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Detection of Potholes on Road Using Drone

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ABSTRACT
Potholes on road can generate costly damage to flat tire or can cause wheel damage of vehicle. Especially in India vehicle collision and major accidents happens due to immense depth of pothole on road. Thus, detecting and repairing of potholes on road is major challenge. In order to ensure safe transportation, we have designed a prototype for potholes detection. This paper aims to develop a technology that detects abnormality on the road using Unmanned Aerial Vehicles (UAVs). This information will be stored and updated continuously on a web server using the concept of Internet of Things (IoT). Such critical road quality information can be made public or shared with local authorities and government bodies for corrective action and maintenance of road.

Keywords
Potholes, Unmanned Aerial Vehicles, Internet of Things, Web Servers, Roads.

1.INTRODUCTION

Development of the country depends on the population, industrialization and infrastructure. Road conditions are the main concern for development of the infrastructure, Aged and poorly maintained roads degrade the quality road as well as the development, which increases the need for inspection and good maintenance of the roads, Unseen Potholes, Speed breakers, are one of the main reasons of accident, According to the Road Accident Report of India, 2021, there were 3625 deaths because of Potholes.

Roads are an essential means of transportation, It carries a major percentage of passenger traffic of any country, It is known that most of the roads in developing countries would be congested and narrow resulting in poor surface quality and the maintenance of the roads is not satisfactory, Due to poor maintenance, poor surface quality or due to a variety of other reasons a pothole could be formed on roads, A pothole is a kind of disruption in the surface of a road in which a portion of the road material is damaged, In rainy seasons, if these potholes are covered by water, it might lead to accidents which might be fatal too, It gets difficult to track all the potholes by the concerned authorities, The aim of this paper is to develop a "Pothole Detection System", which assists the concerned authorities to find and fix the potholes, A manually controlled or automatic drone will be equipped with the Pothole detection system which uses technologies such as Machine Learning and Computer vision to identify the potholes on roads, In today's day and age Unmanned Aerial Vehicles (UAVs), also called drones have a wide variety of applications, They are used for military purposes, they can be used to predict the crop quality, they are being used in photography to capture stunning pictures and videos of landscapes, Also, in the recent times various large organizations are trying to deliver goods through drones, The utility of drones is boundless, its applications can be seen in every industry and vertical, Artificial intelligence also has a wide variety of applications in various fields such as finance, automotive, marketing, health care and etc, Almost every organization today has adopted AI in one way or the other, In this work, an effort is being made to identify the potholes and report them to the relevant authorities which can help them take action, The project uses a camera as a sensor to scan the roads and detect potholes,

To reduce the damage and loss of lives, many traffic system equipment's are invented and studied which contains laser detections, smart traffic control, RADAR, Ultrasonic Sensors and many more. Unmanned Aerial Vehicle (UAV) most likely called as Drones can be used to modernize the Road Safety Methods and hence improve the infrastructure of the country.

A model of pothole detection is constructed using the image library, which is used in an algorithmic approach that combines a road color model with simple image processing techniques such as a Canny filter and contour detection. Using this approach, it is possible to detect potholes with a higher percentage of precision.

This paper focuses on detection and identification on potholes, humps and speed breakers which on detection feed the information to the system whose access can be given to the road civil engineering department. Use of this automation system can be a boon to solve our day-to-day problems and make commute safer and smoother

2.METHODOLOGY

This real-world image is captured and sent to the computer using wireless communication (Wi-Fi). This captured image undergoes grey scaling in image processing where it is scaled and externals factors are filtered out to make it easier for the machine to detect potholes. Python can be used for scaling which later undergoes blurring and morphology, helping to detect the edge of the roads. This method is used to detect potholes and on the road. This data is then saved in server, to help drivers access and get information about the road conditions for the way they have selected. This data can also be sent to the civil department to notify them and help them to understand the exact situations of the roads and repair it on time-to-time basis

A manually or an automatically controlled drone will be equipped with the Pothole detection system.

It uses a 'Camera' as sensor to scan the road for any potholes.

The camera then captures the images / video in real time.
The system uses technologies such as Deep Learning to achieve the results.
It then maps the detected pothole on a map application.

3.BLOCK DIAGRAM

- Transmission Section

Transmission section is nothing but portable device as UAV with camera and Wi-Fi module for transmitting data.

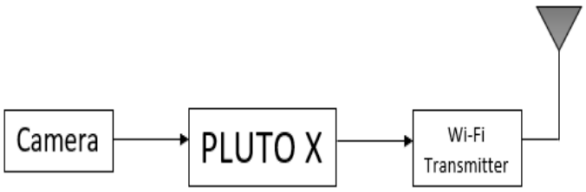

Fig 1:- Transmission Section

- Reception Section

Reception section includes a PC where the image is processed and abnormalities are detected which is then uploaded on the server.

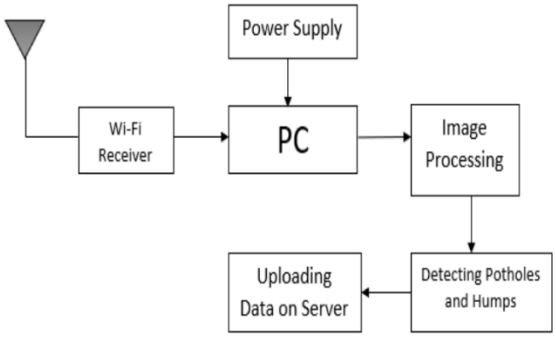

Fig 2:- Reception Section

Pluto X:

UAVs are commonly used where there is a risk of sending human piloted aircrafts, or the situation makes going of human pilot impractical. In modern times, drones are gaining popularity in day-to-day applications, which we have also considered while designing this prototype. Pluto X is one of the most advanced and practical drones which can be used in many applications, having a net weight of 60 grams, makes it portable and has high-definition camera integrated. This is the only stand-alone hardware used because it is smart and designed to perform multi-tasks. It also has 4 inbuild sensors, namely Accelerometer, Barometer, Gyro sensor and Magnetometer, which helps to drone to maintain its stability and gain information faster and smoother. Inbuild Wi-Fi module, ESP12F, makes it easier to send data to the computer wirelessly. This transfer is fast and designed such that it is pre-processed to remove the air filters and get a clear image.

Fig 3:- Pluto X

Technical specifications:

- Processor: STM32F303: 72Mhz
- Sensor suite: 10 DOF
- Weight with battery: 60 g
- Max Range: 60 m
- Propulsion: Brushed
- Photo Format: JPEG
- Photo Resolution: 72ppi
- Video Resolution: 1280p x 720p
- Camera Sensor: CMOS Storage:
- Phone Internal Storage/SD Card Storage

Software Components used:

The model is trained with YOLOv5 algorithm to even detect potholes filled with water, and distinguish potholes from dark road patches, and etc.
The results show good accuracy of 85% in detecting the potholes with a low false-negative and false-positive rate.
In this model first we had to upload the image/ video in the code to get the desired output.
So, for the improvement and to make it usable we connected our model to a live camera to get a real time detection of the potholes.
The system flow is as follows: When the system starts, the camera is switched on and real time detection of potholes using Yolo V5 algorithm takes place.
The images are extracted from live video and processed in order to detect potholes.
The detected potholes are displayed in bounding boxes and as a result real-time potholes detection is achieved

4.RESULT

Pictures of potholes were taken by the UAV as shown below, and were send to the PC through wireless communication using ESP12F module, pre integrated in Pluto X.

Fig 4: -Camera image of pothole

Image after detection:

Fig: -5 Detection of pothole

5.APPLICATIONS

It is believed that a pothole detection and mapping system is essential to not only to prevent road- based accidents but to also maintain better quality of roads within our country which contributes to a faster development. It is believed that a pothole detector and mapping system will help save lives, make a road user experience more enjoyable while also making it easier for governments to maintain the most crucial transportation system in the country. The system accurately detects potholes on a road through imaging and creates an open-source map-based database of potholes on the road that is updated in real time. It also provides real time pothole information to the government and general public through the open-source map which enable the government to maintain and fix potholes faster. The system developed has an accuracy of 85% and also has a low rate of false-positives and false-negatives.

6.CONCLUSION

Potholes are dangerous hurdles on the road and it should be eradicated as soon as possible. The current system includes the use of manual detection by people who are willing to contribute for the betterment of the road. Thus, it is important that manual labor approach is kept to a minimum and switched to an automatic approach instead.

The system is used to detect the potholes through an aerial view which then later processed through a software, aids the authority about the abnormality so that they can take the required steps immediately.

The system dynamically detects potholes in real time without damaging the cars used for hurdle detections. Thus, making the system more feasible, favorable, adaptable and less expensive and complex.

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