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AUTOMATIC POTHOLE DETECTION IN ROAD SURFACE AND REGISTERING COMPLAINT BY USING IOT

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Abstract - *Pothole is one of the important cause for road damage. Due to climatic changes and road usage, roads get damaged. The main aim of our project is to reduce road accidents. Previously the potholes are classified as positive and negative obstacles. In this project, the potholes are classified as dangered and undangered by separating it into small and larger potholes. The collected pothole pictures of the road were pre-processed, the pothole detection convolution neural network classification model was established, and the model was simulated and trained using MATLAB. Here Internet Of Things (IOT) based system is proposed to identify potholes. Using Deep Learning technique it detects the pothole and update the location which correspondingly finds accurate time and location. It reduces physical complaint and updates information to the Roadway Department.*

Key Words: **IOT, Hardware, MATLAB**

1.INTRODUCTION

Pothole have been the major problem in developing countries for several years. Early detection and maintenance of potholes help to create a conducive and reliable road network that facilitates the smooth movement of people, goods and services. Potholes varies in size, shape and depth. Road surface with many potholes affects both the safety and comfort of the road users. Although people face many issues while travelling over a pothole, registering a complaint is never been a matter of concern for them due to time consumption. Various efforts have been taken for developing a technology which can automatically detect and recognize potholes, that may help to improve in efficiency of the survey and pavement quality through prior investigation and quick action. We are implementing an automatic pothole detection system which classifies the potholes using the deep learning technique. The algorithm detects the pothole and automatically registers the complaint in the Department of Roadways. The main objective of our project lies in detecting potholes on roads and maintaining a database of the co-ordinates of such places. These coordinates are then shared with the roadway department to take further actions. All these are achieved through image processing and IOT.

2. RELATED WORK

In Pothole detection, the potholes are only detected and analysed. These papers provide positive and negative obstacle detection Some of the works are mentioned below

Hasith karunasekara and Han Wang[1] used stereo information combined result with saliency to initialize the energy function and use color information to optimize the result for the detection of such holes and potholes.

Youfa Cai; Xing Fu; Yanna Shang; Jing Xinshi [8] used computer vision technology to improve the efficiency of crack detection in bridges this crack measurement system is Integrated mainly with high magnification image acquisition system. The proposed algorithm doess not requires any parameters for detecting road.

Vaishnavi Kinderley, Chaitali Malode and Janvi Bhojwani proposed [3]a system that consist of ultrasonic sensors, GSM and GPS module controlled by the processor. Ultrasonic sensors are used to measure the depth of pothole in addition to identifying them. The geographical location i.e.[3] the coordinates of potholes using a global positioning system can be obtained. This information includes of all the details regarding the depth, width and location of the pothole which is sent to municipal corporation with the help of GSM module. The Municipal Corporation further uses this information for maintaining a record.

Yaqi Li; Ciris Tos Capachriscou; Daniel Weyer [4] proposed a stereo vision system which detects potholes during driving. This system contains two USB cameras taking photos simultaneously. All the points below the road surface region can be detected as pothole region. The length and depth of each pothole can be obtained.

Supratik Kumar Saha; Rishav Bhatt; Aditya Kavankar [11] outlines the different pothole detection methods that at present exists and their methods and their limitations for the maintenance of roads and streets.

S. Jothi, S. Priyanka, P. Yuvaraj and S. Kalaivani [7]proposed a system that detects the pothole and humps on the road and reduces the speed of the vehicle and prevents accident and vehicle damage. Our vehicle contains the database server & the database server collect the information about the pothole and humps and the information are passing to government authorities through the TCP protocol.

Dhwani Desai, Abhishek Soni, Dhruv Panchal and Sachin [5] developed an Automatic Pothole Detection and Alert System is developed using ultrasonic sensor, accelerometer, stereo camera and Global Positioning System (GPS) integrated with Raspberry Pi. The system identifies the pothole and alerts the rider and then generates location database of the existing potholes.

3. PROPOSED SYSTEM

The proposed system of this project with the development of intelligent identification terminal technology, the digital image processing technology has been applied in structural security monitoring. The intelligent terminal recognition technology realizes real-time monitoring of roads, how to process and analyze the information of intelligent terminals, and evolves them into security early warning signals. Here image is captured into frames by video processing and the captured image is preprocessed so that the dangered Pothole is identified and segmented. After segmenting the pothole, the latitutude and longitude of the pothole with the exact time and date is updated in the webpage of the Roadway Department. This data sharing is done using IOT device where the data of the detected pothole is transmitted to the TTL board and the Location to the webpage Roadway. The main aim of this project is to monitor each and every potholes and detects the dangered pothole in road based on image processing and updating to the webpage via IOT to the Roadway department. The main advantage of our proposed system i.e. it is less time consuming, takes action immediately and reduces traffic. The architecture diagram is shown below

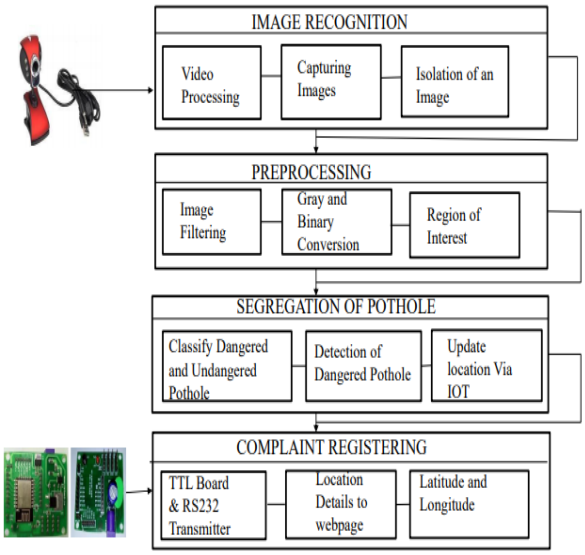

Fig -1: Architecture Diagram

4. IMPLEMENTATION MODULES

4.1 Segregation of Pothole using Image Processing

A camera is placed in front of the vehicle to captures the images. The captured image from the real time is sent to a MATLAB which is running on a server through Wi-Fi or cellular 4G/5G. In the MATLAB, the image received from the server is converted into binary form. A database of different image with the its height and width of the pothole is created and stored in binary form. If the binary value of both the captured image and present images in the database are same, then it is considered as a pothole. This image is then proceeded to MATLAB and then the gradient and magnitude of the image is computed. The regional of interest of the image is computed and then processed further by opening a morphological reconstruction. This processing method involves processing of an image according to the arrangement element where the image is contracted by neglecting the objects which is smaller than the required shape of the pothole. This work proposes an image processing based on the pothole identification mechanism by considering the shape, height and width of potholes present in captured image. The algorithm first assigns a fixed threshold for segmenting the captured images into two classes called parts with potential pothole‘s presence and nondefective parts. Non defective parts represents an undangered pothole. Defective parts is considered to be dangered Pothole. This algorithm is implemented by MATLAB image processing and the images were acquired from the camera.

The dangered pothole latitude and longitude is sent to Roadway department using device IOT.

4.2 Registering Complaint to the Webserver using IOT

This research work implements the real time implementation of image processing based on pothole detection algorithm through a simple low cost hardware setup for identifying potholes. Hardware setup included ultrasonic sensor, camera, GPS module, WIFI module, IOT, RS232 and camera. A camera is fixed in the vehicle which captures images through video processing and sends through the RS232 Cable. Ultrasonic sensors sends the ultrasonic waves of certain frequency and also determine the distance of the object from the duration of the ultrasound which is reflected. This sensor consists of both the transmitter and the receiver. Depending on the distance between vehicle and pothole we can identify the potholes on the road. The detected danger pothole location is sent to roadway department by using sensor interfaced with TTL board and IOT device. TTL board which receives the information through the process of MATLAB for the detection of Danger pothole. In turn TTL board transmits the information location to IOT device. It fetches the exact location of the potholes from GPS unit and updates to webpage of Roadway department. The flow diagram is shown below

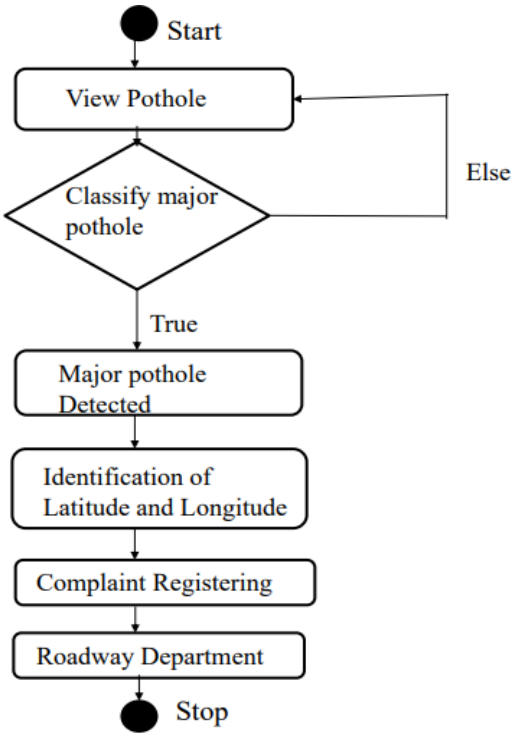

Fig -2: Flow Diagram

5. HARDWARE SPECIFICATIONS

5.1 Camera

Fig -3 Webcam

The webcam which is used in our project captures images up to the range of 30fps from any video streaming device. It includes USB cameras and Network cameras. When the program runs, it sends the captured image and also records the video which is processed. The program also has features like adding text and the image logo or to place a date and time stamp on each of the frame, and also to adjust the frame rate, picture size, and quality of the image.

5.2 RS 232 Connector

The RS232 stands for Recommended Standard 232. It is serial communication which is used for transmission of data to certain distances.

Fig -4: RS 232 Connector

It was firstly introduced in the 1960s and also been used in many applications like computers, printers,automation devices etc. RS232 is a standard protocol that is used for serial communication between computer and peripheral devices. The RS232 is used in serial communication for about 50 feet with the bit rate of 1.492kbps. This defines RS232 as it is used to connect Data Transmission Equipment and Data Communication Equipment.

5.3 TTL Board

TTL stands for Transistor–transistor logic (TTL) which is built from the bipolar junction transistors. The TTLboard performs the logic function as well as the amplifying function, as opposed to any of the resistor-transistor logic (RTL) or diode-transistor logic (DTL). TTL integrated circuits (ICs) are mostly used in applications such as computers, industries, test equipments, instrumentation, consumer electronic devices. Sometimes TTL-compatible logic levels are not associated with the TTL integrated circuits. For example, it may be used in some inputs and outputs of electronic instruments.

5.4 IOT Device

This IoT device is integrated with the Wi-Fi module to share the data to end users so that the date is shared to the webpage of Roadway department. It is highly secure and only the authenticated users can access the IoT board for transmission and receiving the data.

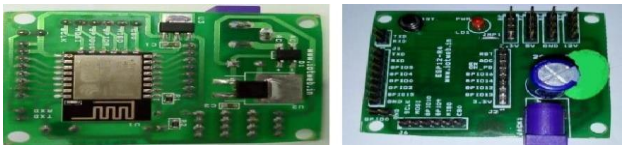

Fig -5: IOT Device

6. RESULTS AND DISCUSSIONS

The implementation details of the proposed system is presented here. The below figure represents the image which is captured by video processing where the clear image of the pothole is detected from the different frames captured in figure 6.

Fig -6: Classification

In figure 7 Preprocessing techniques are applied so that the boundary line of the pothole is segmented to check whether the pothole identified is dangered or undangered.

Fig -7: Pothole Boundary Identification

In Figure 8, The image is segregated from dangered and undangered pothole and the dangered pothole is further moved to the next phase. The dangered pothole is identified and viewed.

Fig -8: Dangered Pothole

7. CONCLUSIONS

The proposed system basically serves two phases, one it is able to identify the potholes on the road and it is get updated to the webserver. This will help the people to avoid accidents and will save many lives. Second, the location of the pothole is updated in the database of Roadway department. This is an effective solution for detecting the potholes. This system is effective to identify the damaged roads at very faster rate.and it sends the alerts from the stored information in the server/database and helps people to avoid dreadful potholes hence it is used to avoid any tragic accidents because of bad road conditions. This information can also be used by the roadway authorities for the maintenance of the roads. The proposed system will identify the danger potholes and the location of the pothole is updated in the webpage of Roadway department. The database could have the mapping of latitude and longitude of the pothole detected. This system can also be updated to work even in rainy season when roads are flooded as well as in winter during low visibility of the roads by identifying the depths, as the alerts are sended to the server/database and helps people to avoid danger potholes and hence to avoid dreadful accidents due to bad road conditions. The information can also be used by Roadway authorities for the maintenance of the roads at faster rate.

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