**Design and Development of Smoking Detection System**



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**B. Tech. in Computer Science and Engineering**

**Faculty of ENGINEERING AND TECHNOLOGY**

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Declaration

**Design and Development of Smoking Detection System**

The project work is submitted in partial fulfilment of academic requirements for the award of B. Tech. Degree in the Department of Computer Science and Engineering of the Faculty of Engineering and Technology of Ramaiah University of Applied Sciences. The project report submitted herewith is a result of our own work and in conformance to the guidelines on plagiarism as laid out in the University Student Handbook. All sections of the text and results which have been obtained from other sources are fully referenced. We understand that cheating and plagiarism constitute a breach of University regulations, hence this project report has been passed through plagiarism check and the report has been submitted to the supervisor.

|  |  |  |  |
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**Date : 7th May 2019**

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# Summary

The Motivation for selecting this Project is to reduce the human intervention in monitoring the human activities. Rather the main field of interested is to train the machine to make the decisions through recognised gestures/activities. The aim chosen is to recognise the person who is smoking in the public areas through his/her gestures.

The scope of this project involves in proposing architecture and designing of the prototype for smoking gesture recognition. All subcomponents in the project collaborate to improve outcomes and achieve our objectives. This provides a high-level overview of implementation of proposed algorithm to detect the gestures. Image Processing is done for Gesture recognition in real time and mail Protocols are used to communicate for identified activities.

In this project, the actions of the person are being detected in real timeand processing is done in parallel, the smoking gestures of human is detected and the object detection (cigarette) is quite challenging to deal with, which remains the highlight of the project.

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# Nomenclature

*M*meter

*A* Area(m2)

*P* Perimeter(m)

*RND* Roundness value

**Abbreviations and Acronyms**

**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

CAM Camera

E-mail Electronic mail

GUI Graphical User Interface

MATLAB Matrix Laboratory

SMTP Simple mail transfer protocol

USB Universal serial Bus

# 

# 1. Introduction

**1.1 Introduction:**

Smoking detection project is undertaken to eliminate health hazards to general public through passive smoking by discouraging smoking in public place by identifying and penalizing the smoker using gesture recognition algorithm.

* 2555 Indians are dying everyday because of tobacco related cancer.
* Apart from this, almost twice the number of people are affected by passive smoking related ill health.
* Tobacco is mainly consumed by “Smoking”.

Steps taken by government to eliminate or discourage smoking:

* High taxes on tobacco products- cigarette, beedi, cigar etc.,
* Statutory warning on tobacco products regarding its ill effects.
* Awareness campaigns in public media(Newspaper, advertisements, hoardings).
* Caution/warning in films and televisions whenever smoking scenes are depicted.
* Banning of “smoking in public places”.

There are many similar projects done using the other algorithms and methodologies such as smoke detectors, sensors etc. There are many cons in all those projects so these are enlisted and overcome using a different procedure in this project. Initially it was started with the Python and Open CV environment but there are comparatively more advantages in the MTALAB environment hence this project is implemented using MATLAB scripting language.

The smoking activity of the person is detected using MATLAB, image-processing technique. While searching for any similar systems which does the work, but the exact system does not exist and hence started working on the gestures of the human while smoking.

There exist different gestures of the smoking which depends on the interest of the person who is smoking. In this the popular gestures of smoking are considered and are fed to machine to recognize gesture.

The main platform of our project is developed using the MATLAB IDE, with the sufficient packages/library and the internet configuration settings. Thus, the intention of the project to deploy the system in the public places and necessary action taken on smokers. Hence, the prototype of smoking gesture detection system is developed and implemented.

**1.2 Organization of the report**

Chapter 1: Introduction

Starting with the small introduction and the motivation for this project, the report is organised by collecting the gestures of humans, doing the literature survey for different projects and the approaches to achieve the project.

Chapter 2: Background Theory

The background theory regarding this project is elaborated. This involves the basics of the image processing, and the purpose of choosing the environment and algorithms which helps us for the gesture recognitions.

Chapter 3: Aim and objectives

The aim and the objectives of this project is defined, in which the division of the entire building of smoking gesture detection system is broken into small steps called objectives and in each objective, the respective methodologies in order to achieve the objectives are mentioned.

Chapter 4: Problem Solving

This involves the design part of the smoking gesture detection system, creation of GUI, the block diagram, the data flow diagram (DFD), flowchart of the model being built and the algorithm to recognise the smoking gestures and the communicating email module.

Chapter 5: Results

Listing out the results in various forms like tables, screenshots and etc, Here all the test cases are explained and respective results are listed. Implementation is done in a certain environment to make the results more accurate. The database videos are tested as well as live streaming with certain number of frames till it runs.

Chapter 6: Project costing

The costing of the project is explained briefly. This includes all the human labour, cost for setting up the environment, and the price of laptops.

Chapter 7: Conclusion

The report is concluded by discussing the pros and cons of this prototype and the analysis of the system under different scenarios, the future work, where the functionalities can be increased, deployment of the project in the public areas, making the system robust and making the deployment in the remote places where the controller part is in some other place.

At last, the references are specified where the information and the ideas which helped in the exploration of this project and finally in the appendix part the entire source code of the project is shown.

# 2.Background Theory

Background Theory for the project involves the literature survey, the knowledge of implementation, assumptions and principles which made to begin the project and the functional requirements written and the environment using which the prototype is being built.

**2.1 Background Theory:**

Many hand gesture detection projects and algorithms exists in which sensors are used, image processing is used, in virtual reality games and etc.,

Something additional that is noticed is the motion detection algorithms. In this project the motion of the hand is being used along with the hand gesture recognition using image processing.

Some assumptions made in our project are:

* Person smoking is standing at the same position.
* Person who is smoking is facing straight to the camera.
* No existence of the multiple people in front of the camera.
* Only detects one person’s gesture at a time.
* There exists a non-varying background behind the person who is smoking.

In the image processing, some terminologies and the definitions for the key terms are to be known. Here are some of the following listed below:

* Pixel: A minute area of illumination on a display screen, one of many from which an image is composed.
* Image: An image is a representation of a two-dimensional image as defined set of digital values, called pixels.
* Image Processing: It is a method to perform some operations on an image, in order to get an enhanced image or to extract some useful information from it.
* Binary Image: A binary image is a [digital image](https://en.wikipedia.org/wiki/Digital_image) that has only two possible values for each [pixel](https://en.wikipedia.org/wiki/Pixel) typically black and white.
* Greyscale Image: Grey-scaled images are composed of shades of grey, varying from black at the weakest intensity to white at the strongest, values varying from 0 to 255.
* RGB image: It is a colourimage, technically, it is a 3 greyscale matrices place in the three different planes.
* Background subtraction: **Background subtraction** is a technique for separating out foreground elements from the background and is done by generating a foreground mask. This technique is used for detecting dynamically moving objects from static cameras. Background subtraction technique is important for object tracking.
* Segmentation: the process of portioning image into multiple segments (set of pixels)
* Thresholding: Converts each pixel into black, white or unchanged depending on whether the original colour value is within the threshold range.
* SMTP: Simple mail transfer protocol
* E-mail: Electronic mail
* Erosion: It is a filtration technique. The value of the output pixel is the minimumvalue of all pixels in the neighbourhood. In a binary image, a pixel is set to 0 if any of the neighbouring pixels have the value 0.
* Dilation: It is a filtration technique. The value of the output pixel is the maximum value of all pixels in the neighborhood. In a binary image, a pixel is set to 1 if any of the neighboring pixels have the value 1.

**Standard formulae that we are using in the project are:**

* Area (A): Area of the region where the boundaries are calculated (m2)
* Perimeter(P): Area of the region where the boundaries are calculated (m)
* Roundness: (RND) = (4\*pi\*AREA)/(PERIMETER^2); (no units constant).

SMTP configuration settings are needed in the MATLAB so that, we can send emails from the MATLAB when the laptop is connected to the Internet.

**Merits and the Demerits:**

* Using MATLAB to build the prototype, is very comfortable with the image processing technique as the image is stored in the form of matrices, can easily perform the operations and it is flexible to alter the algorithms involving the gesture recognition.
* Training of the gestures is practical with more accuracy. A comfortable GUI can be prepared for execution.
* The system also works for the person smoking with both the hands (right as well as left).

Demerits are, as it is the image processing it may have a chance of detecting the similar gestures, in which the person is not really smoking.

* The person who is smoking from the side angle in front of the camera, can’t be detected.
* When suspicious activity is detected, the respective snapshots of the images are sent through the e-mail, it also has an option to check the time and date when the person is smoking in the database.

# 3. Aim and Objectives

In this project, the main goal is to eliminate health hazards to general public through passive smoking by discouraging smoking in public place by identifying and penalizing the smoker using gesture recognition algorithm. The main aim is implementing the prototype of identifying the smoker based on his hand gestures.

Although there are various smoke detectors available, the recognition of smoker by gesture is implemented in this project.

* 1. **Title**

Design and Development of “**Smoking Detection System”.**

* 1. **Aim**

To design a system that detects smoking at public places.

* 1. **Objectives**
* To perform literature survey on existing methodologies in detection of smoking.
* To arrive at the system requirements.
* To design the prototype for monitoring human gestures of smoking**.**
* To train the system to detect the object and the gesture in a particular environment.
* To test and validate developed system for particular test cases.
* To document the report by unifying all the results and outcomes.
  1. **Methods and Methodology**

|  |  |  |  |
| --- | --- | --- | --- |
| **Objective No.** | **Statement of the Objective** | **Method/ Methodology** | **Resources Utilised** |
| 1 | To perform literature survey on existing methodologies in detection of smoking. | 1. Understanding the existing methods of smoking detection. 2. Noticing flaws in already existing methods. 3. Improvisation in our proposed system. | Internet, research papers. |
| 2 | To arrive at the system requirements. | 1. Noting down the functional requirements. 2. Collecting the required hardware components for system development. |  |
| 3 | To design the prototype for monitoring human gestures of smoking. | 1. Block diagram 2. Flowchart 3. Data Flow diagrams | Dia software |
| 4 | To train the system to detect the object and the gesture in a particular environment. | 1. Using MATLAB scripting language. 2. Gesture recognition methods. | MATLAB IDE, packages in matlab, Web camera. |
| 5 | To test and validate developed system for particular test cases. | 1. Considered different types of gestures and tested if the system was working fine for the right gesture. |  |
| 6 | To document the report by unifying all the results and outcomes. |  |  |

# 4. Problem Solving

**Preamble**

This chapter encloses the design and development of the prototype smoking detection system. The design part is done by analysing the various operations to be done in sequence and it is represented using a flowchart, block diagram and data flow diagrams. The implemented prototype is then tested for different gestures. The different test cases are analysed while obtaining the results.

The main objective of the proposed system is to detect the smoking gesture. In this a person is made to come in front of the camera with a plain, constant background and smoke. Generally, for smoking the hand moment is to be made continuously towards and away from the mouth. In order to detect the gesture different methods have been used to detect the gesture part and if the system encounters the same thing for few number of times then the person’s face is detected and sent to the Gmail where the person can cross verify whether he/ she is really smoking or it was just the gesture which was recognised.

In order to make sure the system satisfies the mentioned objectives it was tested for few videos and the results are satisfactory with a success rate of up to 70% if the video is being given as an input by the user and up to the mark for the live streaming.

The gestures were trained to the system in prior and certain calculations were to be made for each gesture and ranges are given to the system where in if the area recognised by the system matches with the range then the output is shown as to which gesture it is actually matching with. A count variable is allotted to the system which can be altered by the user to recognise the gesture for those many times and if it exceeds the value then the person’s image and captured and forwarded to the respective officials.

The inputs for the system are of 2 types which are:

* Database videos
* Live streaming

1. **DESIGN:**
2. **Flowchart**

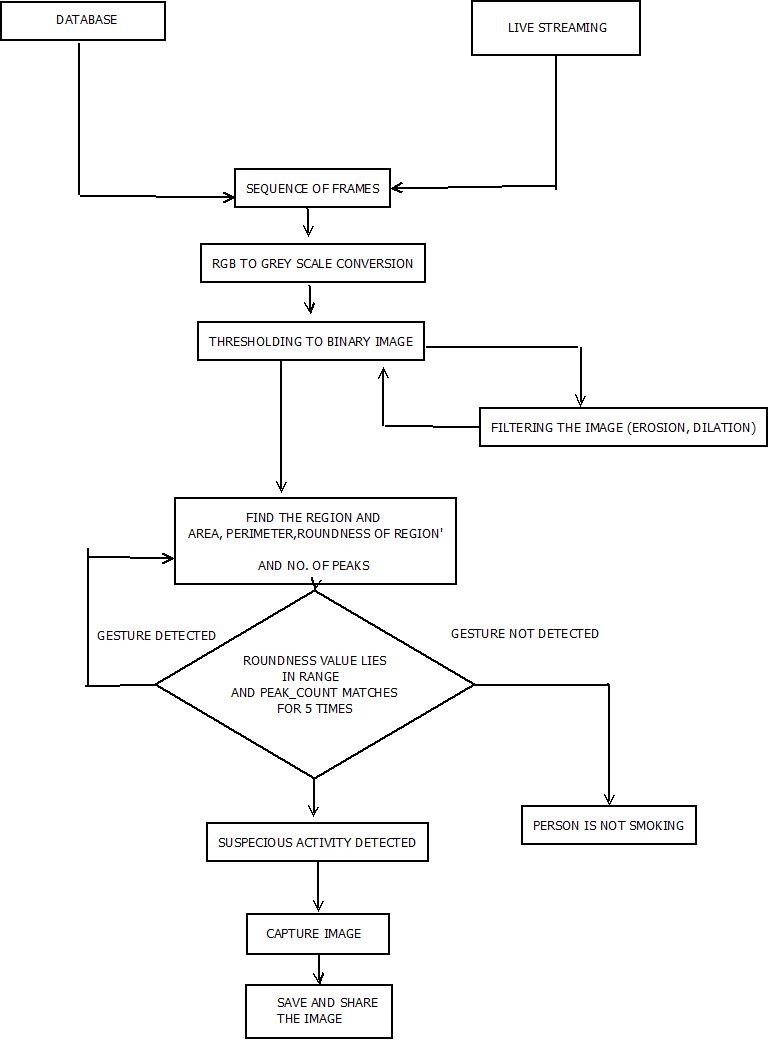
****

Figure 1 Flowchart of Smoking Recognition Process

In the above screenshot the flowchart for the entire procedure being followed by this application is seen. The inputs are of 2 types video fed to the system from the database and the other is the live streaming part. This input is then divided into multiple frames and read by the system. It is then being converted into many formats such as firstly the background is subtracted, greyscale conversion where the video is converted from an RGB format. It is then converted into a binary image since the pixel value is reduced that is either 1 or 0 which depict the colours back and white. For clear and precise recognition by the system it is then processed one last time and depending on the calculations if the gesture is done for multiple times then it is recognised where the image is captured and forwarded the officials as well as a copy is saved in the database. If there is no gesture being recognised, then there is nothing displayed nor anything is forwarded to the officials.

1. **Block diagram**

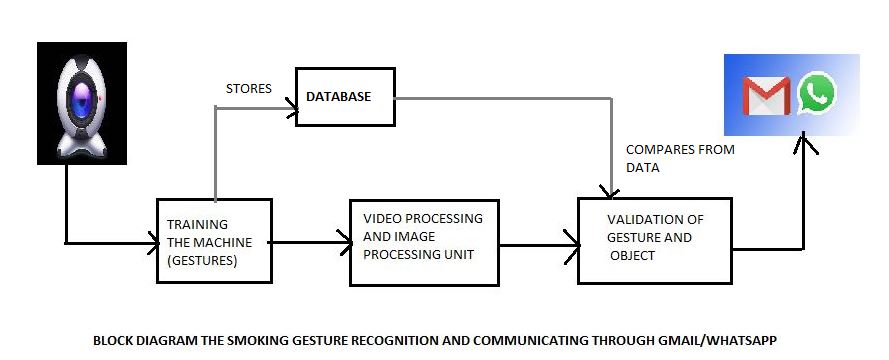
****

Figure 2Block diagram of smoking recognition process

1. **Data Flow Diagram**

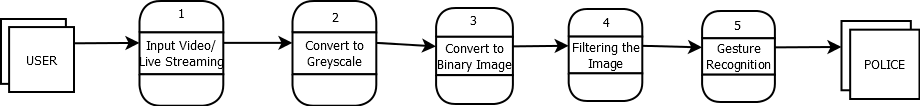
**Level 0:**

****

**Figure 4.3.1 Level 0 DFD diagram**

This is level 0 of the data flow diagram where the external entities are the user and the police/official. The user does a smoking gesture which is forwarded to the police for confirmation.

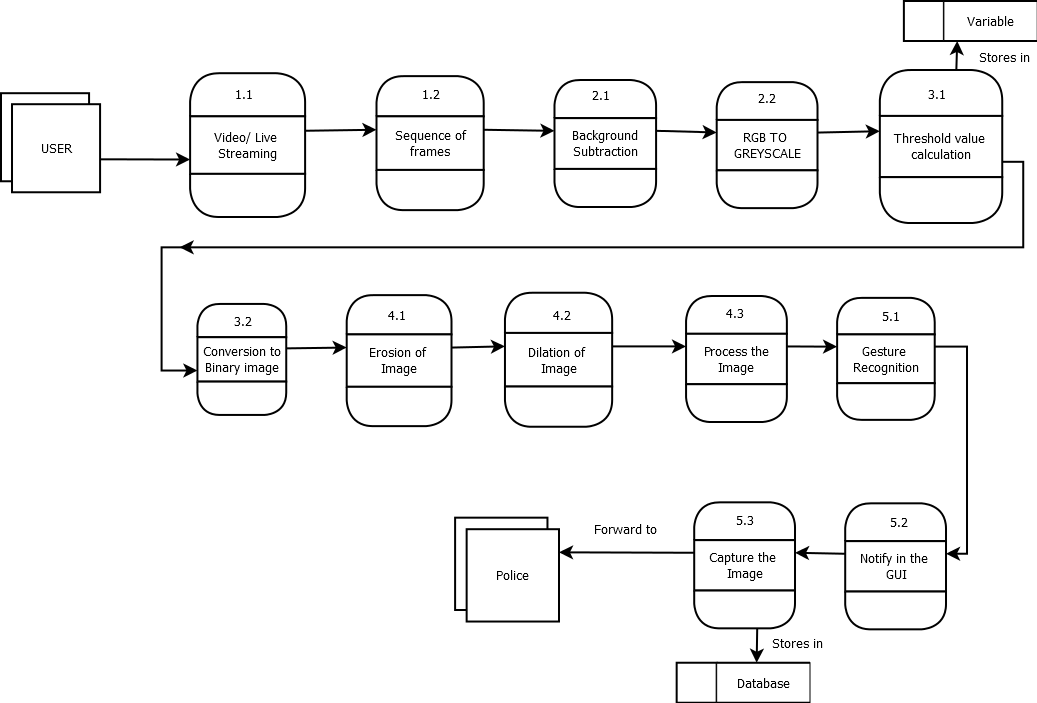
**Level 1:**

****

**Figure 4.3.2 Level 1 DFD diagram**

This is the first level of data flow diagram were the bubble in the 0th level is expanded into 5 bubbles. The input video is given in any of the 2 formats and different types of conversions are done such as the greyscale, binary conversion and also the filtering of the image in a precise and clear format. After that is done the gesture is recognised and that is forwarded to the police for verification.

**Level 2:**



**Figure 4.3.3 Level 2 DFD diagram**

This is the last level of data flow diagram that is level 3 where the procedures are explained and split in an even more detailed way where the user gives the input video which is split into frames and read by the system. The background is subtracted and it is converted to a greyscale format. Now the image is to be converted into a binary format for which the threshold value is required which is calculated and then the image is converted to the binary format. For removing the noise and making the gesture be detected clearly the images are eroded, dilated and again processed. The final processed image is checked by the system and if the gesture is recognised well for multiple times then the user is notified about some suspicious activity and the image is forwarded to the officials. All the images are also saved in a database for future reference and also for cross verification.

Explanation of various steps for gesture recognition:

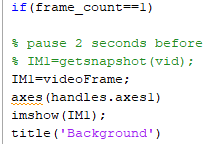
* 1. **Video/ live streaming**- The software is capable of detecting smoking through gesture recognition for an existing video in mp4 format or from a live stream captured from either a web cam or CCTV camera.
  2. **Sequence of frames**- Video is segmented into sequence of frames in order to convert a moving image into a static image of suitable resolution to enable gesture recognition.
  3. **Background subtraction**- Initially one of the frame is captured and considered as reference. Now the complete video is compared with the reference image and whatever is similar that part gets subtracted and the system concentrates on the altered part.
  4. **RGB to Grey scale**- In order to keep the program simpler and at the same time effective, the image captured by the camera or image frames obtained from video file in RGB format are converted into grey scale. Grey scale reduces the complexity from a 3D pixel value (R,G,B) to a 1D value. In grey scale it is still possible to recognize brightness, contrast, edges, shape, contours, texture, perspective, shadows etc., without addressing colour.
  5. **Thresholding binary image-** Thresholding is the process of replacing each pixel in an image with a black pixel if the image density Ii,jis less than a fixed constant T or a white pixel if the image intensity is greater than the constant I. This is one of the important steps in image processing. Thresholding achieves partitioning the image into background and foreground images. This type of image segmentation isolates the objects by converting greyscale image into binary image.
  6. **Gesture recognition-** This is the most important part of the project. The hand gesture for smoking is interpreted and recognised by the software. Bodily motion of hand with the particular pattern is recognised and alert raised in case the smoking gesture is detected.
  7. **Dynamic time stamping of image:**Image of the person so obtained above, is captured, the dynamic time and location stamping is done on the image from the system clock and GPS on the camera. This provides the evidence and audit trail for investigation / penalising the offender (smoker).
  8. **Sharing of image via Gmail:** Image with dynamic time and location stamping is sent to the predetermined Gmail ids (monitors / control room) to initiate necessary action to alert the guards to physically locate the smokers, advise them / penalise them.

1. **IMPLEMENTATION:**

The code was implemented for both live streaming as well as for the videos stored in the database.

In live streaming or in the videos from database the procedure is almost the same. In the entire procedure there were many problems faced at each stage.

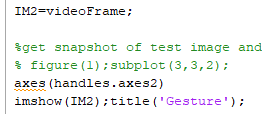
1. Firstly, the video is taken and given as input to the system but in this entire process for the gesture to be recognized there has to be a comparison for the system to recognise the change in the video. Hence the first frame of the video is captured and stored in a variable and displayed in the user interface and named as “BACKGROUND.” This is done in the first axes. The following is the code used for the above procedure:

****

**Figure 4.4.1The initial frame is background frame**

1. In the second axes the full video is made to run which is shown to the user in the user interface.

Code for showing the video in axes 2:



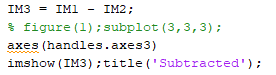
**Figure 4.4.2This is the present frame which is running**

1. In the second axes the full video is made to run which is shown to the user in the user interface. Both these are subtracted just to make sure the system understands the changes in the frames in a better way which is displayed in the third axes, named as “Subtracted” and is displayed.

Background subtraction is actually a process in image processing where the image’s foreground is extracted out for further processing. The main aim of this approach is detecting the moving objects or changes between the current frame and the reference frame which is often called as the background image. This procedure is also called Foreground detection.

Though the system can recognise the changes based on the background subtraction performed and shown in third axes the accuracy is not up to the mark since the video is in an RGB format.

Code for showing the subtracted image in axes 3:

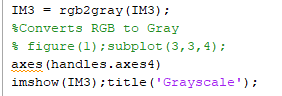


**Figure 4.4.3 Image subtraction of the frames**

An RGB image is a composite of 3 independent greyscale images that correspond to the intensity of red, green and blue light. The main reason for conversion of the RGB image to greyscale is that in our application since image processing plays a major role RGB colours make it difficult to identify important edges and other features.

1. This converted image from RGB to greyscale is stored in fourth axes.

Code for showing the greyscale image in fourth axes:



**Figure 4.4.4 conversion of RGB image to Greyscale image**

In order to make it more simplified and easier for the system to identify every detailing clearly this greyscale image is also converted into a binary image. In order to convert any image into a binary image format the threshold value is necessary for every image for which it is calculated.

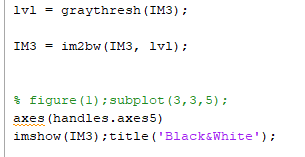
The thresholding for the image is done using the Otsu’s thresholding method. This method chooses a threshold value that minimizes the intra class variance of the black and the white pixels. It automatically performs clustering based image thresholding or conversion from greyscale image to binary image. In this code the variable named “level” stores the calculated threshold value. This process converts the greyscale image into binary image by replacing all pixels in the input image with luminance greater than “level” with value 1 which depicts white colour and all the remaining pixels with value 0 which depicts black colour. This range is relative to the signal levels of the image’s class. Hence a level value of 0.5 corresponds to an intensity value which is exactly halfway between the maximum and the minimum values.

The input to a thresholding operation is typically a greyscale or colour image. In the simplest implementation, the output is a binary image representing the segmentation. Black pixels correspond to background and white pixels correspond to foreground (or *vice versa*). In simple implementations, the segmentation is determined by a single parameter known as the intensity threshold. In a single pass, each pixel in the image is compared with this threshold. If the pixel’s intensity is higher than the threshold, the pixel is set to, say, white in the output. If it is less than the threshold, it is set to black.

All this transformation helps in detecting blobs and reduces the computational complexity. This also helps in finding the region of interest for further processing more precisely if required.

1. The binary image is now stored in fifth axes.

Code for binary image:

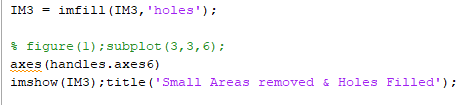


**Figure 4.4.5 Finding the Threshold value of the Image and converting to Binary Image**

The system is now using the binary image but there are problems to be resolved in the binary images also since the pixels are of only 2 values in this which are 0 and 1 depicting black and white colours. Though the pixels are shown based on the threshold value there could be some ambiguity in the pixel values such as unevenness or the pixel values because of the background colours.

Hence to remove this ambiguity firstly delete the tiny and unwanted holes being displayed using the code and this is displayed in the sixth axes.

1. Code for tiny holes removal:



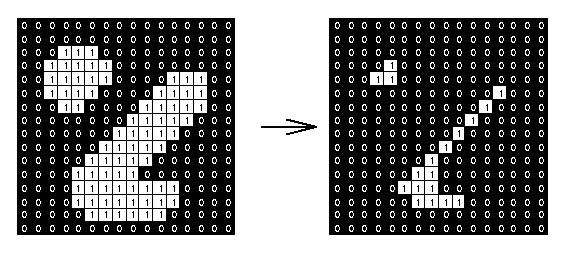
**Figure 4.4.6 Removal of the Tiny Holes**

This image is then made into an eroded image and into a dilated image for proper alignment and values of pixels so that the objects on which the code is concentrating will be in a better highlighted manner.

The image is firstly eroded where it erodes away the boundary regions of the foreground pixels hence making the area of the foreground pixels shrink in size and the holes within them to enlarge.

The erosion operator takes two pieces of data as inputs. The first is the image which is to be eroded. The second is a set of coordinate points known as a structuring element and it is this structuring element that determines the precise effect of the erosion on the input image. The 3×3 square is probably the most common structuring element used in erosion operations, but others can be used. A larger structuring element produces a more extreme erosion effect, although usually very similar effects can be achieved by repeated erosions using a smaller similarly shaped structuring element. With larger structuring elements, it is quite common to use an approximately disk shaped structuring element. In general, erosion using a disk shaped structuring element will tend to round concave boundaries, but will preserve the shape of convex boundaries.

A small example of erosion:

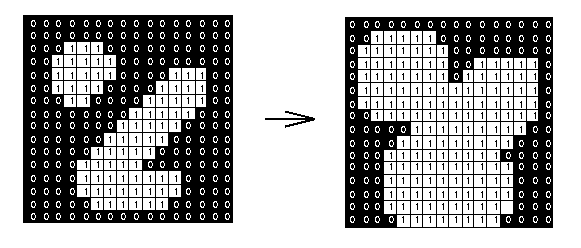


**Figure 4.4.7 An Illustration to show the erosion**

The eroded image is then dilated where it dilates the boundary regions of the foreground pixels hence making the area of the foreground pixels enlarge in size and the holes within them to shrink.

Dilate is a function that accepts a black and white image. It turns on pixels which were near pixels that were on originally, thereby thickening the items in the image. Similar to an eroded image this also takes 2 inputs where one is for the image to be dilated and the other is for the structure element.

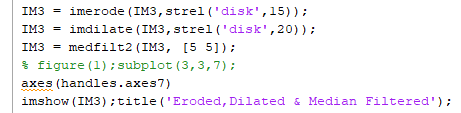
An example of dilation:



**Figure 4.4.8 An Illustration to show the erosion**

1. This image which is eroded and dilated is displayed in the seventh axes.

Code for showing the eroded and dilated images:

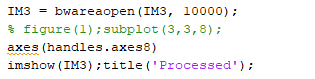


**Figure 4.4.9 Filtration Techniques of the Binary image**

This image is again filtered to give a precise processed output for better working of the system. Area opening operation is done where it takes 2 inputs one for the image and the other for the pixel value “x” where in it removes or eradicates all the connected objects that have fewer than “x” pixels present in the image given as input.

1. This final image is shown in the eighth axes and is named as “Processed”.

Code for the processed image:

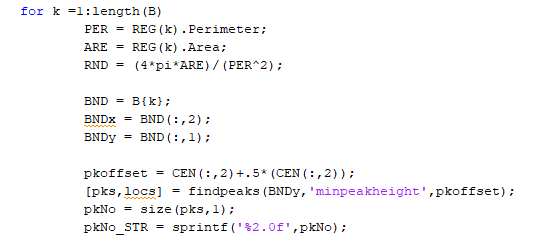


**Figure 4.4.10The Processed Image**

There are also other methods for solving this in MATLAB by using the Edge algorithms such as Sobel, Canny, Prewitt and fuzzy logic methods.

Now for the region of pixels which is shown in the processed image the roundness value is calculated for different things and range is mentioned to detect different types of gestures. For the roundness to be calculated area and perimeter are also calculated and on running the code based on the roundness value of the final shape of pixels in the processed image it shows which type of gesture is being recognised by the system. The system needs to be trained a lot for it to recognise the gestures based on the range of the roundness values calculated.

Code for the calculation performed:

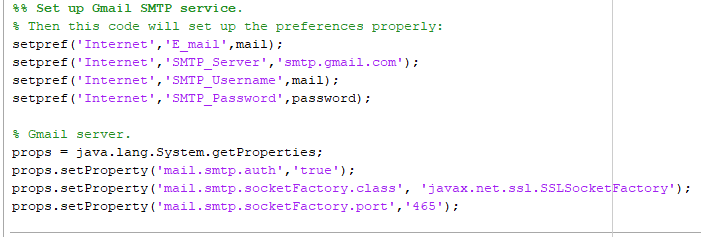


**Figure 4.4.11Finding the Perimeter, Area and the Roundness Value Parameter**

**EMAIL:**

In order to send any email from MATLAB environment first it needs to be made sure that the internet access is given in the settings and then the below code is to be mentioned to imbibe the SMTP server protocols into the code and give the access for sending emails. Firstly, the preferences for the SMTP are to be given and then the authorisation for the Gmail account along with the port number is to specified for the correct functioning of the mail transfer.

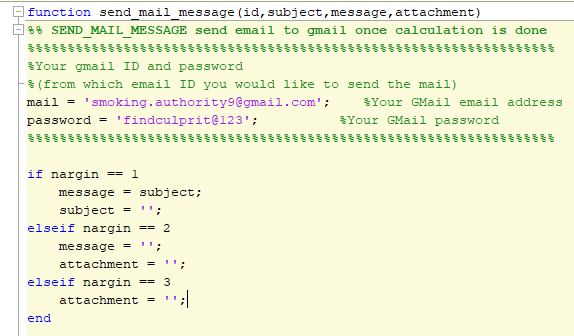
Code for SMTP connection:



**Figure 4.4.12 Setting the SMTP SERVER.**

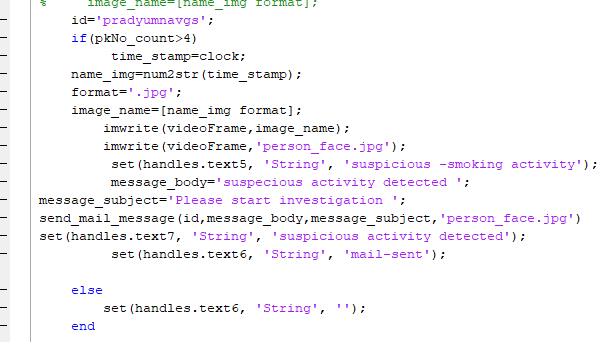
In the below screenshot the code where the details regarding from which account the images are being transferred is mentioned along with what is the structure of the mail received by the other the client or the receiver. According to this code the subject of the mail is specified in the first line followed by the message for the officials to understand what is to be done along with the attachment file which has the image of the person detected. These details of the message and attachment are specified in the main code which is being executed and shown in the next screenshot.

Details of the sender along with data to be sent:



**Figure 4.4.13 A Function to send the email**

Integration with the main code:



**Figure 4.4.14 Integration of the email module to the gesture recognition main function**

In the above screenshot it is see that the link is established between the code written in another file for the mail to be sent and in this the details for whom the mail is to be sent is mentioned. A condition is specified where the system captures the image and sends it to the officials only when the gesture is encountered for that many number of times. In the above code it is seen that the count is given to be 4 which says that if the system recognises the gesture for more than 4 times then the image of the person is forwarded to the receiver. Once the condition is satisfied and the system detects the person the last 10 lines of code show what is to be shown to the user in the interface where it shows that some suspicious activity is detected and also shows the message that the mail is sent.

This system can be expanded widely and the format of the images can be changed accordingly based on the configuration of the system.

If the system does not detect any suspicious activity happening, then nothing will be displayed in the user interface for which the code is mentioned in the else if condition.

1. **TESTING:**

Testing is the activity performed to check if the obtained results match with the expected results and also to make sure that the system or the application is defect free. Since the application or the code specified is basically for detecting the smoking gesture different ways of testing were performed to check the performance of the system. The below link consists of few videos along with the results of what happened during the testing process.

[**https://drive.google.com/open?id=1bxYKqVdcfHKiDlED7hUObBPudw-RAYUP**](https://drive.google.com/open?id=1bxYKqVdcfHKiDlED7hUObBPudw-RAYUP)

The different cases for which it was tested are as follows:

**CASE 1:** Person is made to sit in front of the camera and is given a cigar to do the smoking gesture. As he keeps doing that gesture it means that the hand is actually taken towards and away from the mouth for multiple number of times. Since the gesture is correct after the system has detected for the required number of times it has actually captured the image of the person doing that smoking gesture and sent to the respective mail address.

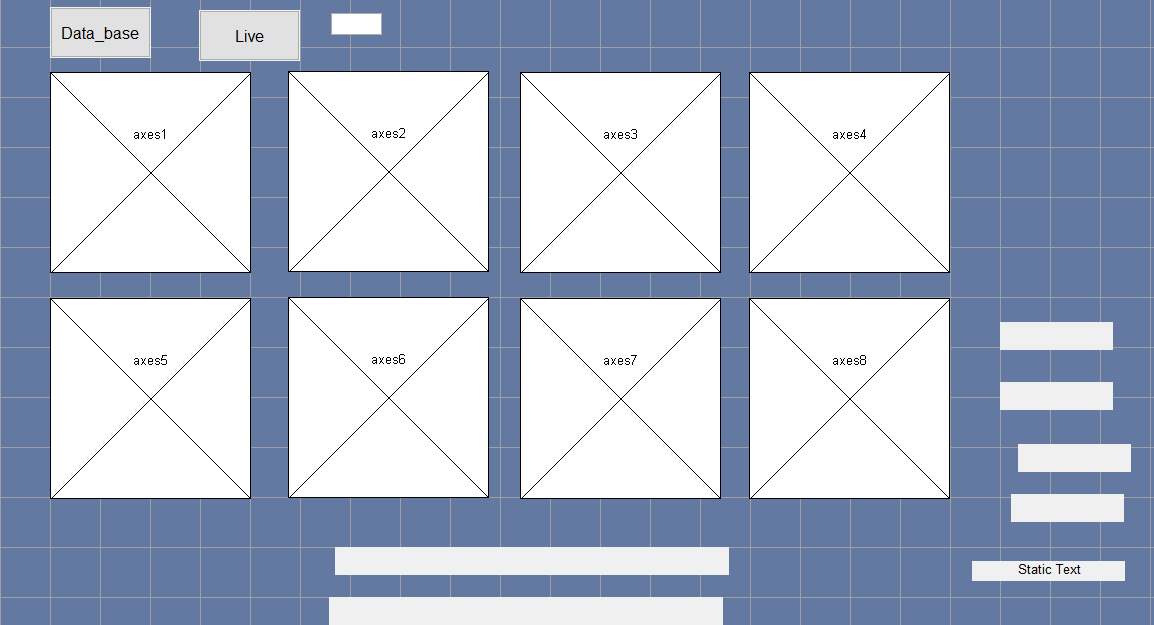
**CASE 2:** In this case another person is made to sit in front of the camera and is asked to do the smoking gesture but this time without any cigar in the hand. In this case the frequency of detection of the gesture is very low and slow compared to the first case but at last it was captured and forwarded to the respective official’s email.

**CASE 3:** Another person is made to sit in front of the camera and is asked to do random actions but nothing related to the smoking gestures but just staring at random things or doing some actions and it was successful since the system did not detect any gesture and no mail was forwarded to the official’s email.

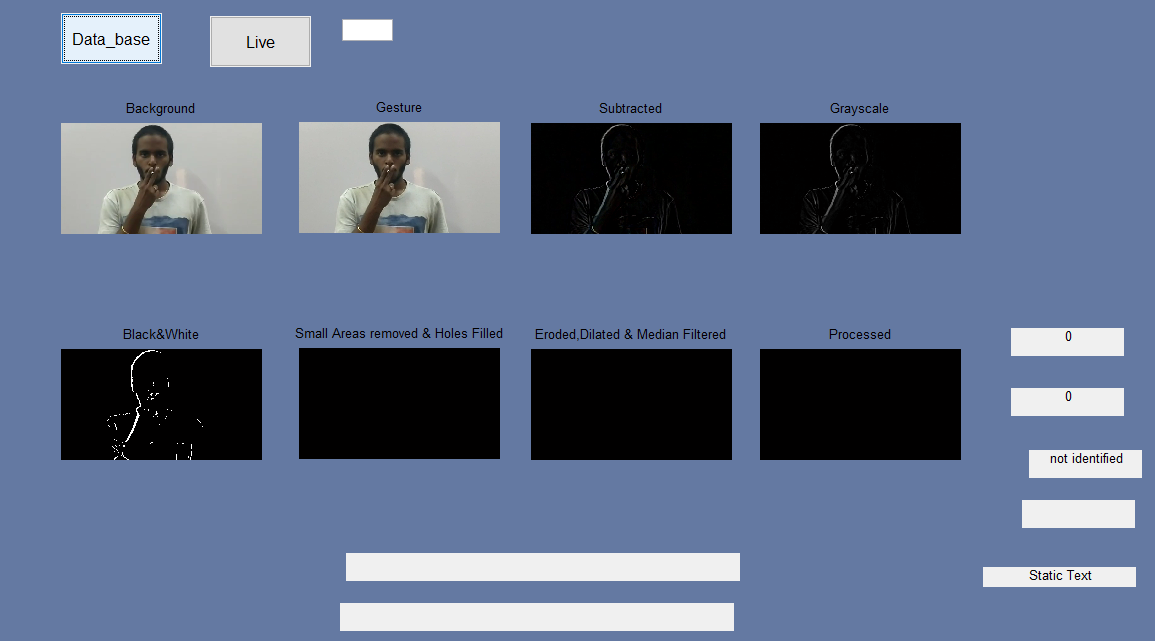
The above cases are implemented for both the live streaming part as well as the videos given as input to the system and the results were found satisfactory.

# 5. Results

**Presentation of results:**

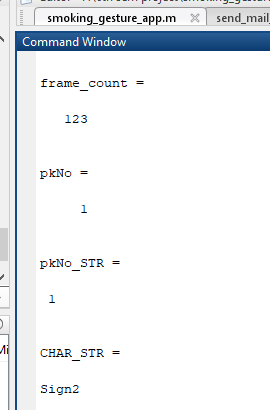
****

**Figure 5.1**This is the GUI created for the implementation done.



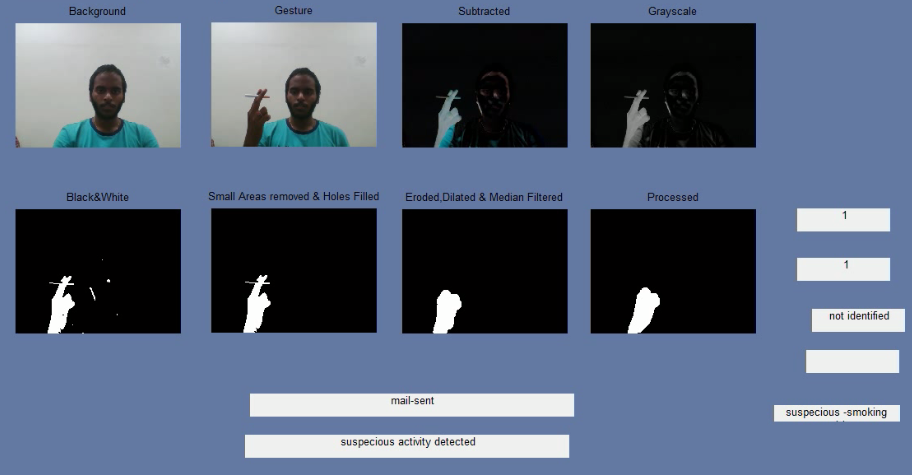
**Figure 5.2The Live Execution of the Smoking Detection System**

Interface that pops up on executing the code.



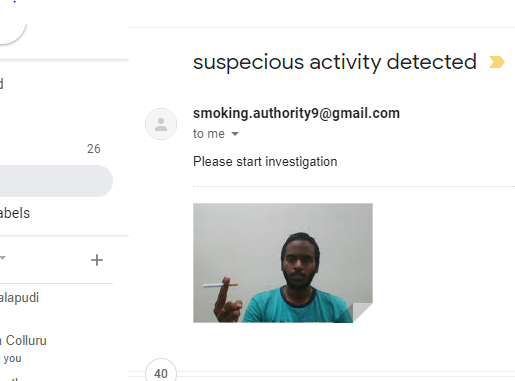
**Figure 5.3The recognised sign is shown in the Output console.**

In the command window when the gesture is recognized by the system it shows the frame number along with the peak offset number and the gesture type.

****

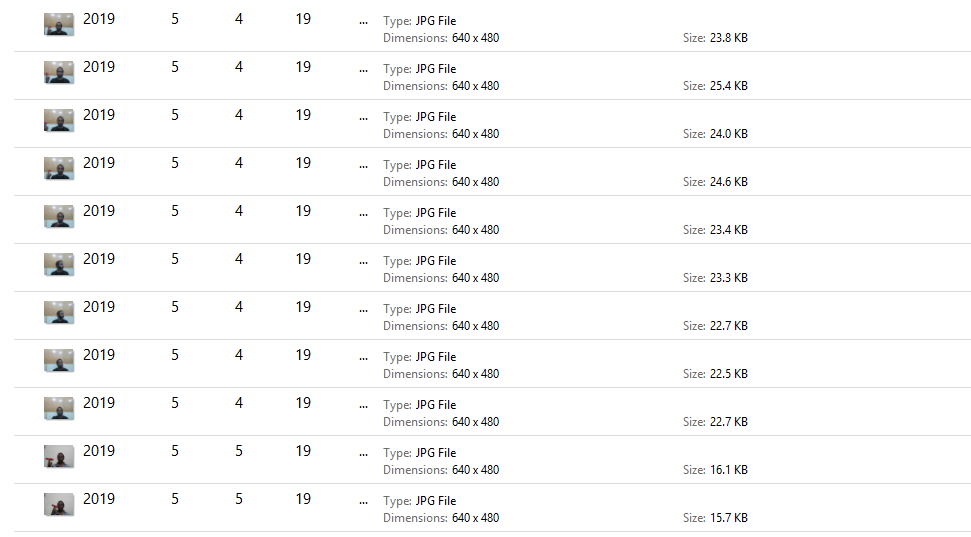
**Figure 5.4The final Output of the GUI where the email acknowledgement is sent**

The above is the result obtained once the gesture is recognized by the system.



**Figure 5.5 Showing of the snapshots received in the mail**

This is how the email sent to the higher officials will be when the system forwards the image of the person smoking on recognition.



**Figure 5.6The list of Snapshots saved in the database along with the Timestamp**

**(Date and Time)**

All the images captured will be saved in the database along with the time stamps for cross verification and future reference.

# 6. Project Costing

## Introduction

All the previous chapters tell about what was designed, implemented and tested in our project through different cases. After implementation of software now in this chapter the total cost to design and implement the project is estimated along with the labour cost.

**6.2 Project Cost**

Components Cost:

* Component -1: LAPTOP = ₹ 50,000
* Component-2:WEB CAMERA = ₹ 1,000

**Labour cost:**

Two hours per day Total 4 persons worked for 16 weeks – @ ₹200 per day

So Total: (2 x 7 x 16 x 4 x 400 = 3,58,400)

Grand Total: (₹50,000+₹ 1,000+₹ 3,58,400)= ₹ 4,09,400

**Summary**

In this chapter, the details about the project costing has been given. This chapter also contains the information of the components as well as the labour cost. The net total cost including the project cost and the labour cost has been provided.

# 7. Conclusions and Suggestions for Future Work

This project was all about detecting the gesture and an object detection where a prototype was developed to monitor the human actions, so that people who are smoking in public areas will be easily caught. In addition, this project provided the ability to capture the picture of the smoking person and automatically that picture is shared to the higher authorities. Motivation behind this project was the fact that 2555 Indians are dying because of tobacco related cancer. In addition, it would lead to passive smoking. This project aimed to develop a prototype to detect the people who are smoking in public areas. If a person is found smoking immediately corresponding person photo will be sent to that related higher authorities via G-mail. The higher authorities can charge that particular person.

The scope of this project was to provide awareness in the citizens so that they would not smoke in public areas. The project was completed by following a sequence of steps – literature survey, requirement analysis, design, implementation and testing. Above all this project provided a single platform to detect a smoking person.

Hence, future work can be concentrated on developing this proto type into a real world system. Approaching the government to approve the project for real time implementation and to create a cigar with special identification.

**References**

* Siddharth S. Rautaray · Anupam Agrawal ,06 November 2012.**Real-time Hand Gesture Detection and Recognition for Human Computer Interaction**
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* Michahial, Stafford. (2015). **Hand gesture recognition using support vector machine.** The International Journal Of Engineering And Science. 4. 42.
* <https://homepages.inf.ed.ac.uk/rbf/HIPR2/dilate.htm>
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* <https://www.quora.com/In-image-processing-applications-why-do-we-convert-from-RGB-to-Grayscale>
* <https://www.pantechsolutions.net/blog/matlab-code-for-background-subtraction/>
* <http://www.labbookpages.co.uk/software/imgProc/otsuThreshold.html>

**Appendix**

**Appendix-A**

The source code of the project Smoking detection System is shown below.

function varargout = smoking\_gesture\_app(varargin)

gui\_Singleton = 1;

gui\_State = struct('gui\_Name', mfilename, ...

'gui\_Singleton', gui\_Singleton, ...

'gui\_OpeningFcn', @smoking\_gesture\_app\_OpeningFcn, ...

'gui\_OutputFcn', @smoking\_gesture\_app\_OutputFcn, ...

'gui\_LayoutFcn', [] , ...

'gui\_Callback', []);

if nargin && ischar(varargin{1})

gui\_State.gui\_Callback = str2func(varargin{1});

end

if nargout

[varargout{1:nargout}] = gui\_mainfcn(gui\_State, varargin{:});

else

gui\_mainfcn(gui\_State, varargin{:});

end

function smoking\_gesture\_app\_OpeningFcn(hObject, eventdata, handles, varargin)

handles.framenum=500;

handles.output = hObject;

guidata(hObject, handles);

function varargout = smoking\_gesture\_app\_OutputFcn(hObject, eventdata, handles)

varargout{1} = handles.output;

function pushbutton1\_Callback(hObject, eventdata, handles)

videoFileReader = vision.VideoFileReader('VID-20190423-WA0002.mp4');

videoFrame = step(videoFileReader);

[row col t]=size(videoFrame);

no\_frame=1;

faceDetector = vision.CascadeObjectDetector();

fc=0;

eye\_sleep\_cnt=0;

while ~isDone(videoFileReader)

fc=fc+1

[videoFrame ] = step(videoFileReader);

gray\_frame = rgb2gray(videoFrame);

if(fc==1)

Image1=videoFrame;

axes(handles.axes1)

imshow(Image1);

title('Background')

end

Image2=videoFrame;

axes(handles.axes2)

imshow(Image2);title('Gesture');

Image3 = Image1 - Image2;

axes(handles.axes3)

imshow(Image3);title('Subtracted');

Image3 = rgb2gray(Image3);

axes(handles.axes4)

imshow(Image3);title('Grayscale');

lvl = graythresh(Image3);

Image3 = im2bw(Image3, lvl);

axes(handles.axes5)

imshow(Image3);title('Black&White');

Image3 = bwareaopen(Image3, 10000);

Image3 = imfill(Image3,'holes');

axes(handles.axes6)

imshow(Image3);title('Small Areas removed & Filled Holes');

Image3 = imerode(Image3,strel('disk',15));

Image3 = imdilate(Image3,strel('disk',20));

Image3 = medfilt2(Image3, [5 5]);

axes(handles.axes7)

imshow(Image3);title('Eroded,Dilated & Median Filtered');

Image3 = bwareaopen(Image3, 10000);

axes(handles.axes8)

imshow(Image3);title('Processed');

Image3 = flipdim(Image3,1);

REG=regionprops(Image3,'all');

CEN = cat(1, REG.Centroid);

[B, L, N, A] = bwboundaries(Image3,'noholes');

Roundness = 0;

peak=0;

peak\_str=0;

for k =1:length(B)

Perimeter = REG(k).Perimeter;

Area = REG(k).Area;

Roundness = (4\*pi\*Area)/(Perimeter^2);

Boundary = B{k};

Boundary\_x = Boundary(:,2);

Boundary\_y = Boundary(:,1);

pkoffset = CEN(:,2)+.5\*(CEN(:,2));

[pks,locs] = findpeaks(Boundary\_y,'minpeakheight',pkoffset);

peak = size(pks,1);

peak\_str = sprintf('%2.0f',peak);

end

Char\_String = 'identified';

if Roundness >0.19 && Roundness < 0.24 && peak ==3

Char\_String = 'Sign1';

elseif Roundness >0.44 && Roundness < 0.47 && peak ==1

Char\_String = 'Sign2';

elseif Roundness >0.37 && Roundness < 0.40 && peak ==2

Char\_String = 'Sign3';

elseif Roundness >0.40 && Roundness < 0.43 && peak == 3

Char\_String = 'Sign4';

else

Char\_String = 'unidentified';

end

peak

peak\_str

Char\_String

set(handles.text1, 'String', peak);

set(handles.text2, 'String', peak\_str);

set(handles.text3, 'String', Char\_String);

end

release(videoPlayer);

function pushbutton2\_Callback(hObject, eventdata, handles)

videoFileReader = vision.VideoFileReader('VID-20190423-WA0003.mp4');

videoFrame = step(videoFileReader);

[row col t]=size(videoFrame);

no\_frame=1;

faceDetector = vision.CascadeObjectDetector();

fc=0;

eye\_sleep\_cnt=0;

aa=webcam;

peak\_count=0;

peakNo\_STR\_count=0;

while fc<handles.framenum

fc=fc+1

videoFrame=snapshot(aa);

gray\_frame = rgb2gray(videoFrame);

Image1=videoFrame;

axes(handles.axes1)

imshow(Image1);

title('Background')

end

Image2=videoFrame;

axes(handles.axes2)

imshow(Image2);title('Gesture');

Image3 = Image1 - Image2;

axes(handles.axes3)

imshow(Image3);title('Subtracted');

Image3 = rgb2gray(Image3);

axes(handles.axes4)

imshow(Image3);title('Grayscale');

lvl = graythresh(Image3);

Image3 = im2bw(Image3, lvl);

axes(handles.axes5)

imshow(Image3);title('Black&White');

Image3 = bwareaopen(Image3, 10000);

Image3 = imfill(Image3,'holes');

axes(handles.axes6)

imshow(Image3);title('Small Areas removed & Filled Holes');

Image3 = imerode(Image3,strel('disk',15));

Image3 = imdilate(Image3,strel('disk',20));

Image3 = medfilt2(Image3, [5 5]);

axes(handles.axes7)

imshow(Image3);title('Eroded,Dilated & Median Filtered');

Image3 = bwareaopen(Image3, 10000);

axes(handles.axes8)

imshow(Image3);title('Processed');

Image3 = flipdim(Image3,1);

Region=regionprops(Image3,'all');

Centroid = cat(1, Region.Centroid);

[B, L, N, A] = bwboundaries(Image3,'noholes');

Roundness = 0;

peak=0;

pk\_STR=0;

for k =1:length(B)

Perimeter = Region(k).Perimeter;

Area = Region(k).Area;

Roundness = (4\*pi\*Area)/(Perimeter^2);

Boundary = B{k};

Boundary\_x = Boundary(:,2);

Boundary\_y = Boundary(:,1);

pkoffset = Centroid(:,2)+.5\*(Centroid(:,2));

[pks,locs] = findpeaks(Boundary\_y,'minpeakheight',pkoffset);

pkNo = size(pks,1);

pk\_STR = sprintf('%2.0f',pkNo);

end

Char\_String = 'unidentified';

if Roundness >0.19 && Roundness < 0.24 && pkNo ==3

Char\_String = 'Sign1';

elseif Roundness >0.44 && Roundness < 0.47 && pkNo ==1

Char\_String = 'Sign2';

elseif Roundness >0.37 && Roundness < 0.40 && pkNo ==2

Char\_String = 'Sign3';

elseif Roundness >0.40 && Roundness < 0.43 && pkNo == 3

Char\_String = 'Sign4';

else

Char\_String = 'unidentified';

end

pkNo

pk\_STR

Char\_String

set(handles.text1, 'String', pkNo);

set(handles.text2, 'String', pk\_STR);

set(handles.text3, 'String', Char\_String);

peak\_count=peak\_count + pkNo;

peakNo\_STR\_count=peakNo\_STR\_count+pk\_STR;

peak\_count

id='pradyumnavgs';

if(peak\_count>8)

time\_stamp=clock;

name\_img=num2str(time\_stamp);

format='.jpg';

image\_name=[name\_img format];

imwrite(videoFrame,image\_name);

imwrite(videoFrame,'person\_face.jpg');

set(handles.text5, 'String', 'suspicious -smoking activity');

message\_body='suspecious activity detected ';

message\_subject='Please start investigation ';

send\_mail\_message(id,message\_body,message\_subject,'person\_face.jpg')

set(handles.text7, 'String', 'suspicious activity detected');

set(handles.text6, 'String', 'mail-sent');

else

set(handles.text6, 'String', '');

end

end

function edit2\_Callback(hObject, eventdata, handles)

handles.framenum=str2double(get(hObject,'String'));

handles.output = hObject;

guidata(hObject, handles);

function edit2\_CreateFcn(hObject, eventdata, handles)

if ispc && isequal(get(hObject,'BackgroundColor'), get(0,'defaultUicontrolBackgroundColor'))

set(hObject,'BackgroundColor','white');

end

function send\_mail\_message(id,subject,message,attachment)

mail = 'smoking.authority9@gmail.com';

password = 'findculprit@123';

if nargin == 1

message = subject;

subject = '';

elseif nargin == 2

message = '';

attachment = '';

elseif nargin == 3

attachment = '';

end

emailto = strcat(id,'@gmail.com');

setpref('Internet','E\_mail',mail);

setpref('Internet','SMTP\_Server','smtp.gmail.com');

setpref('Internet','SMTP\_Username',mail);

setpref('Internet','SMTP\_Password',password);

% Gmail server.

props = java.lang.System.getProperties;

props.setProperty('mail.smtp.auth','true');

props.setProperty('mail.smtp.socketFactory.class', 'javax.net.ssl.SSLSocketFactory');

props.setProperty('mail.smtp.socketFactory.port','465');

%% Send the email

if strcmp(mail,'GmailId@gmail.com')

disp('Please provide your own gmail.')

disp('You can do that by modifying the first two lines of the code')

disp('after the comments.')

end

sendmail(emailto,subject,message,attachment)

end