ARDUINO BASED ANTIPHOTOGRAPHY SYSTEM IN PHOTOGRAPHY PROHIBITED AREAS

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 project 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.

CHAPTER 1

An Anti-Photography System for Photography Prohibited Areas

1.0 Overview:

Photography is an art of creating images by means of light sensitive material or by using electronic digital cameras. No photography policy is a worldwide phenomenon, it is banned at some specific places such as museums, court rooms, shopping malls, industries, defense areas, jewellery stores etc. Banning photography is believes to boost security by preventing thieves or terrorists from visually capturing and pinpointing weakness in alarm systems and surveillance. It is also major threat to the cinema industry due to piracy problems which creates huge losses in this industry. The courts 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 unauthorized photographs in camera prohibited areas.

Digital cameras and smart phones with cameras are very common these days. These cameras used Charge Coupled Device (CCD) sensor, which is responsible for converting light falling on it into equivalent electric charge and process it into electronic signals. Although there are strict rule and regulations to avoid such unauthorized photography, but not much success was found by enforcing these laws. Hence, an alternative way is needed to prevent this 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 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.

For detecting and deactivating digital cameras in photography prohibited areas a new technique is introduced, IR based image processing technique. This system will locate the maximum number of cameras by using image processing algorithms. The detected cameras will be deactivated using IR transmitters. [12]

1.1.1 IR Transmitter based Anti-Photography System:

The system will consist of two parts: Camera detection unit and Camera deactivating unit. Camera detection unit includes web cam interfaced with PC. Web cam will be used to capture the images of prohibited area. The position of the camera lens will be monitored by identifying and tracking distinct features of the lens. An algorithm which is used for the detection of camera lens will be written in any image processing software like MATLAB. Position of the lens of camera will be tracked by referring its axis value as defined in image processing software. Second part is IR transmitter and servomechanism. Control signal from camera detection part will be generated and sent through serial communication to IR transmitter. IR transmitter will be used to reduce the quality of the captured image. It will be fitted on to the servomechanism. After detection of camera lens and its position a signal will be sent to IR transmitter will point in the direction of detected lens and emit strong IR rays which will reduce the quality of captured image. The number of lenses can be counted by using object counting algorithm based on image processing on real time basis.

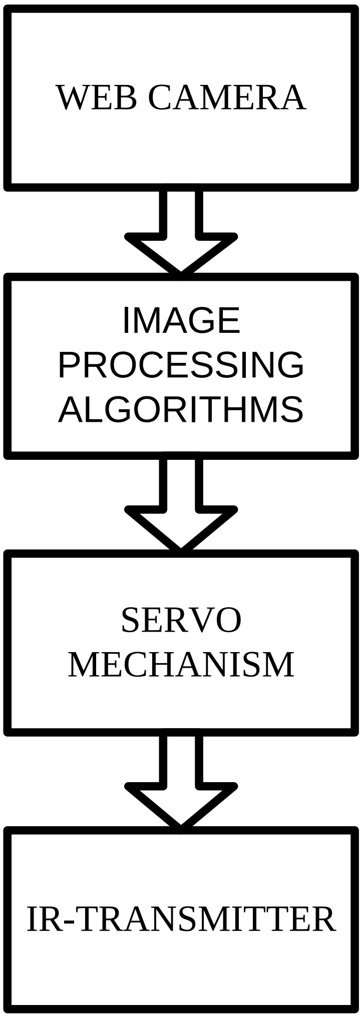

Figure 1.1 Block Diagram of Anti-Photography scheme

Figure 1.1 shows the block diagram of Anti-Photography technique. These are the stages for designing a techniques to detecting and deactivating digital cameras, mobile phones cameras in photography prohibited areas which are based upon image processing.

I. 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.

II. Image Processing Algorithm:

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

III. Servomechanism:

Servomechanism controls the direction of IR transmitter. By the help of servomechanism IR transmitter point in each and every direction.

IV. 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.

1.1.2 Circular Hough Transform (CHT):

Detecting circular objects over digital images have received considerable attention from industries for applications such as detection of pellets in pelletization plant, target detection, inspection of manufactured products etc. A technique for circle detection is the Circular Hough Transform (CHT) and its variants. The Hough transform can be described as transformation to the parameter space from X, Y-plane.

Mathematically equation of circle in x, y-plane is given by,

$$r^2 = (x-a)^2 - (y-b)^2 \qquad (1)$$

Where r is the radius of the circle and a, b are the center of the circle. Equation 2 and 3 are parametric representation of the circle.

$$x = a + r \cos \Theta \qquad (2)$$

$$y = b + r \sin \Theta \qquad (3)$$

The circle has three parameter r, a and b, hence the parameter space will belong to R^3.

When applied traditional CHT technique to industrial images which is obtained from Pelletization plant, the results obtained contains many false circles which may be due to pellets which looks similar to circle but not exactly the circle. For such type of real industrial images we extended the concept of local maxima to different accumulators. Concept of Safe House is also proposed to obtain more accurate results. This paper presents an algorithm which works for this type of real images with enhanced accuracy of detection. The figure 1.2 shows the parametric space representation of a constant radius circle.

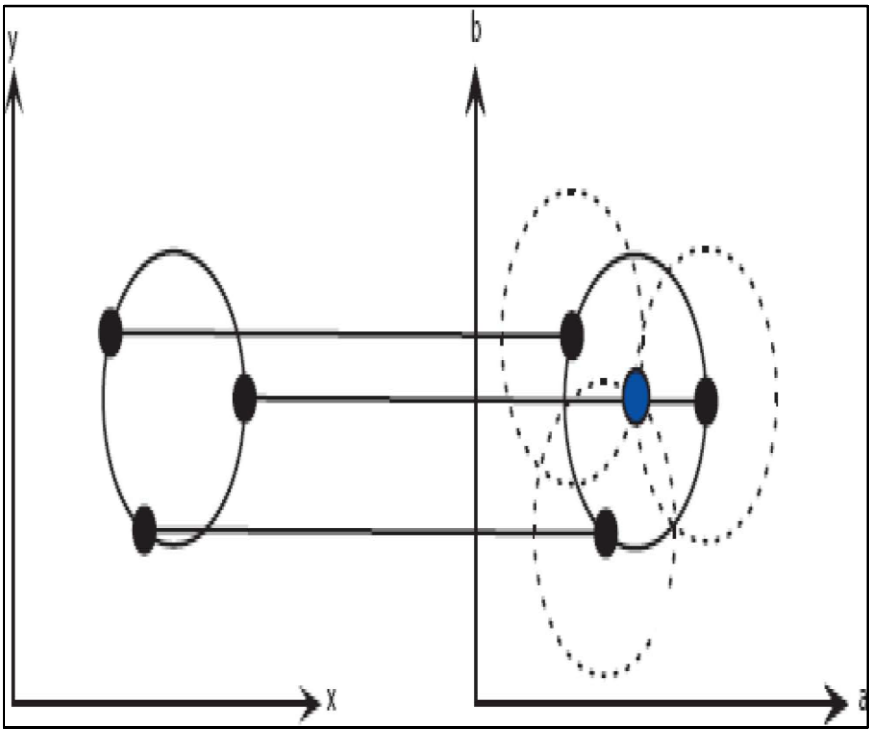

Figure 1.2 Parametric space representation of a constant radius circle

If distance between coordinate which is in the safe house and coordinate which is under consideration is greater than distance threshold, then move the coordinates under consideration to safe house along with the corresponding cell value. If distance calculated is found less than threshold then the coordinate having greater cell values is considered to survive, coordinate having less cell values need to be discarded. Safe house will contain the much more accurate result.

1.1.2.1 Algorithm for detection accurate center object:

Proposed algorithm to Detect center and radii is as follows:

i. Get the edge map of the image using canny edge detector technique.

ii. For each edge point Taking edge point as center with radius r (r € radius range), draw a circle. At the coordinates which lie on the perimeter of the drawn circle in parametric space, increment the value in accumulator matrix.

    / / collecting votes in accumulator (cell values)

iii. Repeat step-2 for all edge points and all radii defined in radius range.

    / / confirmation of candidature

iv. For each maxima found Compare maxima of that accumulator to their consecutive previous and next accumulators.

v. Found parameters (r, a, b) corresponding to local maxima in step-4, map these to original image.

1.2 Objectives

The objectives for the project work is as follows

- To review the various works related to the existing photography prohibition system.

- To design an anti-photography system to avoid taking photography images in prohibited areas.
- Develop a Camera lens detection algorithm using image processing, which detects the presence of camera lens from video.
- To develop a neutralizing system that can avoid taking pictures either through signaling the security personnel or by corrupting the images taken by the camera.

1.3 Hardware and Software requirements

- Hardware Requirement specification:
    - 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
- Software Requirement Specification:
    - Operating System: Windows XP/2000
    - Programming Tool: MATLAB

1.4 Applications:

- Rretroreflective Tape.
- Camoflash.
- Eclipse’s Laser Shield

1.5 Organization of report:

The organization of Dissertation is followed as below. The Chapter-2 contains Literature survey providing information of the works done with respect to the chosen subject. Chapter-3 describes the System design of the proposed method for “Anti-Photography System”. The design details of the complete system are presented here. Chapter-4 and Chapter-5 describes about “Hardware and Software Requirements”. Chapter-6 describes the dissertation conclusion. Chapter-7 presents the Conclusion of the report.

CHAPTER 2

Review of literature

2.0 Preface

This chapter talks about the conventional research works exclusively carried out to detect and disable digital cameras in photography prohibited area using image processing algorithms and servomechanism. Finally the study extracts the research gap after reviewing different conventional studies.

2.1 Review of literature:

Rad et al. [1] has concentrated on the issues related with to find circles which are totally brighter or darker than their backgrounds. Detecting lines and circles in an image is a fundamental issue in image processing applications. The Circle Hough Transform (CHT) has become a common method for circle detection in numerous image processing applications. Because of its drawbacks, [1] has presented a size invariant method to find circles that are totally brighter or darker than their backgrounds called Fast Circle Detection (FCD) method. The experimental results show that the FCD is more than thousand times faster than the CHT and about eighty times faster than the edge oriented CHT in case of 512x512 resolution images. The FCD has good resistance against noise and its accuracy is not affected until 25% salt & pepper noise is applied to the image.

In the study of Lukas et al. [2], has propose a new method for the problem of digital camera identification from its images based on the sensor's pattern noise. To identify the camera from a given image, consider the reference pattern noise as a spread-spectrum watermark, whose presence in the image is established by using a correlation detector. The camera identification method based on a sensor's pattern noise proposed by [2]. The proposed identification method uses the pixel non-uniformity noise which is a stochastic component of the pattern noise common to all digital imaging sensors. The presence of this noise is established using correlation as in the detection of spread-spectrum watermarks. The reliability of camera identification are investigated from image processed by using Joint Photographic Experts Group (JPEG) compression and in-camera resampling. The experimental results were evaluated using False Acceptance Rate (FAR) and False Rejection Rate (FRR) error rates. The proposed method was successful in distinguishing between two cameras of the same brand and model.

Retro-reflection can be used for the detection and classification of optical systems. The probability of detecting sights over large ranges depends on parameters of the laser, the sight, the detector and the atmosphere. So Mieremet et al. [3], has discovered a software tool that simulates a sight detection system. With the use of this tool can 'test' different sight detection system designs and make estimations on detection ranges of optical systems. Retro-reflection techniques are also considered for communication with UAV’s and for Identification Friend or Foe (IFF) techniques. In these applications the retro-reflected signal is modulated by a corner cube to transfer information. The final overcome shows that the proposed technique allows us to make accurate predictions about the possibility to detect optical sights over distances of several kilometres.

Mingzhu and Huanrong [4], has addressed issues in Circle detection and ascertaining its parameters are an important task in computer vision and pattern recognition. The method Hough transform is usually applied in this process, but this algorithm is too complex, slow and needs abundant memory especially when deal with complicated background image with interferential information. To overcome this problem, [4] described a new algorithm to detect the circle’s center and radius. Select an initial point in the region of the circle image, and then track the pixels in the horizontal and vertical direction to two border pixels. According to the coordinates of the circle center's position and radius can be calculated. That result shows that the principle of this algorithm is simple, the calculation is accurate and the error is very small. So this method is very practical.

A novel algorithm is introduced by S. Mukherjee and D. Mukherjee [5], to track multiple circular objects present in a video using Helmholtz perception principle. First, segmentation of circular objects in the video frame is performed using the perception principle and then same perception principle is applied to track the circular objects. For each circular object present in video, taken an assessment of the meaningfulness of the shift of its center of gravity and meaningfulness of the deviation of the direction of movement of the object due to inter-frame displacement. The Helmholtz perception principle method requires parameters which are problem specific and their selection is straightforward. The tracking performance is significant given that most of the circular objects present even in the frames of noisy video could be detected and tracked.

The advantages of digital photography are like, the compactness of the cameras, high reliability, ease of image processing, and transmission of the images via the internet or multimedia messaging. These processes emphasize a big problem which is the ability to photograph an object without the approval of its owner. This unsolved problem has many aspects: the right to privacy, industrial intelligence, and the need to protect objects which have high security sensitivity. Schwarz et al. [6], has describes a method of sensing and then disrupting digital imaging by using a controlled radio frequency transmission. This method can be used in order to create a system that causes a localized malfunction of a digital camera in a specified area so that it will degrade photographic recording done by the digital camera.The given method is used to detect and to disrupt the operation of imaging Charge Coupled Devices (CCD) and Complementary Metal–oxide–semiconductor Technology CMOS sensors. In the CCD sensors, the horizontal pixel rate is the critical frequency for detection and disruption purposes but the vertical pixel rate frequency also has its significance. The CMOS sensors can be detected in the same way as the CCD sensors, but larger field intensity is needed for disruption. Radio-Frequency Identification (RFID) techniques can be used to enlarge the distance and the disruption cover area, specifically with CMOS sensors.

In the study of Li et al. [7], has defined a circle object recognition method based on monocular vision for the home security robots is proposed. This vision system is able to process image and recognize a colour ball rapidly. The proposed method consists of two sub-modules, which are the object segmentation module and the circle detection module. In the object segmentation, the colour feature is applied to find out the region of the object. After the region of the object is determined, a fast randomized circle detection (RCD) method is applied to check that there are enough radius points which all points in the same circle of region. Because of the double detection process, this system can improve the precision for detecting a coloured ball. The experimental results illustrate the effectiveness of the proposed method. It has capability of image processing in real-time and recognizes a coloured ball accurately but without enormous algorithm.

Shah and Vyas [8], has introduced a novel algorithmic approach for object detection using image processing and manipulation of the output pin state of Arduino board with ATmega 8 controller by tracking the motion of the detected object. The main goal of this prototype system is to detect an object, track it and accordingly set digital pin of arduino board high or low. By the help of MATLAB, object detection algorithm has been developed with the method 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 is developed and successfully implemented on a hardware using serial communication. The result show that after using this prototype system, image processing based person counting machine or any such counting mechanism can also be developed. Moreover, using object detection. Different image processing in one frame can also be possible. MATLAB and Arduino ATmega8 board make this system effective.

Yadav et al. [9], has explained that several algorithms were proposed in past few years to detect circular features. One powerful approach for circle detection is the Circular Hough Transform (CHT) and its variants. The [9] presents an algorithm which is based on CHT and Local Maxima concept. 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. Experiments were performed on real industrial images to validate the efficiency of proposed algorithm regarding good accuracy of detection. The result obtained after implementation of traditional CHT will have surely the number of false circle greater than the result which is obtained after the implementation.

Real time object tracking is a challenging task due to dynamic tacking environment and different limiting parameters like view point, anthropometric variation, dimensions of an object, cluttered background, camera motions, occlusion etc. In the study of Kale et al. [10], has developed new object detection and tracking algorithm which makes use of optical flow in conjunction with motion vector estimation for object detection and tracking in a sequence of frames. The motion vector estimation technique can provide an estimation of object position from consecutive frames which increases the accuracy of this algorithm and helps to provide robust result irrespective of image blur and cluttered background. The use of median filter with this algorithm makes it more robust in the presence of noise. The obtained results indicates that the developed algorithm over performs over conventional methods and state of art methods of object tracking.

The study carried out by Seo and Kim [11], presents an efficient edge detector architecture for circle detection using Hough transform. The architecture adopts the scan line-based ball detection algorithm for the edge detection stage and edge-flag algorithm for the voting process. To bolster the performance of the voting process, when drawing a circle, we divide it into 16 sub-parts and compute the parts in parallel. The proposed design employs an internal memory block for the edge list. The proposed circle detection engine improves processing speed by reducing the number of external memory accesses, eliminating complex numerical computations such as trigonometric functions, and processing pipelined modules in parallel. The simulation results shows that the benchmark images in the VGA size of 640 x 480 are processed within 10ms, which indicates that the proposed architecture can satisfy the speed requirements of most real world applications.

Dhulekar et al. [12] has propose a new technique is IR based image processing technique for digital camera deactivation in photography prohibited area. A new technique for detecting and deactivating digital cameras in photography prohibited areas. This technique will locate a camera and then neutralize it. It uses image processing for detecting camera's lens. The directed infrared light causes strong reduction in the quality of the image. It does not interfere with camera's operation and it is harmless to the camera user. This system will locate the maximum number of cameras by using image processing algorithms. The detected cameras will be deactivated using IR transmitters. The work proposed by [12], has applications such as preventing piracy at theatres. Will serve beneficial at places such as museums, industries, historical monuments, exhibitions, changing rooms, shopping malls, jewellery stores where maintaining secrecy is big issue.

In the study of Thomaz et al. [13], has addressed to solve the problem of video surveillance using moving cameras by representing the video data as a low rank projection on a union of subspaces (UoS) plus a sparse residue term. The efficiency of the mcRoSuRe-A method demonstrating that it is able to cope with challenging scenarios in much less processing time than the other methods in mcRoSuRe family, while attaining qualitatively similar results.

Depending on the size of the videos, the method was shown to be able to run up to 2.6 times faster than mcRoSuRe-TA and 100 times faster than the original mcRoSuRe algorithm, placing it among the fastest methods for anomaly detection in moving-camera videos. The outcomes show that the algorithm was shown to perform well in this database attaining the best average performance in all tests, reaching an average rate of 0.91 of true positive detections and around 0.33 of false positive detection, having the best compromise among the tested methods.

CHAPTER 3

SYSTEM DESIGN

This chapter details the design aspects of the proposed Anti-Photography system. The aspects include model of the proposed system, the operation flow of the proposed system design and their flowchart and algorithmic implementations.

3.1 Anti-Photography System Model

The Anti-photography system proposed is described with the help of a system block diagram as shown in figure 3.1. The proposed Anti-photography system is capable of performing two tasks i) camera lens detection section which is based on image processing ii) camera neutralizing section which is based on a controller and servo motor movements. Both these units will be in synchronization with each other.

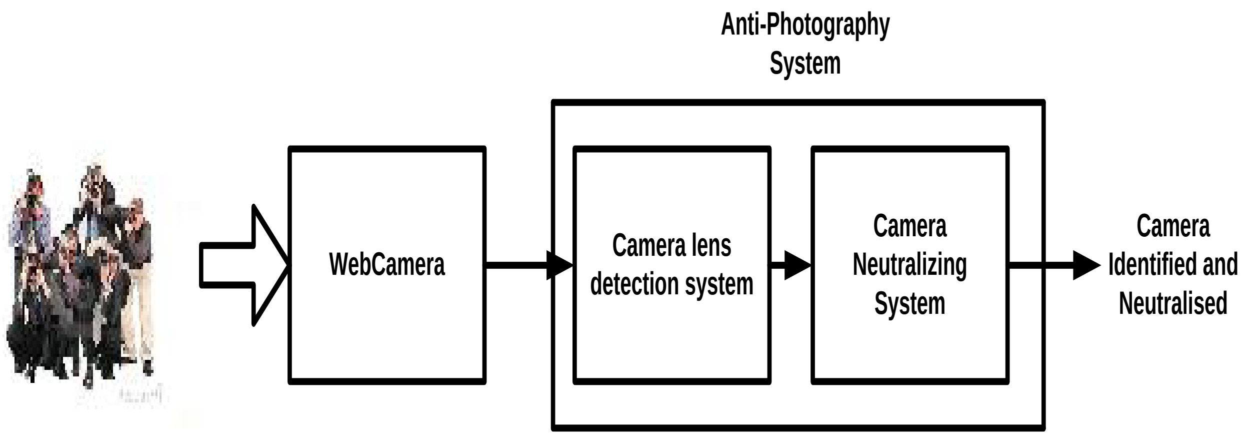

Figure 3.1 Block diagram of the anti-photography system

i. **Camera lens detection section:** This 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.

ii. **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.

The Anti-Photography system architecture presents in figure 3.2 below:

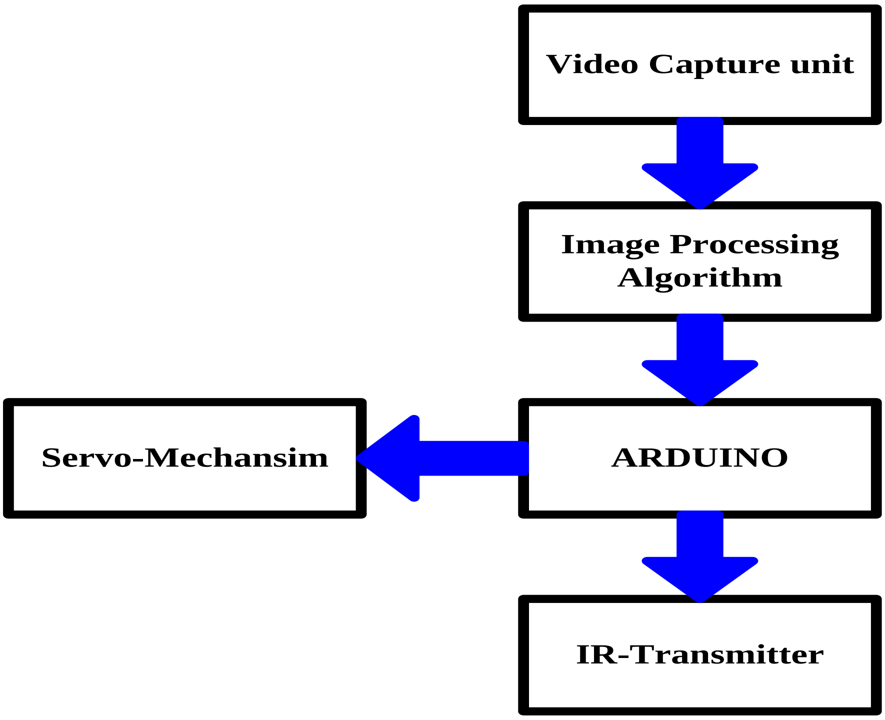

Figure 3.2 The Anti-Photography System architecture

The system architecture contains following steps:

3.2 Video capture unit

The Video Capture unit is a block used in the proposed automation system to capture the video frames from the users making the actions with the intention of controlling the devices. This unit provides the recognition system the necessary information to identify a particular video based HMI. A Kinect sensor is used as a Video capture unit in this system to provide the necessary video information.

3.2.1 Kinect Sensor

Kinect sensor is a high resolution depth and RGB sensing device mainly used for object tracking, object detection, human activity analysis, Hand video based Human Machine Interface (HMI) analysis, 3D mapping and Face expression detection. It mainly consists of an infrared projector, the color camera, and the IR camera. The Output from the Kinect sensor is the RGB and depth information that will be fed as input to the Video based HMI recognition system. The complete hardware details of this sensor are discussed in chapter 4.

3.3 Image processing algorithm

The process of camera detection is based on Image Processing Algorithm. Here, kinect camera is used as an image acquisition tool. The MATLAB command imaqhwinfo can be used to get detail of hardware interface with it. After acquisition of images from the web cam, position of lens can be detected by identifying the distinct features of the camera lens.

3.3.1 Recognition system

A Recognition system is implemented as a software system. This system is implemented as a Matlab code which runs on a host PC. The recognition system uses the depth information obtained from Kinect sensor to track the motion and identify the video based HMI. The depth information is used to track the skeletal structure of the video frame. The coordinates of the skeletal structure are then obtained from which the right hand, left hand and shoulder coordinates of the skeletal structure are obtained. Since the system will be designed for the hand video based HMI recognition, the distance features of the right hand are calculated. The distance features are calculated for right hand as the difference between the (x,y,z) coordinates of right hand and (x,y,z) coordinates of shoulder. These features are fed as an input to the Fuzzy Inference system, which makes decisions based on certain threshold levels and takes suitable actions for the made decision. The actions of the system can be in the form of displaying certain text or sending control information to other units for device control.

3.3.2 Data Acquisition from Kinect

The application must also be able to acquire the capabilities (such as the depth stream, the color stream, skeleton stream) needed from the Kinect sensor which is essential for the successful implementation of the proposed system. This is done by enabling through coding the *ColorStream* component of the Kinect which provides the RGB video stream; the *DepthStream* which provides the 3D representation of the image in front of the sensor and enabling the *SkeletonStream* which is used for acquiring the skeleton data.

3.3.3 Obtain Skeleton Coordinate value

The skeletal tracking features of Kinect combined with the NUI library allow users and their actions to be recognized. A human body is represented by a number of joints representing body parts such as head, neck, shoulders, and arms. Each joint is represented by its 3D coordinates.

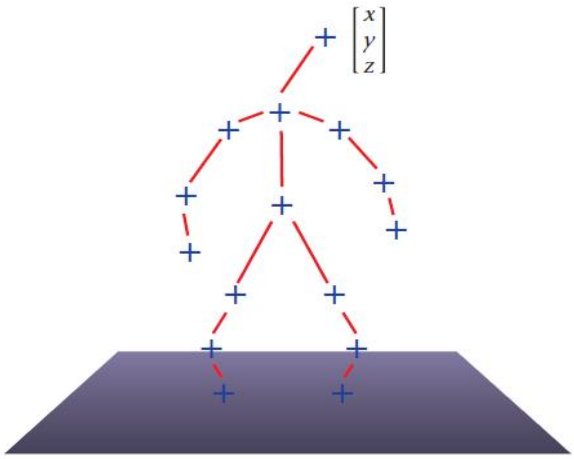

Figure 3.3 Skeletal structure representation

Software running on a PC uses the depth image obtained from Kinect sensor, decodes it and recognizes the elements in image as human body shapes. The software has been “trained” with a wide variety of body shapes. It uses the alignment of the various body parts, along with the way that they move, to identify and track them. After skeleton tracking, the position of each joint in 3D space is returned by the NUI library in the format of X, Y and Z coordinates expressed in meters according to the skeleton space coordinate system.

3.3.4 Fuzzy Inference system

Fuzzy Inference System is the key unit of a fuzzy logic system having decision making as its primary work. It uses the "IF…THEN" rules along with connectors "OR" or "AND" for drawing essential decision rules. The output from FIS is always a fuzzy set irrespective of its input which can be fuzzy or crisp. A defuzzification unit would be there with FIS to convert fuzzy variables into crisp variables.

I. Functional Blocks of FIS

- Rule Base − It contains fuzzy IF-THEN rules.
- Database − It defines the membership functions of fuzzy sets used in fuzzy rules.
- Decision-making Unit − It performs operation on rules.
- Fuzzification Interface Unit − It converts the crisp quantities into fuzzy quantities.
- Defuzzification Interface Unit − It converts the fuzzy quantities into crisp quantities. Following is a block diagram of Fuzzy Inference system.

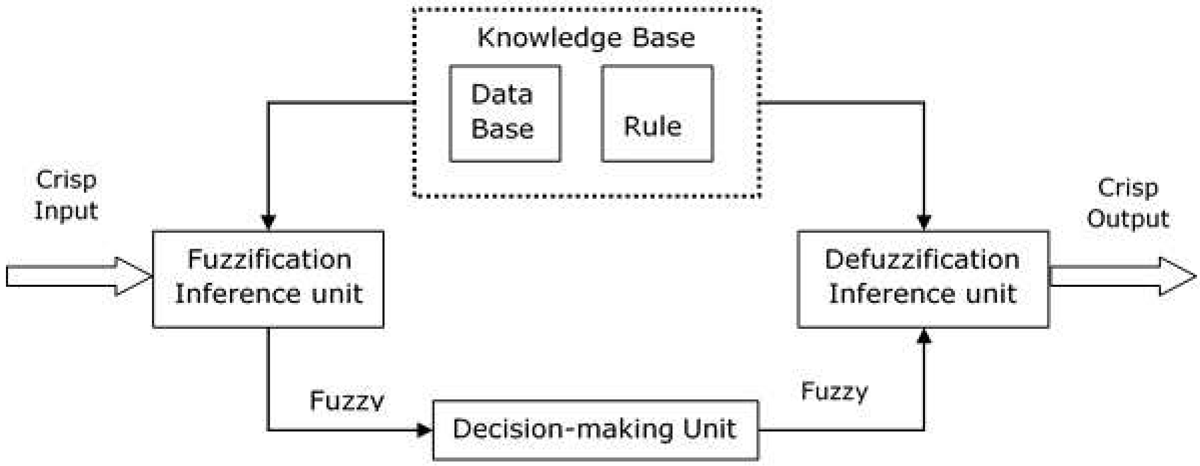

Figure 3.4 Block diagram of Fuzzy Inference system

II. Steps for Computing the Output

Following steps need to be followed to compute the output from this FIS −

- **Step 1** − Set of fuzzy rules need to be determined in this step.
- **Step 2** − in this step, by using input membership function, the input would be made fuzzy.
- **Step 3** − Now establish the rule strength by combining the fuzzified inputs according to fuzzy rules.

- **Step 4** − in this step, determine the consequent of rule by combining the rule strength and the output membership function.
- **Step 5** − for getting output distribution combine all the consequents.
- **Step 6** − finally, a defuzzified output distribution is obtained.

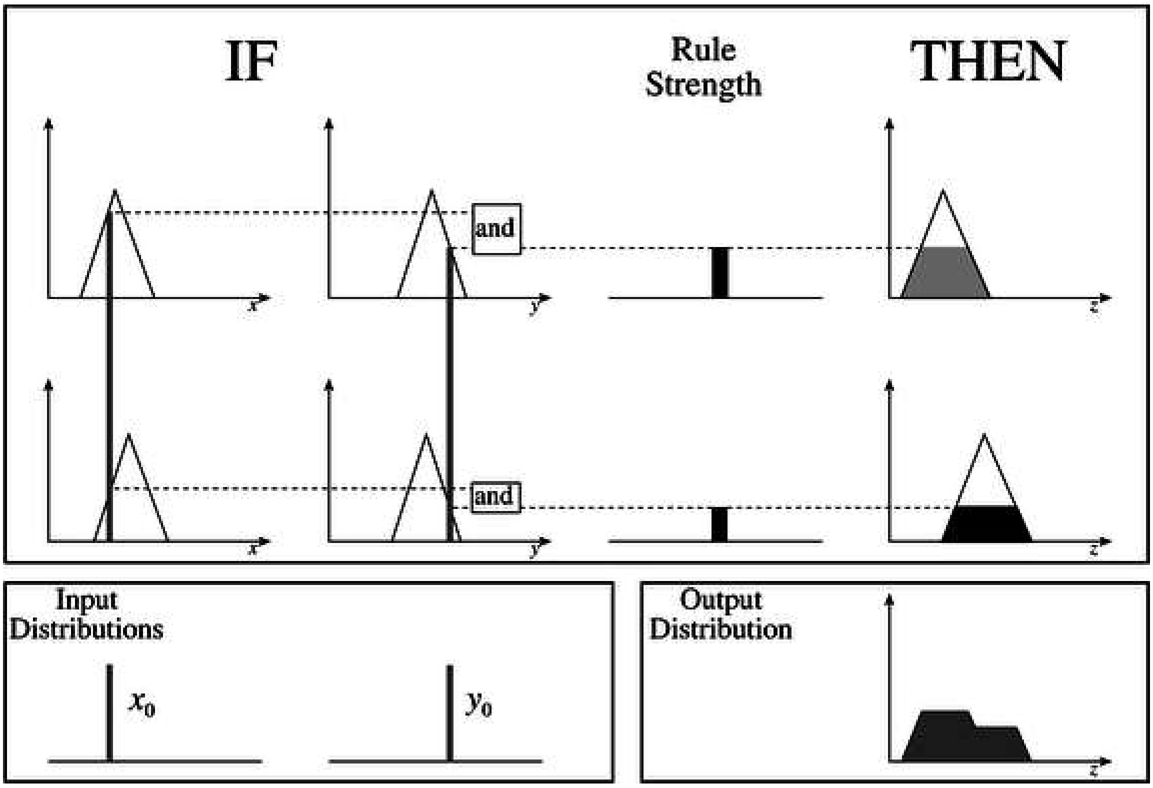

Figure 3.5 Block diagram of Mamdani Fuzzy Interface System

3.3.5 FIS Design

1. The FIS system is designed with four input variables dxR, dyR, dzR and dxL. Each of the four variable represent the x, y,z coordinates of Right hand and left hand.
2. Defining Membership function

The member functions for each of the variable defined is described here.

i. **Membership function for dxR**:The function for dxR is defined such that it is Low upto 0.2 and high above 0.337 and any value in between 0.2-0.337 is fuzzy. In Figure 3.7 shows the membership function for dxR variable

ii. **Membership function for dyR**: The function for dyR is defined such that it is Low upto -0.4, medium between -0.3 to 0.3 and high above 0.4 and any value in between -0.37 to -0.45 and 0.24 to 0.42 is fuzzy. In Figure 3.8 displays the membership function for dyR variable.

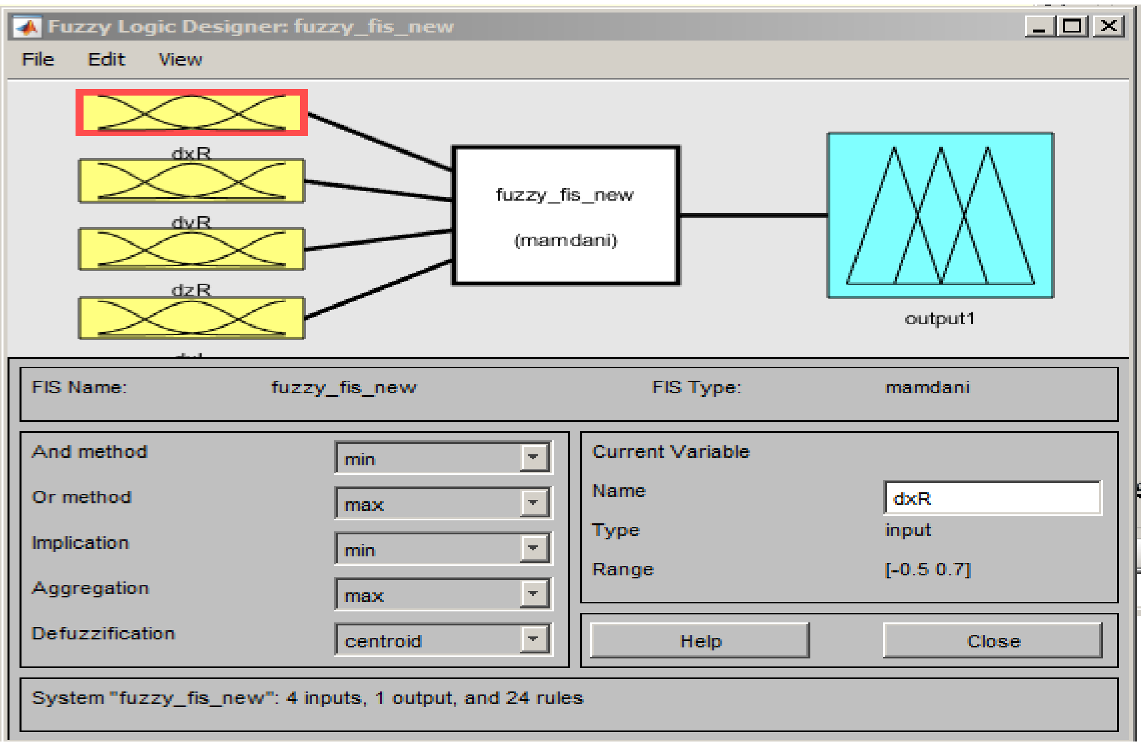

Figure 3.6 FIS system design window

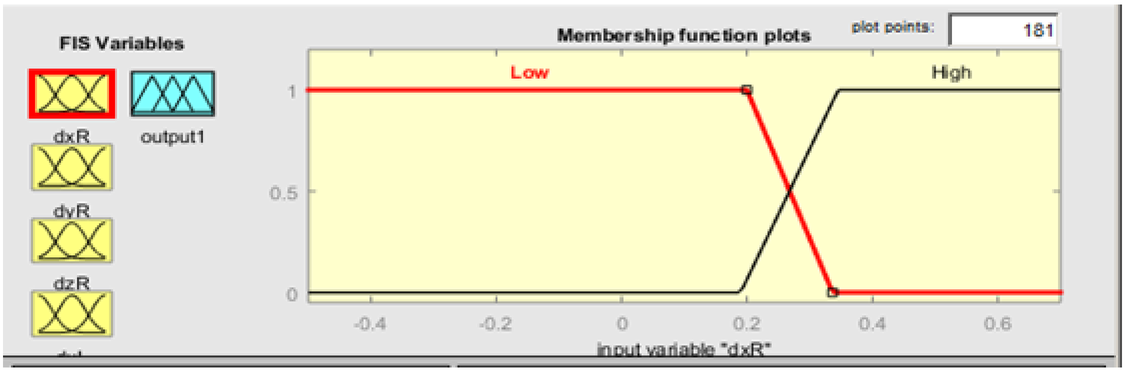

Figure 3.7 membership function for dxR variable

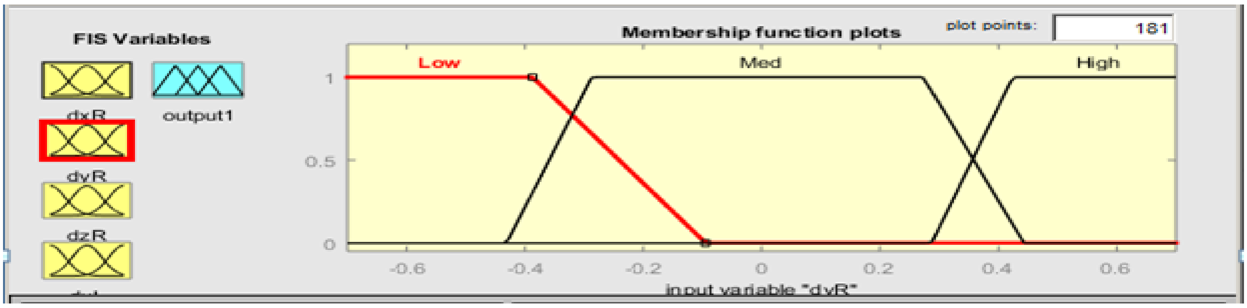

Figure 3.8 membership function for dyR variable

iii. Membership function for dzR

The function for dzR is defined such that it is Low upto 0.22 and high above 0.39 and any value in between 0.22-0.39 is fuzzy.

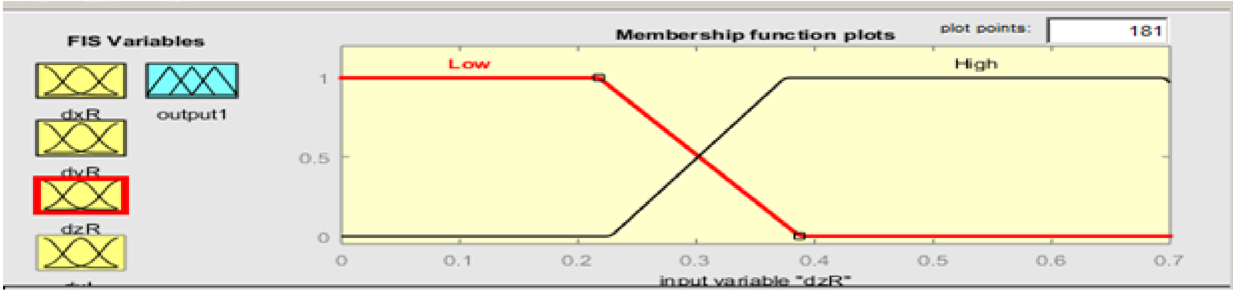

Figure 3.9 membership function for dzR variable

iv. Membership function for dxL

The function for dxL is defined such that it is Low upto 0.4 and high above 0.5 and any value in between 0.4-0.5 is fuzzy.

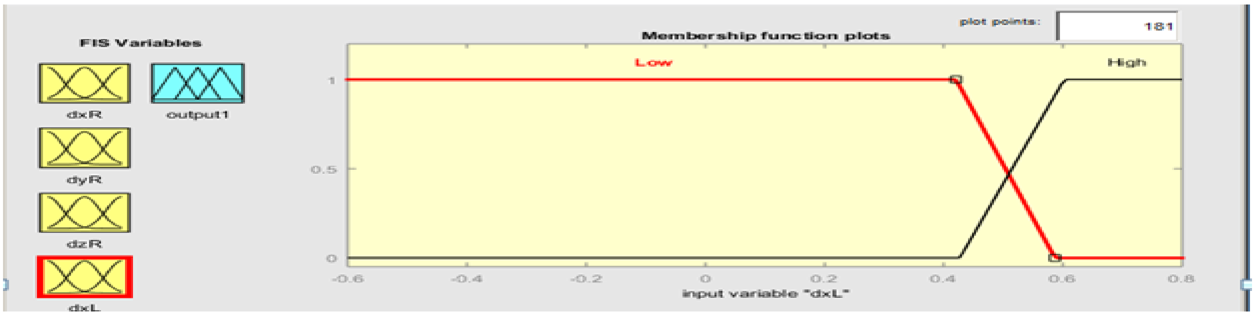

Figure 3.10 membership function for dxL variable

3. Defining Rules

The rules are defined as shown in table 1.

Table1: Rule table for FIS system

dxR	dyR	dzR	dxL	Output
L	L	L	L	No signal
L	L	L	H	Bulb-2
L	L	H	L	No sign
L	L	H	H	Bulb2
L	M	L	L	No signal
L	M	L	H	Bulb-2
L	M	H	L	TV
L	M	H	H	Bulb-2

L	H	L	L	Fan
L	H	L	H	Bulb-2
L	H	H	L	Fan
L	H	H	H	Bulb-2
H	L	L	L	No signal
H	L	L	H	Bulb-2
H	L	H	L	No signal
H	L	H	H	Bulb-2
H	M	L	L	Bulb-1
H	M	L	H	Bulb-2
H	M	H	L	Bulb-1
H	M	H	H	Bulb-2
H	H	L	L	Bulb-1
H	H	L	H	Bulb-2
H	H	H	L	Bulb-1
H	H	H	H	Bulb-2

The rules for the fuzzy system are displayed as shown in figure 3.12 and the graphical view of the rule is shown in figure 3.13.

Figure 3.11 Rule display window of FIS system

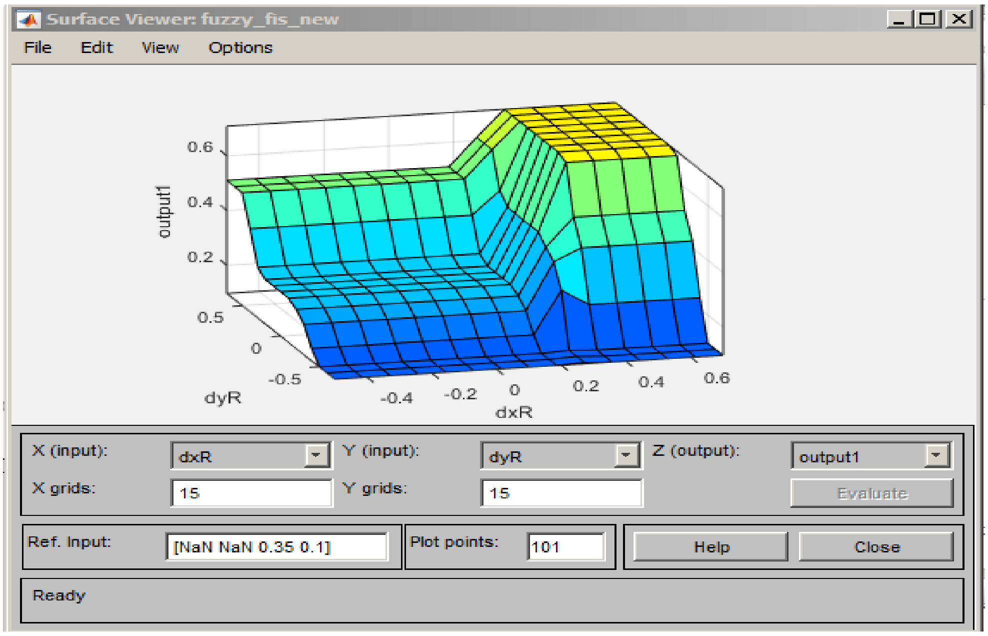

Figure 3.12 Surface viewer of FIS system

3.4 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. The complete hardware details of this sensor are discussed in chapter 4.

3.5 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. The complete hardware details of this sensor are discussed in chapter 4.

3.6 IR Transmitter

The 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.

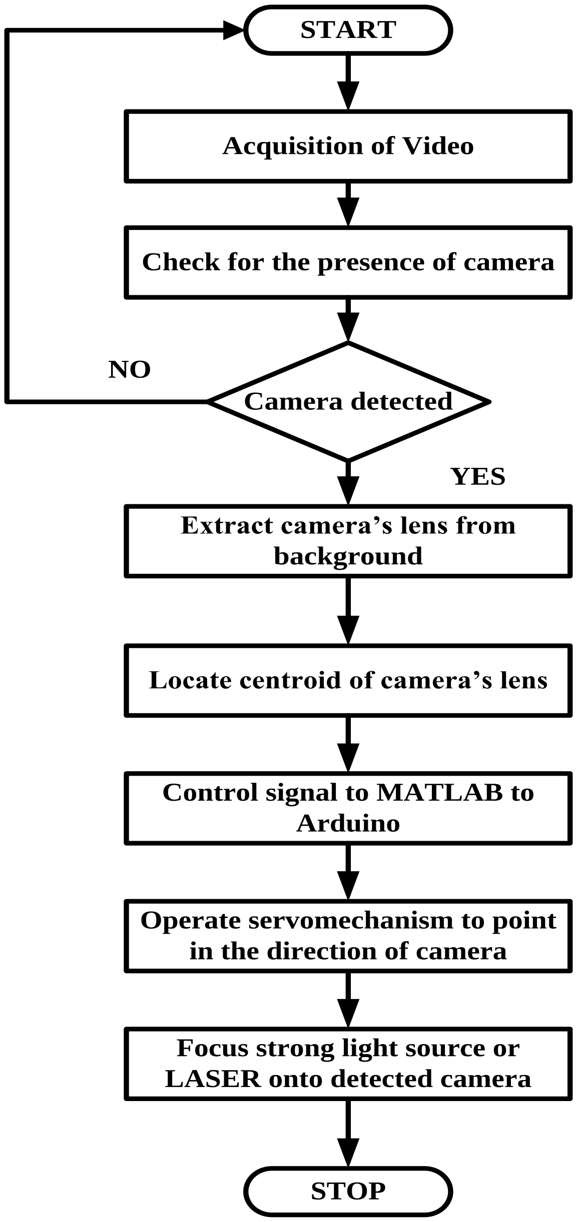

Figure 3.13 Flowchart of the Anti-Photography system

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Chapter 4

HARDWARE

This Chapter discusses about the details of the hardware parts used in the project. The chapter briefly describes about the core technical details of the hardware specifications, their features and characteristics.

The Hardware components used for developing a home automation system are

- Power supply
- Microcontroller
- Servomotor
- Laser device
- Electric Socket
- Kinect Sensor

4.1 Power supply

Power supply is a reference to a source of electrical power. A device or system that supplies electrical energy to an electrical load or group of loads is called a power supply unit or PSU. This power supply section is required to convert AC signal to DC signal and also to reduce the amplitude of the signal. The available voltage signal from the mains is 230V/50Hz which is an AC voltage, but the required is DC voltage (no frequency) with the amplitude of +5V and +12V for various applications.

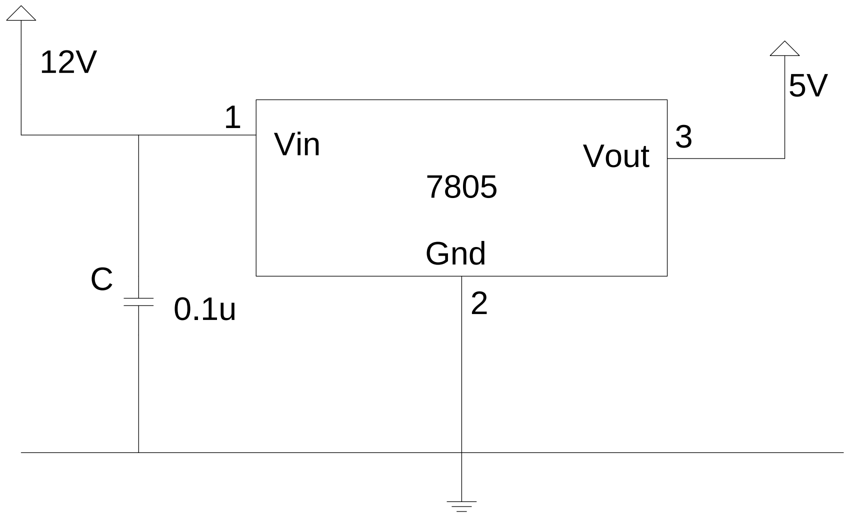

Figure 4.1 shows power supply circuit

In this section we have Transformer, Bridge rectifier, are connected serially and voltage regulators for +5V and +12V (7805 and 7812) via a capacitor (1000µF) in parallel are connected parallel as shown in the circuit diagram below. Each voltage regulator output is again is connected to the capacitors of values (100µF, 10µF, 1 µF, 0.1 µF) are connected parallel through which the corresponding output (+5V or +12V) are taken into consideration.

4.1.1 Bridge Rectifier

A diode bridge or bridge rectifier is an arrangement of four diodes in a bridge configuration that provides the same polarity of output voltage for any polarity of input voltage. When used in its most common application, for conversion of alternating current (AC) input into direct current (DC) output, it is known as a bridge rectifier. A bridge rectifier provides full-wave rectification from a two-wire AC input, resulting in lower cost and weight as compared to a center-tapped transformer design, but has two diode drops rather than one, thus exhibiting reduced efficiency over a center-tapped design for the same output voltage.

4.1.2 IC Voltage Regulator (7805)

A voltage regulator is an electrical regulator designed to automatically maintain a constant voltage level. A regulated power supply is very much essential for several electronic devices

Due to semiconductor material employed in them have a fixed rate of current as well as voltage. The device may get damage if there is any deviation from the fixed rate. The AC power supply is gets converted to Dc by this circuit.

ICs regulator is mainly used in the circuit to maintain the exact voltage which is followed by the power supply. IC 7805 is a regulated IC of 5V. This IC is very flexible and is widely employed in all types of circuit like a voltage regulator. It is a three terminal device and mainly called input, output and ground. Pin diagram of the IC 7805 is shown in figure 4.2 below.

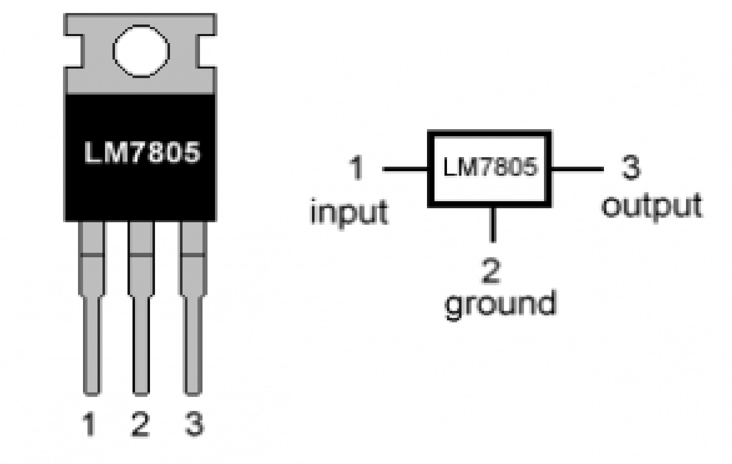

Figure 4.2 pin diagram of IC 7805

4.2 MICROCONTROLLER (ARDUINO UNO)

Arduino uno is well known open source Hardware Platform which allows open source development environment. The Arduino Uno is a microcontroller board based on the

ATmega328 (datasheet). It contains everything needed to support the microcontroller; simply connect it to a computer with a USB cable or power it with an AC-to-DC adapter or battery to get started. The Uno differs from all preceding boards in that it does not use the FTDI USB-to-serial driver chip. Instead, it features the Atmega8U2 programmed as a USB-to-serial converter. "Uno" means one in Italian and is named to mark the upcoming release of Arduino 1.0.

4.2.1 BOARD FEATURES:

- It has 14 digital input/output pins (of which 6 can be used as PWM outputs)
- Six Analog inputs
- A 16 MHz crystal oscillator
- A USB connection
- A power jack
- An ICSP header
- Reset button.

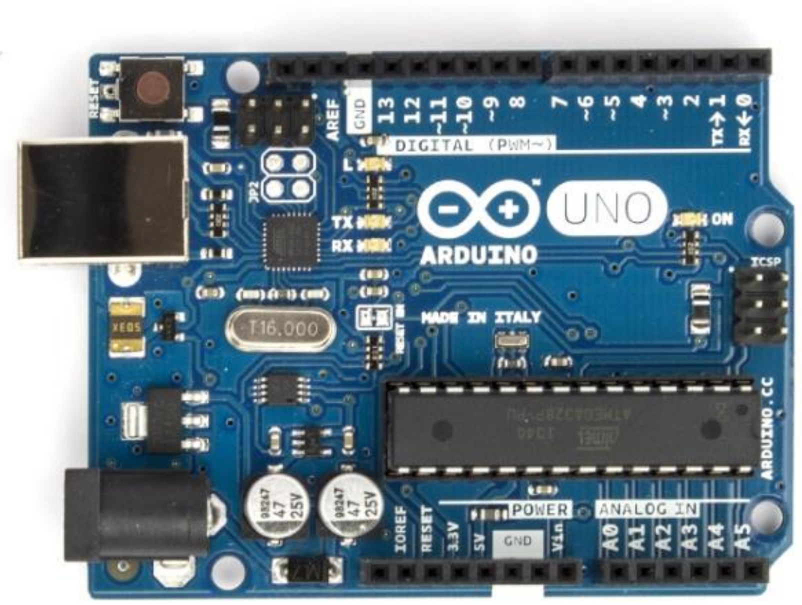

Figure 4.3 shows diagram of Arduino Board

4.2.2 Technical Specifications

Parameter	**Specifications**
Microcontroller	ATmega328
Operating Voltage	5V
Input Voltage (recommended)	7-12V
Input Voltage (limits)	6-20V
Digital I/O Pins	14 (of which 6 provide PWM output)
Analog Input Pins	6
DC Current per I/O Pin	40 mA
DC Current	for 3.3V Pin 50 mA
Flash Memory	32 KB of which 0.5 KB used by
SRAM	2 KB
EEPROM	1 KB
Clock Speed	16 MHz

Table 4.1 shows the specifications of Arduino

4.2.3 BOARD DIAGRAM

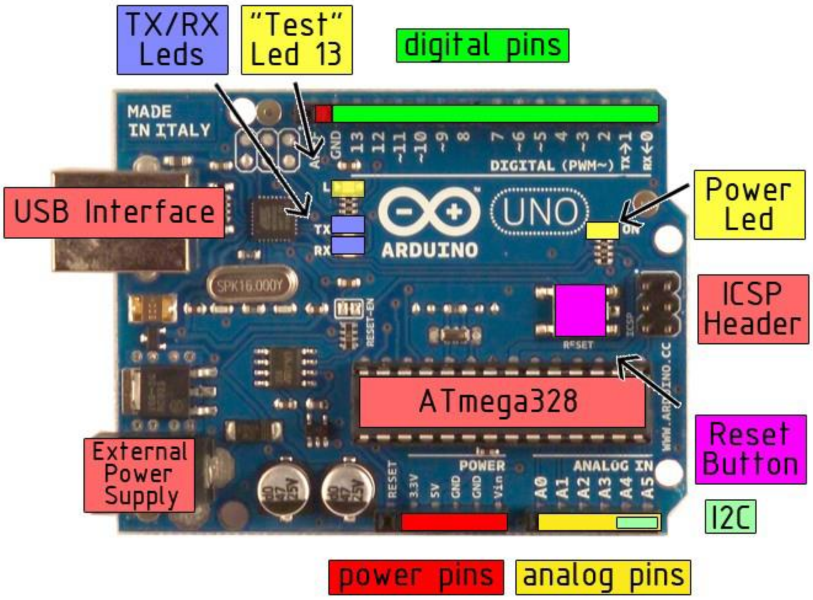

Figure 4.4 pin diagram of Arduino

The Arduino Board is divided into seven main parts

1. USB Connector.
2. Power Connector.
3. Digital Pins.
4. Analog Pins.
5. Power Pins.
6. Reset Switch.

1. USB Connector: This part of the board serves dual purposes. It is used to supply power to the board and also the program to Arduino board can be loaded through this Connector.

2. Power Connector: A Dc Power jack within 7-12 V range is used to supply power to the board. External (non-USB) power can come either from an AC-to-DC adapter (wall-wart) or battery. The adapter can be connected by plugging a 2.1mm center-positive plug into the board's power jack. Leads from a battery can be inserted in the Gnd and Vin pin headers of the POWER connector.

3. Digital Pins: The board is provided with 14 digital input pins. Each of these pins can act as digital input pin reading in the digital values and as digital output pin writing out digital values. Each pin operates with 5V and can source or sink maximum of 40mA current. Apart from Digital IO few of these pins are used for special purpose.

4. Serial pins: Pin 0 (RX) and 1(TX) are used as Hardware serial Communication pins used to transmit and receive serial data. These pins are connected to the corresponding pins of the ATmega8U2 USB-to-TTL Serial chip.

5. External Interrupts: Pins 2 and 3. These pins can be configured to trigger an interrupt on a low value, a rising or falling edge, or a change in value.

6. PWM: Pins 3, 5, 6, 9, 10, and 11. Provide 8-bit Pulse Width Modulated Output.

7. SPI: Pins 10 (SS), 11 (MOSI), 12 (MISO), 13 (SCK). These pins support SPI communication, which, although provided by the underlying hardware.

8. LED: Pin 13 there is a built-in LED connected to digital pin 13. When the pin is HIGH value, the LED is on, when the pin is LOW, it's off.

9. The Power pins:

a. **Vin:** The input voltage to the Arduino/Genuino board when it's using an external power source (as opposed to 5 volts from the USB connection or other regulated power source). The board can be supplied 5V voltage through this pin, or, if supplying voltage via the power jack, 5v can be accessed through this pin.

b. **5V pin**: This pin outputs a regulated 5V from the regulator on the board. The board can be supplied with power either from the DC power jack (7 - 12V), the USB connector (5V), or the VIN pin of the board (7-12V). Supplying voltage via the 5V or

3.3V pins bypasses the regulator, and can damage your board and it is not recommended.

c. **3V3 pin:** A 3.3 volt supply generated by the on-board regulator. It can be used to drive devices that operate on 3.3v. Maximum current drawn from this pin is 50 mA.

d. **GND pins:** Ground pins.

e. **IOREF pins**: This pin on the Arduino/Genuino board provides the voltage reference with which the microcontroller operates. A properly configured shield can read the IOREF pin voltage and select the appropriate power source or enable voltage translators on the outputs to work with the 5V or 3.3V.

10. Reset Switch: As restart button in PC restarts the system. In the same manner reset button restart the Arduino. It means that the program memory ROM set to the starting position or address. Our code starts from the beginning, and hardware resets. SO in case we found any error in execution of code in arduino program then try to reset it so that it will restart.

4.3 Servomotor:

A servomotor is a rotary actuator or linear actuator that allows for precise control of angular or linear position, velocity and acceleration. A servomotor is a closed-loop servomechanism that uses position feedback to control its motion and final position. The input to its control is a signal (either analogue or digital) representing the position commanded for the output shaft. The motor is paired with some type of encoder to provide position and speed feedback. In the simplest case, only the position is measured. The measured position of the output is compared to the command position, the external input to the controller. If the output position differs from that required, an error signal is generated which then causes the motor to rotate in either direction, as needed to bring the output shaft to the appropriate position. As the positions approach, the error signal reduces to zero and the motor stops.

The very simplest servomotors use position-only sensing via a potentiometer and bang-bang control of their motor, the motor always rotates at full speed (or is stopped). This type of servomotor is not widely used in industrial motion control, but it forms the basis of the simple and cheap servos used for radio-controlled models. More sophisticated servomotors use optical rotary encoders to measure the speed of the output shaft and a variable-speed drive to control the motor speed. Both of these enhancements, usually in combination with a Proportional Integral Derivative (PID) control algorithm, allow the servomotor to be brought to its commanded position more quickly and more precisely, with less overshooting.

4.3.1 Features of Servomotors:

The servo motor is specialized for high-response, high-precision positioning. As a motor capable of accurate rotation angle and speed control, it can be used for a variety of equipment.

Figure 4.5 shows general figure of Servomotor

4.3.1.1Closed Loop Control: A rotation detector (encoder) is mounted on the motor and feeds the rotation position/speed of the motor shaft back to the driver. The driver calculates the error of the pulse signal or analog voltage (position command/speed command) from the controller and the feedback signal (current position/speed) and controls the motor rotation so the error becomes zero. The closed loop control method is achieved with a driver, motor and encoder, so the motor can carry out highly accurate positioning operations.

- An END signal is obtained that communicates the completion of the positioning operation.
- An alarm can be output if there is an abnormality such as an overload, making it possible to communicate equipment abnormalities.

4.4 Laser Device:

A laser is a device that emits light through a process of optical amplification based on the stimulated emission of electromagnetic radiation. In other words, it is a device that transforms light of various frequencies into a chromatic radiator in the visible, infrared and ultraviolet regions with all the waves in phase capable of mobilizing immense heat and power when focused a close range.

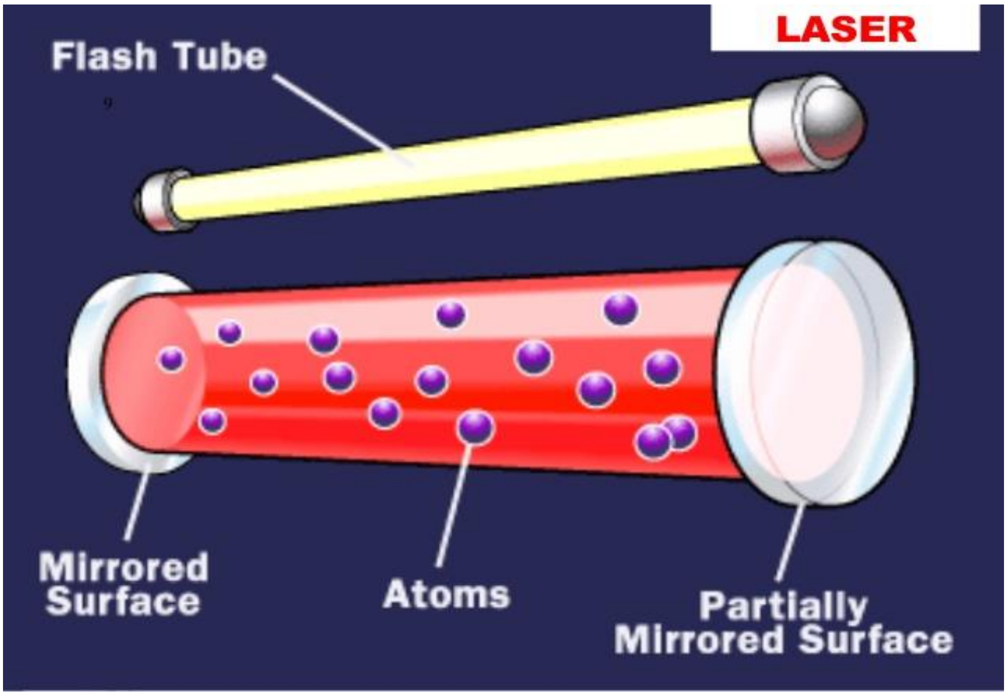

Figure 4.5 Snapshot of Laser device

4.4.1 The characteristics of laser:

i. **Coherence:** the wave trains which are identical in phase and direction are called coherent waves.
ii. **High intensity:** due to the coherent nature of laser, it has the ability to focus over a small area.
iii. **High Directionality:** the angular spread of a laser beam 1mm/meter.
iv. **High Mon-chromaticity:** the light from a normal monochromaticity source spread over a range of wavelength of the order 100nm. But the spread is of the order of 1nm for laser.

4.5 Electric Socket:

AC power plugs and sockets are devices that allow electrically operated equipment to be connected to the primary alternating current (AC) power supply in a building.

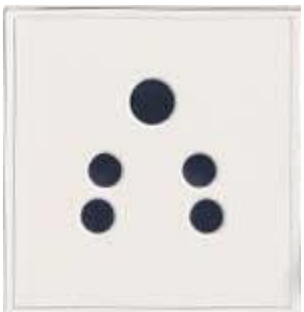

Figure 4.6 Snapshot of electric socket.

4.6 Microsoft Kinect Sensor:

The Kinect sensor is a motion-sensing input device that was originally developed in November 2010 for use with the Xbox 360 but has recently been opened up for use with Windows PCs for commercial purposes.

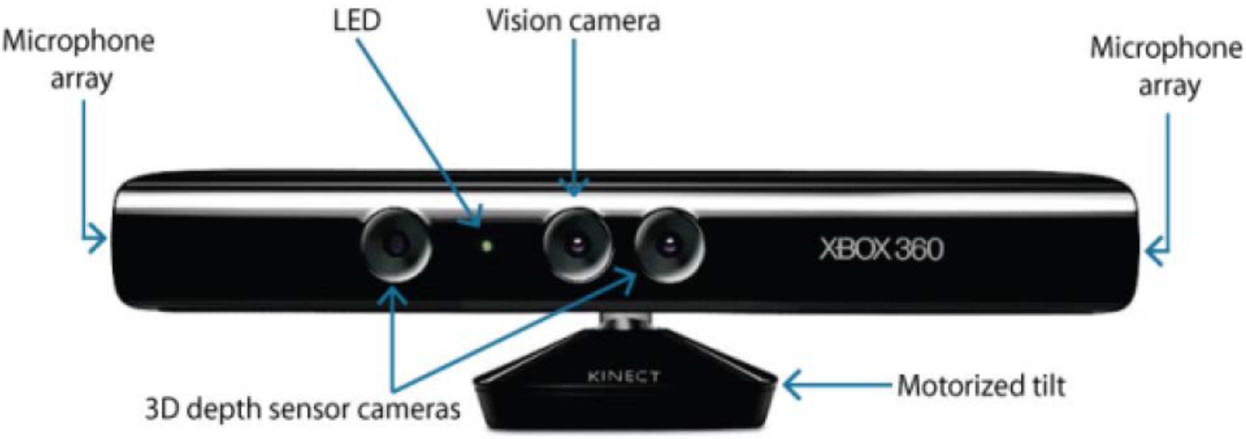

Figure 4.7 Kinect Sensor Components

The Kinect sensor as shown in Figure 4.7 has the following properties and functions:

- An RGB Camera that stores three channel data in a 1280x960 resolution at 30Hz. The camera's field of view as specified by Microsoft is 43° vertical by 57° horizontal [10]. The system can measure distance with a 1cm accuracy at 2 meters distance
- An infrared (IR) emitter and an IR depth sensor used for capturing depth image.
- An array of four microphones to capture positioned sounds.
- A tilt motor which allows the camera angle to be changed without physical interaction and a three-axis accelerometer which can be used to determine the current orientation of the Kinect.

4.6.1 Hardware Interface

The sensor interface with the PC via a standard USB 2.0 port; however an additional power supply is needed because the USB port cannot directly support the sensor's power consumption.

4.6.2 Hardware and Software Requirements

According to Microsoft, the PC that is to be used with the Kinect sensor must have the following minimum capabilities

(a) 32-bit (x86) or 64-bit (x64) processors,

(b) Dual-core, 2.66-GHz or faster processor,

(c) USB 2.0 bus dedicated to the Kinect, and

(d) 2 GB of RAM.

To access Kinect’s capabilities,the following software is also required to be installed on the developer’s PC: Microsoft Visual Studio 2010/2012 Express or other Visual Studio edition. The development programming languages that can be used include C++, C# (C-Sharp), and Visual Basic.

4.6.3 Kinect for Windows SDK

Installing Kinect for Windows SDK is necessary to develop any Kinect-enabled application. Figure 4 shows how Kinect communicates with an application. The SDK in conjunction with the Natural User Interface (NUI) library provides the tools and the Application Programming Interface (APIs) needed such as high-level access to color and calibrated depth images, the tilt motor, advanced audio capabilities, and skeletal tracking but requires Windows 7 (or newer) and the .NET Framework 4.0.

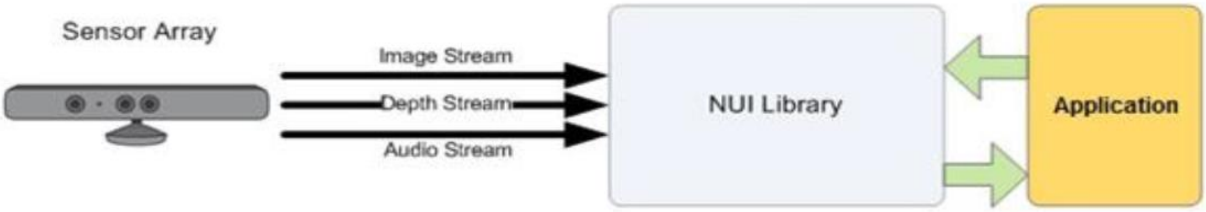

Figure 4.8 Kinect Interaction with an Application

CHAPTER 5

SOFTWARE

This chapter provides an overview of the software tools utilized in the project implementation.

5.1 Matlab

MATLAB (matrix laboratory) is a fourth-generation high-level programming language and an interactive environment tool developed by Math Works for numerical computation, visualization and programming.

5.1.1 Features

- It is a high-level language for numerical computation, visualization and application development.
- It also provides an interactive environment for iterative exploration, design and problem solving.
- It provides vast library of mathematical functions for linear algebra, statistics, Fourier analysis, filtering, optimization, numerical integration and solving ordinary differential equations.
- It provides built-in graphics for visualizing data and tools for creating custom plots.
- MATLAB's programming interface gives development tools for improving code quality, maintainability, and maximizing performance.
- It provides tools for building applications with custom graphical interfaces.
- It provides functions for integrating MATLAB based algorithms with external applications and languages such as C, Java, .NET and Microsoft Excel.

5.1.2 Applications

MATLAB is widely used as a computational tool in science and engineering encompassing the fields of physics, chemistry, math and all engineering streams. It is used in a range of applications including:

- signal processing and Communications
- image and video Processing
- control systems
- test and measurement
- computational finance
- computational biology

5.1.3 Matlab Environment

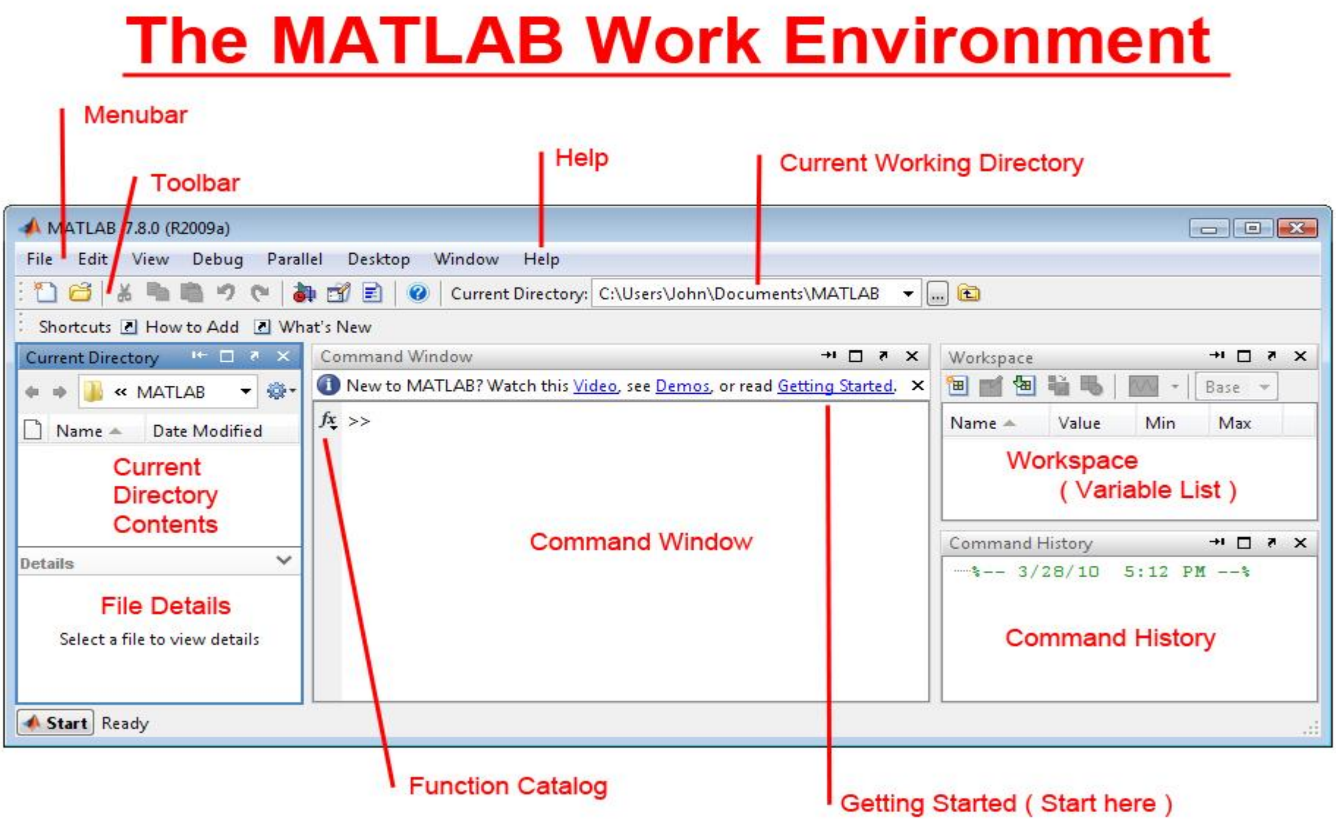

Figure 5.1 Matlab environment

Current Folder - This panel allows access of the project folders and files.

Command Window - This is the main area where commands can be entered at the command line. It is indicated by the command prompt (>>).

Workspace - The workspace shows all the variables created and/or imported from files.

Command History - This panel shows or rerun commands that are entered at the command line.

The Matlab programs are written and saved in a file of format .m file extension. This file may be executed by using a run option available in the Matlab window.

5.1.4 THE FUZZY LOGIC TOOLBOX SOFTWARE

Fuzzy inference systems are created with Fuzzy Logic Toolbox software. These systems use graphical tools or command-line functions, or generated automatically using either clustering or adaptive neuro-fuzzy techniques. Fuzzy systems can be easily simulated if Matlab has access to Simulink. The toolbox also let us runs your own stand-alone C programs directly. This is made possible by a stand-alone Fuzzy Inference Engine that reads the fuzzy systems saved from a MATLAB session. The standalone engine can be customized to build fuzzy inference in to a developer’s code.

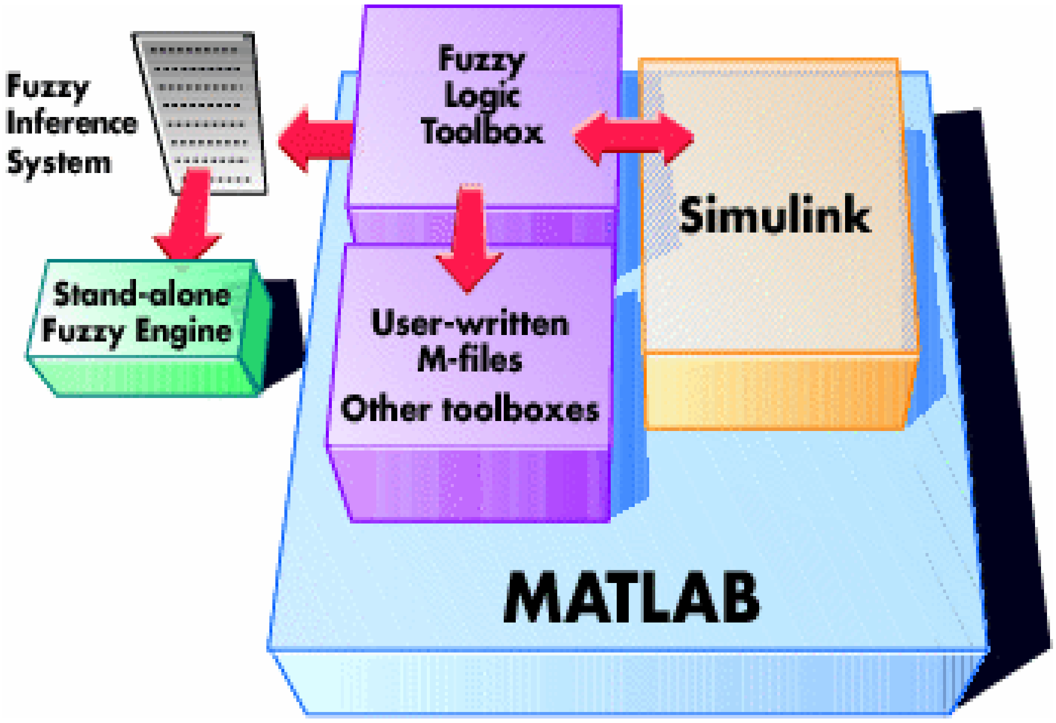

Figure 5.2 Matlab tool box

5.1.5 FUZZY LOGIC TOOLBOX GRAPHICAL USER INTERFACE TOOLS

Use the following GUI tools to build, edit, and view fuzzy inference systems

Fuzzy Inference System (FIS) Editor to handle the high-level issues for the system—How many input and output variables? What are their names? Fuzzy Logic Toolbox software does not limit the number of inputs. However, the number of inputs may be limited by the available memory of your machine. If the number of inputs is too large, or the number of membership functions is too big, then it may also be difficult to analyze the FIS using the other GUI tools.

Membership Function Editor to define the shapes of all the membership functions associated with each variable

Rule Editor to edit the list of rules that defines the behaviour of the system.

Rule Viewer to view the fuzzy inference diagram. Use this viewer as a diagnostic to see, for example, which rules are active, or how individual membership function shapes influence the results

Surface Viewer to view the dependency of one of the outputs on any one or two of the inputs -that is, it generates and plots an output surface map for the system.

5.2 Arduino Software (IDE)

The Arduino Integrated Development Environment - or Arduino Software (IDE) - contains a text editor for writing code, a message area, a text console, a toolbar with buttons for common functions and a series of menus. It connects to the Arduino and Genuino hardware to upload programs and communicate with them.

5.2.1 Writing Sketches

Programs written using Arduino Software (IDE) are called sketches. These sketches are written in the text editor and are saved with the file extension .ino. The editor has features for cutting/pasting and for searching/replacing text. The message area gives feedback while saving and exporting and also displays errors. The console displays text output by the Arduino Software (IDE), including complete error messages and other information. The bottom right-hand corner of the window displays the configured board and serial port. The toolbar buttons allow you to verify and upload programs, create, open, and save sketches, and open the serial monitor.

Verify: Checks your code for errors compiling it.

Upload: Compiles your code and uploads it to the configured board. See uploading below for details.

New: Creates a new sketch.

Figure 5.3 shows the main window of Arduino IDE

Open: Presents a menu of all the sketches in your sketchbook. Clicking one will open it within the current window overwriting its content.

Save: Saves your sketch.

Serial Monitor: Opens the serial monitor.

i. Sketchbook

The Arduino Software (IDE) uses the concept of a sketchbook: a standard place to store arduino programs (or sketches). The sketches in sketchbook can be opened from the File > Sketchbook menu or from the Open button on the toolbar. The first time the Arduino software will automatically create a directory for the sketchbook. The programmer can view or change the location of the sketchbook location from with the Preferences dialog.

ii. Tabs, Multiple Files, and Compilation

Allows the programmer to manage sketches with more than one file (each of which appears in its own tab). These can be normal Arduino code files (no visible extension), C files (.c extension), C++ files (.cpp), or header files (.h).

5.2.2 Uploading Procedure

Before uploading the sketch, the programmer need to select the correct items from the Tools > Board and Tools > Port menus. The boards are described below. On the Mac, the serial port is probably something like /dev/tty.usbmodem241 (for a Uno or Mega2560 or Leonardo) or /dev/tty.usbserial-1B1 (for a Duemilanove or earlier USB board), or /dev/tty.USA19QW1b1P1.1 (for a serial board connected with a Keyspan USB-to-Serial adapter). On Windows, it's probably COM1 or COM2 (for a serial board) or COM4, COM5, COM7, or higher (for a USB board) - to find out, look for USB serial device in the ports section of the Windows Device Manager. On Linux, it should be /dev/ttyACMx, /dev/ttyUSBx or similar. Once selected the correct serial port and board, press the upload button in the toolbar or select the Upload item from the Sketch menu. Current Arduino boards will reset automatically and begin the upload. With older boards (pre-Diecimila) that lack auto-reset, you'll need to press the reset button on the board just before starting the upload. On most boards, you'll see the RX and TX LEDs blink as the sketch is uploaded. The Arduino Software (IDE) will display a message when the upload is complete, or show an error.

When a sketch is uploaded using the Arduino boot loader, a small program that has been loaded on to the microcontroller on your board. It allows you to upload code without using any additional hardware. The boot loader is active for a few seconds when the board resets; then it starts whichever sketch was most recently uploaded to the microcontroller. The boot loader will blink the on-board (pin 13) LED when it starts (i.e. when the board resets).

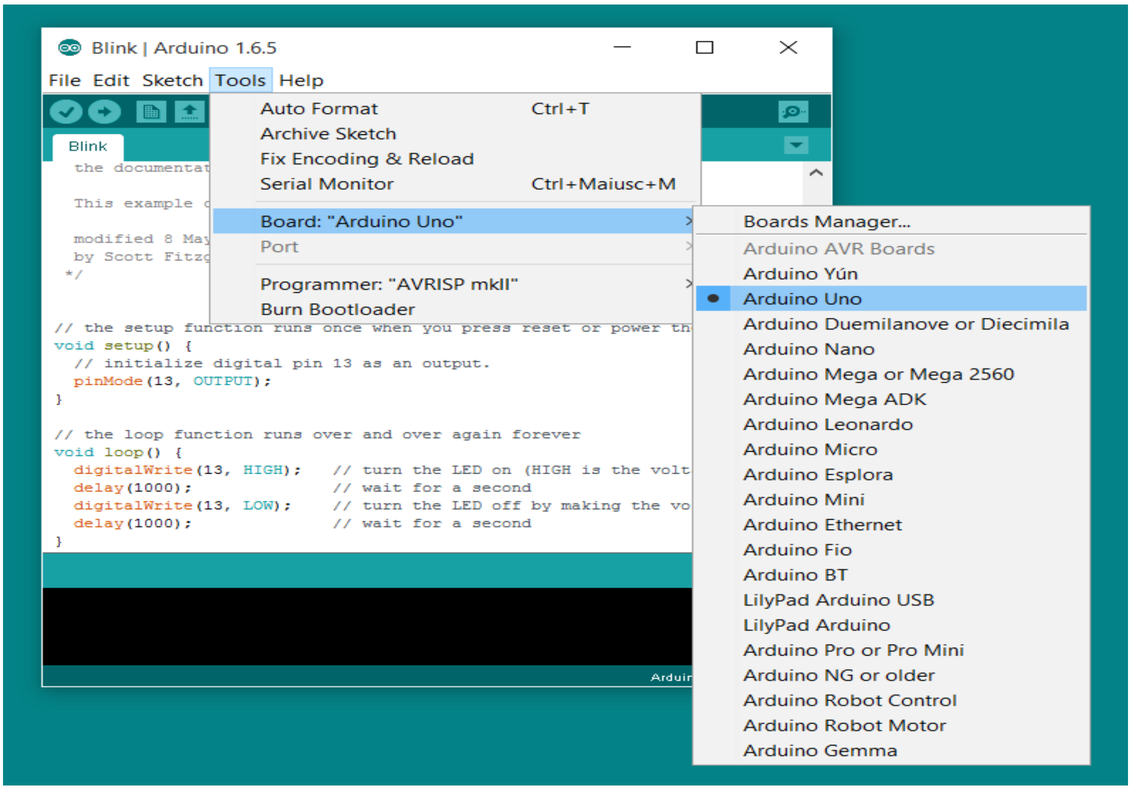

Figure 5.4 shows the method of selecting the hardware board

5.2.3 Libraries

Libraries provide extra functionality for use in sketches, e.g. working with hardware or manipulating data. To use a library in a sketch, select it from the Sketch > Import Library menu. This will insert one or more #include statements at the top of the sketch and compile the library with your sketch. Because libraries are uploaded to the board with your sketch, they increase the amount of space it takes up. If a sketch no longer needs a library, simply delete its #include statements from the top of your code.

There is a list of libraries in the reference. Some libraries are included with the Arduino software. Others can be downloaded from a variety of sources or through the Library Manager.

Starting with version 1.0.5 of the IDE, you do can import a library from a zip file and use it in an open sketch. See these instructions for installing a third-party library.

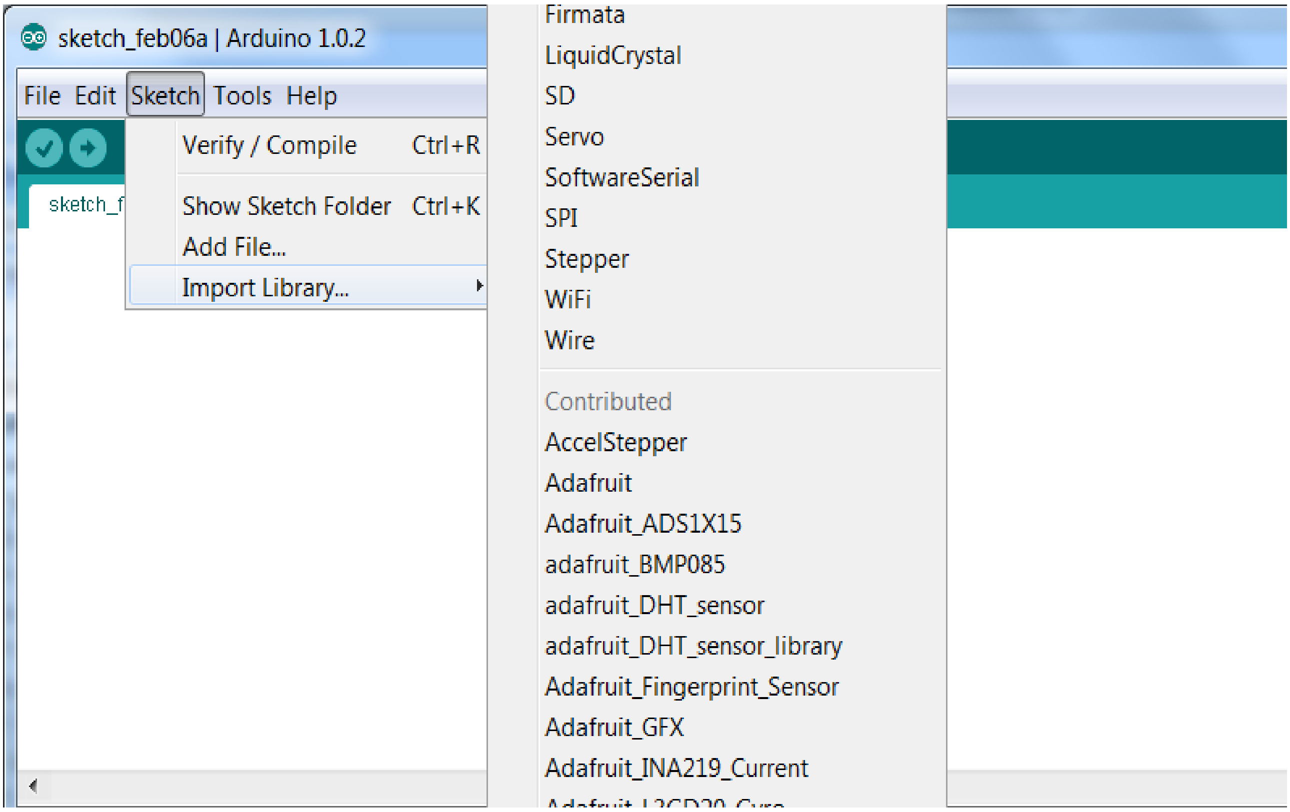

Figure 5.5 shows the method of importing libraries

5.2.4 Third-Party Hardware

Support for third-party hardware can be added to the hardware directory of your sketchbook directory. Platforms installed there may include board definitions (which appear in the board menu), core libraries, boot loaders, and programmer definitions. To install, create the hardware directory, then unzip the third-party platform into its own sub-directory. (Don't use "arduino" as the sub-directory name or you'll override the built-in Arduino platform.) To uninstall, simply delete its directory.

5.2.5 Serial Monitor

Displays serial data being sent from the Arduino or Genuino board (USB or serial board). To send data to the board, enter text and click on the "send" button or press enter. Choose the baud rate from the drop-down that matches the rate passed to Serial. Begin in your sketch. Note that on Windows, Mac or Linux, the Arduino or Genuino board will reset (rerun your sketch execution to the beginning) when you connect with the serial monitor.

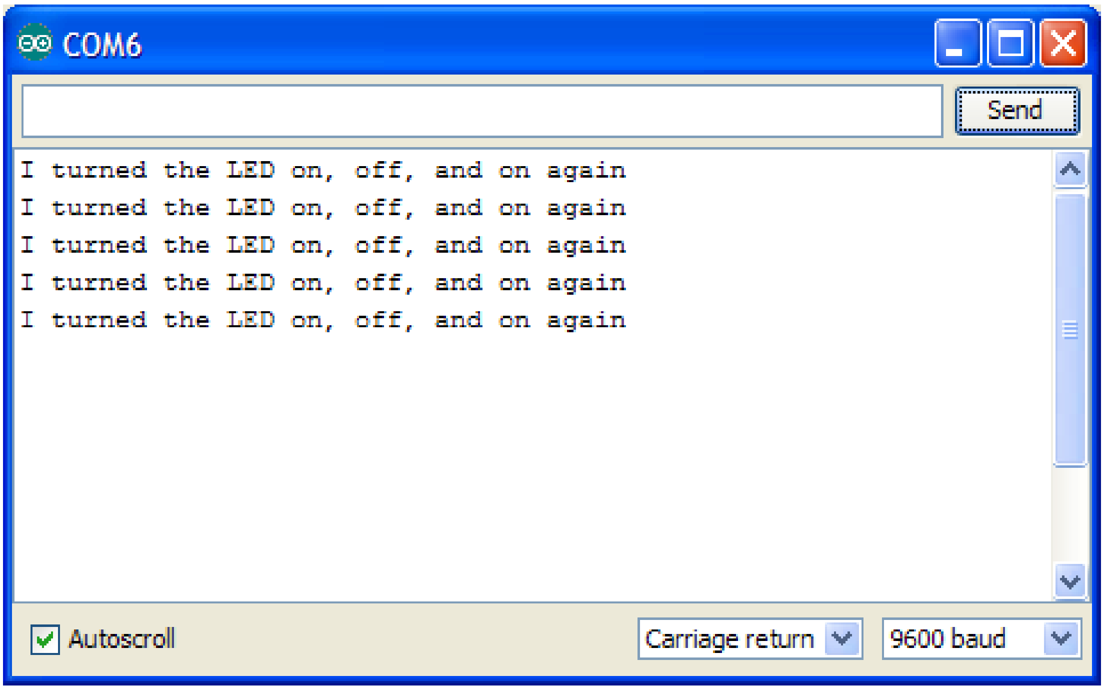

Figure 5.6 shows the serial monitor window

5.2.6 Arduino Programming

I. Basic code definitions

setup ( ): A function present in every Arduino sketch. Run once before the loop ( ) function. Often used to set pin mode to input or output. The setup ( ) function looks like:

```
void setup( ){
//code goes here
}
```

loop ( ): A function present in every single Arduino sketch. This code happens over and over again. The loop ( ) is where (almost) everything happens. The one exception to this is setup ( ) and variable declaration. ModKit uses another type of loop called “forever ( )” which executes over Serial. The loop ( ) function looks like:

```
void loop( ) {
//code goes here
}
```

• Input: A pin mode that intakes information.

• Output: A pin mode that sends information.

• HIGH: Electrical signal present (5V for Uno). Also ON or True in Boolean logic.

• LOW: No electrical signal present (0V). Also OFF or False in Boolean logic.

• digitalRead(): Get a HIGH or LOW reading from a pin already declared as an input.

• digitalWrite(): Assign a HIGH or LOW value to a pin already declared as an output.

• analogRead(): Get a value between or including 0 (LOW) and 1023 (HIGH). This allows you to get readings from analog sensors or interfaces that have more than two states.

• analogWrite(): Assign a value between or including 0 (LOW) and 255 (HIGH). This allows you to set output to a PWM value instead of just HIGH or LOW.

• PWM: Stands for Pulse-Width Modulation, a method of emulating an analog signal through a digital pin. A value between or including 0 and 255. Used with analogWrite.

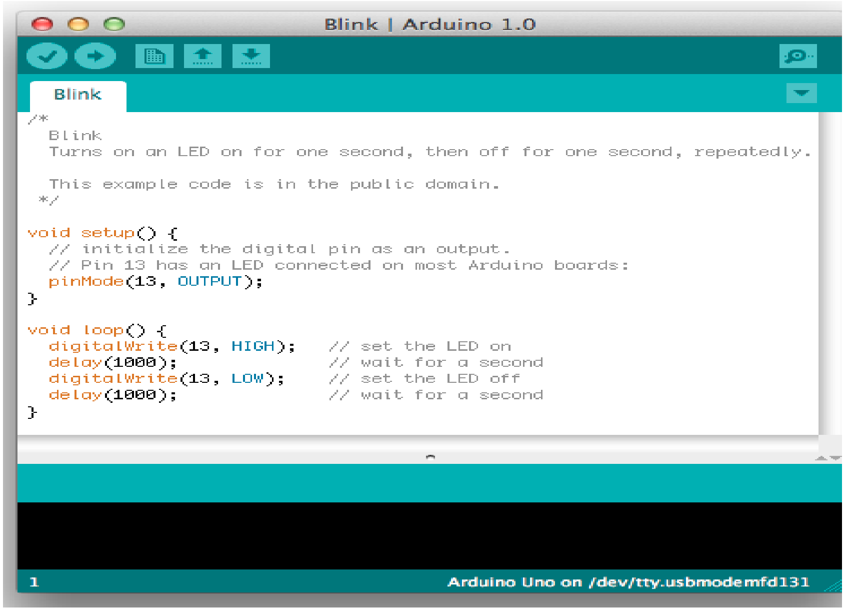

Figure 5.7 shows the image of sample LED Binky code

Chapter 6

RESULTS AND DISCUSSION

This chapter discusses the results obtained after successful implementation of the proposed system whose design was shown in Chapter 3.

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.

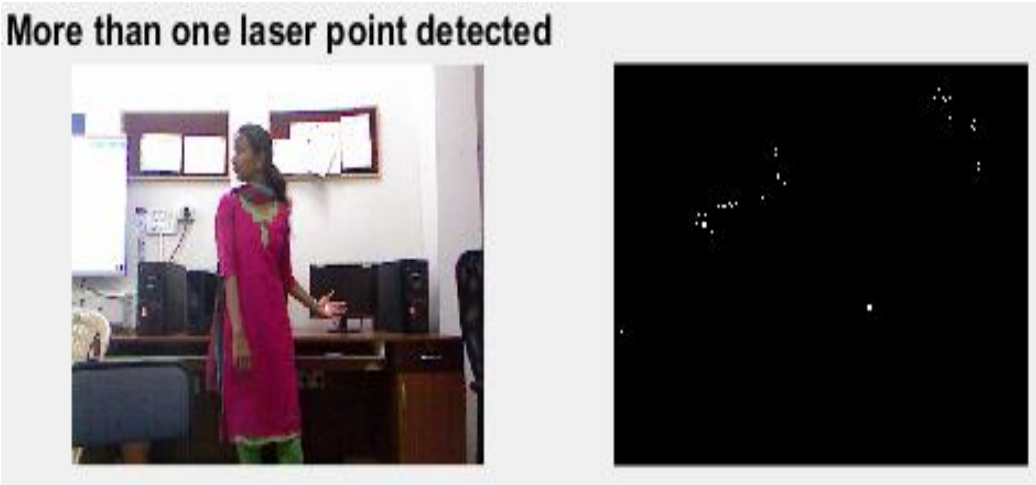

Figure1. Testing in more light

- 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.

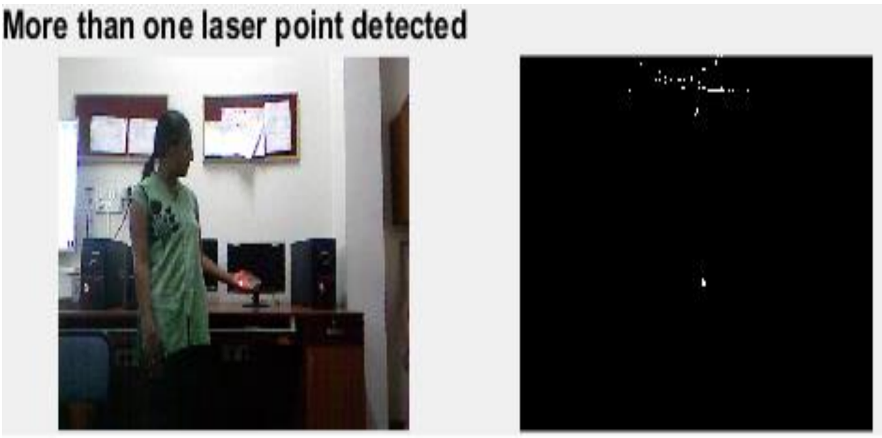

Figure2. Testing in medium light

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

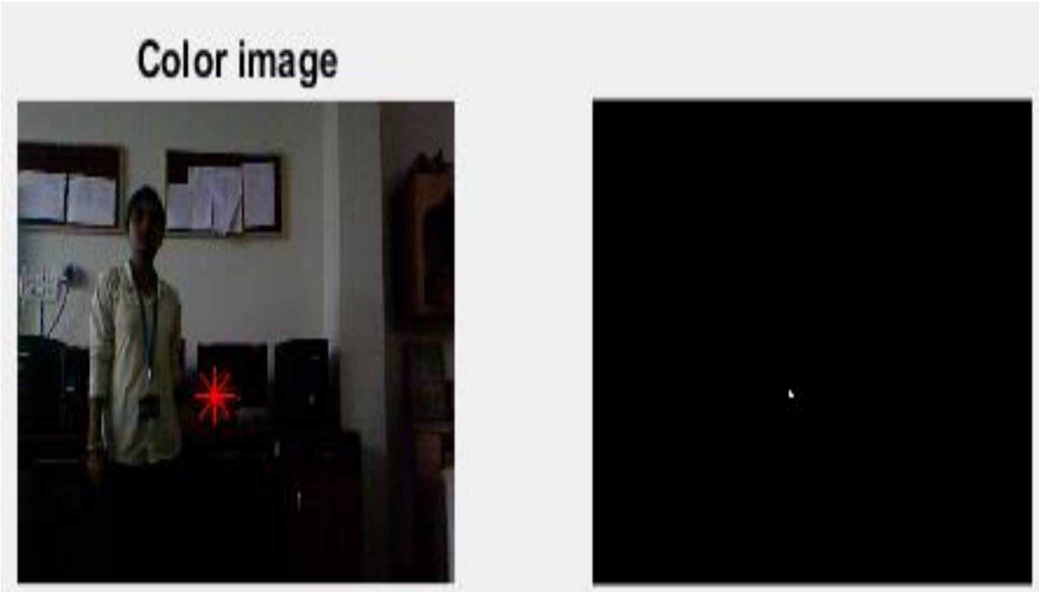

Figure 3. Testing in uniform lightning condition

DEPTH CAMERA TESTING:

To detect the person who trying to capture the image:

- Initially it identify the person
- After that it track the skeleton

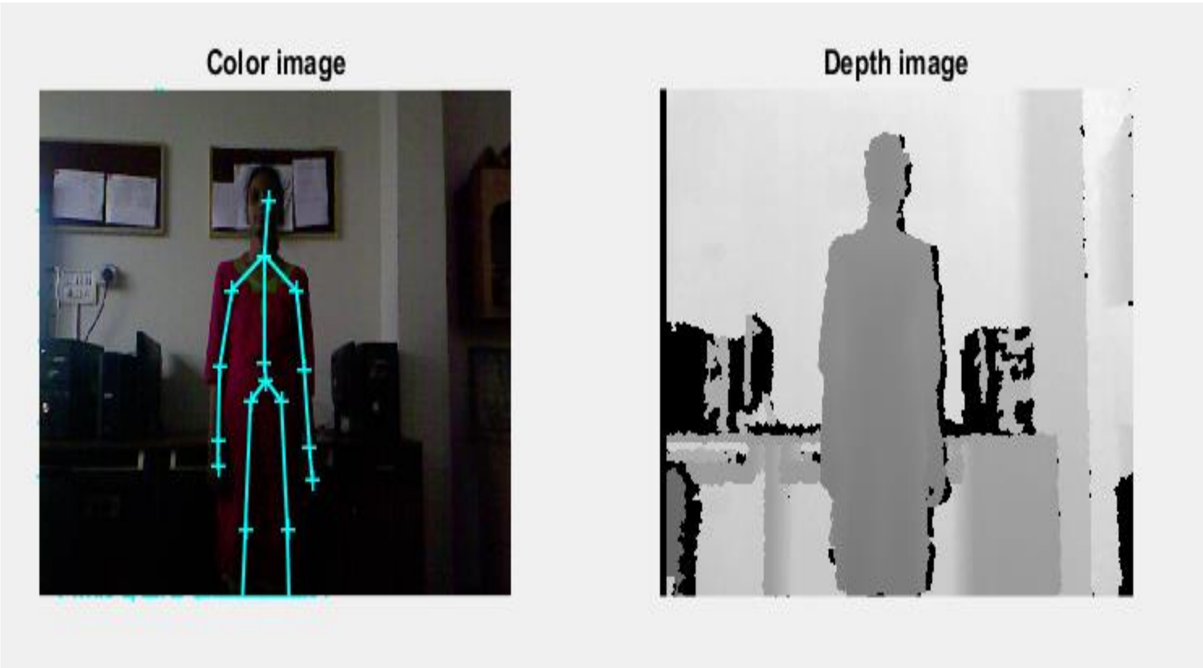

Figure 4 identifying the person

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.

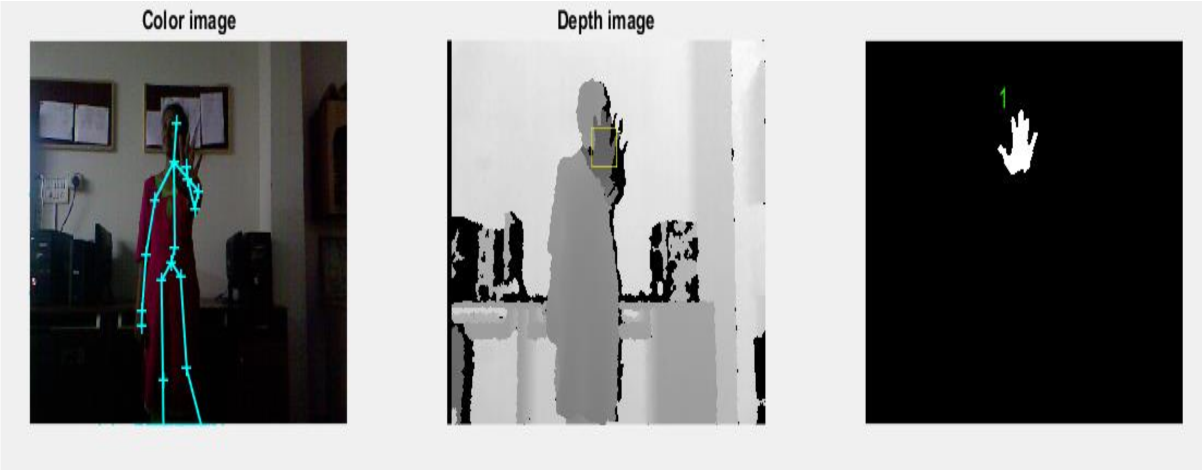

Figure 5 detect the rectangular object in hand

To detect the rectangular object 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".
- After showing this message the camera confirms that the person is trying to capture an image.

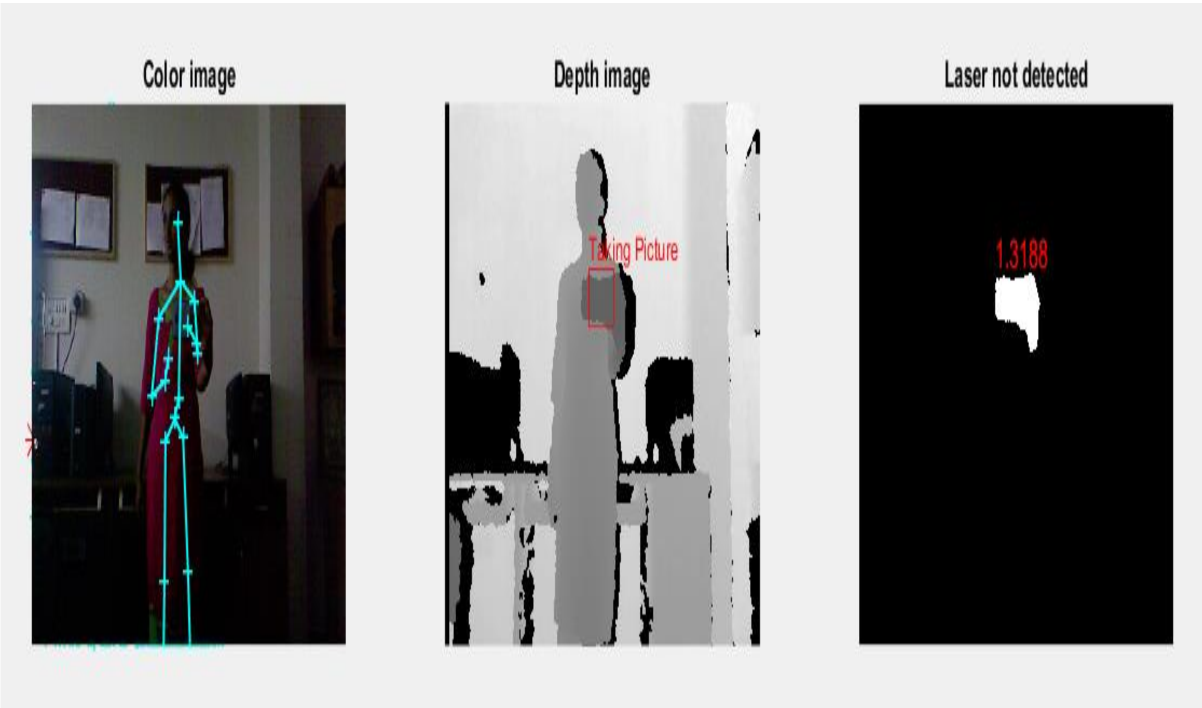

Figure 6 detecting the rectangular object in person hand

Disabling the image while capturing:

Finally system shows the detected rectangular object by disabling the other part of the person image.

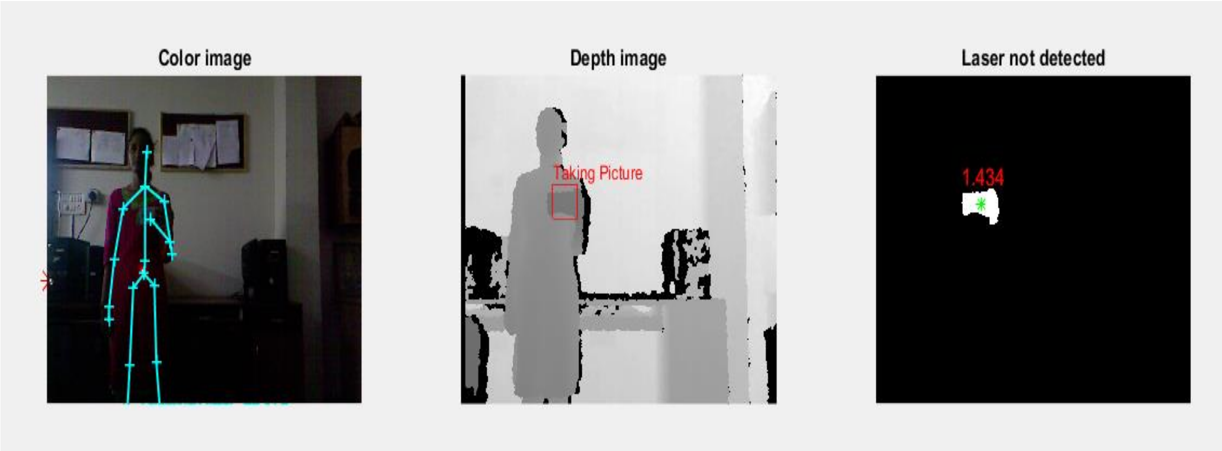

Figure 7 the final object pointed

Chapter 7

CONCLUSION & FUTURE SCOPE

The main objective of this project is to detect and disable digital cameras in photography prohibited area using image processing algorithms servomechanism and Arduino microcontroller. 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. 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. This work will beneficial in the areas such as theatres for prevention of piracy. It has many application which includes maintaining secrecy at defence areas, courts, industries, government offices, research and development sectors, museums, historical monuments, religious places etc. The outcomes shows that proposed method can effectively detect the rectangular object and disabling the picture while capturing.

The main objective of this project 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. 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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