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# Implementation of Potholes Detection System Using Nanodrone and Image Processing

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**Abstract:- Aging, poor maintenance and increased in the number of vehicles has linearly increased the number of potholes and humps on the roads. In order to ensure safe transportation, we have designed a prototype for potholes and humps 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, Humps, Unmanned Aerial Vehicles, Internet Of Things, Web Servers, Roads.*

## I. 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, Humps are one of the main reasons of road accidents. According to the Road Accident Report of India, 2017, there were 3597 deaths because of Potholes and around 3248 because of Humps on roads.[13]

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.

## II. PROBLEM STATEMENT

Abnormality in the roads has caused many mishaps, leading to cost of lives which becomes a huddle to commute safely on roads. The abnormality can occur because of varied different reasons. Ground water, aging of roads, improper maintenance of roads on regular basis, friction because of vehicles leading to cracks on roads are some of the reasons.

Potholes, Humps, Speed-Breakers has a huge economic impact and hurdles for daily commute. Few approaches have been made to these hurdles including throw-and-go method, In-Car Artificial Intelligence (AI), use of Microwaves and Magnets, etc. Now a days, studies of highly automatic detection is widely used in many regions. Identification of potholes is not enough but repairing it can help the commute to be smoother. Automatic systems not only help in reducing human efforts but also helps to save time, also, it is more efficient.[9,6]

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.

## III. PROBLEM STATEMENT

Using Black-Box Camera, a new pothole-detection system using a commercial black-box camera. The proposed system detects potholes over a wide area and at low cost. Where they have developed a novel pothole-detection algorithm specifically designed to work with the embedded computing environments of black-box cameras. A pothole-detection algorithm is installed on an embedded board in the black-box camera. This algorithm collects information regarding the size of potholes and their location, and this information is stored in the black box and then transmitted to a pothole-management server.[2]

Another automatic pothole detection system which uses laser technology. The proposed system captures the geographical location coordinates of the potholes and humps. It can actively learn the knowledge about the suspension system of the host vehicle without any human intervention vibration model to infer the presence of pothole while the vehicle is hitting the pothole. To ensure the use of laser technology, they have used raspberry pi for software-based control over the system.[3]

Drones are used to detect potholes over the roads using Real Time Dense Stereo Embedded System. The major drawback for this proposed paper was, it was expensive, Manual visual inspection can increase human errors, time consuming and also dangerous for humans to fly such heavy drones with such high tech and heavy components.[4]

Images of the roads were acquired by Unmanned Aerial Vehicle (UAV) and four popular supervised learning algorithms (KNN, SVM, ANN, RF) were used to distinguish between the normal pavement and pavement damages (i.e. cracks and potholes). Each of learning algorithms was given a series of different parameters, and the classification accuracy and computational time as two assessment criteria of the algorithm performance were calculated.[5]

## IV. PROPOSED METHODOLOGY

Detecting real world images using UAV, Pluto X, which can be used to get real time data and images from a definite height without actually bumping through the potholes or humps. The camera is pre mounted on the Pluto X drone, whose output is clear and communicated through the ESP12F Wi-Fi module integrated in the Embedded board which acts as a control processing unit for the UAV.

This real-world image is not only captured but is 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 and humps. 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 humps 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.

## V. NETWORK ARCHITECTURE

➢ *Transmission Section*

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

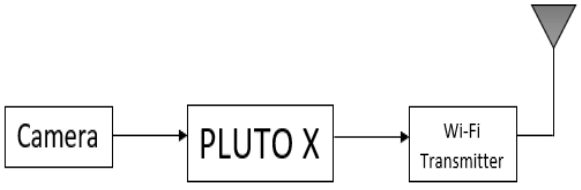


Fig 1:- Transmission Section

➢ *Reception Section*

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

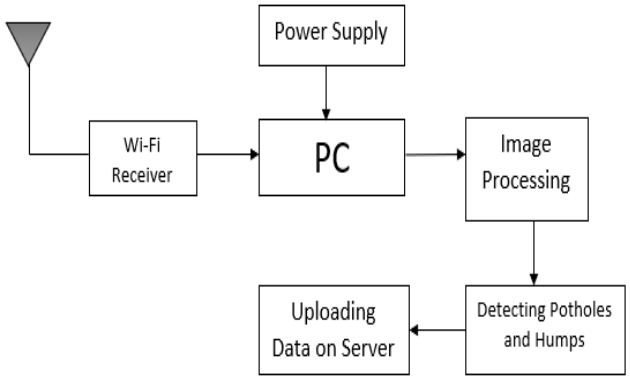


Fig 2:- Reception Section

## VI. COMPONENTS USED

❖ *Hardware Components used;*

➢ *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.

❖ *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

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Fig 3:- Pluto X

❖ *Software Components used*

➢ *Python*

Python is a general purpose, interpreted programming language majorly used for web development, software development, mathematical calculations and such complex operations. It's a popular programming language owing to its easy syntax as well as large scale user community support, since it is open source.

Python has a robust standard library, which allows to undertake various development, analysis and production tasks without writing the actual code. With immense support from python libraries, calculations, analysis, etc. are carried out smoothly.

OpenCV -Python is a Python library designed to solve computer vision problems. OpenCV-Python makes use of NumPy, which is a highly optimized library for numerical operations with a MATLAB-Style Syntax. Computer reads image data as arrays and hence for processing and manipulating images. NumPy converts data into array structures and these array structures are used for computer vision.

## VII. OBSERVATION

Pictures of potholes and humps 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 road

On receiving the images they are greyscale and number of potholes are detected using canny filter and prewitt filter as shown in the result.

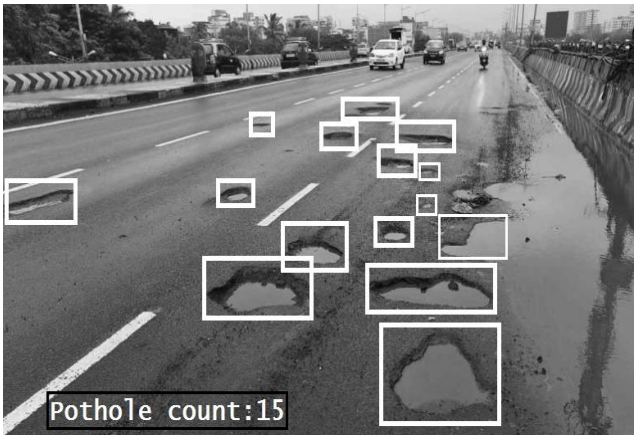


Fig 5:- Detection of Potholes

## VIII. RESULTS

No. of potholes are detected and displayed on the monitor as shown. This data is then uploaded on ThingSpeak- IoT based web server for plotting graphical presentation of it. This is useful to detect and identify the number of potholes per unit length of road (100m).

An observation specimen was also recorded pre and post monsoon. This corelates number of potholes before and after rainy season.

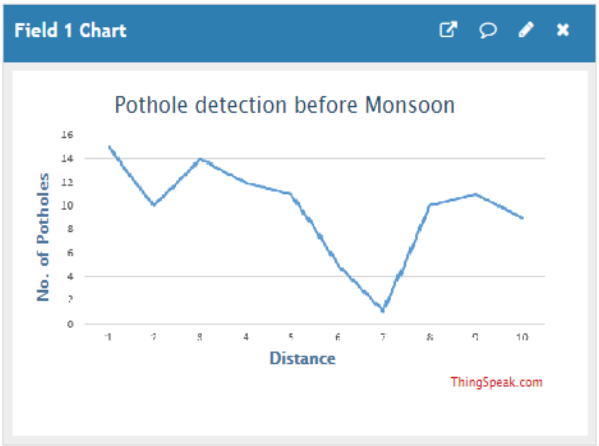


Fig 6:- Pothole detection before Monsoon

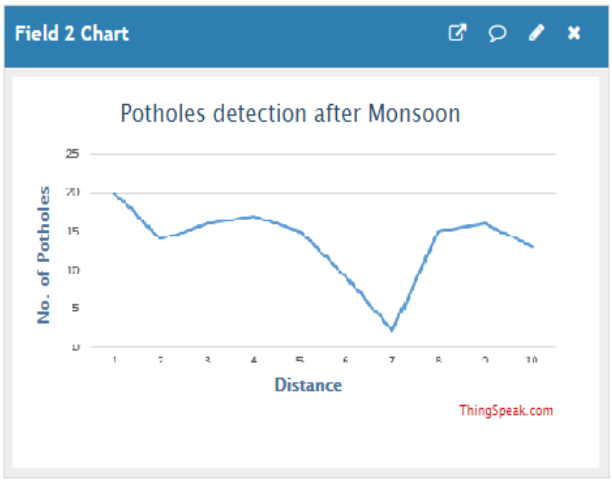


Fig 7:- Potholes detection after Monsoon

This information can be made public or provided to the government authorities for precise pothole location and swift repairment of roads.

## IX. CONCLUSION

Potholes and humps 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.

Hence it can be concluded that the number of potholes before monsoon is less than the number of potholes after monsoon.

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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