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Arduino based Anti-Photography System for Photography Prohibited Areas

Pravin Dhulekar[1], Swapnali Choudhari[2,] Priyanka Aher[3], Yogita Khairnar[4]
[1,2,3,4] *Department of Electronics and Telecommunication, Sandip Institute of Technology and Research Centre, Nasik, Maharashtra, India*

Abstract : *Digital cameras and smart phones with cameras are very common these days. These cameras used CCD sensor, which is responsible for converting light falling on it into equivalent electric charge and process it into electronic signals. When we visit places such as banks, courts, theatres etc. people tend to capture images of the site which interferes with the privacy of the site owner. This paper aims at a solution which will detect the cameras which are interfacing with privacy or security of site owner. After detection of camera a strong light source i.e. LASER will be focused onto that camera's lens, the highlighted content of the image will be distorted due to overexposure of light. Result shows the implementation of this proposed solution.*
Keywords - *Digital camera, smart phones, CCD sensor, LASER, over-exposure.*

I. INTRODUCTION

It is Supreme Court justices themselves who have been the most vocal opponents of allowing cameras into courtroom. The no-photography policy is not limited just to India. But it is a worldwide phenomenon. Photography is banned at places such as museums, court rooms, shopping malls, industries, defence areas, jewellery stores etc. Eliminating use of cameras in such places improves visitor experience. Preventing photography ensures the gift shop maintains a monopoly on selling images. Banning photography is believes to boost security by preventing thieves or terrorists from visually capturing and pinpointing weakness in alarm systems and surveillance. Also, taking photographs after violates copyright protection. 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. This paper presents solution for this undesired photography to prevent security and privacy of the site. Our solution is based on detecting the camera's that are capturing pictures of the site. After detection of camera's a strong light is focused onto detected camera, which degrades the quality of the captured image, thus rendering the captured photograph useless.

II. LITERATURE REVIEW

The detection of digital cameras or other optical devices in the background could help military forces to detect possible attacks. By scanning the surroundings with a laser beam, a relatively strong retro reflection signal is created by an optical sight that is pointed the direction of the laser source [1].In 2005, a group of four people Khai N. Truong, Shwetak N. Patel, Jay W. Summet, Gregory D. Abowd published their results in Springer-verlag Berlin, Heidelberg of 7th International Conference on Ubiquitous Computing. System implementation includes use of Sony digital handy-cam video camera. This camera was held in night shot mode. The lens of this handy-cam was surrounded by IR-transmitter and narrow band pass IR filter. This arrangement projects IR radiations in field of view, due to retro-reflection lens appears as a bright white circular sparkle through the handy cam (capturing device). The detected reflection in located by tracking the bright regions in handy cam above some luminance threshold. For neutralizing camera, 1500 lumens projector which emits localized light beam at each detected camera [2].In 2014, Virendra Kumar Yadav, Saumya Batham, Anuja Kumar Acharya published their results in Electronics and Communication Systems. They used Circular Hough Transform and Local Maxima concept for detecting multiple circles. These results can be used to track circular lens of a camera. [3]In 2014, Panth Shah, Tithi Vyas published their results in International Journal of Engineering Research & Technology (IJERT), which are based on interfacing between Arduino for Object Detection Algorithm. These results can be used to locate the axis value of camera's lens and passing those values by serial communication to Arduino [4].

III. PROPOSED SYSTEM

Our system involves two sections: First section is camera lens detection section which is based on image processing and second section is camera neutralizing section which is based on a controller and servo motor movements. Both these units will be in synchronization with each other. Fig. 1 shows proposed system.

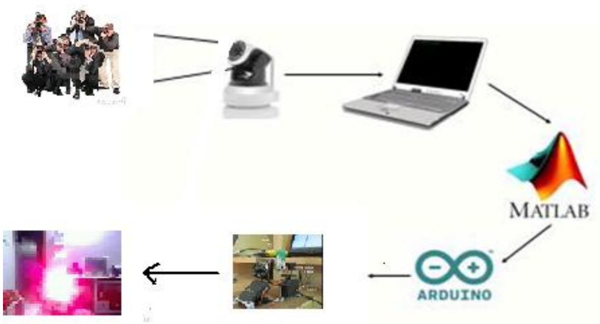

Fig. 1. Proposed System

A. Camera lens detection section:

*Th*is section consist of a web camera of resolution 1280*720 pixels and IR transmitter module. This module have specifications: 36 IR LEDs (850nm), 90 degree view, range (40-50m).The result were obtained in a square room 10*10m. Web camera is used to acquire the video of the room. The camera is interfaced with the laptop or PC using Image acquisition toolbox MATLAB 2015a. The web camera's lens is surrounded by the IR transmitters.

First step is to get video feed from camera which is connected to the laptop. This video is then converted into sequence of frames. These converted frames will undergo further image processing. 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. Retro-reflection is returning light only within an extremely narrow-cone, with minimum scattering. This circular speckle can be detected using thresholding. The luminance threshold can be set nearer to bright white speckle. Thresholding can be done using MATLAB 2015a. After locating white speckle, centroid is calculated later and axis position of the camera's lens is calculated.

B. Camera Neutralizing Section:

Second part consist of camera neutralizing unit which consist of strong light source for e.g. LASER, servomechanism and a controller (Arduino). The axis position will be sent to Arduino via serial communication. Arduino will give this control signal to the servomechanism. A strong light source will be mounted on the servomechanism. When camera's lens will be detected by camera detection section, the control signal will be sent to Arduino and servomechanism will rotate in that direction and focus strong light onto camera's lens.

IV. BLOCK DIAGRAM

Block diagram consists of following parts:

A. Web Camera

The first stage of any vision system is an image acquisition device. Web camera will be used as an image acquisition device for capturing images in photography prohibited areas. This web camera will be interfaced with computer via image acquisition toolbox in MATLAB. The image acquisition toolbox enables modes such as processing in loops, hardware triggering, background acquisition, etc. The obtained data will be in the form of video. The video will be divided into frames for further processing.

B. Image Processing Algorithms

After acquisition of images from the web cam, position of lens can be detected by identifying the distinct features of the camera lens. This can be done by using different image processing algorithms

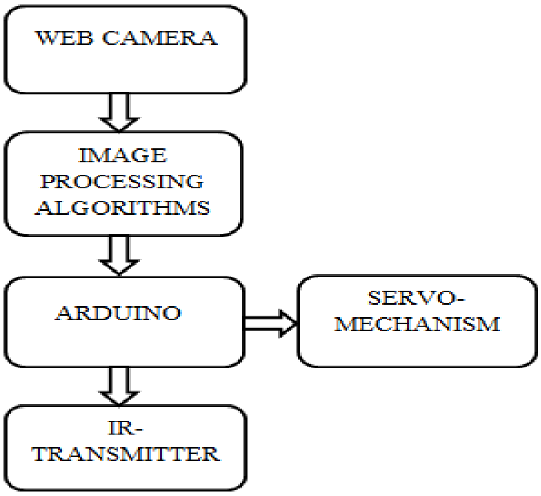

Fig 2. Block Diagram

C. Arduino

Image processing algorithms identifies the camera lens and generates control signal. The control signal will be sent to the Arduino to control the servomechanism movement. The mode of communication between the MATLAB and Arduino will be serial communication via COM Port.

D. Servomechanism

Servomechanism will operate as per the control signal received by the Arduino board. Servomechanism controls the direction of IR transmitter. It includes the servomotors interfaced with the Arduino board so that IR transmitter can point in each and every direction.

E. IR- Transmitter or Strong Light Source

R transmitter or IR LED plays an important role in the camera disabling part. With the control of servomechanism IR transmitter point to the direction of camera and it will reduce the quality of captured image.

V. METHODOLOGY

We developed a new method for solving the problem of digital camera detection. The process of camera detection is based on Image Processing Algorithm. Here, web camera is used as an image acquisition tool. The web camera can be inbuilt camera or any other USB camera. The MATLAB command imaqhwinfo can be used to get detail of hardware interface with it [5]. The whole procedure can be divided into several parts:

A. Image Acquisition

The initial step is to feed the video from the web camera. The video is captured by the web camera having resolution 1280*720 pixels continuously. The video is then converted into sequence of frames. The converted sequence of frames will undergo further image processing algorithm. Here, web camera performs role of image acquisition toolbox. In the sequence of the frame each 5^{th} frame of video is considered for the processing.

B. Detection of camera

Circular shape object detection is very much important for image analysis in various computer vision application. For detecting circular camera lens the circular object detection method can be used. The algorithm for detecting camera's lens can be written in image processing software such as MATLAB. The define algorithm can detect circular shape as well as position of detected lens.

C. Locating camera

After detecting the camera's lens from the background the exact position of the lens can be detected by calculating the centroid. The X-Y axis values are calculated for locating the centroid of the detected camera lens then according to the axis value the control signal is given to the Arduino to operate the servomechanism.

D. Neutralizing camera:

Servomechanism plays vital role in neutralizing the detected camera. Servomechanism is interfaced with the Arduino board. On the servomechanism a strong point laser is mounted to operate as per the control signal sent from Arduino. The laser have alternatives such as IR transmitters or any other strong light source. The only duty of laser is to degrade the quality or fine details of the image by using over- exposure property of light. And the requirement of the strong laser of any other strong light source is that the intensity of strong light source must be greater than background light.

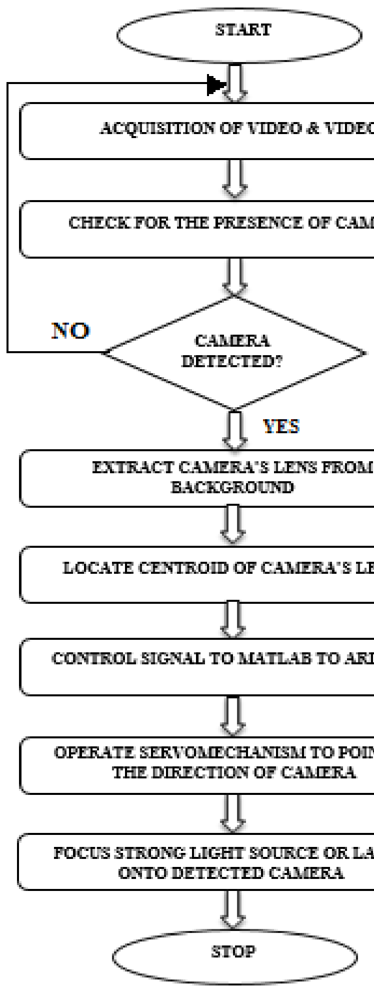

Fig. 3 Flow Chart

VI. EFFECT OF OVER-EXPOSURE ON IMAGES

When camera lens will be located it has to be neutralized by using infrared transmitters or strong light source. Since this beam is of high intensity as compared to the other light incident on the lens from the image, the camera tends to be overexposed. After this effect the photograph will be distorted. This will contribute in loss of fine details of image rendering it useless.

Example of overexposure on image by point laser:

Fig. 4 shows normal image. Fig. 5 Shows overexposed image which is obtained by manually pointing a laser towards camera's lens. Fig. 6 shows over-exposed image when the point laser is exactly focused at the center of lens.

Fig. 4 Normal Image

Fig. 5 Over- Exposed Image (a)

Fig. 6 Over-Exposed Image (b)

VII. Implementation

The prototype of the system is as shown in the Fig. 7.

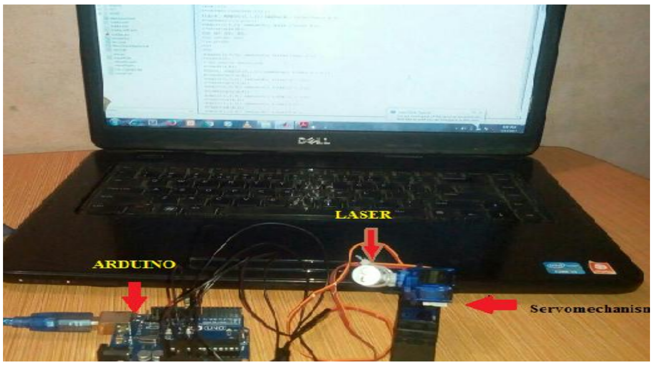

Fig. 7 Implemented System

VIII. Conclusion

The main objective of project is to detect and disable digital cameras in photography prohibited area using image processing algorithms and servomechanism. The image processing techniques are used to locate the position of multiple cameras in prohibited area. It locates the lens of multiple cameras but it neutralizes the only one camera lens. The axis values of camera lens received by controller. The servomechanism rotates according to control signal which are received from controller. Because of the strong light source or LASER focused on centroid of camera, the user gets the distorted image. This work will beneficial in the areas such as theatres for prevention of piracy. It has many application which includes maintaining secrecy at defense areas, courts, industries, government offices, research and development sectors, museums, historical monuments, religious places etc.

IX. FUTURE WORK

The main objective of this work was to prevent unauthorized capture of images and videos in a photography prohibited areas. This solution cannot distinguish between the authorized cameras and unauthorized cameras. Hence, further work involves allowing the capture of images to authorized camera. It can be achieved by putting a glyph sticker to the authorized camera as shown in figure. This glyph sticker can be placed just below the lens of that authorized camera. The pattern of glyph can be recognized using image processing algorithms. A suitable algorithm can be developed to allow such authorized photography.

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