

Sri Lanka Institute of Information Technology

**Image content based classification of
Vacation/ tourism related images**

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Component : Object Formation

Software Requirements Specification

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1. Introduction

1.1 Purpose

As a group we are going to research on image content based classification on vacation and tourism related images. This document provides all of the requirements for the research. All parts are intended primarily for customers of the application, but will also be of interest to software engineers building or maintaining the software. The developers can reduce their time and effort to achieve desired goals with the use of this SRS and it also reduces the development cost. Misunderstandings, omissions, and inconsistencies can be revealed by a careful review of the requirements in the SRS early in the development cycle when these issues are much easier to correct. Testers can use this document to test the system against the requirement.

1.2 Scope

We will research to provide an intelligent image processing application that is able to identify objects in an image and scenarios in the images using the objects in the images and classify the objects in the images and Group the images into (semantically) meaningful categories using low-level and high-level visual features.

The Second major part of image classification is identifying the objects in the image from the segmented image data. This SRS covers the requirements of it for Image Content Based Classification of Vacation/Tourism Related Images research which will be released in October 2016.

Scope of this research part is formation of objects from the previously segmented parts for the use of further research areas like object identification. Features of object formation part of the research will be mentioned throughout this document. It will guide the developers in selecting a design that will be able to accommodate the full-scale application.

1.3 Definitions, Acronyms, and Abbreviations

Acronyms

SRS	Software Requirement Specification
RNN	Recursive Neural Network
CNN	Convolutional Neural Network
R-CNN	Region-based Convolutional Networks

Definitions

SRS	A document that completely describes all the functions of a proposed system and the constraints under which it must operate.
Database	Collection of all the images and information stored in the system
Stakeholder	Any person with an interest in the project or any person who can affect the project in development.

Abbreviations

The System	The project “Image content based classification of vacation/ tourism related images” will hereafter be simply referred as “The System”
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1.5 Overview

Object formation will be used after segmentation to identify the similar regions and their surrounding regions and group them in order to identify objects clearly. Previously segmenting image will have a set of different segmented layers which are separated based on color, regions, curves etc... In here I will to form the segmented parts into meaningful objects

Rest of the SRS contain Overall Descriptions, System Requirements and Supporting Information.

I will be discussing the overall description of the function in section 2. In this section software will be compared with other related or competing products. Under product perspective the research part will be compared with other related or competing products with System interfaces, User interfaces, Hardware interfaces, Software interfaces, Communication interfaces, Memory constraints, Operations and Site adaptation requirements.

In section 3, I discuss will about the external interface requirements, Classes/Object, performance requirement, design constraints, the software system attributes and other requirements.

2. Overall Descriptions

A segmented image shall have several segmented layers. But the problem is that we cannot identify objects by just taking layers separately. We need a proper mechanism for identifying correlation between these layers and group them in order to come up with a meaningful object. For this purpose we need object formation process.

Most of the time it is a difficult task to form the layers because of having large no of segmented layers. Because of this problem [1] has used geometrical features like smoothness, area ratio, inclusion and continuity. So that if one of these features is satisfied the condition, they will be merged together. The segmented layers shall be taken one by one and check the geometrical features like smoothness, ratio to identify the similar segmented layers in the same object.

A neural network will be used to map the image segments into “semantic” space. Using these semantic region representations as input, we can use a RNN algorithm to merge semantically related neighboring regions to form a recognizable object which Richard Socher has used in his thesis [2].

2.1 Product perspective

Since this system is a research project, research projects similar to the system we are planning to develop will be observed closer.

[3] are trying to identify an object in an image by automatically selecting the Region of Interest (ROI), the most important part of the image, or the main object in the image by selecting a rectangular area of the image as a Region of Interest (ROI)

On the subject of multiple object recognition from an image we came across an interesting research project [4] done at google recently, which has managed to improve the problem of multiple object recognition effectively, they have made use of customized convolutional neural network. For the detection part of the application, an improved neural network model was used in the sophisticated R-CNN detector.

Another interesting research on image classification using deep convolutional neural network (CNN) [5] they have trained a large deep CNN to classify 1.2 million high resolution images. Results obtained in [5] show that a large, deep CNN is capable of achieving record-breaking results on a highly challenging data set using purely supervised learning. They have noted that their network's performance degrades if a single convolutional layer is removed. For example they state, removing any of the middle layers results in a loss of around 2% for the top 1 performance of the network. So the depth really is important for achieving results according to [5]

2.1.1 System interfaces

Since Image content based classification of vacation/ tourism related images is a system with a simple interface to upload the images and a button to process the image and download them and complex algorithms which is used to classify large no of images.

2.1.2 User interfaces

A simple interface to upload the images and a button to process the image and download them is the only main user interface.

The screenshot shows a Windows application window titled "Form1". The interface displays classification statistics and a grid of image category placeholders.

Statistics:

- Images classified: 14
- Images failed to classify: 2
- Images Categories Identified: 6

Image Categories:

Category	Percentage
Beach	20%
Forests	20%
Mountains	18%
Urban Areas	20%
Gardens	20%
Waterfalls	1%

Image Category Grid:

The grid consists of 12 placeholders, each labeled "Image Category". The placeholders are arranged in two rows of six. The top row of placeholders is currently empty, while the bottom row contains six small, low-resolution images.

Buttons:

- Upload Images

Figure 2.1.2.1 Upload image interface

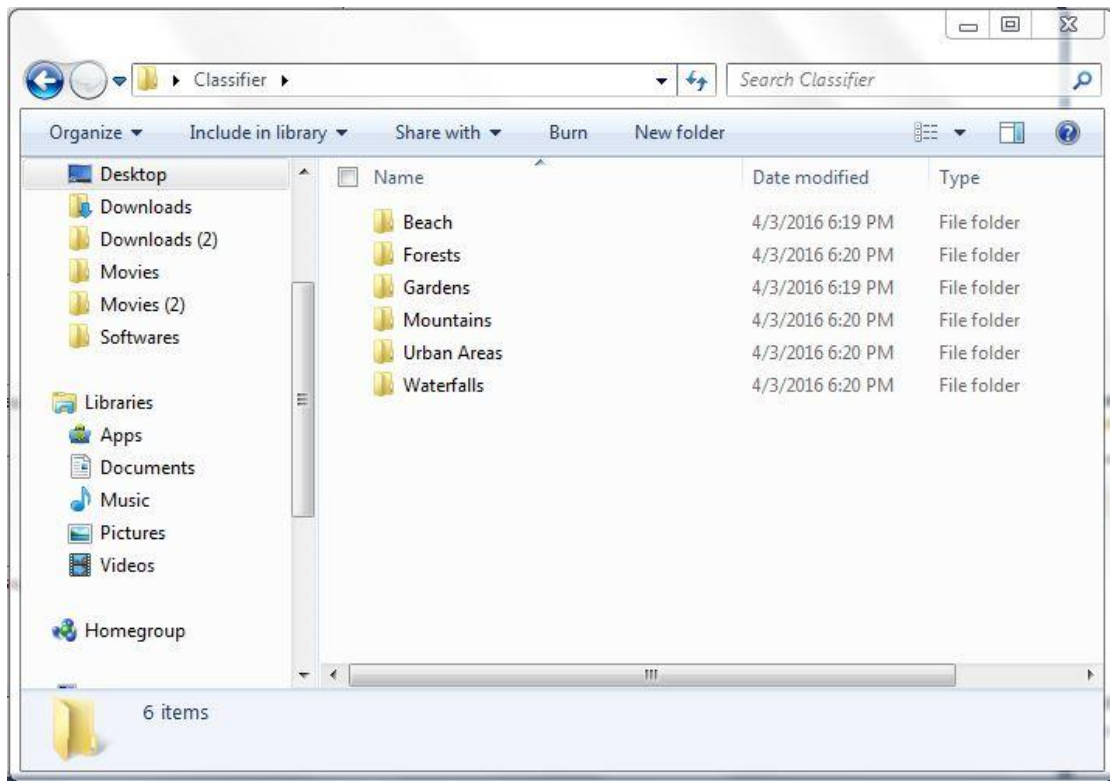


Figure 2.1.2.2 Categorized images interface

2.1.3 Hardware interfaces

The user only needs a decent computer with a core i3 or above process and with a built in or external VGA. Other than that no other hardware required.

2.1.4 Software interfaces

The system must use MySQL Server as its database component.

2.1.5 Communication interfaces

The system will work offline unless it is used in a server hosted as a web service.

2.1.6 Memory constraint

User's computer machine is expected to use at least 4GB of Ram and 1GB of external storage.

2.1.7 Operations

- User must enable the web access of the computer
- User should upload images for classification

2.1.8 Site adaptation requirements

Since the system will be initially developed to be as a standalone application to be run on a computer with windows 7 or above. The system wont be adapted to other operating systems or environments until this research phase is complete. Since the user can be of any nationality the user interface must be created for English language.

2.2 Product functions

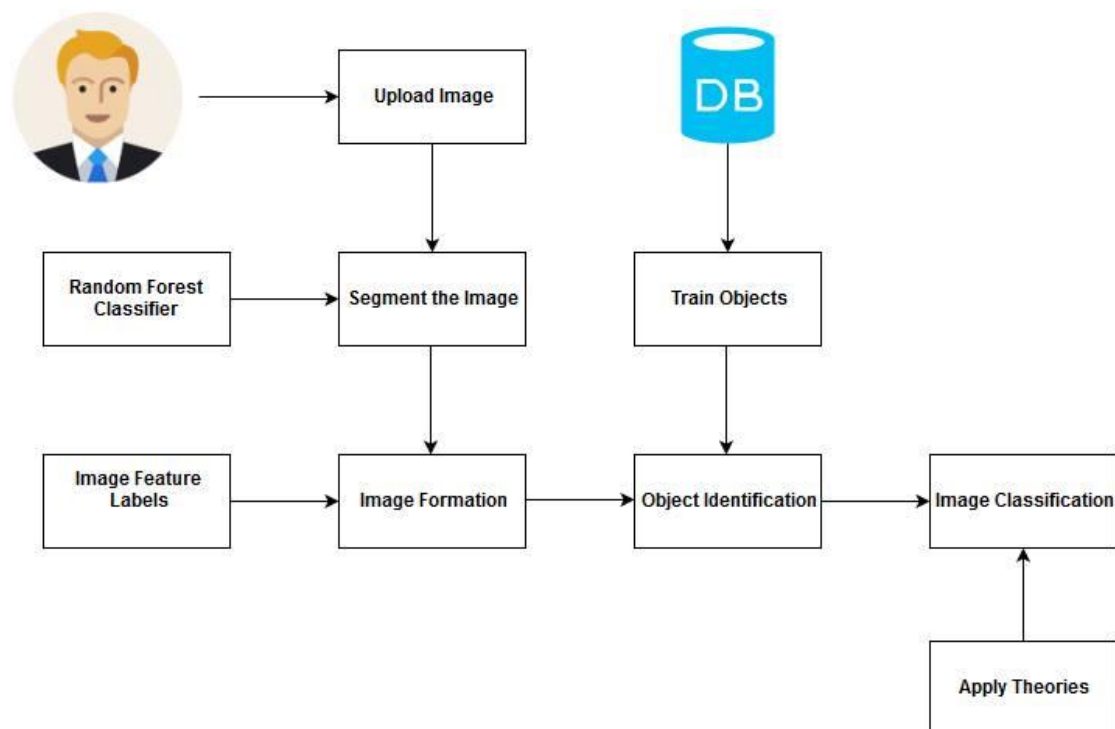


Figure 2.2.1 High Level diagram

The system consists of mainly four functions namely image spatial representation and segmentation, object formation from segmented images parts, object classification and identification ,Image context identification and classification. This SRS document mainly covers the requirements for the “Object formation” component of the application.

In Object formation the segmented parts of the image will be collected and merged them according to the connection between the labeled segments to form objects.

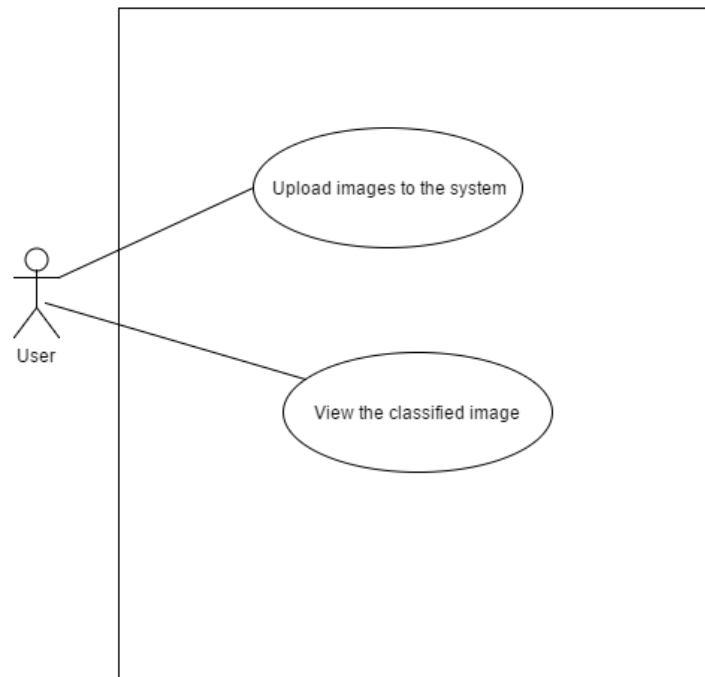


Figure 2.2.2 Use case diagram

Use case scenario

Use case 01	Upload images to the system
Primary Actor(s)	User
Pre-Condition	Images should be related to vacation/tourism related images
Post-Condition	Uploaded image should be display in the interface.
Main Scenario	<ol style="list-style-type: none"> 1. Start with opening the application 2. User click on the browse image button 3. Select image and click OK button.
Extensions	If user input a different file to the system, system will display an error message

Table 2.2.1 Use case scenario1

Use case 02	View the classified image
Primary Actor(s)	User
Pre-Condition	Images should be related to vacation/tourism related images
Post-Condition	
Main Scenario	<ol style="list-style-type: none"> 1. Start with opening the application 2. User click on the browse image button 3. Select image and click OK button. 4. User click “Apply Classification” button
Extensions	If user input a different file to the system, system will display an error message

Table 2.2.2 Use case scenario2

2.3 User characteristics

- General Computer user
- software professional

2.4 Constraints

- This algorithm will only consider about the images which belong to traveling/tourism related images.
- This algorithm shall operate on PCs running Windows 7 or later at a minimum speed of 2.2 GHZ.
- User must have a proper Internet connection.

2.5 Assumptions and dependencies

- User have an average speed of computer machine and good Internet connection.
- User inputs only the vacation/tourism related images

2.6 Apportioning of requirements

Essential Requirement

1. Allow user to upload images to be classified
2. Segmented image parts should be merged again to form objects.

Desirable Requirements

1. Use this algorithm as a web service for the travelling/tourism related applications for get the user preferences and suggest the places where user wish to visit.

Optional Requirements

1. Connect with social profiles, check the contents and suggest the places according to their desires.

3. Specific requirements⁽¹⁾ (for “Object Oriented” products)

3.1 External interface requirements

3.1.1 User interfaces

Name of the item	“Upload images” button
Description of purpose	Pop up a new window to browse images from the computer
Source of input or destination of output	Mouse point
Valid range, accuracy and/or tolerance	N/A
Units of measure	No
Timing	No
Relationships to other inputs/outputs	No
Screen formats/organization	Bottom left
Window formats/organization	Left of screen
Data formats	N/A

Table 3.1.1.1 User interface details for figure 2.1.2.1

3.1.2 Hardware interfaces

- Core i3 processor may be required in order to process the large no of images

3.1.3 Software interfaces

- Python 2.7 -

This is the main environment for building the algorithms

- MySQL -

This is for storing the sample images in the database

- MATLAB -

This environment is used to check the algorithms are working properly or not.

3.1.4 Communication interfaces

- All users must have a proper Internet connection. Therefore a modem or a wifi router is required.

3.2 Classes/Objects

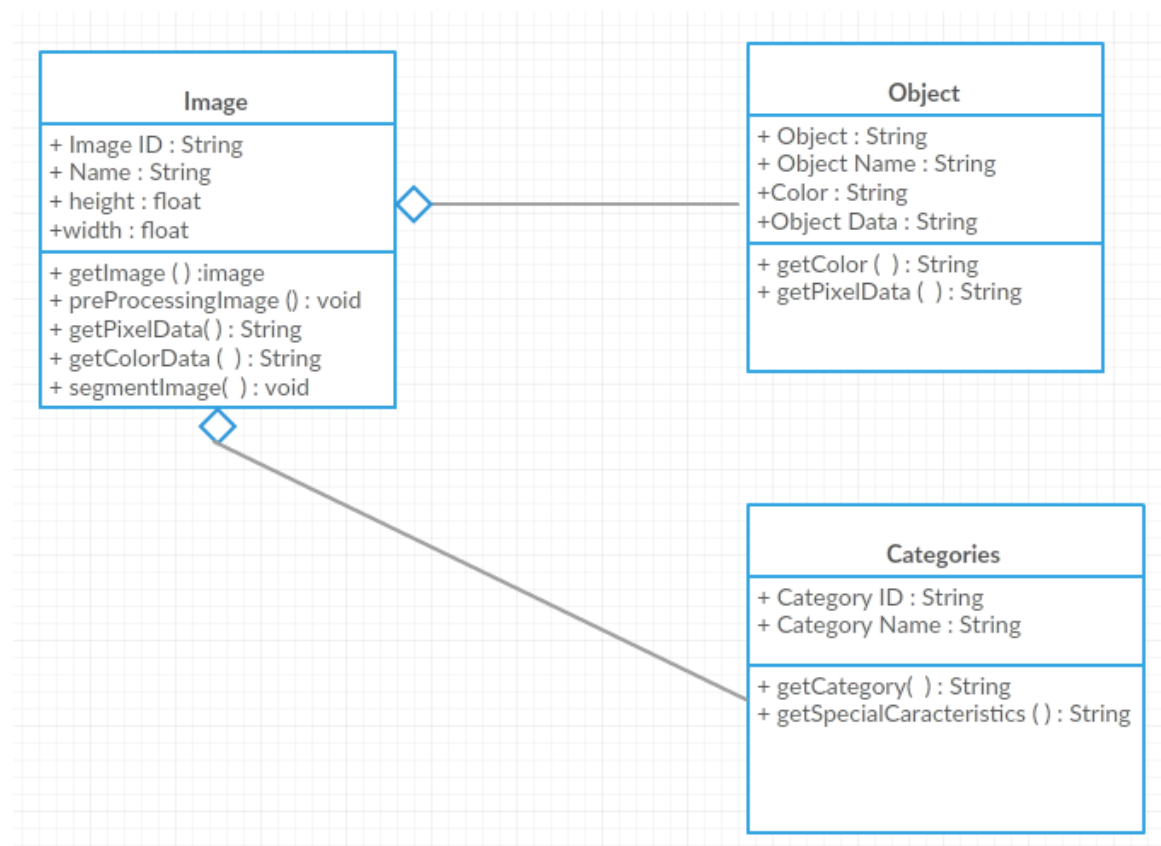


Figure 3.2.1 Class diagram

3.3 Performance requirements

- Since large no of objects training is main part of this algorithm, the system will require at least 2GB RAM
- The processor speed should be at least 2.2 GHZ.

3.4 Design constraints

Since we are developing an algorithm for image classification, we are not going to worry about the design interfaces now. In future we could use this algorithm for various applications.

3.5 Software system attributes

3.5.1 Reliability

Most of the time it is a difficult task to form the layers because of having large no of segmented layers. Because of this problem I will use geometrical features like smoothness, area ratio, inclusion and continuity. So that if one of these features is satisfied the condition, they are merged together.

3.5.2 Availability

This system should be available for any web user and they must have a proper Internet connection for maintaining availability.

3.5.3 Security

The sample images are stored in the database. Therefore security is needed. And when user closed the application, uploaded images must be removed from the system.(Because all they want is to classify the given image)

3.5.4 Maintainability

The system should be able to classify the images properly after the maintenance has done and updated categories also need to be classified and give output correctly.

3.6 Other requirements

- User friendly -

User can easily upload images to the system without finding it difficult and the predicted results should be displayed in well formed.

- Modifiable -

The proposed system should be able to accept modifications.

4. Supporting information

4.1 References

- [1] Toru Tamaki, Tsuyoshi Yamamura and Noboru Ohnishi: "Image segmentation and object extraction based on geometric features of regions",Part of IS&T/SPIE Conf. on VCIP'99, SPIE Vol.3653, Part Two, pp.937{945 (1999 1)
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