PART - B

SCIENCE AND HUMANITIES

APPLICATION OF VISUAL INTELLIGENCE FOR DETECTION OF PHYSICAL DAMAGES IN OBJECTS

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ABSTRACT: The main aim of the project is to find the physical damages of the object through images by comparing with the original image of the object at the time of sales or delivery. In this project, the images taken at the timeof inspection are compared to the original images (those taken at the time of delivery / sales), and the damaged portions are highlighted and recordedfor future reference. This comparison process involves analyzing the objects in images and modelling in 3D viewpoint, so that the comparison can be more accurate and robust even in case of any distortion, noise and change in illumination. As the comparison involves homographic object modelling, the target identification will be more accurate even in the case of change in orientation, lighting and external noise on the target object.

1. INTRODUTION

Many tools are available for Image Comparison in various platforms, in addition to that many service vendors provide API support for image comparison that areplatform independent. Such tools can be used for detection of physical damages of the objects but those tools break down the actual image into many small images and further into a two- dimensional array of pixel, where each pixel has its own color properties. By comparingimages in this manner, the tools highlight the dissimilarities / differences. These tools require the image of original object (without damages) in similar orientation, lighting, angle, position, etc,.

For example, let us consider a scenario, where a car is damaged at a rurallocation, in such case the car should not be moved until the damage is inspected. Getting the picture of original object in the similar scene is impossible. In such scenarios, the above discussed comparison methodology will not be accurate. Hence, an application is required, that is robust and should overcome this scenario and identify thedamages irrespective of orientation, illumination and environmental lighting noises.

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1.1 FEATURE EXTRACTION

Data captured in real world applications are high dimensional and use of such data in algorithms like computer vision, object identification, objects classification etc.. yield low accuracy and overfitting of data [1], [2], [5], [7] and [9]. This issue is solved using features extracted from the images. The use of features aid in transformation invariant object detection and identification. Features are also invariant to illumination and 3D camera viewpoint in most of the cases. The complexity of feature extraction can be reduced by application of techniques like cascade filtering [1], [6], [4] and [8].

1.2 SCALE INVARIANT FEATURE TRANSFORM (SIFT)

SIFT is a method to identify salient feature points in an image. In addition to the feature points, features describing a small region around the point can also be obtained. The features thus obtained are invariant to scaling and rotation. The features thus obtained are invariant to scaling and rotation, colour of the pixel and minor image artifacts. First the key points are identified by looking for the intensity changes .Difference of Gaussians is used. As the key points are either maxima or minima in the images segments used, both location and scale of the key points can be determined. It is better to avoid the points on edges as key points. Then based on the dominant orientations of the points in a small window around the key point, its orientation are fixed. For each of the key points descriptors are determined.

HOMOGRAPHY

Homography is used to get warped versions of the original image. This is useful in applications like image rectification, image registration etc. Tow images are related to homography if both are taken from same camera but from different angle or both images are viewing the same place from a difference angle. Homography is applicable only when there is no translation.

2 SYSTEM ANALYSIS

This phase of the document contains the details of the existing systems, their drawbacks and the proposed system details that is to be developed.

2.1 EXISTING SYSTEM

There are existing off-the-shelf open source software's available for image comparison, that performs comparison with pixels of the two images under process. Some of the examples are ImageMagick, PerceptualDiff, Resemble.js, etc,. The above mentioned software's compare the image pixels and highlight the differences. The main challenge in this type of image comparison software's is that the images under comparison should be taken under similar orientation, lighting, angle and illumination [3], [7], and [9].

2.2 PROPOSED SYSTEM

Proposed system is built to compare the images by modelling the objects in theimages in 3D viewpoint and compare the corresponding objects in the other image and determine the similarities and differences irrespective of orientation, illumination, and angle of the images. The objects after comparison will be highlighted, in this case, the damages are the objects and the same will be highlightedin the image under comparison.

In addition to the damage detection, this application allows damaged image contribution feature for interested users to upload the images of damaged objects for fine tuning the dataset and increase accuracy on further usage. Each contribution will be verified manually and added to the dataset by the administrator.

2.3 REQUIREMENTS SPECIFICATION

This phase of the document contains the requirements specified for the application development and execution, both in technical and non-technical aspects.

2.3 FUNCTIONAL REQUIREMENTS

Functional requirements are product features or functions that developers must implement to enable users to accomplish their tasks. Below mentioned requirements are fundamental for application developed. Physical damages of the object are to be detected by comparing the image ofdamaged object with the dataset and highlight the damaged parts.

2.4 NON-FUNCTIONAL REQUIREMENTS

Following are the non-functional requirements considered:

Reliability:

Reliability also known as the accuracy of the results in predicting the required user attributes.

Data Integrity:

Data Integrity is the assurance of the accuracy and consistency of data over the entire life-cycle of the application execution.

Performance:

Performance is the way of functioning of the application and the extent to which the application is responsive to the app to the end-user while detecting the physical damages.

Scalability:

Scalability of the application is the potential of an application to grow in time, being able to efficiently handle more and more requests per minute.

3. SYSTEM DESIGN

This section of the document contains the UML diagram(s) createdduring the design phase of the application development.

3.1 USE CASE DIAGRAM

There are two types of users with different roles and access levels. First is the generic user, the application can be used to identify damages and highlight the same of the car by uploading the image, the output (damage highlighted) image can be downloaded for further usage. In addition to the damage detection, the generic user can contribute to dataset by uploading damaged object images in order to update the dataset for more accurate results. Second role is the admin, that will be manually validating the contributions and approve the images that are to be integrated with the dataset in order to restrict in-appropriate contributions.

Figure 1 shows the use case diagram of the application to detect physical damages of the object under comparison.

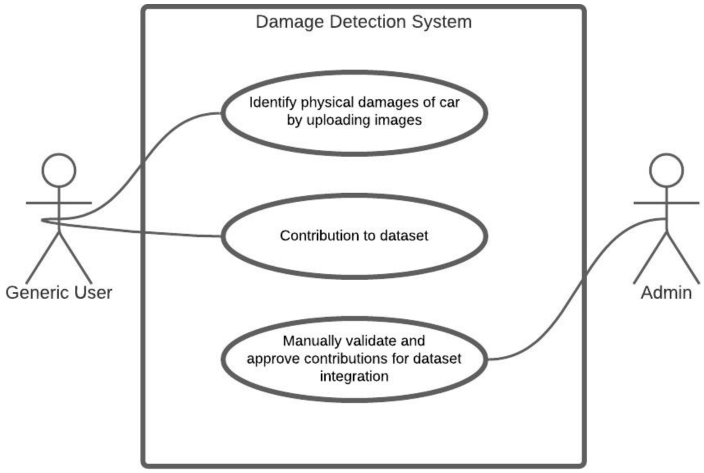

Fig 1 Use Case Diagram of the application.

3.2 FLOWCHART

Figure 2 depicts the steps involved in identifying the physical damages of the objects from uploading the image to server until the detection.

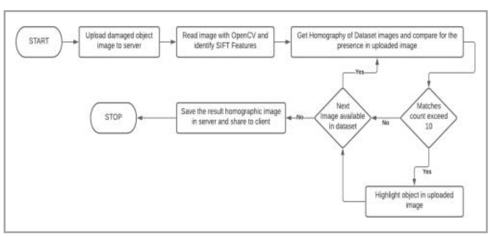

Fig 2 Flow chart of the application.

As the first step, the generic user will be uploading the image of the damaged object to the server, a copy of uploaded image will be saved in the server, later the same image will be read with OpenCV library and the SIFT features (briefly explained section 4 of the document) of the uploaded images are extracted. As next step, each image of the dataset will be iterated, homography of the objects are found and compared for the presence in the uploaded image. If the count of the matches exceeds 10, the corresponding object is highlighted and next image of the dataset is iterated. Once all the images in dataset are iterated, the result image is saved to the outputs directory of the server and link is shared to the client, from where the usercan download the highlighted image for further usage.

3.3 MODULES OF THE APPLICATION

The application consists of two modules mainly, one of them is to identify the physical damages and highlight the same, and the other module is to contribute damage object images in order to increase dataset prediction accuracy for future usage. Once the user contribution is done, the same is validated manually by the user and approved for dataset integration.

4. **EXPERIMENTAL STUDY AND DATA SET**

Experiments were conducted to test and validate algorithms proposed.

Car Damage Detection

Experiments were conducted to test and validate our proposed algorithm to show significant changes in finding the damaged parts in images while comparing with the original car image is shown in figure 4.

Figure 3 Single Car Damage Detection

Car Damage Dataset

KSGGLR Car Damage Dataset consists of images of the damaged cars. A portion of the collection is shown in Figure 4. From the image of a damaged car, the damaged portions are split and used as objects in homographic comparison.

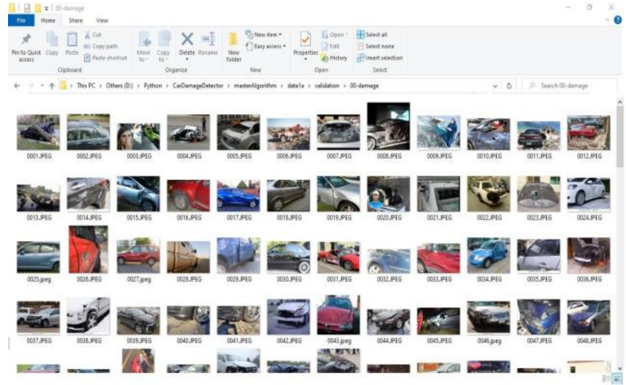

Fig 4 KSGGLR Car Damage Dataset

5 CONCLUSION

The physical damages of the objects are detected using visual intelligence and the damaged parts will be highlighted in the output image so the user would be able to analyze it efficiently for further usage. As this detection involves homographic comparison, the objects under comparison need not to be in similar angleor posture so as to identify the damage. As an additional feature, the users cancontribute damaged object images for enriching the dataset and improve the accuracy of the results on further predictions. Those contributions will be validated manually and added to the dataset only after the approval of the system admin in order to eliminate in appropriate contributions by anonymous users.

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