A PROJECT REPORT ON

AN INTELLIGENT VISUAL SEARCH

SUBMITTED TO THE SAVITRIBAI PHULE PUNE UNIVERSITY , PUNE IN THE PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE AWARD OF THE DEGREE

BACHELOR OF ENGINEERING
(Computer Engineering)

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Sinhgad Institutes

CERTIFICATE

This is to certify that the Project Entitled

AN INTELLIGENT VISUAL SEARCH

Submitted by

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PROJECT APPROVAL SHEET

A Project Report Titled as

An Intelligent Visual Search

Is verified for its originality in documentation, problem statement, proposed work and implementation successfully completed by

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SAVITRIBAI PHULE PUNE UNIVERSITY,PUNE

ACADEMIC YEAR 2018-2019

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Abstract

In todays world text search engine is used by the users for searching purpose. This is manual process and is prone to many human errors . There are some methods like applying filters and sort by options developed but these systems also have some or other drawbacks . In the current times it Is very difficult to get the exact results of your search input. To overcome the traditional systems we propose and intelligent Visual Search System. In this system a user can query by clicking an image of the product he/she wants and our deep search engine will search the internet for similar products and recommend the results. This is based on Deep Object detection model and a Deep Feature extraction pipeline designed to understand the image at the deepest level so as to differentiate different images and recommend the most similar products. The system is very user friendly and easy to use.

Acknowledgments

It gives us great pleasure in presenting the preliminary project report on **'AN INTELLIGENT VISUAL SEARCH SYSTEM'**.

I would like to take this opportunity to thank my internal guide **Prof. V. Y. Baviskar** for giving me all the help and guidance I needed. I am really grateful to them for their kind support. Their valuable suggestions were very helpful.

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In the end our special thanks to **Prof. Venu R. M.** for providing various resources such as laboratory with all needed software platforms, continuous Internet connection, for Our Project.

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Project Title - AN INTELLIGENT VISUAL SEARCH

1.2 Project Option

No

1.3 Internal Guide

Prof. V. Y. Baviskar

1.4 Sponsorship and External Guide

No

1.5 Technical Keywords (As per ACM Keywords)

NLP (Natural Language Processing), VOTT (Visual Object Tagging Tool), Fast-RCNN (Fast Regional Convolutional Network)

1.6 Problem Statement

To develop an Intelligent Visual Search Engine with the help of Region Convolutional Neural Network with Keras API. The system should allow the user to click and upload the photo as input and should view similar images as output.

1.7 Abstract

In todays world text search engine is used by the users for searching purpose. This is manual process and is prone to many human errors. There are some methods like applying filters and sort by options developed but these systems also have some or other drawbacks. In the current times it Is very difficult to get the exact results of your search input. To overcome the traditional

systems we propose and intelligent Visual Search System. In this system a user can query by clicking an image of the product he/she wants and our deep search engine will search the internet for similar products and recommend the results. This is based on Deep Object detection model and a Deep Feature extraction pipeline designed to understand the image at the deepest level so as to differentiate different images and recommend the most similar products. The system is very user friendly and easy to use.

1.8 Goals and Objectives

- To design simplified searching with respect to traditional searching system.
- To design a search system which will not require human efforts to type the text.
- To design an intelligent visual search for faster and accurate results.

1.9 Relevant mathematics associated with the Project

System Description:

- Input: User's query Image
- Output: Similar product Recommendations
- Identify data structures, classes, divide and conquer strategies to exploit distributed/parallel/concurrent processing, constraints.
- Functions : Identify Objects, Morphisms, Overloading in functions, Functional relations
- Success Conditions:
  - Object detected.
  - Similar products resulted.
- Failure Conditions:
  - Product not found.
  - Object not detected.

1.10 Names of Conferences / Journals where papers can be published

- IRJET - International Research Journal of Engineering and Technology
- IJCA - International Journal of Computer Applications
- IJSRES - International Journal of Scientific Research and Engineering Studies

1.11 Review of Conference/Journal Papers supporting Project idea

[1] Alikov A.Y., Kalinichenko A.V. "Efficiency of Unstructured Text Search Improving Methods in the Electronic Archive of Computer-aided Design Systems", 2017.

[2] M S Raunak, D. Richard Kuhn, Raghu Kacker "Combinatorial Testing of Full Text Search in Web Applications", 2017.

[3] Laith Mohammad Abualigah, Ahamad Tajudin Khader, Mohammed Azmi Al-Betar, Zaid Abdi Alkareem Alyasseri, Osama Ahmad Alomari and Essam Said Hanandeh "Feature Selection with -Hill climbing Search for Text Clustering Application", 2017.

[4] Jingkun Qin, Haihong E, Meina Song and Zhijun Ren "Image Retrieval Based on a Hybrid Model of Deep Convolutional Encoder", 2018.

[5] HoudongHu, YanWang, LinjunYang, PavelKomlev, LiHuang, Xi(Stephen)Chen, JiapeiHuang, YeWu, MeenazMerchant, ArunSacheti "Web-Scale Responsive Visual Search at Bing", 2018.

[6] N. S. Chang and K.S.Fu, "image query by pictorial example," IEEE Trans Software, 1979.

[7] A.V. Men'kov, V.A. Ostrejkovskij "Theoretical Foundations of Automated Control", 2006.

[8] Dominich "The Modern Algebra of Information Retrieval", 2008.

[9] S. Dominich, T.A Kiezer "Measure Theoretic Approach to Information Retrieval", 2007.

[10] A. Kofman "Introduction to the theory of fuzzy sets", 2014.

[11] A.Ju. Alikov, A.V. Kalinichenko "Application of fuzzy clustering for the automatic publication of pohozhih documents", 2017.

[12] Christopher D. Manning, Prabhakar Raghavan, Hinrich Schtze "Introduction to Information Retrieval", 2010.

[13] B. Djuran, P. Odell "Cluster analysis", 2013.

[14] Masumeh Islami Nasab, Reza Javidan "A new approach for finding semantic similar scientific articles", 2015.

[15] V.N.Gudivada and J.V. Raghvan, "Special issues on content based image retrieval system," IEEE Com. Magzine, 1985.

[16] M. K. Hu, "Visual Pattern Recognition by moment invarriants," Computer methods in image analysis, IRE Transactions on Information Theory,1992.

CHAPTER 2
TECHNICAL KEYWORDS

2.1 Area of Project

This Project is based on Computer Vision and Machine Learning.

2.2 Technical Keywords

NLP (Natural Language Processing), VOTT (Visual Object Tagging Tool), Fast-RCNN (Fast Regional Convolutional Network)

CHAPTER 3
INTRODUCTION

3.1 Project Idea

- We are developing this idea to improve user's buying experience on E-Commerce.

3.2 Motivation of the Project

- As we are living in the age of innovation and entering the age of recommendation.
- Text search is a very tedious job.
- To improve user's buying experience on e-commerce websites.

3.3 Literature Survey

Content based image retrieval is the task of retrieve the images from the large collection of database on the basis of their own visual content. This is the survey of technical achievements in the research area of image retrieval, especially content based image retrieval. The research in this field way began way back at the end of nineteenth century but this has gained impetus from 1970 onwards with the thrust from two major research communities, database management and computer vision.

Due to exponential increase of size of so called multimedia files in recent years because of the substantial increase of affordable memory storage on one hand and the wide spread of World Wide Web (www) on the other hand, the need for the efficient tool to retrieve the images from the large data base becomes crucial. This motivates the extensive research into image retrieval systems. From the historical perspective, the earlier image retrieval systems are rather text-based with the thrust from database management community since the images are required to be annotated and indexed accordingly [6]. However with the substantial increase of the size of images as well as size of image database, the task of user-based annotation becomes very cumbersome and at some extent subjective and thereby, incomplete as the text often fails to convey the rich structure of images. In the early 1990s, to overcome these difficulties this motivates the research into what is referred as content based image retrieval where retrieval is based on the automating matching of feature of query image with that of image database through some image-image similarity evaluation [15]. Therefore images will be indexed according to their own visual content such as color, texture, shape or any other feature

or a combination of set of visual features. The advances in this research direction are mainly contributed by the computer vision community

In image retrieval, depending on the applications, some require the shape representation to be invariant to translation, rotation and scaling, whiles others do not. in general shape representation can be divided into two categories:

1. Boundary based which uses only the outer boundary of the shape.

2. Region-based which uses the entire shape regions.

The most successful representative for these two categories are Fourier descriptor and Moment invariants. The main idea of a Fourier descriptor is to use the Fourier transformed boundary as the shape feature. Rui et al. proposed a modified Fourier descriptor which is robust to noise and invariant to geometric transformation[16]. The main idea of moment invariant is to use region based moments which are invariant to transformation, as the shape feature. Hu identified seven such moments. Based on discrete version of Green's theorem, Yang and Albregtsen proposed a fast method of computing moments in the binary images[4]. Polynomial filtering is done to represent local geometric information, from which geometric invariants are used in object matching and recognition. Some recent work in the shape representation includes the finite element method (FEM), the turning function and wavelet transform.

All the above methods are based on statistical methods and hard considerations that have to be satisified before similarity search. In [4] JingKun Qin proposed the method of retrieval of images using a deep convolutional encoder and a nearest neighbour image similarity search. They used this method to find similar images of handwritten digits (MNIST) and images of cars and aeroplanes (CIFAR-10). This method proved to be promising.

CHAPTER 4

PROBLEM DEFINITION AND SCOPE

4.1 Problem Statement

To develop an Intelligent Visual Search Engine with the help of Region Convolutional Neural Network with Keras API. The system should allow the user to click and upload the photo as input and should view similar images as output.

4.1.1 Goals and objectives

- To design simplified searching with respect to traditional searching system.
- To design a search system which will not require human efforts to type the text.
- To design an intelligent visual search for faster and accurate results.

4.1.2 Statement of scope

In the software we can make use of Deep Learning for Object Detection and deep similarity matching using Cosine Similarity. Also an Image Retrieval system will be needed for suggesting and recommending products to the user.

4.2 Major Constraints

- Initial training of Object Detection model requires a lot of labelled image data.
- As more and more products will be launched everyday there will be a need of retraining the model. It is a feedback loop that will keep on evolving.

4.3 Methodologies of Problem solving and efficiency issues

- Currently methods available for search in E-Commerce are searching through keywords and applying filters. This method is time consuming and interactive as every time the user gets the search results he/she needs to refine them using filters and sort by options. In our proposed method the user only needs to upload the picture of a product he/she

wants and then similar products are recommended. This is a one time process and there is no need of iterative filtering again and again.

4.4 Outcome

Visual search technology is much more sophisticated than text-based search, as with visual search the image itself is the query. Search engines are getting better at understanding the components of images, resulting in more reliable results and heightened usage.

4.5 Applications

- Product Recommendation System
- Inventory Management

4.6 Hardware Resources Required

Sr. No.	Parameter	Minimum Requirement
1	CPU Speed	2 GHz
2	RAM	8 GB
3	GPU	NVIDIA GTX 1050

Table 4.1: Hardware Requirements

4.7 Software Resources Required

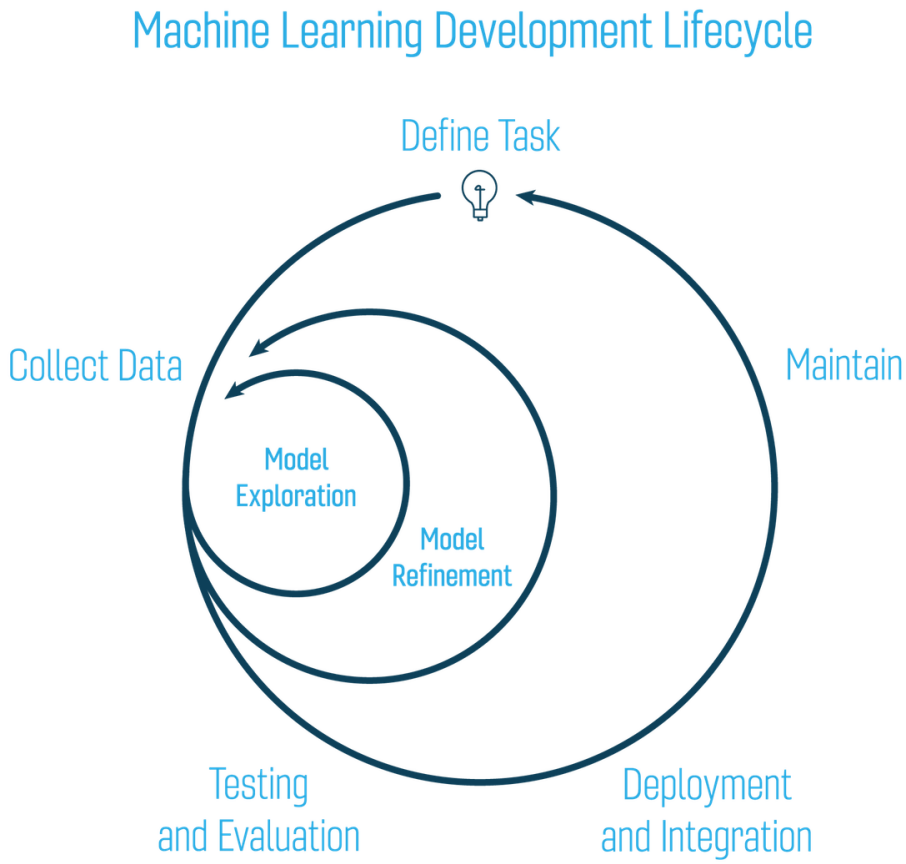
Platform :

1. Operating System: Linux
2. IDE: Visual Studio Code
3. Programming Language:Python 3+

CHAPTER 5
PROJECT PLAN

5.1 Project Estimates

We are using Machine Learning Development Cycle for our project estimation.



1. Planning and project setup
    - Define the task and scope out requirements
    - Determine project feasibility
    - Discuss general model tradeoffs (accuracy vs speed)
    - Set up project codebase

2. Data collection and labeling

- Define ground truth (create labeling documentation)
- Build data ingestion pipeline
- Validate quality of data
- Revisit Step 1 and ensure data is sufficient for the task

3. Model exploration

- Establish baselines for model performance
- Start with a simple model using initial data pipeline
- Overfit simple model to training data
- Stay nimble and try many parallel (isolated) ideas during early stages
- Find SoTA model for your problem domain (if available) and reproduce results, then apply to your dataset as a second baseline
- Revisit Step 1 and ensure feasibility
- Revisit Step 2 and ensure data quality is sufficient

4. Model refinement

- Perform model-specific optimizations (ie. hyperparameter tuning)
- Iteratively debug model as complexity is added
- Perform error analysis to uncover common failure modes
- Revisit Step 2 for targeted data collection of observed failures

5. Testing and evaluation

- Evaluate model on test distribution; understand differences between train and test set distributions (how is data in the wild different than what you trained on)
- Revisit model evaluation metric; ensure that this metric drives desirable downstream user behavior

- Write tests for:
  - Input data pipeline
  - Model inference functionality
  - Model inference performance on validation data
  - Explicit scenarios expected in production (model is evaluated on a curated set of observations)

6. Model deployment
   - Expose model via a REST API
   - Deploy new model to small subset of users to ensure everything goes smoothly, then roll out to all users
   - Maintain the ability to roll back model to previous versions
   - Monitor live data and model prediction distributions

7. Ongoing model maintenance
   - Understand that changes can affect the system in unexpected ways
   - Periodically retrain model to prevent model staleness
   - If there is a transfer in model ownership, educate the new team

5.1.1 Reconciled Estimates

5.1.1.1 Cost Estimate

- Online Cloud Instance : 400/-

5.1.1.2 Time Estimates

The time required for whole project implementation is around six months with following split up :

- First phase for paper work which includes information gathering, etc.
- Second phase which includes development of project.

5.1.2 Project Resources

- People : Prof. V. Y. Baviskar, Prof. Venu R. M. and College staff.
- Hardware : 8 GB RAM, NVIDIA GTX 1050 GPU.
- Software Visual Studio IDE.

5.2 Risk Management w.r.t. NP Hard analysis

5.2.1 Introduction

Risk management in software engineering is related to the various future harms that could be possible on the software due to some minor or non-noticeable mistakes in software development project or process. Software projects have a high probability of failure so effective software development means dealing with risks adequately.

5.2.2 Software Risk Management

Since there could be various risks associated with the software development projects, the key to identify and manage those risks is to know about the concepts of software risk management. There are various Software Risk Management, in include risk index, risk analysis, and risk assessment.

- Risk Index : Risks are categorized into two factors namely impact of risk events and probability of occurence. Risk inedex is the multiplication of impact and probability of occurence.

- Risk Analysis : There are quite different types of risk analysis that can be used. Basically, risk analysis is used to identify the high risk elements of a project in software engineering. Also, it provides ways of detailing the impact of risk mitigation strategies.

- Risk Assessment : Risk assessment is another important case that integrates risk management and analysis. There are many risk assessment methodologies that focus on different types of risks. Risk assessment requires correct explanations of the target system and all security features.

5.2.3 Risk Identification

For risks identification, review of scope document, requirements specifications and schedule is done. Answers to questionnaire revealed some risks. Each risk is categorized as per the categories mentioned in [**?**]. Please refer table 5.1 for all the risks. You can refereed following risk identification questionnaire.

1. Have top software and customer managers formally committed to support the project?
2. Are end-users enthusiastically committed to the project and the system/product to be built?
3. Are requirements fully understood by the software engineering team and its customers?
4. Have customers been involved fully in the definition of requirements?
5. Do end-users have realistic expectations?
6. Does the software engineering team have the right mix of skills?
7. Are project requirements stable?
8. Is the number of people on the project team adequate to do the job?
9. Do all customer/user constituencies agree on the importance of the project and on the requirements for the system/product to be built?

5.2.4 Risk Analysis

The risks for the Project can be analyzed within the constraints of time and quality

ID	Risk Description	Probability	Impact		
			Schedule	Quality	Overall
1	Description 1	Low	Low	High	High
2	Description 2	Low	Low	High	High

Table 5.1: Risk Table

Probability	Value	Description
High	Probability of occurrence is	$> 75\%$
Medium	Probability of occurrence is	$26 - 75\%$
Low	Probability of occurrence is	$< 25\%$

Table 5.2: Risk Probability definitions

5.3 Project Schedule

5.3.1 Project task set

Major Tasks in the Project stages are:

- Task 1: Requirement Gathering
- Task 2: System architecture designing, Flowchart designing
- Task 3: UML diagrams, DFD designing
- Task 4: Paper Publications
- Task 5: Project Designing
- Task 6: Implementation
- Task 7: Execution

5.3.2 Timeline Chart

5.4 Team Organization

5.4.1 Team structure

The team structure for the project is identified. Roles are defined.It was a combined effort. However, everyone was assigned tasks and mistakes were rectified through group discussions.

No	Agenda	Points Discussed	Start Date
1.	Project Domain Discussion	Various aspects of IOT, Data Mining, AI, Computer Vision, Machine Learning	19/06/2018
2.	Project Domain Finalisation	Selecting Computer Vision and Machine Learning as domain	21/06/2018
3.	Finalisation of Problem Statement	Finding about various solutions to recommendations	28/06/2018
4.	Searching information about domain	Extensive search on internet	30/06/2018
5.	Discussion on various IEEE papers	Different papers discussed	31/06/2018
6.	Submission of Problem Statement	Possible changes in problem statement	02/07/2018
7.	Discussion on related IEEE papers	Discussion on more related papers	03/07/2018
8.	Submission of project	Created an abstract	02/07/2018
9.	Correction in abstract	Modified abstract	03/07/2018
10.	Project Synopsis submission	Submission of synopsis	06/07/2018
11.	Correction in synopsis	Resubmitted synopsis	14/07/2018
12.	Presentation for 1st review	Presentation Review-1	27/08/2018
13.	Presentation on first review	1st Review	31/08/2018
14.	Platform learning	Training Object Detection Model	13/09/2018
15.	Presentation on second review	2nd Review	27/09/2018
16.	Presentation on thid review	3rd Review	27/10/2018
17.	GUI Modeling	GUI designed	09/11/2018
18.	Presentation on fourth review	4th Review	16/11/2018
19.	Software Implementation	implemented	18/12/2018
20.	Presentation on fifth review	5th Review	15/01/2019
21.	Implementation Paper	Paper Published	29/01/2019
22.	Testing	Performed Manual Testing	13/02/2019
23.	Project Exhibition	Exhibited the Project	06/03/2019
24.	Documentation	Preparation of documentation	11/03/2019
25.	Presentation on sixth review	6th Review	15/03/2019

Table 5.3: Plan of Project Execution

Team Structure	Work
1. Indrajeet Ambure	Designing the Review Paper and publishing it and designing of UML's
2. Sakshi Amrutkar	Designing of Report
3. Nilesh Mahakulkar	Designing of all assignments and Annotating the pictures
4. Deepam Patel	Collaborating information from the web and deploying the model

Table 5.4: Team Structure

5.4.2 Management reporting and communication

Reporting to the internal guide is done within time in allocated slot for project work.

CHAPTER 6

SOFTWARE REQUIREMENT SPECIFICATION

6.1 Introduction

The purpose of SRS document is to provide a detailed overview of our software product, its parameters and goals. This document describes the projects target audience and its user interface, hardware and software requirements. It tells us how our client, team and audience see the product and its functionality. Nonetheless, it helps any designer and developer to assist in software development life cycle (SDLC) processes.

6.1.1 Purpose and Scope of Document

To develop a system that makes it easy for user to search products on e-commerce websites.

6.1.2 Overview of responsibilities of Developer

- Take query image from user.
- Apply Object Detection to find out wearable items in that image.
- Use the detected items to find similar items in the image store using cosine similarity.
- Developer should develop an easy to understand GUI.
- Manual Testing should be done properly by the developer leaving no test cases.
- Co-ordinate with other developers and team members.

6.2 Usage Scenario

This project would be developed completely using open source software. So, anybody can use and enhance the software further without spending any money. Since all users are familiar with the general usage of computers, no specific training should be required to operate the system.

6.2.1 User profiles

- User : one who uses the product.

6.2.2 Use-cases

A use case diagram is a type of behavioral diagram defined by the Unified Modeling Language (UML) created from a Use-case analysis. Its purpose is to present a graphical overview of the functionality provided by a system in terms of actors, their goals represnted as use cases and any dependencies between the use cases.

6.2.3 Use Case View

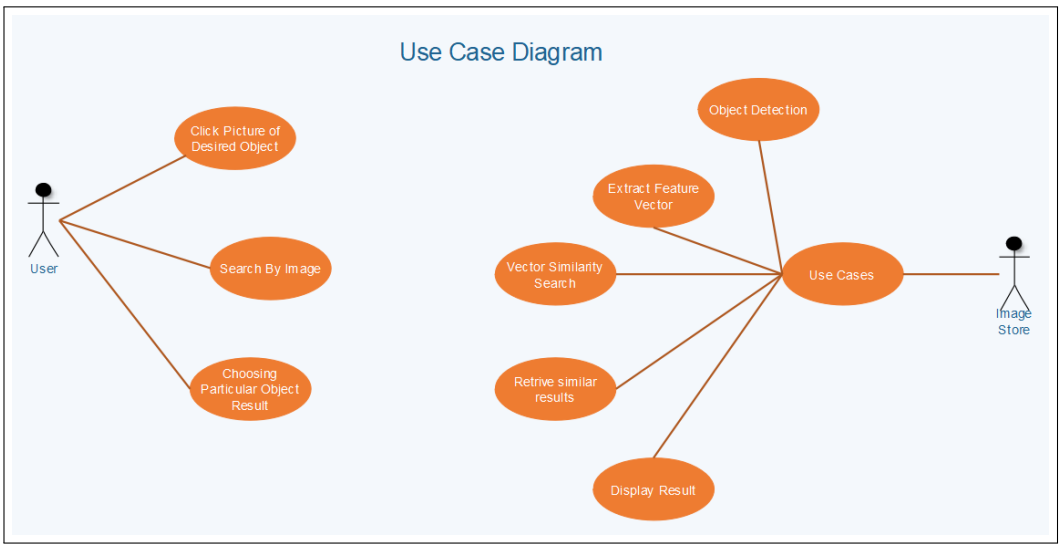


Figure 6.1: Use case diagram

6.3 Data Model and Description

6.3.1 Data Description

We crawled many images of shirts pants to train the object detection model. Each image was manually labelled using VOTT.

6.3.2 Data objects and Relationships

Data objects and their major attributes and relationships among data objects are described using an ERD- like form.

6.4 Functional Model and Description

6.4.1 Data Flow Diagram

6.4.1.1 Level 0 Data Flow Diagram

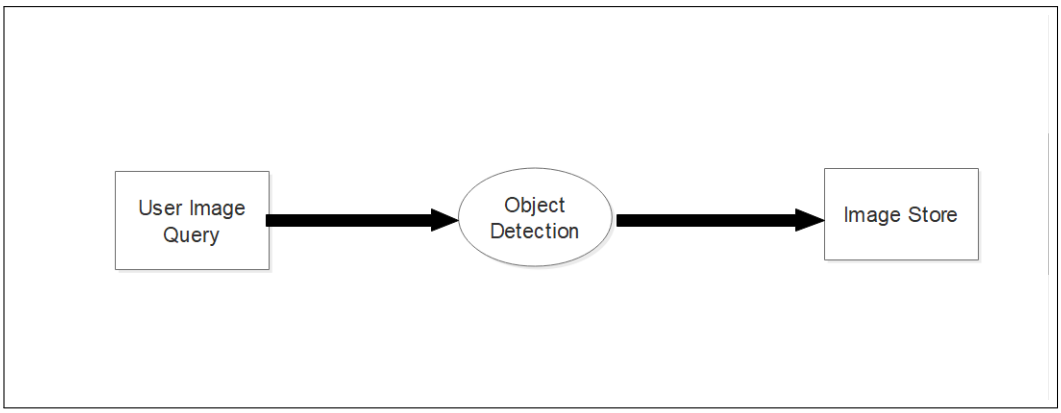


Figure 6.2: Level 0 Data Flow Diagram

6.4.1.2 Level 1 Data Flow Diagram

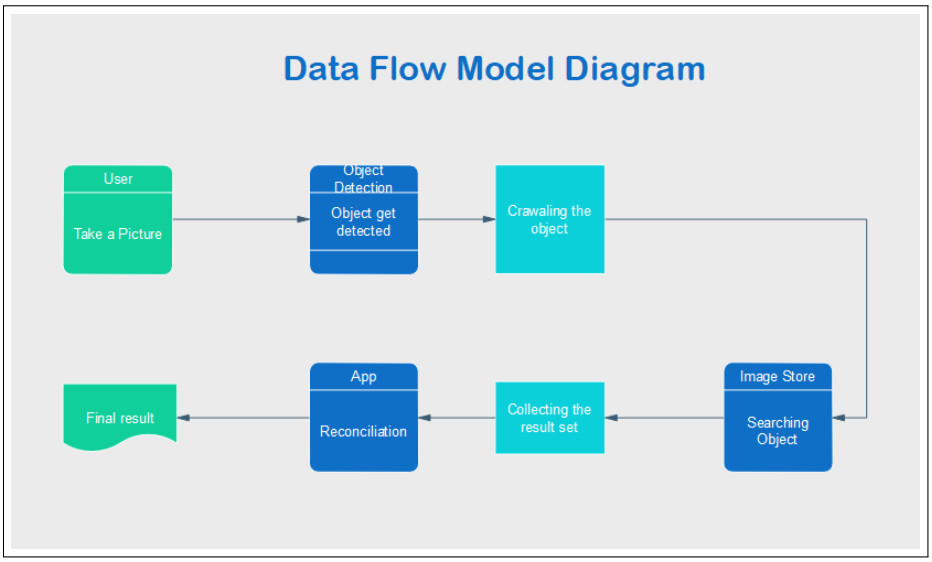


Figure 6.3: Data Flow Model Diagram

6.4.2 Activity Diagram:

The Activity diagram represents the steps taken.

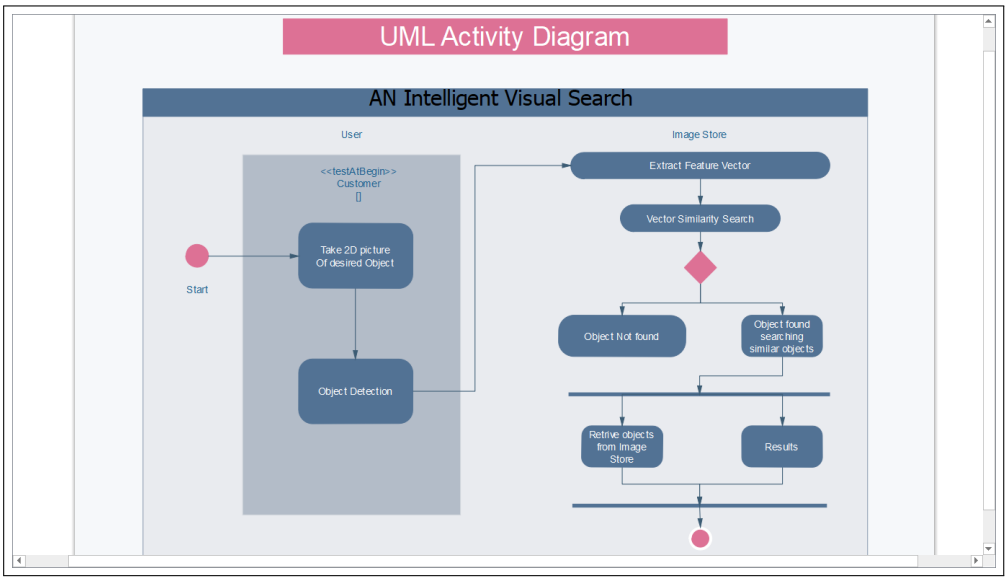


Figure 6.4: Data Flow Model Diagram

6.4.3 Non Functional Requirements:

- Performance Requirements
  - Software should be easy to maintain.
  - Software should be easily understood by users.
  - bug free
- Software quality attributes such as availability
  - This project is developed completely using open source software.
  - No specific training would be required to operate the system.

6.4.4 State Diagram:

State Transition Diagram
Fig.6.5 example shows the state transition diagram of Cloud SDK. The states are represented in ovals and state of system gets changed when certain events occur. The transitions from one state to the other are represented by arrows. The Figure shows important states and events that occur.

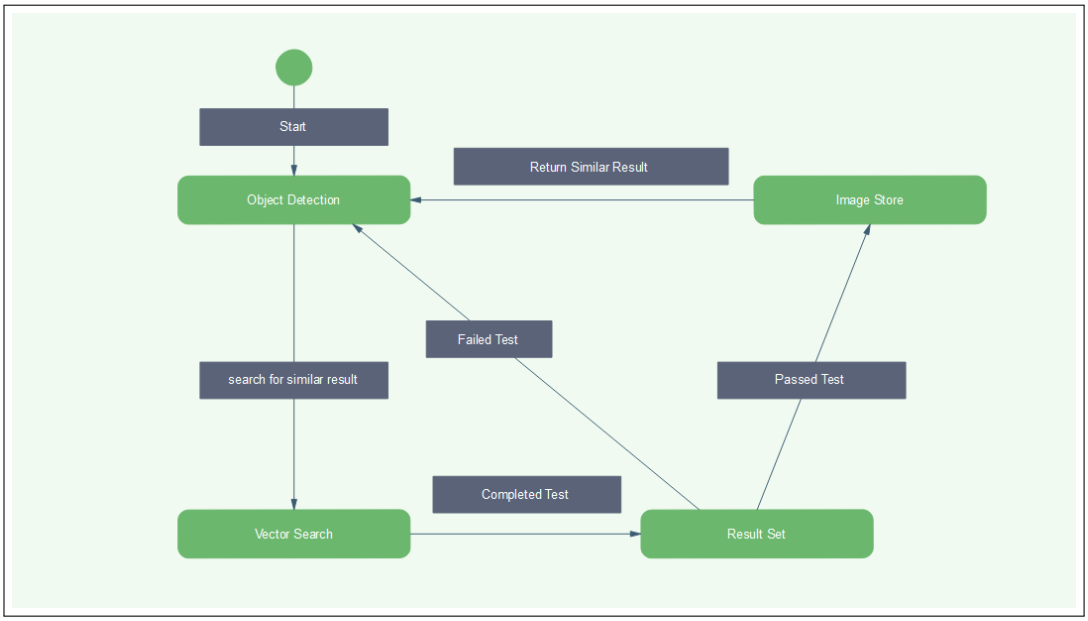


Figure 6.5: State transition diagram

6.4.5 Design Constraints

- Application should be tested before use.
- GUI must be clear.

6.4.6 Software Interface Description

A key principle of design is to prohibit access to all resources by default, allowing access only through well-defined entry points, i.e. interfaces. GUI would be like this :

6.4.7 Input Page

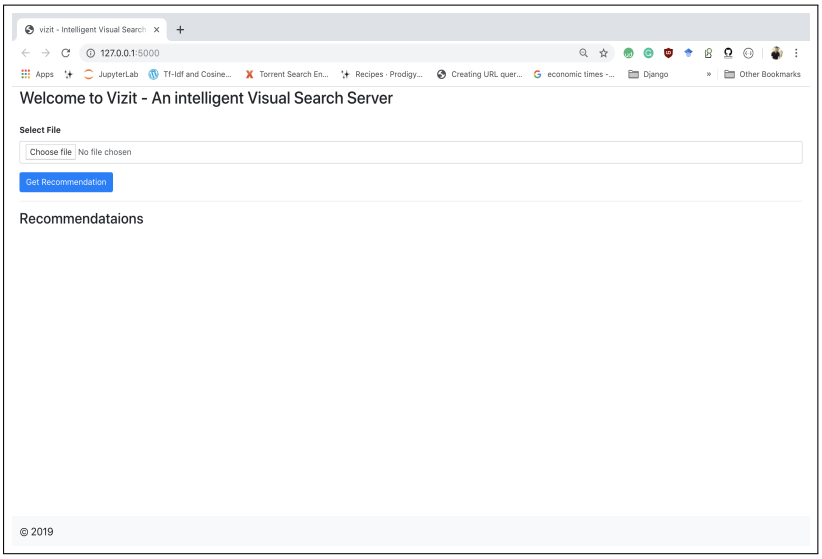


Figure 6.6: User Input

6.4.8 Selected user image

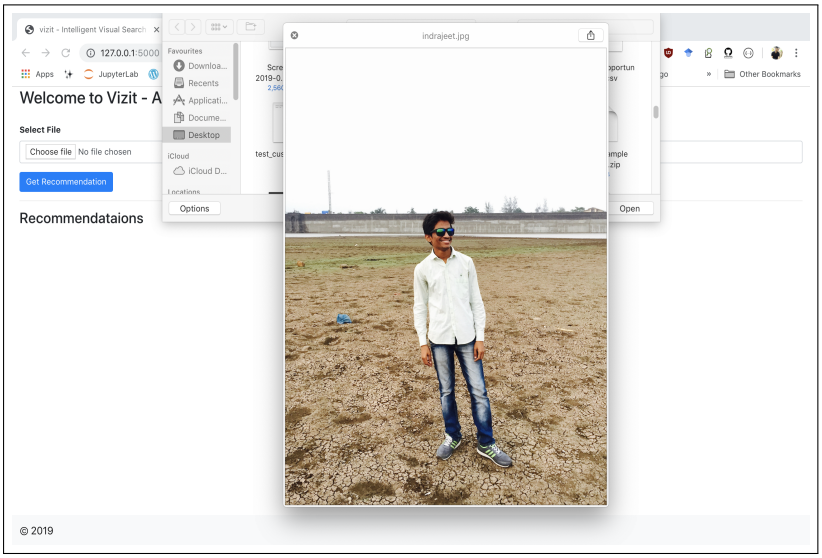


Figure 6.7: Selected Image

6.4.9 Results

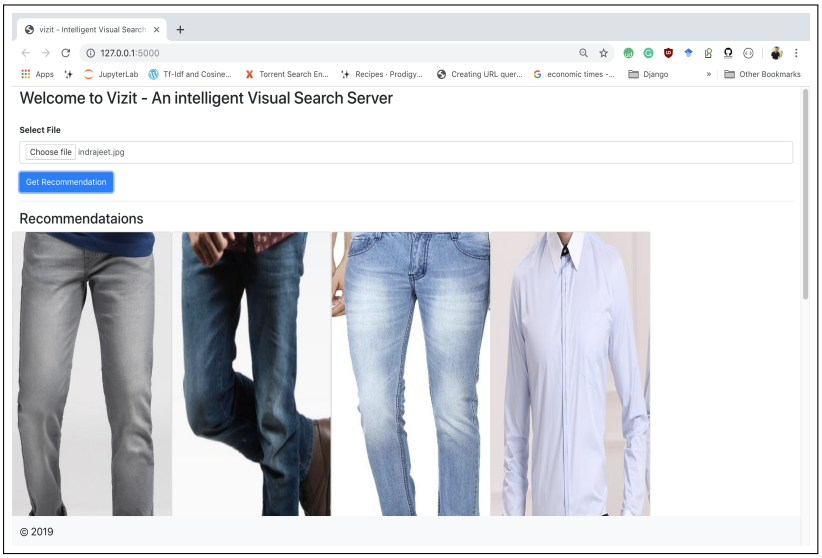


Figure 6.8: Result Images

CHAPTER 7

DETAILED DESIGN DOCUMENT USING ANNEXURE A AND B

7.1 Introduction

This document specifies the design that is used to solve the problem of Product.

7.2 Architectural Design

The Architecture consist of user, database and object detection. A user queries with an image captured from the phone camera or any similar source. Service responds with the recommendations

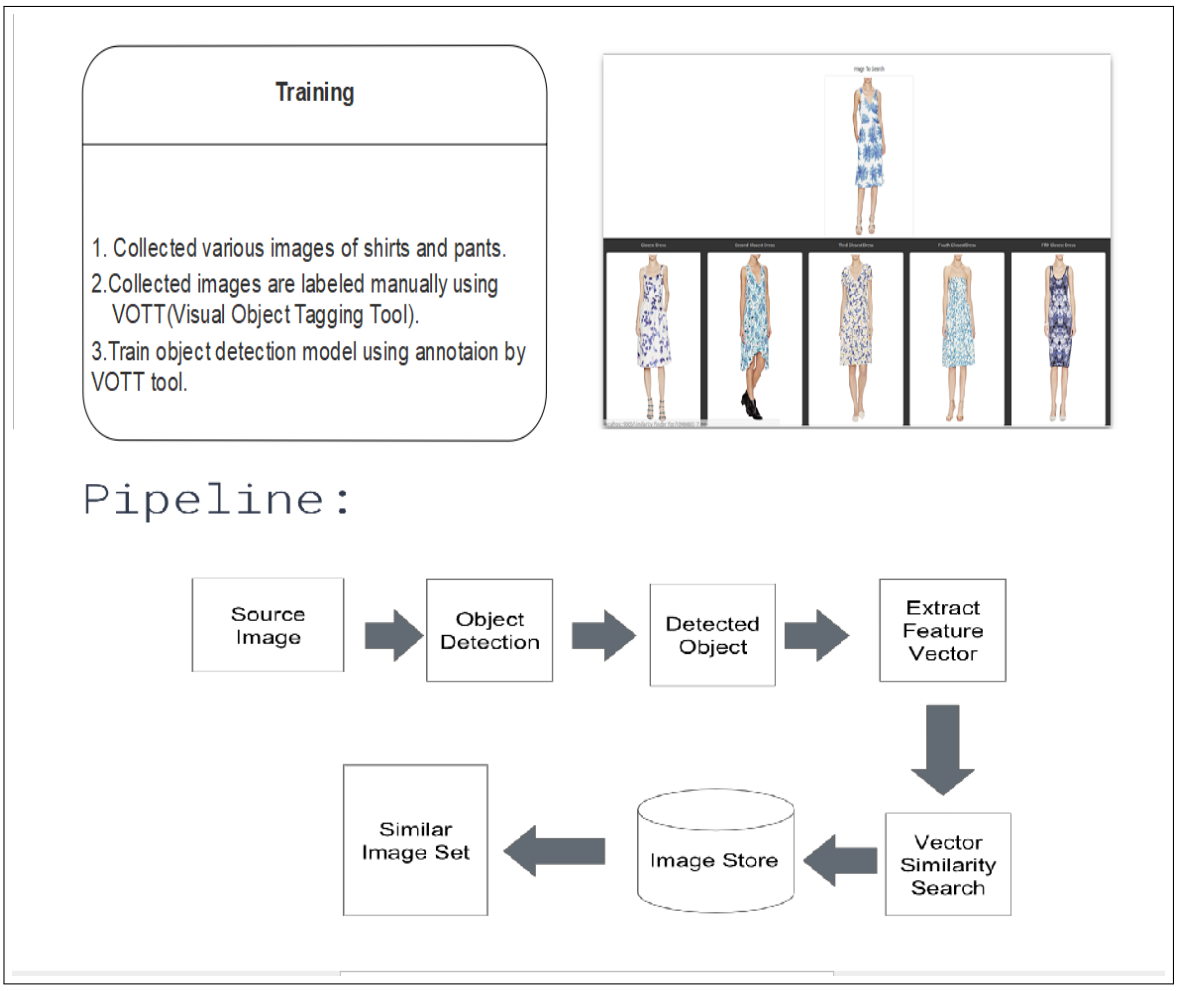


Figure 7.1: Architecture diagram

7.3 Component Design

Class diagrams, Interaction Diagrams, Algorithms. Description of each component description required.

7.3.1 Class Diagram

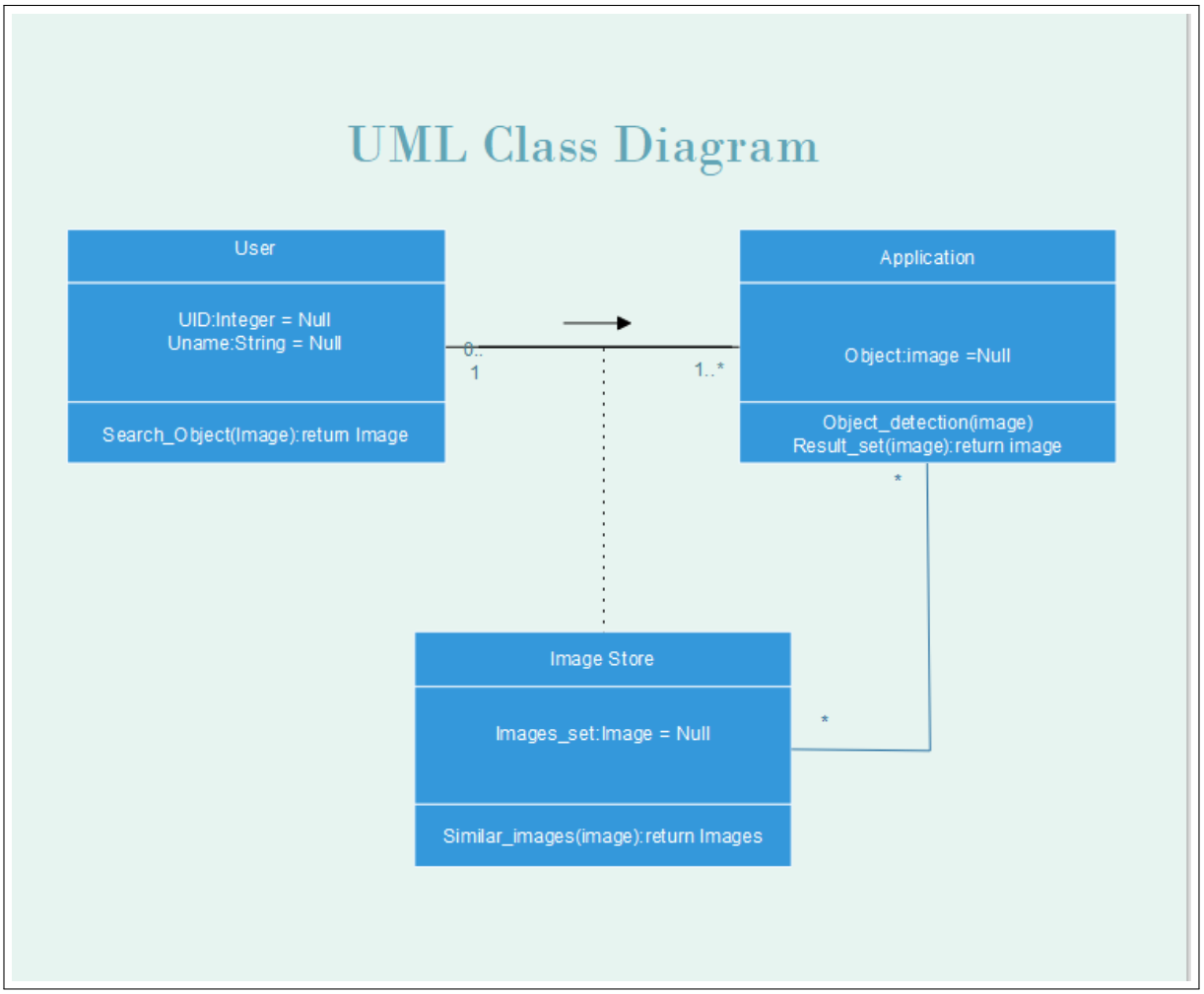


Figure 7.2: Class Diagram

CHAPTER 8
PROJECT IMPLEMENTATION

8.1 Introduction

In this project a user can query by clicking an image of the product he/she wants and our deep search engine will search the internet for similar products and recommend the results. This is based on Deep Object detection model and a Deep Feature extraction pipeline designed to understand the image at the deepest level so as to differentiate different images and recommend the most similar products. The system is very user friendly and easy to use.

8.2 Tools and Technologies Used

8.2.1 Tensorflow

TensorFlow is Google Brain's second-generation system. Version 1.0.0 was released on February 11, 2017. While the reference implementation runs on single devices, TensorFlow can run on multiple CPUs and GPUs (with optional CUDA and SYCL extensions for general-purpose computing on graphics processing units).TensorFlow is available on 64-bit Linux, macOS, Windows, and mobile computing platforms including Android and iOS.

Its flexible architecture allows for the easy deployment of computation across a variety of platforms (CPUs, GPUs, TPUs), and from desktops to clusters of servers to mobile and edge devices.

TensorFlow computations are expressed as stateful dataflow graphs. The name TensorFlow derives from the operations that such neural networks perform on multidimensional data arrays, which are referred to as tensors. During the Google I/O Conference in June 2016, Jeff Dean stated that 1,500 repositories on GitHub mentioned TensorFlow, of which only 5 were from Google.

In Jan 2018, Google announded TensorFlow 2.0. In March 2018, Google announced TensorFlow.js version 1.0 for machine learning in JavaScript and TensorFlow Graphics for deep learning in computer graphics.

8.2.2 Python

Python is among developers favorite programming languages for AI developmentbecause of its syntax, simplicity, and versatility. Python is very encouraging formachine learning for developers as it is less than languages such as C++ and Java. Italso a very portable language as it is used on platforms including Linux, Windows,Mac OS, and UNIX. It is also popular because it allows you to create interactive,interpreted, modular, dynamic, portable

and high-level code, which makes it moreunique than Java.Also, Python is a multi-paradigm programming language that supports object-oriented, procedural, and functional styles of programming. Python supports neural-networks and development of NLP solutions thanks to its simple function libraryand ideal structure. Advantages :

1. Python has a rich and extensive variety of library and tools.
2. Supports algorithm testing without having to implement them.
3. Python's object-oriented design increases a programmer's productivity.
4. Compared to Java and C++, Python is faster in development.

8.3 Methodologies/Algorithm Details

8.3.1 Fast-RCNN

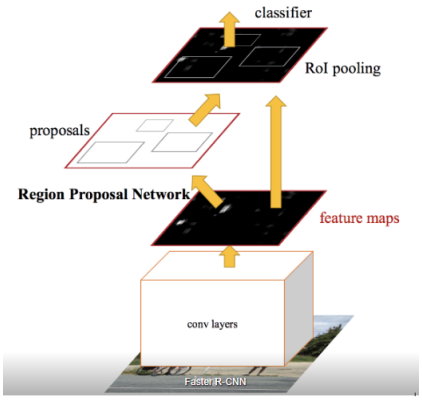


Figure 8.1: Fast-RCNN

After the rise of Deep Learning, Convolutional Neural Networks started getting used for image classification, image segmentation, and other Computer Vision tasks. Some general principles for CNN architecture based on experimental evidence are:

- Avoid bottlenecks with extreme compression. The size should decrease gradually.
- Increasing activations per tile will result in disentangled features and lead to faster training.

- Reducing the dimension of the input before spatial aggregation can be done without much loss of representation.
- Distribute the computational budget between height and width of the network.

Factorizing Convolutions with Large Filter Size

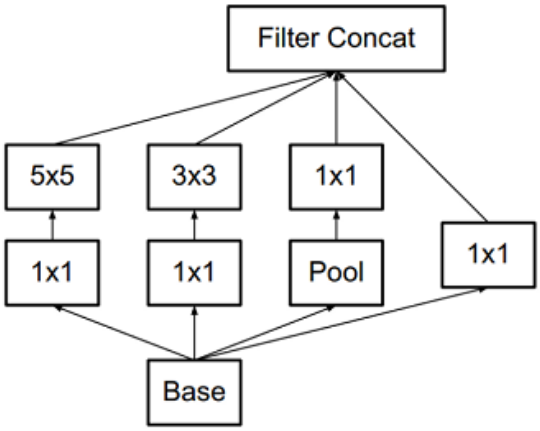


Figure 8.2: Inception Module

But, convolutions with large filter sizes like 5x5, 7x7 are computationally very expensive. If we replace the 5x5 filter with two 3x3 filter layers like this This two layer network does the same job as a 5x5 convolution, but with less

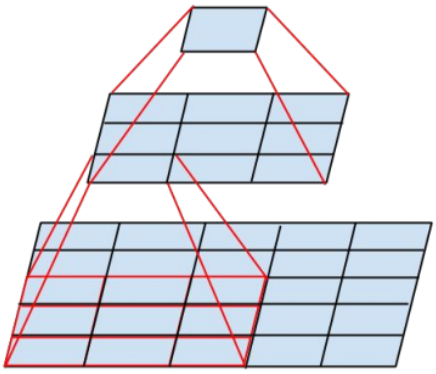
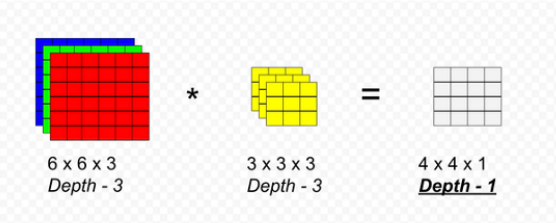
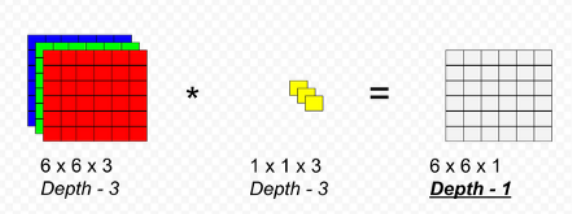


Figure 8.3: Mini network replacing 5x5 convolutions

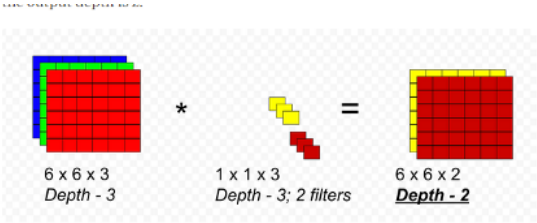
parameters, and therefore less computation. Hence we end up with (9+9/25) time less computation.



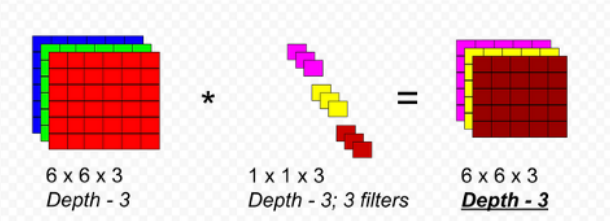
Convolution Operation 1x1 filter, Depth 3, No. of Filters-1:



Convolution Operation 1x1 Filter, Depth -3, No. of filters- 2:



Convolution Operation 1x1 Filter, Depth -3, No. of filters- 3:



8.3.2 Cosine Similarity

The cosine similarity between two vectors (or two documents on the Vector Space) is a measure that calculates the cosine of the angle between them.

This metric is a measurement of orientation and not magnitude, it can be seen as a comparison between documents on a normalized space.

$$\text{similarity} = \cos(\theta) = \frac{A \cdot B}{\|A\|\|B\|} = \frac{\sum_{i=1}^{n} A_i \times B_i}{\sqrt{\sum_{i=1}^{n} (A_i)^2} \times \sqrt{\sum_{i=1}^{n} (B_i)^2}}$$

Figure 8.4: Cosine Similarity

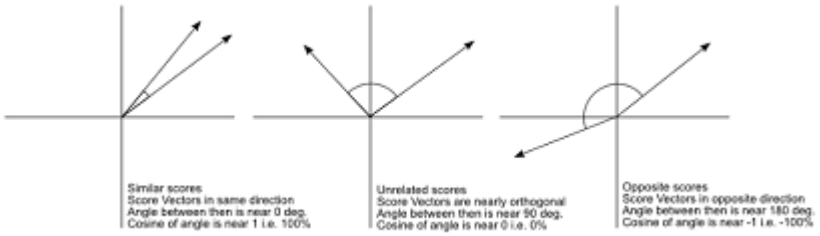


Figure 8.5: For different documents
The Cosine Similarity values for different documents, 1 (same direction), 0 (90 deg.), -1 (opposite directions)

Even if we had a vector pointing to a point far from another vector, they still could have an small angle and that is the central point on the use of Cosine Similarity, the measurement tends to ignore the higher term count on documents. Suppose we have a document with the word sky appearing 200 times and another document with the word sky appearing 50, the Euclidean distance between them will be higher but the angle will still be small because they are pointing to the same direction, which is what matters when we are comparing documents.

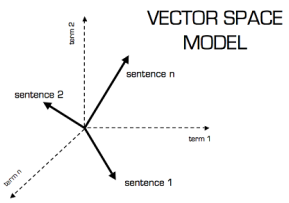


Figure 8.6: Vector Space Model

CHAPTER 9
SOFTWARE TESTING

9.1 Type of Testing

Key Aspects of AI Systems Testing :

- Data Validation : The effectiveness of AI systems is largely dependent on the quality of training data, including aspects such as bias and variety. For example, smart phone assistants and car navigation systems find it difficult to comprehend different accents. The impact of training data is illustrated in an experiment by researchers from MIT Media Lab who trained Norman, an AI powered psychopath by exposing it to data from the dark corners of the web. Where a regular algorithm perceived a group of people standing around a window as just that, Norman saw them as potentially jumping out of the window. This experiment shows that training data is of utmost importance for AI systems to give the desired output.

- Core Algorithm : The heart of AI systems is built on algorithms, which process data and generate insights. Model validation, learnability, algorithm efficiency and empathy are among the key features of this approach. Learnability is the ability of a system to learn and modify its behavior with time. Some examples of websites with learnability include Netflix and Amazon, which understand user preferences and come up with appropriate recommendations. Another example is a Voice Recognition System like Siri or Cortana, which picks up the semantics of language websites. However, with Cortana now responding to I am being abused with the number for the National Domestic Violence hotline, it is important for chatbots to be tested for comprehension of things such as sarcasm and tone.

CHAPTER 10

RESULTS

10.1 Screen shots

10.1.1 Input Page

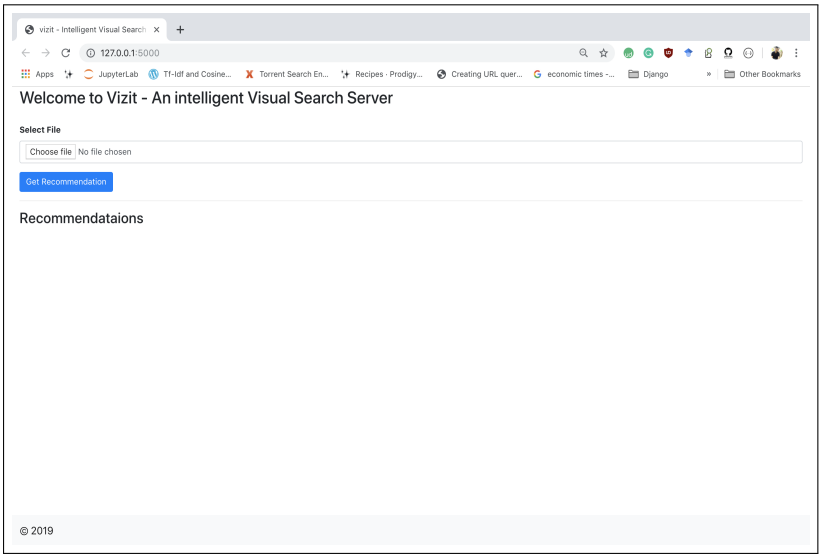


Figure 10.1: User Input

10.1.2 Selected user image

10.1.3 Results

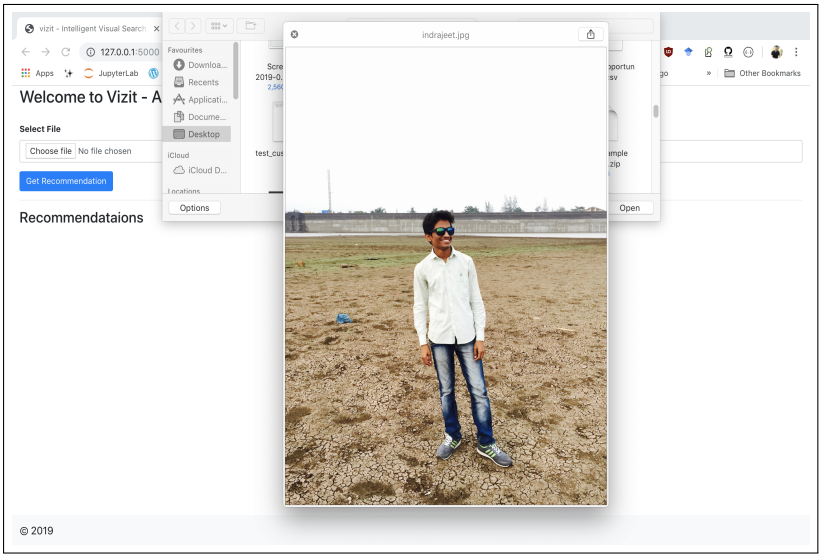


Figure 10.2: Selected Image

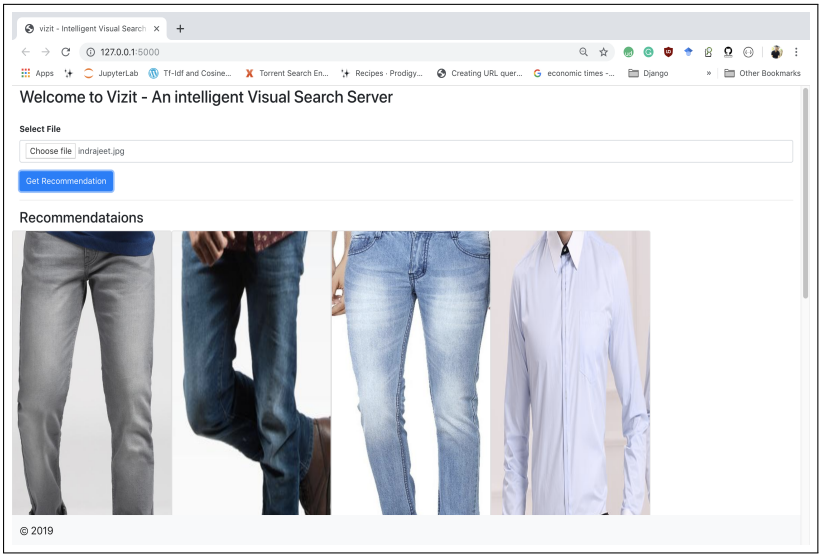


Figure 10.3: Result Images

CHAPTER 11

DEPLOYMENT AND MAINTENANCE

11.1 Installation and un-installation

11.1.1 Installation of Visual Studio Code

```
sudo snap install --classic code # or code-insiders
```

11.1.2 Installation of Tensorflow for Ubuntu

- Install the Python development environment on your system Check if your Python environment is already configured:

```
$ pip3 install --user --upgrade tensorflow  # install in $HOME
```

- Create a virtual environment (recommended) Python virtual environments are used to isolate package installation from the system.

- Install the TensorFlow pip package

Ubuntu | mac OS | Windows | Raspberry Pi | Other

```
$ sudo apt update
$ sudo apt install python3-dev python3-pip
$ sudo pip3 install -U virtualenv  # system-wide install
```

CHAPTER 12

CONCLUSION AND FUTURE SCOPE

12.1 Conclusion

With the development of software and hardware capabilities of devices, there is anincreased need for device-specific content, what resulted in market changes. RegionConvolutional Neural Network technology is of particular interest for the object de-tection. The searching is generally manual, which is an inconvenient task and wasteof time for a user. To avoid this the system is developed, a Visual Search Engine isa search engine designed to search for information on the World Wide Web throughthe input of an image or a search engine with a visual display of the search results.Information may consist of web pages, locations, other images and other types ofdocuments. The accuracy and speed of searching has significantly increased and be-come more accessible to everyone. The system, unlike text search does not requireuser to enter the text everytime. Moreover, the advantage of visual search is that itprovides accuracy and removes the manual process of searching by text.

12.2 Future Scope

It is safe to assume that the future of visual search engines will be retail-dominated.For now, its easier to search for information with words. As a result, visual searchengines are convenient, but theyre not ultimately necessary for every industry tosucceed. Services, for instance, may be more likely to rely on textual search engines,whereas sales may be more likely to rely on visual search engines. 69 percent ofyoung consumers showing an interest in making purchases based on visual-orientedsearches alone, the future of visual search engines is most likely to be a shoppersparadise in the right retailers hands.

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ANNEXURE A

LABORATORY ASSIGNMENTS ON PROJECT ANALYSIS OF ALGORITHMIC DESIGN

A.1 Laboratory assignments on Project Analysis of Algorithmic Design

AIM: Project problem assessment : feasibility assessment using p-complete, np-complete, np hard,or satisfiability issues using modern algebra and/or relevant tools.

P Problems
As the name says these problems can be solved in polynomial time, i.e.; O(n), O(n2) or O(nk), where k is a constant.

NP Problems
Some think NP as Non-Polynomial. But actually it is Non-deterministic Polynomial time. i.e.; yes/no instances of these problems can be solved in polynomial time by a non-deterministic Turing machine and hence can take up to exponential time (some problems can be solved in sub-exponential but super polynomial time) by a deterministic Turing machine. In other words these problems can be verified (if a solution is given, say if it is correct or wrong) in polynomial time by a deterministic Turing machine (or equivalently our computer). Examples include all P problems. One example of a problem not in P but in NP is Integer Factorization

NP Complete Problems(NPC)
Over the years many problems in NP have been proved to be in P (like Primality Testing). Still, there are many problems in NP not proved to be in P. i.e.; the question still remains whether P=NP (i.e.; whether all NP problems are actually P problems).
NP Complete Problems helps in solving the above question. They are a subset of NP problems with the property that all other NP problems can be reduced to any of them in polynomial time. So, they are the hardest problems in NP, in terms of running time. If it can be showed that any NPC Problem is in P, then all problems in NP will be in P (because of NPC definition), and hence P=NP=NPC.
All NPC problems are in NP (again, due to NPC definition). Examples of NPC problems

NP Hard Problems (NPH)
These problems need not have any bound on their running time. If any NPC Problem is polynomial time reducible to a problem X, that problem X belongs to NP Hard class. Hence, all NP Complete problems are also NPH. In

other words if a NPH problem is non-deterministic polynomial time solvable, it is a NPC problem. Example of a NP problem that is not NPC is Halting Problem.

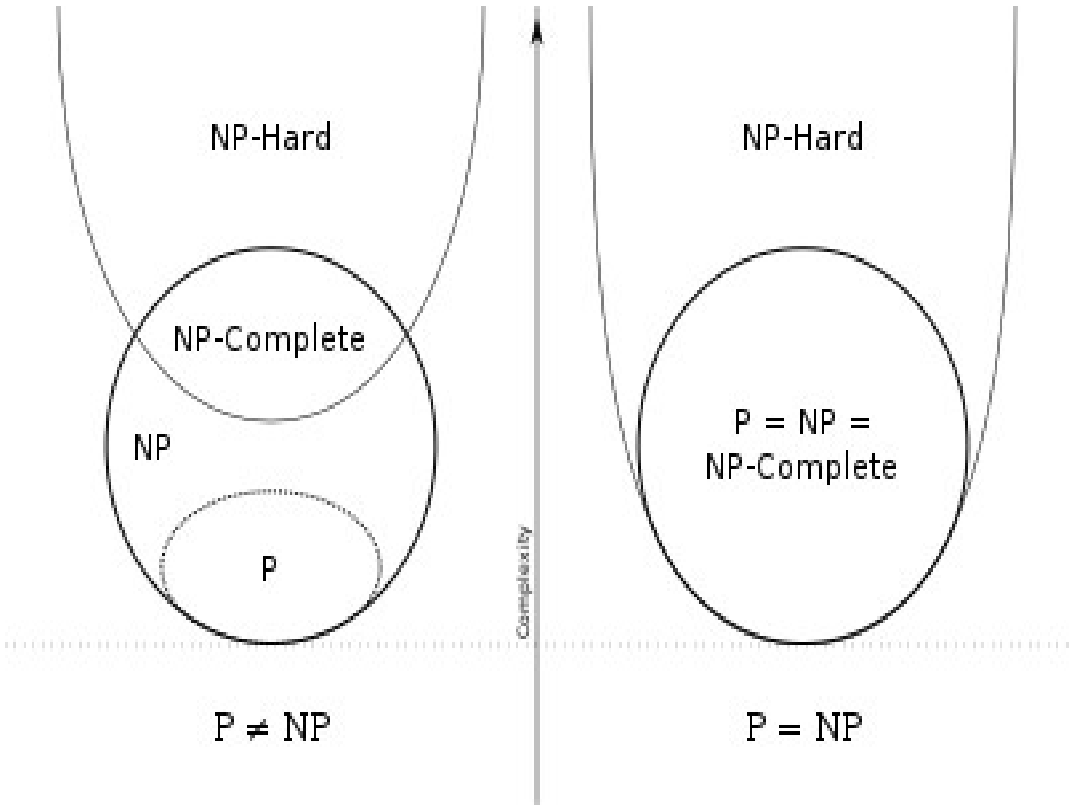

Figure A.1: NP Hard Problems

From the diagram, its clear that NPC problems are the hardest problems in NP while being the simplest ones in NPH. i.e.; NPNPH=NPC. Hence our problem comes under NP hard problem.

AIM: To develop the problem under consideration and justify feasibilty using concepts of knowledge canvas and IDEA Matrix.

Refer below for IDEA Matrix and Knowledge canvas model. Case studies are given in this book. IDEA Matrix is represented in the following form. Knowledge canvas represents about identification of opportunity for product. Feasibility is represented w.r.t. business perspective.

I	D	E	A
INCREASE: Accuracy of showing similar results.	DRIVE: User Interaction	EDUCATE: The user to use the application can get the result.	ACCELERATE: Accuracy and performance rate.
IMPROVE: Performance to select Best similarity product Available.	DELIVER: High performance in terms of showing results	EVALUATE: Fused Affinity Matrix using LRR and ASML	ASSOCIATE: User choice with search result
IGNORE: The user using the application can search for similar product.	DECREASE: Time required showing similarity result.	ELIMINATE: Complexity	AVOID: Less similarity products.

Table A.1: IDEA Matrix

ANNEXURE B

LABORATORY ASSIGNMENTS ON PROJECT QUALITY AND RELIABILITY TESTING OF PROJECT DESIGN

AIM: Testing of project problem statement using generated test data (using mathematical models, GUI, functiontion testing principle if any) selection of appropriateuse of testing tool, testing of UML diagrams realiability.

A process of analyzing a software item to detect the differences between existing and required conditions (i.e., defects) and to evaluate the features of the software item.

Manual Testing:
Manual testing is the process of testing the software manually to find the defects. Tester should have the perspective of an end users and to ensure all the features are working as mentioned in the requirement document. In this process, testers execute the test cases and generate the reports manually without using any automation tools.

Automation Testing:
Automation testing is the process of testing the software using an automation tools to find the defects. In this process, testers execute the test scripts and generate the test results automatically by using automation tools. Some of the famous automation testing tools for functional testing are QTP/UFT and Selenium.

Software Testing:
Software testing is the process of evaluation a software item to detect differences between given input and expected output. Also to assess the feature of A software item. Testing assesses the quality of the product. Software testing is a process that should be done during the development process. In other words software testing is a verification and validation process.

Verification:
Verification is the process to make sure the product satisfies the conditions imposed at the start of the development phase. In other words, to make sure the product behaves the way we want it to.

Validation:
Validation is the process to make sure the product satisfies the specified requirements at the end of the development phase. In other words, to make sure the product is built as per customer requirements.

Basics of software testing

There are two basics of software testing: blackbox testing and whitebox testing.

Blackbox Testing:
Black box testing is a testing technique that ignores the internal mechanism of the system and focuses on the output generated against any input and execution of the system. It is also called functional testing.

Whitebox Testing:
White box testing is a testing technique that takes into account the internal mechanism of a system. It is also called structural testing and glass box testing

There are many types of testing like

Unit Testing
Unit testing is the testing of an individual unit or group of related units. It falls under the class of white box testing. It is often done by the programmer to test that the unit he/she has implemented is producing expected output against given input.

Integration Testing
Integration testing is testing in which a group of components are combined to produce output. Also, the interaction between software and hardware is tested in integration testing if software and hardware components have any relation. It may fall under both white box testing and black box testing.

Functional Testing
Functional testing is the testing to ensure that the specified functionality required in the system requirements works. It falls under the class of black box testing.

System Testing
System testing is the testing to ensure that by putting the software in different environments (e.g., Operating Systems) it still works. System testing is done with full system implementation and environment. It falls under the class of black box testing.

Stress Testing
Stress testing is the testing to evaluate how system behaves under unfavorable conditions. Testing is conducted at beyond limits of the specifications.

It falls under the class of black box testing.

Performance Testing
Performance testing is the testing to assess the speed and effectiveness of the system and to make sure it is generating results within a specified time as in performance requirements. It falls under the class of black box testing.

Usability Testing
Usability testing is performed to the perspective of the client, to evaluate how the GUI is user-friendly? How easily can the client learn? After learning how to use, how proficiently can the client perform? How pleasing is it to use its design? This falls under the class of black box testing.

Acceptance Testing
Acceptance testing is often done by the customer to ensure that the delivered product meets the requirements and works as the customer expected. It falls under the class of black box testing.

Regression Testing
Regression testing is the testing after modification of a system, component, or a group of related units to ensure that the modification is working correctly and is not damaging or imposing other modules to produce unexpected results. It falls under the class of black box testing.

Beta Testing
Beta testing is the testing which is done by end users, a team outside development, or publicly releasing full pre-version of the product which is known as beta version. The aim of beta testing is to cover unexpected errors. It falls under the class of black box testing.

ANNEXURE C

REVIEWERS COMMENTS OF PAPER SUBMITTED

1. Paper Title: AN INTELLIGENT VISUAL SEARCH
2. Name of the Conference/Journal where paper submitted : International Research Journal of Engineering and Technology (IRJET)
3. Paper accepted/rejected : Accepted
4. Review comments by reviewer :
   - Suggested to make Android App
   - One of innovative idea need to work on UI go ahead.
5. Corrective actions if any : No

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CERTIFICATE

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Dr. J.R. Shaikh — COORDINATOR

Mrs. R.M. Thadi — HOD E&TC DEPT CONVENER

Dr. M.S. Rohokale — PRINCIPAL

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This is to certify that **Nilesh Mahakulkar** has published a research paper entitled *'An Intelligent Visual Search'* in the International Journal of Scientific Research in Science, Engineering and Technology (IJSRSET), Volume 5, Issue 7, March-April-2019.

This Paper can be downloaded from the following IJSRSET website link
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This is to certify that **Indrajeet Ambure** has presented the research paper entitled *'An Intelligent Visual Search'* in the National Conference on 'Information, Communication and Energy Systems and Technologies' ICEST-2019 on 5th and 6th April, 2019.

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This is to certify that **Sakshi Amrutkar** has presented the research paper entitled *'An Intelligent Visual Search'* in the National Conference on 'Information, Communication and Energy Systems and Technologies' ICEST-2019 on 5th and 6th April, 2019.

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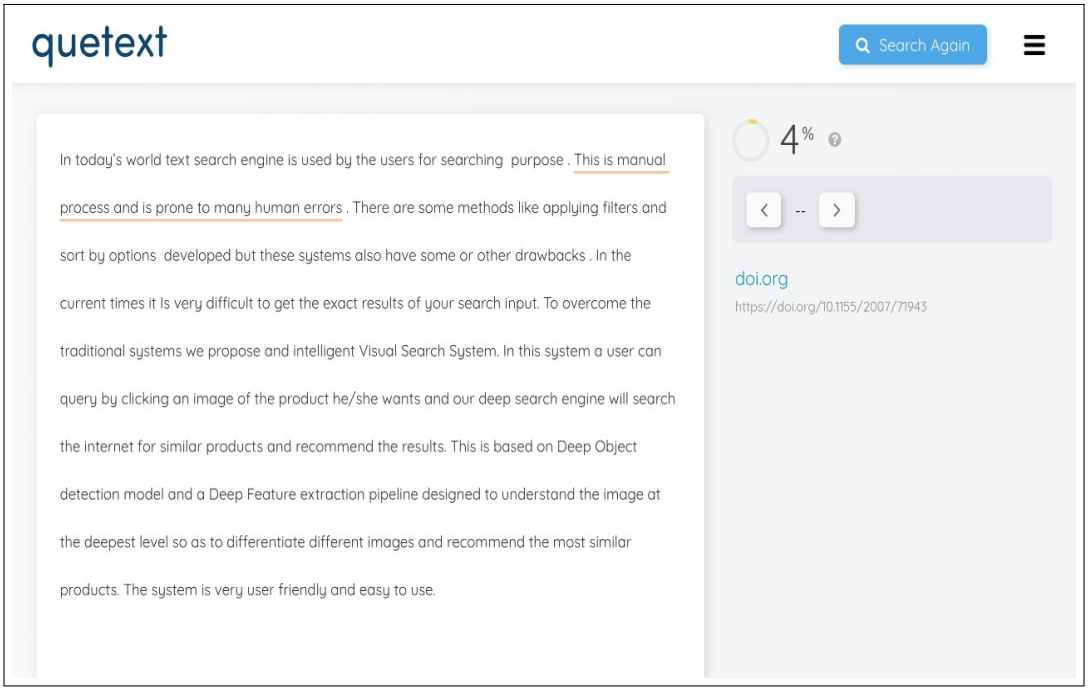
ANNEXURE D
PLAGIARISM REPORT


quetext
Search Again
In today's world text search engine is used by the users for searching purpose . This is manual process and is prone to many human errors . There are some methods like applying filters and sort by options developed but these systems also have some or other drawbacks . In the current times it Is very difficult to get the exact results of your search input. To overcome the traditional systems we propose and intelligent Visual Search System. In this system a user can query by clicking an image of the product he/she wants and our deep search engine will search the internet for similar products and recommend the results. This is based on Deep Object detection model and a Deep Feature extraction pipeline designed to understand the image at the deepest level so as to differentiate different images and recommend the most similar products. The system is very user friendly and easy to use.
4%
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doi.org
https://doi.org/10.1155/2007/71943

ANNEXURE E

INFORMATION OF PROJECT GROUP MEMBERS

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8. Paper Published : Yes

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8. Paper Published : Yes