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*A project on*  
**“ARDUINO BASED ANTIPHOTOGRAPHY SYSTEM IN PHOTOGRAPHY  
PROHIBITED AREAS”**

*Submitted by*

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# INTRODUCTION:

- Photography is the skill, job or process of producing photographs.
- It is an art of creating images by means of light sensitive material or by using electronic digital cameras.
- Photograph is a picture made using a camera, in which an image is focused on to light-sensitive material and then made visible and permanent by chemical treatment, or stored digitally.
- In general, photography means, 'writing with light' or 'painting with light'. In today's common definition, to make a photograph is to capture an image, and make it immortal on a 2-D plane.
- Perhaps the opposite of a photograph would be to 'Delete with darkness' also termed as Anti-photography.

- Photography is restricted in some areas such as military areas and museums to avoid illegal access to the video content, images or any copyright information.
- The court and defense areas avoid photography to avoid confidential information leakage which can show serious effects in security.
- The miniature cameras available nowadays are misused today by taking photographs in photograph prohibited areas.
- Although there are strict rules and regulations to avoid such unauthorized photography, not much success was found by enforcing these laws.
- An alternative way is needed to prevent these undesired photography.
- Automatic detection systems are used in many areas today such as fire detection, theft detection, intruder detection etc to avoid manual approach of detection.

- The proposed work presents a solution for this undesired photography to prevent security and preserve privacy of the site.
- The 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.



*Figure 1: Normal image*



*Figure 2: over exposed images by a laser point*

# LITERATURE REVIEW

1. In 2006, “Modeling the detection of optical sights using retro-reflection” work was proposed by the author named L. Mieremet, Ric.
  - This work focused on the detection of digital cameras or other optical devices in the background that could help military forces to detect possible attacks.
  - By scanning the surroundings with a laser beam, a relatively strong retro reflection signal was created by an optical sight that pointed the direction of the laser source [1].

2. In 2005, the author Khai et al proposed a work titled "Preventing camera recording by designing a capture resistant environment".

- This work included 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 is 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]



3. In 2014, the author named Panth Shah proposed a work titled “Interfacing of MATLAB with Arduino for Object Detection Algorithm Implementation using Serial Communication”.

- Main aim of this prototype system was to detect an object, track it and accordingly set digital pin of Arduino board HIGH or LOW.
- Using MATLAB, object detection algorithm has been developed with the technique of thresholding.
- RGB component of any object is read and accordingly threshold values is set which eventually make an object, a white spot and rest background black.
- Taking this white spot in consideration, an algorithm for tracing an object was developed  
and successfully implemented on a hardware using serial communication [3].

## PROBLEM DEFINITION:

In photography prohibited areas such as defense areas, museums, courts where security is needed to prevent the highly confidential sites.

- During exhibitions, one cannot avoid each and every individual from taking photography of each monument with the human help as it takes some time to identify that person and stop him from capturing that image.
- In defense areas, the image can be captured from any corner of the border security.so, it cant be avoided or prohibited completely by just providing a human security.

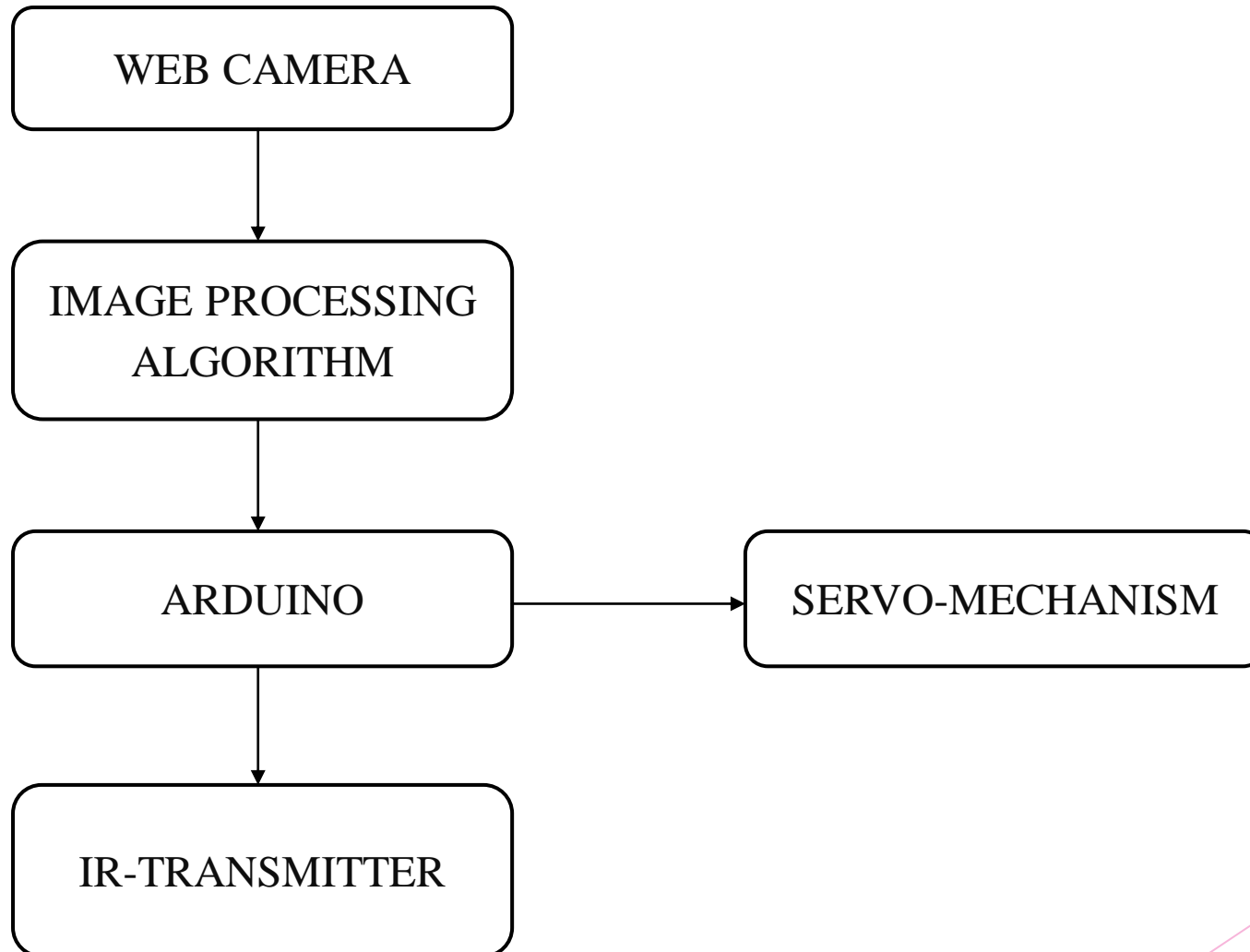
## SOLUTION:

- This prototype helps in solving this problem by detecting such kind of photography and make it useless by over exposing technique with the help of a laser beam.

## OBJECTIVES:

- To understand the existing system of digital camera detection.
- To implement the web cameras or USB cameras in photography prohibited areas that aims at a solution which will detect the cameras which are interfacing with privacy or security of site owner.
- To implement the real time module for the proposed method from the above anti-photography system using Arduino.
- To develop Arduino based anti-photography system that aims to detect and disable the cameras in photography prohibited areas using image processing algorithm and servomechanism.
- To test and validate the proposed working prototype with the existing system.

## BLOCK DIAGRAM:



*Figure: Block diagram of a prototype.*

The proposed working prototype consists of following parts:

**1. Web Camera or USB 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.
- One frame is selected from that video and it undergoes the pre-processing.

## 2. Image Processing Algorithms:

- After acquisition of images from the web cam, it acquires the skeleton coordinates and tracks the skeleton of a person.
- Then by detecting the forward and backward movement of a person's hand the camera is detected with the help of calculating the width and height of it.
- Position of camera can be detected by calculating the ratios of width and height of the detected rectangular object. This can be done by using different image processing algorithms.

## 3. Arduino Image processing algorithms:

- It identifies the camera 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.

#### 4. 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.

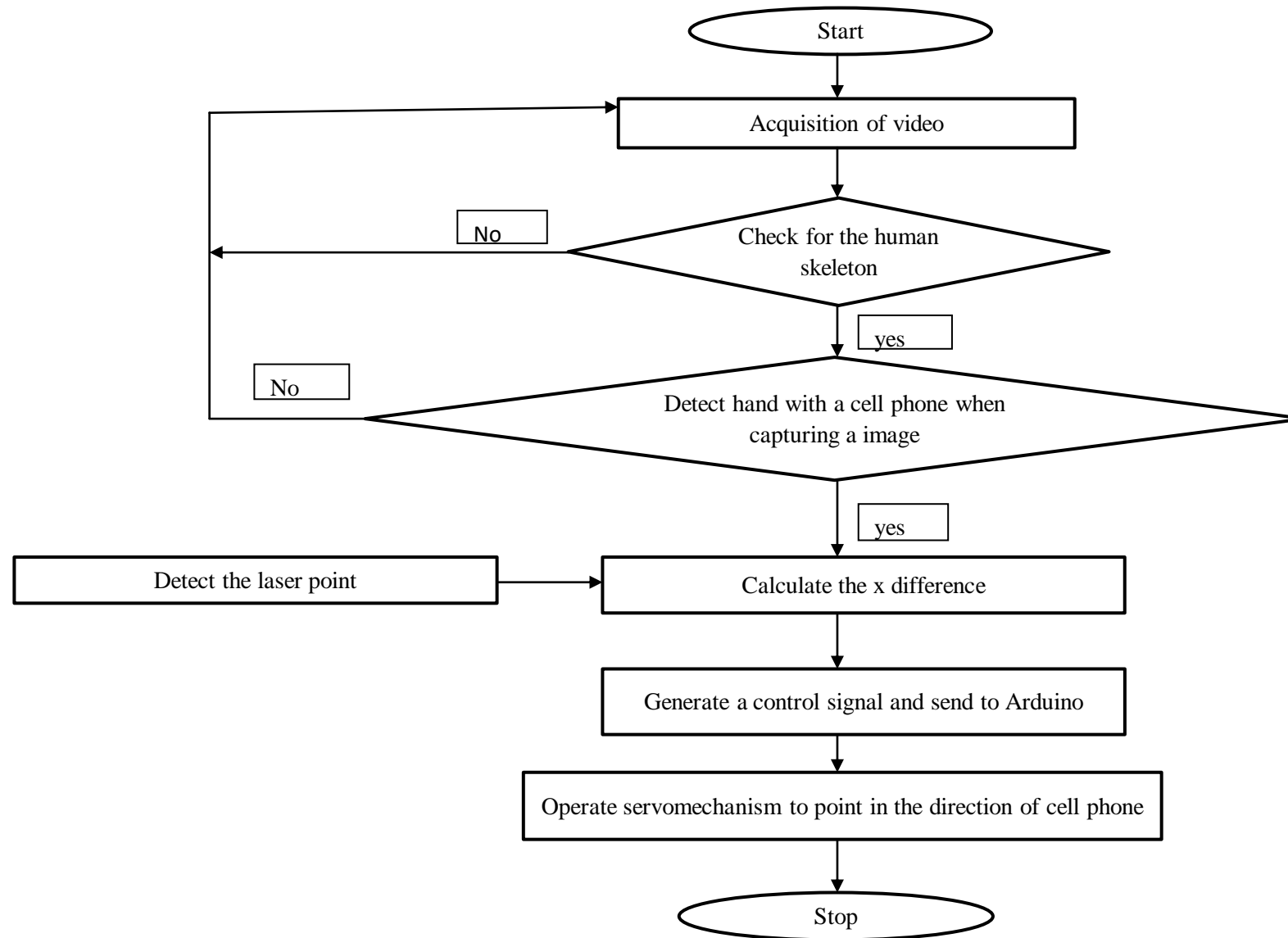
#### 5. IR-transmitter or strong light source:

- IR 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.

# METHODOLOGY

- The proposed working prototype provides a new method for solving the problem of camera detection.
- The methodology to implement the proposed Anti-Photography system.
- It starts from continuous video acquisition of the place under investigation. The video is then converted into sequence of frames.
- The converted sequence of frames will undergo further image processing algorithm.
- 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 image info can be used to get detail of hardware interface with it.





*Figure : Flowchart of the proposed work*

The whole procedure is divided into several parts:

1. Image acquisition
2. Detection of camera
3. Locating the camera
4. Laser point detection
5. Integrating both the detected camera and the laser point to neutralize the camera.

#### ➤ 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 one frame of video is considered for the processing.

## ➤ DETECTION OF THE CAMERA:

- After image acquisition the web cam performs the acquisition of skeletal coordinates and tracks it in order to identify the skeleton of a person.
- Then by observing the forward and backward movement of the persons hand with the help of skeletal coordinates it detects whether the person is holding the camera hand or not.
- Rectangular shape object detection is very much important for image analysis in various computer vision application.
- For detecting rectangular shaped object the rectangular object detection method can be used.
- The camera is detected based on its shape .i.e, a rectangular object
- The algorithm for detecting camera can be written in image processing software such as MATLAB. The defined algorithm can detect rectangular shaped object or a camera as well as its position.

## ➤ DETECTION OF CAMERA LOCATION:

- After detecting the camera from the background the exact position of that can be detected by observing the movement of a right hand of a skeleton with respect to its forward and backward movement .
- The ratio of width and height of the detected camera is calculated and then according to the axis value and specified threshold value the control signal is given to the Arduino to operate the servomechanism.
- So, finally the web camera detects the person who is trying to capture an image with exact location of that object.

## ➤ LASER POINT DETECTION:

- 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 has alternatives such as IR transmitters or any other strong light source.

- 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.
- As the laser is mounted on a servomotor and it rotates in degrees as per the control signal obtained from the Arduino.
- The laser is rotated in degrees left or right angularly with the help of code generated to move a laser.
- The web cam detects the laser point by running the arduino servo code. So, laser point is detected.

## ➤ INTEGRATING BOTH THE DETECTED CAMERA AND THE LASER POINT:

- After the camera and the laser point are detected. Both are integrated by calculating the x-displacement between them.

- As per that it sends the control signal to the Arduino to move the laser point towards the camera.
- The over exposed light from the laser will disable the captured image.
- Later on it undergoes the neutralization process which signifies antiphotography.

#### ➤ EFFECT OF OVEREXPOSURE ON IMAGE:

- When camera is 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.

# HARDWARE REQUIREMENTS:

- Processor: Intel Pentium III Processor or higher versions
- RAM: 2 GB
- Storage: 80 GB HDD
- Web Camera
- Photographic camera
- Arduino board
- Servo motor
- Laser light source

## ❖ HARDWARE IMPLEMENTATION:

### ➤ WEB CAMERA OR DEPTH CAMERA (KINECT Xbox 360):

- Kinect is a line of motion sensing input device that was produced by Microsoft for Xbox 360.
- It is a combination of Microsoft built software and hardware.
- It is a horizontal bar connected to a small base with motorized pivot and is designed to be positioned lengthwise above or below the video display.
- The device features an “RGB camera, depth sensor and multi-array microphone running propriety software, which provide full-body 3D motion capture and facial recognition”.
- It makes use of a propriety connector combining USB combination with additional power.
- The hardware is capable of resolution upto 1280\*1024 (at a lower frame rate) and other color format such as UYVY.



- Kinect camera is used to identify the camera which is being hold by the person.



*Figure: Kinect camera*

- As per the information supplied to the retraces , Kinect is capable of simultaneously tracking up to 6 people including two active players for motion analysis with a feature extraction of 20 joints per player.

➤ DIGITAL CAMERA(MOBILE PHONE):

- This is used by the user to take the photograph.
- Rectangular shaped object is detected as mobile phone camera.



*Figure: sample of detectable users mobile phone camera.*

## ➤ SERVOMOTOR :

- It is a 2D high speed motor with high torque as it can bear the load around 5-6kg.
- Angle rotation- it rotates angle wise (eg:2 degrees). This motor runs through pulse width modulation (PWM).
- It is a direction controlled device.
- MG996R motor is used in this work, as it a large motor which has the capacity of baering high load
- The motor is powered by a battery or any regulators . It requires a power range of around 4.2 to 7.5V. Current range required to run the motor is 1.3or 1A.
- The program is generated regarding the PWM pins to run MATLAB programs.
- It consists of three wires: Brown-ground, red-5v, yellow-control signal



*Figure : Servomotor*

- The laser beam device is will be mounted on the rotating part of the servomotor to provide angular movement to the laser device.

## ➤ LASER DEVICE:

- A laser is a device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation.
- The laser has alternatives such as IR transmitters or any other strong light source.
- It is used to project accessing of infrared beam to the user's camera.

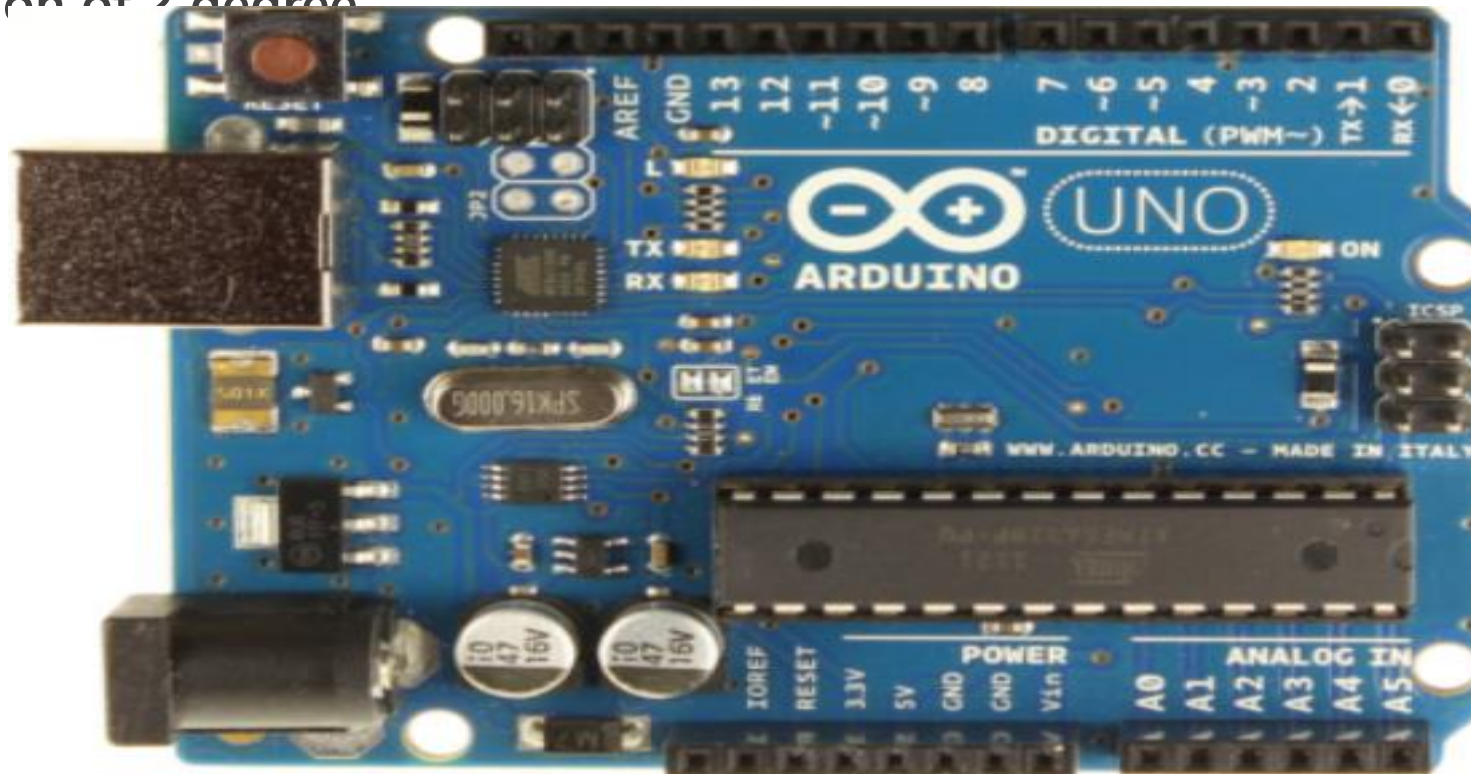


*Figure : laser point source.*

## ➤ ARDUINO UNO BOARD:

- It is a microcontroller board consisting of a ATMEGA 328P microcontroller along with some interfaces.
- This is used to control in/ out devices. It requires the power supply of 12v/5v DC.
- It consists of a USB interface that is used for communication and is powered by 5V.
- It consists of a 13 pins micro IC:
  - Power pins – 1 Vin and 2 Gnd pins, 5V pin-output , Iref-reference voltage.
  - Analog pins – 8 channel ADC with 1024 bit resolution. Power supply-0 to 5v.
  - Digital pins – 0 to 13 pins, used to read and write the output data, '~'-PWM pins(11,10.9.6.5 &3).
  - Serial communication pins – UART consists of a 8 bit data along with start and stop bits. It consists of FT232RL chip that converts the USB signal to UART signal for communication.

- Pin number 9 is configured as control pin in the Arduino. The program is developed with respect to this PWM pin to provide control signals for the servomotor to rotate the laser source towards the detected camera in a specific direction in terms of angular rotation of 2 degrees.



*Figure : Arduino Uno board.*

## SOFTWARE REQUIREMENTS:

- Operating System: Windows XP/200.
- Programming Tool: MATLAB.



## EXPECTED OUTCOME

- The proposed work is expected to present solution for undesired photography that prevents security and privacy of the site.
- Easily detects the digital cameras that are capturing the images of that site with respect to its shape.
- The proposed work is beneficial to maintain secrecy at some highly confidential sites such as defense areas, theaters for prevention of piracy.

## ADVANTAGES

- Detection of a camera is faster.
- Reduces the human errors.
- Time consuming.
- Simple in design.
- It will be more helpful to provide high security for confidential sites.

## LIMITATIONS

- Exact location of a camera's lens is not possible due to the limited components, as 3-d motors are unavailable in the market right now and it is also speed limited-no special high speed processors to respond faster.
- This prototype is designed just to detect one camera at a time.multiple camera detection is not possible due to limited off shelf components.

## SIMULATION RESULTS:

### ❖ LASER BEAM CALIBRATION TESTING:

#### ➤ The ideal testing scenarios:

- Case 1:- within more light- all the brighter parts at the background will be detected as a laser points. In that case we get the command as more than one laser points are detected. It is difficult to point out the exact laser beam point.



*Figure : testing to detect the laser point within more light.*

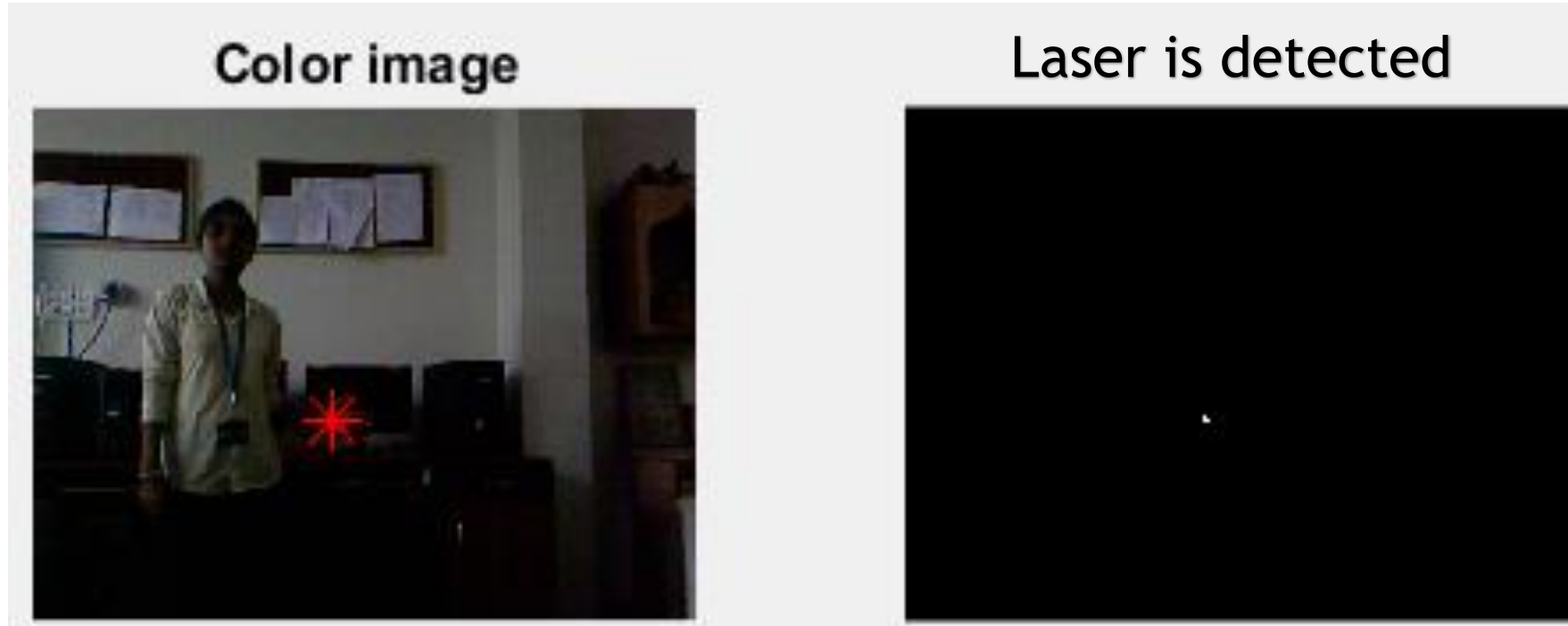
- Case 2: within medium light- in this case less number of beams will be detected. Due to the detection of shiny particles at the background.

More than one laser point detected



*Figure . Testing in medium light to detect the laser point.*

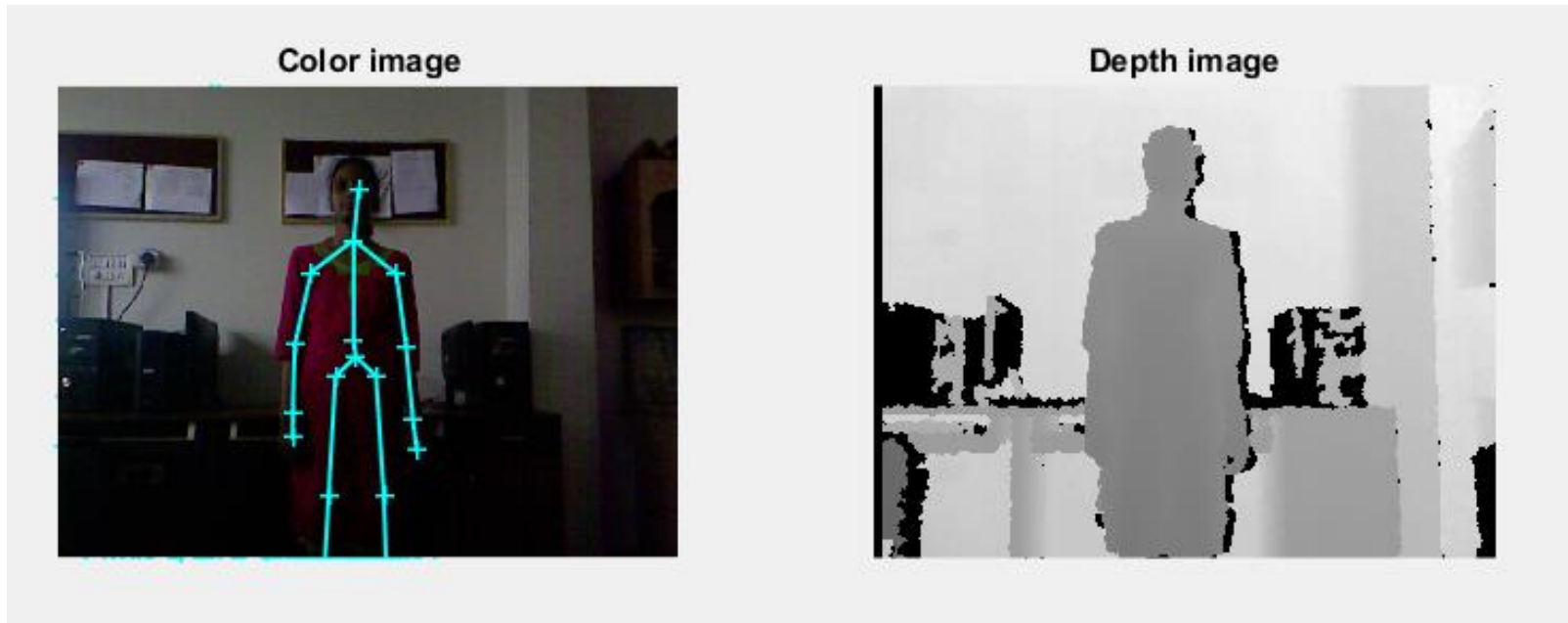
- Case 3: uniform background and uniform lightening condition with ideal threshold case. It will identify the central object position.



*Figure : Testing in lower light to detect the laser point.*

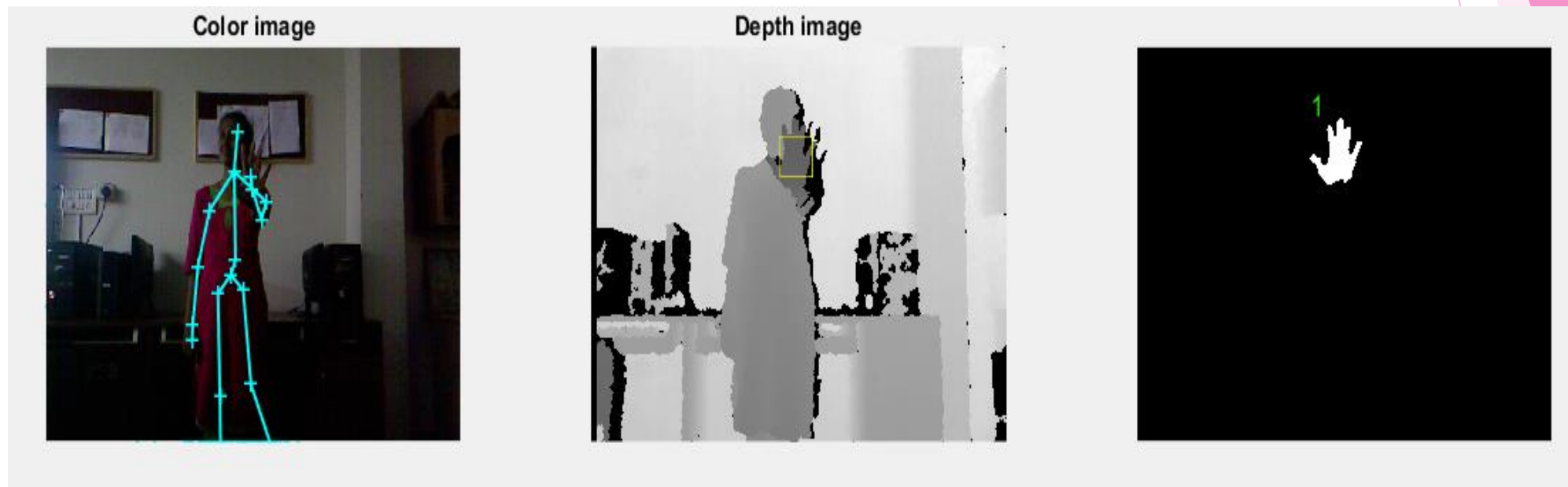
## ❖ DEPTH CAMERA TESTING:

- To detect the person who is trying to capture the image:
- Initially it identifies the person.
- After that it tracks the skeleton.



*Figure : Testing to Track the skeletal coordinates of a person by the depth camera.*

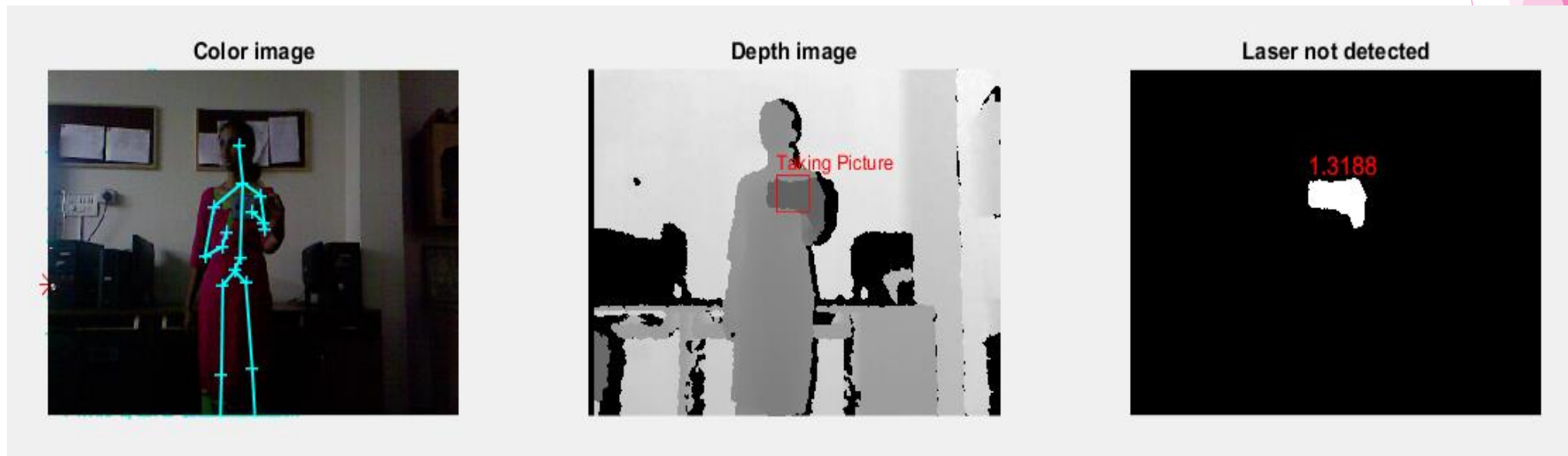
- To detect the presence of rectangular object in a person's hand:
  - Hand should be at the level of specified threshold value
  - It checks whether the object is placed in a person's hand, if not it signifies that the person is not trying to capture any images.



*Figure : Testing to detect the presence of camera in the persons hand.*

❖ TO DETECT THE CAMERA IN A PERSON'S HAND:

- It checks for an object in persons hand after that a shape of that object will be found.
- The camera calculates the width and height of that object.
- When the rectangular object is detected after that it will display that "TAKING THE PICTURE".



*Figure : Testing to detect a specific camera that is involved in capturing an image.*



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*Thank  
You!*



Any queries

