NUMBER PLATE DETECTION

A PROJECT REPORT

Submitted by

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In fulfillment for the award of the degree

of

BACHELOR OF ENGINEERING

in

COMPUTER ENGINEERING

LDRP Institute of Technology and Research, Gandhinagar

Kadi Sarva Vishwavidyalaya

FEBUARY, 2022

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CE-IT Department

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This is to certify that the Project Work entitled **"NUMBER PLATE DETECTION"** has been carried out by **VADNAGARA ABHISHEK VIPULBHAI(19BECE30004)** under my guidance in fulfilment of the degree of Bachelor of Engineering in Computer Engineering Semester-6 of Kadi Sarva Vishwavidyalaya University during the academic year 2021-22.

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ABSTRACT

Number Plate recognition, also called License Plate realization or recognition using image processing methods is a potential research area in smart cities and Internet of Things. This project presents a image processing system for number plate detection and recognition that can deal with, noisy, low illuminated, non-standard font number plates. This work employs several image processing techniques such as, gray scale transformation, Gaussian smoothing, and Gaussian thresholding, in the pre-processing stage. Next, for number plate segmentation, contours are applied by border following and contours are drawn based on contours of length four found in the image. Finally, after getting the region of interest we will crop the image. Pytesseract technology is used for character recognition. The proposed methods demonstrated promising result.

Acknowledgement

Initially, we would like to express our sincere gratitude and gratefulness to our mentor Mr. Hitesh Barot for providing us with all sorts of basic ideas and techniques essential for carrying out this project work from the very beginning to the end and enabled us to present this dissertation in this form. The teaching staffs also deserve our sincere thanks for sharing their discussion and exchange of ideas.

We are very much grateful to the Leelaben Dashrathbhai Ramdas Patel Institute Of Technology And Research, Gandhinagar for providing us an enthusiastic support and opportunity. Department of Computer also must come in special mention for their unstinting cooperation in completion of this project. We would like to give heartily thanks to our friends who have provided a great help and cooperation for the existence of this output. Our obligation goes to our family and all our friends who assisted us directly and indirectly in completing this study.

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1. Introduction

1.1 Introduction

Traffic control and vehicle owner identification has become major problem in every country. These systems are based on different methodologies but still it is really challenging task as some of the factors like non-uniform vehicle number plate, language of vehicle number can affect a lot in the overall recognition rate. Most of the systems work under these limitations. Sometimes it becomes difficult to identify vehicle owner who violates traffic rules and drives too fast. Therefore, it is lot time consuming to catch and punish those kinds of people because the traffic personal has to do 24 x 7 watch on multiple surveillance footages.

1.2 Scope

In last few years, Vehicle Number Plate Detection has been one of the useful approaches for vehicle surveillance. It is can be applied at number of public places for fulfilling some of the purposes like traffic safety enforcement, automatic toll text collection, car park system and Automatic vehicle parking system.

1.3 Project Summary and Purpose

It is quite clear that Vehicle number plate detection system is difficult system because of different number of phases and presently it is not possible to achieve 100% overall accuracy as each phase is dependent on previous phase. Certain factors like different illumination conditions, vehicle shadow and non-uniform size of license plate characters, different font and background color affect the performance of Vehicle number plate detection. Some systems work in these restricted conditions only and might not produce good amount of accuracy in adverse conditions. Some of the systems are developed and used for specific country.

The purpose of this project is to detect vehicle number plate using image processing.

1.4 Overview of the Project

Firstly, the image is browsed from the given path then the image is converted to gray scale and after that, applying bilateral filter to smooth the image then using canny we sharp the edges of given image then by finding contours we draw the rectangle that was found using approx. poly curve and crop the number plate from the browsed image. Finally using pytesseract we read the number plate. After detecting number plate we fetch the details of the detected number plate using REST API.

1.5 Problem Definition.

Detecting the number plate of vehicle from the browsed image.

2. Technology and Literature Review

2.1 About Tools and Technology

- Python: Python is a high-level, interpreted, interactive and object-oriented scripting language. Python is designed to be highly readable. It is also easy to learn, easy to read, extensible, portable and scalable.
- OpenCV: OpenCV (Open Source Computer Vision Library) is an open source computer vision and machine learning software library. OpenCV was built to provide a common infrastructure for computer vision applications and to accelerate the use of machine perception in the commercial products. The library has more than 2500 optimized algorithms, which includes a comprehensive set of both classic and state-of-the-art computer vision and machine learning algorithms.
- Tesseract: Python-tesseract is a wrapper for Google's Tesseract-OCR Engine which is used to recognize text from images.
- Flask: Flask is Python web framework built with a small core and easy to extend philosophy. Flask is based on the Werkzeug WSGI toolkit and Jinja2 template engine. Both are Pocco projects.

2.2 Brief History of work done

Firstly the image is browsed from the given path then the image is converted to gray scale and after that, applying bilateral filter to smooth the image then using canny we sharp the edges of given image then by finding contours we draw the rectangle that was found using approx. Poly curve and crop the number plate from the browsed image. Finally using pytesseract we read the number plate. After detecting number plate we fetch the details of the detected number plate like vehicle owner name , insurance company details, email of owner, etc using REST API.

3. System Requirement Study

3.1 User Characteristics

Analyzing user characteristics is an important aspect of any project. It allows us to clearly define and focus on who the end users are for the project. Also, it allows checking the progress of the project to ensure that we are still developing the system for the end users. The user must have following characteristics:

- User must have basic knowledge of Computers.
- User should understand the use of all modules.
- User can easily interact with the proposed system.
- User must know the technical terms used in the company for performing different tasks specially related to call logs, payment details, transportation details and report retrieval.
- User should be also being aware about the running process of the system

3.2 Hardware and Software Requirements

Software and Hardware Requirements are used to describe the minimum hardware and software requirements to run the Software. These requirements are described below.

3.2.1 Software and Hardware Requirements:

- Client:
  - Operating System: Windows or Linux
  - Web Browser: Any HTML Compliant Browser
- Server:
  - Operating System: WINDOWS or LINUX SERVER OS
  - Technologies: Python, Flask, Pytesseract, OpenCV

3.2.2 Functional Requirements:

- Firstly, user can select the type of number plate.
- Then after selecting it can browse the image.
- After browsing the user gets details of detected number plate.

3.2.3 Non-Functional Requirements:

Following is a list of non-functional requirements:

- Performance: This system should remain accessible 24x7. At least 100 users should be able to access the system altogether at any given time.
- Security: The database of system should not store any password in plain text rather the ceaser cipher text has to be stored.
- Reliability: It can be accessed by the end users 24*7 as an when needed hence is highly reliable for end users.
- Availability: Internet connection for the nodes with the database server is ensured and hence the application will be available any time for access.
- Portability: The developed web application is portable as it can be accessed from any operation system regardless Windows, Mac, Linux provided they have a browser to access Internet.

3.3 Constraints

3.3.1 Regulatory Policies

Regulatory policy is about achieving organization's objectives through the use of regulations, laws, and other instruments to deliver better economic and social outcomes and thus enhance the life of business. Thus the system should be developed by using these regulations to provide better outcome to the company.

3.3.2 Hardware Limitations

Hardware Limitations are other constraint of the system. Hardware Limitations should be overcome for better performance of the system. This can be achieved by using minimum and only necessary hardware.

3.3.3 Parallel Operations

The project is on basis of single user. This is used for carrying out updating as well as entry by preventing the redundancy of the data.

3.3.4 Reliability Requirements

Reliability requirements of the system are one of the prime ones in the list. The system is needed to be highly reliable in terms of performance and capable of delivering robust performance. If the reports are generated within 5 seconds, then the system is said to be reliable.

3.3.5 Criticality of the Application

The system can stop working on computers with very low internet connection. Other than that there won't be any issues. Apart from these the system should be able to make updates at regular time intervals.

3.3.6 Safety and Security Consideration

Safety and security too are other major concerns of any system. It is necessary to provide safety and security as the system is web application and might be intrude by security threats from the internet.

3.4 Assumptions and Dependencies

3.4.1 Assumption:

- Browsing of images are assumed to be secure and reliable.
- User is the person having enough knowledge for the traversing operation.
- We will provide a user-friendly interface so that any user can easily navigate through the system.
- The REST API is used for data storing is always secured.

3.4.2 Dependencies

- The system is dependent upon the proper details of detected number plate.
- This system depends on the proper browsing of image and then proper image processing

4.System Analysis

4.1 Study of Current System

Firstly, the image is browsed from the given path then the image is converted to gray scale and after that, applying bilateral filter to smooth the image then using canny we sharp the edges of given image then by finding contours we draw the rectangle that was found using approxPoly curve and crop the number plate from the browsed image. Finally using pytesseract we read the number plate. After detecting number plate we fetch the details of the detected number plate like vehicle owner name , insurance company details, email of owner, etc using REST API.

4.2 Problem and Weaknesses of Current System

- The system does not detect tilted number plate.
- The system does not detect very far image of number plate.

4.3 Feasibility Study

An important outcome of the preliminary investigation is the determination that the system requested is feasible. The feasibility study is carried out to examine the likelihood that the system will be useful to the organization.

- Does the system contribute to the overall objectives of the organization?
- Can the system be implemented using the current technology and within the given cost and schedule constraints?
- Can the system be integrated with other system which are already in place?

4.4 Requirements Validation

It is concerned with showing that the requirements actually define the system which the customer wants. User should browse the image properly means giving clear image to the system.

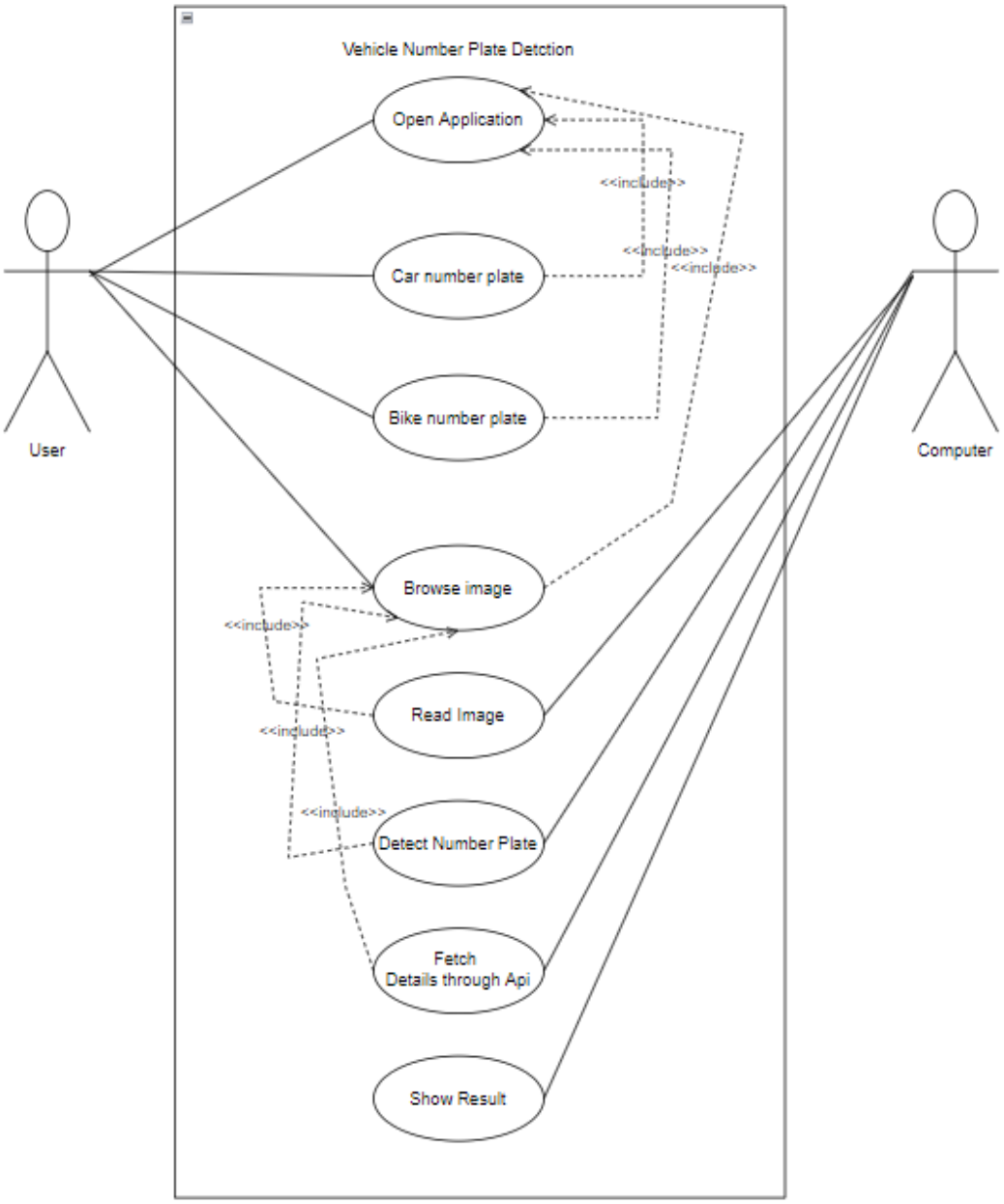
4.5 Activity/Process in New System (Use event table)

EVENT	PROCESS
	Image taken by camera.
	Image is processed to gray and then filtered.
	Edge detection is applied.
	We use contour mapping to detect number plate.
	The detected number plate.
	The final output i.e fetching the details of detected number plate using REST API.

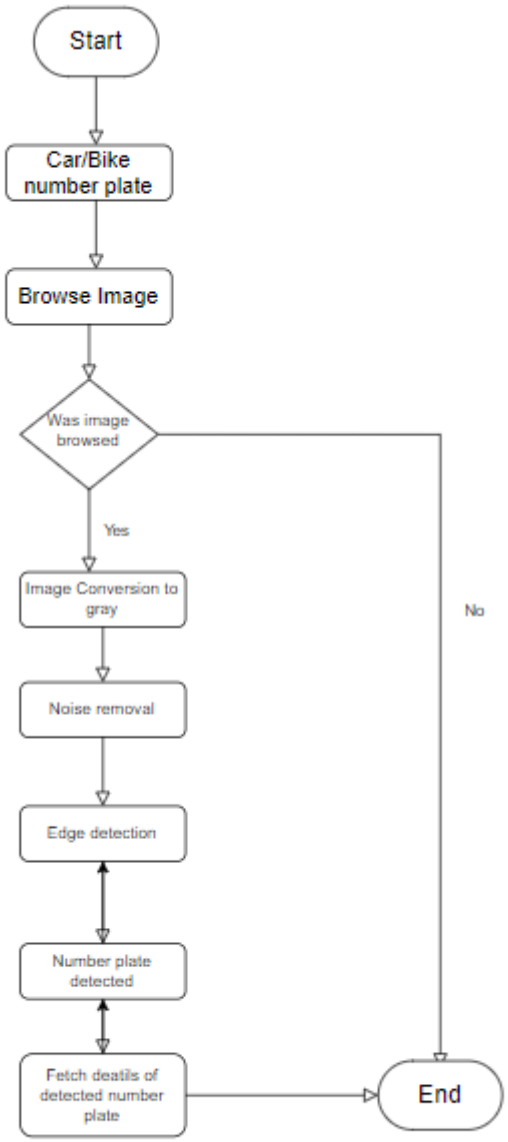
4.6 Features of New System

Firstly, the image is browsed from the given path then the image is converted to gray scale and after that, applying bilateral filter to smooth the image then using canny we sharp the edges of given image then by finding contours we draw the rectangle that was found using approx. Poly curve and crop the number plate from the browsed image. Finally using pytesseract we read the number plate. After detecting number plate, we fetch the details of the detected number plate like vehicle owner name , insurance company details, email of owner, etc. using REST API.

4.7 System Activity (Use case and/or scenario diagram)



4.8 Object Interaction/Flowchart



5. System Design

5.1 System Application Design

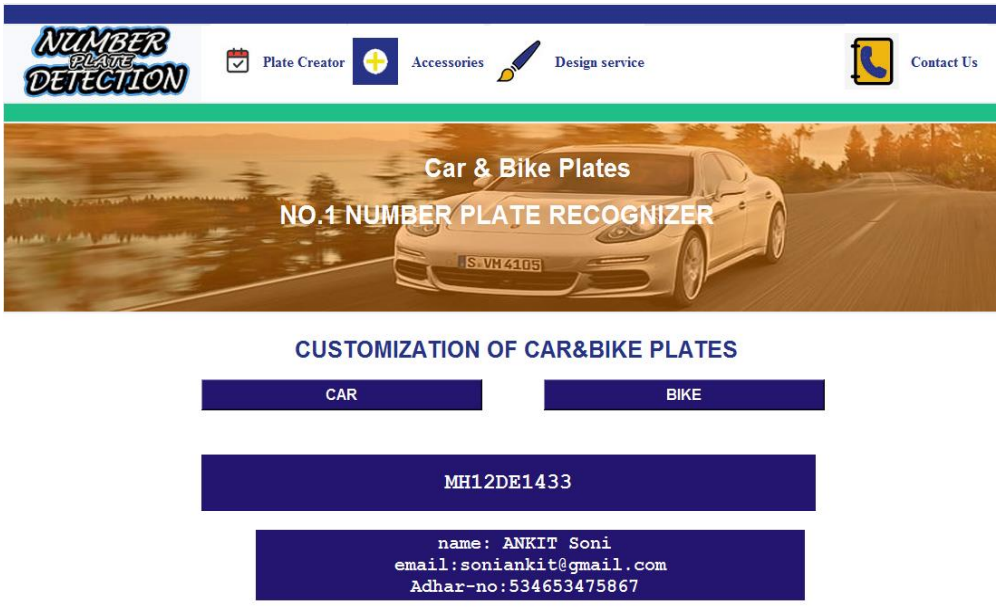
5.1 Table and Relationship

FUNCTION USED	APPLICATION OF FUNCTIONS USED
bilateralFilter	Used to smoothening the image and reducing noise while preserving the edges.
cvtColor	To convert rgb to gray.
Canny	For edge detection.
findContours	Find contours.
askopenfile	Used to browse file .

6. System Testing

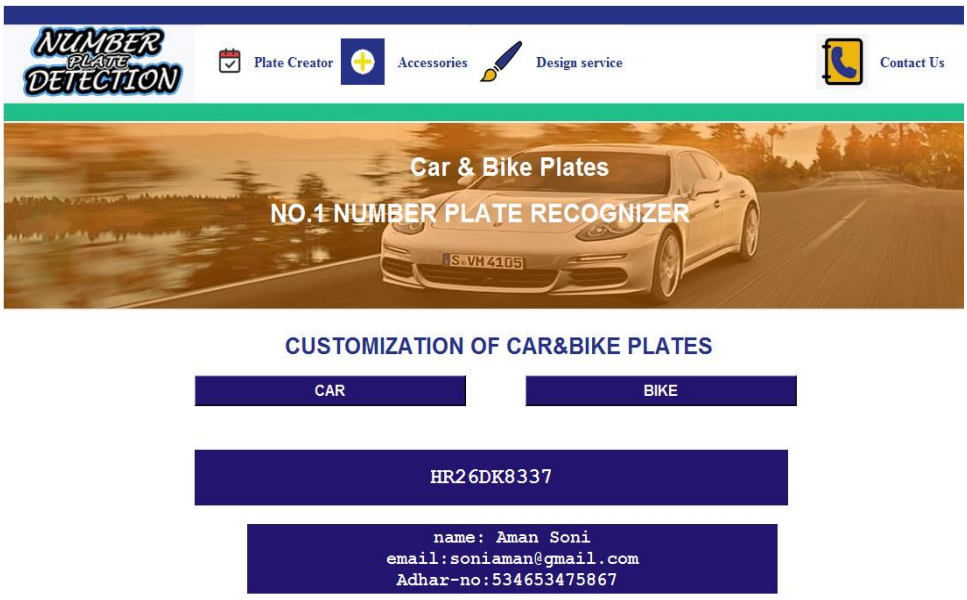
6.1 Test Case

Test case1:



Test case2:


IND HR26DK8337


NUMBER PLATE DETECTION
Plate Creator
Accessories
Design service
Contact Us
Car & Bike Plates
NO.1 NUMBER PLATE RECOGNIZER
CUSTOMIZATION OF CAR&BIKE PLATES
CAR
BIKE
HR26DK8337
name: Aman Soni
email:soniaman@gmail.com
Adhar-no:534653475867

Test case3:

CUSTOMIZATION OF CAR&BIKE PLATES

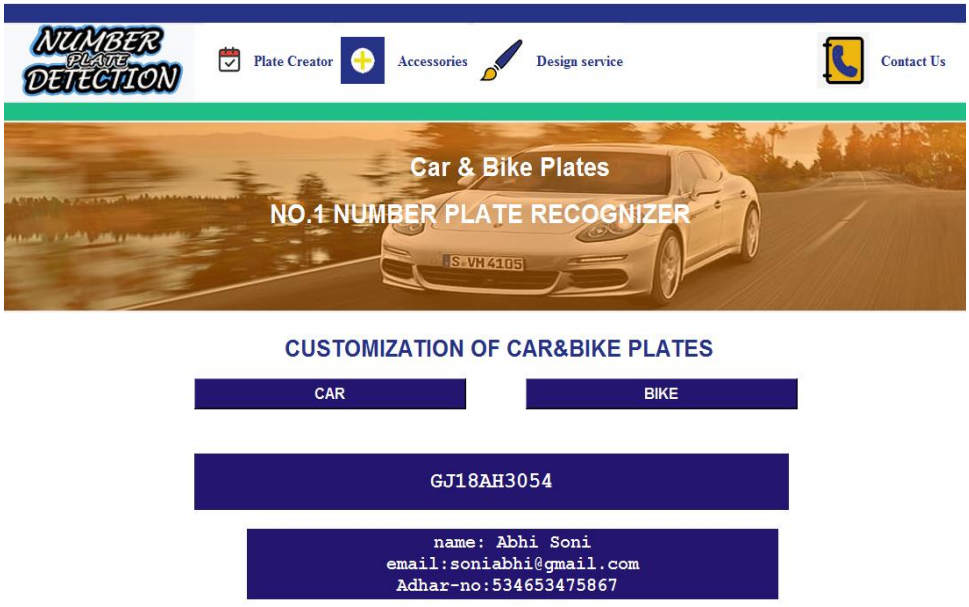
CAR BIKE

21BH2345AA

name: ANKIT Soni
email:soniankit@gmail.com
Adhar-no:534653475867

Test case4:


IND GJ18AH3054
RAVI CAR AC


NUMBER PLATE DETECTION
Plate Creator
Accessories
Design service
Contact Us
Car & Bike Plates
NO.1 NUMBER PLATE RECOGNIZER
S VM 4105
CUSTOMIZATION OF CAR&BIKE PLATES
CAR
BIKE
GJ18AH3054
name: Abhi Soni
email:soniabhi@gmail.com
Adhar-no:534653475867

6.2 Test Report:-

Test Report is a document which contains a summary of all test activities and final test results of a testing project. Test report is an assessment of how well theTesting is performed. Based on the test report, stakeholders can evaluate the quality of the tested product and make a decision on the software release.

For example, if the test report informs that there are many defects remaining in the product, stakeholders can delay the release until all the defects are fixed.

- What does a test report contain?

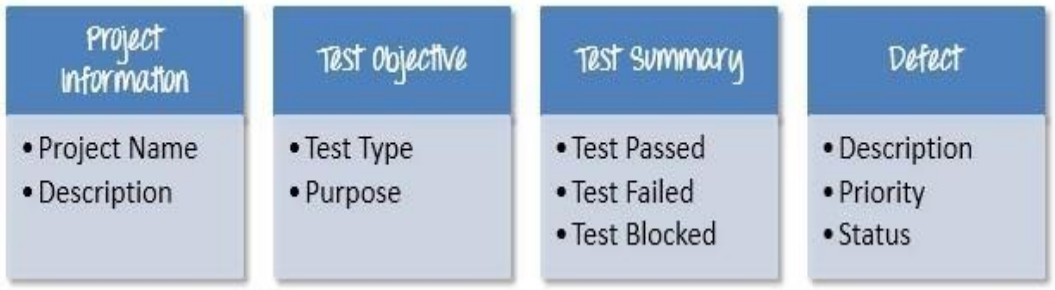


Fig. 10 test report diagram

Project Information:

All information of the project such as the project name, product name, and versionshould be described in the test report.

Test Objective:

As mentioned in Test Planning tutorial, Test Report should include the objectiveof each round of testing, such as Unit Test, Performance Test, System Test …etc.

6.3 Testing Planning Step:-

1) Functionality Testing
2) Usability testing
3) Interface testing
4) Performance testing
5) Security testing

6.3.1 Functionality Testing:

Test for – all the links in web pages, database connection, forms used in the webpages for submitting or getting information from user, Cookie testing. Check all the links:

- Test the outgoing links from all the pages from specific domain under test.
- Test all internal links.
- Test links jumping on the same pages.
- Test links used to send the email to admin or other users from web pages.
- Test to check if there are any orphan pages.
- Lastly in link checking, check for broken links in all above-mentioned links.

Test forms in all pages: Forms are the integral part of any web site. Forms are used to get information from users and to keep interaction with them. So, what should be checked on these forms?

- First check all the validations on each field.
- Check for the default values of fields.
- Wrong inputs to the fields in the forms.
- Options to create forms if any, form delete, view or modify the forms.

6.3.2 Usability Testing:

- **Test for navigation:** Navigation means how the user surfs the web pages, different controls like buttons, boxes or how user using the links on the pages to surf different pages. Usability testing includes: Web site should beeasy to use. Instructions should be provided clearly. Check if the provided instructions are correct means whether they

satisfy purpose. Main menu should be provided on each page. It should be consistent.

- **Content:** Content should be logical and easy to understand. Check for spelling errors. Use of dark colours annoys users and should not be used insite theme. You can follow some standards that are used for web page and content building. These are common accepted standards like as I mentionedabove about annoying colours, fonts, frames etc.
- Content should be meaningful. All the anchor text links should be workingproperly. Images should be placed properly with proper sizes. These are some basic standards that should be followed in web development. Your task is to validate all for UI testing.

6.3.3 Interface Testing:-

The main interfaces are:

- Web server and application server interface
- Application server and Database server interface.

Check if all the interactions between these servers are executed properly. Errorsare handled properly. If database or web server returns any error message for anyquery by application server then application server should catch and display theseerror messages appropriately to users.

Check what happens if user interrupts any transaction in-between? Check what happens if connection to web server is reset in between

6.3.4 Performance testing:-

Web application should sustain to heavy load. Web performance testing should include:

- Web Load Testing
- Web Stress Testing

Test application performance on different internet connection speed. In the webload testing test if many users are accessing or requesting the same page. Can system sustain in peak load times? Site should handle

many simultaneous user requests, large input data from users, Simultaneous connection to DB, heavy loadon specific pages etc.

Stress testing: Generally, stress means stretching the system beyond its specification limits. Web stress testing is performed to break the site by giving stress and checked how system reacts to stress and how system recovers from crashes.

Stress is generally given on input fields, login and sign up areas. In web performance testing web site functionality on different operating systems, different hardware platforms are checked for software, hardware memory leakageerrors.

6.3.5 Security Testing:

Following are some test cases for web security testing:

- Test by pasting internal url directly into browser address bar without login. Internal pages should not open.
- If you are logged in using username and password and browsing
- internal pagesthen try changing url options directly. I.e. If you are checking some publisher site statistics with publisher site ID= 123.
- Try some invalid inputs in input fields like login username, password, input textboxes. Check the system reaction on all invalid inputs.
- Web directories or files should not be accessible directly unless given downloadoption.
- Test if SSL is used for security measures. If used proper message should get displayed when user switch from non-secure http:// pages to secure https:// pages and vice versa.
- All transactions, error messages, security breach attempts should get logged inlog files somewhere on web server.

6.4 Testing Strategies:-

6.4.1 White Box Testing:

If we go by the definition, "White box testing" (also known as clear, glass box orstructural testing) is a testing technique which evaluates the code and the internalstructure of a program.

White box testing involves looking at the structure of the code. When you know the internal structure of a product, tests can be conducted to ensure that the internal operations performed according to the specification. And all internal components have been adequately exercised.

White box testing coverage specifications:

1. **Code coverage**

2. **Segment coverage:** Ensure that each code statement is executed once.

3. **Branch Coverage or Node Testing:** Coverage of each code branch in from allpossible was.

4. **Compound Condition Coverage:** For multiple conditions testeach condition with multiple paths and combination of the different path to reach that condition.
5. **Basis Path Testing:** Each independent path in the code is taken for testing.
6. **Data Flow Testing (DFT):** In this approach you track the specific variables through each possible calculation, thus defining the set of intermediate paths through the code. DFT tends to reflect dependencies but it is mainly through sequences of data manipulation. In short, each data variable is tracked and its use is verified. This approach tends to uncover bugs like variables used but notinitialize, or declared but not used, and so on.

7. **Path Testing:** Path testing is where all possible paths through the code are defined and covered. It's a time-consuming task.

8. **Loop Testing:** These strategies relate to testing single loops, concatenated loops, and nested loops. Independent and dependent code loops and values aretested by this approach.

Limitations:

Not possible for testing each and every path of the loops in the program. Thismeans exhaustive testing is impossible for large systems.

This does not mean that WBT is not effective. By selecting important logicalpaths and data structure for testing is practically possible and effective.

6.4.2 Black Box Testing:

Black Box Testing is also known as behavioral, opaque-box, closed-box, specification-based or eye-to-eye testing.

It is a Software Testing method that analyses the functionality of a software/application without knowing much about the internal structure/design ofthe item that is being tested and compares the input value with the output value.

The main focus in Black Box Testing is on the functionality of the system as a whole. The term 'Behavioral Testing' is also used for Black Box Testing. Behavioral test design is slightly different from the black-box test design because the use of internal knowledge isn't strictly forbidden, but it's still discouraged.

Each testing method has its own advantages and disadvantages. There

are some bugs that cannot be found using the only black box or only white box technique.

Majority of the applications are tested by Black Box method. We need to cover the majority of test cases so that most of the bugs will get discovered by a Black-Box method.

This testing occurs throughout the software development and Testing Life Cyclei.e., in Unit, Integration, System, Acceptance, and Regression Testing stages.

Advantages:

- The tester need not have a technical background. It is important to test bybeing in the user's shoes and think from the user's point of view.
- Testing can be started once the development of the project/application is done. Both the testers and developers work independently without interfering in each other's space.
- It is more effective for large and complex applications.
- Defects and inconsistencies can be identified at the early stage of testing.

Disadvantages:

- Without any technical or programming knowledge, there are chances ofignoring possible conditions of the scenario to be tested.
- In a stipulated time, there are possibilities of testing less and skipping allpossible inputs and their output testing.
- A Complete Test Coverage is not possible for large and complex projects.

6.5 Test case scenarios:

Test Case ID:-	TC01
Test Case Scenario:-	Check Web Server is online or not.
Test Step:-	1. To Run the Program 2. Then Check the response code returned by server.
Test Data(Input data):-	Run the program
Expected Result	If your Web Server is properly running, It will give the expected user data.

Test Case ID:-	TC02
Test Case Scenario:-	Check File is uploaded by user or not.
Test Step:-	1. To Run the Program 2. Then Check user as uploaded the file or not.
Test Data(Input data):-	Run the program
Expected Result	Image file has been uploaded by user.

Test Case ID:-	TC03
Test Case Scenario:-	Check File uploaded by user is proper or not.
Test Step:-	1. To Run the Program 2. Then Check user as uploaded the image file or not.
Test Data(Input data):-	Run the program
Expected Result	File uploaded by user is image file.

Test Case ID:-	TC04
Test Case Scenario:-	Check uploaded Image is proper or not.
Test Step:-	1. To Run the Program 2. Then Check the uploaded image has proper orientation and clearly visible.
Test Data(Input data):-	Run the program
Expected Result	File uploaded by user has proper orientation and clearly visible.

7. Conclusion

The package was designed in such a way that future modifications can be done easily. The following conclusions can be deduced from the development of the project.

- Automation of the entire system improv es the efficiency
- It provides a friendly graphical user interface which proves to be better when compared to the existing system.
- It gives appropriate access to the authorized users depending on their permissions.
- It effectively overcomes the delay in communications.
- System security, data security and reliability are the striking features.
- The System has adequate scope for modification in future if it is necessary.
- Updating of information becomes so easier.

8. Bibliography

The following books were referred during the analysis and execution phase of the project.

8.1 Books Referred:

- Fluent Python – Luciano Ramalho
- Digital Image Processing – Kenneth Castleman
- Learning OpenCV – Adrian Kaehler and Gary Rost Bradski

8.2 Website Referred:

- www.geeksforgeeks.org