170002: Project 2

Project report

On

Content based Image Retrieval using Super-Fast Robust Features (SURF)

As partial fulfillment of award of

Bachelor of Engineering in

Information technology

Prepared by

Prashant Italiya (110010116001)

Internal Guide

Prof. Sudhir Vegad

May-2015

Department of Information Technology

A.D. Patel Institute of Technology

Gujarat Technological University

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FIGURES

Content Based Image Retrieval Using SURF (Super-fast Robust Features)

- **Acknowledgment**
- **Certificate of Collage**
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ACKNOWLEDGEMENT

With great pleasure we would like to acknowledge the contribution of certain distinguished people, without their support and guidance this project work would not have been completed.

Firstly, we express our sincere thanks and deep sense of gratitude to our project guide ***Prof. Sudhir P. Vegad,*** Asst. Professor Information Technology, ADIT, for his guidance and moral support during the course of preparation of this project report. We really thank her from the bottom of my heart for always being there with his extreme knowledge and kind nature.

We take this opportunity to thank all our friends, colleagues and parents who started us out on the topic and provided extremely useful review feedback and for their all time support and help in each and every aspect of the course of my project preparation.

Prashant italiya

Internal Guide

Prof Sudhir Vegad

A. D. Patel Institute of Technology

Information Technology

CERTIFICATE

This is to certify that the project work entitled **"Content Based Image Retrieval using SURF"** is a report of the work carried out by **"Prashant Italia (110010116001)"** under the guidance and supervision as a part of syllabus in B.E. Computer Engineering at **A.D. Patel institute of Technology-Vallabh Vidyanagar, Gujarat.**

Date: 05/22/2015.

Guided By:
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Information Technology
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Head of Department
Dr. Narendra Chauhan
Information Technology
ADIT V.V.Nagar.

GUJARAT TECHNOLOGICAL UNIVERSITY

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Business Model Canvas (Report)	Uploaded
Patent Drafting Exercise (PDE)	Completed
Final Project Report	Uploaded
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1. The descriptor describes a distribution of Haar
2. to geometric deformations and the wavelet responses in horizontal

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1. to reduce the searching time of images from the image

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1. The descriptor describes a distribution of Haar

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1. The descriptor describes a distribution of Haar

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1. In a second step, the region is split up

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1. In a second step, the region is split up

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Content Based Image Retrieval Using SURF (Super-fast Robust Features)

Chapter-1

- **Abstract**
- **Title: Introduction**

ABSTRACT

Content-Based Image Retrieval (CBIR) is a challenging task which retrieves the similar images from the large database. Most of the CBIR system uses the low-level features such as color, texture and shape to extract the features from the images. In Recent years the Interest points are used to extract the most similar images with different view point and different transformations. In this project the SURF is combined with the color feature to improve the retrieval accuracy. SURF is fast and robust interest points detector/descriptor which is used in many computer vision applications. To improve the performance of the system the SURF is combined with Color Moments since SURF works only on gray scale images. The KD-tree with the Best Bin First (BBF) search algorithm is to index and match the similarity between the features of the images. Finally, Voting Scheme algorithm is used to rank and retrieve the matched images from the database.

INTRODUCTION

Recent advances in science and technology has increased the use of image data in diverse areas such has entertainment, art galleries, education, fashion design, industry, medicine etc. Explosion of World Wide Web (WWW) in last decade has seen an enormous increase in the usage of digital images and the ease of access these randomly stored images in remote databases. Therefore, it is necessary to store and retrieve image data efficiently to perform assigned task and to make a decision. Developing proper tools for retrieving images from large image collections is challenging.

Text-based approach is also employed for image retrieval. In text-based approach, the images are manually annotated by text descriptors and then these descriptors are used by database management system to perform image retrieval. This technique requires vast amount of labor for manual image annotation and also there are inconsistencies between user textual queries and image annotations. To overcome the inconsistency problem, content-based approach is used. Content-Based Image Retrieval (CBIR) aims at constructing meaningful descriptors of physical attributes from images to facilitate efficient and effective retrieval.

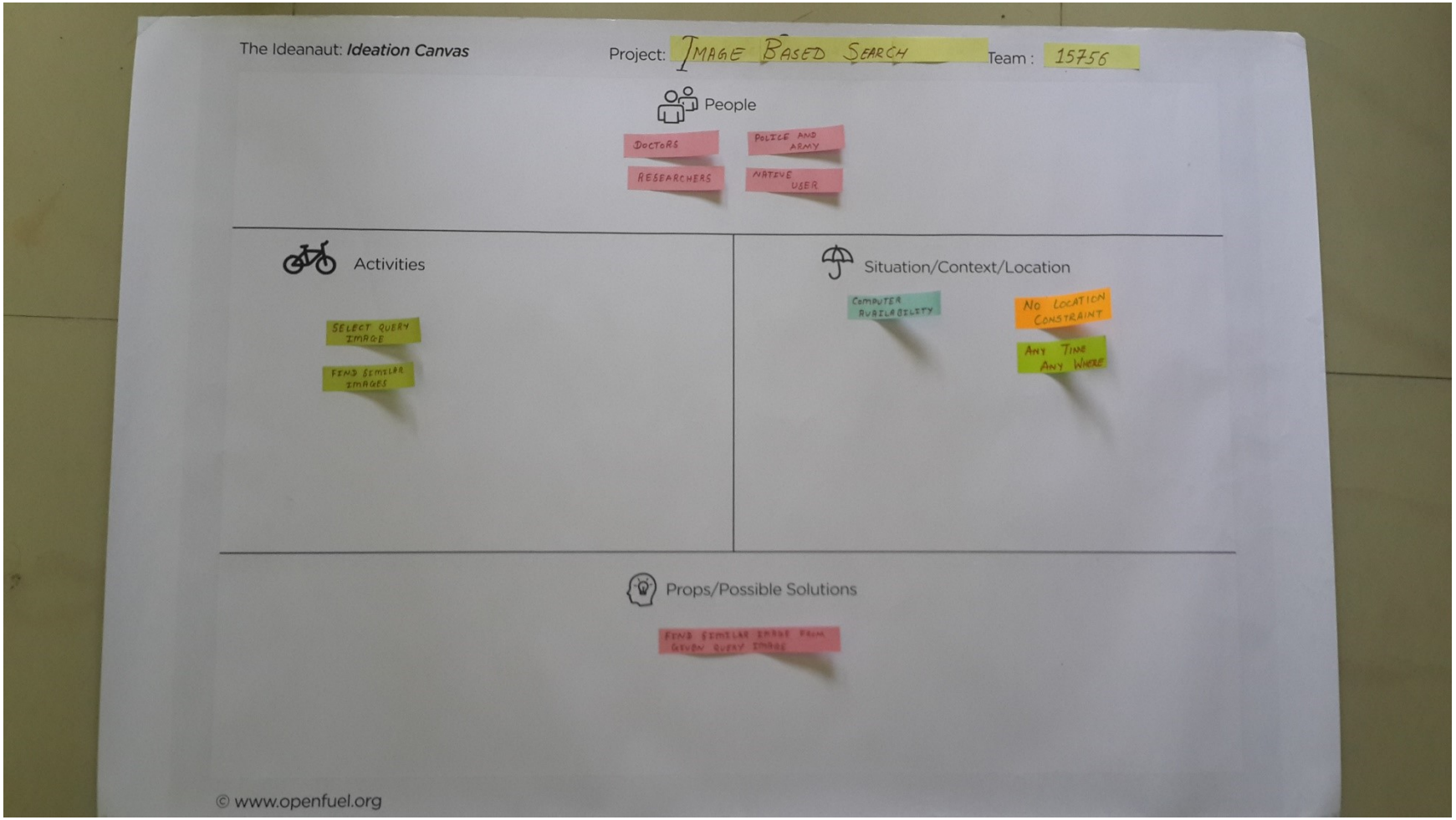
Research activities in CBIR have progressed in 3 major directions: global image properties based, region level feature based and relevance feedback based. Initially, developed algorithms fall under first approach and they exploit only low-level features of an image such as color, texture and shape of an object to retrieve images. They can be easily implemented and they perform well for simple images. They are not suitable for broad content image databases. Region-based approach retrieves images via image segmentation. These methods attempt to overcome the drawbacks of global feature by representing images at object level. But, the performance of these methods mainly relies on results of segmentation. Relevance feedback (RF) is an interactive process which refines the retrievals to a particular query by utilizing the user's feedback on previously retrieved results. A user defined evaluation function is necessary in this approach and also there is interaction between user and computer at each level of iteration. This approach is expensive in terms of space and time.

We are using a hybrid SURF descriptor for efficient and fast image retrieval. SURF (Speed Up Robust Feature) is one of the most and popular interest point detector and descriptor which has been published by Bay et al.. It is widely used in most of the computer vision applications. The SURF has been proven to achieve high repeatability and distinctiveness. It uses a Hessian matrix-based measure for the detection of interest points and a distribution of Haar wavelet responses within the interest point neighborhood as descriptor. An image is analyzed from both global and local image details. In addition to that, the dominant orientation of each of the interest points is determined to support rotation-invariant matching. SURF is one of the best interest point detectors and descriptors currently available.

Content Based Image Retrieval Using SURF (Super-fast Robust Features)

Chapter-2

- **Design: Analysis, Design Methodology and Implementation Strategy.**
- **Diagrams**
    1. **Use Case Diagram**
    2. **Activity Diagram**
    3. **Data Flow Diagrams**


The Ideanaut: Ideation Canvas
Project: IMAGE BASED SEARCH
Team : 15756
People
DOCTORS
POLICE AND ARMY
RESEARCHERS
NATIVE USER
Activities
SELECT QUERY IMAGE
FEND SEMILAR IMAGES
Situation/Context/Location
COMPUTER AVAILABILITY
NO LOCATION CONSTRAINT
ANY TIME ANY WHERE
Props/Possible Solutions
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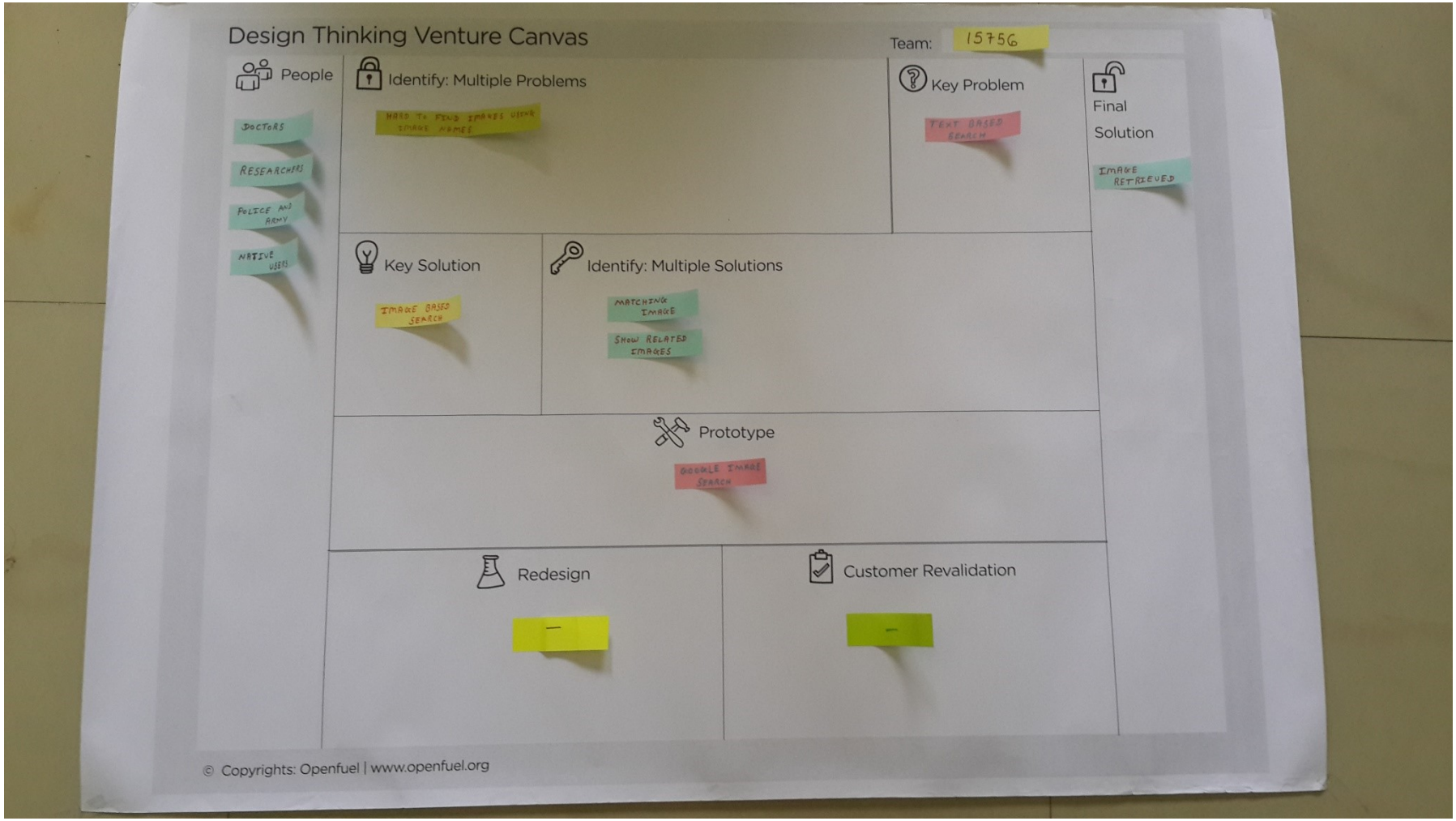
IDEATION CANVAS

- **People**
  - Doctors
  - Researchers
  - Police and Army
  - Native People

  This application can be used by above mentioned people. It can be used by more peoples too.
- **Activities**
  - Select Query Image
  - Find Similar Images

  Then above mentioned activities are the main activities of the application.
- **Situation/Context/Location**
  - Computer Availability
  - No Location Constraint
  - Any Time Any Where
- **Props/Possible Solutions**
  - Find Similar Image From Given Query Image

  The above mentioned all are the possible solution of the application.


Design Thinking Venture Canvas
Team: 15756
People
DOCTORS
RESEARCHERS
POLICE AND ARMY
NATIVE USERS
Identify: Multiple Problems
HARD TO FIND IMAGES USING IMAGE NAMES
Key Problem
TEXT BASED SEARCH
Final Solution
IMAGE RETRIEVED
Key Solution
IMAGE BASED SEARCH
Identify: Multiple Solutions
MATCHING IMAGE
SHOW RELATED IMAGES
Prototype
GOOGLE IMAGE SEARCH
Redesign
—
Customer Revalidation
—
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DESIGN THINKING VENTURE CANVAS

❖ People

- Doctors
- Researchers
- Police and Army
- Native User

  This application can be used by above mentioned people. It can be used by more peoples too.

❖ Identify: Multiple Problems

- Hard to Find Images Using Image Name

  The above mentioned all are the identified multiple problems during analysis.

❖ Key Problems

- Text Based Search

  The above mentioned all are the identified key problems during analysis.

❖ Key Solution

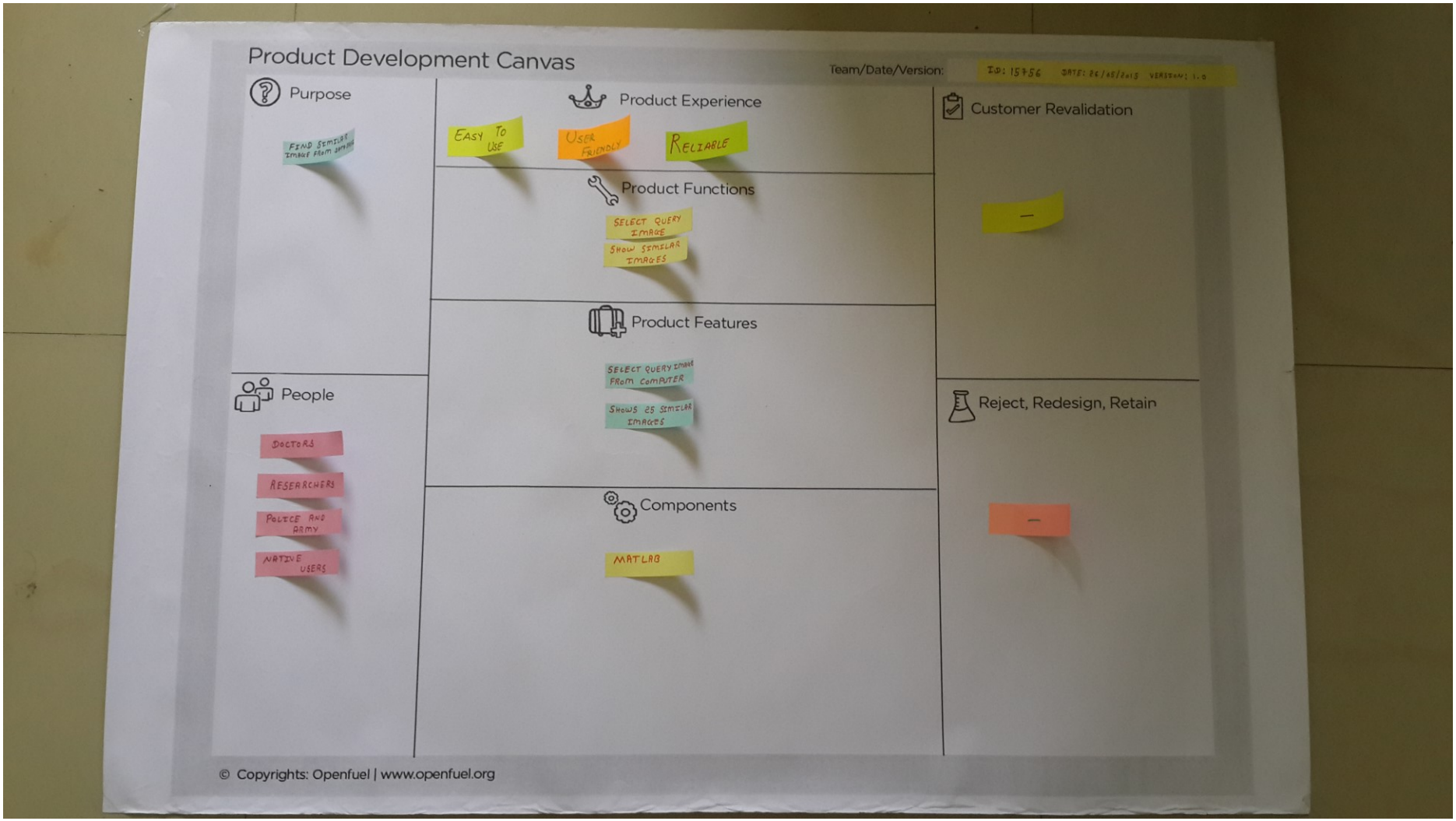
- Image Based Search

  The above mentioned all are the identified key Solutions during analysis.

❖ Identify: Multiple Solutions

- Matching Image
- Show Related Images

  The above mentioned all are the identified multiple Solution by implementing the application.


Product Development Canvas
Team/Date/Version:
ID: 15756 DATE: 26/05/2015 VERSION: 1.0
Purpose
FIND SIMILAR IMAGE FROM DATA
Product Experience
EASY TO USE
USER FRIENDLY
RELIABLE
Customer Revalidation
—
Product Functions
SELECT QUERY IMAGE
SHOW SIMILAR IMAGES
Product Features
SELECT QUERY IMAGE FROM COMPUTER
SHOWS 25 SIMILAR IMAGES
People
DOCTORS
RESEARCHERS
POLICE AND ARMY
NATIVE USERS
Reject, Redesign, Retain
—
Components
MATLAB
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PRODUCT DEVELOPMENT CANVAS

❖ Purpose

- Find Similar Image From Database

  The purpose of the application is to find the similar images from the database based on the query image.

❖ Product Experience

- Easy to Use
- User Friendly
- Reliable

  The above mentioned all are the product experience from the user.

❖ Product Function

- Select Query Image
- Show Similar Image

  The above mentioned all are the main product functions.

❖ Product Features

- Select Query Image from Database
- Shows 25 Similar Image

  The above mentioned all are the main product features.

❖ People

- Doctors
- Researchers
- Police and Army
- Native People

  This application can be used by above mentioned people. It can be used by more peoples too.

USE-CASE DIAGRAM

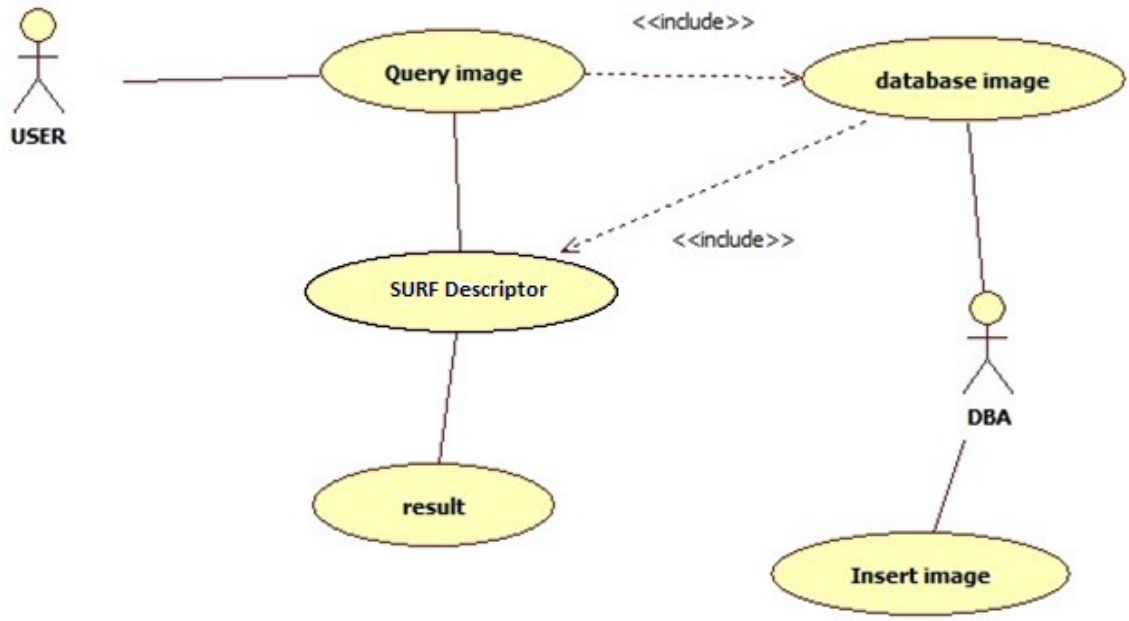


Fig. 4: Use-Case Diagram

ACTIVITY DIAGRAM

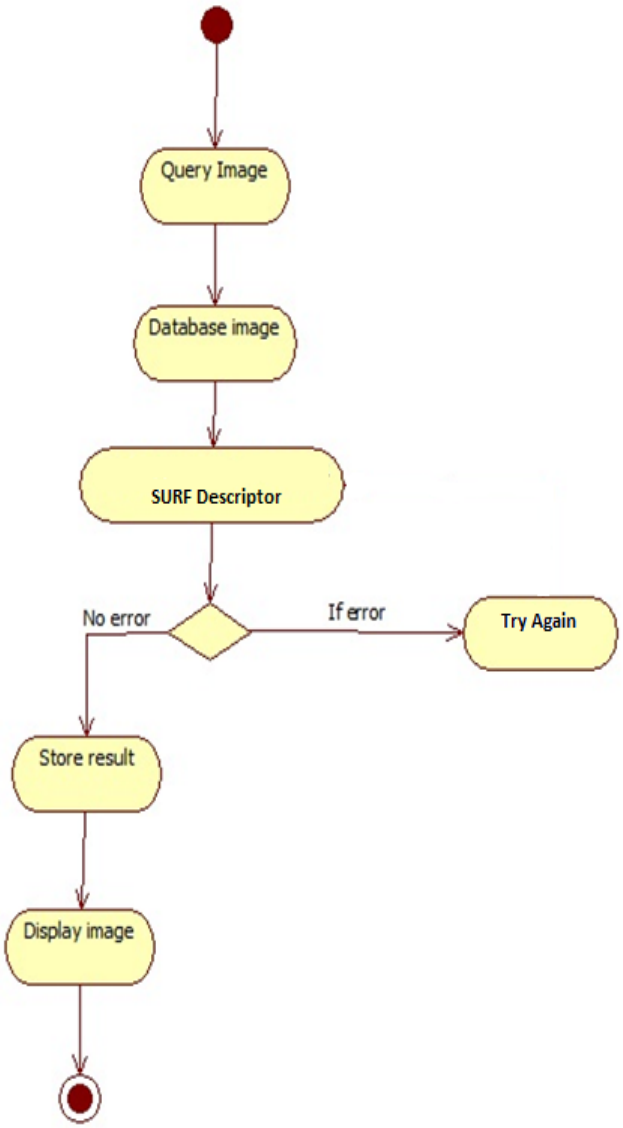


Fig. 5: Activity Diagram

DATA FLOW DIAGRAM

Level 0:

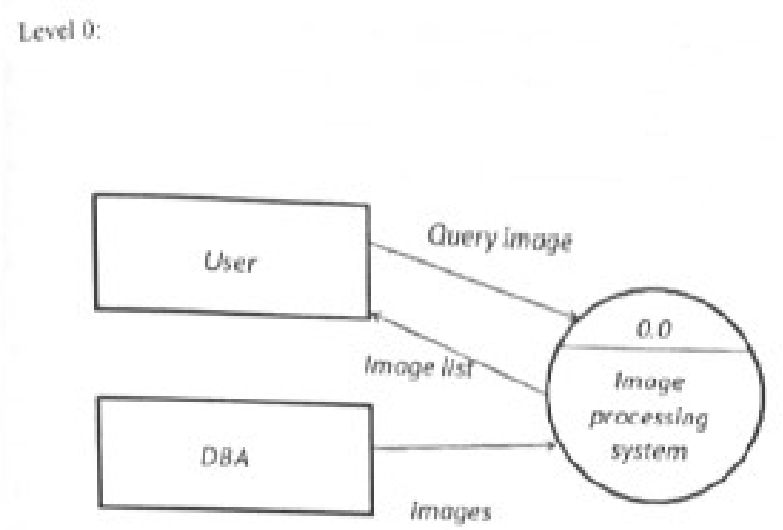


Fig. 6: Level 0 DFD Diagram

Level 1:

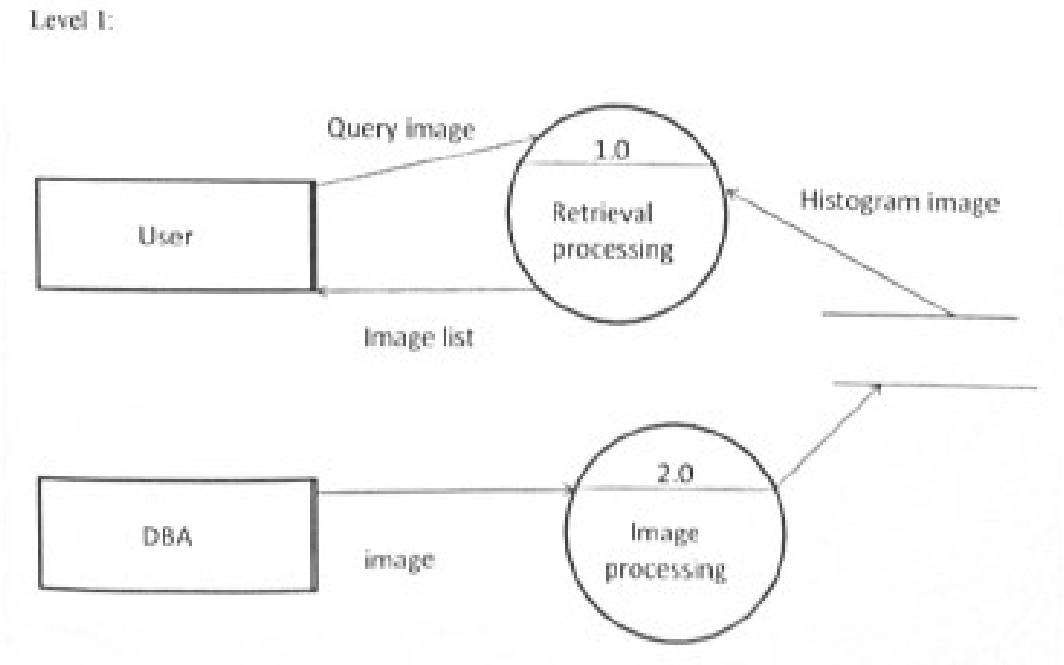


Fig. 7: Level 1 DFD Diagram

DATA FLOW DIAGRAM

Level 2:

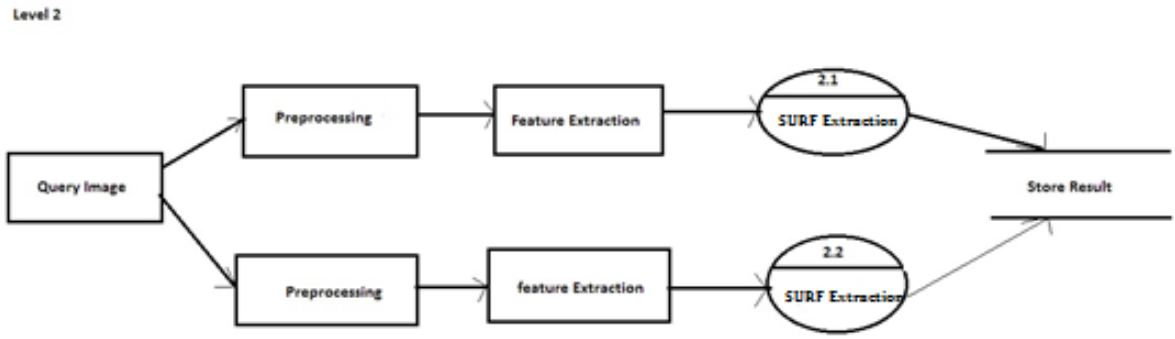


Fig. 8: Level 0 DFD Diagram

LEVEL 0:

The level 0 DFD diagram shows the input and the output to the system .User and the database admin are the actors of the image retrieval system.

LEVEL 1:

Level 1 DFD diagram is giving more detailed description of the level 0 DFD. Here the image processing system which calculates the histogram of each image and stores in a file or the database.

LEVEL 2:

Level 2 DFD diagram is giving more detailed description of the level 1 DFD. Here the image processing system is divided into two systems.

1) SURF for Database Images
2) SURF for Query Images

Content Based Image Retrieval Using SURF (Super-fast Robust Features)

Chapter-3

- **Implementation**
- **Proposed System**

IMAGE FEATURES AND SURF

This section presents a brief review of considered low-level visual features in the proposed approach and then reviews the basic concepts of the feed-forward back-propagation neural network.

A). Color Descriptor

Color is one of the important features of an image, which depicts much of the information from the image. RGB color model do not correspond to the human way of perceiving the colors. And also RGB space does not separate the luminance component from the chrominance ones. Therefore, HSV color space is used in our approach. Each component of HSV model contributes directly to visual perception; therefore it is commonly used in image retrieval systems. Hue is used to distinguish colors; saturation gives a measure of the percentage of white light added to a pure color. Value indicates perceived light intensity.

The required amount of information about the image can be obtained from color distribution of pixels in an image. For this purpose, color histograms are used as color descriptors. In case of digital images, a color histogram represents the number of pixels that have colors in the image's color space, the set of all possible colors. For a given image, the procedure for calculation of color histogram is as follows: 1) Read images in database and extract RGB format pixel information from images. 2) Create normalized histograms for each of the RGB components of each image read from database.

B). SURF

The Speeded up robust features algorithm is a scale and rotation-invariant interest point detector and descriptor which is computationally very fast. It uses Integral images to improve the speed. The key points are detected by using a Fast-Hessian matrix. The descriptor describes a distribution of Haar-wavelet responses within the interest point neighborhood. The performance of SURF
increased by using an intermediate image representation known as the Integral Image. The integral image is computed rapidly from an input image and is used to speed up the

calculation of any upright rectangular area. The major computational steps of SURF algorithm is as follows:

Step 1: Fast Interest Point Detection.

The SURF feature detector is based on the Hessian matrix. The determinant of the Hessian matrix is used to determine the location and scale of the descriptor. The Hessian matrix is defined as H(x, σ) for a given point $\boldsymbol{xx}$ = (xx, yy) in an image as follows:

$$H(x,\sigma) = \begin{bmatrix} L_{xx}(x,\sigma) L_{xy}(x,\sigma) \\ L_{xy}(x,\sigma) L_{yy}(x,\sigma) \end{bmatrix} \quad (1)$$

Where Lxx (x,σ) is the convolution of the Gaussian second order derivative with the image I in point x and similarly for Lxy (x,σ) and Lyy (x,σ). The SURF approximates second order derivatives of the Gaussian with box filters. Image convolutions with these box filters can be computed rapidly by using integral images. The determinant of the Hessian matrix is written as:

$$Det\,(H_{approx}) = D_{xx}D_{yy} - (0.9D_{xy})^2 \quad (2)$$

In order to localize interest points in the image and over scales, non-maximum suppression in a 3 × 3 × 3 neighborhood is applied. Finally, the found maxima of the determinant of the Hessian matrix are then interpolated in scale and image space.

Step 2: Interest Point Descriptor

The SURF descriptor is extracted from an image in two steps: the first step is assigning an orientation based on the information of a circular region around the detected interest points. The orientation is computed using Haar-wavelet responses in both x and y direction. Once the Haar-wavelet responses are computed and they are weighted with a Gaussian with σ = 2.5s centered at the interest points. In a next step the dominant orientation is estimated by summing the horizontal and vertical wavelet responses within a rotating wedge which covering an angle πo/f3 in the wavelet

response space. The resulting maximum is then chosen to describe the orientation of the interest point descriptor. In a second step, the region is split up regularly into smaller square sub-regions and a few simple features at regularly spaced sample points are computed for each sub-region. The horizontal and vertical wavelet responses are summed up over each sub-region to form a first set of entries to the feature vector. The responses of the Haar-wavelets are weighted with a Gaussian centered at the interest point in order to increase robustness to geometric deformations and the wavelet responses in horizontal dx and vertical Directions dy are summed up over each sub-region. Furthermore, the absolute values |dy| and |dy |are summed in order to obtain information about the polarity of the image intensity changes. Therefore each sub-region has a four-dimensional descriptor vector

$$V = (\sum d_x, \sum |d_x|, \sum |d_y|) \qquad (3)$$

Where, ddxx denotes the horizontal wavelet response & ddyy the vertical response. The resulting descriptor vector for all 4 by 4 sub-regions is of length 64.

Indexing and Matching

In our CBIR system the KD-tree algorithm is used to match the features of the query image with those of the database images. The KD-tree with the BEST bin First (BBF) search algorithm is used for indexing and matching the SURF features. The KD-tree is a kind of binary tree in which each node chooses a dimension from the space of the features being classified: all features with values less or equal to the node in that particular dimension will be put in the left sub-tree; the other nodes will be put in the right sub-tree and thus recursively. The BBF algorithm uses a priority search order to traverse the KD-tree so that bins in feature space are searched in the order of their closest distance from the query. The k-approximate and reasonable nearest matches can be returned with low cost by cutting off further search after a specific number of the nearest bins have been explored. The Voting scheme algorithm is used to rank and retrieved the matched images.

IMPLEMENTATION

Proposed Method

In this, a new method for image retrieval is formulated in order to reduce the searching time of images from the image database. The coarse content of image is grouped under nine Categories as: Custard apple, Pineapple, Mango, Green Apple, Red Apple, Banana, Red Capsicum, Pear, and Watermelon. Thereby, we can reduce the search space by one third of what was earlier.

Image Retrieval

Image Retrieval from the image collections involved with the following steps:

- Pre-Processing
- Feature Extraction
- SURF Extraction
- Database Creation
- Similarity Comparison using Kd-Tree

Pre-Processing

The aim of the pre-processing is an improvement of the image that suppresses unwilling distortions or enhances some image features, In preprocessing for image classification we are following two steps

1) Resizing of image into 256 * 256 pixels

Feature Extraction

Surf works only on gray scale images to extract the color features around the region of each interest points the Color Moments are used. Color moments are calculated for a 5x5 region around the SURF interest point for the RGB channel. Since most of the information is concentrated on the low order moments, only the first moment (mean) and the second moments (variance) will be used as the color features.

SURF Extraction

SURF features of images like Interest Points and Descriptors for each image in database will be performed using Hessian Matrix and Haar-Wavelet respectively.

Database Creation

Quantized features of image (SURF + Color) will be stored in binary database. This database will be used at time of retrieval of similar images according to query image.

Similarity Comparison using Kd-Tree

When user will give any query image, first three steps will be performed on query image. After quantized feature extraction of query image, vector distance between database images and query image will be calculated. After this final result will be stored in Kd-Tree according to similarity of database image and query image.

System we proposed is shown in below image:

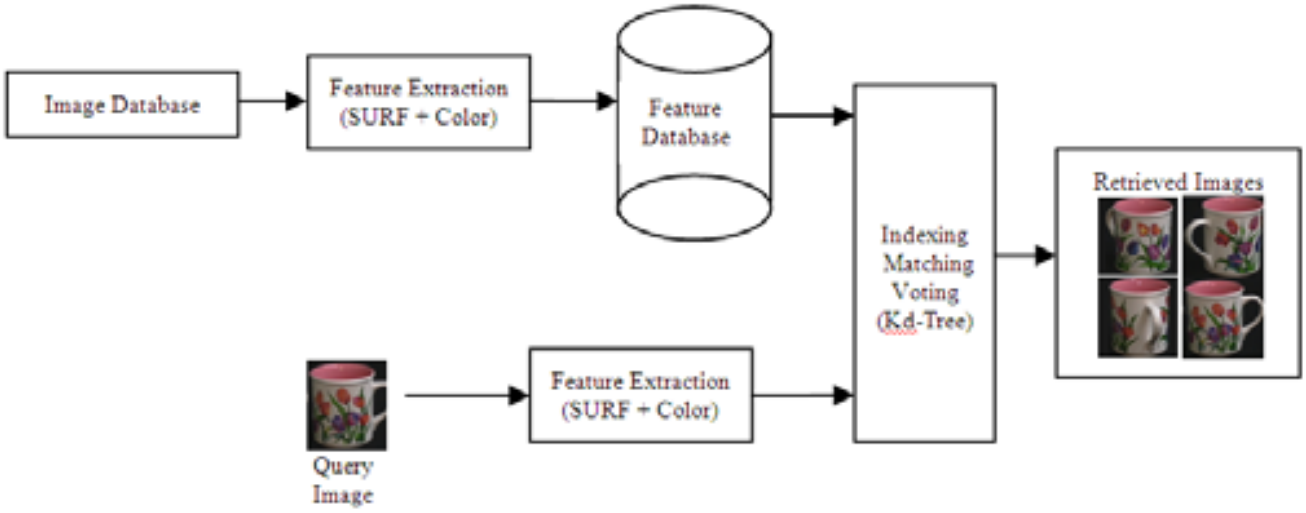


Fig 9: Proposed System Working

Content Based Image Retrieval Using SURF (Super-fast Robust Features)

Chapter-4

- **Result**
- **Summary**
- **Usefulness of existing solutions**
- **Scope of future work**

RESULT

As a part of implementation, we used the MATLAB tool to implement the HSV color space to retrieve the similar images from the database based on the query image. We used a folder as the database for our experiment.

The snapshot of the folder is as below:

Fig 10: Image Database

We used the MATLAB tool to design the GUI for our experiment. The GUI is user friendly in use. The user is allowed to create a database, Initialize network, Train network and can do test on query image. Based on query image user is viewed the similar images.

The following snapshot shows the default GUI page that will be initially viewed to all the users

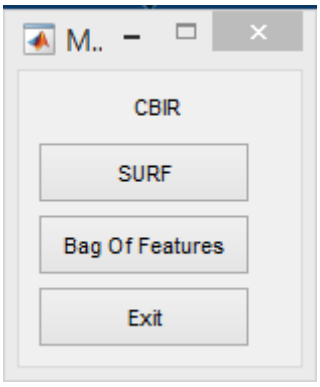


Fig 11: User Interface

The following snapshot shows the result according to query:

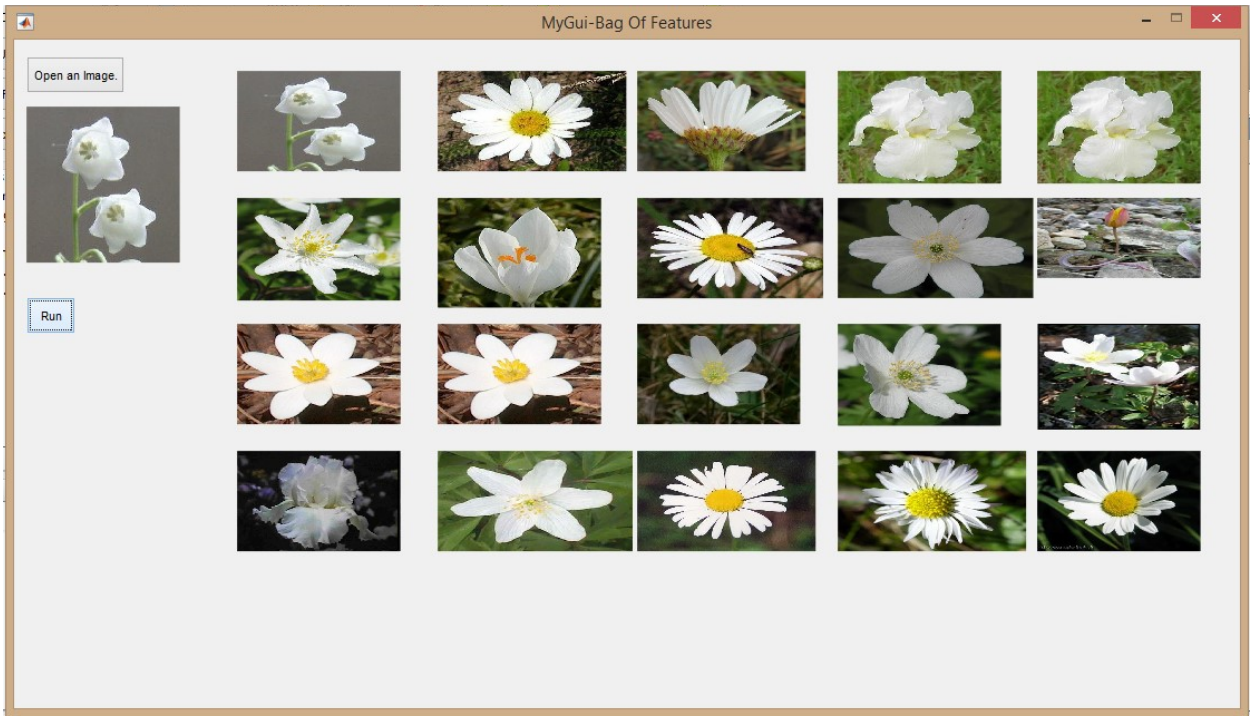


Fig 12: Output for Query Image

SUMMARY

The explosive growth of image data leads to the need of research and development of Image Retrieval. Content-based image retrieval is currently a very important area of research in the area of multimedia databases. Plenty of research works had been undertaken in the past decade to design efficient image retrieval techniques from the image or multimedia databases. More précised retrieval techniques are needed to access the large image archives being generated, for finding relatively similar images. In this work the SURF is combined with color Moments to improve the retrieval accuracy of the system which improves 23% of Average Precision. The proposed method gets 88% of Average Precision.

USEFULNESS

Following are the usefulness of the CBIR system:

- Can be used for Image Learning (i.e. Weather Forecasting)
- Medical Image Learning
- Security Systems
- Cyber Crime
- Face Detection
- Finger Print Recognition
- Data Security

SCOPE OF FUTURE WORK

We can build SURF-CBIR system by using following methods to achieve high accuracy:

- Neural Network
- SVM
- Relevance Feedback Based

1

Content Based Image Retrieval Using SURF (Super-fast Robust Features)

Reference

REFERENCE

1) Digital Image Processing using MATLAB, Second Edition, Rafael C. Gonzalez, Richards e. Woods, Steven L. Eddins.

2) www.gituhub.com/

3) www.mathworks.com/

4) www.stackoverflow.com/

5) www.mathworks.in/

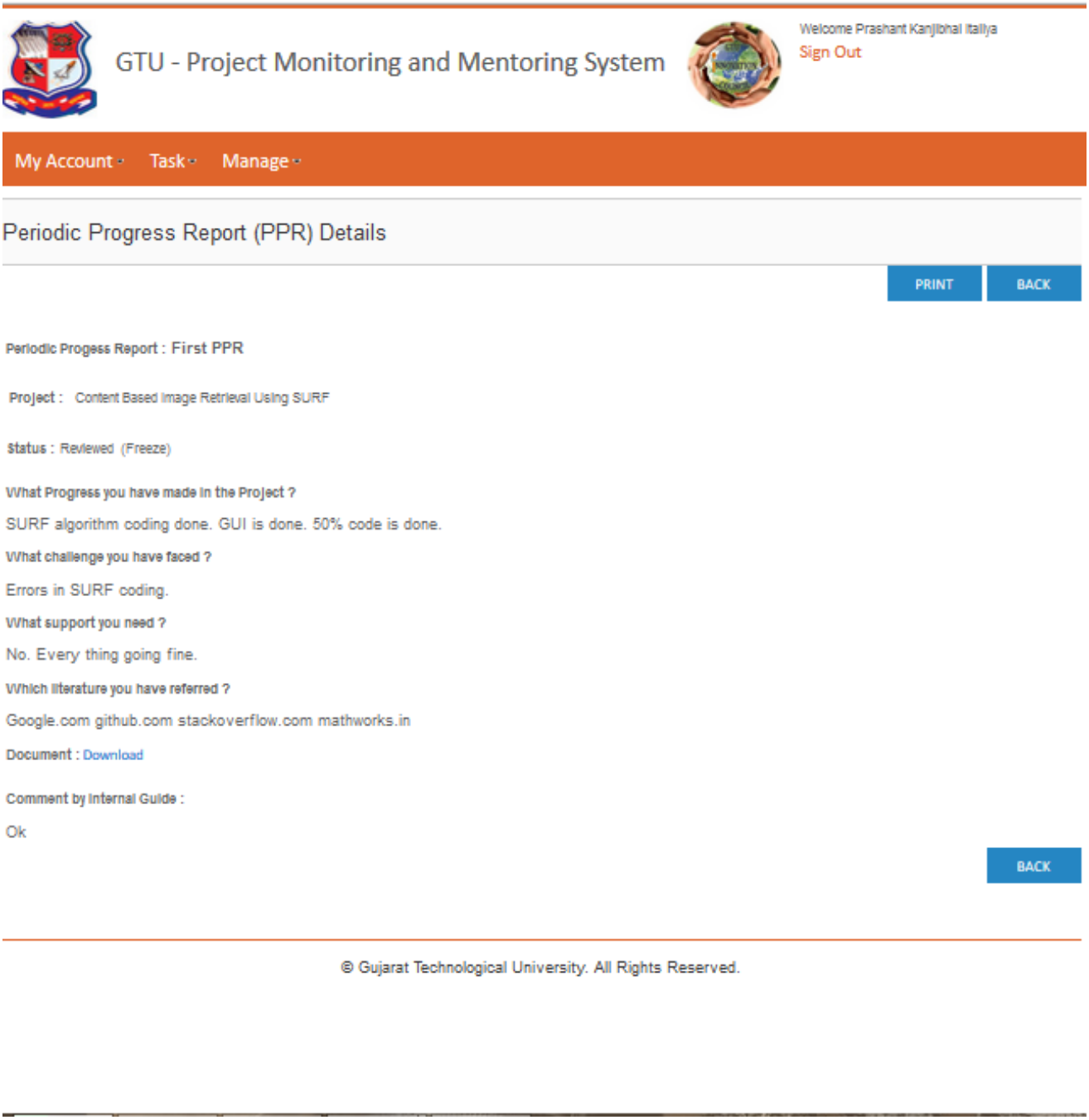
6) Y. Liu, D. Zhang, G. Lu, andW.-Y.Ma, "A survey of content-based image retrieval with high-level semantics," Pattern Recognit., vol. 40, no. 1, pp. 262–282, Jan. 2007.

Content Based Image Retrieval Using SURF (Super-fast Robust Features)

Appendix

- **Copy of four Periodic Progress Reports (PPR)**
- **Business Model Canvas (BMC)**
- **Patent Drafting Exercise (PDE) Report**
- **Copy of Paper: IEEE Published(Content based Image Retrieval using Neural Network)**

First PPR:


GTU - Project Monitoring and Mentoring System
Welcome Prashant Kanjibhai Italiya
Sign Out
My Account
Task
Manage
Periodic Progress Report (PPR) Details
PRINT
BACK
Periodic Progess Report : First PPR
Project : Content Based Image Retrieval Using SURF
Status : Reviewed (Freeze)
What Progress you have made in the Project ?
SURF algorithm coding done. GUI is done. 50% code is done.
What challenge you have faced ?
Errors in SURF coding.
What support you need ?
No. Every thing going fine.
Which literature you have referred ?
Google.com github.com stackoverflow.com mathworks.in
Document : Download
Comment by Internal Guide :
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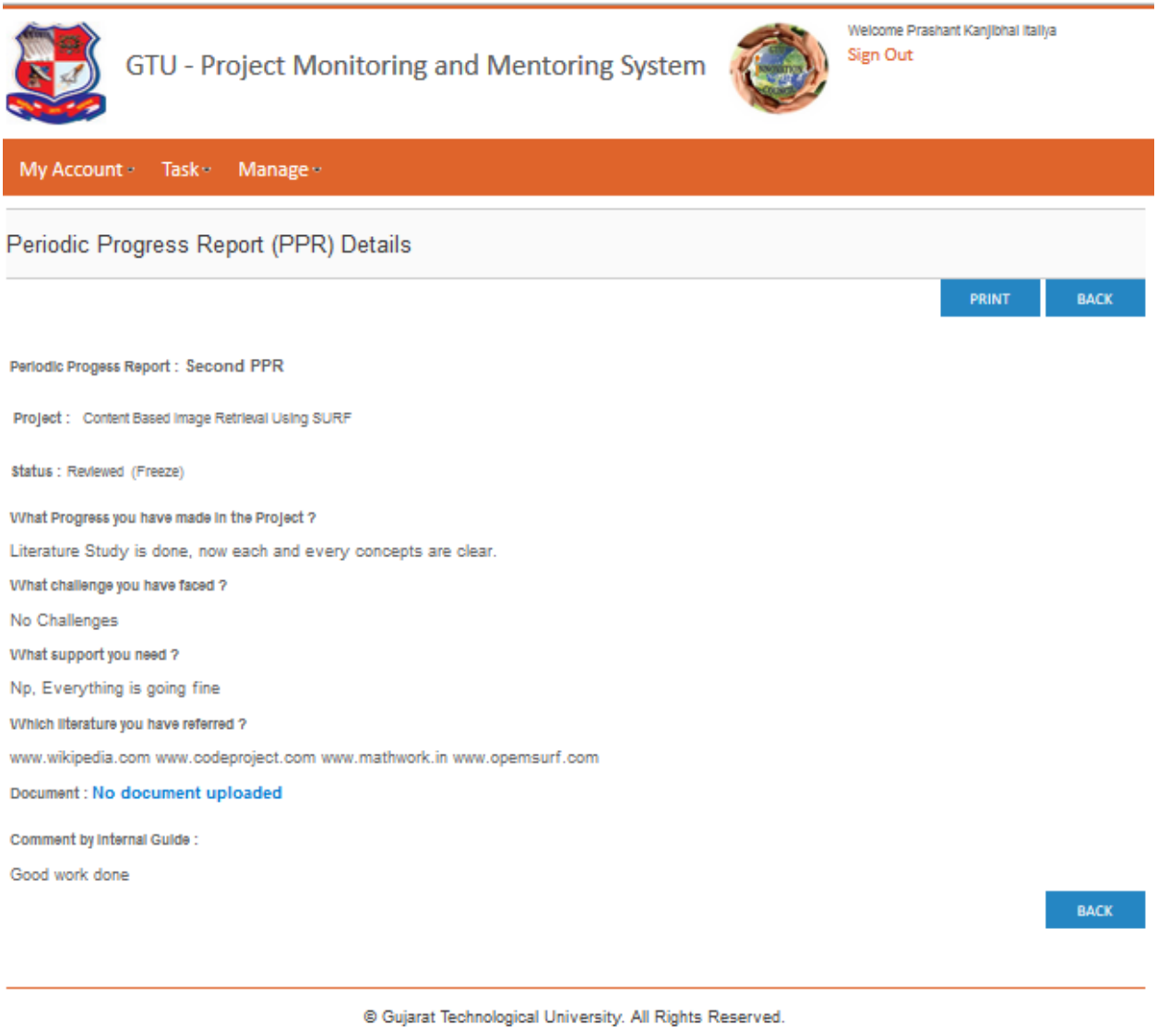
Second PPR: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BACK
Periodic Progess Report : Second PPR
Project : Content Based Image Retrieval Using SURF
Status : Reviewed (Freeze)
What Progress you have made in the Project ?
Literature Study is done, now each and every concepts are clear.
What challenge you have faced ?
No Challenges
What support you need ?
Np, Everything is going fine
Which literature you have referred ?
www.wikipedia.com www.codeproject.com www.mathwork.in www.opemsurf.com
Document : No document uploaded
Comment by Internal Guide :
Good work done
BACK
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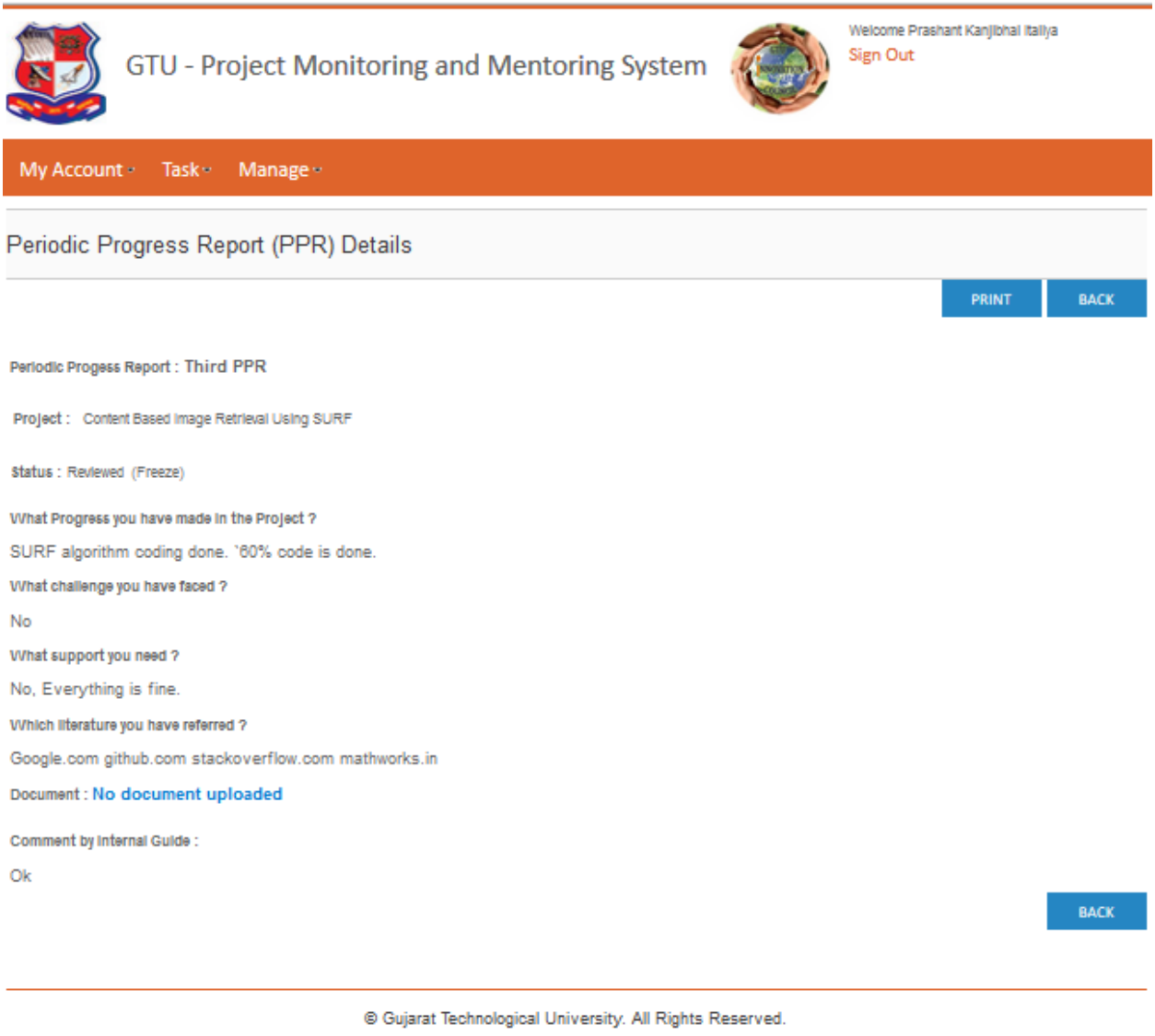
Third PPR:


GTU - Project Monitoring and Mentoring System
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Task
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Periodic Progress Report (PPR) Details
PRINT
BACK
Periodic Progess Report : Third PPR
Project : Content Based Image Retrieval Using SURF
Status : Reviewed (Freeze)
What Progress you have made in the Project ?
SURF algorithm coding done. `60% code is done.
What challenge you have faced ?
No
What support you need ?
No, Everything is fine.
Which literature you have referred ?
Google.com github.com stackoverflow.com mathworks.in
Document : No document uploaded
Comment by Internal Guide :
Ok
BACK
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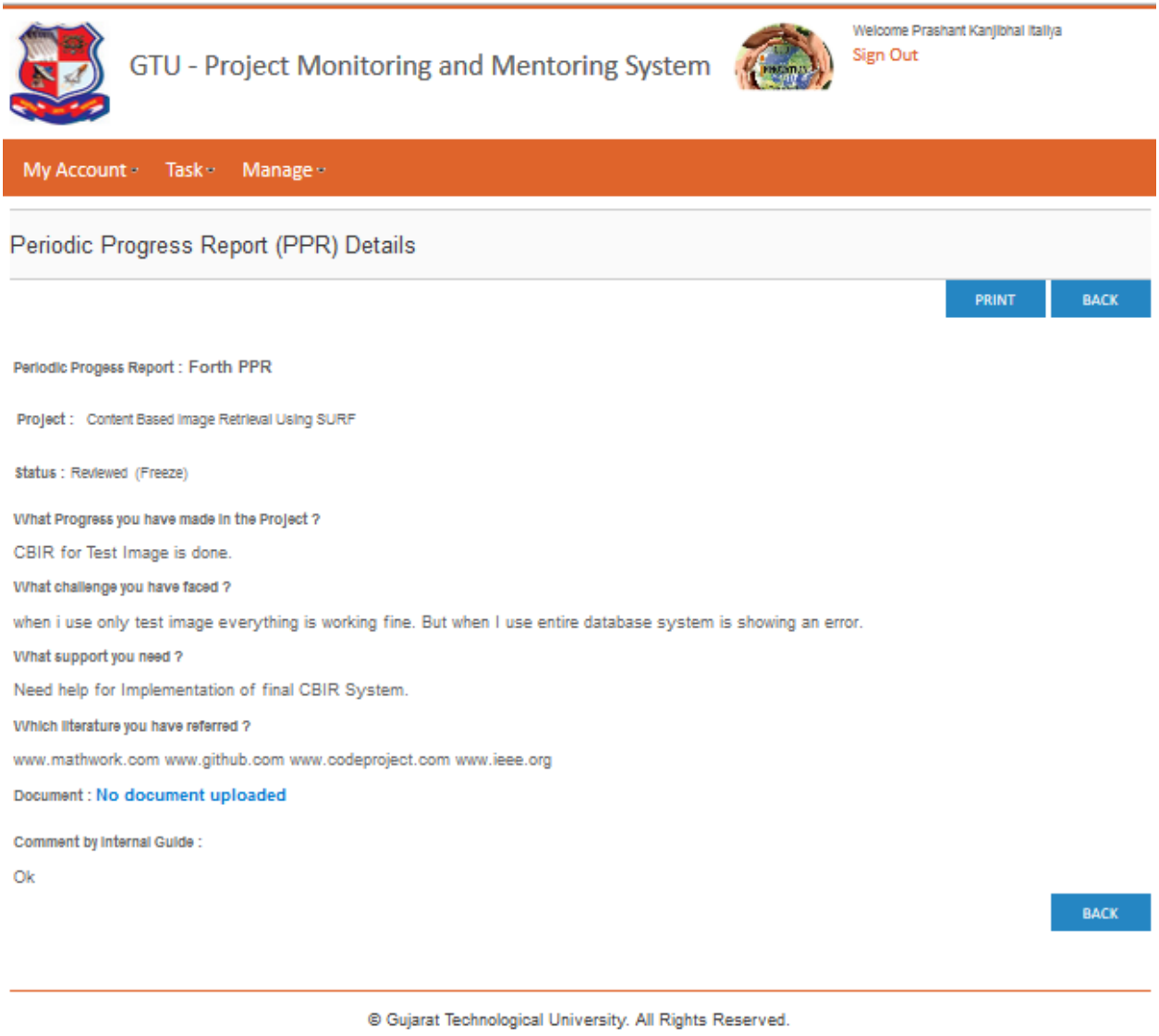
Fourth PPR: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Periodic Progess Report : Forth PPR
Project : Content Based Image Retrieval Using SURF
Status : Reviewed (Freeze)
What Progress you have made in the Project ?
CBIR for Test Image is done.
What challenge you have faced ?
when i use only test image everything is working fine. But when I use entire database system is showing an error.
What support you need ?
Need help for Implementation of final CBIR System.
Which literature you have referred ?
www.mathwork.com www.github.com www.codeproject.com www.ieee.org
Document : No document uploaded
Comment by Internal Guide :
Ok
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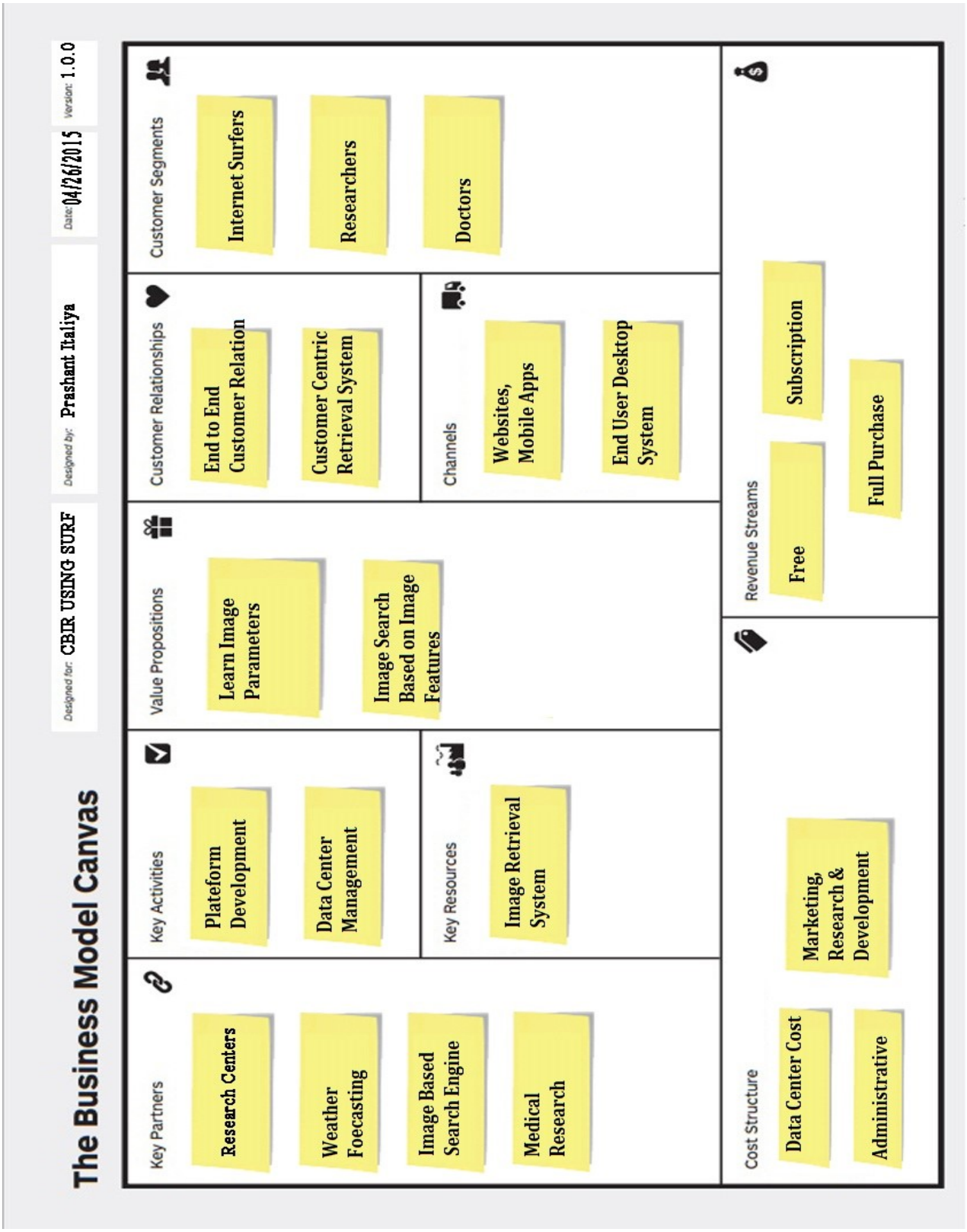
BUSINESS MODEL CANVAS



Business Canvas Report: Content Based Image Retrieval Using SURF

The **Business Model Canvas** is a strategic management and lean startup template for developing new or documenting existing business models. It is a visual chart with elements describing a firm's or product's value proposition, infrastructure, customers, and finances. It assists firms in aligning their activities by illustrating potential trade-offs.

There are few main components of BMC that completely describes your organization. Here this BMC model is illustrated for **"Content Based Image Retrieval System Using SURF'**. Aspects of business model are listed below:

1) Key Partners:

- Research Centers
- Weather Forecasting
- Image Based Search Engine
- Medical Research

2) Key Activities:

- Platform Development
- Data Center Management

3) Key Resources:

- Image Retrieval System

4) Value Proposition:

- Learn Image Parameters
- Image Search Based on Image Parameter

5) Customer Relationship:

- End to End Customer Relation
- Customer Centric System

6) Channels:

- Websites
- Mobile Application
- End User Desktop System

7) Customer Segments:

- Internet Surfers
- Researchers
- Doctors

8) Cost Structure:

- Data Center Cost
- Administration
- Marketing
- Research & Development

9) Revenue Stream:

- Free
- Subscription Based
- Full Purchase

GTU Innovation Council

Patent Drafting Exercise (PDE)

FORM 1 THE PATENTS ACT 1970 (39 OF 1970) & THE PATENTS RULES, 2003 APPLICATION FOR GRANT OF PATENT	(FOR OFFICE USE ONLY) Application No: Filing Date: Amount of Fee paid: CBR No: _____

1. Applicant(s) :

ID	Name	Nationality	Address	Mobile No.	Email
1	Prashant Kanjibhai Italiya	Indian	GTU	8000006587	praitaliya@gmail.com

2. Inventor(s):

ID	Name	Nationality	Address	Mobile No.	Email
1	Prashant Kanjibhai Italiya	Indian	GTU	8000006587	praitaliya@gmail.com

3. Title of Invention/Project:

Content Based Image Retrieval Using SURF

4. Address for correspondence of applicant/authorized patent agent in india

Name: Prashant Kanjibhai Italiya

Address: Information Technology , A. D. Patel Institute Of Technology, Karamsad , Gujarat Technological University.

Mobile: 8000006587

Email ID: praitaliya@gmail.com

Note : This is just a mock Patent Drafting Exercise (PDE) for semester 8, BE students of GTU. These documents are not to be submitted with any patent office.

5. Priority particulars of the application(S) field in convention country

Country	Application No.	Filing Date	Name of the Applicant	Title of the Invention
N/A	*N/A*	*N/A*	*N/A*	*N/A*

6. Particulars for filing patent co-operation treaty (pct) national phase Application

International application number	International filing date as alloted by the receiving office
N/A	N/A

7. Particulars for filing divisional application

Original(First) Application Number	Date of filing of Original (first) application
N/A	N/A

8. Particulars for filing patent of addition

Original(First) Application Number	Date of filing of Original (first) application
N/A	N/A

9. DECLARATIONS:

(i) Declaration by the inventor(s)

I/We, the above named inventor(s) is/are true & first inventor(s) for this invention and declare that the applicant(s).
herein is/are my/our assignee or legal representative.
Date : 8 - May - 2015

	Name	Signature & Date
1	Prashant Kanjibhai Italiya	_____

(ii) Declaration by the applicant(s) in the convention country

I/We, the applicant (s) in the convention country declare that the applicant(s) herein is/are my/our assignee or legal representative.applicant(s)

(iii) Declaration by the applicant(s)

I/We, the applicant(s) hereby declare(s) that:-

☑ I am/We in possession of the above mentioned invention.

☑ The provisional/complete specification relating to the invention is filed with this aplication.

☒ The invention as disclosed in the spcification uses the biological material from India and the necessary permission from the competent authority shall be submitted by me/us before the grant of patent to me/us.

☒ There is no lawful ground of objection to the grant of the patent to me/us.

☑ I am/we are the assignee or the legal representative of true & first inventors.

☑ The application or each of the application,particulars of each are given in the para 5 was the first applicatin in the convention country/countries in respect of my/our invention.

☑ The application or each of the application,particulars of each are given in the para 5 was the first applicatin in the convention country/countries in respect of my/our invention.

☑ I/we claim the priority from the above mentioned applications(s) filed in the convention country/countries & state that no application for protection in respect of invention had been made in a convention country before that date by me/us or by any person

☒ My/Our application in india is based on international application under Patent Cooperation Treaty (PCT) as mentioned in para 6

☒ The application is divided out of my/our application(s) particulars of which are given in para 7 and pray that this application may be treated as deemed to have been filed on _____under section 16 of the Act.

☒ The said invention is an improvement in or modification of the invention particulars of ehivh are given in para 8.

10. Following are the attachments with the application:

☑ (a) Provisional specification/Complete specification

☒ (b) Complete specification(In confirmation with the international application) / as amended befo international Preliminary Examination Authority (IPEA),as applicable(2 copies),No.of pages.. claims.....

☑ (c) Drawings (In confirmation with the international application)/as amended before the interr Preliminary Examination Authority(IPEA),as applicable(2 copies),No.of sheets....

☒ (d) Priority documents

☒ (e) Translations of priority documents/specification/international search reports

☑ (f) Statement and undertaking on Form 3

☑ (g) Power of Authority

☒ (h) Declaration of inventorship on Form 5

☒ (i) Sequence listing in electronic Form

☒ (j) ..... Fees Rs.XXX in Cash /Cheque/Bank Draft bearin No.XXX Date: XXX o Bank.

I/We hereby declare that to the best of my /our knowledge, information and belief the fact and mtters stated herein are correct and I/We request that a patent may be granted to me/us for the said invention.
Dated this **8** day of **May** , **2015**

Note : This is just a mock Patent Drafting Exercise (PDE) for semester 8, BE students of GTU.
These documents are not to be submitted with any patent office.

	Name	Signature & Date
1	Prashant Kanjibhai Italiya	

Note : This is just a mock Patent Drafting Exercise (PDE) for semester 8, BE students of GTU.
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FORM 2
THE PATENTS ACT, 1970
(39 OF 1970)
&
THE PATENTS RULES, 2003
PROVISIONAL SPECIFICATION

1. Title of the project/invention :

Content Based Image Retrieval Using SURF

2. Applicant(s) :

Prashant Kanjibhai Italiya , (Indian)
Address :GTU

3. Preamble to the description :

The following specification describes the invention.

4. Description :

a. Field of Application / Project / Invention :

Image Processing, Supervised Learning, CBIR

b. Prior Art / Background of the Invention / References :

No

c. Summary of the Invention/Project :

Content-Based Image Retrieval (CBIR) is a challenging task which retrieves the similar images from the large database. Most of the CBIR system uses the low-level features such as color, texture and shape to extract the features from the images. In Recent years the Interest points are used to extract the most similar images with different view point and different transformations. In this project the SURF is combined with the color feature to improve the retrieval accuracy. SURF is fast and robust interest points detector/descriptor which is used in many computer vision applications. To improve the performance of the system the SURF is combined with Color Moments since SURF works only on gray scale images. The KD-tree with the Best Bin First (BBF) search algorithm is to index and match the similarity between the features of the images. Finally, Voting Scheme algorithm is used to rank and retrieve the matched images from the database.

d. Objects of the Invention/Project :

Content-Based Image Retrieval (CBIR) is a challenging task which retrieves the similar images from the large database. Most of the CBIR system uses the low-level features such as color, texture and shape to extract the features from the images. In Recent years the Interest points are used to extract the most similar images with different view point and different transformations. In this project the SURF is combined with the color feature to improve the retrieval accuracy. SURF is fast and robust interest points detector/descriptor which is used in many computer vision applications. To improve the performance of the system the SURF is combined with Color Moments since SURF works only on gray scale images. The KD-tree with the Best Bin First (BBF) search algorithm is to index and match the similarity between the features of the images. Finally, Voting Scheme algorithm is used to rank and retrieve the matched images from the database.

e. Drawing(s) :

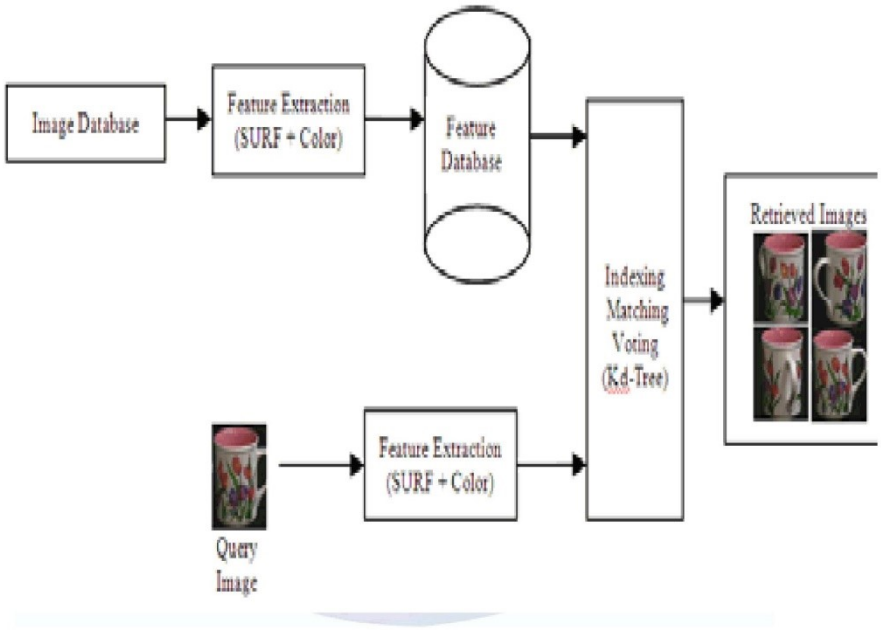
21210_1_546

f. Description of the Invention

Content-Based Image Retrieval (CBIR) is a challenging task which retrieves the similar images from the large database. Most of the CBIR system uses the low-level features such as color, texture and shape to extract the features from the images. In Recent years the Interest points are used to extract the most similar images with different view point and different transformations. In this project the SURF is combined with the color feature to improve the retrieval accuracy. SURF is fast and robust interest points detector/descriptor which is used in many computer vision applications. To improve the performance of the system the SURF is combined with Color Moments since SURF works only on gray scale images. The KD-tree with the Best Bin First (BBF) search algorithm is to index and match the similarity between the features of the images. Finally, Voting Scheme algorithm is used to rank and retrieve the matched images from the database.

Drawing Attachments :

21210_1_546



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FORM 3
THE PATENTS ACT, 1970
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&
THE PATENTS RULES, 2003
STATEMENT AND UNDERTAKING UNDER SECTION 8

1. Declaration :

I/We, Prashant Kanjibhai Italiya ,

2. Name, Address and Nationality of the joint Applicant :

Prashant Kanjibhai Italiya (Indian)
Address : GTU

Here by declare:

(i) that I/We have not made any application for the same/substantially the same invention outside India.
(ii) that the right in the application(s) has/have been assigned to,

Name of the Country	*Date of Application*	*Application Number*	*Status of the Application*	*Date of Publication*	*Date of Grant*
N/A	*N/A*	*N/A*	*N/A*	*N/A*	*N/A*

(iii) that I/We undertake that up to the date of grant of patent by the Controller , I/We would keep him inform in writing the details regarding corresponding application(s) for patents filed outside India within 3 months from the date of filing of such application.

Dated this **8** day of **May** , **2015**.

3. Signature of Applicants :

Sign and Date
Prashant Kanjibhai Italiya

To
The Controller of Patent
The Patent Office, at **Mumbai**.

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These documents are not to be submitted with any patent office.

International Conference on Electrical, Electronics, Signals, Communication and Optimization (EESCO) - 2015

Image Classification using Neural Network for Efficient Image Retrieval

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***Abstract*— Traditional keyword based image retrieval systems has become inefficient for retrieval of images because of extensive digitalization of images and wide explosion of World Wide Web. To overcome such limitations Content Based Image Retrieval systems are used to retrieve similar images from large database for a given query image. There are various methods for CBIR are available some of which used Global image features such as Color, Texture and Shape. Some methods uses region level image features such as image segments. In our system we are using hybrid approach. We uses global image features based CBIR with feed forward back-propagation neural network. Neural network is used for classification of query image as per training database. At first neural network is trained about the color features of images in the database. The training is done by using back-propagation algorithm. This trained database is used for classification of the query image. According to retrieved image class further color based CBIR is used for retrieving similar images.**

Keywords— Content-Based Image Retrieval (CBIR), low-level descriptors, neural network, feed-forward, back-propagation.

I. INTRODUCTION

Content-based image retrieval is the application of computer vision techniques to the image retrieval problem, that is, the problem of searching for digital images in large databases.

"Content-based" means the search which analyzes the contents of an image rather than metadata such as keywords, tags, or descriptions associated with the image. The term "content" in this context might be referred to as colors, shapes, textures, or any other information that can be derived from the image itself. CBIR is desirable because the searches which rely purely on metadata are dependent on annotation quality and completeness. Having humans manually annotate images by entering keywords or metadata in a large database can be time consuming and may not capture the keywords desired to describe the image.

There are three different kinds of CBIR systems: global image properties based, region level feature based and relevance feedback based. First approach uses low-level features of an image such as color, texture and shape of an object to retrieve images. They can be easily implemented and they perform well for simple images. They are not suitable for broad content image databases. Region-based approach uses image segmentation for the retrieval of image. CBIR systems can make use of *relevance feedback*, where the user progressively refines the search results by marking images in the results as "relevant", "not relevant" to the search query, then repeating the search with the new information.

In our system we are using hybrid approach which is global image property based and neural network for effective and efficient image retrieval. As Global image property we are using color features of the image and feed forward back propagation (FFBP) neural network. FFBP precedes both in forward and backward direction. Output computation is carried out in forward direction and error computation in backward direction. We are using two unique properties for our system. 1) Global image features – HSV histogram and 2) Neural Network for classification of images by training and testing algorithms. In training we make FFBP NN to learn about the features of images in the database. We use this trained network during the testing (Retrieval of Images). Back-propagation technique, which is a supervised method for learning is used for training the neural network.

II. RELATED WORK

In digital neural network implementation, complexity of the forward phase can be reduced when the activation function is implemented through a lookup table (LUT) [1]. The LUT access time is noticeably independent from the function shape. It is well known that the network behavior, as that shown by the multilayer perceptron (MLP), greatly depends on the shape of these activation functions.

Focusing on literature survey, we find some most important CBIR systems [2], [3]. The conventional neuron model, proposed by McCulloch and Pitts in 1943 [4], is composed of a linear combiner followed by a nonlinear function (activation function) with hard-limiting characteristics. Recently, in order to develop gradient based learning algorithms, such hard-limiters are substituted with nonlinear differentiable functions [5]. Some papers overview and compare the current technique in this area [6], [7]. Earliest developed CBIR adopted various color descriptors.[8] proposed a signature-based color-spatial image retrieval system. A CBIR scheme based on global and local color

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distributions in an image is presented in [9]. [10] Proposed a CBIR method based on an efficient combination of multi-resolution of a color and texture features. The color features used in this paper are color auto-correlograms of the hue, saturation component of images in HSV color space. The texture features taken are including block difference of inverse probabilities and block variation of local correlation coefficient moments of the value component image. A survey on CBIR systems based on relevance feedback approach yields [11]. This paper introduces interactive genetic algorithm to include human computer interaction and tries to use user's subjectivity in retrieval process using a user defined fitness function. A comparison is made between two pattern recognition using statistical and neural techniques in [12]. Finally, a neural network based approach for image processing is described in [13], which reviews more than 200 applications of neural networks in image processing and discuss the present and possible future role of neural networks, in particular feed-forward neural networks.

III. Background Study And Literature Review

This section presents a brief review of considered low-level visual features in the proposed approach and then reviews the basic concepts of the feed-forward back-propagation neural network.

A. Color Discriptor

Color is one of the important features of an image, which represent the information of the images. In our system we used HSV color model because RGB color model do not correspond to the human way of perceiving the colors. And also RGB space does not separate the luminance component from the chrominance ones. Hue is used to distinguish colors; saturation gives a measure of the percentage of white light added to a pure color. Value indicates perceived light intensity.

Information of the images can be obtained by color distribution of the pixels in the image. For this color histograms are used. A color histogram represents the number of pixels that have colors in the image's color space. For a given image, the procedure for calculation of color histogram is as follows: 1) Read images in database and extract HSV format pixel information from images. 2) Create normalized histograms for each of the HSV components of each image read from database.

B. Neural Network

In machine learning, artificial neural networks (ANNs) are a family of statistical learning algorithms inspired by biological neural networks and are used to estimate or approximate functions that can depend on a large number of inputs and are generally unknown. Artificial neural networks are generally presented as systems of interconnected "neurons" which can compute values from inputs, and are capable of machine learning as well as pattern recognition.

This neural computing technique is used in fields of classification, optimization, and control theory and for solving regression problems. NN are very effective in case of classification problems where detection and recognition of target is required. NN is preferred over other techniques due to its dynamic nature. Dynamic nature is achieved by adjusting the weights according to final output and applied input data. This adjustment of weights takes place iteratively until desired output is obtained. And this weight adjustment of network is known as "learning" of neural network.

The architecture of neural network consists of a large number of nodes and interconnection of nodes. A multiple-input neuron with multiple inputs '*R*' is shown in Figure 1. The individual inputs $p_1, p2, \ldots p_n$ are each weighted by corresponding elements $w_{1,1}, w_{1,2} \ldots w_{1,R}$ of the weight matrix '**W**'.

The neuron also has a bias '*b*', which is summed with the weighted inputs to form the net input '*n*':

$$\mathbf{n} = w_{1,1}*p_1 + w_{1,2}*p_2 + \ldots + w_{1,R}*p_R + \mathbf{b} \quad (3)$$

In matrix form, this can be rewritten as

$$N = W_p + b \quad (4)$$

Now, the neuron output is given as,

$$A = f(Wp + b) \quad (5)$$

The transfer function used above is a log-sigmoid transfer function. This transfer function takes the input (which may have any value between plus and minus infinity) and squashes the output in between 0 to 1 range, according to the expression:

$$\mathbf{y} = \mathbf{log sig}(n) \quad (6)$$

$$\mathbf{y} = \frac{1}{1+e^{-n}} \quad (7)$$

Where '*y*' is output of the function for input '*n*'.

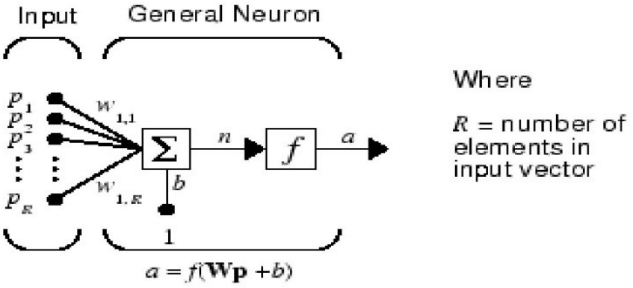


Figure-1: Multiple-Input Neuron [16]

The nodes at a particular stage constitute a "layer". The first layer is called input layer and last layer is called output layer. The layers in between output and input layer are called hidden layers. As the number of hidden layers in the network increases, the performance of network increases. Each node in a network serves the purpose of summation of all its inputs. The output of a node is further applied to the next node. The simplest of all neuron is perceptron. Perceptron is a two layer structure: input layer and output layer. The output function of perceptron may be step, linear or sigmoidal. If the output function of perceptron is step then it solves classification problems, if the output function is linear then it solves regression problems. Simple perceptron or neuron is used for resolving linearly separable data. If the data is linearly non-

separable then other technique such as back-propagation is used.

C. Feed Forward Back-Propagation Neural Network(FFBP)

FFBP NN is technique for pattern recognition and classification. FFBP NN is a multilayer neural network, used to implement non-linear differential functions. The architecture of FFBP NN consists of input, hidden and output layer. FFBP precedes both in forward and backward direction. It computes output in the forward procession and computes error in the backward procession.

In the forward procession, training data is applied on the neural network through the input layer. Then data is fed to the hidden layer, the hidden layer actually performs the processing. Finally the data is applied to Output Layer; Output Layer incorporates the activation function according to which output is computed. If the function at the Output Layer is step, then it performs Classification problem. If the function at the Output Layer is linear, then it performs Regression problem.

The values computed in the forward pass are compared with desired output. The difference between the desired output and the actual output gives the error. This error is computed and propagated back towards the Hidden Layer. The gradient of the error is computed and applied on a node k in this manner

$$e_k = desired\_output - actual\_output \quad (8)$$

$$e_k = d_k - y_k \quad (9)$$

Where e_k error on a single output neuron k is, d_k is desired output and y_k is calculated output of neuron k. Then gradient is calculated using question:

$$\delta k = \frac{\delta y k}{\delta x k} * e_k \quad (10)$$

Where x_k is weighted sum of input values to node k. This method of error reduction is called Gradient Decent. This method reduction converges to output in faster manner. All of the above processing is performed in the backward pass if FFBP algorithm.

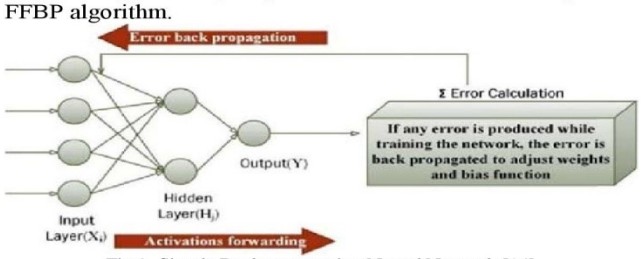


Fig 2. Simple Back propagation Neural Network [16]

The figure 2 shows a basic BPNN comprising of an input, hidden and output layer. Where inputs applied on the input layer X_i, H_j is the hidden layer and the output of the network is Y. Error signal that is generated when the output 'Y' is compared to the target output of the training dataset comprising of the ideal classification result. The error signal moves from the output layer to the hidden layer changing the weights to adjust to the correct result. Once this error is minimized lose to zero the weights are fixed meaning the network is trained and can be tested.

IV. Problem Defination

We have two phases in our system. First is neural network that is used for classification of the query image. After successful classification of query image further retrieval is proceed based on Image retrieval using low level image features. In our system HSV Color model is used. Color images normally are in three dimensional. HSV color components are taken from each and every image. Then the average value of H, S, and V values for both query image and target images are calculated. These three average values for each image are stored and considered as features. By using these stored features the target image from the repository is retrieved with respect to the query image. The resulted values of both the query image and target images are compared by Euclidean distance method.

A. Proposed Methods

In this, a new method for image classification is formulated in order to reduce the searching time of images from the image database. The coarse content of image is grouped under nine Categories as: Custard apple, Pineapple, Mango, Green Apple, Red Apple, Banana, Red Capsicum, Pear, and Watermelon. Thereby, we can reduce the search space by one third of what was earlier.

B. Image Retrieval

Image Retrieval from the image collections involved with the following two phases:

1) Phase-1

During Phase-1 classification of query image is performed. This result is then passing on to phase-2. Steps for phase-1 are Pre-processing, Feature Extraction and Image Classification.

a) Pre-Processing

The aim of the pre-processing is an improvement of the image that suppresses unwilling distortions or enhances some image features, in preprocessing for image classification we are following two steps

- Resizing of image into 256 * 256 pixels
- Convert each image into gray image

b) Feature Extraction

Feature Extraction is processes of knowing the color distribution information of any image. For this histograms are used. Process for creating histogram is given below:

- Read images in database and extract gray format pixel information from images.
- Create normalized histograms for each components of each image read from database.

In our system we are using 54 Images as test images that are to be used during training phase of the neural network.

c) Image Classification

Image Classification is processes of determining the class of the image according to database. For example in our system we have total nine classes. For each class we have six test images. Architecture for the phase-1 is shown in fig. 3.

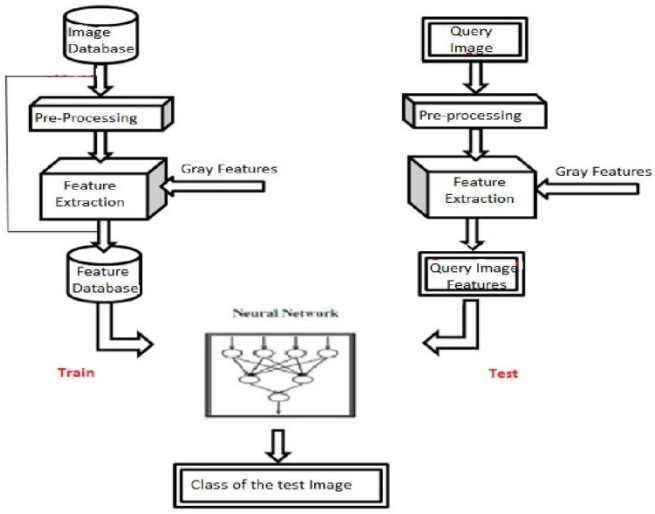


Fig 3. Architecture of phase-1

The training process includes creation, configuring a three-layered neural network and making it learn about the extracted features of training images. Training set includes all the images from image database (6 Images for each 9 classes). The learning process is carried out using back-propagation algorithm, which include computing error, updating weights In order to minimize the error.

The training makes the network store the learnt knowledge in its knowledge base. This knowledge base is used in later phase in comparison and decision making tasks by network. The comparing the features between query and training set images. And decision making task includes making decision about which two images features are most matched with respect to each other.

The testing phase includes the querying and retrieving class of the query image. The query image is first preprocessed and also its features are extracted. The trained network is presented with query image features. The network, acting as a classifier, selectively retrieves top matched, relevant, similar images as that of query image from the training database and gives the class of the query image.

2) Phase-2

Phase 2 is process of retrieving similar image from the database using global image properties (Color Features) as per result of phase-1. Result of phase-1 gives class of the query image. During Phase-2 retrieval of similar image is performed according to query image and its class. Steps for phase-2 are Pre-processing, Feature Extraction, similarity comparison and displaying n most similar images.

a) Pre-Processing

Pre-processing of this phase is same as first phase but in this phase processing and enhancement is perform on RGB image rather than gray image. In preprocessing for image retrieval phase we are following two steps; 1) Resizing of image into 256 * 256 pixels and 2) Convert each RGB color space into HSV color space

b) Color Feature Extraction

Feature extraction is carried out in the same way as we did in phase-1.

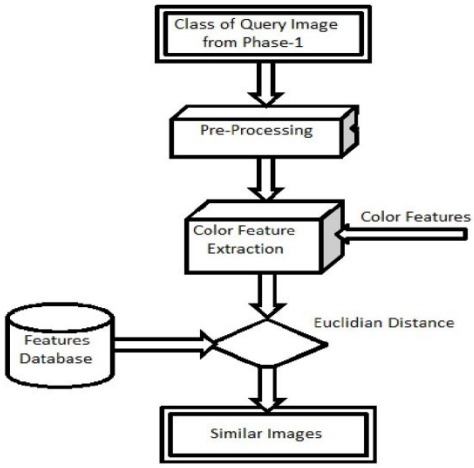


Fig 4. Architecture of Phase-2

c) Similarity Comparision

Similarity comparison means finding images from the database which are near (Similar) to query image according to its color features. Euclidian Distance is used to find similarities between query image and dataset images.

d) Display

Most similar images according to Euclidian Distance are displayed as per its priority.

V. Implemetation And Result

The experimental work is carried out using the database of the fruit images for experiment. The database is partitioned into nine categories of fruits, including, Sitafal, Guava, Banana, Pineapple, apple, pear, green apple, mango, watermelon, red capsicum etc., and each category contain six images. Images from each category are shown in fig 5.

To realize the proposed system MATLAB is used. The GUI design environment tool is used to develop the required front end GUI. The Image Processing toolbox and the neural network toolbox of MATLAB are used to implement the required image processing and network tasks.

A three layered neural network which is used as classifier, is setup and configured with parameters that are best suitable for image retrieval task. The configuration includes setting the permissible error to 0.001, and selecting the Back-Propagation as training algorithm, then, network is trained

about the extracted features of all images from the training database.

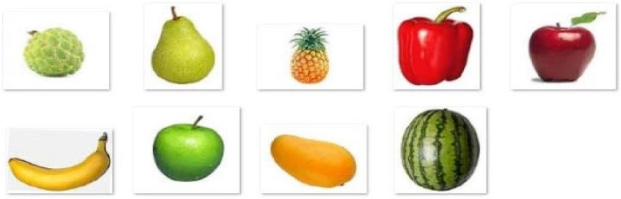


Fig 5. Images from each Category

The performance plot is a graph of epochs versus the mean square Error (MSE). The number of epochs we have taken is 500 and MSE measure the average of the squares of the errors. A given query image features are extracted and searched for similar images. For query image relevant images are considered to be those which are belong to same class. Fig 6 shows the graph for best training performance:

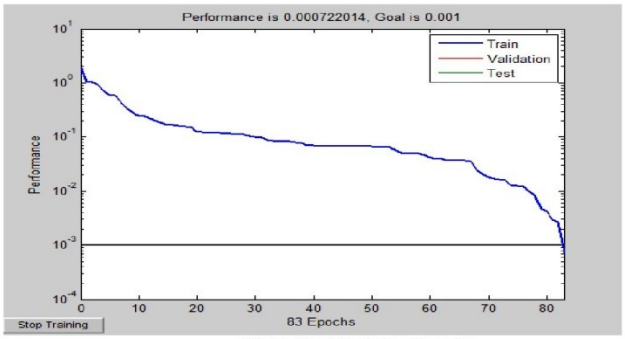


Fig 6. Best Training Epochs

Fig 7 (a) describes the query image and output for query image of custard apple without neural network is shown in fig 7 (b).

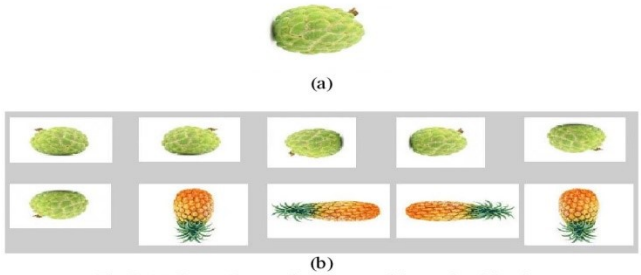
Fig 8 (a) describes the query image and output for query image of custard apple with neural network is shown in fig 8 (b).

The performance of the system is measured and compared by calculating precision and recall for the cases of retrieval using classification and without classification. Precision and recall is defined as,

$$\text{Precision} = N_{A(q)}/N_{R(q)} \quad (11)$$

$$\text{Recall} = N_{A(q)}/N_t \quad (12)$$

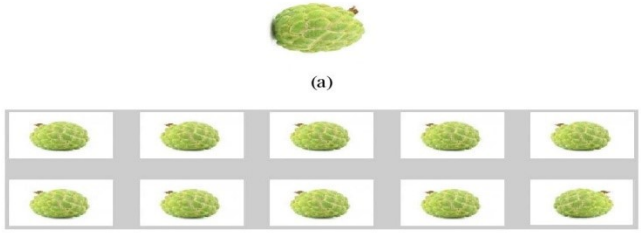
Where $NA(q)$ is the number of relevant images similar to the query, $NR(q)$ is the number of images retrieved by the system in response to the query, and Nt represents the total number of relevant images available in the database.



(a)

(b)

Fig 7. (a) Query Image (b) Output without classification



(a)

(b)

Fig 8. (a) Query Image (b) Output with classification

The table given below shows the details of retrieval precision and recalls values for each class of image. The TABLE I give the precision values along with the average precision and similarly gives recall values along with their average. Values for $N_{R(q)}$ and N_t are 10 and 54 respectively.

		CBIR with Neural Network		CBIR without Neural Network	
Class	*Category*	*Precision*	*Recall*	*Precision*	*Recall*
1	Sitafal	100	90	60	60
2	Pineapple	100	90	60	60
3	Green Apple	100	90	60	60
4	Red Apple	100	90	60	60
5	Banana	100	90	60	60
6	Red Capsicum	100	90	60	60
7	Mango	100	90	60	60
8	Watermelon	100	90	60	60
9	Pear	100	90	60	60
	Average	**100**	**90**	**60**	**60**

Table 1: Precision and Recall value

VI. CONCLUSION

This paper has presented a CBIR system using feed-forward neural network. The color histograms are used as color information of an image. The experiments are done on limited classes of fruit images. The use of feed-forward neural network has considerably improved the recall rate and also retrieval time, due to its highly efficient and accurate classification capability. Also, the back-propagation algorithm has increased the retrieval precision due to its capability of minimizing the error during training process itself. The result may be affected if the images of same fruit, taken for training, are having less global similarity.

References

[1] M. Marchesi, G. Orlandi, F. Piazza, and A. Uncini, "Fast neural networks without multipliers," *IEEE Trans. Neural Networks*, vol. 3pp. 101–120, Nov. 1992.

[2] Y. Liu, D. Zhang, G. Lu, and W.-Y.Ma, "A survey of content-based image retrieval with high-level semantics," Pattern Recognit, vol. 40, no. 1, pp. 262–282, Jan. 2007.

[3] A. W. M. Smeulders, M. Worring, S. Santini, A. Gupta, and R. Jain, "Content-based image retrieval at the end of the early years," IEEE Trans. Pattern Anal. Mach. Intell., vol. 22, no. 12, pp. 1349–1380, Dec. 2000.

[4] W. S. McCulloch and W. Pitts, "A logical calculus of the ideas imminent in nervous activity," *Bull. Math. Biophys*, vol. 5, pp. 115–133, 1943.

[4] D. E. Rumelhart, J. L. McClelland, and the PDP Research Group, "Parallel Distributed Processing (PDP): *Exploration in the Microstructure of Cognition*," vol. 1. Cambridge, MA: MIT Press, 1986.

[6] S. Antani, R. Kasturi, and R. Jain, "A survey of the use of pattern recognition methods for abstraction, indexing and retrieval of images and video." Pattern Recognit., vol. 35, no. 4, pp. 945–965, Apr. 2002.

[7] X. S. Zhou and T. S. Huang, "Relevance feedback in content-based image retrieval: Some recent advances," Inf. Sci., vol. 148, no. 1–4, pp. 129–137, Dec. 2002.

[8] H.-W. Yoo, H.-S. Park and D.-S. Jang, "Expert system for color image retrieval," Expert Syst. Appl., vol. 28, no. 2, pp. 347–357, Feb.2005.

[9] T.-C. Lu and C.-C. Chang, "Color image retrieval technique based on color features and image bitmap," Inf. Process. Manage. vol. 43, no. 2, Mar. 2007.

[10] Y. D. Chun, N. C. Kim, and I. H. Jang, "Content-based image retrieval using multi resolution color and texture features," IEEE Trans. Multimedia, vol. 10, no. 6, Oct. 2008.

[11] Chih-Chin Lai, and Ying-Chuan Chen, "A User-Oriented Image Retrieval System Based on Interactive Genetic Algorithm," IEEE TRANS. Instrumentation and measurement, VOL. 60, NO. 10, pp. 3318 – 3325, OCTOBER 2011.

[12] Tasweer Ahmad, Ahlam Jameel, Dr. Balal Ahmad, "Pattern recognition using statistical and neural techniques," IEEE CONFERENCE. Computer Networks and Information Technology, pp. 87 - 91, 11-13 July 2011.

[13] M. Egmont-Petersen, D. De Ridder, and H. Handels, "Image processing with neural networks - a review," Pattern Recognition, 35:2279-2301, 2002.

[14] H.-W. Yoo, H.-S. Park, and D.-S. Jang "Expert system for color image retrieval," Expert Syst. Appl., vol. 28, no. 2, pp. 347–357, Feb. 2005.

[15] H. Nezamabadi-pour and E. Kabir, "Image retrieval using histograms of uni-color and bi-color and directional changes in intensity gradient," Pattern Recognit. Lett., vol. 25, no. 14, Oct. 2004.

[16] Content-Based Image Retrieval System Using Feed Forward Backpropagation Neural Network, Arvind Nagathan et al. / International Journal of Computer Science Engineering (IJCSE) ISSN : 2319-7323 Vol. 2 No.04 July 2013