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Analytical Construction of Pothole using Flutter Android App with Contour and Edge Detection

Shivam Yadav[1], Shubham Sangwan[2], Yashwardhan Singh[3]

[1]Department of Electronics and Communication Engineering, KIET Group of Institutions, Ghaziabad, Uttar Pradesh, India
sy9891099[at]gmail.com

[2]Department of Electronics and Communication Engineering, KIET Group of Institutions, Ghaziabad, Uttar Pradesh, India
sangwan.shubham10[at]gmail.com

[3]Department of Electronics and Communication Engineering, KIET Group of Institutions, Ghaziabad, Uttar Pradesh, India
yash.wardhan038[at]gmail.com

Abstract: ***Many geologists associate potholes with large amounts of highly turbulent water. Potholes are common in countries like India. And certainly, potholes and deaths from injuries are still not considered a significant and serious problem. About 3, 597 people die each year from potholes. Over 30% of people die from potholes. But still, it is not taken as a serious issue in India. Still, potholes are getting originated. Pot Hole Fill (PH Fill) is a way of educating and awaring the people of India about this growing problem of potholes. Many people directly or indirectly are affected by this issue. They by the help of this app can solve this evolving problem. PH Phil will provide a platform for immediate response to this failure with responsible authorities. This paper will improve the urban development process beyond where governments rarely reach. With the help of this project, we were also able to reduce the number of serious accidents caused by potholes. It also helps in the development of specific areas in terms of construction. Previous slow method of emailing and offline complaining can be improved to a very good percentage by use of this application. The construction process can be further fastened by use of the discussed methods.***

Keywords: Potholes, gaussian blur, contour detection, edge detection, location integration

1. Introduction

Potholes are a worrying topic for all today because they cause serious problems in real life. If the tyres goes into a deep hole, the sharp edges of the hole can cause the tyre to burst or be damaged. Damage to the tyre [1] structure can cause it to contract rapidly and burst. In addition to a flat tyre, a flat tyre can cause you to lose control of your vehicle and turn into oncoming vehicles, grooves, or medians. In addition to the potential damage to the vehicle, the impact force of the fall can cause serious impact injuries to everyone in the vehicle. Shock injuries include whiplash, concussion, neck and spinal cord trauma, bone fractures, and internal tissue bleeding. To make matters worse, if a vehicle loses control, you can face injuries from various collisions.

Many manufacturers develop systems that work after an accident or are very expensive [2]. We need a smart and intelligent system that can prevent accidents by making full use of the latest technology. This paper aims to inform, educate and raise awareness of Indian people about this growing problem of potholes. Many people directly or indirectly are affected by this issue. They by the help of this app can solve this evolving problem. PH Fill gives them the platform to address this obstacle straight away to the concerned authorities. The 3 image capturing sections are provided for a user so as they can click images of potholes. Then using the location integration, they can mention the correct location of the places. And finally, they must identify the correct problems faced by citizens for potholes in the requirements section and submit them all.

2. Literature Review

2.1 Janpreet Singh and Shashank Shekhar [1] designed convolutional neural net-based instance detection and classfication approaches for the road damage detection and classification in smartphone captured image using mask R-CNN. In this paper, Mask-RCNN, one of thecutting-edge algorithms for item detection, localization and image segmentation is explained. It further provides the different damages in road images using a camera.

2.2 Hiroya Maeda, Yoshihide Sekimoto, Toshikazu Seto, Takehiro Kashiyama, Hiroshi Omata [2] proposed road damage detection by deep neural network technique to classify the damage of road. It is a data set driven neural network that was trained first to identify the classification of road damage.

2.3 SeungboShim, JinKim, Seong-WonLee, Gye-ChunCho [3], proposed road surface damage detection based on hierarchical architecture using lightweight auto-encoder network. In this article, they proposed a new neural network structure and training and prediction methods. Backed up 1300 training images and 400 test images to train the network, the images contain multiple types of road emergencies. The main focus was on the safe driving network.

After knowing all the working models of above literature reviews, our working model is different from that. Our working model mainly focused on the construction of pothole via mobile application so that it would be convenient to do this work digitally with the help of common people.

3. Principle Model and Discussion

The app is designed using flutter technology. Flutter is Google's open-source framework for building beautifully natively compiled multi-platform applications from a single code base. It follows a bottom to top approach and consist of two layers:-

1) Rendering layer:-Provides an abstraction for handling layouts. You can use this layer to create a tree of renderable objects. The tree can automatically update the layout to reflect the changes and manipulate these objects dynamically.
2) Widgets Layer: Each render object in the render layer has a class that corresponds to the widget layer. At the widget level, you can define a combination of classes that can be reused. This is the layer where the reactive programming model was introduced.

Flutter framework uses Dart as the programming language. During the compilation the Dart code is converted into native code. Flutter also has hot reload feature which boosts the development cycle. Proposed model of the application consists of:

- User Authentication.
- Image and location integration.
- Request page and final submission of request to database.

3.1 Flow Chart of PH Fill App

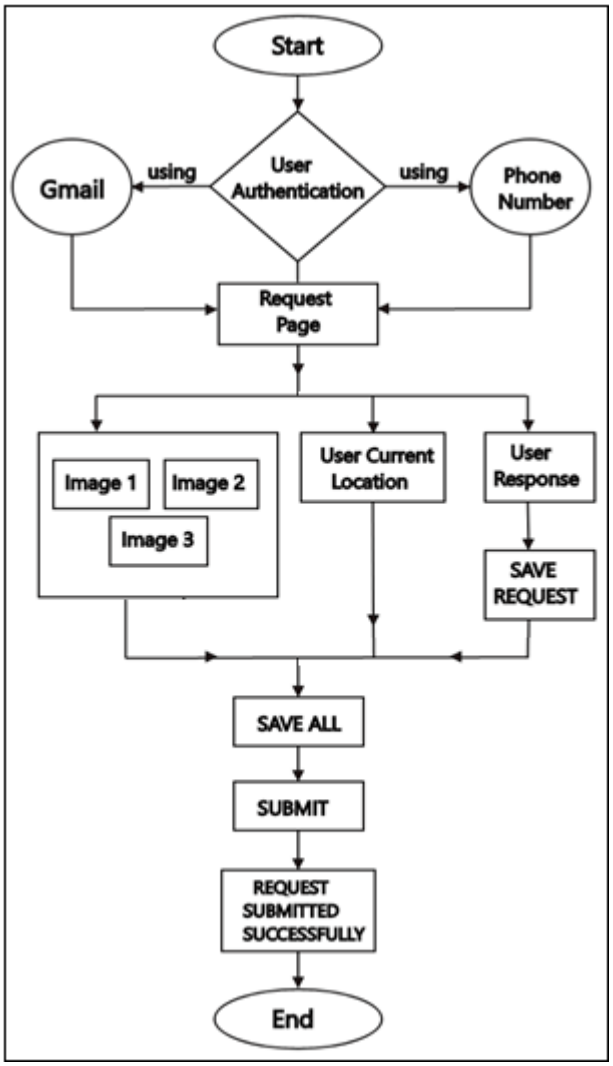

Figure 1: Proposed model of the work flow of the app

The basic idea behind the app is to inform the government about the required construction of potholes located at any place so as to avoid serious accidents. All the details that will be filled by the users will be send to the database and give sufficient information to government database about the necessity of required construction in that particular pothole.

3.2 Structure of the app

3.2.1 Authentication Module

The authentication module helps the real time user to register on the app so that to access the main content. The authentication can be done by two ways: 1) Through **Gmail**.2) Through **Phone Number**. As per user convenient he/she can choose between these two.

Figure 2: Login Page through gmail and phone no of proposed app design.

3.2.2 Request page module

After successful login, the user will be redirected to the main page of the app where he/she can make request. This is the main section of the app and all the main work is done in this section. A main screen will appear, here user will capture 3 images from different angles as shown in Fig.3.

Click on Location button, so as to reach current location. Fill the response in the Response Box. Save all the details and click on submit button as shown in the below image. That's all. User can check progress status in MY REQUEST SECTIONas shown in Fig.4.

It will send all data to database successfully. The Government body incharge can get access to all images with exact location. And also all the images with their urls that are uploaded on the database.

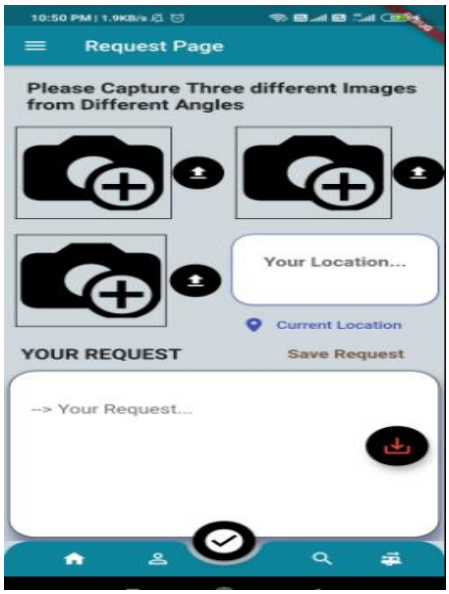

Figure 3: (a) Request Page of built android application

Figure 3: (b) Request Page of built android application

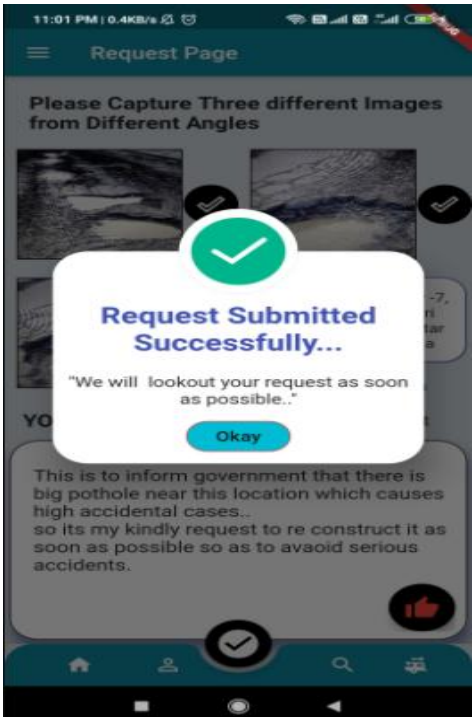

Figure 4: (a) My Requests Page of final developed application

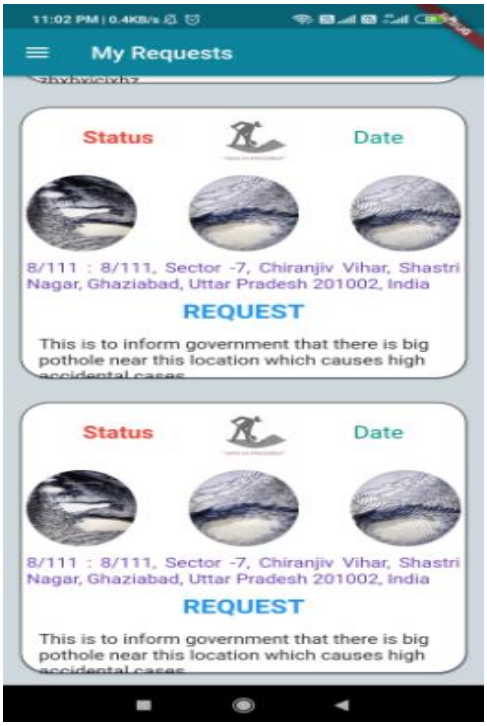

Figure 4: (b) My Requests Page of final developed application

3.2.3 Contour Detection and Canny Edge Detection Algorithm using OpenCV

After receiving images from the main app source, the images will undergo through contour and Edge Detection algorithm. Contour Detection is the process of shape analysis and object detection of closed curve by joining all the continuous point having some colour [7]. And Edge detection is an image processing technique used for finding the boundaries of objects within images. As you can see all the relevant images in this. There are 8 images you can see, the most important amongst them is the yeast shaped image which is called the EDGE IMAGE. If you look closely there are white lines that are visible. These lines show the amount of damage caused by the creation of pothole. The EDGE IMAGE is the main output that we got and showbelow.

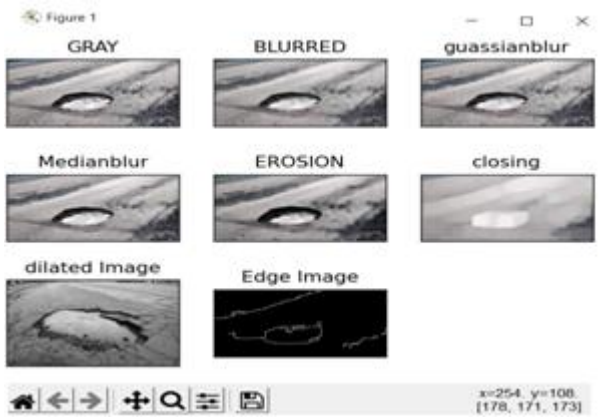

Figure 5: Contour and Edge detection of received Pothole image in database using OpenCV.

It also uses Gaussian Blur formula [8] which is a type of image blurring filter used for calculating the transformation to apply to each pixel in the image:

$$G(x) = \frac{1}{\sqrt{2\pi\sigma^2}} e^{\frac{-x^2}{2\sigma^2}} \quad (1)$$

3.2.4 Pseudo Code for Canny Edge Detection Algorithm

- Installing main python libraries
- Read the image
- Convert it to gray scale
- Show the gray scale image
- Perform the canny detector to detect image edges

If the damage caused is more subsequently the lines would also increase showcasing the same [9]. So looking at this output the Government authorities will get to know where the construction is needed.

3.2.5 Database Module

The database will receive all the filled details by users in the main app and will store it in the following manners.1) User authentication.2) User Personnel Details.3) User Response.4) User Picked Images. Given below images shows the pictorial procedure of database.

3.2.5.1 Authentication Details

- sign in time
- date
- personal details like email and phone no.

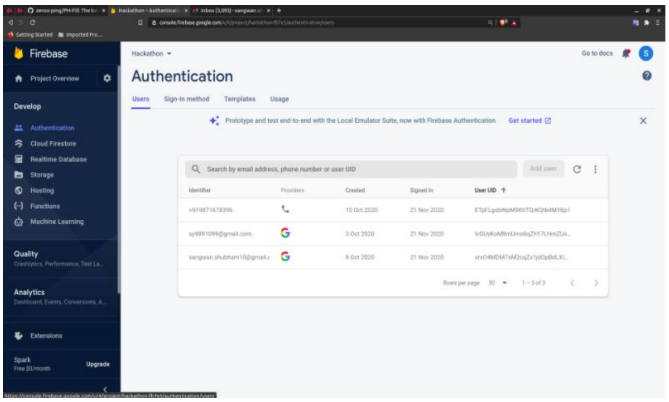

Figure 6: Authentication Section in Firebase Database

3.2.5.2 User Details Section

It will take user details like:

- email,
- name,
- image only.

And feed them in the databse for the further usage.

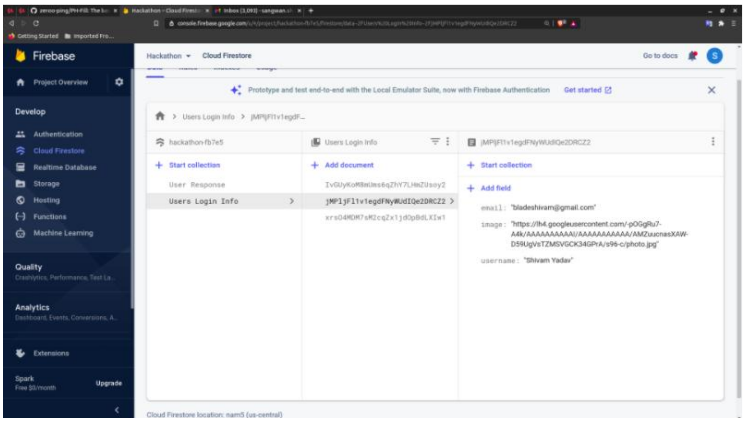

Figure 7: User details Section in Firebase Database

3.2.5.3 User Request Details

Details like date, location, request, pothole images will be stored here [10].

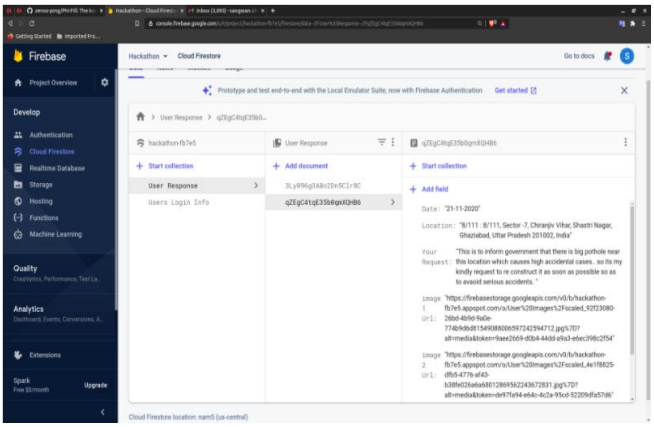

Figure 8: User request details Section in Firebase Database.

3.2.5.4 User Pothole Images

The images that were captured from three different angles will be stored here for construction references as shown below.

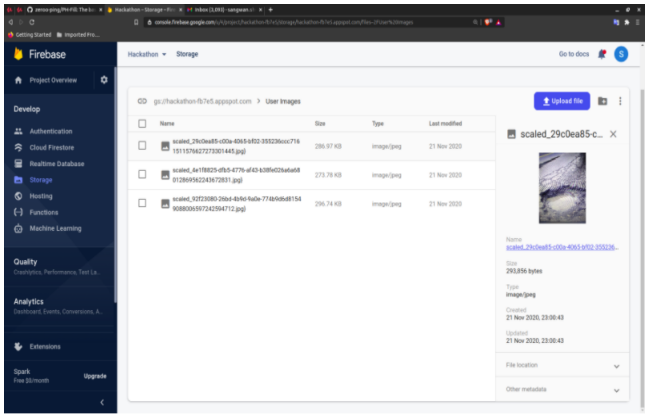

Figure 9: Pothole images stored in Firebase

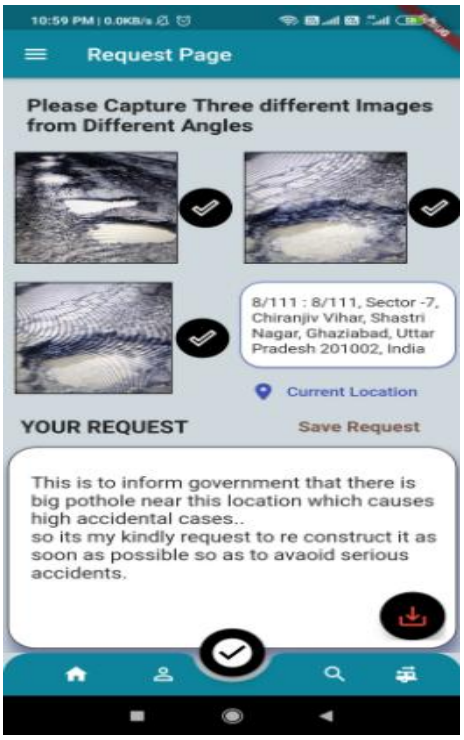

Figure 10: (a) Pothole App request Pages example in final built application.

4. Results

I) Image integration, Location functionality and sending all the data to the database is working properly. Also all the information is correctly storing in the database with exact location.

Figure 10: (b) Pothole App request Pages example in final built application.

In the Fig.10 (a) and Fig.10 (b). the app shows the images taken by user and Fig.9. shows the given pothole images being send to database. Which can be used by concerned authorities for their construction.

II) The Fig.11. shows the image received in database after sending of request by the user with user details and location of pothole.

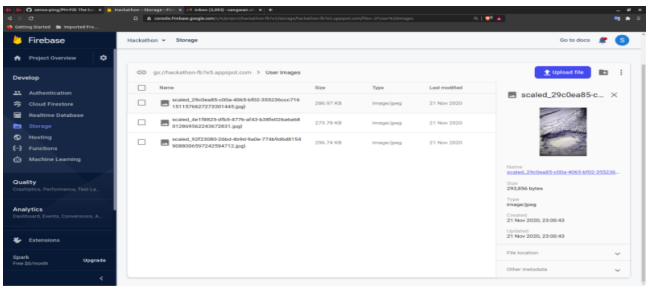

Figure 11: Received images in database of request send in Fig.10

III) At last proposed, contour and edge detection algorithm can be used on images to identify the pothole that shows damage by highlighting the pothole and construction areas with white lines. The final edge image shows the area which need to be constructed.

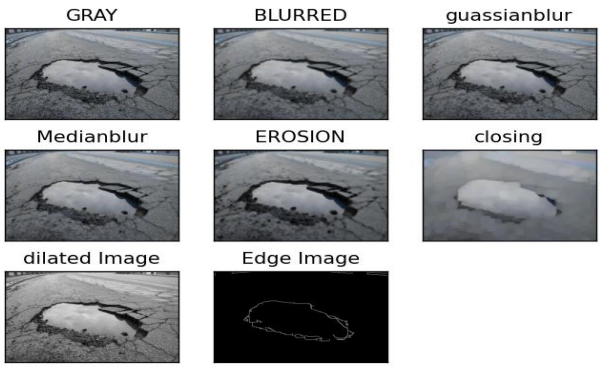

Figure 12: Using proposed canny edge detection algorithm on received images in database.

5. Conclusion

Pothole Fill (PH Fill) is a way of educating and awaring the people of India about this growing problem of potholes. Many people directly or indirectly are affected by this issue. They by the help of this app can solve this evolving problem. PH Fill gives them the platform to address this obstacle straight away to the concerned authorities. The basic idea behind the app is to inform the government about the required construction of potholes located at any place so as to avoid serious accidents. After submitted all the required details, the details will be redirected to the database that gives sufficient information to government database about the necessity of required construction in that particular pothole.

This paper will enhance the development process over the cities over places where government rarely reaches. Also, with the help of this project the cases of serious accidents due to pothole could be reduce. It also helps in development of particular region in terms of construction.

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