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AUTOMATIC POTHOLE DETECTION

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Abstract - *Most of the Indian rural and sub urban roads are not ideal for driving due to faded lanes, irregular potholes, improper and invisible road signs. This has led to many accidents causing loss of lives and severe damage to vehicles. Many techniques have been proposed in the past to detect these problems using image processing methods. But there has been little work specifically carried out for detecting such issues of Indian roads. Potholes can generate damage such as flat tire and wheel damage, impact and damage of lower vehicle, vehicle collision, and major accidents. Thus, accurately and quickly detecting potholes is one of the important tasks for determining proper strategies in ITS (Intelligent Transportation System) service and road management system. Several efforts have been made for developing a technology which can automatically detect and recognize potholes. In this project, a pothole two dimensional (2D) images based pothole detection method is used for improving the existing method.*
This system proposes a system Automatic detection of cracks in road surfaces, which is used to detect and find the severity level of cracks, used to reduce errors in manual calculation.

Index Terms – *Ultrasonic Sensor, Raspberry Pi 3 model ,Pi camera, Motor driver L293D ,Python.*

I. INTRODUCTION

INDIA, the second most populous Country in the World and a fast growing economy, is known to have a gigantic network of roads. Roads are the dominant means of transportation in India today. They carry almost 90 percent of country's passenger traffic and 65 percent of its freight [1]. However, most of the roads in India are narrow and congested with poor surface quality and road maintenance needs are not satisfactorily met. No matter where you are in India, driving is a breath-holding, multi-mirror involving, potentially life threatening affair.

Over the last two decades, there has been a tremendous increase in the vehicle population. This proliferation of vehicles has led to problems such as traffic congestion and increase in the number of road accidents. Pathetic condition of roads is a boosting factor for traffic congestion and accidents.

Roads in India normally have speed breakers so that the vehicle's speed can be controlled to avoid accidents. However, these speed breakers are unevenly distributed with uneven and unscientific heights. Potholes, formed due to heavy rains and movement of heavy vehicles, also become a major reason for traumatic accidents and loss of human lives. According to the survey report "Road Accidents in India, 2011", by the ministry of road transport and highways, a total of 1,42,485 people had lost their lives due to fatal road accidents. Of these, nearly 1.5 per cent or nearly 2,200 fatalities were due to poor condition of roads. Figure 1 portrays the condition of roads with killer potholes. To address the above mentioned problems, a cost effective solution is needed that collects the information about the severity of potholes and humps and also helps drivers to drive safely. With the proposed system an attempt has been made to endorse drivers to ward off the accidents caused due to potholes and raised humps.

II. LITERATURE SURVEY

The number of recently published papers dealing with crack detection and characterization of pavement surface distresses shows an increasing interest in this area. A recent publication a hierarchical method present in [1], which deals with detection of roads and slopes. In this paper, a novel framework is proposed for segmenting road images in a hierarchical manner that can separate the following objects: road and slopes with or without collapse, sky, road signs, cars, buildings and vegetation from the images. The experiments show that the approach in this paper can achieve a satisfied result on various road images. The roads are unstructured, which are more complex than the structured roads.

In [2] multiscale approach based on Markov random field is proposed to segment fine structures (cracks) in road pavement surface images. Cracks are enhanced using a 1-D Gaussian smoothing filter and then processed by a 2-D matched filter to detect them. A total of 64 road pavement surface images representing several crack types are considered for experimentation, producing a qualitative evaluation. Details on image characteristics or the type of sensor used to capture them are not provided. Another paper [3] evidences the difficulty of detecting cracks of less than 3 mm width when using edge detectors. A non-subsampled contourlet transform is adopted in [4] to detect cracks, wherein a limited set of experimental results is presented.

A complete methodology to automatically detect and characterize pavement defects is proposed in [5], using grayscale images captured by line scan cameras illuminated by lasers during road surveys performed using a high-speed image acquisition system. Crack detection uses a conditional texture anisotropy measurement to each image, and defect

characterization uses a multilayer perceptron neural network with two hidden layers. The results presented are promising, but the experimental evaluation does not support the distinction of multiple cracks in the same image. In paper [6],.Neural network method is used. The automated pavement defect detection can only identify crack type defects. To classify defect, a multi layer perceptron neural network (MLPNN) is used. Neural network is used to classify the images into four classes: defect-free, crack, joint and bridged. Experimental results are performed on real road images which are labeled by human operators.

There are more additional filters required for this system. In paper [7], Vision-based approaches are used to address functionalities such as lane marking detection, traffic sign recognition, pedestrian detection, etc. This system is possible to detect the free road surface ahead of the ego-vehicle using an on board camera. Novelty Method is used for both Shadowed and unshadowed regions which provide highest performance. Road detection algorithm is devised by combining the illuminant invariant feature space and likelihood based classifier. The defect of this system is under saturation by improving image acquisition system. In paper [8], A neural network based technique for the classification of segments of road images into cracks and normal images. The features are passed to a neural network for the classification of images into images with and without cracks. Another approach [9] extracts linear features (cracks) using two methodologies: one based on holistic thresholding and the second employing the Otsu algorithm.

III. PROPOSED SYSTEM

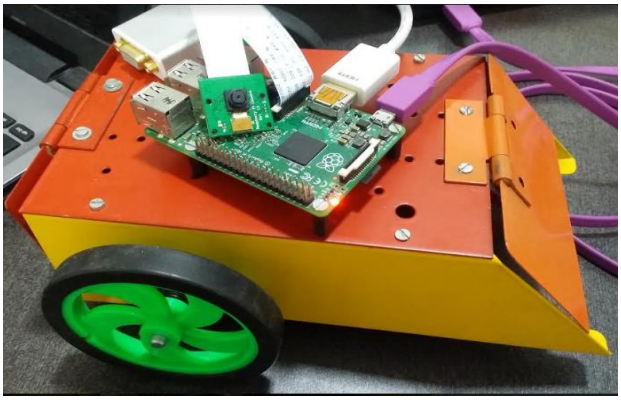

Fig.1 setup

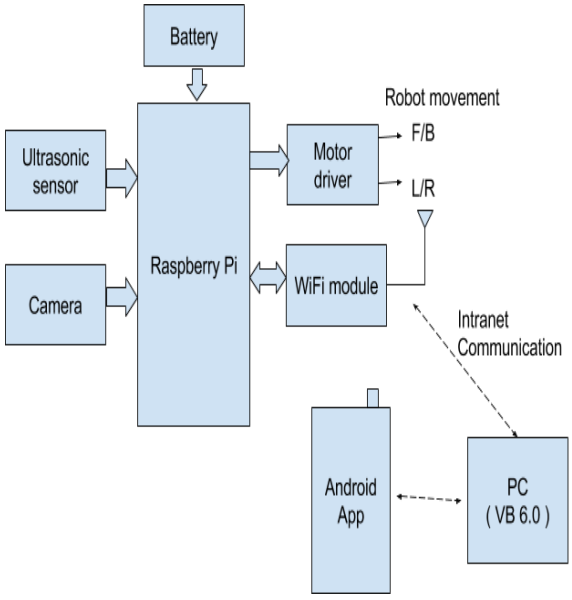

Fig2. Block Diagram

Raspberry Pi

The credit-card-sized single-board computer developed in the UK by the Raspberry Pi Foundation with the intention of promoting the teaching of basic computer science in schools.
The Raspberry Pi is manufactured in two board configurations through licensed manufacturing deals with Newark element14 (Premier Farnell), RS Components and Egoman. These companies sell the Raspberry Pi online. Egoman produces a version for distribution solely in China and Taiwan, which can be distinguished from other Pis by their red coloring and lack of FCC/CE marks. The hardware is the same across all manufacturers.
The Raspberry Pi has a Broadcom BCM2835 system on a chip (SoC), which includes an ARM1176JZF-S 700 MHz processor, VideoCore IV GPU, and was originally shipped with 256 megabytes of RAM, later upgraded to 512 MB. It does not include a built-in hard disk or solid-state drive, but uses an SD card for booting and persistent storage.

Ultrasonic sensor

Ultrasonic sensors work on a principle similar to sonar which evaluate distance of a target by interpreting the echoes from ultrasonic sound waves. Ultrasonic ranging module HC - SR04 provides 2cm - 400cm non-contact measurement function, the ranging accuracy can reach to 3mm. The modules includes ultrasonic transmitters, receiver and control circuit. The basic principle of work:

(1) Using IO trigger for at least 10us high level signal,

(2) The Module automatically sends eight 40 kHz and detect whether there is a pulse signal back.

(3) IF the signal back, through high level, time of high output IO duration is the time from sending ultrasonic to returning.

Test distance = (high level time×velocity of sound (340M/S) / 2

Motor Driver

Since motors require more current then the microcontroller pin can typically generate, you need some type of a switch (Transistors, MOSFET, Relay etc.,) which can accept a small current, amplify it and generate a larger current, which further drives a motor. This entire process is done by what is known as a motor driver.
L293D is a typical Motor driver or Motor Driver IC which allows DC motor to drive on either direction. L293D is a 16-pin IC which can control a set of two DC motors simultaneously in any direction. It means that you can control two DC motor with a single L293D IC, Dual H-bridge Motor Driver integrated circuit (IC). The l293d can drive small and quiet big motors as well.

DC motor

In any electric motor, operation is based on simple electromagnetism. A current-carrying conductor generates a magnetic field; when this is then placed in an external magnetic field, it will experience a force proportional to the current in the conductor, and to the strength of the external magnetic field. The internal configuration of a DC motor is designed to harness the magnetic interaction between a current-carrying conductor and an external magnetic field to generate rotational motion.

Pi Camera

The Raspberry Pi Camera Module is a custom designed add-on for Raspberry Pi. It attaches to Raspberry Pi by way of one of the two small sockets on the board upper surface. This interface uses the dedicated CSI interface, which was designed especially for interfacing to cameras. The CSI bus is capable of extremely high data rates, and it exclusively carries pixel data.

IV. ARCHITECTURE AND IMPLEMENTATION

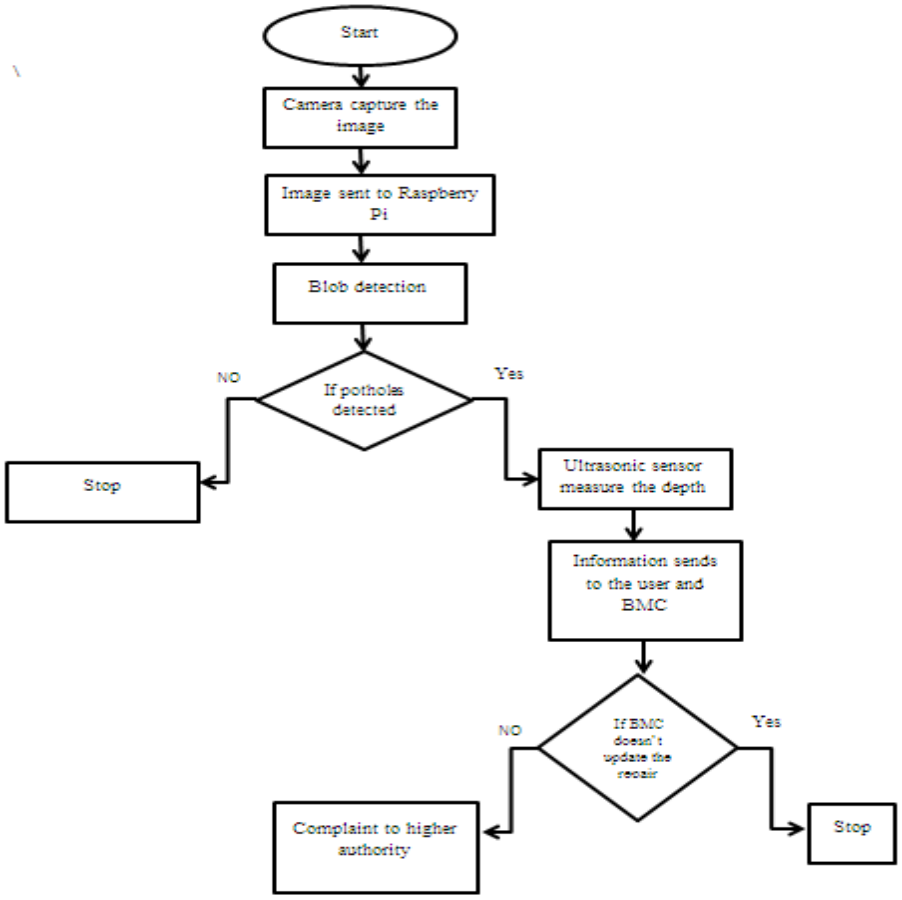

Fig3. Flow Chart

In this proposed system ,a robot structure is designed to move on a road surface .To detect any pothole, Image Processing is done .This image processing is done by Raspberry pi and camera .Webcam is connected to Raspberry pi board which will give live images of road to Raspberry pie. The pixel values are to be set for pothole .The set pixel value and the image captured by the webcam is compared. Depending upon the set pixel value and image captured by webcam , potholes are detected.

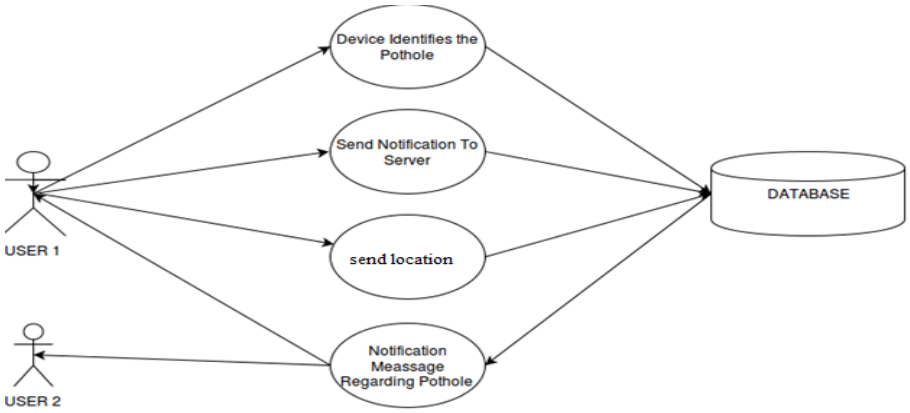

Fig4.UML diagram

Python language is used for image processing with the help of Raspberry pi. The height of the pothole is measured using ultrasonic sensor which is also connected with the Raspberry pi. A database server is created to store all information regarding pothole. Notification will be sent to the user regarding presence of potholes.Users using particular application will be notified for the same with different ringtone.BMC will also be connected with the server.Regular updation should be done by the BMC in the server regardsing the repairation of the pothole.If potholes are not repaired within defined period of time,a complaint message is sent to the higher authority of BMC.

VI. RESULT AND DISCUSSION

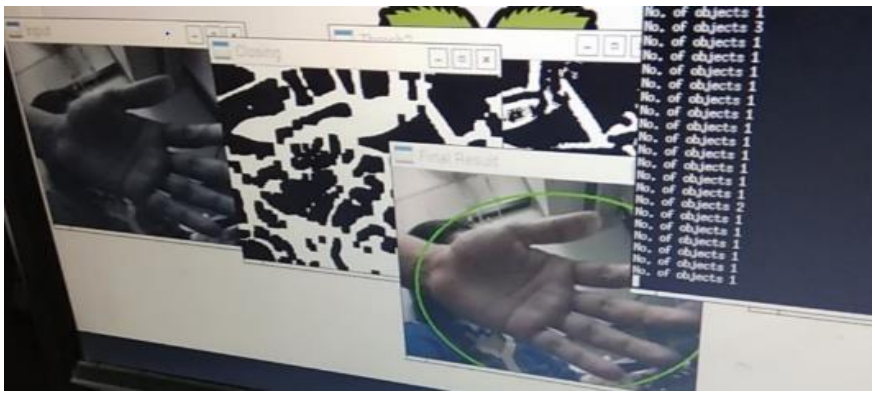

Fig5. Hollow object detection

In proposed system we obtain results which is shown in fig 4.It will show circle on potholes and count of objects will be shown as a result which is shown in fig.

V. CONCLUSION AND FUTURE SCOPE

This system gives high efficiency result because of image processing .Android app will help users by providing timely notification .Database is regularly updated for user and BMC convenience.

This system gives view about image-processing method for the potholes detection of road. A different method for the detection of road potholes has been introduced. We have presented a new evaluation and comparison method for automatic detection of road potholes. It considered pixels as for detection of cracks. The dimension of the distressed area such as height of potholes is measured using ultrasonic sensor.

In future this system could be implemented in each and every vehicle. Phased array ultrasonic sensors can be used to obtain better results and accuracy. It is an advanced form of ultrasonic testing. It basically refers to a bank of ultrasonic sensors. We can implement a system which will going to repair the pothole at that time only it is detected.

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