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Development of Image Processing Technique for Preventing Unauthorized Photography

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Abstract - *Smart phones with camera are very common these days. While visiting places such as museums, historical monuments, temples, exhibitions or places where maintaining secrecy is a big issue, user carries his smart phone with him. This system provides the solution for this undesired photography to prevent security and privacy of the site. The system will simply detect camera in photography prohibited area and then it will emit a strong light source at each device to neutralize it from capturing image or video. It is neither a health dangerous to health nor it will affect the detected camera's operation. This detection and deactivation method of camera or other optical device can be more useful in defense areas to identify possible attacks.*

Key Words: **Circular Hough transform, CCD sensor, Digital Camera Deactivation, over-exposure, Retro-Reflection etc.**

I. INTRODUCTION

Though photography is prohibited in museums, historical monuments, temples, user tend to capture images of these sites secretly, which is not significant. Considering the Piracy at theaters, Indian film industry suffers heavy losses due to it. To avoid such problems, there is a need to develop a system which will detect any digital (DSLR) camera and then neutralize image or video taken by that camera. Film industry also suffers 1/3 loss due to movie Piracy. Hence, there arises a need to prevent this undesired photography, to avoid this heavy loss. The solution is based on detecting the camera's that are capturing pictures of the site. Photography is banned at places such as museums, court rooms, shopping malls, industries, defense areas, jewelry stores etc. Preventing photography ensures the gift shop maintains a monopoly on selling images. Banning photography believes to boost security by preventing thieves or terrorists from visually capturing images in defense areas[3].

II. LITERATURE REVIEW:

There are two methods for the detection of the digital camera. The first method is based on the Circular Hough Transform. Virendra Kumar Yadav et al. have presented their study in International Conference on Electronics and Communication Systems (ICECS-2014) on the "Approach to Accurate Circle Detection: Circular Hough Transform and Local Maxima Concept". The authors wrote about method for detecting circular objects over digital images have received considerable attention from industries for applications such as detection of target detection, inspection of manufactured products etc. Finding one or several maxima considering different accumulators simultaneously and mapping the found parameters corresponding to the maxima back to the original image is key concept of proposed algorithm[6].

The second method is based on the Retro-Reflection property of the digital camera. P. A. Dhulekar, PriyankaAher et al. has presented their work in Journal of Science and Technology (JST) in 2017 on the "Arduino based Anti-Photography System for Photography Prohibited Areas". They have proposed the system for detecting and deactivating digital cameras in photography prohibited areas. This technique will locate a camera and then neutralize it. It uses image processing algorithms for detecting camera's lens. For the detection of the digital camera, they have used Retro-reflection method. Retro-reflection is returning light only within an extremely narrow-cone, with minimum scattering[2].

A.K.Veeraraghavan, S.Shreyas Ramachandran, V.Kaviarasan had presented A Survey on Movie Piracy using Automated Infrared System. According to authors, technologies like electronic device jammers which jam the operation and functioning of the device itself. This in a way prevents the camera from capturing videos and pictures. However, in places where usages of other devices like cell phones, laptops, etc are necessary, this system fails to give the suitable environment In that, they have used infrared blasters which give IR rays which are easily detectable by digital cameras. These IR blasters are inbuilt within the projector circuit, giving out IR light beams along with the visible rays of the movie projection. It is connected to a microcontroller which helps in altering the radiations frequency and wavelength characteristics. This is mainly done to neglect the use of infrared filters by a person while capturing the film using a camera. As infrared has a large bandwidth, a person would have to use a large number of filters to neglect the effect of IR, which is not feasible or possible[1].

III. PROPOSED SYSTEM:

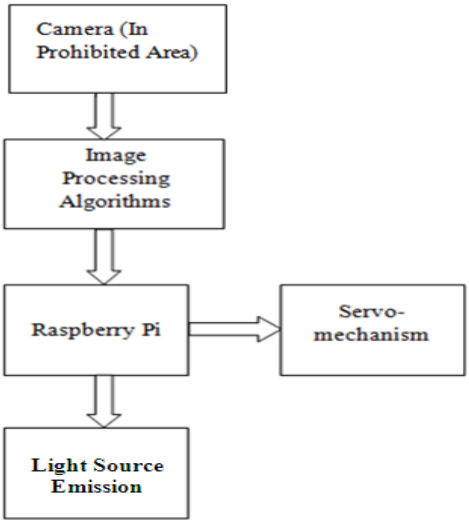

Fig-1 Block Diagram of the Proposed System

This technique is useful for detecting and deactivating digital cameras in photography prohibited areas. It consists of two parts. The first part is camera detection unit. The second part is digital image deactivating unit. Camera detection unit includes camera interfaced with PC. There is an camera in the photography prohibited area which is used to capture the image in that prohibited area. When there is an any digital camera appears in the photography prohibited area, then that digital camera is detected by using the image processing algorithms and camera in that area. The position of the lens of camera will be tracked by referring its axis value as defined in image processing algorithm.

The digital image deactivating unit consists of Raspberry Pi board, light source emission and servomechanism. Control signal from camera detection unit will be generated and sent through wireless communication to Raspberry Pi board. The Raspberry Pi board is interfaced with the MATLAB using Wi-Fi. The Raspberry Pi board will operate the servomechanism such that light source emission will point in the direction of detected lens and emit strong light source which will reduce the quality of captured image. It does not interfere with camera's operation and it is harmless to the camera user.

IV. METHODOLOGY:

The Fig-1 shows block diagram of proposed system which consists of following parts:

A. Camera(In prohibited area):

Camera will be used as an image acquisition device for capturing images in photography prohibited areas. This camera will be interfaced with computer via image acquisition toolbox in MATLAB. The data obtained from the camera is in the form of video. It can be further divided into the frames for further processing.

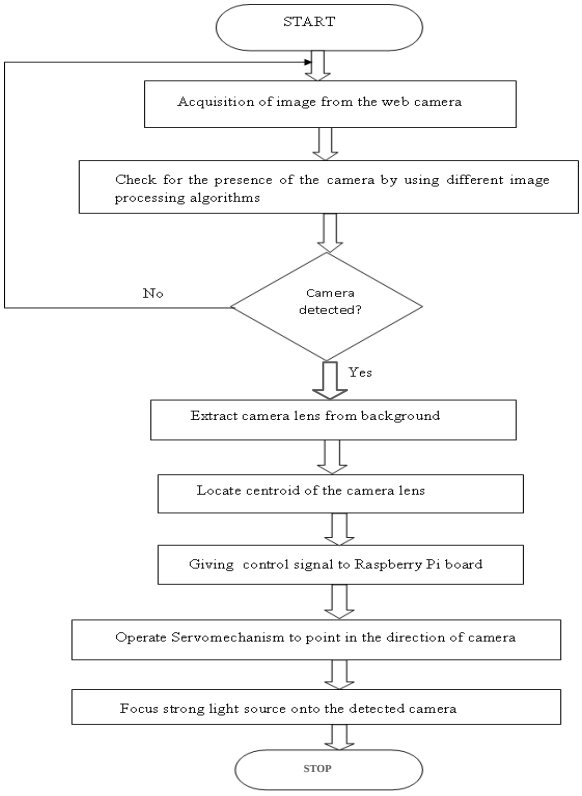

Fig-2 Flow chart of the Proposed System

B. Image Processing Algorithms:

After acquisition of images from camera, image processing algorithms are used in order to find the position of the camera. In that Circular Hough Transform is used for the detection of the digital camera.

C. Raspberry Pi 3 Board:

By using the different image processing algorithms in the MATLAB, the position of the camera lens is identified and the respective control signal is given to the Raspberry Pi 3 Board. Raspberry Pi 3 Board is used to control the servomechanism.

D. Servomechanism:

It will operate as per the control signal obtained from the Raspberry Pi 3 Board. It includes the servo motors which are moved in the particular direction in order to neutralize the camera.

E. Light Source Emission:

The Strong Light Source is placed on the servo motor. So that, strong light source will focus the strong light on to the camera lens. So that the captured image will get distorted.

V. EXPERIMENTAL RESULTS:

There are two algorithms for the detection of the camera. First algorithm is based on Circular Hough

Transform and second algorithm based on Retro-reflective property.

The algorithm based on the Circular Hough Transform consists of detection of objects having circular shapes in digital images is important for image analysis. It relies on the equation of circle. In that, minimum and maximum values of radius are defined. According to that the circular object is detected.

The Fig-3 shows the input image for the circular object detection. This is the reference input image which is used in order to detect the cameras having different radius ranges.

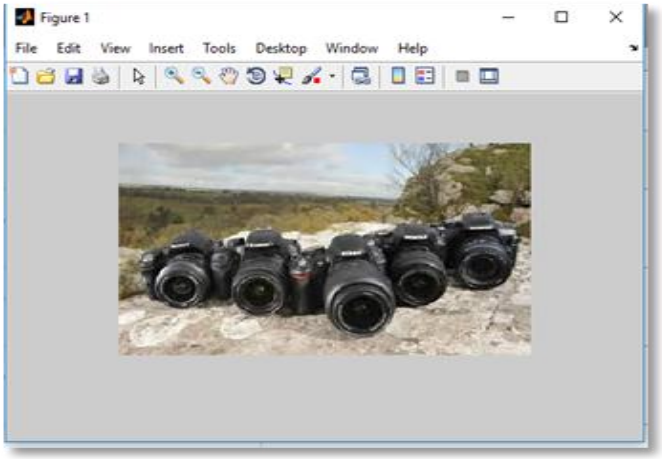

Fig- 3 Input image for the circular object detection

Fig-4 shows the cameras having radius in the range between 10-19. In that, minimum and maximum radius range is given. Here, Minimum radius is 10 and Maximum radius is 19. So, the camera in the range of 10-19 is detected. The results obtained are given as follows:

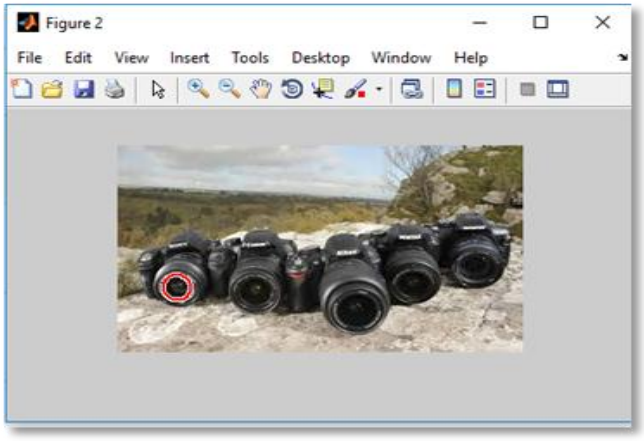

Fig-4 cameras having radius(pixel difference) in range between 10-19

Fig-5 shows the cameras having radius in the range between 15-30. In that, minimum and maximum radius range is given. Here, Minimum radius is 15 and Maximum radius is 30. So, the camera in the range of 15-30 is detected.

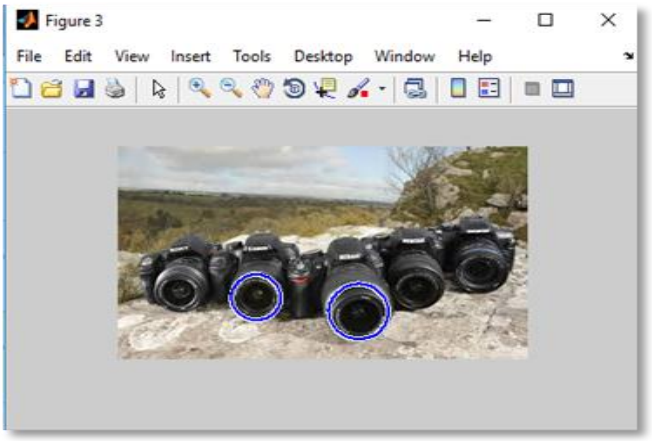

Fig-5 cameras having radius (pixel difference) in range between 15-30

Fig-6 shows the cameras having radius in the range between 12-30. In that, minimum and maximum radius range is given. Here, Minimum radius is 12 and Maximum radius is 30. So, the camera within the range of 12-30 is detected.

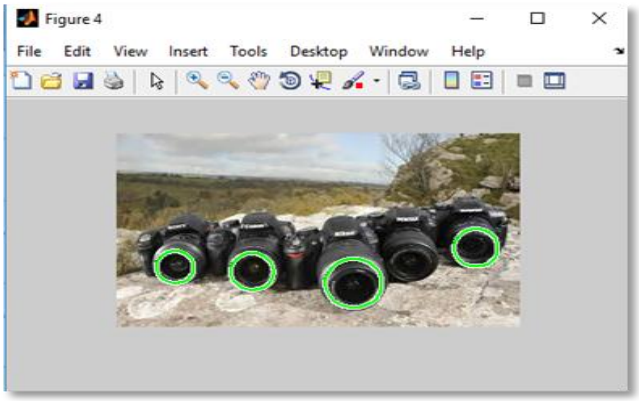

Fig-6 cameras having radius (pixel difference) in range between 12-30

Fig- 7 shows the real time captured image from the web camera. The algorithm takes 200 frames continuously and it process two frames simultaneously. Here, the camera is detected by using the circular hough transform. The Fig-8 shows that the position of camera is detected and it is indicated by blue circle.

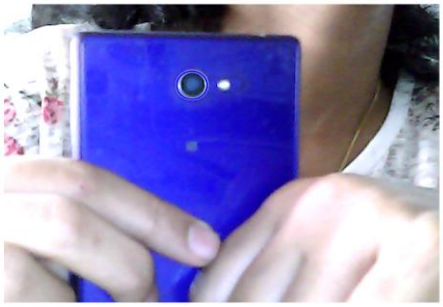

Fig-7 Real Time captured image

The algorithm which is based on Retro-reflective property uses retro-reflective property in order to detect the location of camera. Digital cameras are having the CCD sensors. The CCD sensors are having retro-reflective property. Retro-reflection causes light to reflect directly back to its source, independent of its incident angle. CCD sensors are mounted at the focal plane of the camera's optical lens. CCD cameras have an optical property that when the light incident on camera then it produces well-defined light reflections. By tracking these retro-reflections we can detect and track cameras pointed at a given area.

Retro-reflection is returning light only within an extremely narrow-cone, with minimum scattering. The IR transmitter module which surrounds the lens of web camera, will continuously transmit the IR rays in the field of view. When these IR rays strikes on camera's lens, a white circular speckle is seen in the image captured by the web camera. This white circular speckle can be seen due to the retro reflection. This circular speckle can be detected using algorithm in MATLAB.

After locating white speckle, centroid is calculated later and axis position of the camera's lens is calculated. The Fig-8 represents input image is captured by the camera. These three flashes are considered as an retro-reflections obtained by the corresponding three digital cameras.

Fig-8 Input image

The Fig-9 shows YCbCr format of the input image. The RGB image is converted into the YCbCr format. It's luminance, chrominance blue and chrominance red part is separated.

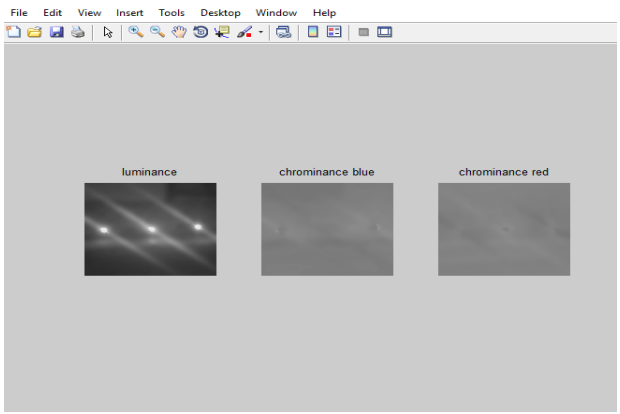

Fig.9 YCbCr format image

Fig-10 shows the binary part of the input image. The image is then converted in to binary image with the help of thresholding.

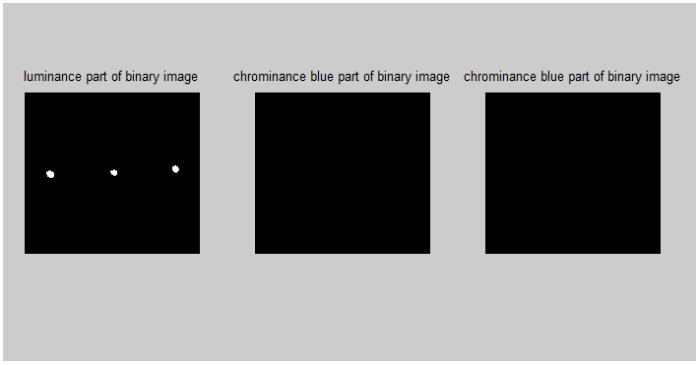

Fig-10 Binary image

In that, the area and the centroid is calculated so that it is given to the Raspberry Pi Board.

Table 1. Centroid and Area Calculation:

Sr. No.	Area	Centroid	
		X- axis coordinates (pixels)	Y-axis coordinates (pixels)
1	1431	152.54	456.95
2	976	526.33	447.48
3	1284	886.81	427.40

Table-1 represents Centroid and Area Calculation of the obtained reflections. It gives X-axis co-ordinates and Y-axis co-ordinates of the obtained reflections. It is obtained by using the image processing algorithms. Fig-11 shows the RGB image in which camera position is detected.

Fig-11 RGB image in which camera position is detected

After detection of the camera, it is necessary to neutralize the camera. This can be takes place by using Raspberry Pi 3 Board, Servomechanism and strong light source. Raspberry Pi Board has an inbuilt Wi-Fi. First to provide the interface between the Raspberry Pi 3 Board and MATLAB different support packages needs to be installed.

Fig-12 Hardware Setup

After installation of the different support packages such as support package for Raspberry Pi 3 Board, support package for Web Camera Raspberry Pi 3 Board is interfaced with the MATLAB by using Wi-Fi. Fig-12 shows the servomechanism which is used to neutralize the camera. In the servomechanism two servo motors are used. One servo motor is used for movement in the X-direction and another servo motor is used for movement in the Y-direction.

Fig-13 Distorted captured image

Fig-13 shows the captured image which is get distorted. As per the control signal obtained from the image processing algorithms Servomechanism will move towards the Camera's lens direction and strong light source(LASER) is emitted on the camera lens so that the captured picture is get distorted.

VI. CONCLUSION:

This system is used to detect the digital camera in the photography prohibited area. By using different image processing algorithms, position of camera lens is calculated. There are two image processing algorithms, first is based on the Circular Hough Transform and other is based on the Retro-Reflection method. The Raspberry Pi 3 board gives control signal to the Servomechanism. The Servomechanism operates according to control signal which are received from image processing algorithm(MATLAB). The strong light source is placed on the Servomechanism . Because of the strong light source is focused on the camera , the user gets the distorted image. This system provides many applications such as for preventing piracy at the theaters, the places where maintaining secrecy is important such as in museums, temples, Shopping malls, jewelry stores etc.

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