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Mobile Driven Vehicle For Roadcrack Detection And Refill Using 3-D Printing Mechanism

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ABSTRACT-
Ithasbeenseenthatmillionsofdollarsare being invested in highway/subway tunnel maintenance and restoration all over the world.. As the reparation process depends on the type of cracks, so we need to take action for the next steps on how it would be repaired. It would be a very good decision to repair the cracks as earlier we findit.
In this project, the detection of destroyed roads is done by image processing. Here the python is the language used for the image processing with the help of Raspberry pi and a raspberry pi camera. Also, image processing is used for the self-control of the vehicle to travel along the road. The captured images of the road will be compared with the predetermined images for the detection of crackers in the road.Then basedonthecapturedimageifthecrackisfoundthen automatically 3D printer will get activated and it startsrefillingthematerialsoncethecrackisdetected bythevehicle.ThiswillmakeuseofPLAtypeplastic material which can be converted to the fluid format with a high temperature of 215 to 139 degrees Celsius. This liquid will be the main component of our prototype. In this project, 3D printingtechnology is the heart of the system.
Here we make use of an electric vehicle. Which doesn't need a human to control theirmovement alongtheroad.Byusingavarietyofsensorsanddata collected that vehicle will move. The sensors HCSR- 04 is used to check whether any obstacles are present intheway.Ifanyobstacle isfoundthenitwilldisplay an alertmessage.
Key Words: Raspberry pi, motor driver, pi camera, 3Dprinter extruder, HC-05 Bluetooth module, 12v Battery, 12v Dc motor, 12v 2 Channel Relay .

I. INTRODUCTION

It has been seen that millions of dollars are being invested in highway/subway tunnel maintenance and restoration all over the world. As the reparation process depends on the type of cracks, so we need to take action for the next steps on how it would be repaired.

Toovercomefromthisproblemweareimple menting the model of Automated Vehicle for Road Repair, which will detect the road cracks and refill thecracks with suitablematerials.

II. PROPOSEDARCHITECTURE

2.0 Raspberrypi

Raspberry Pi is a small single board computer. By connecting peripherals like keyboard, mouse to the raspberry Pi, it will act as a mini personal computer. It is popularly used for real time Image/Video Processing, IoT based applications and Robotics applications. Raspberry Pi is slower than laptop or desktop but is still a computer which can provide all the expected features or abilities, at a low power consumption.

2.1 Motor Driver IC(L298N)

TheL298Nisanintegratedmonolithiccircuit ina15- lead Multi Watt and PowerSO20 packages. Two enable input are provided to enable or disable the device independently of the input signal. The emitters of the lower transistors of each bridge are connected together. An additional Supply input is provided so that the logic works at a lowervoltage.

2.2 PiCamera

Ittendstobeutilizedtotaketopqualityvideo,a ndin addition, stills photos. It underpins 1080p30, 720p6, andVGA90videomodes,andstillcapture.Itappends by means of a 15cm lace link to the CSI port on the RaspberryPi.

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2.3 3D-PrintingExtruder

The 3D extruder is the part of the 3D printer that ejects material in liquid or semi-liquid form in order to deposit it in successive layers within the 3D printing volume. In some cases, the extruder serves only to deposit a bonding agent used to solidify a material that is originally in powder form.

2.4 DcMotor

TheDcmotorisusedinthe3dprinteraswellasi n the autonomous vehicle for the movement of the vehicle. Here we are using a 12V DC motorwhich canbecontrolledbytheraspberrypiandconnected through a motor driver.

2.5 HCSR-05

It is an ultrasonic sensor,also known as an ultrasonictransducerthatisbasedonatransmitter and receiver and mainly used to determine the distance from the target object. The distance of object can be detected depending on the time taken by thesensors.

III. IMPLIMENTATION AND WORKING

The block diagram of Mobile driven for vehicle for road crack detection and refill using 3D printing as shown in figure1.

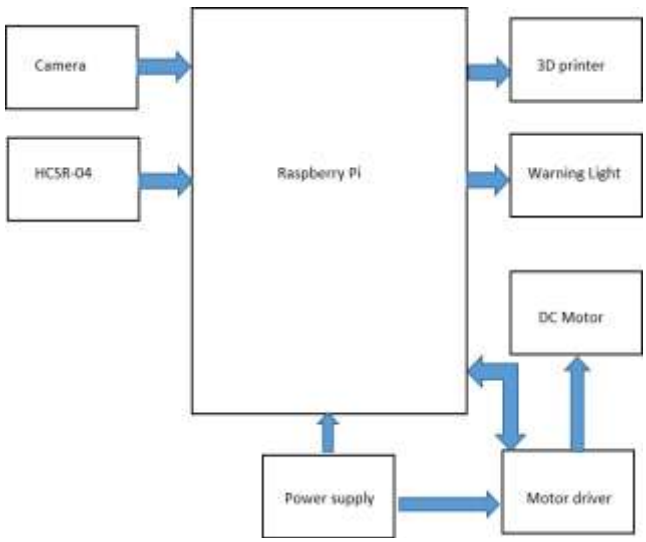

Fig. 1 Block diagram of Mobile driven for vehicle for road crack detection and refill using 3-D Printing mechanism

WORKING:

Here the road repairing can be classified into some following steps below:

- ImageCapture
- Image Processing
- Mobile drivenvehicle
- 3-D Printing

3.1 Image Capturing:

Image will be captured by using pi camera which is attached to the vehicle that will be capable of capturing high resolute images of highways from any angle but focus should be perfect. If needed then the original images could be resized.

Procedure:

- Open thecamera
- Start to capture theimages

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Here are some examples of images on which we are going to detect cracks.

Fig. 2 Captured image using pi camera

3.2 Image Processing:

The detection of destroyed roads are done by the image processing. Here the python is the language used for the image processing with the help of Raspberry pi and a raspberry pi camera.Alsotheimageprocessingisusedfor the self-control of the vehicle to travel along the road.
The captured images of road will be compared with the predetermined imagesfor the detection of crackers in theroad.
Procedure for Image processing:

- Open thecamera
- Start to capture the images in everyseconds
- Compared the capturedimages with pre-defined images in the database
- Once the crack is detected then inform to theprocessor

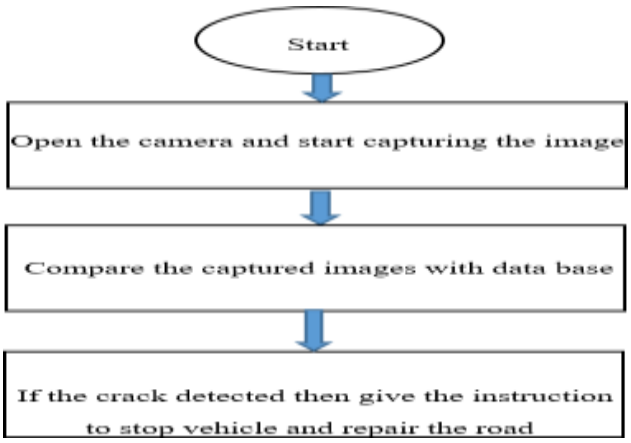

Fig. 3 Flowchart of Image processing

Different steps used for detecting Cracks: Step 1: Image Capture
Imagewillbecapturedbyusingcamerawhich is attached to the vehicle that will be capable ofcapturinghighresoluteimagesofhighways from any angle but focus should be perfect.If needed then the original images could be resized.

Step 2: Histogram equalization
Histogram equalization is an image processing technique that adjusts the contrast of an image by using its histogram. For enhancingtheimagecontrst,it spreadsoutthe most frequent pixel intensity values or stretches out the intensity range of theimage.

Step 3: Median filter
The median filter is a non-linear digital filtering technique, often used to remove noise from an image or signal. Median filtering is widely used in it because, under certain conditions, it preserves edges while removing noise.

Step 4: Gamma adjustment
It can also be called as power law transformation.

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Gamma adjustment is used to correct the differences between the way a camera captures content, the way in which a display displays content and the way inwhich our visual system processeslight.

Step 5: Binarization
Binarization is the method of converting any gray-scale image (multi tone image) into black-white image (two tone image). To perform binarization process, first find the threshold value of gray scale and check whether a pixel having a particular grayvalue ornot.

Step 6: Binary Filtering
Binary filters are used to morphologically filter binary structures or objects in images or other maps. You can for instance enhance the outlines of a structure by making structures 1 pixel wider in any direction by making structures 1 pixel smaller in any direction etc.

Step 7: Crack detected
Finally the crack will be detected.

3.3 Mobile DrivenVehicles:

In the mobile driven vehicles the vehicle control is done by using a mobile which is connected with vehiclethroughBluetooth.Inthisprojecttheandroid mobile is used to control the vehicle. Here the raspberry pi and its inbuilt Bluetooth is used for the controlling of the vehicle. The sensors HCSR-04is usedtocheckwhetheranyobstaclesarepresentinthe way.

Procedure for mobile driven vehicle:

- Check the Bluetooth connectivity ofvehicle
- If the connection is done properlythenit'sgoodtomove
- Open the app in the mobile to control the movement of vehicle

Procedure:

- Wait for theinstructions
- Once got the instruction then activate the extruder andcheck for thefilament
- Start to fill thecrack
- Fill the crack till getting stop signal from theprocessor

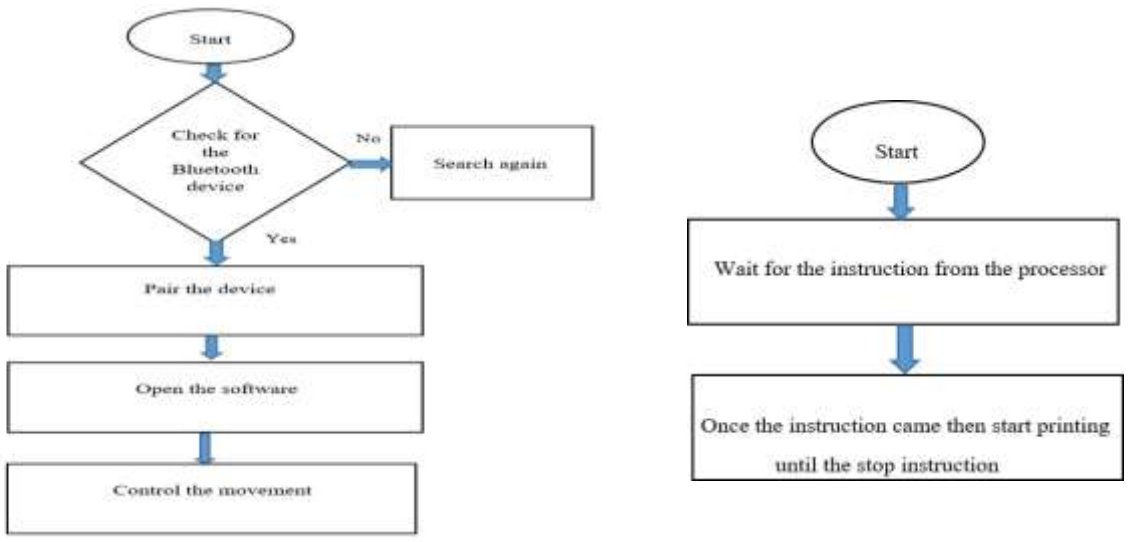

Fig. 4 Flowchart of mobile driven Vehicles

3.4 3D-Printing:

The 3D printing technology is having an important role in our project. This technology will be used for the refilling of the materials once the crack is detected by thevehicle.ThiswillmakeuseofPLAtype plastic material which can converted tothe fluidformatwithahightemperatureof215 to 230 degree Celsius. This liquid will be the, main component of our prototype.

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IV. FLOWCHART:

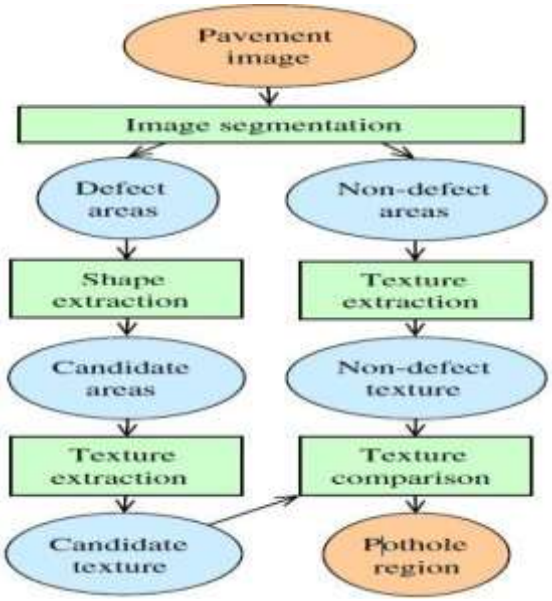

Fig.6 Flowchart of Mobile driven for vehicle for road crack detection and refill using 3D-Printing mechanism

The first step is image segmentation. The second step for this model is shape extraction. The third step for this method is texture extraction and comparison. The shape extraction and texture extraction steps will be removed in the crack detection model in this study. Since most of the potholes are ellipse, the step of shape extraction is needed in the previous study to select the candidate areas. However, since most cracks are irregular curves,theareasofthecracksaresosmallthat the shape extraction process is unnecessary in the crack detection model. For the image segmentation process, in particular RGB values, are not essential 12 when performing the segmentation process with regard todefect detection.However,theRGBvaluewillbethe primarythresholdvalueinthefirstselectionin this study. This is a big difference betweenthe pothole detection model and the crack detectionmodel.Thepurposeofthisprocessis to transform the color images into gray-scale images.

V. CIRCUIT DIAGRAM:

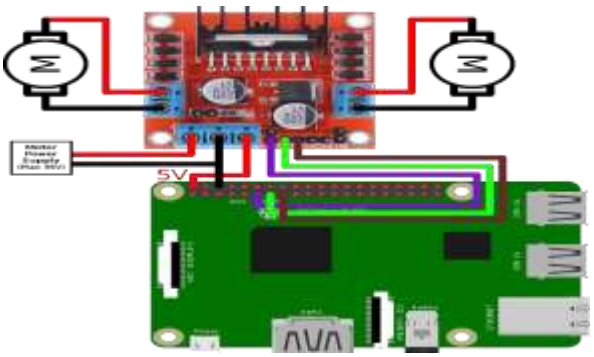

Fig.7 Flowchart of Mobile driven for vehicle for road crack detection and refill using 3D-Printing mechanism

InterfacingL298NMotorDriverModulewit h Raspberry Pi will allow us to control a DC Motor (in fact, we can control two DC Motors). Now connect 12V Power Supply to L298NMotorDriverModule.Then,makethe GND terminals of Raspberry Pi and L298N Motor Driver

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Module common(connect them together. Now, since we are controlling a single DC Motor, we need to use a single channel of theL298N.

VI. OUTCOME:

Thisprojectwilltakethepropertimagesand process it and detect for the crackers onthe road with the help of image processing, cameraandtheraspberrypi.Oncethecrack is detected then the 3D printer will put the material on the crack to fill that. And when the work is in progress if any obstacle found then it will give the alert message.

Theallequipmentwillbeonself-controlled vehicle which will move as per the environment and the pre-defined instructions.
Images obtained after performing some image processing techniques are shown below :

Step 1: Image Capture

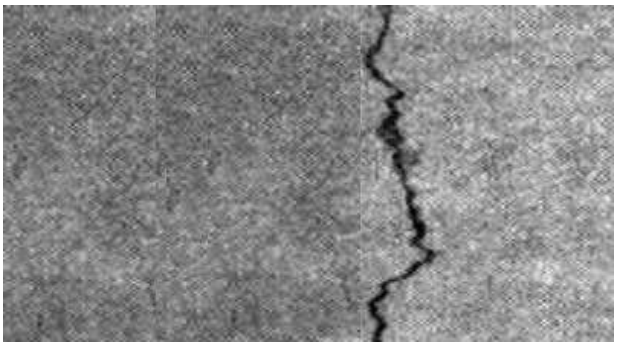

Fig 8. Input image

Step 2: Histogram equalization

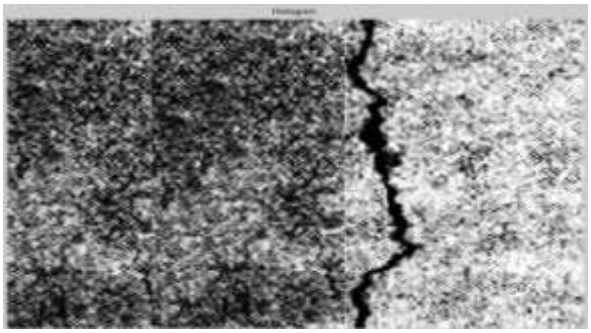

Fig 9. Histogram equalization

Step 3: Median filter

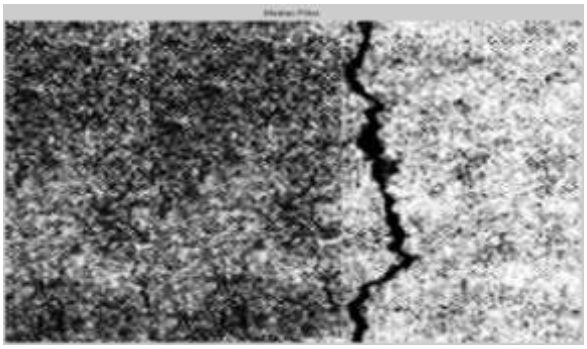

Fig 10. Median filter

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Step 4: Gamma adjustment

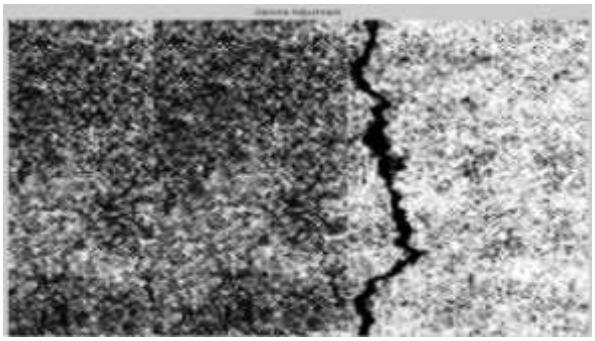

Fig 11. Gamma adjustment

Step 5: Binarization

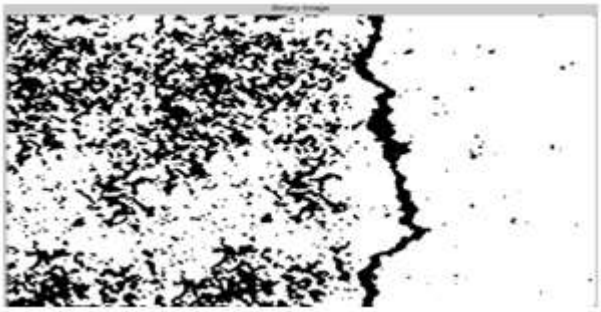

Fig 12. Binarization

Step 6: Binary Filtering

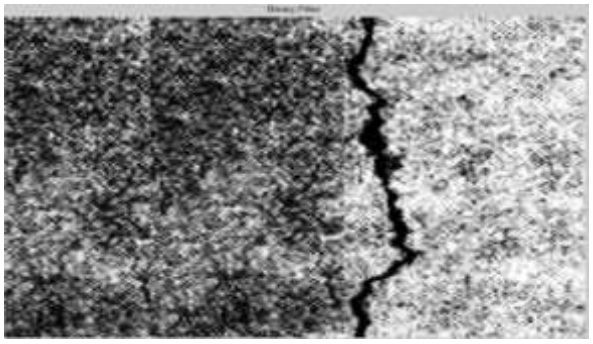

Fig 13. Binary filtering

Step 7: Crack detect

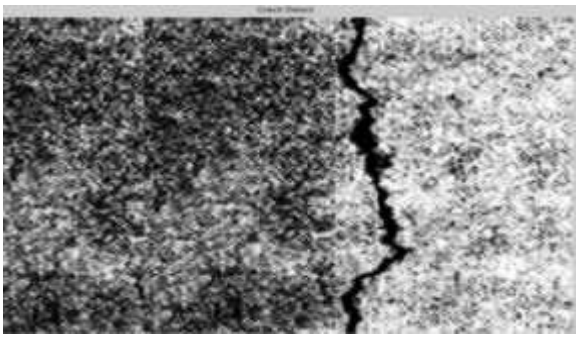

Fig 14. Detected crack

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