GESTURE RECOGNITION SYSTEM

Project report submitted in partial fulfillment of the requirement for the degree of Bachelor of Technology

in

Computer Science and Engineering

By

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Under the supervision of

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to

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CERTIFICATE

I hereby declare that the work presented in this report entitled **"Gesture Recognition System"** in partial fulfillment of the requirements for the award of the degree of **Bachelor of Technology** in **Computer Science and Engineering** submitted in the department of Computer Science & Engineering **,** Jaypee University of Information Technology , Waknaghat is an authentic record of my own work carried out over a period from August 2016 to April 2017 under my supervision of Dr. Amit Kr. Singh (Assistant Professor).

The matter embodied in the report has not been submitted for the award of any other degree or diploma.

Kashish Arora (131329)

This is to certify that the above statement made by the candidate is true to the best of my knowledge.

Supervisor Name- Dr. Amit kr. Singh
Designation- Assistant Professor
Department name-Computer Science &Technology
Dated:

ACKNOWLEDGEMENT

The sense of fulfillment comes along with the successful completion of any task is incomplete without expressing gratitude to all those who made it possible with their guidance and support.

We thank the almighty for giving us such excellent facilities and support through the way of JAPYPEE UNIVERSITY OF INFORMATION TECHNOLOGY for the completion of this project.

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I am especially indebted to my parents for their love, sacrifice, and support and would like to thank my parents for raising me in a way to believe that I can achieve anything in life with hard work and dedication.

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LIST OF ABBBREVIATIONS

MATLAB- Matrix Laboratory

PSNR- Peak Signal To Noise Ratio

KNN- k Nearest Neighbor

PC- Personal Computer

GUI- Graphical User Interface

HMI- Human Interface Interaction

SVM- Support Vector Machine

COG- Center Of Gravity

HSV- Hue saturation value

RGB- Red Green Blue

UML- Unified Modeling Language

HMM- Hidden Markov Model

MSE- Mean Square Error

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ABSTRACT

Gesture based interaction systems are becoming more and more prominent both at work environment and home. The projects expects to build up a system that can perceive hand gesture which can be utilized as a input to associate with the PC which can be connected to various operation of PC. One of the key zones that should be taken a gander at while developing such systems is the image processing stage..

We have proposed a technique for real Hand Gesture Recognition and feature extraction utilizing a web camera. In this approach, the picture is gotten through digital camera related to associated with the system. To start with ,the input picture is preprocessed and threshold value is used to remove noise from it and smoothen the image. After this apply region filling to fill holes in the object of interest. This helps in improving of the classification and recognition step. At that point expel all little object, this is done to evacuate additional undesirable noise or object from picture. At the point when the preprocessing is finished the image is passed on to feature extraction stage. For feature extraction “HU moments” are used because of their distinct properties like scale rotation and translation invariance. The exaggerated elements are normalized and composed to tell the comparing gesture. The classification results are displayed to user. The purpose of this is to improve the accuracy of classification.

CHAPTER 1

Gesture Recognition System: An Introduction

1. Introduction

Humans can easily acknowledge and distinguish between faces and objects. Recently computers have shown the same ability . Gesture Recognition is one of the feature in the field of computer science that deals with the goal of interpreting human gestures , thus helping to build a method to interact between the machines and humans.

Gesture recognition enables one to interface with the machine and interact naturally without any devices. Gesture recognition is done with techniques from image processing.

Gesture are one of the critical and helpful elements in user interaction applications. Interest in the field has increased in recent times due to its potential application in the field of Human Computer Interaction. The most imperative element of this strategy which recognize it from other is that the machine utilizes hand gesture as an information source , through which the user can collaborate and control the framework or gadgets without touching any outside gadgets, for example, mouse and so on. Likewise, it gives user a feeling of flexibility and straight forwardness to do distinctive operation. This serves as a motivating factor to carry out this project. The aim of this project is to develop a system, which captures certain hand gestures as an input from the users using a web camera, and performs the specific task associated with that gesture recognized.

There are various types of gestures that can be used and identified by computers which can be used to perform specific computer operations

Immersive Game Technology: Gestures can likewise be utilized to control connections inside computer games to attempt and make the amusement player's experience more intuitive or immersive.

Virtual Controllers: For structures where the showing of finding or securing a physical controller could require too much time, movements can be used as alternative control frameworks.

1.1 Gesture Recognition :

Human gestures constitute a space of movement communicated by the body, confront, and additionally hands. Among an assortment of gesture, hand motion is the most expressive and the most often utilized. Gesture have been utilized as an option frame to speak with PCs in a simple way. This sort of human-machine interfaces would enable a client to control a wide assortment of gadgets through hand signals. Most work in this exploration field tries to escape the issue by utilizing markers, gloves or requiring a straightforward simple background.

Gestures have been classified in two categories static and dynamic. Static gestures refer to still body posture and dynamic refers to movement of body part. Gestures can be performed with any body part like head , face, arms, hands, etc. but most predominately we use hand to say “hello”. Hand gestures are used in many applications like robotics, sign language, human machine interaction, etc. With the advancement in this field HCI has become an emerging field in recent years.

The innovation on digital cameras and microchips are progressing quickly that it is conceivable to make a human PC interfaces utilizing these assets for recognition of user gestures. The Gesture recognition interface acts as a interface amongst people and machines. The human-machine interaction is similar to human-human interaction, in

which, the important data are communicated using the human organs like hand gesture, head movement, face expression, voice communication and overall body posture.

1.2 Problem Statement :

What are we going to do?

We have used hand gesture recognition for performing different operation of computer. The aim of this project involves converting captured images via a vision-based sensor (web-cam) and apply different image processing techniques to analyze the image better which can then be used in future works to detect hands and recognize gestures. The main focus will be on image processing.

Project is based on static phase of hand gesture in which we use different gesture to perform different task.

A new technique is proposed which begins by detecting the hand & determining its center, finding the roundness and peak offset , and finally recognizing the gestures.

1.3 Objective :

- To provide a platform where we can provide the input in such a way in which we interact with each other , which is also more technologically advanced , easy and simple to use , fast ,efficient and more interactive .Computer recognize and interpret various gestures made by us and perform computer operation accordingly.

- To design an efficient algorithm that increases the accuracy and performance for hand gesture recognition in the run time without making use of the database with minimum false rejection rate and maximum recognition rate.

1.4 Methodology :

Proposed Method:

In order to extract features and recognize a gesture following method is proposed:

1. Capture Scene 1 with plain background then Capture Scene 2 with hand. This phase is called image acquisition.
2. After capturing the image, we detect the hand and separate it from the scene because if it is not separated from the scene it will affect the accuracy of the system later when we will be extracting and matching the features.
3. Crop hand out of scene by subtracting two images.
4. Preprocessing steps, which are:
    a. Convert RGB to Gray scale.
    b. Convert image into black & White using threshold value.
    c. Median filtering:-
        i. Noise removal and smoothing.
        ii. Remove small objects other than hand.
        iii. Calculate the MSE & PSNR.
    d. Winner filtering & Calculate the MSE & PSNR
    e. Mean filtering & Calculate the MSE & PSNR
5. Compare and contrast these three technique with three different noises :-
        i. Speckle noise
        ii. Salt & pepper noise
        iii. Gaussian noise
6. Feature extraction by Modified Moore Neighbor Contour Tracing algorithm.
7. Matching and identifying the corresponding gesture and calculating recognition rate .

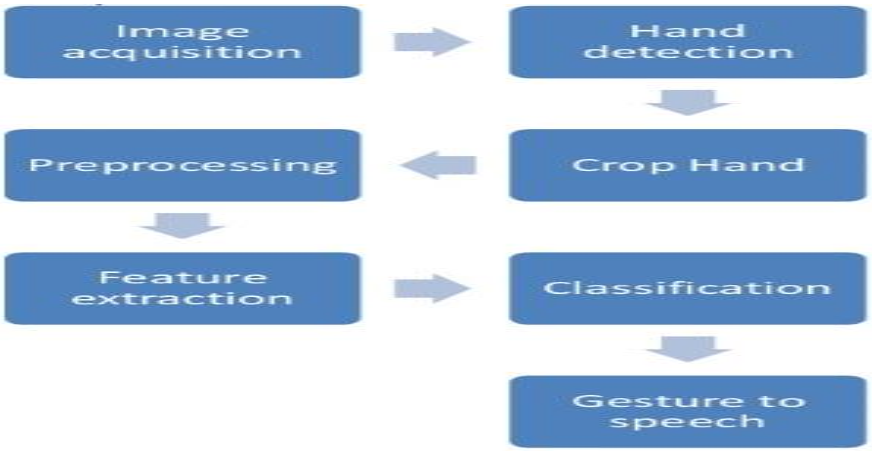


Figure 1.1 Steps of image processing

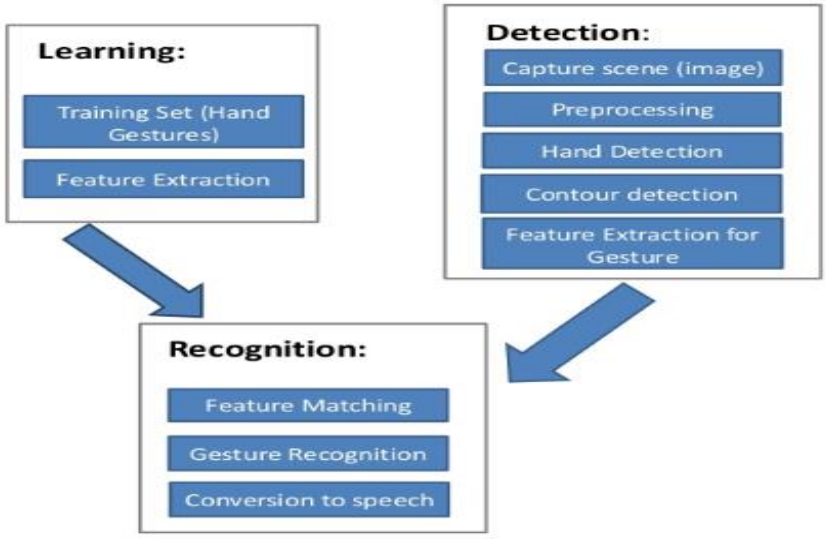


Figure 1.2 Block Diagram of processing

1.5 ORGANISATION: We started with the requirement phase , in which we gathered all the information by published papers of different years, book, etc. Then further we had planned our model for the project. We started coding in matlab, with different steps in it.

CHAPTER 2

Literature Survey

2.1 Introduction:

This chapter focuses on research, covering important literature relating to this project on hand gesture based human computer interaction. Proper journals, books, Internet sites will be utilized to assemble the important writing. This chapter describes the literature associated with gesture recognition and image processing. It discusses the different steps that comprise image processing and the techniques used to accomplish the stages. The literature also involves previous studies that aimed at development of similar systems.

2.2 Literature Review:

Several methods are proposed for both dynamic and static hand gestures.

Ziaie [1] proposed a strategy of first registering distinctive gesture and after that allocates probabilities to them utilizing Bayesian Interface Rule. Invariant were evaluated from these utilizing a change of KNN (K-Nearest Neighbor).These classes comprise of Hu- moments with geometrical qualities like turn, change and scale in variety which was utilized as elements for order. Execution of this procedure was exceptionally well and it was giving 95 % exact outcomes.

Chourasia et al.[2] presents a motion acknowledgment framework utilizing KNN. Assist,

Procedure propose by Neha S. Chourasia, Kanchan Dhote and Supratim Saha utilized a crossover include descriptor, consolidating HU invariant moments and SURF. They utilized (KNN) K-Nearest neighbors and SVM for grouping. They Achieved 96% exactness.

Alsheakhali et al.[3] proposed a method which Begins by identifying the hand direction and investigating the varieties in the hand areas , lastly perceiving the developments of hand. The proposed method beats foundation unpredictability and separation from camera. It can perceive 12 motions with 94% accuracy.

Pradhana et al.[4] proposed a method with a straightforward and proficient approach for perceiving hand signals that speaks to numbers from zero to nine. The work fundamentally speaks to the dynamic and non dynamic fingers with double esteem 0 &1 individually, in various blends for speaking to various numbers. The technique for speaking to the double signal in paired example contributes a considerable measure for expanding the execution of arrangement process. The parallel Support vector machine(SVM) is considered as a rearrangement instrument in their paper.

Nayakwadi et al.[5] Dynamic Hand Gestures Recognition System with Natural Hand. In this paper a continuous framework for characteristic hand motion acknowledgment with element hand developments is displayed. Other than utilizing static hand signals it is constantly simple to client to utilize dynamic hand developments. This paper gives a framework which can work for both static and element hand motions as required by the client. We can utilize this framework in mechanical technology, PowerPoint introductions, media players, turning 3D objects and so forth. The framework is tried in both of the indoor and outside conditions and demonstrates the heartiness to lighting change and clients' blunders.

Jing Lin et al.[6] proposed a strategy in view of histograms of arranged angles (HOG) with a specific end goal to expel the impediment brought on by jumbled foundation amid hand limitation and displaying. Histograms of situated inclinations and SVM are connected to confine the hand and afterward movement direction components of worldly motions are separated and standard database is made. For acknowledgment Mahalanobis separation is

utilized. The method is tried on 6 standard motions and normal exactness of 91.7% is acquired yet this framework can work for entangled signals.

Zhou Ren et al. [7] developed a robust part based technique using kinect sensor keeping in view the limitations of glove based and vision based techniques. In their approach, first of all kinect sensor is used to capture the both color images and depth maps corresponding to that image. Using depth maps, hand can be easily detected even in cluttered background also by using depth thresholding. After detecting the hand it is represented by its finger parts using time series curve. Then for gesture recognition a dissimilarity measure called Finger-Earth Mover's Distance (FEMD) is proposed which can recognize noisy hand contours as compared to other recognition methods and is robust to change in scale, orientation, local distortions and background conditions. For experiments dataset consisting of 10 person, 10 gestures and 10 cases/gestures id used and achieves accuracy of 93.2% and system is tested on two real time applications.

Palacios et al.[8] "Human-Computer Interaction Based on Hand Gestures Using RGB-D Sensors" , Jos'e Manuel Palacios created hand signal acknowledgment system utilizing RGB-D sensors taking the benefit of profundity data to expel the issues brought on by lightning conditions and jumbled foundation. The proposed philosophy incorporates four essential strides - Hand division, Feature extraction, Static signal characterization and Dynamic motion arrangement. For hand division skin shading division and foundation subtraction is utilized. Above all else face is identified from the picture and is evacuated and after that wrist is distinguished and hand is extricated. For motion acknowledgment different components extricated from the hand are used. For static signal acknowledgment fingertip location is utilized and fingertip is distinguished utilizing greatest ebb and flow and convexity deserts.

Trigueiros et al.[9] proposed a general human PC connection framework in view of hand signals. The framework utilizes vision based and approach as they have advantage contrasted with customary information glove approaches. Essentially, the examinations comprises of three stages obtaining and preprocessing, highlight extraction and acknowledgment. For acknowledgment machine learning classifier are utilized however they are by all account not

the only choice yet here are utilized keeping in the view the removed element – centroid separate. For static gesture acknowledgment SVM is utilized and for element HMM is utilized. The investigations gets the 99.7% exactness with SVM and 93.7 % with HMM with 11 predefined motions.

Chetan Dhule et al. [10] proposed a dream based hand signal acknowledgment method for human PC connection. They proposed the technique keeping in view that most the prior strategies depend on motion acknowledgment calculations that require ANN preparing which is extremely tedious and is very little exact. So by utilizing shading recognition methods they grow ongoing application to limit the mouse's movement in windows by recognizing change in pixel estimation of RGB hues and which is conceivable without ANN preparing.

Table 2.1 Comparison between various techniques

Year	Image acquisition Method	No. of gesture recognised	Segmentation Technique	Features Extracted	Recognition Method	Accuracy
2011 [3]	Webcam	8	Bressenham's midpoint circle scan-conversion algorithm	Hand Orientation	HMM	96%
2012 [4]	CMOS image sensor	10	Illumination compensation of RGB color, Skin color segmentation	Shape based features- Area of hand , perimeter of hand, thumb detection, Radial profile		94.4%
2013 [5]	CCD cameras	6	Histogram oriented gradient	Velocity and angle	Mahalanobis distance	91.7%
2013 [6]	Kinect sensor	14	Depth thresholding	Finger's Earth mover's Distance	Template Matching	93.2%
2013 [7]	RGB Sensor	10- static 6- Dynamic	Skin color segmentation ,depth thresholding	Fingertips using curvature and convexity defects, Euclidean distance, direction	Feature based classifier	Precision-92.1% Recall-83.3%

2.3 Image Processing:

The Digital image processing is the utilization of PC algorithms to perform image processing on digital images. As a subcategory or the sphere of digital signal process, digital image process has several focal points over analog image process. It permits a spread of algorithms to be applied to an input and avoid the issues like the noise and distortion throughout process.

Image processing usually refers to the digital image processing. The acquisition of images is referred to as imaging.

2.4 Gesture Recognition:

Gestures can be described as different types of human movements. These is 2 dimensional or three-dimensional and might be specific to the hand, arm or body movements likewise as facial expressions.

Gesture recognition empowers people to interface with the machine and collaborate normally with no outside gadgets**,** such as the keyboard It is a method for allocating orders to the computer to perform explicit assignments. This project can concentrate significantly on the market hand gesture, as they're easier to perform and acknowledge with less effort. Different varieties of the recognition problem are described in the literature:

Object Recognition: One or the many pre such or the learned objects or the thing categories are often recognized, sometimes along within the image with their second positions within the scene.

Identification: An individual instance of an object can also recognize .Examples: identification of a particular persons face or fingerprint.

Detection: The image data is scanned for some specific conditions.

2.5 Vision Based Method:

Bare-hand gestures are probably the most straightforward interpretations when people think about gestures. Here we have a tendency to ask the gestures that outlined entirely by the movements of the users hands and/or fingers. generally the vacant hand gestures square measure captured mistreatment pc vision techniques, i.e. cameras looking at the users movements. This project needs a gesture recognition methodology that's simple to use and permits the user an exact level of freedom. This project uses one camera (web camera) as associate device to capture gestures performed by the users. The vision based gesture recognition looks to be a much better possibility over non-vision based methodology. The devices utilized in non-vision ways are expensive and convey weighty expertise to the users. Also, the devices are measure typically connected to the pc, that restricts free movement of the users to perform the activity they require. Whereas in vision methodology, the users square measure liberated to perform gestures with none restrictions .

The development of vision based gesture recognition software generally goes through different phases.

• Image Processing

• Hand Tracking

• Hand Gesture recognition

2.6 Image Acquisition:

In this step a user interface, is created that shows the video stream of the scene. From that user interface once the capture button is clicked it takes a picture of the scene. The matter is that this scene includes the entire body and alternative unwanted objects similarly. The figures below shows the user interface based mostly side of the system through that user will capture the image.

Figure 2.1 system GUI

Figure 2.2: preprocessing steps

2.6.1 Color:

The color of the article to be detected has already been laid out in the application. However later with a further functionality, this could be done by choosing the color from color panel. A tool color dialog box merely describes the vary of colors, or gamut, that a camera will see, a printer will print, or a monitor will show. The assorted color areas exist as a result of they present color information in ways in which ensure calculations a lot of convenient or as a result of they supply the simplest way to spot colors that's a lot of intuitive.

2.6.2 RGB to Grayscale:

RGB stands for Red, Green and blue. It's a system of color during which these 3 mentioned are added in different quantities to give totally different quantities to grant different colors. A human's ability of visions will distinguish

between many various colors, their intensities and shades. Once it involves the shades of gray, human vision will solely distinguish or so one hundred shades of gray.. Therefore it's evident from this incontrovertible fact that the photographs that colored contain a lot of data.

RGB to grayscale Gray filtering using value Binarize Noise removal and smoothing take away tiny objects aside from hand Region filling.

Figure 2.3 RGB image

Figure 2.4 Grayscale image

2.6.3 Binarize:

Binarization may be a method that converts a gray level image to a binary image. Gray level image has zero to 255 levels, whereas in binary image there area unit solely 2 values; zero and 1(black and white). There are many alternative variety of filters within the field of Digital Image process, gray level filter is one in all them. This

filter works on gray level image. The aim is to reduce noise so as to extend accuracy and acquire higher results out of this technique.

Figure 2.5: Image after grayscale filtering

2.7 Noise removal and smoothing:

What is noise? Noise is really a variation in a picture or unwanted and unwanted changes within the color or brightness of a picture. Noise within the image ought to be removed, as a result of it'll have an effect on the results. If options extracted from a noisy image are used and so it's classified, it'll be deceptive and can end in worst classification and results.
To avoid this image is preprocessed by removing noise from this image. It'll increase the accuracy of the system. within the field of digital image process smoothing is employed as a preprocessing step. This is often a method which is able to use totally different style of filters and apply them on the image. What it will is that it'll provide associate degree approximation, which suggests that you simply will get the necessary portion or pattern in a picture and therefore the noise in this image are going to be reduced considerably, thus up the results massively. Within the figure below there's a tiny low dot, that is unwanted and may be a noise, which require to be removed, In the figure below there is a small dot will participate within the feature extractions method and so in classifying this image in a labeled class it might deviate and provides wrong results.

Figure 2.6 Image with noise

Figure 2.7 Filtered image with noise being removed

In-order to get rid of noise from this image a 3x3 median filter is employed. What produce is a little matrix of dimensions 3x3 and this matrix will locate the image pixel by pixel.. This may calculate the median of all the covered pixels and replace the center value or this pixel with the median of its neighborhood pixels. It'll conjointly create edges clear.

2.8 Contour Detection:

The term contour are often outlined as an overview or a boundary of AN object. Therefore, contour detection deals with detective numerous objects in a picture .Use of contour detection in image process is to find objects and their boundaries in pictures. Also, output of contour detection shows solely the distinguished region boundaries forgoing unwanted edges within the image. Hence, detection of specific objects within the image is barely potential throughcontours. Therefore during this project, it's important to sight contour of the hand before we are able to extract the hand options from the image taken from the camera.

2.9 Hand Detection:

First of all colored image is read that is captured in image acquisition step. Once we have a tendency to get the image, the size of the image are calculated. Range of color bands ought to be one. If the image isn't a grayscale, convert it to grayscale by solely taking green channel. Currently realize the most important blobs. This method ends up in giving 2 biggest blobs, ignore the primary biggest blob, that is that the largest one. The second biggest blob are going to be the hand. This lead to drawing box round the blobs and second biggest blob is separated from the image. The limitation of this method is that color of garments and different objects in scene may result it.

2.10 Hand Cropping:

Once the portion of hand is separated from the Image, the hand is cropped out, for this sure threshold is employed. Really in binarizing of the image a threshold value is employed, that solely offers out the portion of image with hand and so we will crop the hand. This image of hand is then keep and passed to successive part.

2.11 Biometric Recognition:

Biometric recognition refers to the employment of distinctive anatomical (e.g., fingerprints, face, iris) and activity (e.g., speech) characteristics, referred to as biometric identifiers or traits or characteristics for automatically recognizing people. Biometrics is changing into an important element of effective person identification solutions as a result of biometric identifiers can not be shared or misplaced, and that they as such represent the individual's bodily identity. Recognition of someone by their body, then linking that body to an outwardly established "identity", forms a really powerful tool of identity management with tremendous potential consequences, each positive and negative.

2.12 Biometric Systems:

An important issue in designing a practical biometric system is to determine how an individual is going to be recognized. Depending on the application context, a biometric system may be called either a verification system or an identification system:

• "A verification system authenticates a person's identity by comparing the captured biometric characteristic with her previously captured (enrolled) biometric reference template pre-stored in the system. It conducts one-to-one comparison to confirm whether the claim of identity by the individual is true. A verification system either rejects or accepts the submitted claim of identity".

• An identification system recognizes an individual by searching the entire enrollment template database for a match. It conducts matched comparison to verify whether or not the claim of identity by the individual is true. A verification system either rejects or accepts the submitted claim of identity. • In identification system acknowledges a personal by looking out the complete enrollment model information for a match. It conducts one-to-many comparisons to ascertain if the individual is gift within the information and if therefore, returns the symbol of the enrollment reference that matched. In identification system, the system establishes a subject's identity (or determines that the topic isn't registered within the system database) while not the topic having to assert in identity.

"The term authentication is also used in the biometric field, sometimes as a synonym for verification; actually, in the information technology language, authenticating a user means to let the system know the identity of the user regardless of the mode (verification or identification)".

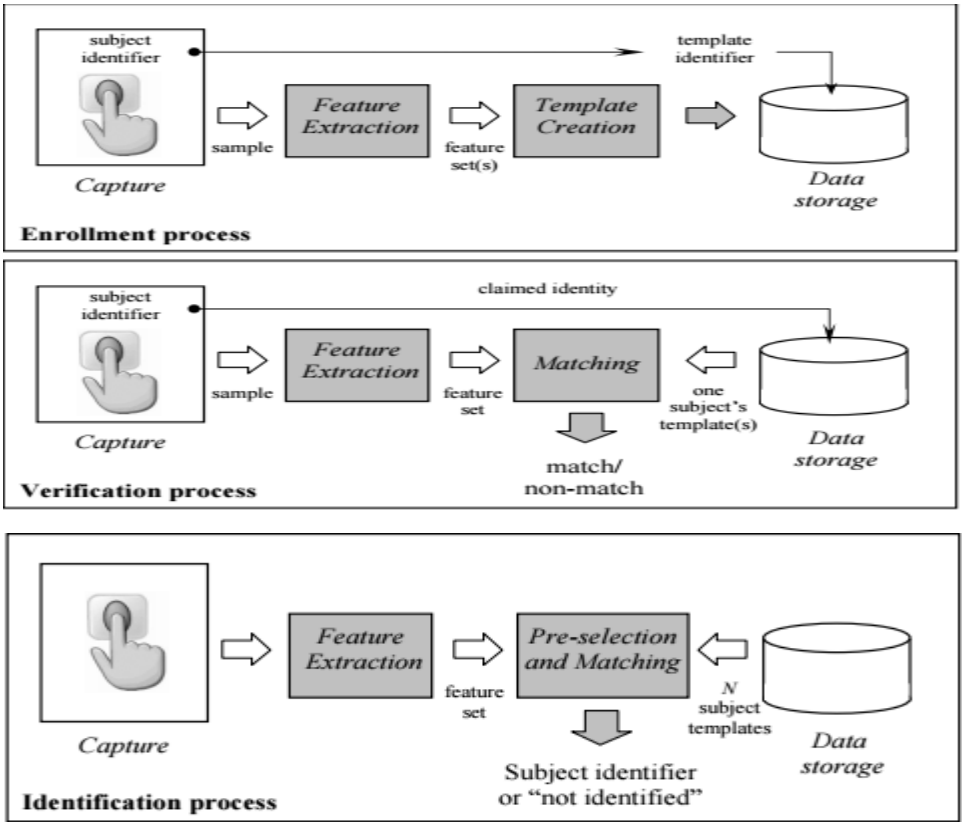


Figure 2.8 Biometric systems

2.16 Summary:

This chapter looked into completely different areas of gesture recognition and its quality in application. The analysis helped to assemble information available gesture recognition system and its design requirements. Also looks into the various image process steps specifically image segmentations, skin detection and contour detection. completely different techniques for skin detection was looked into and the decision was made on using HSV color space and expressly outlined skin detection model. The gathered literature covers what aspects are required to develop initial ideas throughout style and implementation stages . so edges the initial ideas needed throughout style and implementation stages. Consecutive chapter appearance into the various strategies and tools employed in the event of the project and therefore the software system.

CHAPTER 3

System Development

3.1 Introduction:

This chapter will illustrate the difference between different system development Lifecycle approach namely Waterfall and Spiral models, also the picked framework Development lifecycle approach utilized all through the venture. Distinctive philosophies to help in the advancement of the software are discussed.

3.2 System Development Life Cycle:

Waterfall approach was initial method Model to be introduced and followed wide in software system Engineering to confirm success of the project. within the falls model, the total method of software system development is split into separate method phases. The phases in are: Requirement Specifications, Software Design, Implementation and Testing & Maintenance as shown within the figure below. of these parts are associated with one another so second part is started as and once outlined set of goals are achieved for initial phase.

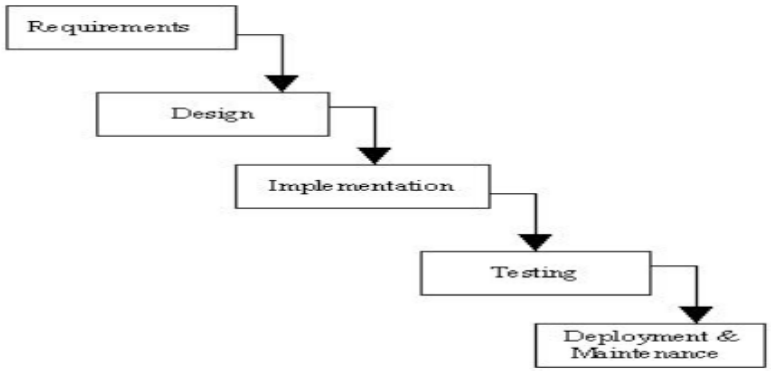


Figure 3.1 System Development life cycle

3.2.2 Spiral Model:

The spiral model was recommended by Barry Bohme in 1988 associate degree to falls model however follows an biological process or unvarying approach to system developments. The spiral model, as seen in figure below, combines the unvarying nature of prototyping with the controlled and systematic aspects of the falls model, in this providing the potential for fast development of progressive versions of the computer code. During this model the computer code is developed in an exceedingly series of progressive releases with the first stages being either paper models or prototypes. Later iterations become more and more complete versions of the merchandise. Further, there aren't any mounted phases for necessities specification, style or testing within the spiral model. So, spiral model is employed in cases wherever the need isn't understood or troublesome to specify. the most feature of this methodology is distinctive potential risk to the system.

3.3 Development Methodology Chosen:

The falls model is that the appropriate development methodology as a result of as our project is software system orientating, its vital to form positive the program works at every stage with none errors and is manufacturing the expressed result. In falls model, there's no user involvement throughout the event method and focuses on minimum quantity of necessities set that may not be modified throughout the project. The users area unit concerned solely once the top product is finished that is that the case during this project. Whereas, spiral model needs user involvement throughout the project. in contrast to Spiral model, that deals with risk analysis, in falls model risk analysis may be a sub-task. As this project involves no risk employing a model that focuses extremely on a section that's not vital simply results in loss of your time. Also, the spiral model is time intense because of the actual fact that it’s associate degree unvaried lifecycle.

Requirements – necessities of the systems were analyzed by researching the prevailing literature on image process techniques. Therefore be ready to style the desired algorithmic rule to perform basic image process particularly image segmentation, skin detection and contour detection.

Design – This stage can take the knowledge gathered from the wants and design an appropriate system that may relate to the objectives set. With the relevant demand gathered type the literature researched, the system necessities are obtained. UML diagrams are accustomed perceive the look of the code thorough.

Implementation - Once stage has been completed; the implementation of the planned system design are initiated. the subsequent steps are administrated

- Implementation of the algorithmic rule that captures the image from the camera
- Implementation of the algorithmic rule that appearance into image process

Testing – during this stage, the enforced algorithms are tested. These processes can use completely different testing methodologies that may be mentioned later during this chapter**.**

Evaluation – Finally, the analysis of the applying against the aims and objective are performed.

3.4 Summary:

This chapter explains the chosen software package development lifecycle is that the falls model that the project can adopt. Also, it looked into however this project goes regarding the various stages of the event cycle. It mentioned the various implementation methodology chosen which will be used as resolution to the event of the software package.

3.5 Requirements analysis and design:

3.5.1 Requirements Specification:

From the findings in chapter two, literature review, we are able to state the necessities of the package which will be developed. A demand could be a statement that identifies a necessary characteristic or quality of a system so as for it to possess worth and utility to a user. They're used as associate degree input into the look stage of a system as this can be utilized in coming up with and implementation of the merchandise. necessities also are a very important input into the testing part, because the take a look at ought to turn out output as expressed within the demand. Hence, it's vital for necessities to be easy and specific.

As we are able to see type chapter one, the aim of the project is to make package which will is capable will perform basic image process techniques acknowledge hand gestures performed by the users, which is able to be accustomed flick thru the image gallery of the laptop getting used. this provides America a general plan of what the package has to do however to urge associate degree in-depth plan of what the user will be able to do with the package however the system operates we'll state the careful useful necessities. The useful necessities describe however the system is needed to operate.

3.5.2 Functional Requirements:

The camera used are going to be ready to capture user pictures from the video sequences.
The software are going to be ready to turn out multiple frames and show the image within the RGBcolor.
The software are going to be ready to show the regenerate RGB image during a new window.
The software are going to be ready to find the skin regions of the user within the image captured.
The software are going to be ready to find the contours of the detected skin regions.

3.6 Block Diagram:

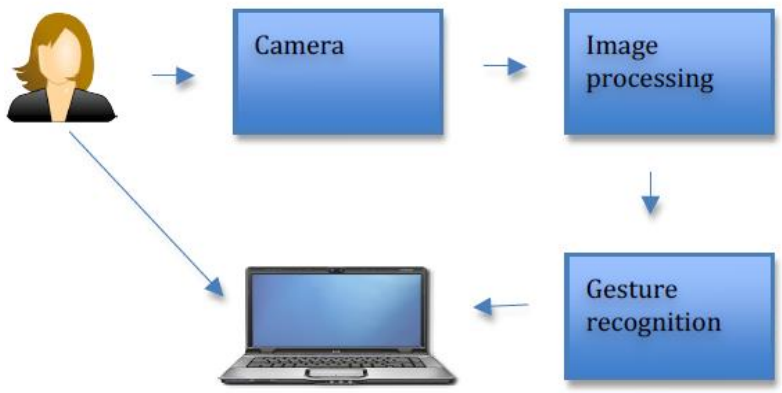


Figure 3.2 Block Diagram

3.7 UML Diagrams:

UML(Unified Modeling Language) may be a most helpful technique of image and documenting software systems style. It includes a collection of graphic notation techniques to make visual models of code systems. It's wont to specify, visualize, modify, construct associated artifacts of an object-oriented software beneath development.

3.8 UML Use Case Diagram:

The use case diagram is employed to spot the first components and processes that type the system. It defines a goal-oriented set of interactions between external actors and therefore the system. the first components are termed as “actors” and therefore
the processes are referred to as use cases or actions. Actors are entities that may utilize the applying so as to finish a task. Associate in Nursing actor perhaps a category of users, roles users will play or alternative systems.

Since this project focuses a lot of on the image process part, this explicit use case

diagram can target the secondary actor i.e. the net camera and its half within the practicality of the software package.

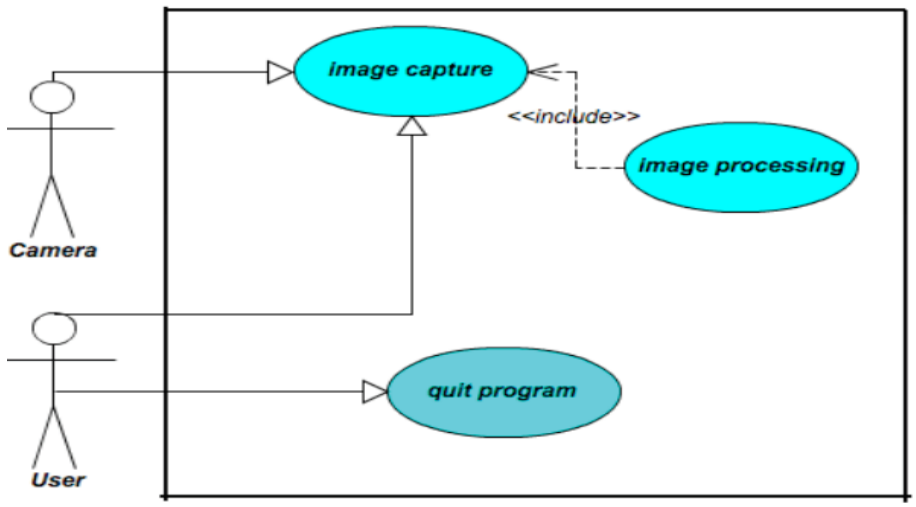


Figure 3.3

Figure 3.3, shows the use case diagram that has 2 actors, wherever "user" is that the primary actor and "camera", the secondary actor. As mentioned earlier, the diagram focuses additional on the secondary actor as these comes deals in the main with the image process part.

The user actor, that may be a human accessing the system, will quit the program outwardly when it's initiated. Also, the image captured by the camera is that the image of the user accessing the system.

The camera actor, that is that the camera of the laptop being employed, is answerable for capturing the user image in real time. Since, this project appearance into vision based mostly hand gesture recognition in real time, which implies that we tend to try to spot the hand within the image while not the assistance of any external device just like the information glove (described in chapter two, literature review) within the video sequences captured by the camera, image process becomes vital very important part of the system because it helps to eliminate any unwanted background objects and helps

to concentrate on additional important elements of the image. Also it makes it easier to investigate the image to extract helpful info .Below are the Use Cases, these go through each use case and detail what actions are performed by the actor and what outcome is expected.

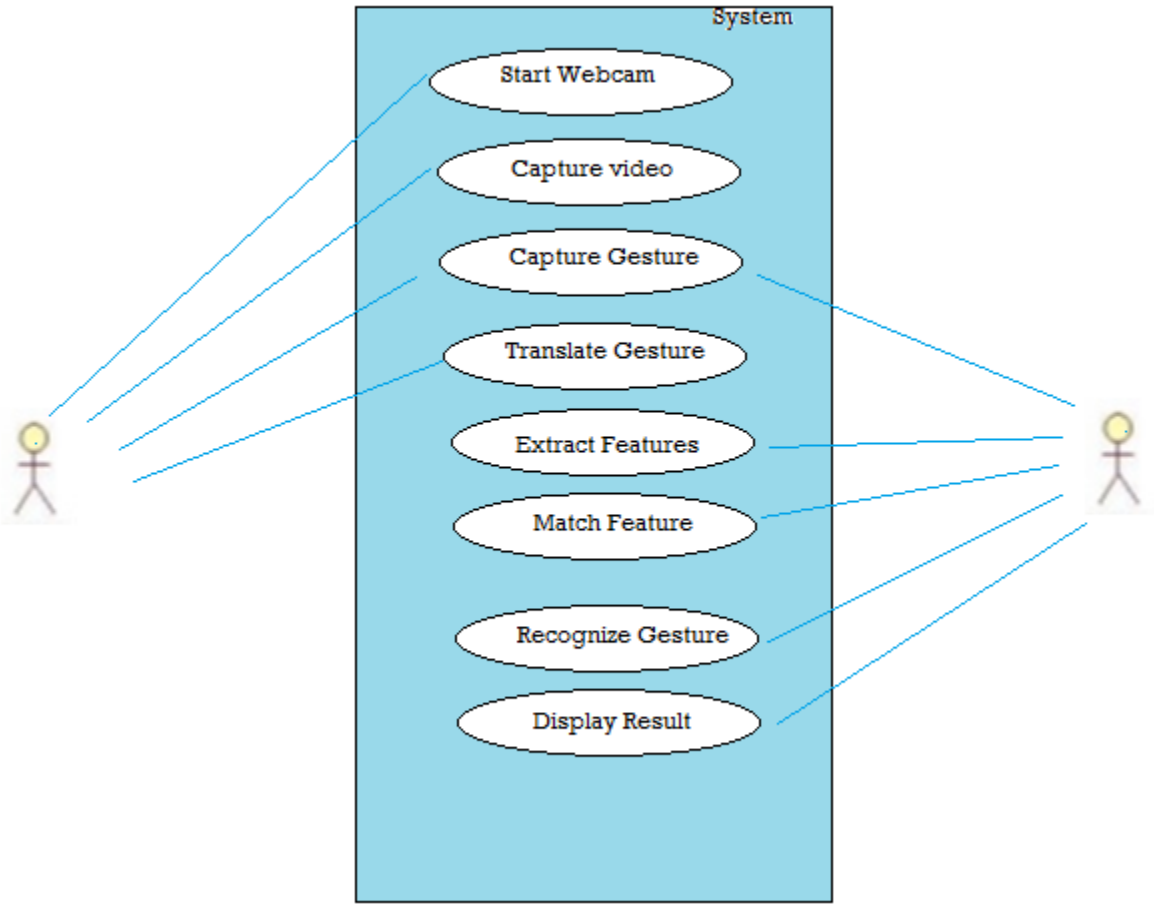


Figure 3.4 Use case diagram

3.9 Activity Diagram:

The process flows within the system square measure captured within the activity diagram. associate degree activity diagram consists of activities, actions, transitions, initial and final states and guard conditions.
It is used for modeling the logic captured by one use case situation.

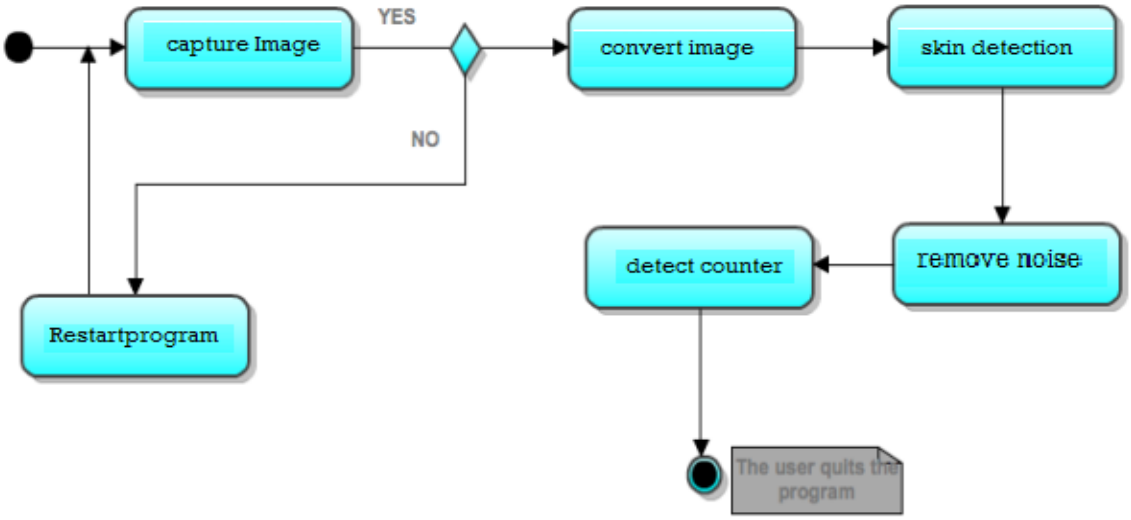


Figure 3.5 Activity Diagram

3.10 Sequence Diagram:

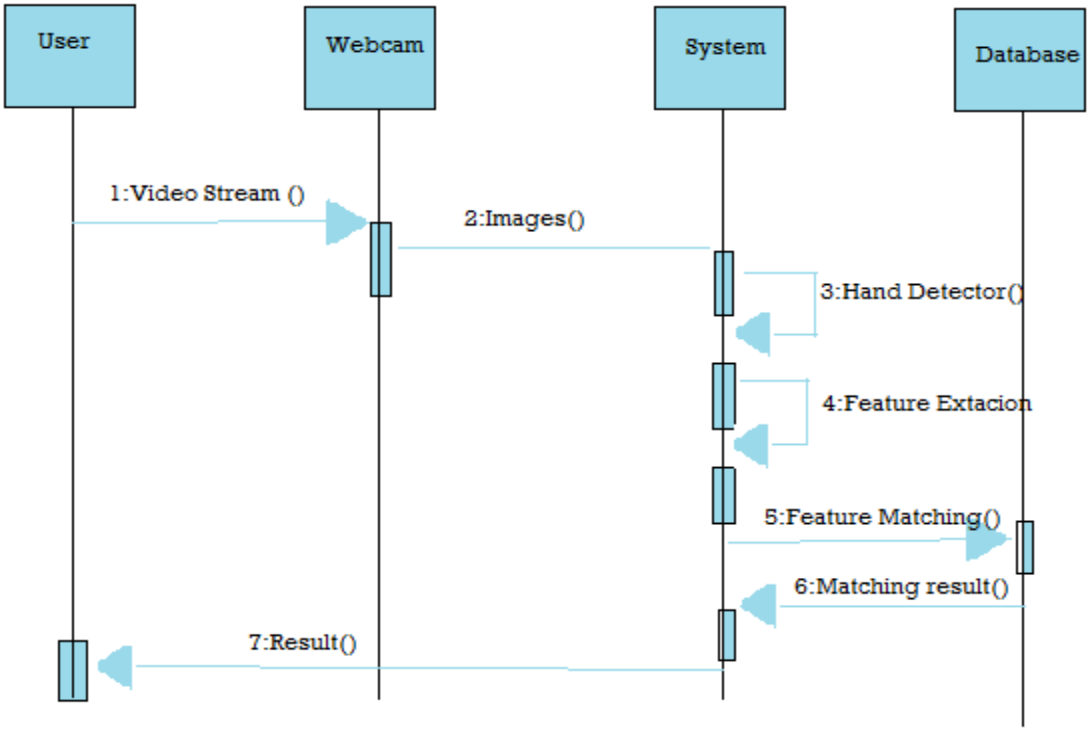


Figure 3.6 Sequence diagram

3.11 Flow Diagram:

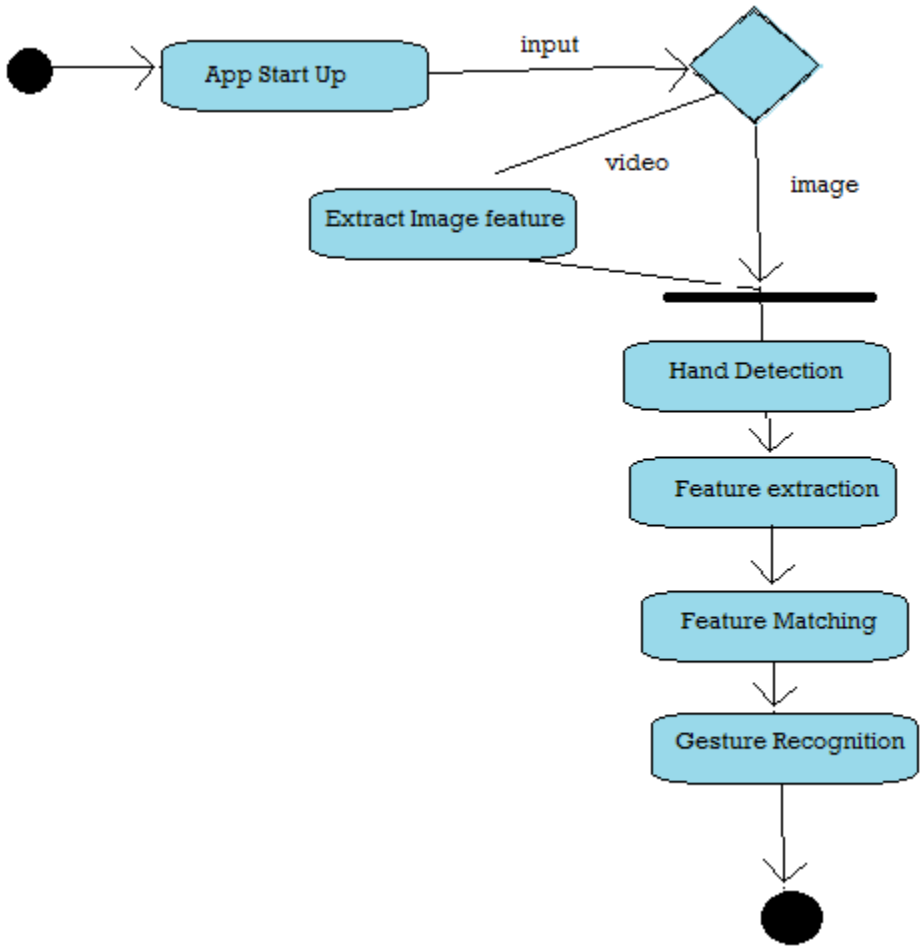


Figure 3.7 Flow diagram

3.12 Assumptions:

Throughout the design, there were many assumptions made. This section briefly describes some of the important assumptions made. The most assumption was created concerning the setting during which the system was operated. The place wherever the user intends to use the system is anticipated to possess enough lighting

for the camera to capture the video. Variable lighting conditions could cause undesirable outputs. Also, the user is assumed to be sporting a full sleeves garments with solely the hand space shown, because the program isn't totally useful to exclude alternative skin regions just like the arms. whereas it may be doable to program in preparation for such issues, like once skin detection section is enforced, phase the hand space from alternative regions then apply contour detection rule within the divided hand image. However, the event of such algorithms need the maximum amount work as another project all by itself, and aren't possible within the time allotted and need high level programming information.

3.13 System Overview:

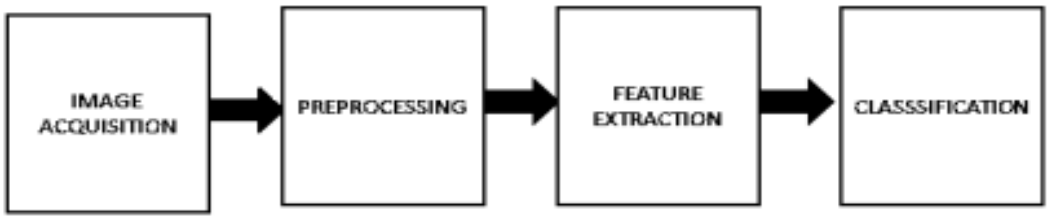


Figure 3.8 Block Diagram of hand gesture recognition system

Vision primarily based analysis, relies on the approach men understand data regarding their surroundings, however it's in all probability the foremost tough to implement during a satisfactory approach. many totally different approaches are tested to date.

• One is to create a three-dimensional model of the human hand. The model is matched to pictures of the hand by cameras, and parameters admire palm orientation and joint angles are calculable. These parameters are then used to perform gesture classification.

• After capturing the image , extract some feature and hand gesture are used as input during a classification algorithmic program for classification.

3.14 Required system behavior:

The following are the features and the facilities which a user expects of the system.

The package should be economical enough to acknowledge the gesture properly. Such software's square measure typically not good and square measure adequate just for the documentation functions. this method is predicted to be really useful for a home laptop. so perfection is that the greatest demand. There should not be any constraints on the background color. typically no matter color we have a tendency to specify for associate degree object additionally seems somewhere within the background too in most of the cases. so there's forever a restriction of employing a set up single colored background associate degreed not a varicolored background and therefore the use of an object of such a color so it will simply be seen once more the background. Such a restriction most not be gift as a result of a user cannot forever seem before of a comprehensible background simply to form a gesture.

It should be sturdy enough to address the illumination conditions and therefore the distinction changes. Whenever we have a tendency to choose a color then because the object moves before of the camera its color might amendment slightly in each frame because of the amendment of sunshine conditions within the area, the sunshine falling on the article, a shine or reflection etc,. This can cause some drawback within the color detection and thence the article wouldn't be with success half-track, thereby spoiling the performance.

Algorithms should be speedy enough to method the frames with high speed so the package doesn't lag behind .When we take lower frame with high speed so the package doesn't look to be real time. however with the upper frame rate the pc has got to method additional range of frames during a given time. This slows down the performance of the system. In such a case whenever we have a tendency to build a gesture it takes a major quantity of your time to seem within the video then on operation is performed.

3.15 System Functionalities:

All the functionalities of the project can be categorized into 3 types:

- Basic operations
- Mouse control
- Keyboard

BasicOperations:

This class includes numerous operations like gap net Browsers, Microsoft ppt, Notepad, switch off the pc,etc.Certain gesture is allotted to every action therefore on perform that action. once that gesture is appeared before of the camera, it detects that and performs that bound action that is allotted thereto gesture within the program.

MouseControl:

These embody the motion and clicks of the mouse: moving the mouse indicator, playing left and right clicks.

KeyboardFunctionalities:

In this we tend to area unit dominant the arrow keys of keyboard by explicit gesture like moving our hand during a particular direction therefore on press the arrow key of that direction. We tend to area unit then causing the key presses to a particular running application . Therefore we will amendment the PowerPoint presentation slides, center and out of the pictures, play games, navigate with gestures rather than arrow keys.

3.16 Hand Detection And Recognition:

Hand Segmentation:

The Input captures the RGB image that is reborn to workplace color house. “In CIE L* a* b* Co-ordinates, wherever L* defines lightness, a* represent red/green price and b* denotes the blue/yellow color price. a* axis and +a direction shift towards red whereas on the b*axis +b movement shift toward yellow. Once the image gets reborn into a* and b* planes, thresholding was done. Convolution operation was applied on binary pictures for the segmentation”. Morphological process was done to urge the superior hand form. This algorithmic program works for color detection however it had been sensitive for advanced background. The steps as follows:

- Capture the Image
- Read the input image
- Convert RGB image into color space
- Convert the color values in I into color structure
- specified in c form
- Compute the threshold value.
- Convert Intensity image into binary image
- Performing arts morphological operations like erosion.

Hand Detection:

The technique is constructed round the concept that Splits the input video screen into 2 components and processes every half one by one, in order that the process within the 2 components is comparable and co occurring. The operators used for image process should be unbroken low time overwhelming so as to get the quick process rate required to realize real time speed.

3.17 K-Nearest Neighbors Algorithm:

The k-Nearest Neighbors algorithmic program (or k-NN for short) may be a non-parametric methodology used for classification and regression.
In each cases, the input consists of the k nearest neighbor examples within the feature house. The output depends on whether or not k-NN is employed for classification or regression: "In k-NN classification, the output may be a category membership. Associate in Nursing object is classed by a majority vote of its neighbors, with the item being appointed to the category commonest among its k nearest neighbors (k may be a positive whole number, usually small)". If k = 1, then the item is solely appointed to the category of that single nearest neighbor.
In KNN regression, the output is that the property worth for the item. This worth is that the average of the values of its k nearest neighbors.
"KNN may be a sort of instance-based learning, or lazy learning, wherever the perform is simply approximated domestically and every one computation is delayed till classification. The k-NN algorithmic program is among the only of all machine learning algorithms".

Where can we use KNN algorithm?

It will be used for each classification and regression prophetical issues.
However, it's additional wide employed in classification issues within the trade. to judge any technique we tend to typically cross-check three necessary aspects:

1.Ease to interpret output

2.Calculation time

3. Power

Let us take a number of examples to position KNN within the scale:

Table 3.1: KNN Algorithm

	Logistic Regression	CART	Random Forest	KNN
1. Ease to interpret output	2	3	1	3
2. Calculation time	3	2	1	3
3. Predictive Power	2	2	3	2

Chapter-4

Experimental Results and Performance Analysis

4.1: Peak Signal-To-Noise Ratio:

"Peak signal-to-noise ratio", often abbreviated PSNR, is a building term for the proportion between signal and the power of corrupting noise that affects the fidelity of its representation. Since many signs have a wide element , PSNR is generally communicated as the logarithmic decibel scale.

It is most easily defined via the mean squared error (*MSE*). Given a noise-free *m*×*n* monochrome image *I* and its noisy approximation *K*, *MSE* is defined as:

$$MSE = \frac{1}{m\,n}\sum_{i=0}^{m-1}\sum_{j=0}^{n-1}[I(i,j) - K(i,j)]^2$$

The PSNR (in dB) is defined as:

$$\begin{aligned} PSNR &= 10 \cdot \log_{10}\left(\frac{MAX_I^2}{MSE}\right) \\ &= 20 \cdot \log_{10}\left(\frac{MAX_I}{\sqrt{MSE}}\right) \\ &= 20 \cdot \log_{10}(MAX_I) - 10 \cdot \log_{10}(MSE) \end{aligned}$$

The mean squared error (MSE) for our handy purposes enables us to look at the "true" pixel values of our original image to our corrupted picture. The MSE represents the normal of the squares of the "errors" between our actual image and

our noisy image. The error is the is the sum by which the estimations values of the original image differ from the degraded image.

Ordinary qualities for the PSNR in lossy picture and video pressure are in the vicinity of 30 and 50 dB, gave the bit profundity is 8 bits, where higher is better. For 16-bit information common qualities for the PSNR are in the vicinity of 60 and 80 dB. Worthy qualities for remote transmission quality misfortune are thought to be around 20 dB to 25 dB. Without clamor, the two pictures I and K are indistinguishable, and in this way the MSE is zero.

4.2 Type of filtering:

Median Filter:

- It turns out to be best in expelling " salt and pepper noise" and "impulse noise".
- Median filter deletes dark spots called the pepper and fills in white openings in the picture, called salt**.** It preferred works over mean filter by protecting sharp edges.
- It just replaces every pixel value by the middle of the intensity level in the neighborhood area of that pixel.

Winner Filtering :

- The known flag may comprise of an unknown signal of interest that has been corrupted by additive noise.
- It can be utilized to filter out the noise from the corrupted signal to give an estimate of the signal of interest underlying.
- It also provides good results in removing noise from photographs.

Mean Filtering :

- "Average filter" or "mean filter' is simple, intuitive and straightforward.

- It performs smoothing of images i.e lessening measure of intensity variation between one pixel and the following.
- Every pixel esteem in a picture is supplanted within the normal estimation of its neighbors, including that pixel.

4.3 Type of noises:

Gaussian Noise :

- It is evenly distributed over the signal.
- In telecommunications and computer networking, communication channels can be affected by wideband Gaussian noise coming from many natural sources, such as the "thermal vibrations of atoms in conductors" , "black body radiation from the earth" and other warm objects, and from celestial sources such as the Sun.

Salt and Pepper Noise:

- Its also known as "Impulse Noise".
- This noise can be brought on by "sharp & sudden disturbances" in the image.
- Its appearance is haphazardly scattered white or black (or both) pixel over the picture.

Speckle Noise

- Speckle noise influences every single inner characteristics of coherent imaging, including medical ultra sound imaging.
- It is brought on by coherent processing of backscattered signs from different disseminated targets.

4.4 Recognition Rate

- It is the Percentage of number of recognized gesture over total number of samples.

$$\textbf{\textit{Recognition Rate}}(\%) = \frac{\textbf{\textit{Number of Recognized gesture}}}{\textbf{\textit{Total Number of samples}}}$$

4.5 False Rejection Rate

- The **false rejection rate** is the measure of the hand gesture recognition system that will incorrectly **reject** the correct gesture.

$$\textbf{\textit{False Recognition Rate}}(\%) = \frac{\textbf{\textit{Number of false rejections}}}{\textbf{\textit{Total Number of samples}}}$$

4.6 Calculation of PSNR for Speckle noise

Table-4.1:Image1

Image 1

		1%	3%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Median	MSE	12.86	38.64	64.52	128.55	259.35	384.15	506.2	606.43	694.63	773.61	841.46	908.37	960.34
	PSNR	37.07	32.29	30.07	27.07	24.03	2.32	21.12	20.34	19.75	19.28	18.91	18.58	18.34
Winner	MSE	12.91	38.48	64.49	128.22	256.84	384.85	506.19	606.62	696.25	773.25	840.18	908.99	966.19
	PSNR	37.15	32.31	30.07	27.09	24.09	22.34	21.12	20.34	19.74	19.38	18.92	18.58	18.36
Mean	MSE	12.88	38.57	64.65	128.26	256.31	386.01	508.18	607.99	693.49	769.45	843.39	908.75	964.53
	PSNR	37.06	32.3	30.06	27.08	24.08	22.3	21.1	20.33	19.75	19.3	18.9	18.58	18.32

Figure 4.1.1 Original Gray Scale Image1

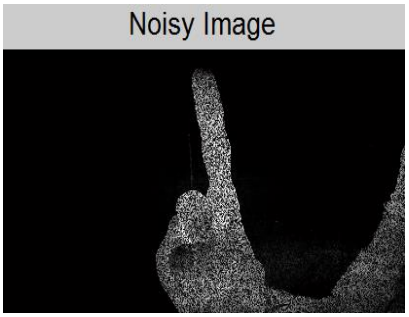


Figure 4.1.2 Noisy Image1

Table-4.2:Image2

Image 2

		1%	3%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Median	MSE	14.05	42.31	70.28	140.7	281.18	420.33	554.66	667.06	766.3	846.6	934.39	1003.59	1068.96
	PSNR	36.69	31.9	29.7	26.68	23.68	21.93	20.7	19.92	19.32	18.89	18.46	18.15	17.88
Winner	MSE	14.09	42.27	70.09	140.52	280.26	421.67	555.77	667.12	766.36	850.62	929.64	99.56	1069.49
	PSNR	36.68	31.91	29.71	26.79	23.69	21.92	20.72	19.92	19.32	18.87	18.5	18.17	17.9
Mean	MSE	14.02	42.18	70.2	140.26	281.48	422.15	554.96	667.74	76094	849.43	928.37	99.69	1065.49
	PSNR	36.7	31.91	29.7	26.7	23.67	21.91	20.72	19.92	19.35	18.87	18.43	18.17	17.89

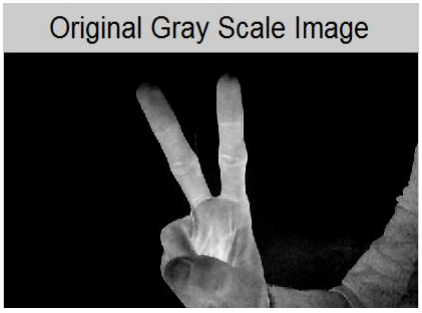


Figure 4.2.1 Original Gray Scale Image2

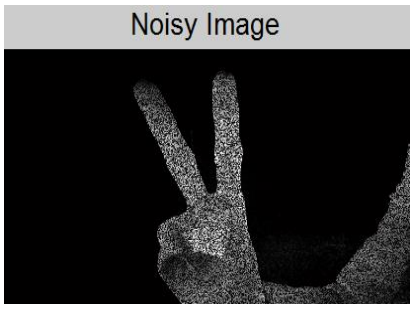


Figure 4.2.2 Noisy Image2

Table-4.3:Image3

Image 3

		1%	3%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Median	MSE	15.89	48.09	80.18	161.53	320.76	482.68	634.61	762.47	886.59	989.43	1079.39	11682	1238.34
	PSNR	36.15	31.34	29.12	2608	23.01	21.33	20.14	19.34	18.72	18.21	17.83	17.49	17.24
Winner	MSE	16.17	48.18	79.96	160.63	322.04	481.54	640.37	760.55	883.86	980.27	1072.86	1158.77	1245.57
	PSNR	36.19	31.37	29.14	26.11	23.09	21.34	20.1	19.35	18.7	18.25	17.86	17.52	17.21
Mean	MSE	16.05	47.83	79.9	161	322.9	485.89	636.41	768.48	883.11	979.84	1075.76	1162.86	1240.22
	PSNR	36.11	31.37	29.14	26.1	23.07	21.3	20.13	19.31	18.7	18.25	17.85	17.51	17.23

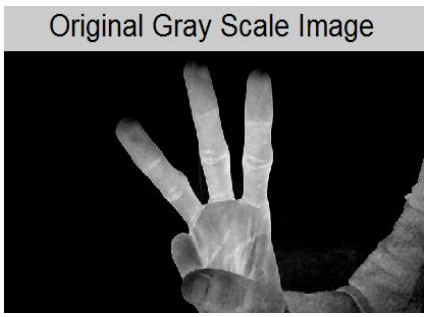


Figure 4.3.1 Original Gray Scale Image3

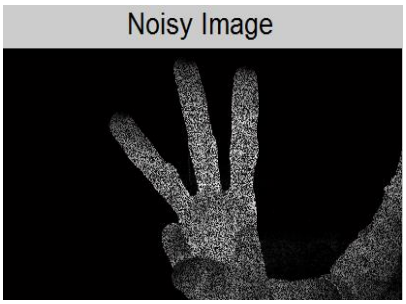


Figure 4.3.2 Noisy Image3

Table-4.4:Image4

Image 4

		1%	3%	5%	10%	20%	30%	40%	50%	60%	70%	80%	90%	100%
Median	MSE	16.34	4874	81.36	163.51	323.46	483.72	640.22	778.33	89085	996.54	1095.2	1184.83	1272.13
	PSNR	36.03	31.29	29.06	26.03	23.04	21.32	20.1	19.25	1867	18.18	17.77	17.43	17.12
Winner	MSE	16.32	48.92	81.9	163.07	323.79	490.82	640.92	774.64	899.46	990.88	1094.96	1181.12	1263.16
	PSNR	36.04	31.27	29.09	26.04	23.06	21.34	20.1	19.27	18.62	18.2	17.77	17.44	1715
Mean	MSE	16.38	48.8	81.15	161.78	325.89	488.51	642.63	775.82	893.36	997.54	1096.02	1183.67	1263.04
	PSNR	36.02	31.28	29.07	26.08	23.03	21.28	20.09	19.27	18.65	18.18	17.77	17.43	17.15

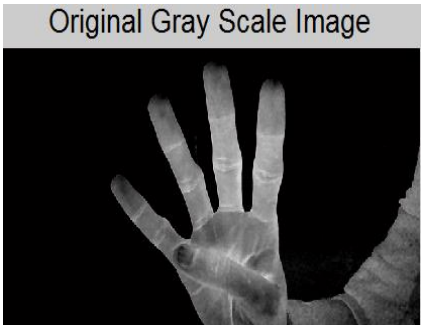


Figure 4.4.1 Original Gray Scale Image4

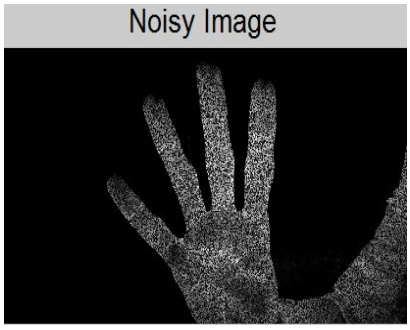


Figure 4.4.2 Noisy Image4

Observation:

1.Speckle noise affects all inner feature of coherent imaging, including medical ultra sound imaging. It is caused by coherent backscattered signals

2. Speckle noise is caused by scattering.

3. Though this results It can be concluded that winner filter is best in removing speckle noise

4.7 Salt & Pepper noise

Table-4.5:Image1

Image 1

		0.001	0.003	0.005	0.007	0.009	0.01	0.03	0.05	0.1
Median	MSE	28.67	94.7	147.83	211.77	264.12	309.12	604.33	1505.83	3035.68
	PSNR	33.89	28.53	26.47	24.91	2395	23.46	20.45	16.49	13.44
Winner	MSE	27.35	92.29	151.13	215.53	274.4	297.4	587.09	1499.47	3025.41
	PSNR	33.8	28.51	26.37	24.83	2378	23.43	20.48	16.45	13.36
Mean	MSE	25.34	92.72	156.59	216.79	265.07	321.23	59440	1494.33	2999.73
	PSNR	33.13	28.49	26.22	24.8	23.93	23.1	20.42	16.42	13.3

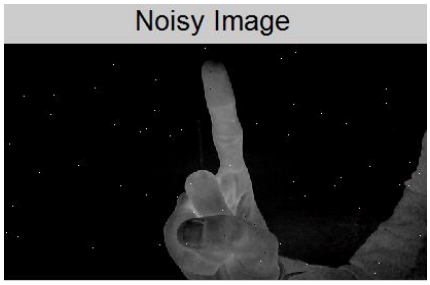


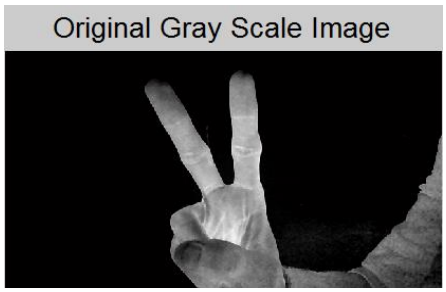
Figure 4.5.1 Original Gray Scale Image1

Figure 4.5.2 Noisy Image1

Table-4.6:Image2

Image 2

		0.001	0.003	0.005	0.007	0.009	0.01	0.03	0.05	0.1
Median	MSE	27.92	90.27	148.1	267.2	269.89	309.09	878.45	1477.91	2976.68
	PSNR	33.71	28.64	26.83	25.19	23.85	23.56	18.73	16.52	13.43
Winner	MSE	31.86	89.56	136.3	202.77	252.75	291.13	88.06	1519.34	3015.24
	PSNR	33.13	28.64	26.82	25.19	24.8	23.52	1868	16.55	1343
Mean	MSE	26.24	84.05	150.32	200.62	273.61	296.32	887.07	1462.02	2978.13
	PSNR	33.1	28.52	26.39	25.15	23.79	23.45	18.69	16.52	13.43



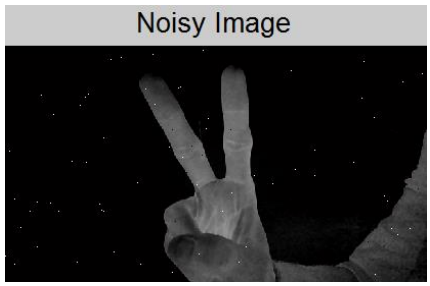


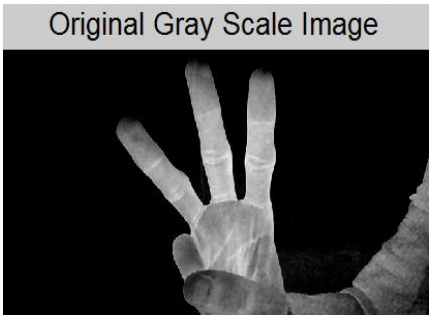
Figure 4.6.1 Original Gray Scale Image2

Figure 4.6.2 Noisy Image2

Table-4.7:Image3

Image 3

		0.001	0.003	0.005	0.007	0.009	0.01	0.03	0.05	0.1
Median	MSE	31.03	89.45	145.78	198.27	255.45	306.32	849.63	1475.32	2862.85
	PSNR	33.44	29.65	26.53	25.19	24.09	23.64	18.87	16.6	13.6
Winner	MSE	30.02	81.22	150.34	211.03	259.03	301.28	863.77	1481.38	2943.51
	PSNR	33.39	29.07	26.39	24.92	24.03	2358	18.8	16.56	13.48
Mean	MSE	26.2	84.38	141.2	211.07	266.04	290.48	886.22	1459.58	2940.94
	PSNR	33.25	28.9	26.3	24.92	23.91	23.53	18.69	16.52	13.48



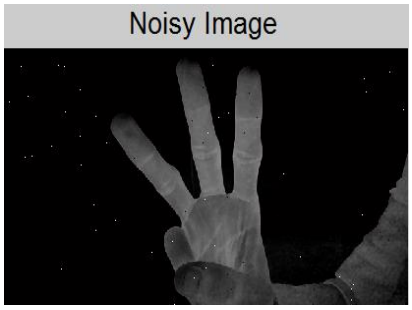


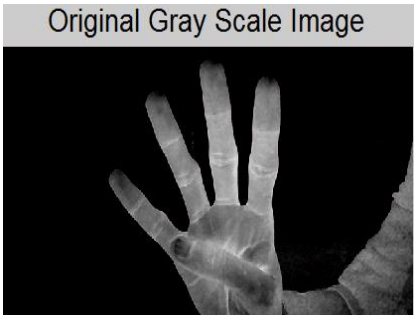
Figure 4.7.1 Original Gray Scale Image3

Figure 4.7.2 Noisy Image3

Table-4.8:Image4

Image 4

		0.001	0.003	0.005	0.007	0.009	0.01	0.03	0.05	0.1
Median	MSE	27.98	87.82	135.39	210.96	266.71	284.53	865.31	1441.9	2839.96
	PSNR	33.78	28.73	26.85	24.92	23.9	23.62	18.99	16.58	13.63
Winner	MSE	30	95.662	138.24	189.08	263.13	295.31	844.12	1456.84	2916.5
	PSNR	33.39	28.36	26.85	25.4	23.89	23.49	18.9	16.47	13.56
Mean	MSE	25.15	84.12	145.01	21.46	252.11	295.1	884.11	1444.76	2871.17
	PSNR	33.16	28.12	26.55	24.39	23.15	23.47	18.7	16.37	13.52



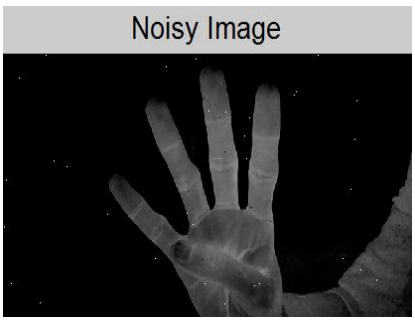


Figure 4.8.1 Original Gray Scale Image4

Figure 4.8.2 Noisy Image4

Observation:

1.Salt and pepper noise is caused by sharp, abrupt disturbances within the signal and it is randomly scattered white or black (or both) pixels over the image.

2.An image containing this noise can have dark pixels in bright regions and bright pixels in dark regions.

3.Though this result it has practically verified that median filter is effective in removing salt & pepper noise than mean filter.

4.Another result that can be concluded is that even winner filter is best in removing salt and pepper noise.

4.8 Gaussian noise

Table-4.9:Image1

Image 1

		0.001	0.003	0.005	0.007	0.009	0.01	0.03	0.05	0.1
Median	MSE	39.47	117.97	194.42	269.03	349.17	386.42	1120.33	187.57	3470.36
	PSNR	32.2	27.45	25.3	23.84	22.77	22.28	17.67	15.57	12.76
Winner	MSE	39.6	117.7	193.53	270.99	346.05	384.39	1127.79	1820.76	3475.58
	PSNR	32.19	27.46	25.3	23.84	22.77	22.32	17.67	15.56	12.75
Mean	MSE	39.69	116.84	195.8	271.64	347.47	387.53	1124.64	1816.17	3505.57
	PSNR	32.19	27.46	25.3	23.82	22.77	22.28	17.65	15.57	12.75

Figure 4.9.1 Original Gray Scale Image1

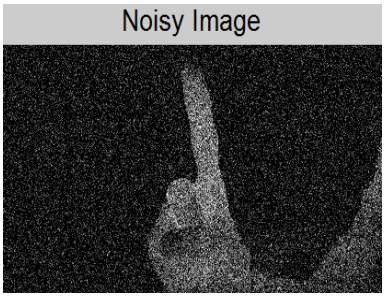


Figure 4.9.2 Noisy Image1

Table-4.10:Image2

Image 2

		0.001	0.003	0.005	0.007	0.009	0.01	0.03	0.05	0.1
Median	MSE	40.25	119.57	197.95	278.43	352.79	392.46	1148.52	1853.13	3536.69
	PSNR	32.12	27.39	25.2	23.72	22.69	22.23	17.56	15.49	12.68
Winner	MSE	40	119.5	197.81	277.18	356.32	393	1145.62	1861.35	353.75
	PSNR	32.14	27.39	25.2	23.74	22.65	22.22	17.6	15.5	12.68
Mean	MSE	40.27	119.37	197.48	276.84	352.85	393.28	1137.85	1845.57	3522.56
	PSNR	32.12	27.4	25.21	23.74	22.69	22.22	17.6	15.5	12.7

Original Gray Scale Image

Figure 4.10.1 Original Gray Scale Image2

Noisy Image

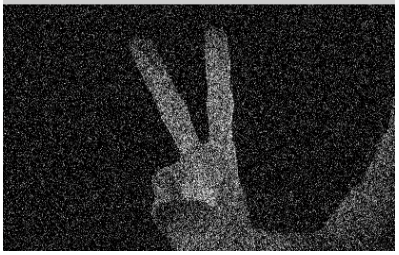


Figure 4.10.2 Noisy Image2

Table-4.11:Image3

Image 3

		0.001	0.003	0.005	0.007	0.009	0.01	0.03	0.05	0.1
Median	MSE	41.29	122.7	204.44	287.89	361.35	403.52	1169.18	1891.19	3573.06
	PSNR	32.01	27.28	25.06	23.66	22.59	22.11	17.49	15.4	12.63
Winner	MSE	41.25	122.04	202.84	283.84	362.45	404.46	1163.61	1889.69	3580.05
	PSNR	32.01	27.28	25.09	23.63	22.57	22.1	17.51	15.4	12.63
Mean	MSE	41.06	123.01	203.93	282.07	361.93	404.1	1165.54	1894.78	3572.45
	PSNR	32.03	27.28	25.07	23.66	22.58	22.1	17.5	15.39	12.64

Original Gray Scale Image

Figure 4.11.1 Original Gray Scale Image3

Noisy Image

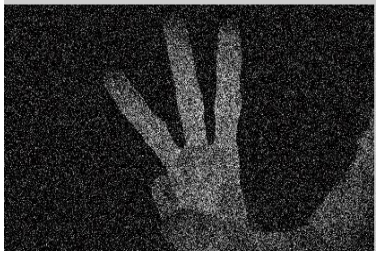


Figure 4.11.2 Noisy Image3

Table-4.12:Image4

Image 4

		0.001	0.003	0.005	0.007	0.009	0.01	0.03	0.05	0.1
Median	MSE	41.96	125.94	206.19	287.7	369.32	409.02	1176.89	1913.25	3575.39
	PSNR	31.94	27.2	25	23.58	22.49	22.05	17.44	15.35	12.63
Winner	MSE	41.42	124.77	207.51	287.82	367.46	410.08	1192.15	1903.59	3590.77
	PSNR	31.99	27.2	24.99	23.82	22.5	22.05	17.44	15.35	12.61
Mean	MSE	41.89	123.73	207.61	288.46	368.78	408.52	1182.64	1930.24	3577.69
	PSNR	31.94	27.24	24.99	23.57	22.5	22.05	17.44	15.31	12.63

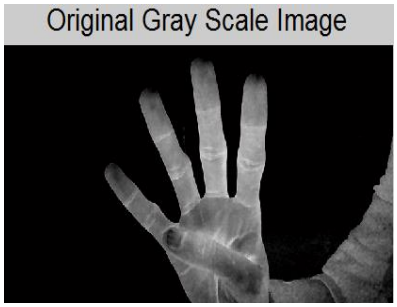


Figure 4.12.1 Original Gray Scale Image4

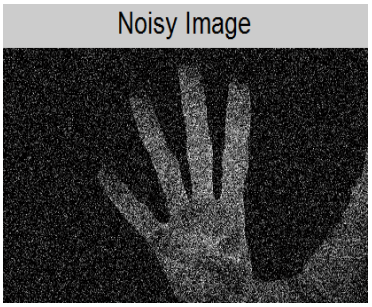


Figure 4.12.2 Noisy Image4

Observation:

1.It is evenly spread over the captured image.

2.It is during acquisition Phase ,the principal source of Gaussian noise lies in image e.g high temperature.

3. From the result it is concluded that in Gaussian noise the performance of all the filter are almost same.

4. We cannot say that which filter will perform best as they have almost nearly same and common value.

Table-4.13:The Performance Of Recognition Of Gesture

S.No	Gesture	Recognized No.	Unrecognized No.	Recognition Rate(%)	False Rejection Rate(%)	Corresponding Task
1.		25	1	96.00%	4.00%	Notepad
2.		25	1	96.00%	4.00%	Power Point Presentation
3.		24	2	92.30%	7.7%	Command Prompt
4.		23	3	88.46%	11.54%	Paint
5.		24	2	92.30%	7.7%	Opening Google chrome

6.		24	2	92.30%	7.7%	Sticky notes
7.		25	1	92.30%	7.7%	Calculator
8.		25	1	96.00%	4.00%	Window Media Player
9.		25	1	96.00%	4.00%	Control Panel

4.9 Analysis Parameters:

In order to find out the performance following testing and analysis parameters could be considered

a) **Robustness:** In the real-world, visual data can be very "rich", "noisy", and "incomplete", due to changing illumination, clutter and dynamic backgrounds etc. Vision-based frameworks ought to be client autonomous and vigorous against every one of these components.

b) **Scalability:** The Vision-based system ought to be effortlessly adjusted to various sizes of utilizations. For e.g. the center of Vision-based connection ought to be the same for "desktop environments", "Sign Language Recognition", "robot navigation "and furthermore for VE.

c) Computational Efficiency: Generally, Vision based interaction often requires real-time systems. The vision and learning algorithms utilized as a part of Vision-based interaction . It should be effective as well as cost efficient.

d) **Tolerance:** The malfunctions or mistakes of Vision-based interaction should be tolerated. At the point when an error is made, it ought not cause much loss. Users can be asked to repeat some actions, rather than giving the PC a chance to settle on more wrong choices.

4.10 :Output:

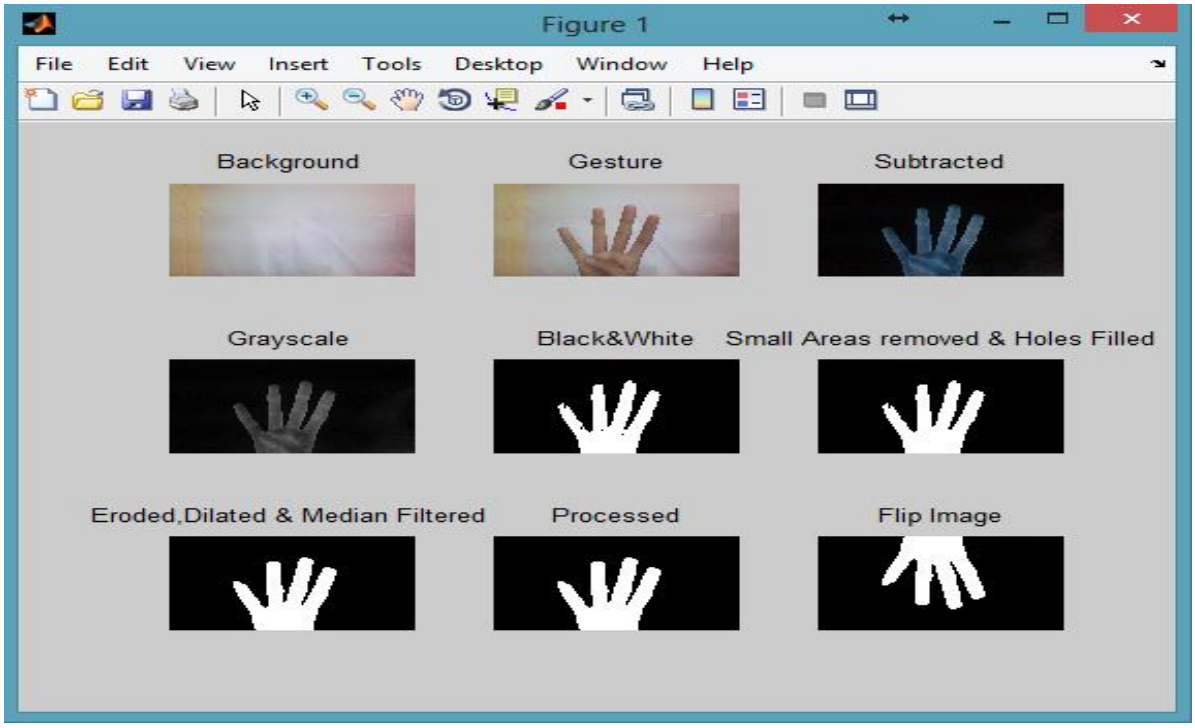


Figure 4.13 Output of Preprocessing

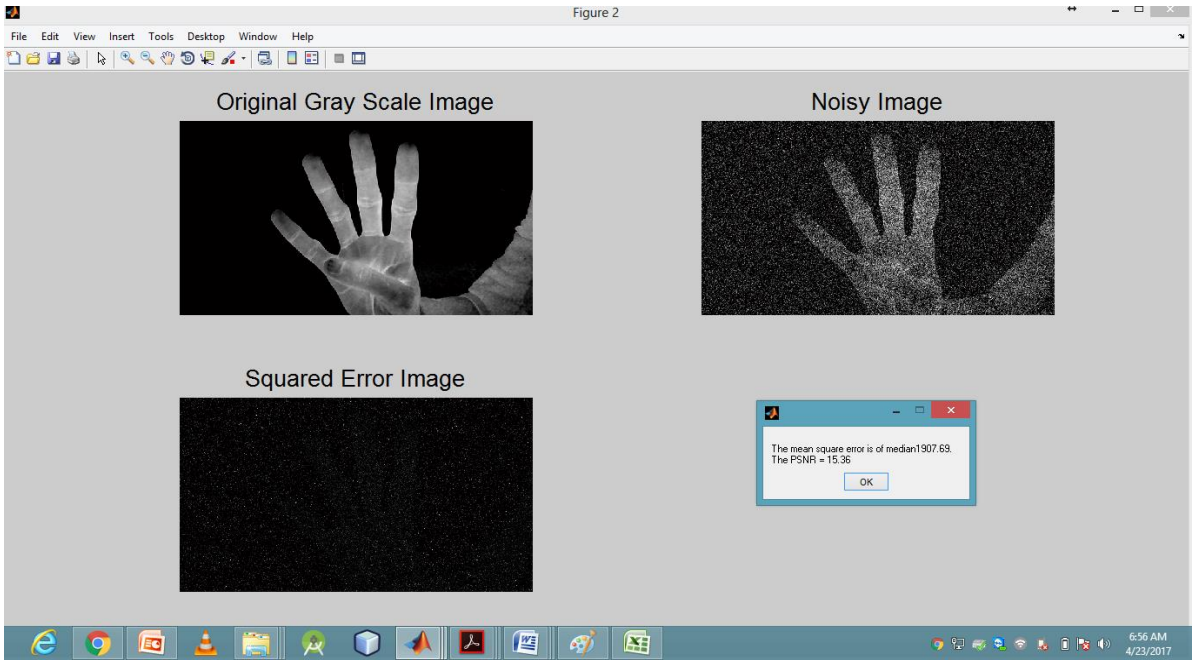


Figure 4.14 Output of PSNR

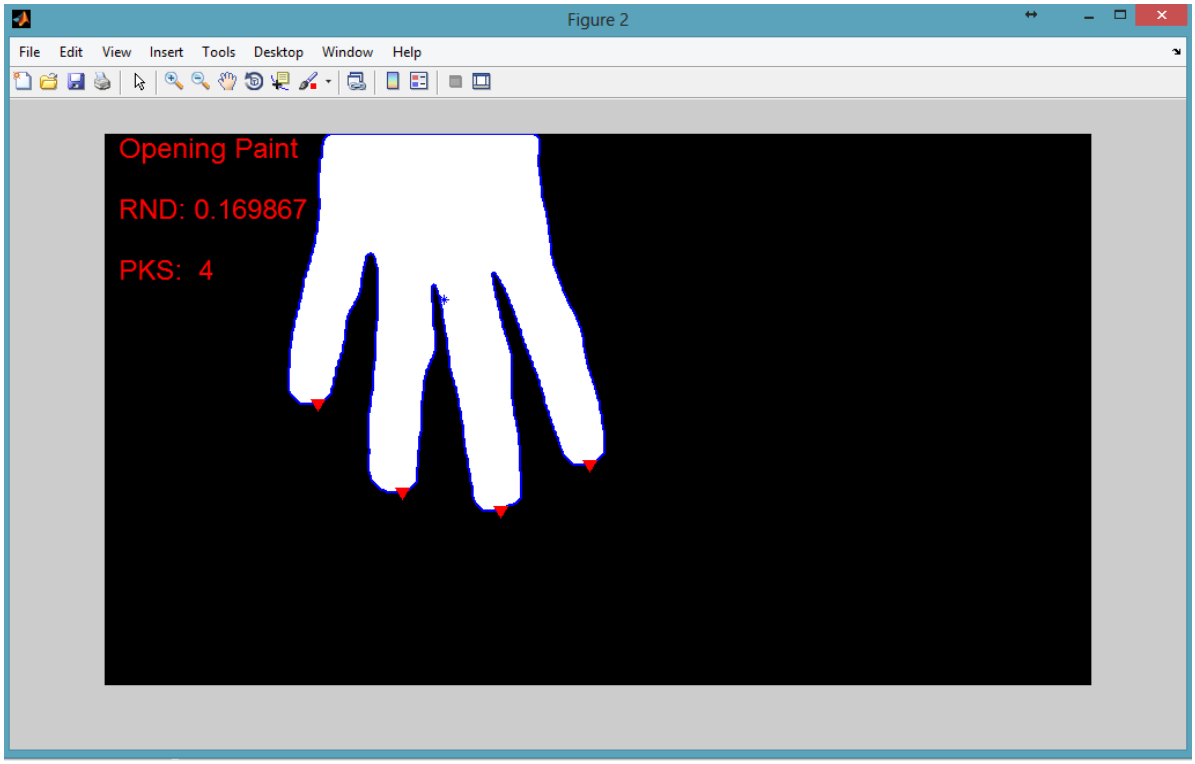


Figure 4.15Output of feature extraction

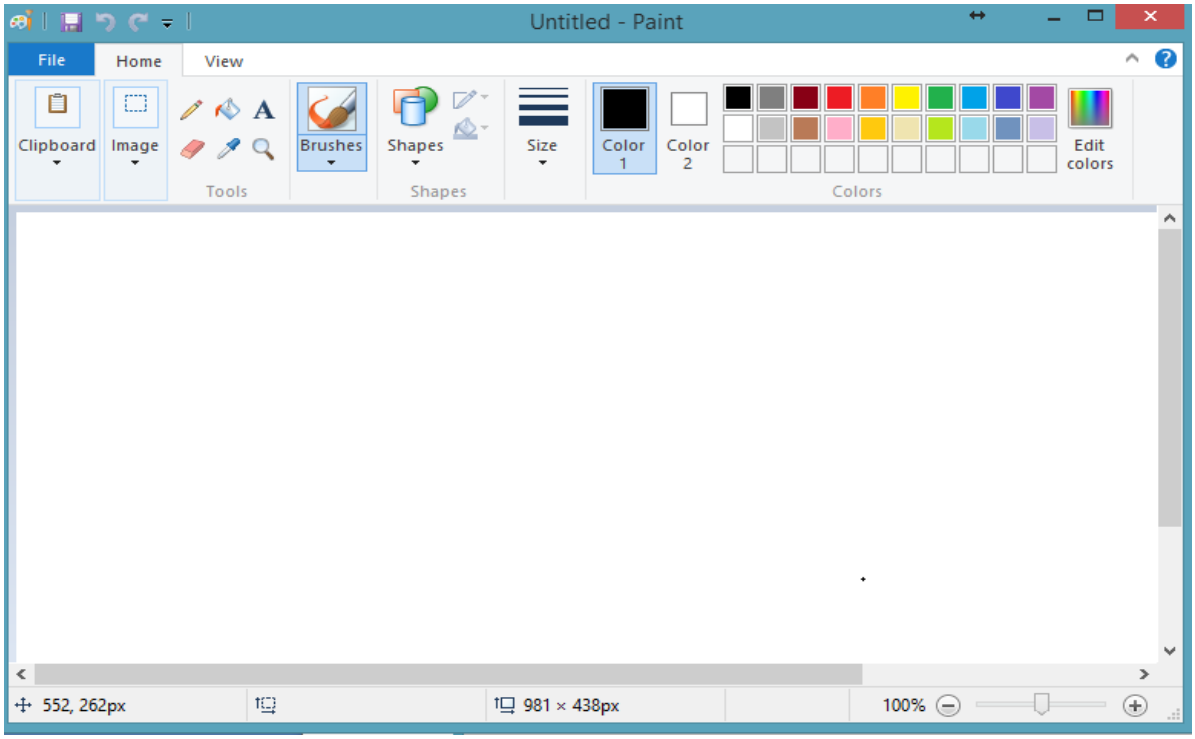


Figure 4.16 Output correspond to recognized gesture

CHAPTER 5

Conclusion

5.1 Conclusion:

The following are the findings of the work we have done so far:

- We proposed a simple hand gesture recognition algorithm, trailed by various steps like pre-processing, picture changed over into RGB so that fluctuating lightening won't bring on any issue.
- Then smudge elimination is done with a specific end goal to get the finest image. These pre-processing steps are as important as any other step. After performing the pre-processing on the image, the second step is to determine the orientation of the image, only horizontal and vertical orientation is considered here and images with uniform background is taken.

- Even little contrasts in the hand orientation can bring about huge change in the detection process.

- The background and environment of the user can altogether hamper the recognition procedure if not controlled legitimately.

- Tracking algorithms are very computationally expensive and hence have limited utility in real time applications , for example , the “Cam shift algorithm” is the least computationally expensive and still is managed to hang our system several times.
- The shortcoming of this technique is that sure parameters and limit qualities are taken tentatively that is it doesn't take after any orderly approach for motion acknowledgment, and numerous parameters taken in this calculation depend on supposition made in the wake of testing number of images.

- In this system we only take the static gesture, but in real time we have to extract the gesture form the moving scene.

- The real time processing ability of the system is based on the proposed architectural framework which opens up its applicability to a wide range of applications where the proposed framework can be customized based on specific performance requirements in “speed of processing” , “noise tolerance” , “fuzzy interpretations” , etc.

- We have used matlab codes in our project .

- This work presented results of a gesture based system that extracts features from our hands .

5.2 Future Scope:

- Following constraints are there in the project which need to be removed :

    i. Presence of dark background behind the hand

    ii. Detection of only one hand

- The future extension lies in making this algorithm applicable for different introductions of hand gestures, also different classification scheme can be applied. Gesture recognition could be utilized as a part of numerous settings later on..

- The algorithm can be enhanced so that pictures with non uniform foundation can also be used, this will enhance will upgrade the human PC interaction.

- Visually impaired individuals can make utilization of hand gestures for “human computer interaction “ like controlling TV, in games and also in gesture to speech conversion.

- Hand gesture recognition system can be valuable in many fields like “robotics”, “computer human interaction” and thus make hand gesture recognition offline system for real time will be future work to do.

- Support Vector Machine can be altered for decrease of complexity. Less complexity provides us less calculation time so that we can make framework to work ongoing.

- Instead of webcam a better and more accurate acquisition device can be used which even used Infrared for accuracy e.g. Kinect.

- Mechanism for hand identification is not precise.

- HU set of invariant moments are very basic descriptors as features of image which will not have good accuracy. A superior descriptor can give great outcomes yet grouping component may change.

- **Removal of colored objects:** The system relies on the using a colored object to remove variations degree of freedom , making recognition , via comparison, possible. It would be advantageous if this were not the case. There are strategies that could be utilized to play out the acknowledgment with no protest straightforwardly with the hand yet they would be probably not going to be as precise.

- **Detection of more than one color:** If the system can distinguish more than one color then we will have one more parameter of which can be utilized to expand the number of gestures by a factor of ‘n’ where n is the number of different colors.

- **Multi gestures**: It will be conceivable to speak to a considerably bigger no. of gesture if each comprised at least 2 motions joined with hand positions changes.. For instance : “wave hi” label will correspond to the open hand gesture with an alternating inc. and dec. of hand yaw angle.

- **Two-handed gestures:** It would be conceivable to identify the gestures given by both hands . A technique would need to be conceived to identify a signal that is spoken to by a halfway impeded hand.

5.3 Applications:

a) Virtual Reality: Gestures for virtual and increased reality applications have encountered one of the best levels of take-up in processing. Virtual reality connections utilize motions to empower reasonable controls of virtual items utilizing ones hands, for 3D show associations or 2D shows that reproduce 3D cooperation

b) Games: When, we take a gander at motions for PC recreations. Freeman followed a player's hand or body gesture to control development and introduction of intuitive diversion questions, for example, autos. Konrad et al. utilized motions to control the development of symbols in a virtual world, and Play Station 2 has presented the Eye Toy, a camera that tracks hand developments for intuitive amusements

c) Sign Language: It is a vital instance of informative motions. The gesture based communications are profoundly basic, they are extremely reasonable as proving grounds for calculations. In the meantime, they can likewise be a decent approach to help the debilitated to communicate with PCs. Communication via gestures for the hard of hearing (e.g. American Sign Language) is an illustration that have gotten critical consideration in the motion writing

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APPENDIX

Glossary A:

Binary Image: "A binary image is a digital image that has only two possible values for each pixel. Typically the two colors used for a binary image are black and white through any two colors can be Used".

Filter: "It's a device or process that removes from a signal some unwanted component or feature. Filtering is a class of signal processing, the defining feature of filters being the complete or partial suppression of some aspect of the signal".

Gray Image: "Image in which the value of each pixel is a single sample, that is, it carries only intensity information. Images of this sort, also known as black and white, are composed exclusively of shades of gray, varying from black at the weakest intensity to white at the strongest".

Image Processing: "In electrical engineering and computer science, image processing in any form of signal processing for which the input is an image, such as a photograph or video frame, the output of image processing may be either an image or, a set of characteristics or parameters related to the image".

Matlab: "Numerical computing environment and forth generation programming language. Developed by Math work, Matlab allows matrix multiplication, plotting of functions and data, implementation of algorithms, creation of user interfaces and for writing codes".

Median Filtering: "The median filter is a nonlinear digital filtering technique, often used to remove noise. Such noise reduction is a typical pre-processing step to improve the results of

later processing. Median filtering is very widely used in digital image processing because, under certain conditions, it preserves edges while removing noise".

RGB Image: "An RGB image has three channels: red, green, blue. RGB channels roughly follow the color receptors in the human eye, and are used in computer displays and image scanners. If the RGB image is 24-bit, each channel has 8bits".

Compression: "Removal of any redundant data that may be present within the image, to reduce amount of data to manipute or store".

Enhancement: "algorithms and processes that improve an image based on subjective measures. The aim is to accentuate certain image features for display or for subsequent analysis".

Feature: " any of the properties that are characteristics of an image, from which a description, interpretation or understanding of the scene can be provided by a machine".

Histogram: "distribution of pixel gray level values. A graph of number of pixels at each gray level possible in an image".

Resolution: "smallest feature(spatial) or gray level value (quantization) that an image system can resolve".

Restoration: "algorithms or processes that attempt to remove a degradation (noise, blurring, and defocusing effects) based on an objective criterion".

Segmentation: "separation of different objects in the image" .

Skeletonization: " algorithm used to identify the central axis of an image object".