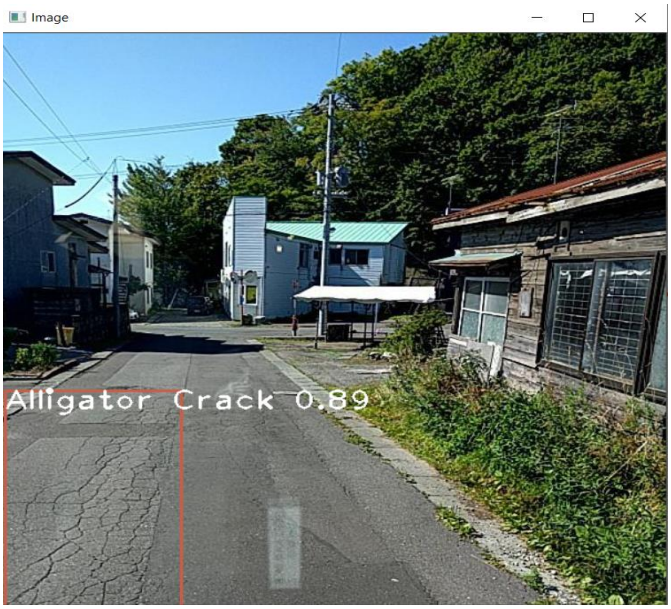

Fig 2. Alligator crack detected by custom trained YOLOV4

4.10.2 EFFICIENTDET:

Fig3. Pothole detected by custom trained EfficientDet

4.10.3 YOLOV5:

Fig4. Pothole detected by custom trained YOLOV5

4.10.4 RESNET:

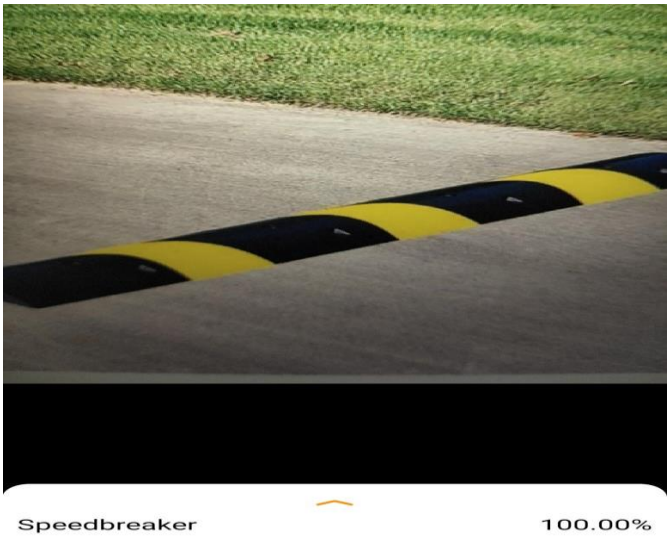

Fig5. SpeedBreaker detected by custom trained RESNET

4.11 Comparison:

Table -1: Comparison of all models implemented

Model	Accuracy (%)
Yolov4	87.6
Yolov5	91.4
EfficientDet	96.9
ResNet	86.9

5. METHODOLOGY AND IMPLEMENTATION OF THEFT PREVENTION SYSTEM

The Anti-theft alarm system works with the help of sensors installed inside and near the car. The impact or movement inside the car activates the sensors. This then activates the Anti-theft Alarm and the alarm sounds. The alarm sounds and alerts the owner.

5.1 Block Diagram:

A diagram of a two-wheeled safety system block is shown in fig. Contains Arduino-Nano, Buzzer, Vibration Sensor, As Arduino-Nano requires 5V supply to run Arduino-Nano, from the car battery. As well as the provision of 5V to operate the buzzer module and the 3.3V vibration sensor SW-420. [12]

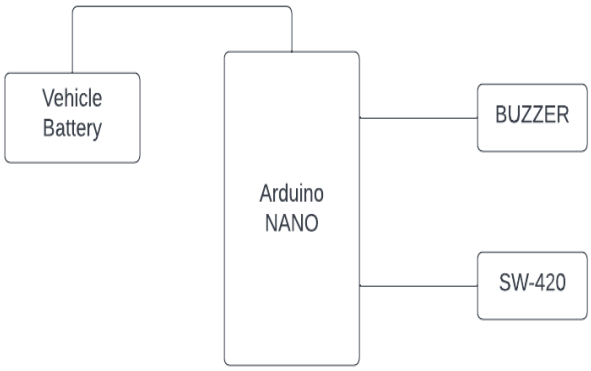

Fig6. Block Diagram of Two wheeler security System

5.2 Hardware Implementation:

The hardware works as if the used module is connected to the car and there is a Switch To Use Module, and the module is connected to the Car battery. In the use of Hardware we mainly focus on following the Section.

5.2.1 Arduino-Nano:

The Arduino Nano is a single type of microcontroller board, and is designed by Arduino.cc. It can be built with a microcontroller like ATmega328. this Nano board is different from the packaging. It does not have a DC jack so power supply is provided using a small USB port otherwise connected directly to pins such as VCC & GND. This board can be supplied with 6 to 20volts using a small USB port on the board. The ATmega328P microcontroller comes from an 8-bit AVR family, the Operating Voltage is 5V and the input voltage is 7V to 12. and there are 22 input / output pins, 14 digital pins. The 3.3V is the small voltage generated by the electrical controller on board.

Fig7. Arduino-Nano

5.2.2 Vibration Sensor (SW420):

V-sensor-based sensor module SW-420 and Comparator LM393 are used to detect vibrations. The threshold can be adjusted using an on-board potentiometer. During non-vibration, the sensor provides Logic Low and when vibration is detected, the sensor provides Logic High. VCC PIN Enables Module, Typically +5V, Power Supply Ground (GND), Digital Output PIN (DO). Operating Voltage is 3.3V to 5V DC, Operating Current is 15mA, SW-420 is usually closed with vibration type sensor, LEDs display power and power and is a design based on LM393.

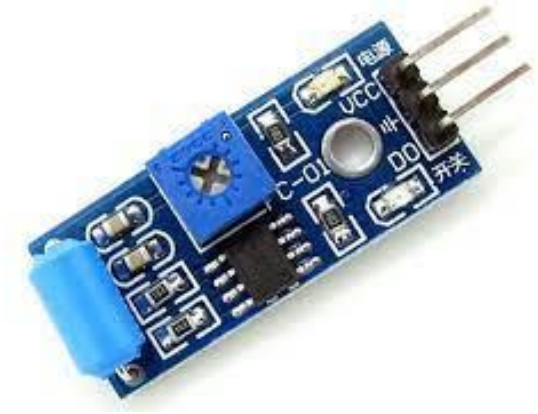

Fig8. Vibration Sensor(SW420)

5.2.3 Buzzer Module:

There are two pins in the Buzzer Module. One is positive and the other negative. Good is indicated by (+) or long term lead. Can be powered by 6V DC. And a negative (-) indicated with a short term lead lead is usually connected at the bottom of the circuit. Its rated voltage is 6V DC, Operating Voltage is 4-8V DC, Rated Current is less than 30mA, has continuous vibration noise, its frequent frequency is 2300Hz.

Fig9. Buzzer Module

5.3 SOFTWARE IMPLEMENTATION:

Arduino-nano, which will be edited with Arduino software. Arduino board is designed in such a way that it uses microprocessors and controls of various types, these boards with digital I / O pins and analogs are used to communicate with other circuits [14]. Arduino Board has Universal Serial Bus & visual interface; these are used to load programs from other computers. Microcontrollers are usually configured using a range of features from programming languages C and C ++. The Arduino project provides an integrated development environment (IDE) based on the Processing Language project using a standard set of integration tools.

5.4 CIRCUIT DIAGRAM:

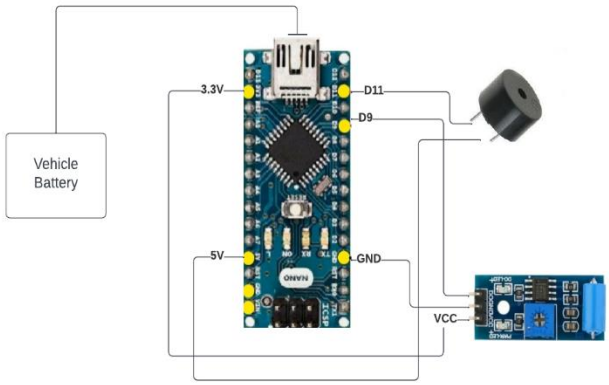

Fig10. Circuit diagram of anti theft system

6. Conclusion:

In this paper, we have proposed a real-time pothole detection system for camera / video footage and to provide the driver with information about potholes in the front of the vehicle. In addition, our system will detect the location of the pothole and upload the same to the map (however this is our future job) so that other users who do not have a camera installed in their car can be aware of the pothole using the app only. In this program, we used the popular and sophisticated RESNET in our system. In test data, the system shows excellent results. Our future activities include system development tests and simplification of common / regular use (Read more in the next activity section).With the advent of anti-theft strategies, compile components and outcomes, this project concludes that Motorcycle Risk Protection and Rehabilitation Program is a very effective and efficient way to prevent motorcycle theft. The alarm system feature is very useful for stealing motorcycles.

7. Acknowledgement:

We would like to thank all those people who assisted us in successfully completing the “Street Pothole and Speed breakerdetect with Theft Prevention Techniques”. I would like to thank **Prof. Kishor T. Patil & Prof. Dipti V. Chandran of Smt. Indira Gandhi College of Engineering**, with this guide. Learning a lot from this also encouraged me and strengthened my confidence in my thesis. We would like to express our deepest gratitude for his valuable suggestions and continued encouragement which has greatly helped the presenting work successfully. Throughout the introductory work, his helpful suggestions, constant encouragement gave us the right direction and context for my learning. If we can say it in words, we should at the beginning of my relationship to receive loving care from Smt. Indira Gandhi College of Engineering for providing such a state of imitation and a good working environment.

8. Future Work:

Our system successfully detects potholes in videos / photos but there are still some tasks to be done. That is our future work on mining. We will try some of the best CNN architecture as the latest versions of the launch(start v3 and ResNet introduction) to improve speed and accuracy. Additionally, a GPS system should be developed to improve the location of the holes in the map for all users. In the near future, we will create a GPS-enabled system and the android app (with GPS and google-enabled maps) with which we will update the pothole location on the map when a user finds it on the street for other users to find. location of pits prematurely without detection.

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