

Query-Based Image Retrieval using SVM

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Abstract

Now a day's image plays an important role to extract the information about the object in various industries. Many traditional methods have been employed to retrieve images. It interactively determines the user's query by asking the user whether the image is relevant or not. In this information tech age, graphics have become a major portion of information processing. In the Image registration processing, the image plays an important part to extract the information regarding the item in a variety of fields including in tourism, medical and geological, weather systems calling. There are lots of Approaches individuals who are used to recover images. It interactively determines an individual's query by requesting the users whether the image will be relevant (similar) or maybe not. In content-based image retrieval (CBIR) system, effective company of this image database used to improve the functioning of the procedure. The research of content-based image retrieval (CBIR) technique has become a significant research topic. Being an individual, we've Studied and done investigation of various features in this manner or in mixes. We found that image Registration processing (IRP) is the key area in above mentioned industries. Various research papers through color feature and texture feature extraction were studied and concluded that point cloud data structure is best for image registration process using Iterative Closest Point (ICP) algorithm.

Keywords: CBIR; SVM; Feature Extraction; Point Cloud.

1. Introduction

Currently a day's image processing performs a vital part in image registration. A new research field was born in the 90's: Content-based Image Retrieval targets at indexing and retrieving images based on the visual contents. It's also called Query By Image Content (QBIC), introduces the technologies allowing to organize digital pictures by their visual features. They're based to this image retrieval problem in data bases. CBIR includes retrieving the pictures to a query image in the database of graphics. One of the tasks of CBIR is similarity comparison.

1.1. Image Registration Process

Image registration is an elementary job in image processing used for pattern matching of two or more pictures taken at different time slots from different sensors and from different viewpoints. Almost all large industries which appraise images call for the image registration as a stalwartly associated operation. Literal guesses of anomalies where image registration is a major component embrace identical for objective reorganization real time images are targeted.

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There are two types of Image registration are performed on 3-D datasets first manually and second automatically. In manually registration human operators are responsible for all the process corresponding features of the images are to be registered. In sequence to get logically good registration results a user has to choose a significantly large number of feature pairs crosswise the whole images. Manual process is not only monotonous and exhausting but also subject to discrepancy and limited accuracy. That's why there is a heavy standard needs to develop automatic registration techniques that require less time or no human operator control [1].

Generally there are four supporters' steps for image registration such as:

Feature Detection: It is an essential step for Image registration. It detect the features like closed-boundary fields, ranges, edges, outlines, line points going across, angles, and so on.

Feature Matching: In this step, Process of matching the features extracted by Database Images and Query image that yield to a result that is visually similar.

Transform model Estimation: The sort and parameters of the so-named mapping purposes, uses, getting into line the sensed image with the statement, direction image, are put a value on. The parameters of the mapping purposes, uses are worked out with the help of the made certain point letters.

Image re-sampling and transformation: The sensed image is greatly changed with the help of the mapping purposes, uses. Image values in non-integer orders are worked out by the right interpolation expert way of art and so on.

1.2. Fundamentals of CBIR System

In typical CBIR systems, the visual content of the pictures are extracted from the database. And it described by multi-dimensional feature vectors. These features vector of the images in the database forms a feature database. To retrieve the images, users offer the retrieval system with example images.

There are three main components used in this CBIR system such as:

1. User's Query, 2. Database Unit, 3. Retrieval system.

- **Query unit:**

Query unit selects an image from the database after which 3 features have been extracted and stored as a feature vector. The 3 features are both texture, color, and shape. Along with feature may be the color moment. Extracting the color feature the image can be converted and the image is partitioned into the grid. There are a few seconds are extracted. To extract the texture feature pyramid structured and tree-structured wavelet transform is used. The image is altered to gray scale and also daubechies wavelet is applied. In the end, the features are combined from the image's feature vector.

- **Database unit:**

In the database unit feature vectors of the graphics are pulled and stored like a feature database (FDB). For comparison query, image and database images have to have capabilities and so they must be of exactly the identical length. Therefore features are expressed.

- **Retrieval unit:**

This unit carries the feature vector of have database and the query image. It plays with an SVM classification. After that, the query image is classified into some of those class. It calculates the similarity between the query image and the images in that class in which the image is classified and the best 20 images are retrieved

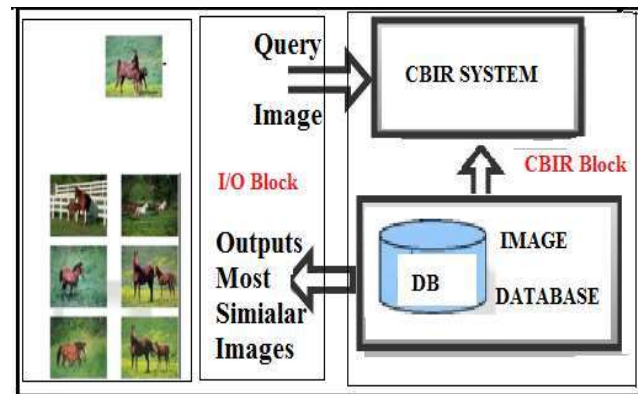


Fig. 1. Block Diagram of CBIR

1.3. CBIR Applications

There are many applications for CBIR technology as below:

- To identification of defect and fault in industrial automation.
- It is used as face recognition & copyright on the Internet.
- In medical plays a very important role in Tumors detection, Improve MRI and CT scan.
- For the weather forecast, satellite images.
- To map making from photographs.
- For crime detection using fingerprints matching.
- In the defence used for detection of targets.

1.4. Feature Extraction

The feature extraction techniques are used to extract the features. There are some attributes such as color, texture, shape, and show vectors etc.

- **Color:** Color is widely used for image representation and independent of the size of an image. Color is a property that depends into the eye and the processing of the data in the mind. We use color to share with the difference between places, objects, and the time. Usually, colors are defined in coloring spaces. Color feature extraction usages similarity dimension key components & color space, color quantization. These can either be RGB (Red, Green, and Blue), HSV (Hue, Saturation, and Value) or HSB (Hue, Saturation, and Brightness). Histogram, Block-based; Color histogram moments are cases. Color is widely used for independent and image representation of their magnitude of an image.
- **Texture:** Texture is that inherent property of all surfaces which describes visual patterns, each having possessions of homogeneity. It contains essential information concerning the structural arrangement of this outer lining, such as; clouds, leaves, bricks, and fabric, etc. It describes the relationship of the top to the nearby atmosphere.
- **Shape:** Shape defined as the characteristic configuration of a thing; an outline or shape. Shape does not mention into the shape of a region but although the shape of a image which is being sought out. It enables an object to become distinguished from its surroundings. Shape representations may be divided into two categories: Boundary-based, and Region-based. Shape descriptors might have to become invariant to scale, rotation, and translation.
- **Feature Vectors:** In pattern recognition and machine learning, a feature vector is an n-dimensional vector of numerical features that represent some object. Many algorithms in machine learning require a numerical representation of objects since such representations facilitate processing and statistical analysis. When representing images, the feature values might correspond to the pixels of an image, when representing texts perhaps to term occurrence frequencies. ·In pattern recognition and machine learning, a feature vector is an n-

dimensional vector of numerical features that represent a few thing. Since such representations facilitate statistical investigation and processing many algorithms in machine learning require a numerical rendering of items. The feature worth might correspond to the pixels of an image, when representing texts perhaps when representing images.

1.4.1 Basic architecture of Feature Extraction System

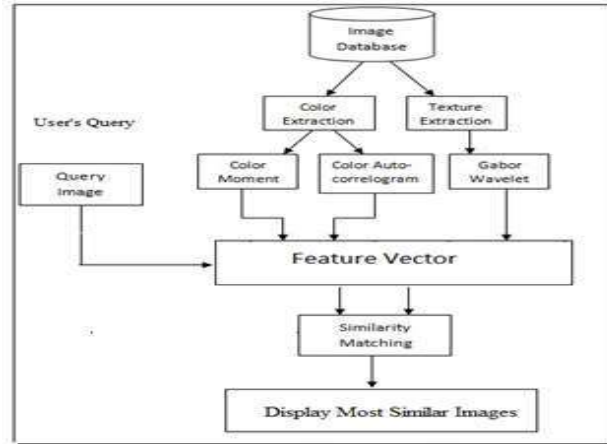


Fig. 2. Feature extraction System

1.4.2 Feature Extraction Techniques

There are following techniques used as follows:

- **Color-Based Feature Extraction:** There are following Color Feature Extraction namely first one is Color moments and another one is Color Auto-Correlogram.

Color moments: Color moments are measures that characterize color distribution in an image. Each comparison between images results in a similarity score, and the lower this score is the more identical the two images are supposed to be. Color indexing (CI) is the main application of color moments. Images can be indexed, and the index will contain the computed color moments. Color moments can be computed for any color model. Three color moments are computed per channel (9 moments if the color model is RGB and 12 moments if the color model is CMYK).

Color Auto-Correlogram: Correlogram can be stored as a table indexed by pairs of colors (i,j) where d-th entry shows the probability of finding a pixel j from pixel i at distance d. Whereas an auto-correlogram can be stored as a table indexed by color I where d-th entry shows the probability of finding a pixel i from the same pixel at distance d. Hence auto-correlogram shows the spatial correlation between identical colors only [2].

- **Texture-Based Feature Extraction:** In this Text-based technique, there is some Texture properties include including Coarseness, Contrast, Directionality, Line-likeness, Regularity, and Roughness in the image. There are some methods of classifying texture such Wavelet Transform and Gabor Wavelet.

Wavelet: Just as a tool, wavelets may be used to extract information from different sorts of information, including audio signals and graphics. Analysis enables the usage of very long time intervals where we desire details. It is capable of revealing aspects of data which aspects are missed by other signal investigation methods like self-similarity, breakdown points, discontinuities in higher derivatives, along with trends. Wavelet analysis de-noise or can usually compress a signal without appreciable degradation [3].

Gabor Wavelet: The Gabor filter, called after Dennis Gabor, is actually a filter. Gabor filter is also called Gabor wavelet). It's widely embraced to extract texture features from the images to image retrieval. Conceptually Gabor filters really are a set of wavelets, together with each wavelet shooting energy at a direction and a specific frequency. Frequency and orientation representations of the Gabor filter are much like those of the anatomy. Gabor filters make use of the Fourier transform of the function for its extraction purpose and the harmonic function. Features can then be extracted using this group of energy distributions. The orientation and frequency tunable property of Gabor filter causes it easy for texture evaluation [4].

1.5. Performance Evaluation

In system a retrieval system's performance is evaluated based on several criteria. So, some of the performance measures that are commonly used are average accuracy recall, average retrieval rate. All these performance measures parameter are calculated using precision and recall values computed for each query image.

Precision indicates the portion of one's results that are relevant retrieved from recovered graphics that are absolute. On the flip side, recall denotes the percentage of total results out of database graphics that are overall.

2. Literature Survey

In this literature survey we analyzed various research papers that described the new trends of CBIR techniques by various authors in various domain of computer vision and its applications. Apart from that some technical aspects of current content-based image retrieval systems is discussed also. There are many existing technical aspects describe as below:

2.1 Overview of Support Vector Machine (SVM)

Support vector machine (SVM) was proposed by V. Vapnik in mid-1990. It is the most popular machine learning algorithm in the last decade. Currently, SVM as a powerful tool in machine learning was widely used in data mining like a CRM project. Now a day's it is widely used as the baseline in computer vision, pattern recognition, information retrieval, and data mining also. It is used to find the linear separating hyperplane of a binary labeled dataset. It is a classifier defined by a separating hyperplane.

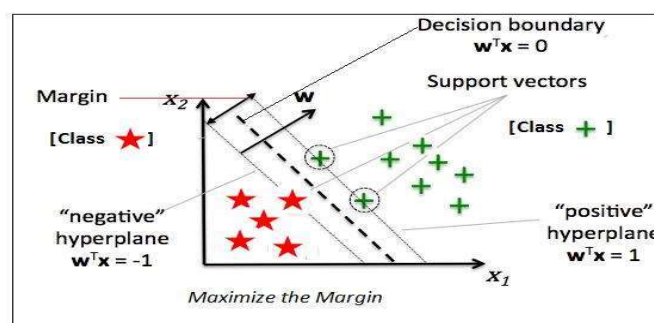


Fig. 3. SVM maximize the Hyperplane and Margin two different class Red Star and Green plus (under 2D)

SVM model represents the Examples as things in space, mapped that the types of those different categories are broken up by a transparent gap that's as wide as feasible. It is accustomed to performing non-linear classification and classification. It provides mapping their inputs in to high-dimensional feature spaces. Classifier achieves this by making a classification decision centered on the importance of the linear combination of the features.

SVM is a binary option Classification procedure that takes as input labelled data from 2 groups, after the sparks are produced by it file for maximizing new data. Mainly two steps like analyzing and training. Training an SVM involves

feeding statistics to the SVM along with decision worth that are previously known forming a finite training set. As input data is mapped you can find two class classification problem Into higher dimensional space using RBF kernel and hyper-plane linear Classifier is put in this space Vectors which are closest to the decision boundary.

Let m -dimensional inputs= x_i ($i= 1,2,3 \dots ,M$) belong to Class –“*”or Class –“+” and the associated labels be $y_i= 1$ for Class A and -1 for Class B.

Here Class -A is Red Star and Class -B is Green Plus.

Decision function for SVM is

$$D(x) = w^T x + b; \quad (1)$$

Where w is an m -dimensional vector, b is a scalar, and y_i

$$D(x_i) \geq 1 \text{ for } i=1, 2, 3 \dots ,M. \quad (2)$$

The distance between the separating hyper plane $D(x) = 0$ and the training datum nearest to the hyper plane is called the *margin*. The hyper plane $D(x) = 0$ with the maximum margin is called the optimal *separating hyper plane*.

2.2 Surface Based Image Registration

The 3-D edge surface of an anatomic object or composition is innate and gives major geometrical feature data that can be promoted in the medical industry for image registration. These registration methods fasten shaping corresponding surfaces in different images and computing the transformation that can be used for aligning these surfaces. Surface representation of points on the surface is just one thing that can be collected. A facial view surfaces an implicit surface or a parametric surface like a B-spline surface. Extraction of surfaces such as the skin or bone is fairly easy and head CT and MR images automatically [5].

2.2.1 Applications of Surface-Based Image Registration

Image registration is widely used remote sensing, medical imaging, computer vision, and in many others. Surface Based Image Registration technique is divided into following main groups such as:

- **Different Times (Multiview registration):** Images of the same view are acquired at different times. The mean is to find and estimate changes in the view.
- **Different Viewpoints:** Images of the same scene are acquired from different perspectives. The aim of a large 2-D view or a 3-D representation of the scene being imaged is to gain. There are some applications like remote sensing: for mosaicing of images of the surveyed area and Computer vision for shape recovery.
- **Multimodal modal image registration (Different Sensors):** Image of the same scene is acquired from a different source of sensors. The main aim is to integrate the information obtained from different source streams to gain more detailed scene representation.

2.3 Iterative Closest Point Algorithm (I.C.P)

This algorithm is used to evaluation on 3D medical data. There are different ICP variants can be classified according to different criteria such as Selecting subsets from the given 3D data sets, Finding correspondence points, Weighting the estimated correspondence pairs, Rejecting false matches, Assigning an error metric, Minimizing the error metric. ICP algorithm is a general-purpose, representation-independent shape-based the number on a list algorithm that can be used with a range of geometrical early persons including point puts, line part puts, triangle puts (much-sided comes to the top), and if true, then some other is necessarily true and parametric curves and comes to the top.

$$\sqrt{\sum_{j=1}^N W_j^2 d^2(T(x_j), y)} = \sqrt{\sum_{j=1}^N W_j^2 \|T(x_j) - y\|^2} \quad (3)$$

$$\text{Where } y_j = C(T(x_j), y) \quad (4)$$

2.4 Academic proposals

Literature survey is important for Understanding, extracting and gaining knowledge about specific field of an issue. In this paper several existing proposals examined to picture retrieval as:

M.E. ElAlami," [6] that spoke that the 3 D color histogram And the Gabor filter algorithm is able to effortlessly describe properties of this image. A version incorporated the color coherence vector and wavelets features to enhance recovery performance. There are two sequential procedures preliminary and reduction, for pulling the features set. After that this strategy is utilised to reduce the search space and consumed moment in the retrieval process.

Darshana Mistry, et.al., [7] that presented by this newspaper. It is possible to just two or more of the identical scene shot at various times, from different viewpoints, or detectors such as references and feel graphics. They are classified according to area and feature.

It's four steps of the image registration procedure.

- 1) Inch. Feature detection
- 2) Feature matching
- 3) Alter model estimation
- 4) Image Re-sampling and transformation.

B.Bohra, et.al [8] that presented in this newspaper, to minimization of mistake and time in the surface based image registration means of data sets using point-cloud data arrangement. Normally used in the industry to store the CT images, MRI images and Tumor images and used to create 3 d models collections. I.C.P algorithm which registers two 3d data collections and find the nearest points into data collections as per giving tolerance distance.

N.Ali, et.al. [9] that presented to Enhances the overall effectiveness of image retrieval. The Standard graphics are constructed by following the rule of thirds that split an image into two parts by setting regions or objects of attention in the cortical lines of this grid. Thus, texture and color feature gives a appropriate and efficient result from the human visual system.

Pratistha Mathuretl., Neha Janu, [10] who Presented the Gabor feature extractions have higher accuracy in contrast to different wavelet transform and discrete cosine transform. This results of Gabor's analysis features, it is analyzed that Gabor is extraction procedure for edge or shape features extraction compared to DCT and DWT feature extraction. Back in DWT and DCT feature extraction, so the feature is extracted in low frequency feature sub-band (LL) along with other frequency group are lost so a number of the features are lost that will be the cause of lower accuracy compare to Gabor. Accuracy was achieved by gabor with scale projection in contrast Gabor without scale.

G.S.Somnugpong, Kanokwan Khiewwan, [11] which presented the Combination of 2 new methods likes graphic feel and spatial significance of pairs of color inside feature adds the high image that is shifting with more robustness. To provide averaging precision additionally better the techniques. By employing color correlogram can treat information while EDH provides that the geometry information when it comes to the image but different coloration. It is a blend of low-end features provides a better result than a single feature. Euclidean distance is useful for purposes dimension.

AtifNazir et.al [12]. In this newspaper that introduced the feature includes shape descriptors, shape representations, and texture features. CBIR strategy combines the local and global features for information. They have suggested a CBIR strategy that was new to fuse color and texture features. Color Histogram (CH) can be utilized to extract color information. Features are pulled Edge Histogram Descriptor and by Discrete Wavelet Transform. The features are made. They have combined better outputs are given by a couple of features as compared to one feature. Thus, texture

and colour feature gives an efficient and appropriate end from the human visual system.

Neha Janu, PratisthaMathuretl. [13] that introduced the characteristic Extraction procedure in the frequency domain. There are three feature extraction procedure used enjoys Gabor filter, Discrete Cosine Transform and Discrete Wavelet Transform.

J.Cook, et.al [14] that introduced in this newspaper a New way of 3D face recognition using Iterative Closest Point(ICP) algorithm. It's useful for registering rigid portions of the facial and face modeling of enrollment error over a region when contrast is exhibited. 3D registration techniques are used by this method. ICP algorithm is employed to compensate for the nature of those surfaces and to establish a correspondence between target and evaluation.

RuigangFu, BiaoLi, YinghuiGao Wang [15] that provided by mainly attributes similarity measures and representations. This paper applies convolution neural network (CNN) to CBIR and uses linear support vector machine (SVM) to train a hyperplane which could divide similar image pairs and dissimilar graphic pairs to a large level. Tests reveal that the procedure may enhance the overall effectiveness of CBIR. This research newspaper a system based on SVM and CNN, SVM is utilized to learn the similarity measures and where CNN can be utilized to extract the feature representations

3. Conclusion and Research Motivation

In this paper brief overview of image retrieval and its structure is discussed. Many researchers are implemented feature extractions processes to retrieve the graphics from the training database. Each of these databases textures, shapes, and includes many different unique graphics with different colours. Color histogram (RGB and HSV) is used like a feature extraction technique for retrieving images based on color and Gabor filters have been all found to be most useful for implementing texture based extraction. At last the classifier support vector machine (SVM) and also Surface-based image registration techniques are widely utilised in 3-D Data sets image enrollment in numerous businesses. Point-based image registration procedure is most efficient and popular in the entire surface centered image registration processes with famous algorithm I.C.P (Iterative Closest Point), which is useful for better image registration .Based on account of varied papers it is concluded that service vector system may make this task more easy and effective. ICP algorithm gives effective outcomes and chooses the pictures that meet an individual's demand. In future directions picture enrollment in datasets may be done with ICP and SVM.

References

- [1] Darshana Mistry, Asim Banerjee,” Review: Image Registration”, International Journal of Graphics & Image Processing |Vol 2|issue 1|February 2012.
- [2] J. Yu, Z. Qin, T Wan, and X. Zhang, Feature integration analysis of bag-of-features model for image retrieval, Neurocomputing, vol. 120, pp. 355-364, 2013.
- [3] H. A. Hassan ; N. M. Tahir ; I. Yassin ; C.H.C Yahaya ; S. M. Shafie International Conference on Computer Vision and Image Analysis Applications Year: 2015 | Conference Paper | Publisher: IEEE.
- [4] J. Yue, Z. Li, L. Liu, and Z. Fu, “Content-based image retrieval using color and texture fused features, Math. Comput. Model. vol. 54, no. 34, pp. 1121-1127, 2011.
- [5] Brian Amberg, Sami Romdhani and Thomas Vetter “Optimal Step Nonrigid ICP Algorithms for Surface Registration”. This work was supported in part by Microsoft Research through the European PhD Scholarship Programme.
- [6] Janu Neha, PratisthaMathur, “Performance analysis of frequency domain based feature extraction techniques for facial expression recognition.” In 7th International Conference on Cloud Computing, Data Science & Engineering-Confluence, 2017, pp. 591-594. IEEE, 2017.
- [7] M. E. Elalami, A novel image retrieval model based on the most relevant features, Knowledge-Based Syst., vol. 24, no. 1, pp. 23-32, 2011.
- [8] Brahmdukt Bohra1# Deepak Gupta2* Shikha Gupta3#” An Efficient Approach of Image Registration Using Point Cloud Datasets”.
- [9] Nouman Ali, Khalid Bashir Bajwa , Robert Sablatnig , ZahidMehmood “ Image retrieval by addition of spatial information based on histograms of triangular regions”.
- [10] Jost T., Hügli H. (2002) Fast ICP Algorithms for Shape Registration. In: Van Gool L. (eds) Pattern Recognition. DAGM 2002. Lecture Notes in Computer Science, vol 2449. Springer, Berlin, Heidelberg.

- [11] Janu Neha, PratisthaMathur, "Performance analysis of frequency domain based feature extraction techniques for facial expression recognition." In 7th International Conference on Cloud Computing, Data Science & Engineering-Confluence, 2017, pp. 591-594. IEEE, 2017.
- [12] AtifNazir, Rehan Ashraf, TalhaHamdani, NoumanAli,"Content based image retrieval system by using HSV color histogram, discrete wavelet transform and edge histogram descriptor",International Conference on Computing, Mathematics and Engineering Technologies (iCoMET),Azad Kashmir,(2018)1-6.
- [13] S. Somnugpong and K. Khiewwan, "Content Based Image Retrieval using a combination of Color Correlograms and Edge Direction Histogram", 13th International Joint Conference on Computer Science and Software Engineering,DOI:10.1109, IEEE, (2016).
- [14] Neha Janu, PratisthaMathur, "Performance Analysis of Feature Extraction Techniques for Facial Expression Recognition", International journal on Computer Applications, ISSN No. 0975 –8887, Volume-166, Issue-1, May 2017.
- [15] Jamie Cook,Vinod Chandran, SridhaSridharan and Clinton Fookes, "Face Recognition From 3d Data Using Iterative Closest Point Algorithm And Gaussian Mixture Models",Greece, 2004, pp. 502-509.
- [16] Ruigang Fu, Biao Li, Yinghui Gao, Ping Wang, "Content-Based Image Retrieval Based on CNN and SVM", 2016 2nd IEEE International Conference on Computer and Communications, pages (638-642).
- [17] Peter J. Kostelec and SenthilPeriaswamy, "Image Registration for MRI". Modern Signal Processing MSRI Publications Volume 46, 2003.
- [18] C. S.Won, D. K. Park and Y. S. Jeon, "an efficient use of MPEG-7 Color Layout and Edge Histogram Descriptors", proceeding of the ACM workshop on multimedia, (2000), pp. 51-54.
- [19] T. Kato, "Database architecture for content-based image retrieval", in Image Storage and Retrieval Systems, Proc SPIE 1662, (1992) pp112-123.
- [20] Jan Elseberg, DoritBorrmann and Andreas Nüchter, "One billion points in the cloud – an octree for efficient processing of 3D laser scans". In Proc. ISPRS Journal of Photogrammetry and Remote Sensing 76 (2013) 76–88.
- [21] A. Kumar and M. Sinha (2014), "Overview on vehicular ad hoc network and its security issues," International Conference on Computing for Sustainable Global Development (INDIACom), pp. 792-797. doi: 10.1109/IndiaCom.2014.6828071.
- [22] Mr. Ankit Kumar, Dr. Dinesh Goyal, Mr. Pankaj Dadheech, (2018), "A Novel Framework for Performance Optimization of Routing Protocol in VANET Network", Journal of Advanced Research in Dynamical & Control Systems, Vol. 10, 02-Special Issue, 2018, pp-2110-2121, ISSN: 1943-023X.
- [23] Mr. Pankaj Dadheech, Dr. Dinesh Goyal, Dr. Sumit Srivastava, Mr. Ankit Kumar, (2018), "A Scalable Data Processing Using Hadoop & MapReduce for Big Data", Journal of Advanced Research in Dynamical & Control Systems, Vol. 10, 02-Special Issue, 2018, pp-2099-2109, ISSN: 1943-023X.