Image content based classification of
Vacation/ tourism related images

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Component : Image Context identification and classification

Software Requirements Specification

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Declaration

I hereby declare that the Software Requirements Specification entitled "Image content based classification of vacation/ tourism related images", submitted to the Sri Lanka Institute of Information Technology is a record of an original work done by me, under the guidance of our supervisor Dr.Rohana Thilakumara. This project work is submitted in the partial fulfillment of the requirement for the award of the degree of Bachelor of Science in Information Technology. The results embodied in this report have not been submitted to any other University or Institution for the award of any degree or diploma. Information derived from the published or unpublished work of others has been acknowledged in the text and a complete list of references is given.

Name: M.N.M.Amjad

Signature: ………………………….

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1 Introduction

1.1 Purpose

This Software requirement specification document provides detailed description about the requirements of the "Image content based classification of vacation/ tourism related images" system. All parts in this document are intended primarily for the both the stakeholders and the development team members of the system. The information is organized in such a way that the team members will not only understand the scope and boundaries within which they need to work, but also what functionality needs to be developed and in what order. This document will be use by the developers to implement the functionalities and to ensure traceability of the software, by testers to test the software against the requirements.

1.2 Scope

Scope of this document is a guideline for developers to further clarify the software limitations and technical challenges when developing the project. This SRS covers the requirements for the system release of the "Image content based classification of vacation/ tourism related images" application in October 2016. Selected features of future releases will be mentioned throughout this document. The purpose of this document is to guide the developers in selecting a technologies and designs that will be helpful to develop the full-scale application easily and within the stipulated time.

The project "Image content based classification of vacation/ tourism related images" will be developed initially as a desktop application. Which can later be hosted on a web server and be used as an API for other web applications. The application consists of 4 major components namely Image segmentation, Object formation from segmented images parts, Object classification and identification and Image Context identification and classification. The final product when uploaded an image or set of image related to travel/tourism such as indoor or outdoor, city, waterfalls, beaches, sunsets/sunrise, forest, and mountain etc will be able to clearly classify the images into related and relevant groups based on the objects found in the images. This document mainly covers the requirements for the "Image Context identification and classification" component of the application.

1.3 Definitions, Acronyms, and Abbreviations

Acronyms

SRS	Software Requirement Specification
ANN	Artificial Neural Network
RNN	Recursive Neural Network
SDLC	Software Development Life Cycle

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"

1.4 References

Please Refer the section 4.1 at the end of this SRS Document to find the complete list of References

1.5 Overview

The System is designed for grouping input images into meaningful categories using classification techniques. Image content based classification of vacation/ tourism related images is an algorithm which is used to classify the content of the image and categories them. The proposed system will be developed first as a standalone application for use on a single computer.

The main goal of this system is to allow the user to easily classify a set of given input images into meaningful categories depending on the objects and features found in the images. With considerably high accuracy.

For this part of the application which will be a desktop based standalone application the ideal user would be anyone who need to sort a batch of images and get the sorted output images.

Section 2 of this document

In this section we describe the overall description of the function and product perspective which compare our system with other related or competing product. Under product perspective we discuss the system interfaces, user interfaces, hardware interfaces, software interfaces, communication interfaces, memory constraints and the operations. Next we discuss about the product function, user characteristics and the constraints.

Section 3 of this document

In this section we describe about the external interface requirements, Classes/Object, performance requirement, design constraint and the software system attributes. Under software system attributes we discuss the non functional requirements like availability, reliability, security and maintainability.

2 Overall Descriptions

The system described here is 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. Specifically, we consider the hierarchical classification of images related to vacation/traveling etc; at the highest level, images are classified as indoor or outdoor; outdoor images are further classified as city,village,town or landscape etc; finally, a subset of landscape images is classified into waterfalls,beaches, sunsets/sunrise, forest, and mountain etc classes. The application will be able to identify the objects and features in those images and classify them accordingly to be used by other web applications. Furthermore the application will be able to learn(train the system) from the images it classifies and will be able to quickly and accurately identify the images as it progresses. The algorithm will be demonstrated for identifying tourist attraction locations in images and classifying them.

2.1 Product perspective

Since this system is a research project we will take a closer look at other research projects similar to the system we are planning to develop.

[1] 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 [2] 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) [3] they have trained a large deep CNN to classify 1.2 million high resolution images. Results obtained in [3]show that a large, deep CNN is capable of achieving record-breaking results on a highly challenging dataset 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 [3]

2.1.1 System interfaces

Since Image content based classification of vacation/ tourism related images is a web application. It only needs a PC which having windows 7 or above Operating system and doesn't need any special system interfaces for the system to run properly.

2.1.2 User interfaces

Since Image content based classification of vacation/ tourism related images is 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. It only needs a PC which having windows 7 or above Operating system

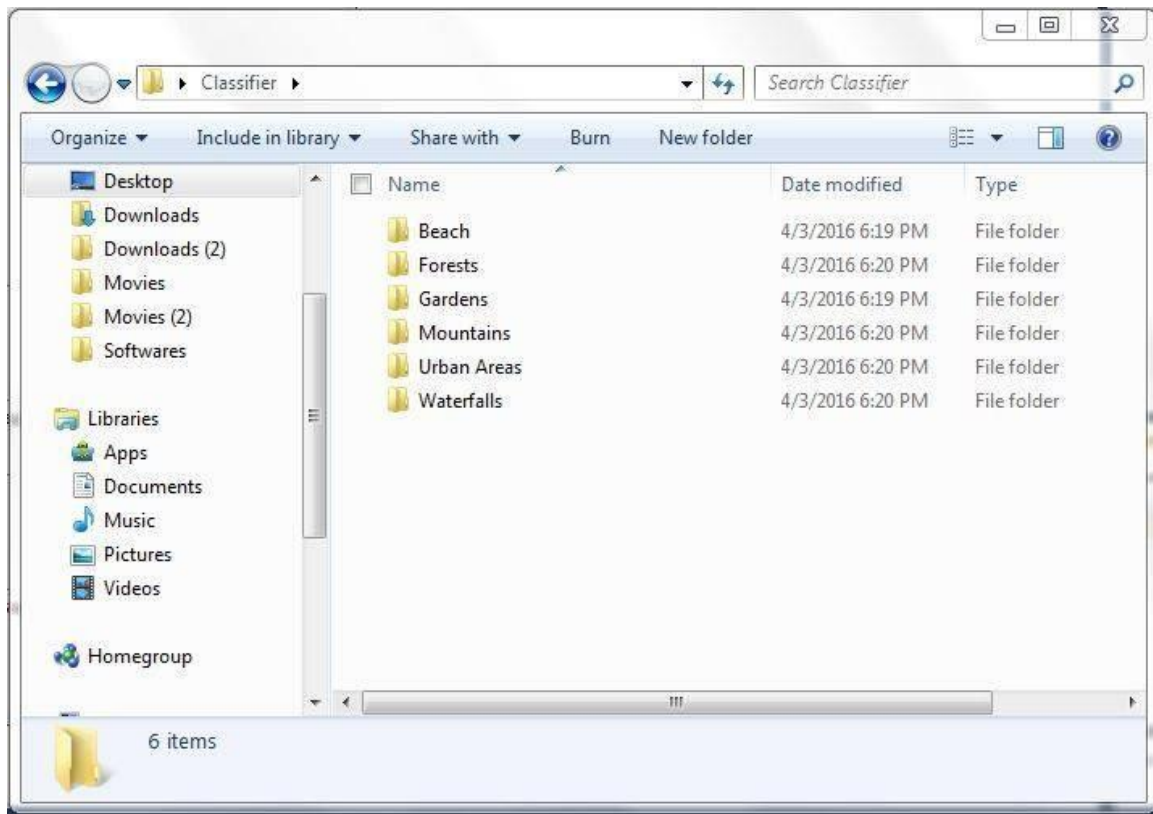*Figure 2.1.2.1 Upload image interface*

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 SQL Server or MySQL server as its database component.
- Python 2.7 or above should be installed in the computer for the system to run properly
- MATLAB will be used to check and train the Neural Networks
- The system must use an apache localhost such as XAMPP
- An updated browser such as Firefox or Chrome must be installed

2.1.5 Communication interfaces

The system will work offline in localhost unless it is used in a server hosted as a web service which will be implemented after the research is complete. For the purpose of this document the system will be considered to work offline.

2.1.6 Memory constraints

The system would work ideally on a computer with 4GB Of ram or more and at least 1GB of storage space in the internal Hard drive

2.1.7 Operations

User can perform the following set of actions by interacting with the system. All normal and special operations required by the user are listed below.

1. The user needs to start the system by clicking the icon for the application or running the application in the browser
2. The user can upload an image or a selection of images by clicking the "upload images" button and selecting the images.
3. The user can then click the button to process the images and group them and save the output categories and images in the computer.

2.1.8 Site adaptation requirements

Since the system will be developed to be as a web application to be run on a computer with windows 7 or above. The system won't be adapted to other operating systems or environments until this research phase is complete.
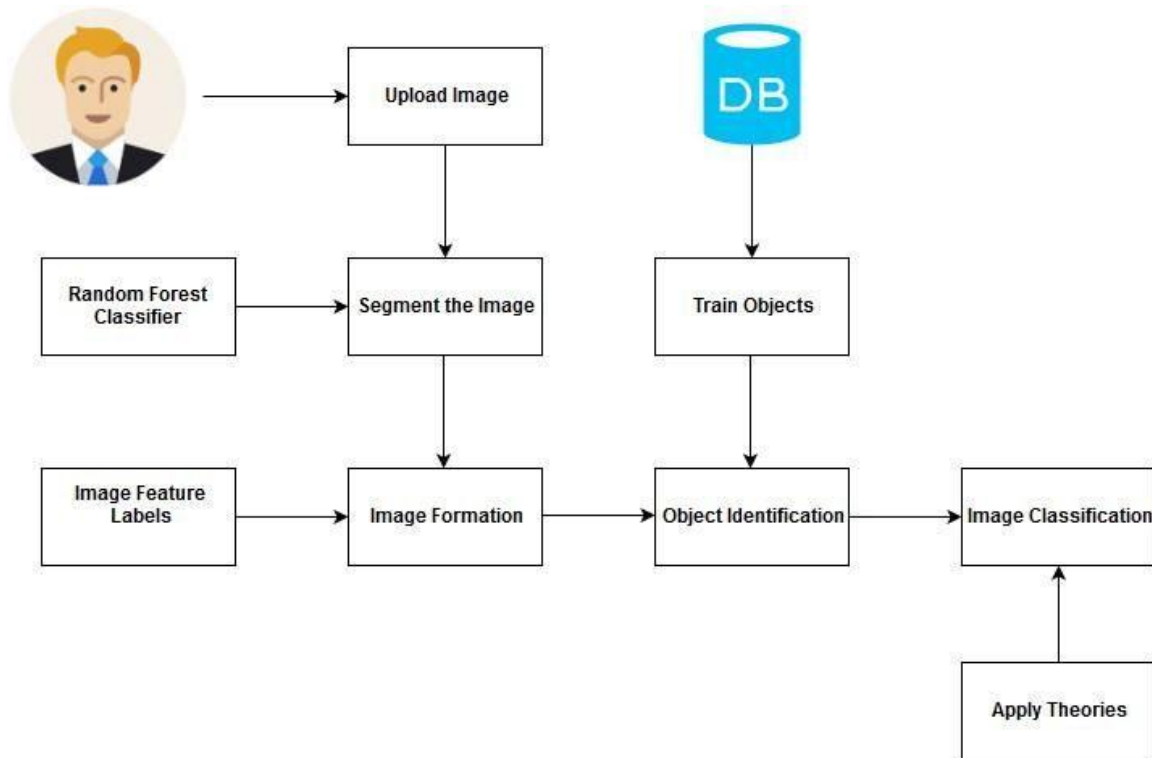
2.2 Product functions

Figure 2.2 High level diagram for the system

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 "Image Context identification and classification" component of the application.

For this system context identification and classification is one of the major part in this research as it is needed to provide the user with the classification category/s for which the input image/s belongs to. Researches have been conducted and are still being conducted on image classification based on high and low level analysis of image content (colour, texture, objects). Our research focuses on identifying the objects in the image and along with image content information and image classification properties, to improve image classification and identify the interrelationships between the objects in the images and their overall contextual category and provide a holistic understanding of the image.

A Recursive neural network with multiple hidden layers and properties like the color of the object the shape of the object and the rotational moments of the object as input as parameters, can be constructed to recursively identify the correlation between objects identified in the previous phase using random forest classifier. the objects identified in the previous phase can be used as the input in this phase and the Neural network model can be trained to recognize the inter-relation between the objects. furthermore an artificial intelligence component can also be used to further clarify and understand the objects in the image and get a holistic idea of the image.

Use of more training images will increase the accuracy of classification. We can classify the sample images into categories which will be stored in the database for classification. They will be compared against the user input.
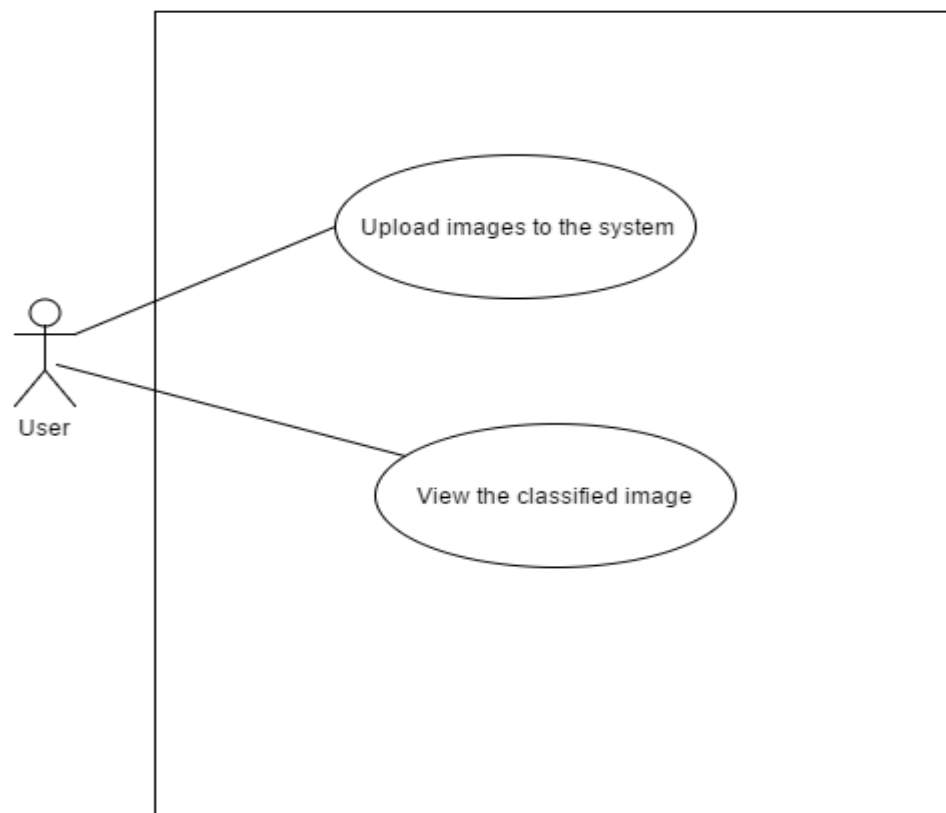

Figure 2.2.2 Use case diagram

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	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 scenario 1

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	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 scenario 2

2.3 User characteristic

- General Computer user
- software professional

2.4 Constraints

The system shall operate on PCs running Windows 7 or later with a intel core i3 or higher.

python shall be the main implementation language of the algorithms in the application.

2.5 Assumptions and dependencies

Assuming the user has a clear knowledge of using a computer.

Assuming the computer is running at normal state with the required softwares installed and configured.

2.6 Apportioning of requirements

Essential Requirement

1. Allow user to upload images to be classified
2. Objects of the image should be identified by the system.

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

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 scenarios

3.1.2 Hardware interfaces

- Core i3 processor recommended to process the large no of images.
- Intel onboard VGA Card or external VGA card recommended for faster processing

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 and train Neural Networks

3.1.4 Communication interfaces

An internet connection is required for the application to work as a webservice else it can be run in a local environment.

3.2 Classes/Objects
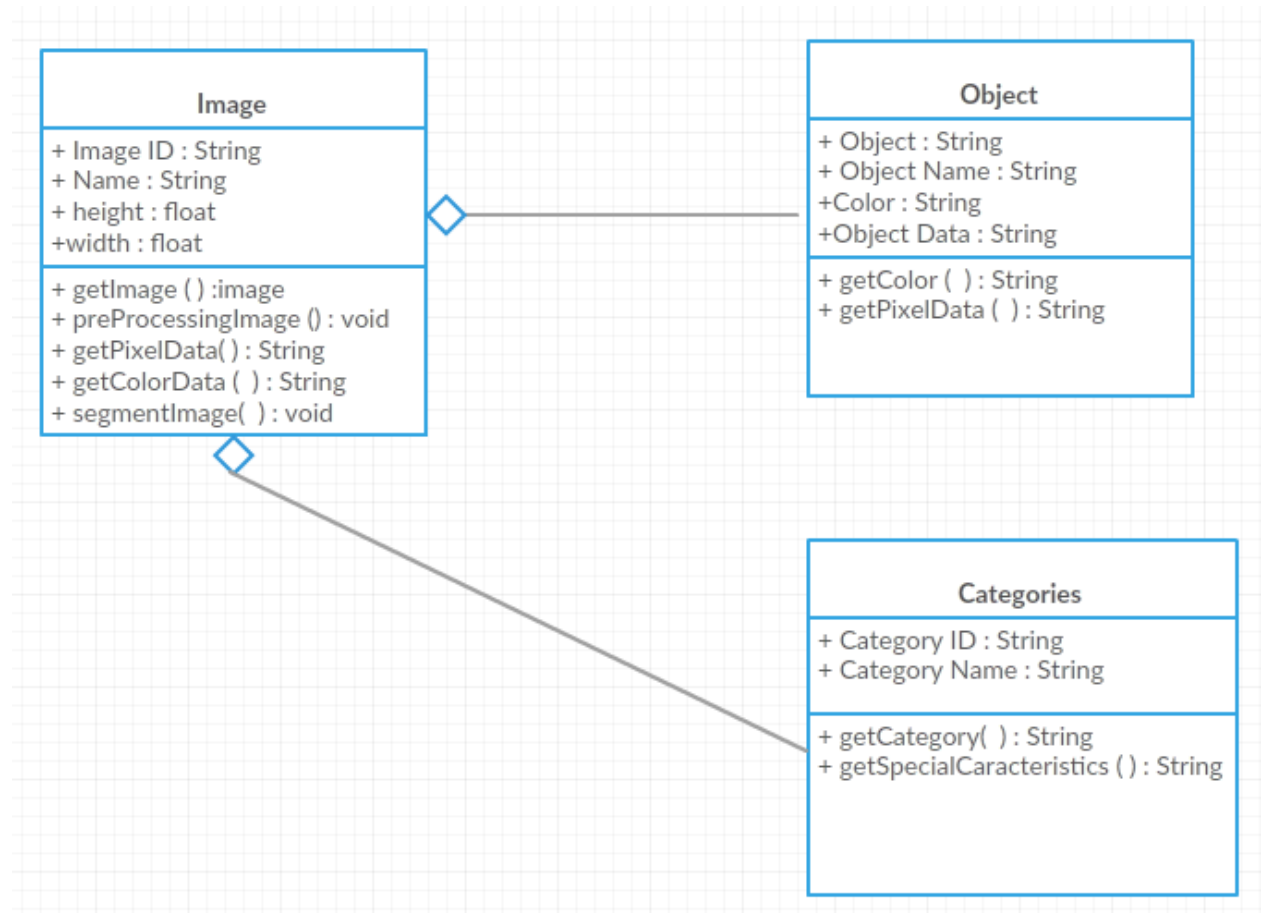
These are the basic objects to be used in the application

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 4GB Recommended
- The processor speed should be a multi core (core i3 or above) at least 2.2 GHZ of speed.
- Time to batch process the images may vary depending on the number of images
- Only one user can use the application at a time

3.4 Design constraints

Since we are mainly focused on developing an algorithm for image classification, we are not concerned about the designing interfaces for now other than the ones depicted in section 2.1.2. In future we could use this algorithm for various applications.

3.5 Software system attributes

3.5.1 Reliability

This algorithm should identify objects in the given image correctly and with the limited time and classify the images properly.

3.5.2 Availability

The Web service should be hosted in a reliable server which doesn't crash during the time of use.

The application should not crash during the processing stage or during the runtime of the application

3.5.3 Security

The web service should be implemented securely, Since the training images and the code will be stored in the server. The images uploaded by the user should be removed after they have been processed and downloaded by the user.

3.5.4 Maintainability

The algorithms in the system isn't expected to be changed after the final implementation much but the interfaces may change. We are not concerned much about the system being modified later on.

4 Supporting information

4.1 References

[1] A. Bosch, A. Zisserman, and X. Munoz. Image Classification using Random Forests and Ferns

[2] Research Blog, "Building a deeper understanding of images", 2016. [Online]. Available: http://googleresearch.blogspot.com/2014/09/building-deeper-understanding-of-images.html [Accessed: 31- Mar- 2016].

[3] Krizhevsky, A., Sutskever I., and Hinton, G., "Imagenet classification with deep convolutional neural networks", *Advances in neural information processing systems, 2012.*