An Efficient Framework for Image Data Retrieval

A Dissertation submitted

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To

Department of Computer Science and Engineering

In partial fulfillment of the requirement for the

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Master of Technology in Computer Science and Engineering

Under the guidance of

Ms. Sheveta
(Assistant Professor)

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CERTIFICATE

This is to certify that **Khushwant Kaur (11204444)** has completed M.Tech dissertation titled **"An Efficient Framework for Image Data Retrieval."** under my guidance and supervision. To the best of my knowledge, the present work is the result of his original investigation and study. No part of the dissertation has ever been submitted for any other degree or diploma.

The dissertation is fit for the submission and partial fulfilment of the conditions for the award of M.Tech. computer science and engineering.

Date:_____________

Ms. Sheveta

(Assistant Professor)

DECLARATION

I hereby declare that the dissertation entitled **— "An Efficient Framework for Image Data Retrieval."** submitted for the M.Tech degree is entirely my original work and all references and ideas have been duly acknowledged. It does not contain any work for the award of any other degree or diploma.

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ABSTRACT

Valuable information can be hidden in images, however, few research discuss data mining on them. Image retrieval means searching, browsing and retrieving images from image databases. There are two different methodologies for image retrieval i.e. text based image retrieval and content based image retrieval. Former one is obsolete. In latter one many visual features like texture, size, intensities, and frequency of pixels and color of image are extracted. In query-by-example search extracted featured are compared with stored ones. In this work an efficient for extracting image features is considered using intensity histogram of gray color image. Here in this general framework based on the decision tree for mining and processing image data. Pixel wised image features were extracted and transformed into a database-like table which allows various data mining algorithms to make explorations on it. Finally results of average gradient vectors are to be compared with previously stored one dimensional array of intensities to find similarities in image data.

Keywords: Convo-Detect, Hybrid Projection, EOAC, DC, EDH, DAC ImgDataRet, Hamming20, Keller6, Brock20.

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ABBREVIATIONS

AIR Automated Image Retrieval

CBIR Content Based Image Retrieval

CMY Cyan Magenta Yellow

CD Coherence Distance

DAC Distance Auto Correlogram

DDSM Data Driven Scene Capturing Model

DMC Digital Modular Camera

EOAC Edge Oriented Auto Correlation

EDH Edge Distance Histogram

GED Gabour Edge Detection

GIS Geographical Information System

GT General Transformation

HCI Hue Chrome Intensity

HIR Hard Intensity Range

HIS Hue Saturation Intensity

HMSC Human Motion Scene Capturing

HSB Hue Saturation Brightness

HSF High Spatial Frequency

HSL Hue Saturation Luminance

HSV Hue Saturation Value

IBR Image Bounding Regions

ICA Independent Component Analysis

IDs	Image Detectors
IFIS	Initial Forest Image Set
IM	Image Mining
IoM	Image observation Measurement
ISMV	Image Science and Machine Vision
IVQ	Image Vector Quantization
LLIM	Low Level Intensity Map
LRGBY	Lab Red Green Blue Yellow
LSF	Low Spatial Frequency
MC	Modeling Coordinates
MFD	Mises Fisher Distribution
MIP	Medical Image Processing
MISR	Multiangle Image Spectro Radiograph
MLA	Micro Lens Array
MRI	Medical Resonance Imaging
NFS	Nodal Frequency Statistics
OBIA	Object Based Image Analysis
OVID	Object Video Information Database
PCA	Principle Component Analysis
PIC	Probability of Image Class
PST	Phase Shift Transformation
PTCS	Probability Theroy of Computer Science
QBE	Query By Example

RGB	Red Green Blue Model
SEDT	Sobel Edge Detection Technique
SF	Spatial Frequency
SIR	Soft Intensity Range
SRM	Sampling and Retrieval Model
SVM	Support Vector Machine
TDB	Training Database
TMA	Tissue Microwave Analysis
TR	Temporal Relation
VHR	Very High Resolution
VID	Video Information Database
VORF	Video Object Reference Frame

CHAPTER 1

INTRODUCTION

1.1 INTRODUCTION

Data Mining is termed as discovering hidden values in data warehouse, extracting hidden information from huge databases is a powerful new methodology which has helped many organizations nowadays to focus on significant information in their data warehouses. [1] Data mining techniques can be implemented rapidly on various platforms on high performance parallel processing computers or client/servers. Data mining tools can work with heavy databases to find answers to various business queries. [3] Many data mining operations are managed outside of data warehouse nowadays and thus require extra steps for extraction, import and to analyze preprocessed data. Also, when new things require operational data implementation, collaborations with the warehouse improves the application of outcomes from data mining. The resulting analytic data warehouse can be applied to improve business processes throughout the organization, in areas such as substantial degree of relevance management, fraud detection, new product rollout, and so on.

The starting point of data mining process is a data warehouse having collaboration of its internal data with external market data from web about rival companies competing with them.[1,2] Previous raw information related to potential customers provides excellent basis for analyst software modules. An OLAP server favors more advanced flexible and fast data access to be applied when navigating data in some data mapping scheme for standardization. The data mining access server must be integrated with OLAP server and data warehouse. It is the job of data mining access server to advance process centric data that will give major data mining objectives like prospecting, promotional integration and campaign management.[3] Integration of newly arrived metadata with existing data warehouse allows operational decisions to be directly focused and tracked. As a result when data warehouse grows with newly bindings in decisions, organization can mine continuously best results to be practiced for future decision making.

1.2 IMAGE MINING PROCESS

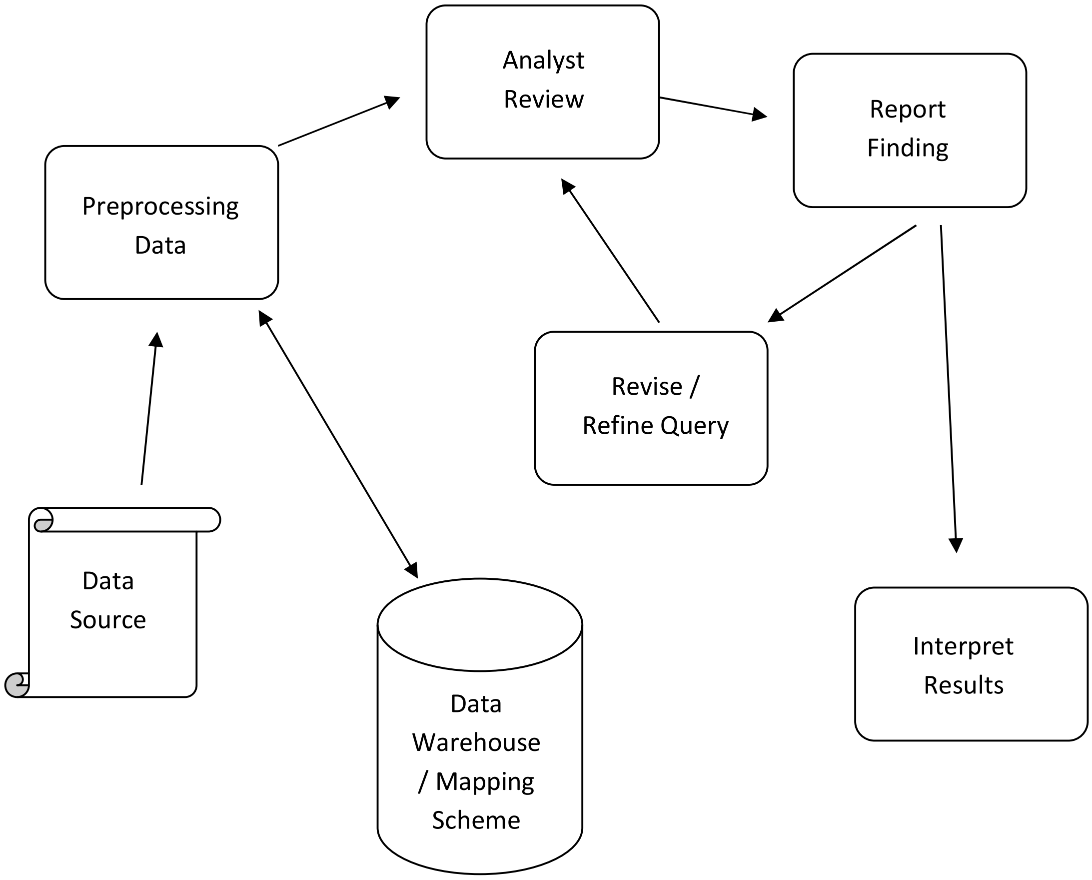


Figure 1.1: Data Mining Process Interpreting Mined Results.

Data mining is the feature detection technique of image data and the use of software based techniques for finding image patterns and bitmap regularities in sets of image data. The computer program is responsible for observing the image bit patterns by elucidating the pre-defined rules and image features in the image data. Data collected from different sources like databases or flat files or any other resources like web is made to be preprocessed. Various standardization techniques of data cleaning or formatting are to be used by data warehouse or mapping schemes. [4] Further preprocessed data is made to be reviewed by data analyst who is done nowadays by computers software. In earlier days it was manually done by data analysts. After reviewing preprocessed data analyst reports are to be made which is revised or refined if something is needed with hand on information to generate finally mined or interpreted results.

1.3 IMAGE DATA RETRIEVAL

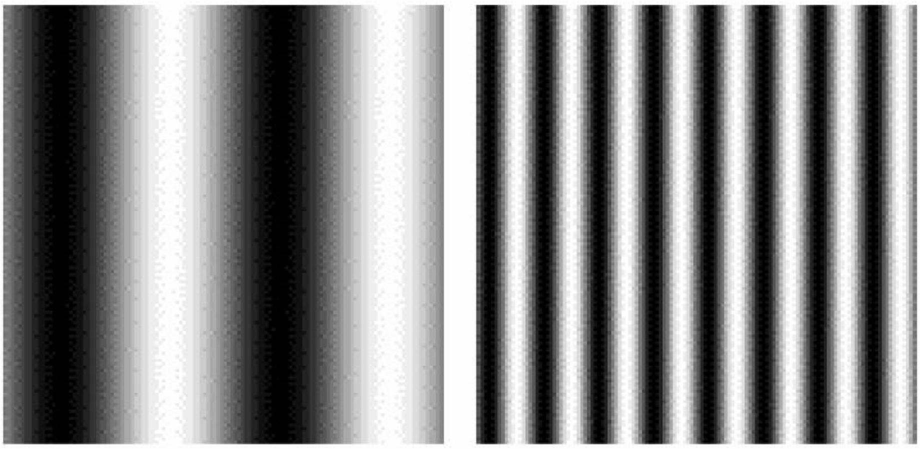
Recent progress of technology in hardware with large capacity of holding data from image, audio, video or textual data and/or combination of them has become more common these days. As a result the need of accessing contents of such data is growing with requirement of fast access database systems. [4] In case of conventional databases, retrieving contents of multimedia data is not enough facilitated. Because in conventional databases most of database systems are based on relational data models. [5] Following are three main reasons behind this lack in support:

a) In relational data models there is a lack of spatio-temporal relations. In linear system theory, it was in context of audition where an auditory data signal is represented as a function of single variable. [6] But the same theory works on an image which is a function of two spatial dimensions x and y. also if temporal sensitivity is considered as well then a signal will be a function of three variables i.e. x, y and t which is in case of movie or sequence of images. In audition basic stimulus used in linear system theory is a sine wave grating. [7] Also temporal relation between audio and video data is a key thing that is needed to be taken care by database systems. In case when textual data is superimposed with video data which is stored separately from textual data, both temporal as well as spatial relations need to be managed in order to define relation between them.

b) Secondly semantics of data being retrieved is a crucial thing in recognition and/or data interpretation process in case of multimedia data, because representation of data and contents perceived are two different things in an image, video and audio data.

c) Third major concern in retrieving multimedia data is query representation. Retrieval of data in conventional databases is totally based on relational algebra with simple query conditions in the form of standard alphanumeric character representation. On the other hand multimedia data retrieval involves types of contents to be diverse and here query-by-example (QBE) would be better solution.

These three conditions relate to all the image components of warehouse database system. [3] That is, the first issue of handling image patterns depends on the image data model or intensity indexing technique, the second on image data in DBMS construction, and the last part favor to the required user interface. Therefore, none of them can be left behind while discussing all possible outcomes of content-based retrieval. Image data classification is a task of machine learning process that enjoys various different applications in the field of image processing, such as image data retrieval or image object recognition. Images are basically n-dimensional data of image, which requires for sure pre-determined image pattern towards dimensionality alleviation.



(a) Low SF (b) High SF

Figure 1.2 Low and High Spatial Frequency Sine Wave Gratings

1.4 SPATIAL RELATIONS

One of the most mandatory features in many multimedia documents is management of spatial coherence. Management of spatial relation of components of image data is done by considering its rectangular Cartesian coordinates. The spatial axis position of a component in object in image data is represented by rectangular coordinates and the relations between components are calculated mathematically. [9, 3] A multimedia document which is composed of images, flowcharts, and other random graphics as well as image text is another example that proves the management of spatial coordinates for layout information in an image [6]. In other applications of image processing such as geographical information system (GIS), the image pattern representation and random indexing of abstract and finite spatial relations in some regions of image is studied. A 2D stream of bits [3], [9] is an image data indexing technique for representing a spatial pattern between different components of an image; 2D stream of bits represents few patterns in position of components in neighboring regions, which is composed of horizontal and vertical ordering of image components. Also, it gives several distinct levels of a sparse-strict spatial relation, where the stiffness of directional data differs from one level of hierarchy to other. In [8] a set of two dimensional bits such as '00' '11' '01' '10' '111' '100' '101' '001' and '011' is defined as primary relations for representing spatial region of image data coordinates in observed components of image. This method along with 2D stream of bits is suitable for sparse bit evaluation of spatial relation in image patterns. The advantage of above method of representation of bits of image is that it left subtle denominations of spatial relations that are not required to be evaluated. However, the spatial relation is not distance-dependent, non-interval-based bits in image data are out of their scope of findings.

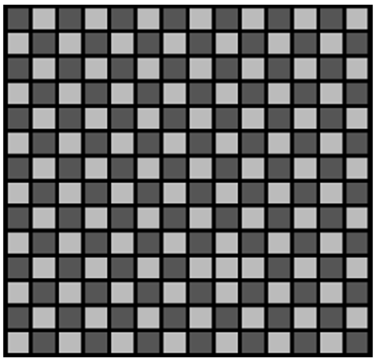


Figure 1.3 Check-Board With One Square Colored Incorrectly

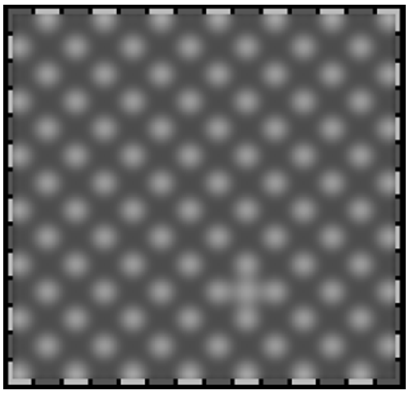


Figure 1.4 Blur Image Of Check-Board

1.5 TEMPORAL RELATIONS

A recent study depends upon bit representation and image data management of temporal relation considers video based applications of image processing such as video information databases (VID). There are two basic techniques for representing time based relationship between objects in multimedia data of a moving image: One is a point-based image data representation containing time lag of various colors in a multimedia document, and the other is an interval-based image data representation which contains intervals of data shifts from neighboring regions of data. [21, 29, 34] The point based representation contains the Cartesian position of objects by points in the image data on timeline, whereas the interval-based representation contains the cohesion of image objects by means of their intervals of the occurrences of similar intensities in neighboring regions of an image. Many studies shows

Interval based modeling technique of data representation. is used to manage the time lag in between various component videos objects that are used in multimedia document. Video elements of document (VID) are shown as if a stream of video bit patterns being defined by the time lag intervals, a video object comprises of different streams of video frames which are stored in contiguous manner. [26, 43, 49] Video objects can be changed using two operations of merge and overlap. To be part of the definition of every video object the textual annotation of the contents of the video are merged or overlapped. Both the frame based and interval based specification are used to query a video object in OVID. Gibbs et.al [17] used a timed based representation of component objects. Sequential representation of component objects is used in this study. So this technique did not give a natural representation of a condition. Reverse and temporal relations were discussed and extended by little and Ghafoor. Allen's basic definition of temporal relations was followed by Hopner.

1.6 DATA RETRIEVAL IN CONVENTIONAL DATABASES

Earlier database systems were designed to manage and retrieve the textual data and their related keyword based retrieval techniques which are not suitable for retrieving the data which comprises of text, video and audio data. Adding to this, in earlier times lot of human effort was required for the manual annotation because as the data which was stored in binary form was of no meaning to the human. Similarity comparison techniques are considered to be the best techniques for the exact matching of the applications. To get the best solutions the mechanisms of filtering and ranking are used. The user can store and query various types of multimedia information with the help of multimedia database system. The process of retrieving images which are exactly same to a given image can be done by the typical multimedia type. [14, 17, 19, 22] So that is why it is known as the content based retrieval technique. This process can be carried out at three different levels of abstraction. First one is raw data in which the comparison is done by comparing each pixel with the other pixel. In this search is also done on the different features of the objects like its texture etc. The other is semantic in which the grouping of different objects is done based on its meaning. The configurationally similarity is based on the direction, topological address and the relation of image object with respect to distance. The preprocessing is required by almost all the techniques which are global or local.

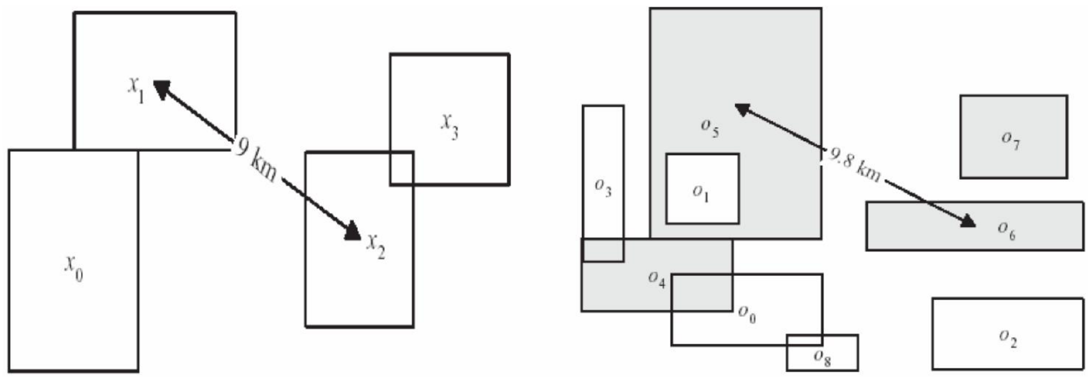


Figure 1.5 Nine Regions of Interests in a Binary Encoding of Relations

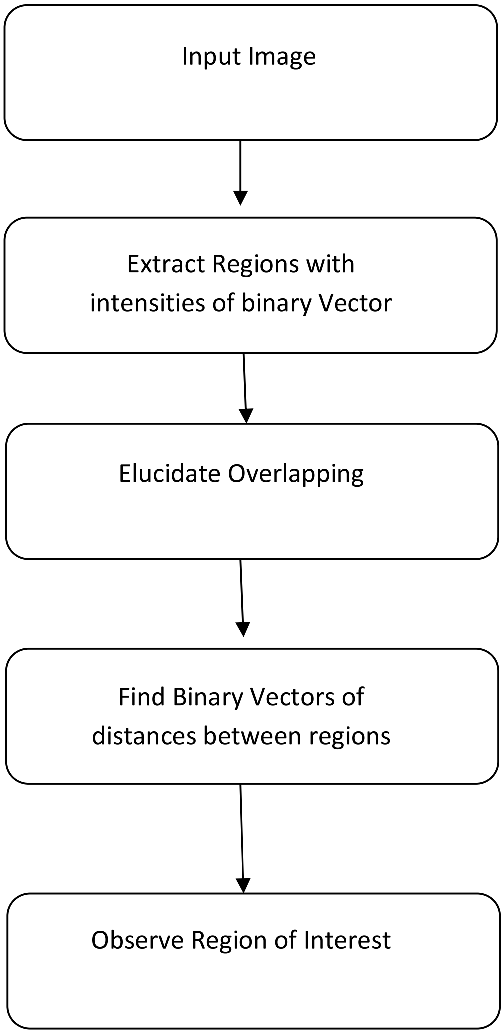


Figure 1.5.1 Region of Interest Finding Model

1.7 IMAGE EXTRACTION THROUGH MINING

The technique of handling the association of image data and its patterns which are not stored in its images is known as image mining. Different methods of image processing and retrieval are used by this technique. There are two approaches to mining, firstly to mine from a large database of images and the other one performed on different collections of images and the data. The co-ordination of structures and the human brain can be deteriorated by this technique. The actual meaning of image mining is the production of different patterns with no knowledge of the image content. There can be different kinds of patterns like description, temporal, spatial etc. [41-43] All huge image databases are being handled but the image mining. This system includes different image retrieval as well as indexing technique for pattern matching. This method is considered as if user friendly for data patterns and can generate in depth knowledge of image representation. The different patterns are grouped together .The sample of different images is taken to extract the content. But during this process different type of distortions and disturbances are being met. The results of mining can only be obtained after the matching of the model description with the symbolic prescription.

1.8 CONTENT BASED RETRIEVAL TECHNIQUE

In this technique a complete image is segmented into small parts which further comprise to form the group of small images based on the index and layout feature. For the large scale data management (AIR)

Automated Image Retrieval System is used to develop the Image Science and machine Vision (ISMV) of ORNL. In the olden days textual description was handled manually. But there were different loopholes such as semantic structure can vary with respect to a retrieval task and it was also a very time consuming process with regard to the size of image databases. The solution to these problems was content descriptors. In these technique global dimensions of the image was used. [32, 34, 36] Due to this another concept came into being that was named as Image segmentation in which the internal content of image was sidelined .But there is no correct technique of segmentation. Although there are different techniques but we could not arrive at the best one. So a definition of segmentation came into being i.e. it is a process with the help of which we can label each and every point of image including the class label. Another feature of segmentation is the capability to work in the unplanned sequence. These techniques do not rely on continuous human efforts. This problem is due to the restriction applied on the size. Due to everyday increase in the size of image which leads to hindrance in the way of conversation. [21, 22, 28, 29] The gap between the low level and high level interpretation can be decreased with the help of image segmentation. The low level image content should be user friendly so that changes can be performed at any stage in a image in CBIR system. So different steps must be taken to reduce this gap. The Semantic representation is based on color, spatial and texture information.

The deformities and ambiguities in different object recognition is due to spatial and spectral adjancies which are based on the type of shadow, object and their complex relations with the adjacent objects. [34] The object recognition can be improved with the use of a knowledge base. This process can be achieved by going through two stages, first one is to define the properties of each segmented region and the second one is to classify results based on the views of the classified objects. [30, 33, 35, 36] The scene contextual information is based on the height, sensory information, the analysis of the visibility mapping etc. the methodology of object recognition is performed at two databases i.e. multi view digital angular camera and multi angular worldview

Figure 1.6 Oak Ridge Image (2m×2m)

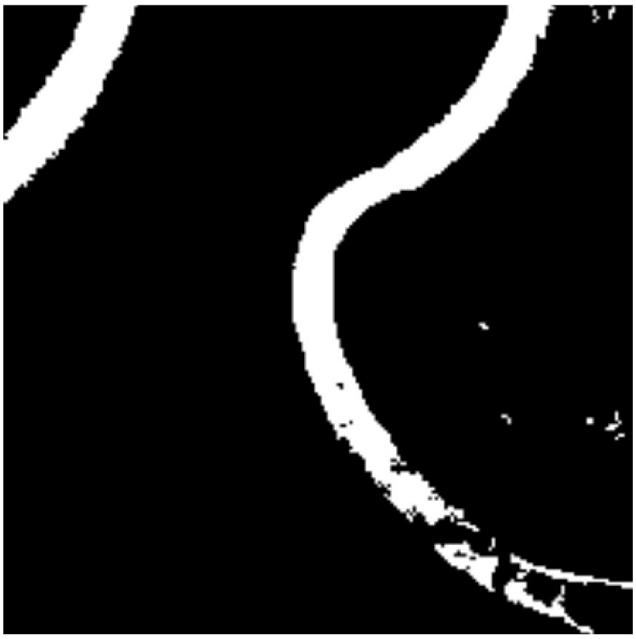


Figure 1.7 Color Histogram Image Of Water Area

1.9 IMAGE OBJECT RETRIEVAL USING CONTEXT AWARE TECHNIQUE

The object recognition can be improved with the use of a knowledge base. This process can be achieved by going through two stages, first one is to define the properties of each segmented region and the second one is to classify results based on the views of the classified objects. The scene contextual information is based on the height, sensory information, the analysis of the visibility mapping etc. the methodology of object recognition is performed at two databases i.e. multi view digital angular camera and multi angular worldview. [42] The gap between the low level and high level interpretation can be decreased with the help of image segmentation. The low level image content should be user friendly so that changes can be performed at any stage in a image in CBIR system.

CHAPTER 2

REVIEW OF LITERATURE

Retrieving desired image data from the huge data sets is a research problem and a heated debate among computer professionals. Here a researcher is basically interested in retrieving desired semantics from image database makes task stiffer and strongly connected with computer vision. It is argued that image retrieval community will be benefitted by an appropriate evaluation process. Here in this [3] [4] paper an approach of automated image retrieval is used to evaluate query-result dual on the basis of both query by text and query by image example.

Hsu. et al. (2009) extracted from extensively large image databases, image acquisition and storage technique have been proved to be an incredible in growth. Extractions of hidden information, image data association or other patterns which are not properly accumulated by an image are facilitated by image mining process. In this paper image mining has proved to be a significant application in the field of machine learning, image processing, image retrieval, databases and computer vision.

Perner et. al 2010 had worked for image mining and proposed a framework and a standard tool and its application to medical image processing. This work of Perner had contributed a tool and a technique of data mining in image retrieval systems. [18] Image identification and knowledge examination from databases of images is supported by determination of observed pre-defined patterns of image. Here in this work Induction decision tree is used to recognize expert's knowledge. This loaded decision tree give basis for decision making that can help an expert to investigate images.

Gholap et. al .2010 proposed a new concept of content based tissue image mining. Images of tissues are found to be rich in huge information contents which are hidden. A process of Tissue Microarray Analysis (TMA) involves analyzing tissue image for finding affected regions with micro-organisms.

Sanjay et. al. 2011 developed an image mining technique using wavelet transformation. In this work a real life image is correlated with particular category of image patterns identical to the scene. Further gathered information is used for learning new patterns with their classifications. Frequency association from wavelet transform is utilized for image mining which act as a substitute for Fourier Transform. Further this frequency association is used to split a broad frequency spectrum into simpler sub bands. [41] These simpler bands give hand on Principle Component Analysis (PCA). The concept of image mining from PCA is used for weather forecasting so that one can be facilitated to know natural disasters that may occur in advance.

Pattnaik et. al. (2012) proposed image mining approach using image data compression and image clustering techniques. Images from satellites are to be taken into account for weather forecasting conditions. [42, 49] Based on some climatic conditions of environment frequencies of images are fixed in some pre-defined threshold range of frequencies. In this work Image Vector Quantization (IVQ) along with image clustering methods are implemented to cluster and compress color images.

Kun Che et. al. (2012) step forwarded a tool for data mining and image processing. Moreover this tool has utilization in various other image mining tasks like X-Ray Imaging for Lung-Nodule Analysis, MRI for Lymph Node Analysis etc. this work includes an approach where a decision tree for mining and processing image data is evaluated under a common framework. [15] Here in this work a pixel-wised image features are extracted and database like table is maintained to implement data mining algorithm on them.

Jie Xian Zeng (2013) introduced a new technique of shape representation using image data retrieval. This technique was named initially Distance-autocorrelogram. In this technique a centroidal distance of a particular region is calculated from a neighboring connected region. [13] These distances are represented by edges between observed regions from an image. Then a shape descriptor feature is applied to content based image retrieval (CBIR).

Ganesh R. Naik and Dinesh K Kumar (2013) presented Independent Component Analysis (ICA), an efficient blind source separation technique, and computationally an area of interest for image retrieval community with many applications in various Computer Science activities. [25] In this paper various ICA methods have been reviewed involving in image retrieval techniques and review its applications. ICA methods are presented with their potential applications to serve as a comprehensive single source for an inquisitive researcher to carry out research in this field. Here firstly scene of the blind source separation is set. Then, Independent Component Analysis is introduced as a widely used technique for solving the blind source separation problem. A general description of the approach to achieving separation via ICA and the underlying assumptions of the ICA framework and important ambiguities that are inherent to ICA are highlighted.

Adeel Ansari et. al . (2014) discovered high dimensionality of data in data warehouse and assuming that this is due to presence of some unknown latent variables. ICA is applied for analyzing complex bindings of data dimensions and random projection of some unknown parameters are observed by considering partial overlapping of some unknown variables with them. [18] Observed data set generated by interactions between latent variables is act as a key to understand different components of data in an image. High dimensionality of data is due to large number of products and large image windows with their huge vocabulary. An optimal way which is chosen for reduction of dimensionality is projection of data onto lower dimensional orthogonal subspace.

Paltis And Jay (2014), November the study Corel image data set which is most used data in image retrieval research is used. This fact alone suggests that a suite of comparison data sets should include data for those images. [7] However, it is remind that the Corel data has significant problems. Additional choices for content based image retrieval are better option to be implemented because many of image documents created by Corel environment are semantically similar. [8] Query by image example document is presented with four additional parallel images in order to make four different reference vectors. These five participants were given very little way of guidelines for making their selection.

Pratt And Cate (2014), December choosing query-result pair is an experimental issue. All the identifications would be poorly matched if there are randomly taken result pair sets. [9] Here selection of image features using existing image retrieval methods is the main idea behind uniform selection process. Trial and error method shows that selection of image features using probability proportional to negative fifth power of rank from the starting point of region taken for selection process. [7] Query-result pair and image retrieval system results are completely independent when evaluated to select images under consideration. Significant biasness in results is observed when four different randomly chosen results are made to be introduced into measurement of retrieval systems.

Srikantha Abhilash and Gall Juergen (2014) find an object recognition technique which extracts image object features by recognizing image objects from video frames. Video frames are organized in a video in which interaction of various objects present in an image constitutes a sequence of frames which is later on taken as an activity. In the proposed algorithm Gall and Srikantha found that image object features are part of activities. [42] From human interaction labeled object data is firstly buffered as initial properties as arguments and at processing stages it gets discharged to the shape of matrix processing by comparing various intensity ranges of pixels in RGB color models.

Mr. Matthias Dantone and Gabriele Fanelli (2014), estimated human objects in a scene by recognizing facial features of human objects in an image. Regression forest is a tree set of locations in an image depicting human faces. On the basis of facial image patches and irregularities, regression forest maps to pre-defined face property set with boundary wall conditions on RGB-levels of facial pixels. Mr. Dantone proposed that initially a forest is built from pre-defined image set. [47] Based on separation of two same intensity pixels on a human face, a feature point for face recognition is made. If human objects from an image are of different levels of intensities then normalization is required. In normalization process four different phase shift transformations are applied. Centriod of each phase shift column is taken to limit the range of surrounding pixel intensity. Based on these normalized ranges, bounding regions are taken to surround each human face in an image. In order to make the result not to deviate from actual human faces, the bounding boxes are scaled up by 30%. When testing the presence of human faces inside the bounding boxes. [50] All pixel locations are compared with regression forest with its bounded wall conditions. Then presence of human faces are ensured by performing stored binary node value of regression forest recursively with its left and right child until a leaf node is reached in the forest.

Samadani and Han (2014) developed a program-assisted query of boundary extraction process, in which whole manual data intake from the user end along with the other image edge patterns of bits generated by an algorithm. In [8], Daneels et al. proposed an enhanced representation technique of active regions of an image. Depending upon the user's intake image, the algorithm firstly introduced a greedy approach to provide a superior outcome of initial intermediate data set of bitmap. Secondly the method of adoption was established through dynamic programming approach. In [9], Rui et al. had given a basic image segmentation procedure based on clustering bitmap of sub-regions of an image and grouping them in spatial intensity space of the given image before proceeding further [1, 5]. It should be pointed out that as it can be seen from this discussion, many folding methods of image segmentations have been proposed, both in Computer Vision background and in Image data Retrieval scheme.

Christen Leistner and Angela Yao (2014), proposed an object recognition method based on interaction between objects in a video data. In this method incrementally image frames are extracted from video data and then sequence of frames is consumed by an image detector algorithm. This object recognition method is an incremental learning approach using datasets drawn from real world images from microscopy, urban planning and television streaming. [33] In this method an object detector is an algorithm which randomly performs decision tree transformation for detection of objects in an image. This algorithm is quite effective and fast for detection of objects randomly from bounded square box region of training data. In this incremental learning method, number of object feature points per node is limited to system's memory and consumes lesser CPU clock cycles. Results of this method reduces the cost of evaluating feature points as 400 to 600 points per node as compared to 800 points per node in many famous allied object detectors like interactive object annotators or tracking based object annotators etc.

Forest is an image data structure for storing image's information. Set of trees with a class label representing probability of finding a nodal value of some intensity region pixel of an image is classified as a category of forest tree. It is useful in finding the image patches from an image. The first and foremost goal of image object recognition is to find the patches in it and classify them to some class of the like category. For finding patches from an image one need to perform regression for its location and secondly scaling of that found patch region. Patches of image corresponds to objects in an image where statistics of each patch found is held by leaf node of tree. [31] Class of trees constitutes a forest containing image patches with each class having some probability value associated with it. On the basis of these associated probability values of each leaf node, location of patch in an image gives presence of strong clue about object. Various objects are classified as according to the class probability associated with each leaf node.

Data driven approach is one of the best image retrieval technique which is out done in 2001 to 2010th decade. Its principle is precise and based on data driven scene capturing model HMSC (Human Motion Scene Capturing). It combines video frame data with a sparse matrix of high intensity regions of an image to find out scene objects and retrieve their boundary values (Hard and Soft Intensity Ranges).

This scene object is acting as a sample particle for deriving valid twist angles pose of scene. Further application of MFD (Mises Fisher Distribution) introduces a noise model to observe uncertainty regions like background clutter, illumination shades and shadow disruptions. In this approach image data is firstly captured in the form of stable sparse matrix with normalized coordinates system. [12, 14, 17] Modeling coordinates differs from world coordinates of scene by unit transformed vector towards the positive (opposite) side of projection vanishing point. This is the point where image cues of various scenes are taken by comparing them with orientation cues. These orientation cues are further helpful in making sampled particles in a scene depicting various poses at different twist angles of scenes. Averaging sampled particles belonging to different scenes with their respective weights provides weighted particles. Weighted particles further undergo optimization process to depict final pose of object.

Data driven approach is already equipped with comparison of sampled particle with world coordinates of object in actual scene. [16, 17] This comparison can be done after a modeling of sensor results through General Transformations (GT) (Composite or individual of reflection, scaling, rotation, phase shift or shear etc.). Let p(x,y) denotes probability of finding a sampled particle in world coordinates, $(x,y)_{IM}$ is image observation location, $(x,y)_{SENS}$ is sampled particle of pose as suggested by sensor. According to Probability Theory of Computer Science (PTCS): Probability of observing image object from a scene will be:

$$\text{Max} [\, p((x,y) \mid (x,y)_{IM} , (x,y)_{SENS}) \,] = p((x,y)_{IM} \mid (x,y)) * p((x,y)_{SENS} \mid (x,y)) * p(x,y)$$

$$p((x,y) \mid (x,y)_{IM} , (x,y)_{SENS}) = (p((x,y)_{IM} , (x,y)_{SENS} \mid (x,y))*p(x,y)) \,/\, p((x,y)_{IM} , (x,y)_{SENS})$$

$$p((x,y) \mid (x,y)_{IM} , (x,y)_{SENS}) = (p((x,y)_{IM} \mid (x,y)) * p((x,y)_{SENS} \mid (x,y)) * p(x,y)) \,/\, p((x,y)_{IM} , (x,y)_{SENS})$$

Hewage et. al . (2015) sequence of frames in a video data represents some action performed by objects present in an image. Each frame corresponds to a pose of some object. Vision Human Motion Analysis (VMHA) is a field of image processing that deals with pose recognition from video data. Temporal coherence of image objects is done through reconstruction of image frame data sets over time. A priory algorithm estimates action of object by retrieving its pose at different twist angles. It is observed that in a scene multiple activities make a sequence of frames depicting some action to be recognized. Since estimated action is always lags a bit from actual action of object. [17, 18, 19] Various techniques for action estimation are in debate. One of them is adopted by Mr. Macullam Mihill Narode : On the basis of appearance (Low Level Intensity Map extraction) of objects, a sparse matrix is maintained which is holding all location bounds (Hard Intensity Regions) of objects. This sparse matrix is labeled with a tag representing an action from class of actions. This action classification task is complex one and is NP-hard. Then row major or column major representation of sparse matrix gives sequencing corresponds to a particular action. This helps in finding out various poses out of sequence of poses of action. Then final pose is described by unit conversion of results through map of object classifiers. Here is the process of pose recognition from action estimation.

Spatial relationship between two particles of an object from image is observed by making depth comparison between them (which object is lying above or below of some other object). Transformed coordinates of an object undergoes high pass and low cut filtering process. Results after removing HSF from object produces longer response times of object recognition, as the CPU cycles consumption in filtering process outdo the removal time of HSF. [11] In this process firstly non filtered image undergoes Fourier Transformation followed by convolution with 2D Gausian envelop. Convoluted image data is applied with inverse Fourier Transformation followed by extraction of low-pass and high-pass filters which brings image object descriptors. Object descriptors like depth values, threshold intensity values or spatial frequencies undergo wavelet transformation to produce final bitmap of image objects.

A Jain (2015), saliency maps are the data structures used to hold object views in the form of graphs. However graph-lets are different data structures with key of node holding more information of object while it is traversed. Saliency maps on the other hand are light weight graphs with grayscale masks superimposed to images of corresponding object views. Dark or bright pixels indicate those regions which are anti-salient or salient respectively. [12] Object similarities can be measured by finding correlation between transparency values of each pixel in bubble masks in the bounding regions along with their responding actions. At first step measuring correlation in the form of binary vectors from object matrix is a tedious job. Its results may deviate from actual object views by a moment corresponding to deviation in the responding actions of objects. [13, 14] For clearer observation normalization process is carried out in which saliency values in each map are subtracted from their minimum range values and then dividing by their maximum value supermoms.

At the second step significant values of correlation coefficients calculated from first step are followed by permutation test. In this permutation test outcomes of various bubble trails are shuffled in such a way that binary vectors may not get distort their object views. [14, 17, 18] This is an intellectual task handled by and allied algorithms of retaining object views. Generally saliency map with significant correlation value of probability $p<=0.05$ for those regions whose object views are having intensities of red color range of RGB model. Whereas anti-salient regions are found in the intensity range of cyan color in CMY color model.

CHAPTER 3

PRESENT WORK

3.1 SCOPE OF STUDY

Image data retrieval problem has important applications; designing an algorithm with good performance becomes necessary and important. A lot of algorithms for recognizing image data problems have been proposed in the literature since the 2000's. The early work focused on the exact algorithms. Some of them achieved success on small images (less than 4000 pixels). For example, R. Gonzalez and R. Woods [1] improved the implicit enumeration algorithm by reducing the number of sub-problems generated from each node of the search tree, which in turn, reduced the size of the whole search path. But still, the running time of exact algorithms increases exponentially with the size of paths. So it is not practical to solve large problems by exact algorithms. The next step is to approximate the size of image data to be within a certain factor of the optimal solution. Therefore, it is necessary to solve the problem using heuristic algorithms. Heuristic algorithms cannot guarantee the quality of solutions but in practice they have been observed to produce very good solutions.

This area of research concentrates on extracting image data through image object extraction process which is a parallel search procedure inspired by the mechanisms of evolution in natural systems and the scenarios under which the solutions are applicable, the various qualitative parameters satisfied by the solutions and their associated costs in order to meet the current and future resource pool of a dynamic requirements in the most efficient way based on various qualitative and quantifiable parameters, so that virtualization or multi-tenancy can be easily deployed for providing various comparison search services.

3.2 OBJECTIVE

One of the main objectives of image retrieval systems is to find out hidden information in an image using data mining techniques. Content based image data retrieval is the branch of image processing for elucidating certain image patterns by accessing image from image data warehouse using sobel edge detection technique of image comparison and identification various qualitative and quantifiable parameters for the representing image data to make intelligent decisions regarding fitness evaluation of image data patterns in a given image.

1. To design a solution for finding Maximum number of data elements (Object Particles) of image based upon extensive distance comparisons.
2. To identify various pattern matching algorithms and their solutions for helping other image processing algorithms.
3. To compete with existing algorithms on ordinary machines with respect to their CPU-Times.
4. To elucidate image particles with their intensities which can be a motivation for Noise reduction models in image enhancement techniques.

3.3 METHODOLOGY

In order to build the efficient scan algorithm based solution to image data mining problem the following methodology is followed:-

1. **Identification**

   In this step the requirement analysis is done. This requires a task analysis to be done to determine the requirements, the inputs and outputs the prospective users.

2. **Conceptualization**

   In this the proposed program is designed to understand and define the specific relationships and interactions in the problem domain. The key concepts, the relationships, processes and control mechanisms are determined. This is the initial stage of knowledge acquisition.

3. **Formalization**

   This involves organizing the key concepts and information into formal representations i.e. rules for the representing and structuring data in memory. It involves deciding the attributes to be determined to solve the problem and to build the initial mutated result.

4. **Implementation**

   This involves mapping of the formalized population into a framework of the development tool (MATLAB) to build a working Matrix. The contents of matrix structures, inference rules and control strategies established in the previous stages are organized into suitable format.

3.4 FLOW CHART OF PROCESS

Firstly image is made input through standard image input construct imread(). Then its preprocessing is done by observing differently labeled regions of intensities. Normalization of regions is done through standard method i.e. selectstrongest(). This will return twenty strongest object particles out of hundred found object particles. Then detection of image object particles is done with Sobel and Minkowsky detection methods. Their result is handed over to Harris Feature Detection Map, that will return two dimensional intensity metric of image object particles.

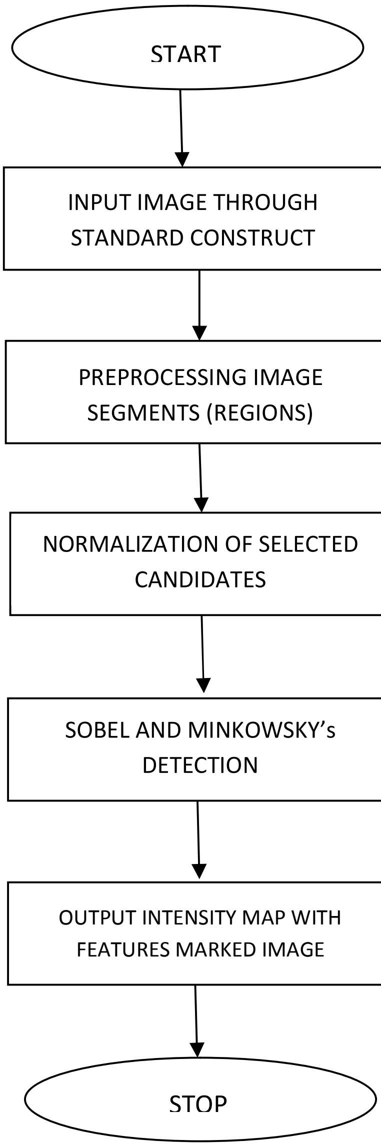


Figure 3.1 Flow chart of Image Retrieval Process

3.5 RESEARCH DESIGN

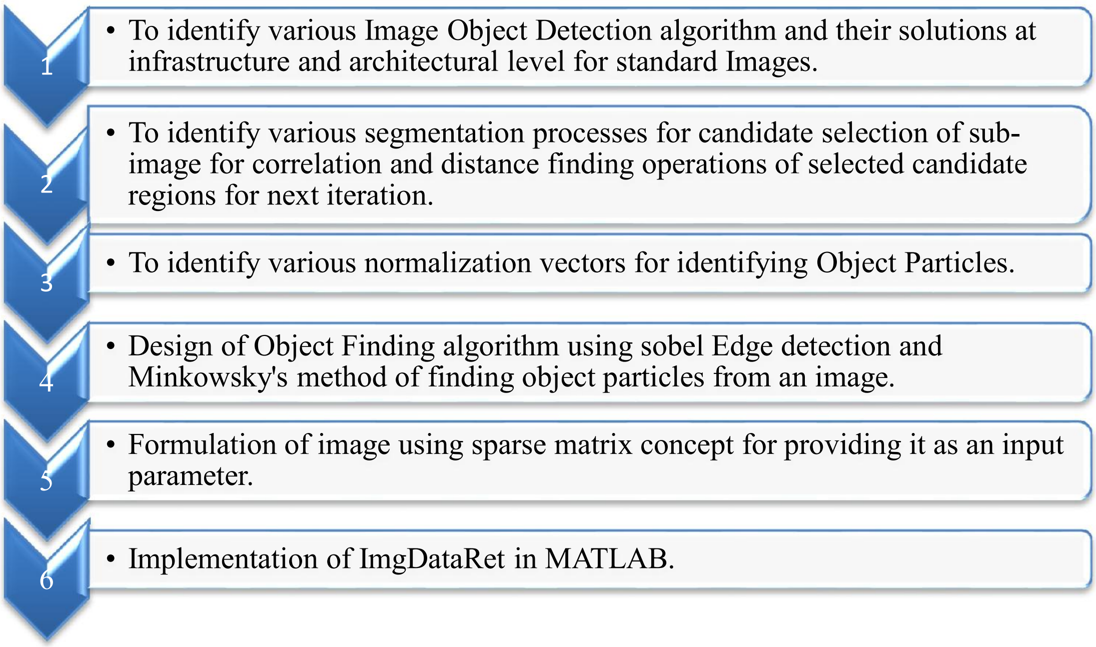


Figure 3.2 Research Design

3.6 VARIOUS ALGORITHMS DETAILS

3.6.1 CONTEXTUAL INFORMATION MULTI-VIEW ALGORITHM

Contextual information of an image is just a view of an object present in a scene; this information is represented in the form of view vector containing binary values of intensity regions of a particular context. Thereafter one by one image views are segmented until last view left, subject to the classification on the basis of locatives and intensity values of object particles. [45] Out of this classification an image map is made which describes a sequence of multiple views containing context information. Image object are recognized on the basis of their visibility analysis. In visibility analysis depth comparisons of two related object are made in the form of distance rafting method. [7, 8, 13, 18] Difference of distances tells that which region needs clipping and which fit automatically in the viewport. Classification map will be having coarse object particles if distance rafting is not in a finite window projection range. Otherwise the visibility analysis yields a multiple view of object representing context in it.

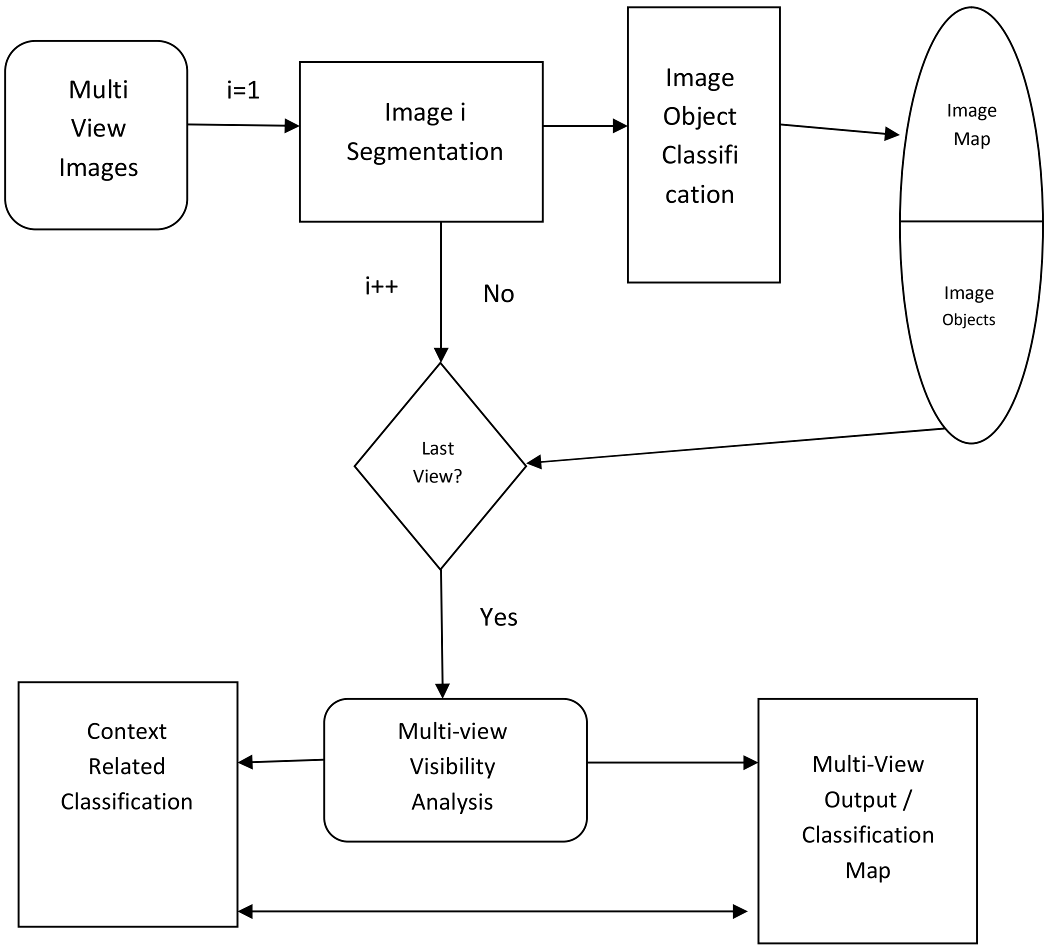


Figure 3.3 Context Aware Object Recognition Model

3.6.2 NEW COLOR MODEL IN IMAGE OBJECT RETRIEVAL

There are various color models describing color of pixels in images. Famous color models are RGB, HSB, HSV, CIE, XYZ, LAB, HSL, HIS, HCI, LRGBY etc. Every color model fixes range of colors from darkest and lightest values of colors. Illumination principle tells that bright color absorbs more light and reflects lesser while a light color absorbs lesser light and emits more. This principle of introducing new color model of image object retrieval is following basic principle of illumination as well as it helps system to improve color recognition rate, introducing resistance to noise, change in luminance for clearer observations and spatial deformations. [41, 48, 49] Color systems transfer their change to convert a representation of other color systems. For example transformation of image heuristics from RGB to HSV and conversion in reverse order. In HSV, Hue is represented in a circle of 360 degree while saturation runs in range (0.0 , 1.0). 0.0 means black or dark and 1.0 means white. In new color model there are five dimensions of brightness i.e. L*R*G*B*Y*. it is also known as expanded LAB model. Here different ranges of Lab are calculated by Mr. Scoof Maroco in January, 2014. i.e.

$$L^* = 116 \ f(X,Y) - 16$$

$$a^* = 500 \ [f(X / Xn) - f(Y / Yn)]$$

$$b^* = 500 [f(Y / Yn) - f(X / Xn)]$$

$$f(t) = t^{1/3} \qquad \text{if } (t > (6/29)^3$$

$$f(t) = 1/3 * (29/6)^2 * t + 4/29 \qquad \text{Otherwise}$$

Lab color model provides depth of colors by specifying certain ranges of basic colors as like other models. But here in this model a new thing is the description of color ranges in a mix of overlapped ranges. One color leaves where, other starts before its leaving from a bit overlapped range. This provides extra smoothness to the image objects. Image objects can be retrieved by transformations of color model with all of its pixels get transformed into color ranges described by other color model. [47, 48] In this way objects with their locatives and intensity values in a particular range represents transformed image with highlighted object particles. These highlighted particles can be made input to various object recognition methods for clearer observations. Allied algorithms for converting them back to their original color space are used in order to track changes in the image objects and image relationships may be preserved. Grounded object particles with new color space sometimes yields uneven results. [8] They may distort image scene by having coherence with vulnerable intensity ranges which can be easily find coherence and results in a noise wave into the image. Object particles may undergo flickering in different surrounding ranges in such a way that image object particles cannot adhere to their original intensity values.

$$t_0^{1/3} = a^*t_0 + b \qquad \text{(Matching by value)}$$

$$1/3 * t_0^{-2/3} = a \qquad \text{(Matching by slope)}$$

where,

$$a = 1/3 \ \Omega^{-2} = 7.54345667$$

$$t_0 = \Omega^3 = 0.003454334$$

3.6.2.1 XLAB TO EXPANDED LAB ALGORITHM

For i =1 to n

For j = 1 to m

If(a[i,j] <= 255)

R[i,j] = a[i,j]

G[i,j] = 0

Else

G[i,j] = a[i,j]

R[i,j] = 0

If(b[i,j] <= 255)

B[i,j] = b[i,j]

Y[i,j] = 0

Else

Y[i,j] = b[i,j]

B[i,j] = 0

End of i For loop

End of j For loop

3.6.3 IMAGE OBJECT RECOGNITION THROUGH PLENOPTIC CAMERA

Plenoptic camera is a handheld device which is used to shoot long range images. Its graphics capturing phenomenon is different from other cameras. [9, 14, 17, 18] It is inspired by projection through MAL where this array is sophisticatedly arranged in such a way that an image is processed by having capturing multiple object arenas. Target plane reconstruction is done by a lens with centre of axis T1(x,y). Here image has gone through rotated object lens which provides filtering action to the process. In this scenario whole image is transformed several times before it is displayed on the view port. [12, 13] Fourier transformation gives foreshortening effect to the image objects which is utilized in the next step by capturing it in its inverse form. Image gets rotated anti-clockwise in order to get its object particles to be clearer in representation in the target plane. Image fisher projections are responsible for taking care of image object identities in the image bitmap. However when its comparison is being made with other allied techniques of image capturing it is found that it needs more computation as the number of iterations needed to fetch image components are clumsy task than image restoration after its distortion in morphological image processing.

3.6.4 OBJECT MOMENT FINDING ALGORITHM

Image with dimensions M X N having moment represented by its classification in view plane of having object particles inclined towards moment of highly dense populated regions of image objects. Image moment Mi is the constituent operator giving differentiation to image object particles in the Gaussian favored dense intensity regions. According to morphological image processing a gateway of image dilation of its corner points identifies presence of an object in the image under sophisticatedly designed frame of reference about a locus point. Moment Mi will be introduced as:

$$M_i = \sum (x_i y_i * Px_i y_i)$$

Where $Px_i y_i$ denotes pixel count of MxN image about first two moments m_{10} and m_{01}

First two moments about bright intensity regions captured in the surroundings of an object are:

$$X_1 = m_{10} / m_{00}$$

$$X_2 = m_{01} / m_{00}$$

Centralized normal moment about locus point under consideration will be given by summation of p power differences of all moments from centralized moment and its product with pixel count in that region surrounding the object space about centralized moment. It is taken as:

$$\mu = \sum (x - x_i)^p * Px_i y_i$$

Object retrieved from image through these distance comparisons made once Euclidian Distance is calculated for observed image object particle under its tolerable attained threshold value of distance vector c_i.

$$c_i = a_i - b_i$$

$$d = \text{sq. root} (\sum c_i^2)$$

Scale balanced moment is observed by dividing normalized moment with invariant initial moment about image object particle locus under the effect of same transformation.

$$\eta_p = \mu_p / \mu_{00}$$

3.6.5 USING GENETIC ALGORITHM

Genetic Algorithm is an emerging field of programming in evolutionary techniques. It is bio inspired methodology in the field of Computer Science. In modern times programming languages with optimization of solution are of great importance because it is human way of processing information favors artificial intelligence at its best. In genetic algorithms initial solution is always assumed as a seed and known as generation of initial population. [32, 33] In image processing image retrieval information is stored in sparse matrix holding all weights for image object particles including image bitmap of scene and is corresponding action depicting image pixel resolution. In case of morphological image processing initialization process is carried out by initialization of input parameters like bias ($0 < bias < 0.2$), number of iterations ($1 < I < 40$), number of trail vectors needed to optimize ($10 < T < 20$). Fitness function is there for evaluating the solution that it is near to the one which is in interest of outcome or not. Fitness function is also known as a guiding function which holds the progress criterion under its control of iterations and number of trails. [6] Sometimes in GA it is observed that candidates of population start deviating from their expected path. Then fitness function reverses its action by fixing a range of moment in such a way that error propagation to next iterations can be waived off. Fitness function taken by [14, 15, 19, 23] to optimize image retrieval task is given as follows:

$$F = (1 - R(A)) / P.E * \log(M)$$

Where R(A) is the coefficient of correlation of two binary vectors making crossover operation. P.E is processing error, generally taken as binary vector distance (Hamming Distance) between two binary vectors. log(M) gives tree depth equivalent processing effort to the mutation process of finite region surrounding object space in the input image. Crossover operation here is two point crossover including edge distance minimization as a goal to be set while P.E is passed to fitness function for evaluation of fitness gained by new population with respect to the previous population in that range of object surrounding binary vectors. These ranges are taken to be exact in the form of Euclidean distance range vectors taken in [14, 15] by taking care of parallel brisk image mode qualification in terms of new obligations introduced in scene by morphological image noise processing. Image may get distorted by its object particle intensity ranges in the form of dark and bright color Hue and domain saturation.

3.6.5.1 GENETIC ALGORITHM FOR IMAGE RETRIEVAL

Step1. Input Image (Binary matrix (Sparse) of bitmap)

Step2. Apply BCN filter to the input image

Step3. Extract largest bounding region surrounding object space

Step4. Find edges using Harris Edge Detection Technique

Step5. Find Centralized Moment

Step6. Find COG (Center of Gravity) of image

Step7. Normalize (m_{01} / m_{00} and m_{10} / m_{00})

Step8. Find invariant moment factor μ_{00}

Step9. Apply G.A. (Selection of initial Binary Vectors)

Step10. Check Fitness ($F = (1 - R(A)) / P.E * \log(M)$)

Step11. Apply Crossover (Two Point Inverse crossover)

Step12. Repeat **Step10**. and **Step11**. Until (P.E > = 0.00001)

Step13. An object with least Euclidean Distance is retrieved.

Here at step 12 Euclidean distances of binary vectors taken from previous population are considered and their processing error is observed if it is lying in an observed range. Otherwise the object may be discarded. Retrieved object undergoes inverse Fourier transformation and is accepted while in comparison with below dark intensity ranges.

Here scope of least processing errors is completely dependent on image under consideration. Its viable processing effort always is objectionable for the wrong choice of initial population. [12, 14] BCN filter applied after selection of also cutting sharp peaks of pixel intensities in the object particles.

3.6.6 IMAGE OBJECT RETRIEVAL USING INCREMENTAL LEARNING

Object retrieval in morphological image processing is a debated heat in modern times. Defining parameters for extraction of image object particles is a big deal. Learning new models for recognizing image particles from pix-map with raw image intensities is a traditional approach of image findings. [13, 17, 22] Mr. Hecoff Domis found a new parameter for image object particles representation. Under that work this newly generated parameter is named confidence level. This is not alone enough to represent image particles. Accuracy is allied parameter with minimum support of confidence level favors image findings.

c.f. Level (%age)	Accuracy Attained (0-1)
70	0.95
80	0.96
90	0.97
95	0.98
99	0.99

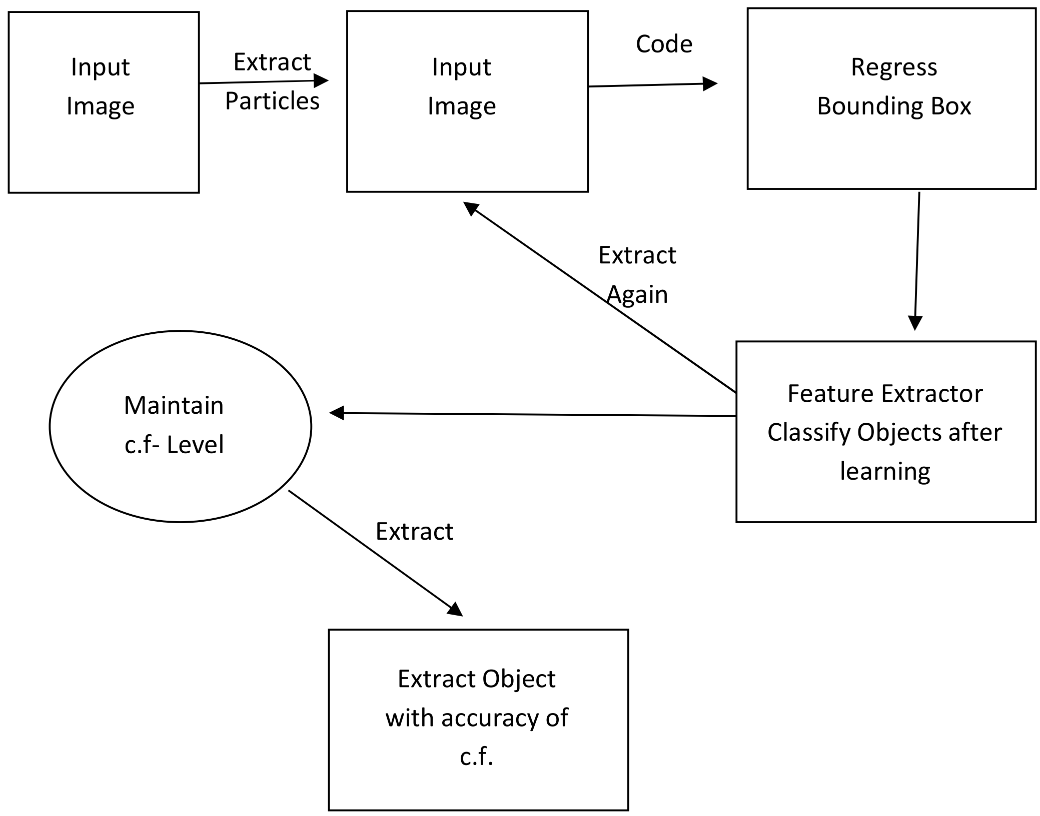


Figure 3.4 Incremental Model for Recognizing Image Particles

3.6.7 USING CONVOLUTION NEURAL NETWORKS ALGORITHM

In Convolution neural networks approach image objects are neurons inspired by visual gap of scene in the fisher cap of coding digital information. Independently finding regions of object particles with frequencies of given range is extracting 120 X 120 pixel surrounds the object particle. Based on inversion of frequent bright regions in object particles, their structuring and erosion is done through binary operation on object bounding regions. [23, 25, 29] Carlton algorithm alone is sufficient in region edge finding of object particle instead of elucidating whole image object range under window frames. Its centre of projection will be the interest point located by binary vector corresponding to distance between two associated regions. However results of "On the shelf cart" in an image clutter may vary due to background disturbance and flickering effect of vulnerable pixels in the region. The probability of finding object interference with neighboring object is given by Carlton's probabilistic function.

$$P(t) = 1 - \sum (a_{xi} - b_{xi})^{\alpha-1} \qquad \text{where } (1 <= i <= n)$$

Where i represents region under consideration. a_{xi} and b_{xi} are two reference particles of interference in two neighboring regions. α-1 is degrees of freedom of associated region with binary vector frequency map.

This probability function is the guiding function in region based approach. For a particular object particle probability of finding its interference with surrounding region is always lies between the ranges (0.02 to 0.5). That means mapping regions of object particles will always be considered in a particular range of associated intensities. This finding of Carlton favors many image morphological processing systems today. Based on heuristic object finding algorithms, finding correlation between image objects and their periphery or background is independent today with a gear towards positive side of image retrieval. Basis function for image binary vectors to be processed by convolution approach is:

$$C(i) = A(i) + \beta(1-\mu_{B(i)}) \ / \ (\alpha-1)$$

Where club of binary vector A(i) with associated vector B(i) is C(i) vector with same degrees of freedom (α-1).

3.6.8 SEQUENCE BASED OBJECT DETECTION

Morphological image processing includes many applications of fetching objects from a complex image of food items or any household items. Objects can be tracked by measuring their trajectories and then their consolidation by bazier curves and B-splines. Image object tracking is a tough job that may not yield good results. [22] Mr. Lebies Bastian achieves real object tracking by applying an approach in which sequencing of objects is done firstly before tracking their trajectories.

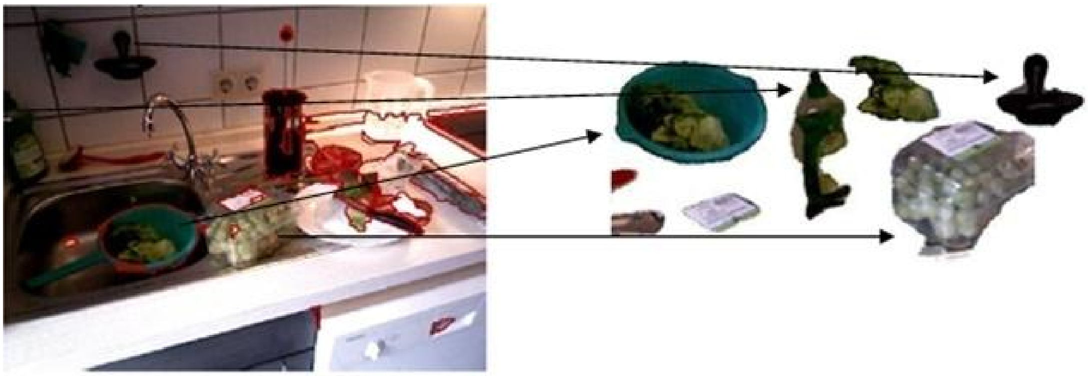


Figure 3.5 Sequence Based Detection Results Taken by Mr. Labis Bastian

3.6.8.1 SEQUENCE BASED OBJECT DETECTION MODEL

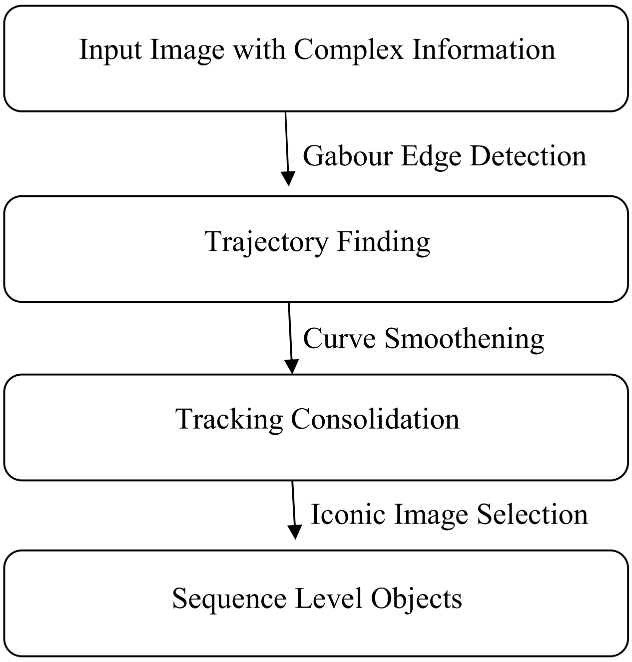


Figure 3.6 Sequence Based Object Detection Model

3.6.9 FINDING OBJECT CLASSES THROUGH ACTIVITY DEPICTION

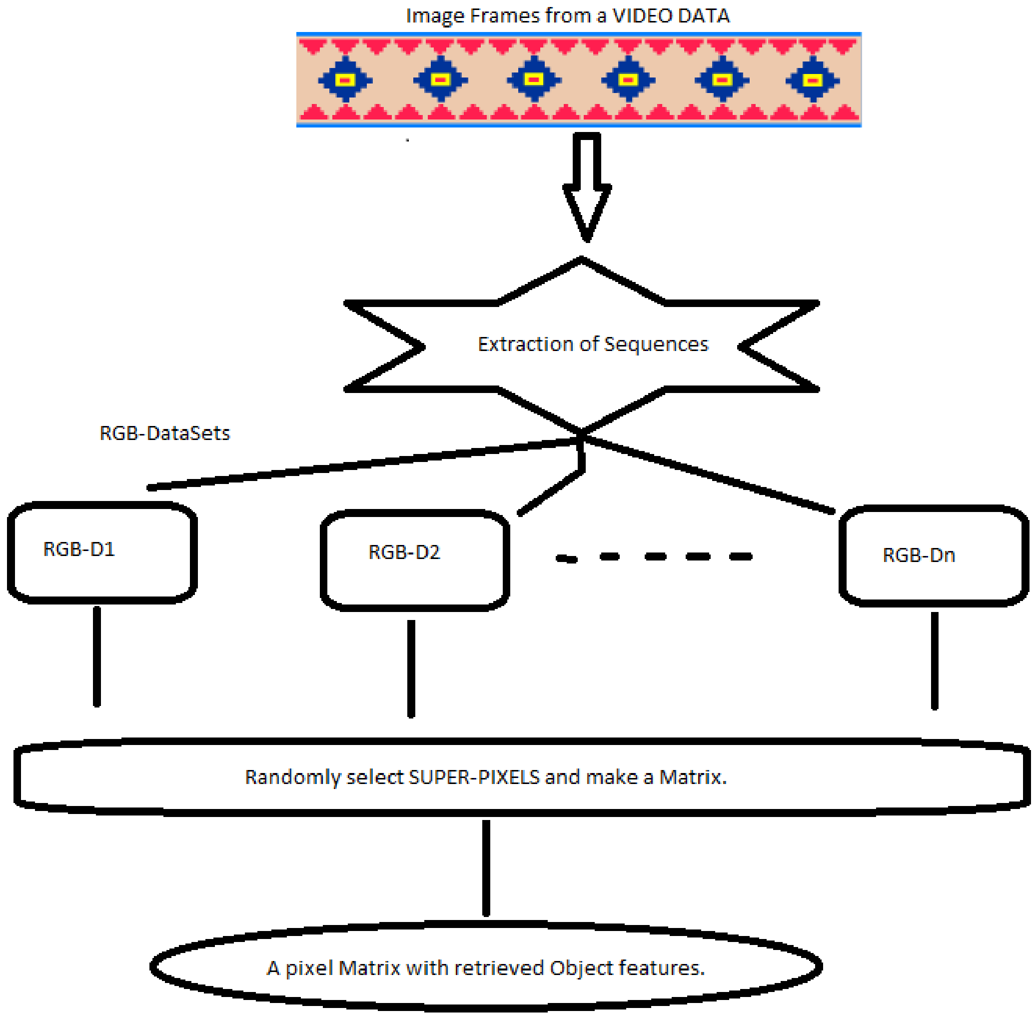


Figure 3.7 Proposed Model of Image Feature Detection by Mr. Gall

3.6.9.1 IMAGE OBJECT RECOGNITION USING REGRESSION FOREST ALGORITHM

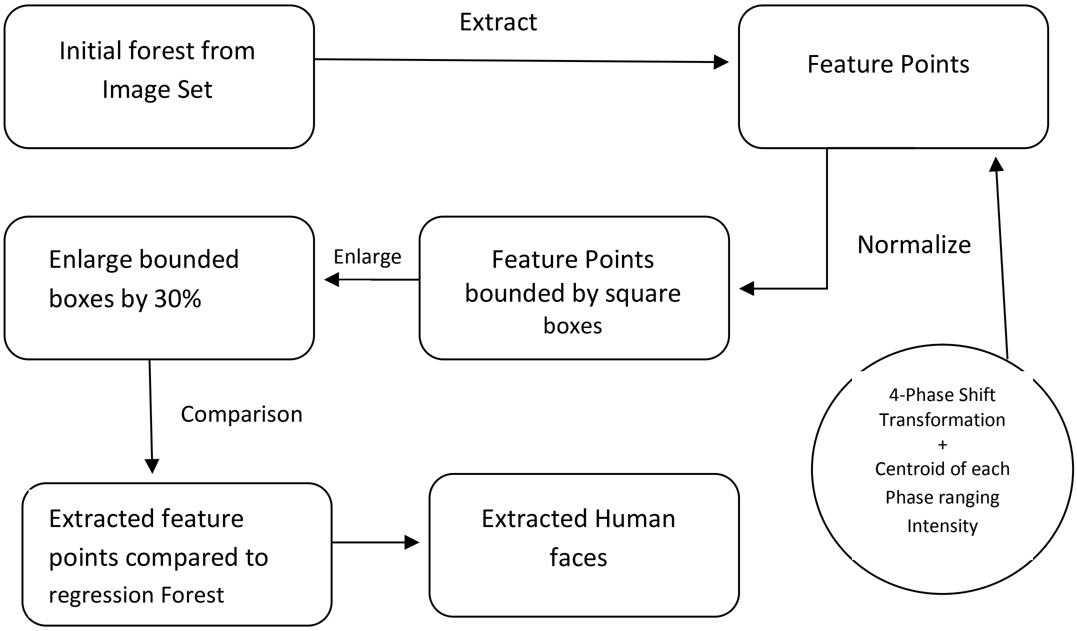


Figure 3.8 Image Object Retrieval Using Regression Forest

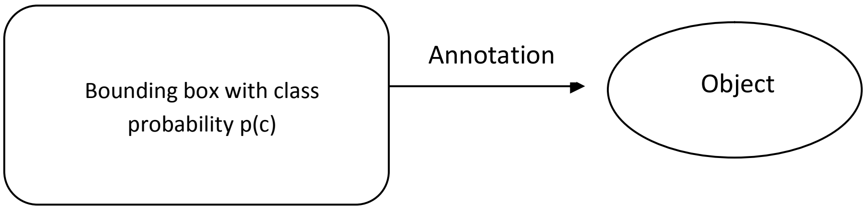


Figure 3.9 Object Annotator

3.6.10 DATA DRIVEN SCENE CAPTURING ALGORITHM

It combines video frame data with a sparse matrix of high intensity regions of an image to find out scene objects and retrieve their boundary values (Hard and Soft Intensity Ranges).

This scene object is acting as a sample particle for deriving valid twist angles pose of scene. Further application of MFD (Mises Fisher Distribution) introduces a noise model to observe uncertainty regions like background clutter, illumination shades and shadow disruptions. In this approach image data is firstly captured in the form of stable sparse matrix with normalized coordinates system. [12, 14, 17] Modeling coordinates differs from world coordinates of scene by unit transformed vector towards the positive (opposite) side of projection vanishing point. This is the point where image cues of various scenes are taken by comparing them with orientation cues. These orientation cues are further helpful in making sampled particles in a scene depicting various poses at different twist angles of scenes. Averaging sampled particles belonging to different scenes with their respective weights provides weighted particles. Weighted particles further undergo optimization process to depict final pose of object.

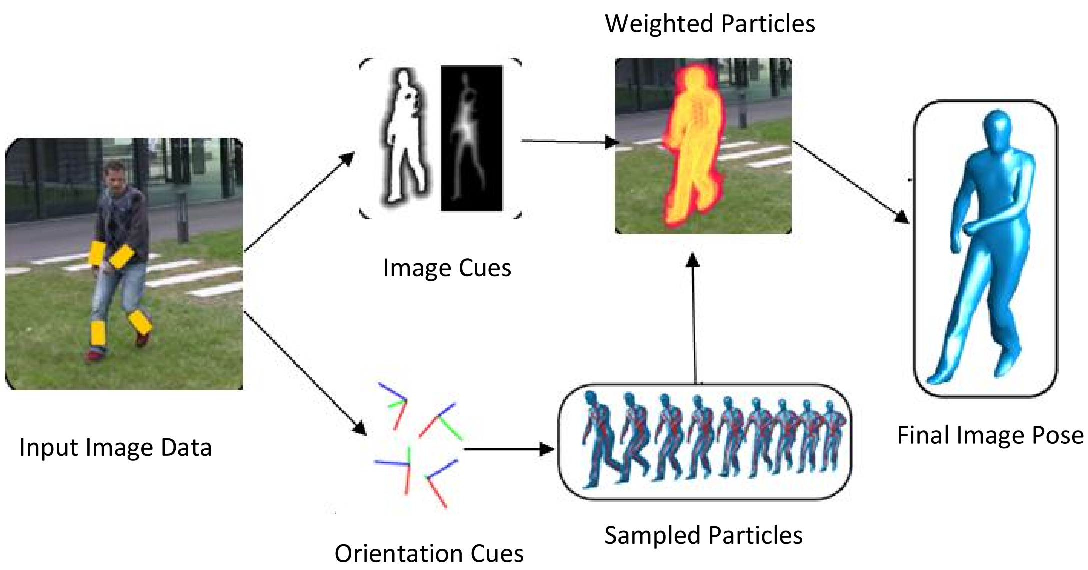


Figure 3.10 Data Driven Scene Capturing Model

3.6.11 OPTIMIZATION ALGORITHM

Data driven approach is already equipped with comparison of sampled particle with world coordinates of object in actual scene. [16, 17] This comparison can be done after a modeling of sensor results through General Transformations (GT) (Composite or individual of reflection, scaling, rotation, phase shift or shear etc.). Let p(x,y) denotes probability of finding a sampled particle in world coordinates, $(x,y)_{IM}$ is image observation location, $(x,y)_{SENS}$ is sampled particle of pose as suggested by sensor.

According to Probability Theory of Computer Science (PTCS): Probability of observing image object from a scene will be:

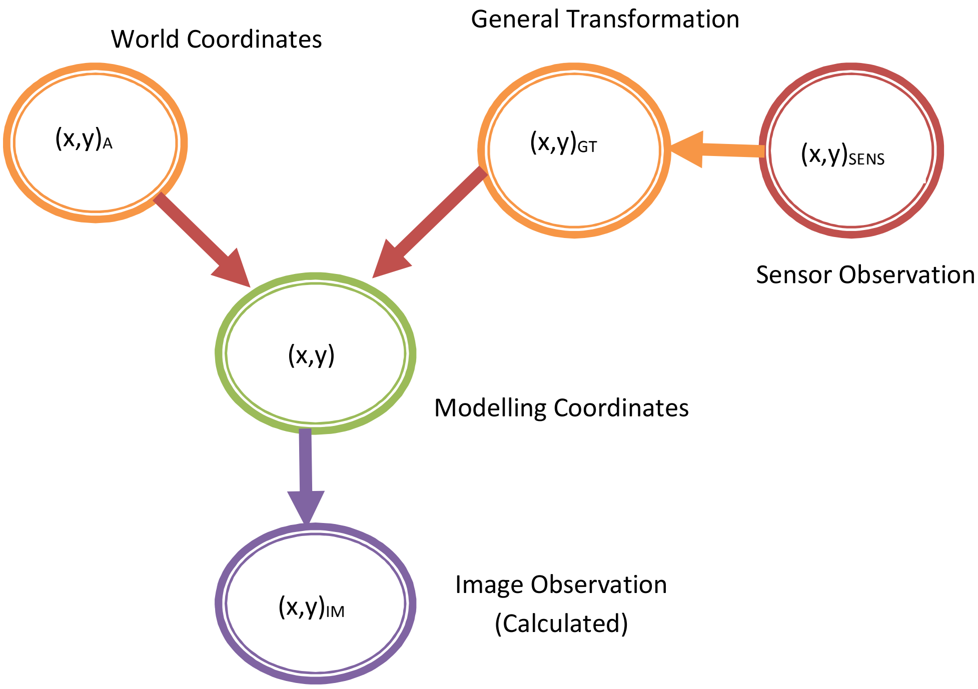


Figure 3.11 Optimization in Data Driven Model

3.6.12 ACTION ESTIMATION AND POSE RECOGNITION TECHNIQUE

Sequence of frames in a video data represents some action performed by objects present in an image. Each frame corresponds to a pose of some object. Vision Human Motion Analysis (VMHA) is a field of image processing that deals with pose recognition from video data. Temporal coherence of image objects is done through reconstruction of image frame data sets over time. A priory algorithm estimates action of object by retrieving its pose at different twist angles. It is observed that in a scene multiple activities make a sequence of frames depicting some action to be recognized. Since estimated action is always lags a bit from actual action of object. [17, 18, 19] Various techniques for action estimation are in debate. One of them is adopted by Mr. Macullam Mihill Narode : On the basis of appearance (Low Level Intensity Map extraction) of objects, a sparse matrix is maintained which is holding all location bounds (Hard Intensity Regions) of objects. This sparse matrix is labeled with a tag representing an action from class of actions. This action classification task is complex one and is NP-hard. Then row major or column major representation of sparse matrix gives sequencing corresponds to a particular action. This helps in finding out various poses out of sequence of poses of action. Then final pose is described by unit conversion of results through map of object classifiers. Here is the process of pose recognition from action estimation.

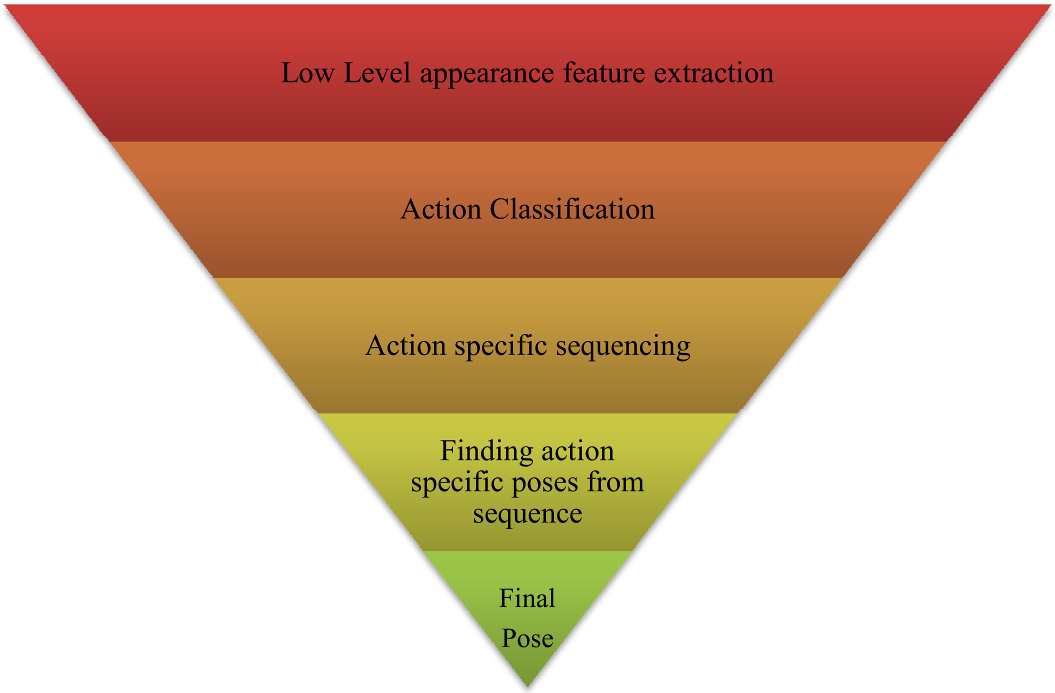


Figure 3.12 Pose Recognition Process Stages

3.6.13 COORDINATE PROCESSING ON SPATIAL FREQUENCIES

Spatial relationship between two particles of an object from image is observed by making depth comparison between them (which object is lying above or below of some other object). Transformed coordinates of an object undergoes high pass and low cut filtering process. Results after removing HSF from object produces longer response times of object recognition, as the CPU cycles consumption in filtering process outdo the removal time of HSF. [11] In this process firstly non filtered image undergoes Fourier Transformation followed by convolution with 2D Gausian envelop. Convoluted image data is applied with inverse Fourier Transformation followed by extraction of low-pass and high-pass filters which brings image object descriptors. Object descriptors like depth values, threshold intensity values or spatial frequencies undergo wavelet transformation to produce final bitmap of image objects.

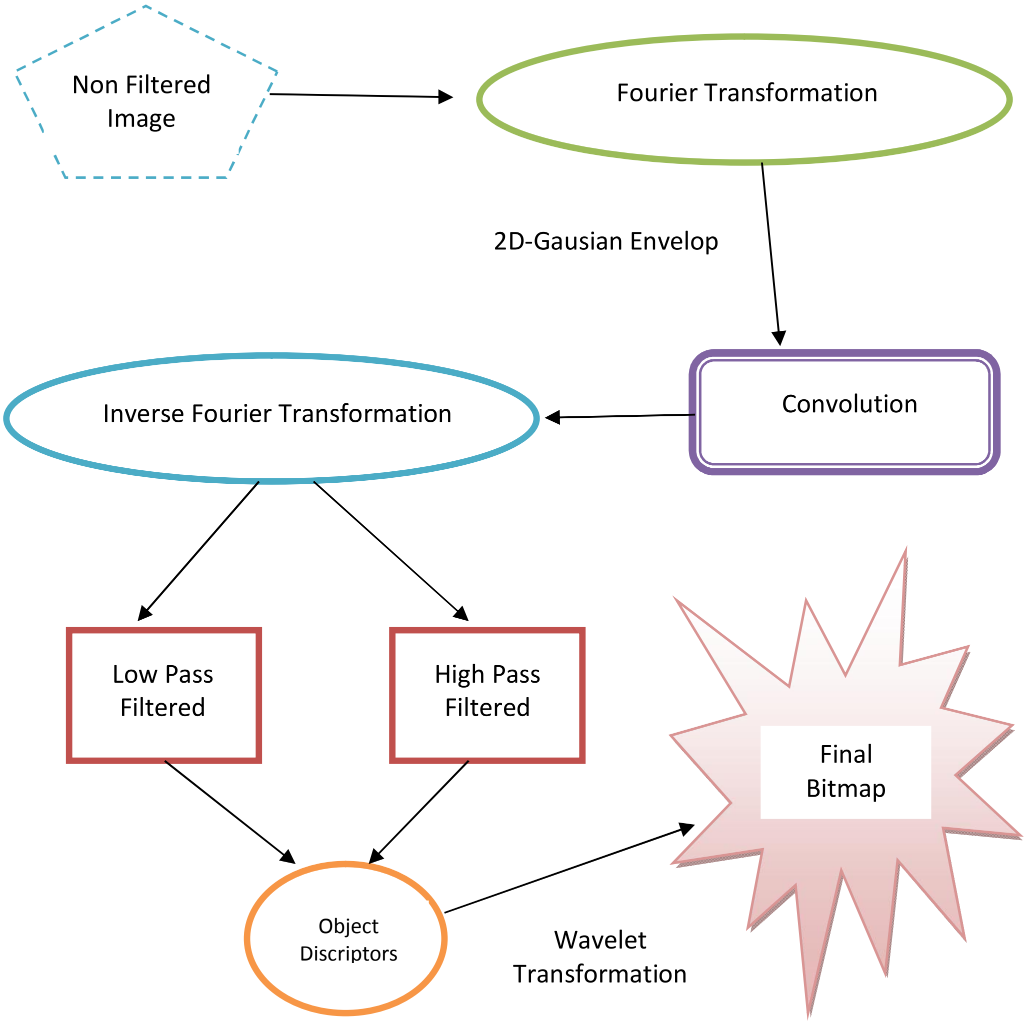


Figure 3.13 Coordinate Processing Model

3.6.14 OBJECT SIMILARITY USING SALIENCY MAP

Saliency maps are the data structures used to hold object views in the form of graphs. However graph-lets are different data structures with key of node holding more information of object while it is traversed. Saliency maps on the other hand are light weight graphs with grayscale masks superimposed to images of corresponding object views. Dark or bright pixels indicate those regions which are anti-salient or salient respectively. [12] Object similarities can be measured by finding correlation between transparency values of each pixel in bubble masks in the bounding regions along with their responding actions. At first step measuring correlation in the form of binary vectors from object matrix is a tedious job. Its results may deviate from actual object views by a moment corresponding to deviation in the responding actions of objects. [13, 14] For clearer observation normalization process is carried out in which saliency values in each map are subtracted from their minimum range values and then dividing by their maximum value supermoms.

At the second step significant values of correlation coefficients calculated from first step are followed by permutation test. In this permutation test outcomes of various bubble trails are shuffled in such a way that binary vectors may not get distort their object views. [14, 17, 18] This is an intellectual task handled by and allied algorithms of retaining object views. Generally saliency map with significant correlation value of probability $p<=0.05$ for those regions whose object views are having intensities of red color range of RGB model. Whereas anti-salient regions are found in the intensity range of cyan color in CMY color model.

3.7 TOOLS USED

Here in this work, Computer Vision toolbox of Matlab 2013 is used. It includes various features of processing images through standard techniques. These techniques are recently developed by Matlab developers.

Computer Vision System Toolbox provides algorithms and tools for the design and simulation of computer vision and video processing systems. The toolbox includes algorithms for feature extraction, motion detection, object detection, object tracking, stereo vision, video processing, and video analysis. Tools include video file I/O, video display, drawing graphics, and compositing. Capabilities are provided as MATLAB functions, MATLAB System objects, and Simulink blocks. For rapid prototyping and embedded system design, the system toolbox supports fixed-point arithmetic and C-code generation.

Its Key Features includes; Feature detection, including FAST, Harris, Shi & Tomasi, SURF, and MSER detectors Feature extraction and putative feature matching, Object detection and tracking, including Viola-Jones detection and CAM Shift tracking, Motion estimation, including block matching, optical flow, and template matching, RANSAC-based estimation of geometric transformations or fundamental matrices, Video processing, video file I/O, video display, graphic overlays, and compositing, Block library for use in Simulink

CHAPTER 4

RESULTS AND DISCUSSIONS

4.1 READ TIME AND RUN TIME OF STANDARD IMAGES

Standard images of University of Ottawa benchmark are tested on various levels of machines. Their variable object particles depend upon complexity of the image. For example brock800 is a heavily loaded image with image object particles of number 100. Since the number of edges are independent on number of object particles but their coherence depends on activities or complexity in an image.

Table 4.1 Read and Run Times of Standard images

Image Name	No. of Particles	Edges	Read_Time (ms)	Run_Time (ms)
brock200	50	80	0.05	26.56
brock400	100	50	0.18	629.72
brock800	100	200	0.72	411.89
c-fat200	100	50	0.05	20.35
c-fat500	100	100	0.25	408.46
hamming6	30	16	0.08	5.36
hamming8	50	50	0.07	29.02
johnson8	30	50	0.02	5.89
johnson16	30	50	0.05	9.87
johnson32	50	50	0.28	116.85
keller6	50	400	17.65	11366.83
MANN_a27	30	75	0.2	667.85
MANN_a45	30	250	1.53	20452.38
p_hat300	75	75	0.1	33.59
p_hat500	100	100	0.3	690.07
p_hat700	50	150	0.63	758.36
p_hat1000	100	200	1.1	434.81
san200	30	50	0.05	57
san400	100	100	0.17	130.29

4.2 RESULTS OF EXISTING ALGORITHMS

Resolution of image objects of mined image data is captured in killo-pixels. Heavily loaded image of a scene has more resolution than others. Various algorithms are tested on standard images and they are proved to be the best one with respect to maximum intensity pixels and their presence in an object particle. Convolution based algorithm is standard technique among all emerged techniques.

Table 4.2 Avg. CPU Elapsed times of Standard Images

Image	Resolution (kp)	Max Intensity	Convolution Based Method	Multi-View Technique	Using Neural Networks	Avg. CPU Times
c-fat200-1	200	1534	12	12	12	0.02
c-fat500-1	500	4459	14	14	14	0.12
Johnson16-2-4	120	5460	8	8	8	0.04
Johnson32-2-4	496	107880	16	16	16	0.32
Keller-4	171	9435	11	11	11	0.05
Keller-5	776	225990	27	27	26.1	2.32
Keller-6	3361	4619898	59	54	53.2	103.4
Hamming10-2	1024	518656	512	512	512	67.69
Hamming8-2	256	31616	128	128	128	3.54
San200-0.7-1	200	13930	30	30	22.0	0.1
San400-0.5-1	400	39900	13	13	8.6	0.2
San400-0.9-1	400	71820	100	100	98.6	0.96
Sanr200-0.7	200	13868	18	18	16.7	0.08
Sanr400-0.5	400	39900	13	13	12.4	0.22
San1000	1000	250500	15	10	9.3	1.02
Brock200-1	200	14834	21	21	18.2	0.1
Brock400-1	400	59723	27	25	22.7	0.24
Brock800-1	800	207505	23	21	20.3	1.68
p-hat300-1	300	10933	8	8	8.0	0.12
p-hat500-1	500	31569	9	9	8.8	0.34
p-hat700-1	700	60999	11	11	9.5	0.54
p-hat1000-1	1000	122253	10	10	9.6	1.00
p-hat1500-1	1500	284923	12	12	10.2	2.78
MANN-a27	378	70551	126	126	123.4	0.70
MANN-a45	1035	533115	345	339	336.2	5.48

4.3 COMPARISON OF IMGDATARET-TECHNIQUE RESULTS WITH OTHER ALGORITHMS

Convo-based algorithm is standard technique for finding image object particles from a complex scene image. However multi-view technique produces equivalent results. In case of multi-view technique results may be better because of presence of different views at different twist angles in the frame of reference. Our algorithm ImgDataRet has performed equally well on these standard images.

Table 4.3 Comparison of Number of Object Particles

Algorithm / Image	Convo-Based	Multi-Views	Neural Based	Hybrid Projection	ImgDataRet
c-fat200-1	12	12	12	12	12
c-fat500-1	14	14	14	14	14
Johnson16-2-4	8	8	8	8	8
Johnson32-2-4	16	16	16	16	16
Keller-4	11	11	11	11	11
Keller-5	27	26.4	27	26.3	27
Keller-6	54	51.88	53	51.4	59
Hamming10-2	512	512	512	512	512
Hamming8-2	128	128	128	128	128
San200-0.7-1	30	29.6	30	30	30
San400-0.5-1	13	8.6	7	9.8	13
San400-0.9-1	100	100	50	100	100
Sanr200-0.7	18	18	17	17.4	18
Sanr400-0.5	13	12.9	12	11.9	13
San1000	10	9.3	8	10.5	15
Brock200-1	21	20.3	20	18.2	21
Brock400-1	25	24.2	20	23.6	27
Brock800-1	21	20.3	18	19.2	23
p-hat300-1	8	8	8	8	8
p-hat500-1	9	9	9	9	9
p-hat700-1	11	10.4	11	10.3	11
p-hat1000-1	10	9.6	10	9.9	10
p-hat1500-1	12	11.1	11	10.4	12
MANN-a27	126	123.5	125	125	126
MANN-a45	339	336.2	337	342	345

4.4 COMPARISON GRAPH OF IMGDATARET RESULTS WITH OTHER ALGORITHMS

All algorithms (Convolution Based, Neural Based, Multi-View and Hybrid Projection) show almost same results of maximum number of image object particles excepting Hybrid Projection which is an optimization of Projection based Object Detection. Horizontal axis shows standard images and vertical axis shows Maximum Number of Image Object Particles.

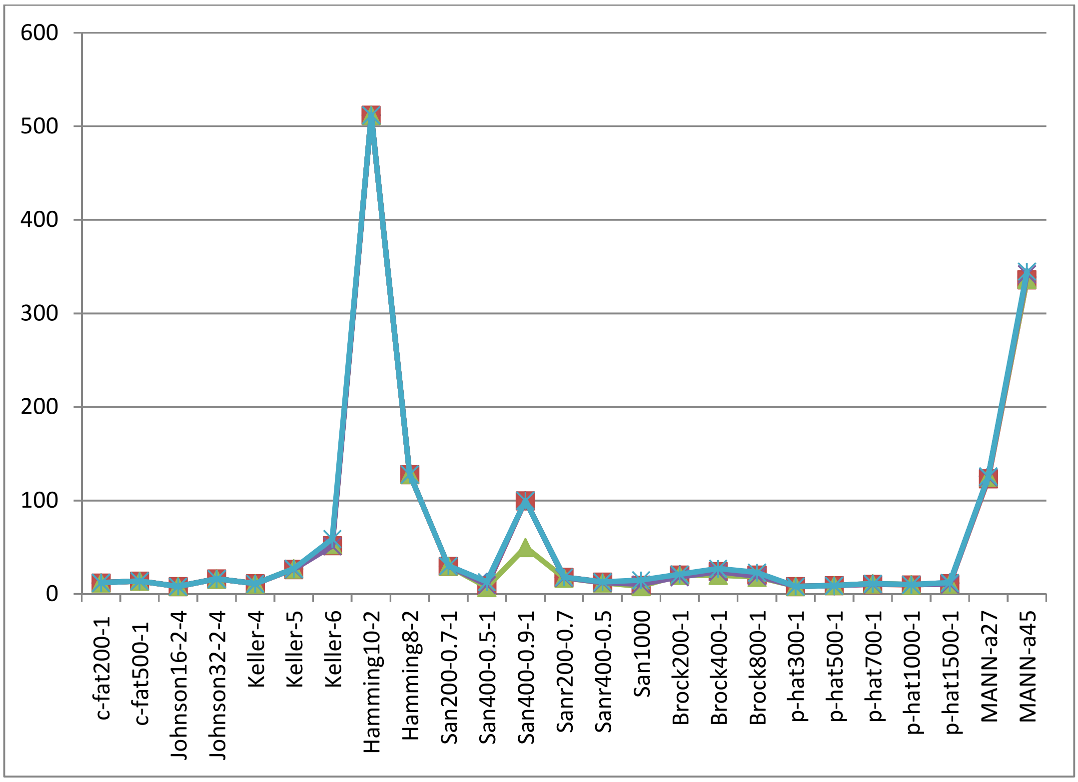


Figure 4.1 Comparison of ImgDataRet number of Object Particles.

4.4 COMPARISON OF IMGDATARET CPU-TIMES WITH OTHER ALGORITHMS

CPU-time is more or less equally good parameter for measuring performance of some technique. It basically depends upon frequency of cpu cycles. On multiprocessor computer systems like Illiac-IV systems with sixteen embedded processors. Any algorithm can perform up to its upper memory bound conditions. However on ordinary machines these algorithms have been tested and our ImgDataRet has proved a best deal in finding image object particles in their number.

Table 4.4 Comparison of ImgDataRet CPU-Times With Other Algorithms

Algorithm / Image	Convo-based	Neural Based	Hybrid Projection	Multi View	ImgDataRet
brock200	9.72	9.13	9.62	8.99	16.5315
brock400	17.63	17.63	17.63	17.63	119.1723
brock800	25.34	25.34	25.34	25.34	96.4398
c-fat200	11.22	11.22	11.22	11.22	120.8724
c-fat500	19.55	19.55	19.55	19.55	108.4654
hamming6	6.78	6.16	8.78	6.78	65.1356
hamming8	10.13	10.93	11.13	10.13	29.0122
johnson8	14.15	14.15	14.15	14.15	152.89
johnson16	21.33	21.33	21.33	21.33	99.1874
johnson32	26.87	27.87	27.87	27.87	96.1985
keller6	14.15	14.95	14.35	14.95	166.1083
MANN_a27	56.23	56.23	56.23	56.23	67.8512
MANN_a45	66.76	66.76	66.76	66.76	52.1038
p_hat300	41.38	43.38	43.48	43.38	133.2509
p_hat500	72.15	76.15	76.15	76.15	90.1037
p_hat700	81.37	88.29	88.29	88.29	148.0316
p_hat1000	132.31	122.13	122.30	122.39	154.1081
san200	29.14	31.70	31.70	31.70	143.4521
san400	51.16	55.69	55.69	55.69	131.9219

4.6 OUTCOME

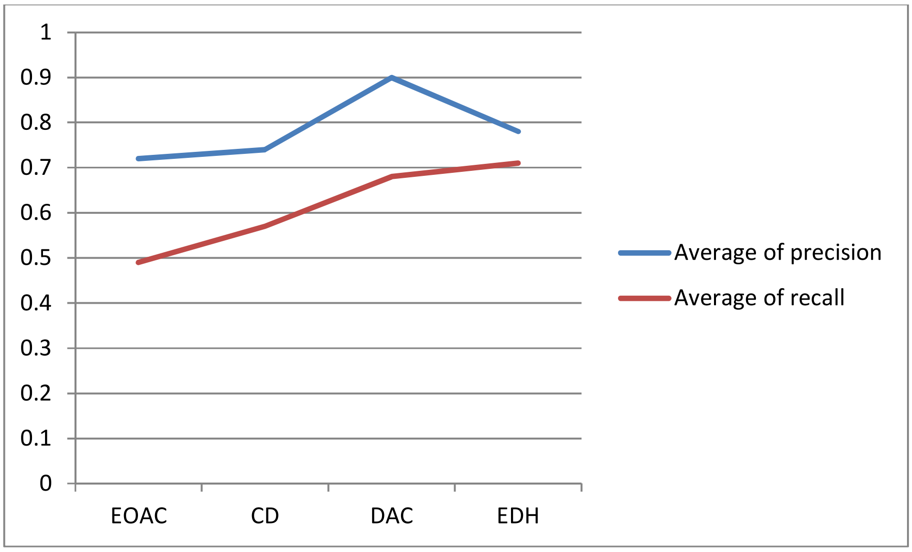
Color and texture of image data patterns are observed through sobel-edge detection mechanism. Semantics of similarity between observed image patterns is the matter of distance between images to measure their similarity. This distance is given by Minkowsky and known as Minkowsky-distance. It is expected that this distance will provide us similarity measure between images. Sobel-edge detection mechanism will help greatly to correlate two images with their appropriate distance.

$$L_P(X,Y) = [\ \sum |x_i - y_i|^P\ ]^{\frac{1}{P}}$$

Here results of various image retrieval methods are given along with their Minkowsky-distances. EOAC (Edge Oriented Auto Correlation), CD (Coherence Distance), DAC (Distance Auto Correlation) and EDH (Edge Detection Histogram).

	EOAC	CD	DAC	EDH
Average of precision	0.72	0.74	0.9	0.78
Average of recall	0.49	0.57	0.68	0.71

4.7 Performance comparison of different Image Retrieval Methods.



4.8 GENERATION OF CORNER MATRIX IN MATLAB

The implementation of the ImgDataRet algorithm using Computer Vision Toolbox in MATLAB.

The implementation was done in 4 phases:-

1. Definition of Inputs and Outputs

2. Creating the Spatial-Region using view Computer Vision tool

3. Defining type and size of input image

4. Simulation of result by finding different object particles from each image.

The following are some snapshots of the inputs, inference engine and output on the editor:-

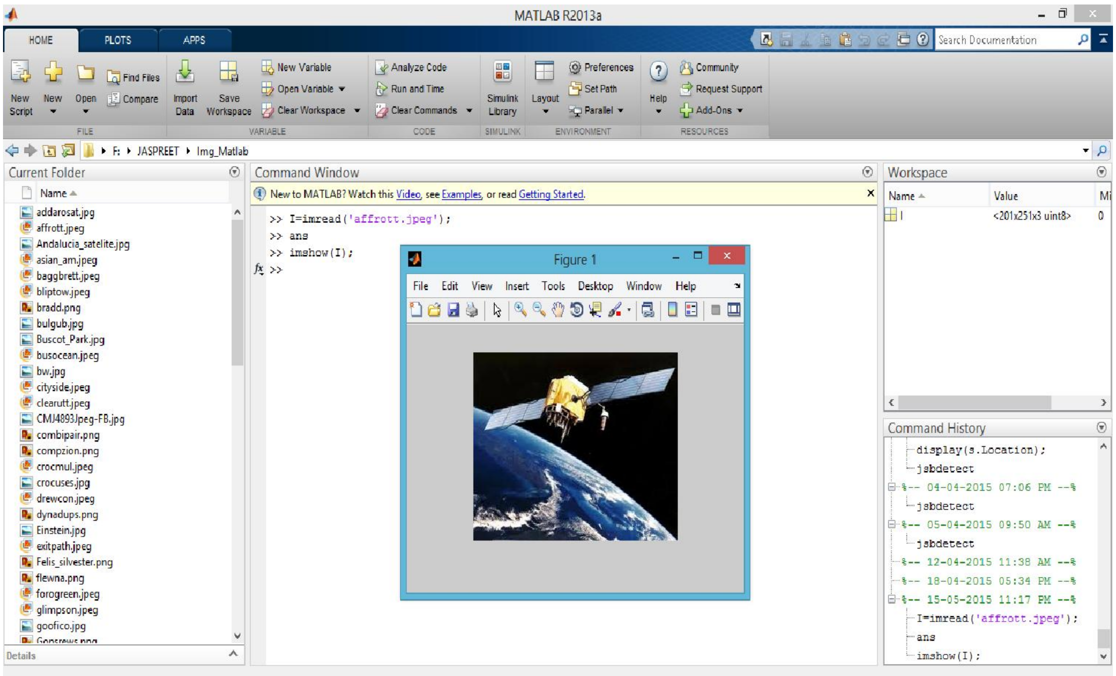


Figure 4.2 Variable I for Input Image

4.9 DESIGNING INTERFACE FOR OBJECT PARTICLES RETRIEVAL (IMGDATARET)

Interface for simulating ImgDataRet method contains one input parameter that is an Image. One input vector is jpeg image or any other dot extension. Another three are output parameters represented with different push buttons in this interface. One output parameter gives CPU elapsed time for finding Maximum Object Particles using ImgDataRet algorithm. Second output parameter gives status of each particle that each particle is a part of some bounding region. While third output parameter gives extracted features found in the input Image in the form of two dimensional Matrix containing two vectors corresponding to object particles.

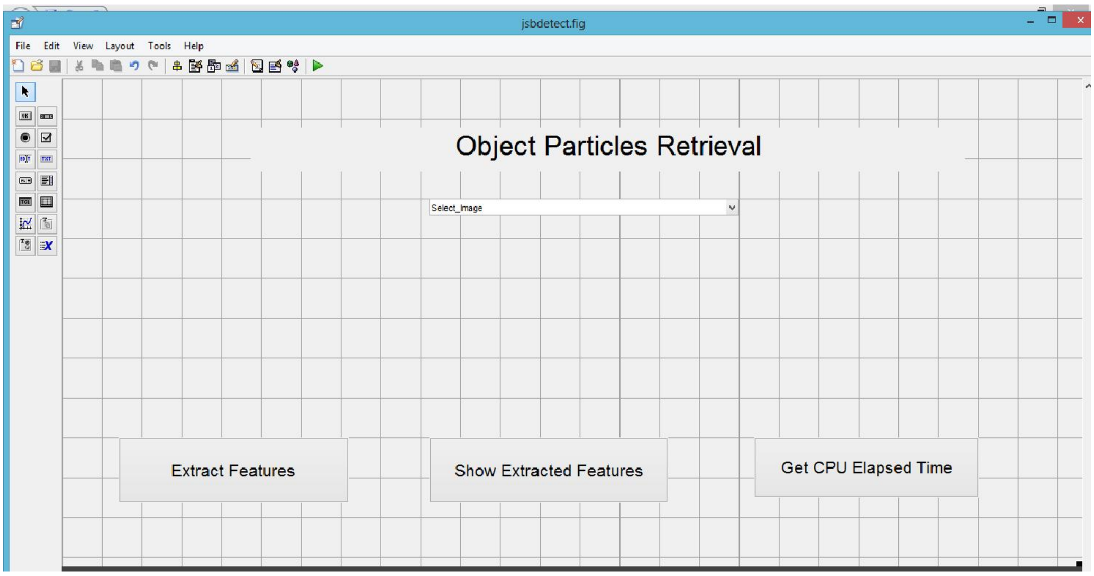


Figure 4.3 Fig File of Interface Design

4.10 IMPLEMENTATION OF IMGDATARET ALGORITHM

One input vector gives connectivity of regions of Image to Object Particles. Any Randomly selected image will make connectivity of domain with the observed input point. Here in this interface user need to load an image from domain of pre-loaded images. One of them got read while selection from drop down list appeared in the interface.

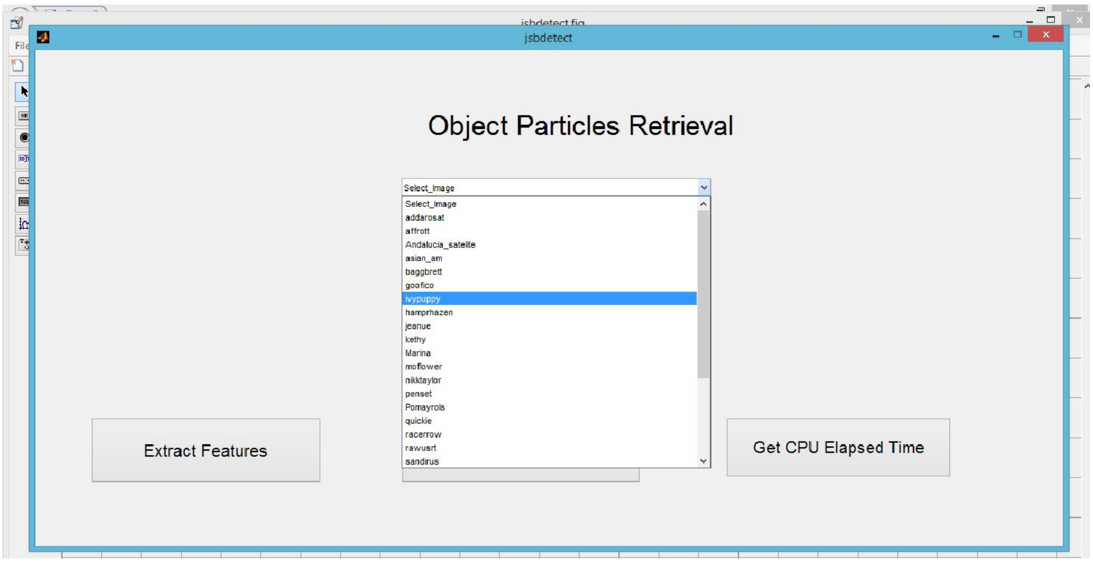


Figure 4.4 Interface of ImgDataRet Approach

4.11 BEFORE OBJECT PARTICLES EXTRACTION

Loading of an image is done through imread() method in Matlab, source location of image must be determined in order to load it to the Computer Vision database. Image formats like tif, jpeg, bmp.. Etc. are accepted. In the interface of this implementation 50 standard images are loaded, they appeared in drop down list.

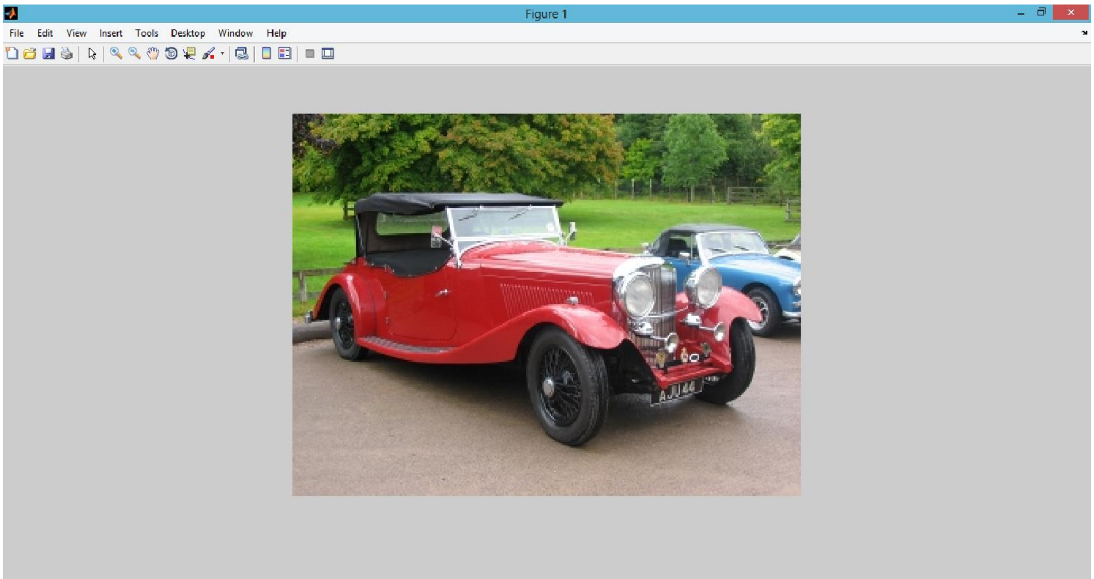


Figure 4.5 Fig File of Loaded Input Image

4.12 AFTER OBJECT PARTICLES EXTRACTION

Extraction of image object particles from input image done by first applying Harris Edge Detection Algorithm. Then results of object particles are normalized with Distance Auto Correlation unit transformations. Object particles with green cross points are drawn here in the output image.

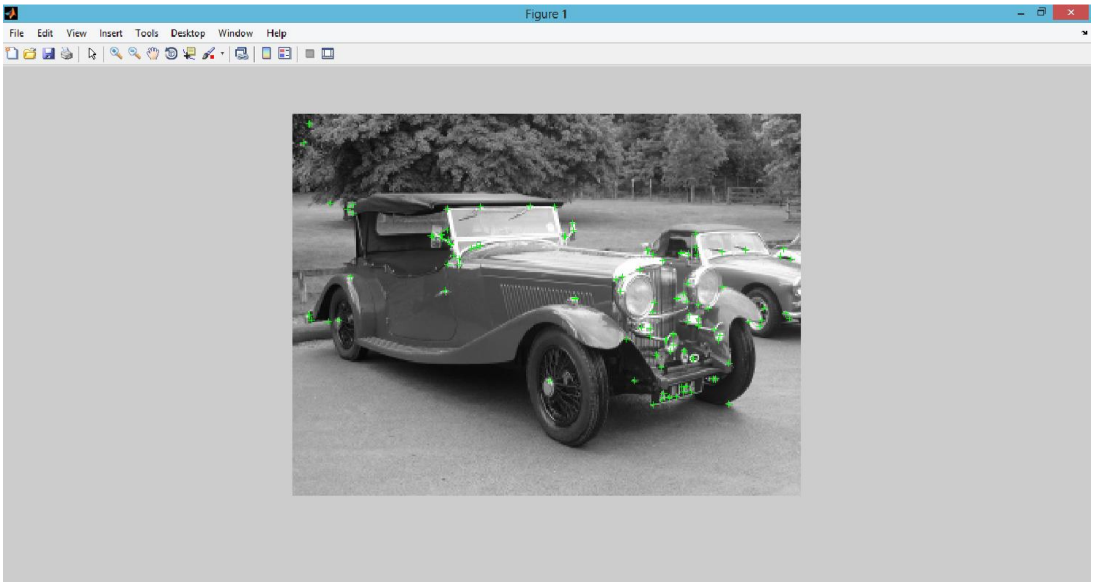


Figure 4.6 Fig File of Output Image with Object Particles.

4.13 EXTRACTED OBJECT PARTICLES MAP

Object particles from an image represent severe intensity regions which are vulnerable to noise, due to which Distance Auto Correlation with noise intensities may distort the image. Image Object particles are key points through which noise can find coherence and image objects are residing in those regions where objects particles are there.

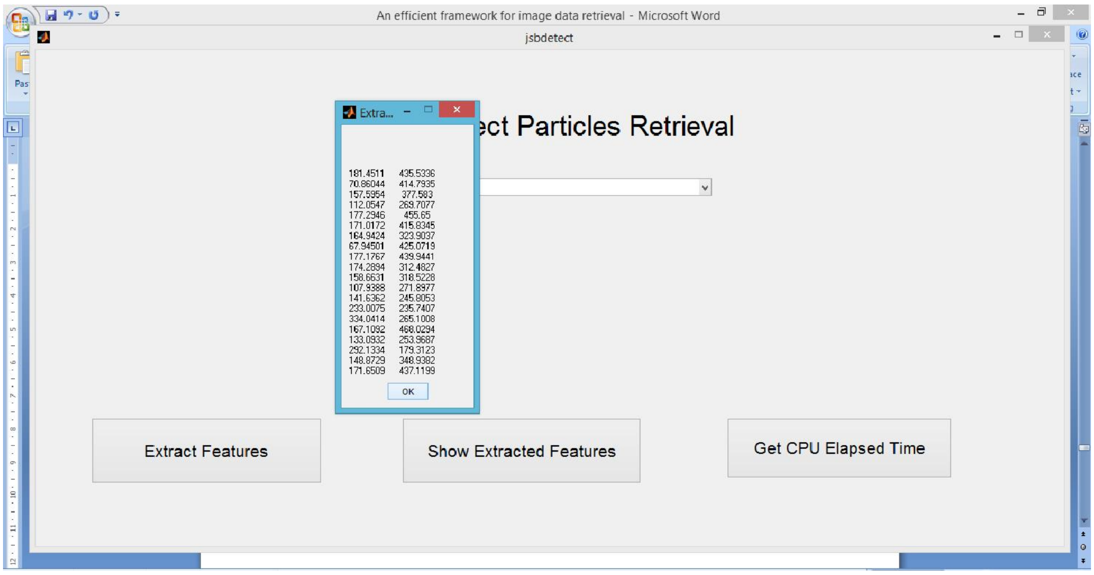


Figure 4.7 Object Particles Matrix of Intensities

4.14 EXTRACTED CPU-TIME

Total cpu elapsed time is the aggregation of number of cpu cycles needed in finding distance correlation vector and mapping intensities with object particles. Here in this interface a push button for extracting object particles map i.e. 2x1 Matrix of object particles is there. Another push button is provided for getting cpu elapsed time of ImgDataRet Algorithm.

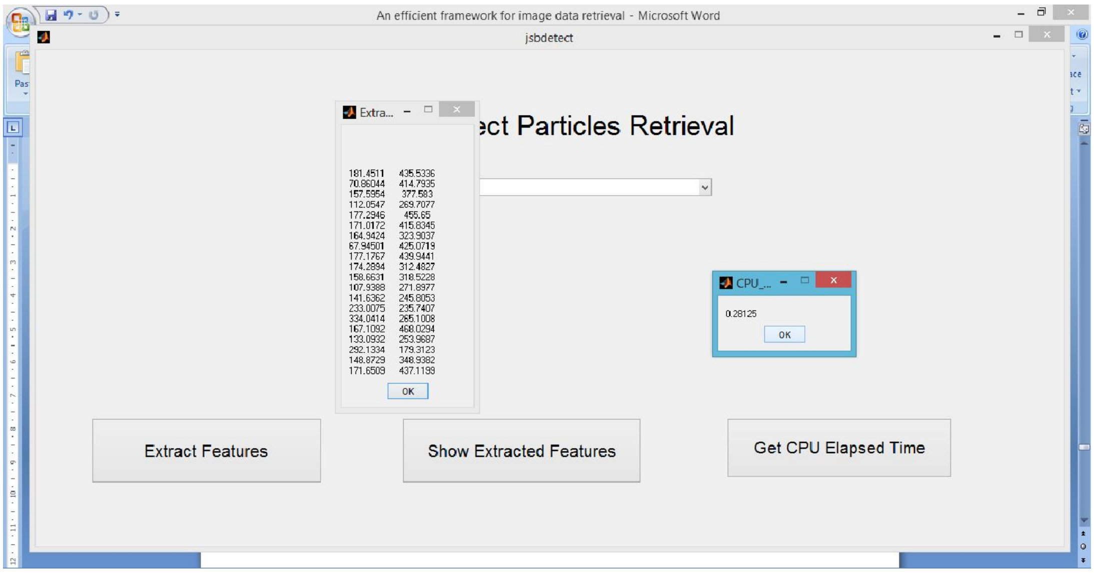


Figure 4.8 CPU Elapsed Time of ImgDataRet.

4.15 COMMAND WINDOW SHOWING OBJECT PARTICLES

Object particles with a two dimensional map of two columns is thrown to the command window. This map is extensively enriched with object intensities from various regions of input image in which objects are residing. This favors to image object detection as well as can be acting as a noise reduction model for image enhancement in morphological image processing.

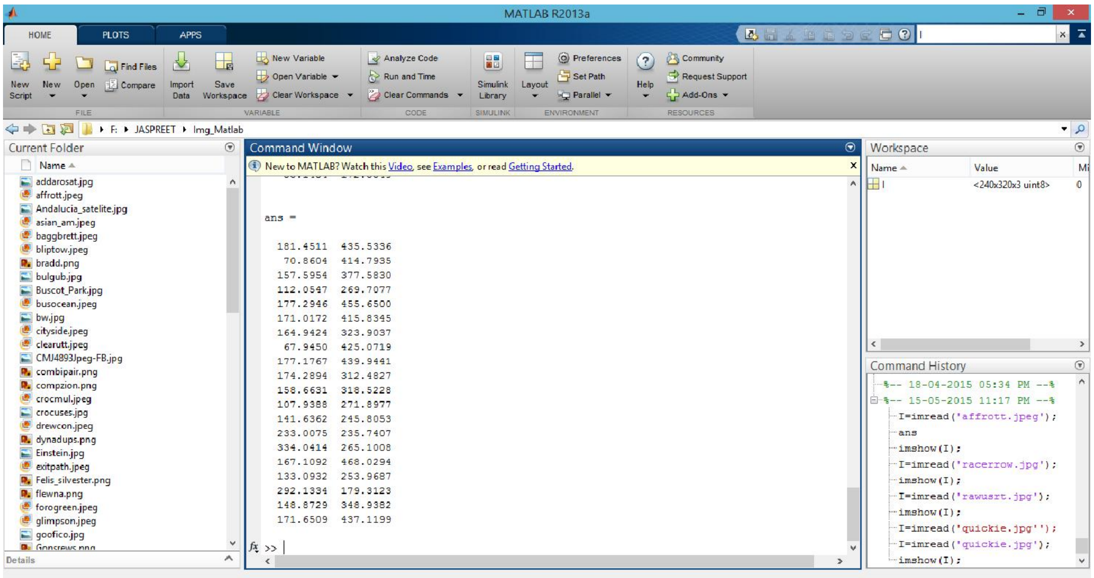


Figure 4.9 Command Window Showing Object Particles Map

CHAPTER 5

CONCLUSION AND FUTURE SCOPE

Method ImgDataRet has performed well only on standard images like brock-26, keller-5 and quickie-12. The main feature which is taken with serious attention is image preprocessing. In image preprocessing loaded input image undergoes segmentation, finding bright intensity values of pixels and their belongingness to particular region is noted in the form of feature. Out of which extracted 2x1 matrix is maintained. This matrix shows presence of image object particles in an image. This algorithm is tested on light background images of courtesy standard benchmark images; this has found its moderate performance with these images as compared to other allied approaches like Convolution Based Detection, Hybrid Projection, Neural based and Multi-View Approach. It has also tested over complex image like hamming-200 and MANN-400; it has performed relatively poorer on these kinds of complex images.

Future work could consider changing the termination condition in ImgDataRet method. If the method reaches stagnancy, then it can reallocate vectors for exploration of new object particles that can be extended from already calculated ones. For exploration of maximum number of object particles in input image ImgDataRet can drop existing vectors and restart new search for more object particles in the new start. In this way the algorithm has a chance to escape from local optimization and explore more of search space. However one needs to find a good reallocation method.

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GLOSSARY OF TERMS

A

Automated Image Retrieval

C

Content Based Image Retrieval

Cyan Magenta Yellow

Coherence Distance

D

Distance Auto Correlogram

Data Driven Scene Capturing Model

Digital Modular Camera

E

Edge Detection Correlation

Entry Map of Edge Distance

G

Gabour Edge Detection

Geographical Information System

General Transformation

H

Hue Chrome Intensity

Hard Intensity Range

Hue Saturation Intensity

M

Multiangle Image Spectro Radiograph

Micro Lens Array

P

PCA Principle Component Analysis

PIC Probability of Image Class

PST Phase Shift Transformation

PTCS Probability Theroy of Computer Science

S

SEDT Sobel Edge Detection Technique

SF Spatial Frequency

SIR Soft Intensity Range

SRM Sampling and Retrieval Model

SVM Support Vector Machine

T

TDB Training Database

TMA Tissue Microwave Analysis

TR Temporal Relation

V

VHR Very High Resolution

VID Video Information Database

VORF Video Object Reference Frame