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| **Computer Vision** | | |
| Lab Manual | | |
| **Department of Computer Science and Engineering**  **The NorthCap University, Gurugram** | | |
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**Computer Vision Lab Manual**

**CSL 447**

**Dr. Neha Gahlan**



Department of Computer Science and Engineering

NorthCap University, Gurugram- 122001, India

Session 2020-21

*Published by:*

**School of Engineering and Technology**

**Department of Computer Science & Engineering**

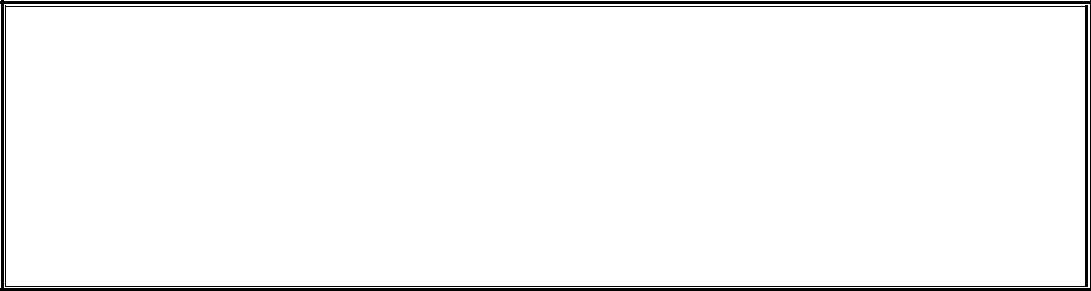
**The NorthCap University Gurugram**

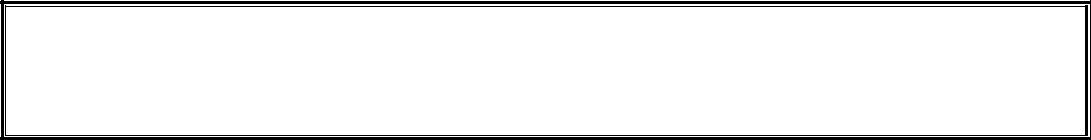
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Copying or facilitating copying of lab work comes under cheating and is considered as use of unfair means. Students indulging in copying or facilitating copying shall be awarded zero marks for that particular experiment. Frequent cases of copying may lead to disciplinary action. Attendance in lab classes is mandatory.

Labs are open up to 7 PM upon request. Students are encouraged to make full use of labs beyond normal lab hours.

**PREFACE**

**Introduction to Image Processing** Lab Manual is designed to meet the course and program requirements of NCU curriculum for B.Tech third year students of CSE branch. The concept of the lab work is to give brief practical experience for basic lab skills to students. It provides the space and scope for self-study so that students can come up with new and creative ideas.

The Lab manual is written on the basis of “teach yourself pattern” and expected that students who come with proper preparation should be able to perform the experiments without any difficulty. Brief introduction to each experiment with information about self-study material is provided. The laboratory exercises will include the introduction to digital image and its visualization through python, arithmetic and bitwise operation on image, spatial and frequency transformation on image for image enhancement, edge detection, morphological operation on image, demonstration of pixel relationship within image, find connected component sets, region and boundary, segmentation techniques and watershed transformation on image. Experimentation also includes mini project based on face and object detection and project related to number, character recognition. Students are expected to come thoroughly prepared for the lab. General disciplines, safety guidelines and report writing are also discussed.

The lab manual is a part of curriculum for the TheNorthCap University, Gurugram. Teacher’s copy of the experimental results and answer for the questions are available as sample guidelines.

We hope that lab manual would be useful to students of CSE branch and author requests the readers to kindly forward their suggestions / constructive criticism for further improvement of the work book.

Author expresses deep gratitude to Members, Governing Body-NCU for encouragement and motivation.

**Authors**

**The NorthCap University**

**Gurugram, India**

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**SYLLABUS**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 1. **Department:** | | | | Department of Computer Science and Engineering | | | | | |
| 1. **Course Name:**   **Introduction to Image Processing and**  **Recognition** | | | | | | 1. **Course Code** | 1. **L-T-P** | | 1. **Credits** |
| CSL316 | 3-0-2 | | 4 |
| 1. **Type of Course (Check one):** | | | | **j✓d** **✓**  Programme Core  Programme Elective **✓** Open Elective | | | | | |
| 1. **Pre-requisite(s), if any:** None | | | | | | | | | |
| 1. **Frequency of offering (check one):** Odd **✓** Even Either semester Every semester | | | | | | | | | |
| 1. **Brief Syllabus:**   Elements of digital image processing, Image model, Sampling and quantization, Relationships between pixels, Image Transforms, Discrete Fourier Transform, Discrete Cosine Transform, Haar Transform, Hadamard Transform, Image Enhancement, Enhancement by point processing, Spatial filtering, Enhancement in the frequency domain, Color Image Processing, Image Segmentation, Discontinuity detection, Edge linking and boundary detection, Thresholding, Region oriented segmentation, Use of motion for segmentation, Introduction to CV, Introduction to Face Detection, Face Detection with OpenCV, Object Detection Introduction, Object Detection with SSD, Generative Adversarial Networks (GANs) Introduction. | | | | | | | | | |
| **Total lecture, Tutorial and Practical Hours for this course (Take 15 teaching weeks per semester):** 90 hours  The class size is maximum 30 learners. | | | | | | | | | |
| **Lectures:**  30 hours | | | | | **Practice** | | | | |
| **Tutorials :** 0 hours | | | **Lab Work:** 60 hours | |
| 1. **Course Outcomes (COs)**   On successful completion of this course students will be able to: | | | | | | | | | |
| **CO 1** | Implement fundamental image processing techniques required for computer vision. | | | | | | | | |
| **CO 2** | Analyze the different segmentation techniques and shape analysis | | | | | | | | |
| **CO 3** | Apply 3D vision techniques to images | | | | | | | | |
| **CO 4** | Develop projects that can detect faces and objects using Open CV | | | | | | | | |
| 1. **UNIT WISE DETAILS No. of Units: 4** | | | | | | | | | |
| **Unit Number: 1** | | **Title: Fundamentals of Image Processing** | | | | | | | **No. of hours: 6** |
| **Content Summary:**  Fundamentals of Image Formation, Transformation: Discrete Fourier Transform, Discrete Cosine Transform, Haar Transform, Hadamard Transform, Convolution and Filtering, Image Enhancement, Restoration, Image Segmentation -Discontinuity detection, Edge linking and boundary detection, Thresholding, Region oriented segmentation, Use of motion for segmentation , Histogram Processing. | | | | | | | | | |
| **Unit Number: 2** | | | **Shapes and Regions** | | | | | | **No. of hours: 6** |
| **Content Summary:**  Binary shape analysis, connectedness, object labeling and counting, size filtering, distance functions, skeletons and thinning, deformable shape analysis, boundary tracking procedures, active contours, shape models and shape recognition, centroidal profiles, handling occlusion, boundary length measures, boundary descriptors, chain codes, Fourier descriptors, region descriptors, moments. | | | | | | | | | |
| **Unit Number: 3** | | | **Title: 3D Vision and Motion** | | | | | | **No. of hours: 8** |
| **Content Summary:**  Methods for 3D vision, projection schemes, shape from shading, photometric stereo, shape from texture, shape from focus, active range finding, surface representations, point-based representation, volumetric representations, 3D object recognition, 3D reconstruction, introduction to motion, triangulation, bundle adjustment, translational alignment, parametric motion, spline-based motion, optical flow layered motion. | | | | | | | | | |
| **Unit Number: 4** | | | **Title: Applications** | | | | | | **No. of hours: 10** |
| **Content Summary:**  Introduction to Face Detection**-** Face Detection with OpenCV. Object Detection Introduction**-** Object Detection with SSD, Generative Adversarial Networks (GANs) Introduction, Active appearance and 3D shape models of faces Application: Surveillance, foreground-background separation, particle filters,Chamfer matching, tracking, and occlusion, combining views from multiple camera, human gait analysis Application: In-vehicle vision system: locating roadway, road markings, identifying road signs, locating pedestrians. | | | | | | | | | |
| 1. **Brief Description of Self-learning components by students (through books/resource material etc.):**   Supplementary MOOC Courses   1. [**https://www.udemy.com/course/complete-python-based-image-processing-and-computer-vision/**](https://www.udemy.com/course/complete-python-based-image-processing-and-computer-vision/) 2. [**https://www.coursera.org/learn/computer-vision-basics**](https://www.coursera.org/learn/computer-vision-basics) 3. [**https://www.classcentral.com/course/computer-vision-object-detection-19259**](https://www.classcentral.com/course/computer-vision-object-detection-19259) 4. **classcentral.com/course/edx-computer-vision-and-image-analysis-11378** | | | | | | | | | |
| 1. **Books Recommended :**   **Text Books:**   1. Szeliski, Richard , *Computer Vision Algorithms and Applications*, Microsoft, Fourth Edition, 2012 2. Jan Erik Solem, *Programming Computer Vision with Python: Tools and algorithms for analyzing images*, O'Reilly Media, First Edition, 2015 3. Rafael C. Gonzalez, Richard E. Woods, *Digital Image Processing*, Prentice, Third Edition, 2016 4. D. L. Baggio et al, *Mastering OpenCV with Practical Computer Vision Projects*, Packt Publishing, First Edition, 2012   **Reference Books:**   1. Mark Nixon and Alberto S. Aquado, ―*Feature Extraction & Image Processing for Computer Vision*, Academic Press, Third Edition,2012 2. Simon J. D. Prince, ―*Computer Vision: Models, Learning, and Inference*, Cambridge University Press, First Edition, 2012   **Ebooks**   1. <https://www.pdfdrive.com/image-operators-image-processing-in-python-e189690145.html> 2. <https://www.pdfdrive.com/learning-image-processing-with-opencv-exploit-the-amazing-features-of-opencv-to-create-powerful-image-processing-applications-through-easy-to-follow-examples-e167899040.html> 3. <https://www.pdfdrive.com/practical-machine-learning-and-image-processing-for-facial-recognition-object-detection-and-pattern-recognition-using-python-e188718832.html>   **Reference Websites: (nptel, swayam, coursera, edx, udemy, lms, official documentation weblink)**   * <https://www.edx.org/course/computer-vision-image-analysis-1/> * <http://www.cse.iitm.ac.in/~vplab/computer_vision.html> * [**www.lms.ncuindia.edu/lms**](http://www.lms.ncuindia.edu/lms)   **Interview/Placement related Commonly asked Questions:**   * [**https://engineeringinterviewquestions.com/digital-image-processing-viva-questions-and-answers-ece/**](https://engineeringinterviewquestions.com/digital-image-processing-viva-questions-and-answers-ece/) * [**https://www.exams99.com/interview-questions/digital-image-processing-interview-questions-and-answers**](https://www.exams99.com/interview-questions/digital-image-processing-interview-questions-and-answers) * [**https://www.sanfoundry.com/digital-image-processing-multiple-choice-questions-answers/**](https://www.sanfoundry.com/digital-image-processing-multiple-choice-questions-answers/) | | | | | | | | | |

1. **INTRODUCTION**



That ‘learning is a continuous process’ cannot be over emphasized. The theoretical knowledge gained during lecture sessions need to be strengthened through practical experimentation. Thus, practical makes an integral part of a learning process.­­­­­­­­­­­­­­­­­­­­­­­

**COURSE OBJECTIVES:**

1. **Implement fundamental image processing techniques required for computer vision.**
2. **Demonstrate the different type operations and transformation on images for image enhancement.**
3. **Demonstrate the morphological operation on image.**
4. **Analyse the different segmentation techniques and shape analysis.**
5. **LAB REQUIREMENTS**

|  |  |  |
| --- | --- | --- |
| **S.No.** | **Requirements** | **Details** |
| **1** | **Software Requirements** | **Python 3.+, Opencv Libraries, Jupyter Notebook (Lab), Matplotlib** |
| **2** | **Operating System** | **Windows 10 (64-bit), Linux, Mac** |
| **3** | **Hardware Requirements** | **8GB RAM, 1TB hard-disk, 1-60GHz-1.80GHz processor,** |
| **4** | **Required Bandwidth** | Nil |

1. **GENERAL INSTRUCTIONS** 
   1. **General discipline in the lab**
   * Students must turn up in time and contact concerned faculty for the experiment they are supposed to perform.
   * Students will not be allowed to enter late in the lab.
   * Students will not leave the class till the period is over.
   * Students should come prepared for their experiment.
   * Experimental results should be entered in the lab report format and certified/signed by concerned faculty/ lab Instructor.
   * Students must get the connection of the hardware setup verified before switching on the power supply.
   * Students should maintain silence while performing the experiments. If any necessity arises for discussion amongst them, they should discuss with a very low pitch without disturbing the adjacent groups.
   * Violating the above code of conduct may attract disciplinary action.
   * Damaging lab equipment or removing any component from the lab may invite penalties and strict disciplinary action.
   1. **Attendance**

* Attendance in the lab class is compulsory.
* Students should not attend a different lab group/section other than the one assigned at the beginning of the session.
* On account of illness or some family problems, if a student misses his/her lab classes, he/she may be assigned a different group to make up the losses in consultation with the concerned faculty / lab instructor. Or he/she may work in the lab during spare/extra hours to complete the experiment. No attendance will be granted for such case**.**
  1. **Preparation and Performance**
* Students should come to the lab thoroughly prepared on the experiments they are assigned to perform on that day. Brief introduction to each experiment with information about self study reference is provided on LMS.
* Students must bring the lab report during each practical class with written records of the last experiments performed complete in all respect.
* Each student is required to write a complete report of the experiment he has performed and bring to lab class for evaluation in the next working lab. Sufficient space in work book is provided for independent writing of theory, observation, calculation and conclusion.
* Students should follow the Zero tolerance policy for copying / plagiarism. Zero marks will be awarded if found copied. If caught further, it will lead to disciplinary action.
* Refer **Annexure 1** for Lab Report Format

1. **LIST OF EXPERIMENTS**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Sr. No.** | **Title of the Experiment** | **Software Used** | **No. of Hours** | **CO Covered** |
|  | Introduction to digital Image processing using PIL and cv2 libraries in python | Python 3.0 | 2 hrs | CO1 |
|  | Mathematical Operations and Image Transformation in Image Processing | Python 3.0 | 2 hrs | CO2 |
|  | Implementation of negative transformation, log transformation, power law transformation | Python 3.0 | 2 hrs | CO2 |
|  | To obtain histogram equalization of ab image, contrast stretching | Python 3.0 | 2 hrs | CO2 |
|  | Implementation of piecewise linear transformation: gray level slicing, Thresholding and Bit plane slicing | Python 3.0 | 2 hrs | CO2 |
|  | Implementation of correlation and convolution filters for Image processing | Python 3.0 | 2 hrs | CO2 |
|  | Implementation of smoothing filters: averaging filter, Median Filter, Mean Filter, Min-Max Filter in spatial domain | Python 3.0 | 2 hrs | CO2 |
|  | Implementation of Sharpening filter in spatial domain: Gaussian Filter (First Order Filter), Laplace Filter (Second Order Filter) | Python 3.0 | 2 hrs | CO2 |
|  | Implementation of Image Smoothening in Frequency Domain | Python 3.0 | 2 hrs | CO2 |
|  | Implementation of Image Sharpening in Frequency Domain | Python 3.0 | 2 hrs | CO2 |
|  | To perform morphological operations on images | Python 3.0 | 2 hrs | CO3 |
|  | To perform practical on edge detection using sobel, prewitt, Robert and Laplace operator |  |  |  |
|  | Perform Region growing for image segmentation | Python 3.0 | 2 hrs | CO3 |
|  | To perform practical to detect lines and circles using Hough transform | Python 3.0 | 2 hrs | CO4 |
|  | To perform the practical for contour Detection | Python 3.0 | 2 hrs | CO4 |
|  | To explore object detection using Deep learning | Python3.0 | 2 hrs | CO4 |

1. **LIST OF FLIP EXPERIMENTS**

|  |  |  |
| --- | --- | --- |
| **Exp. No.** | **Title of the Experiment** | **Mapped CO** |
|  | To perform linear and non-linear transformation on images | CO2 |
|  | Methods to model and process colour images | CO3 |
| 1. O | Thresholding-based segmentation technique | CO4 |
|  | The region growing technique for segmentation | CO4 |
|  | Demonstration of seed selection for segmentation | CO4 |
|  | Experiments with Memory-Based Object Recognition System | CO4 |

1. **LIST OF PROJECTS**

|  |  |  |
| --- | --- | --- |
| **Sr No.** | **Project Title** | **Mapped CO** |
|  | **Licence Plate Recognition** | CO2, CO3, CO4 |
|  | Hand Gesture Detection and Recognition for Human-Computer Interaction | CO2, CO3 |
|  | Localized object detection | CO3, CO4 |
|  | Image Forensic for Digital Image Copy Move Forgery Detection | CO2, CO3 |
|  | Cancer Detection | CO2, CO3, CO4 |
|  | Lane detection for ADAS | CO3, CO4 |
|  | Face Emotion recognition | CO1, CO2, Co3, CO4 |
|  | Intelligent Traffic Light Control using Image Processing | CO1, CO2, CO3, CO4 |
|  | Identification of Human Act by Image Processing | CO1, CO2, CO3, CO4 |
|  | Real time Drowsy Driver Detection | CO1, CO2, CO3, CO4 |
|  | Currency Identification System | CO1, CO2, CO3, CO4 |
|  | Automatic Vehicle Parking System | CO1, CO2, CO3, CO4 |

**Project 1**: **License Plate Recognition**

License Plate recognition is one of the techniques used for vehicle identification purposes. The sole intention of this project is to find the most efficient way to recognize the registration information from the digital image (obtained from the camera).

**Project 2: Hand Gesture Detection and Recognition for Human-Computer Interaction**

This project deals with the detection and recognition of hand gestures. Gesture recognition is one of the essential techniques to build user-friendly interfaces. For example, a robot that can recognize hand gestures can take commands from humans, and for those who are unable to speak or hear, having a robot that can recognize sign language would allow them to communicate with it.

**Project 3: Localized object detection**

Multi-Object detection is one of the active fields of computer vision. The goal of this field is detecting all the objects of a given image.

**Project 4: Image Forensic for Digital Image Copy Move Forgery Detection**

In this day and age, digital images tampering has been made easy with widely available image editing software, such as Adobe Photoshop. The advancement of image editing software has reached a level such that image tampering can be done without degrading its quality or leaving obvious traces. This is alarming as images are now being presented as supported evidences and historical records in various fields, such as in forensic investigation, law enforcement, journalistic photography and medical images

**Project 5: Cancer Detection using MR Image**

In recent years the image processing mechanisms are used widely in several medical areas for improving earlier detection and treatment stages, in which the time factor is very important to discover the disease in the patient as possible as fast, especially in various cancer tumours such as the lung cancer, breast cancer, skin cancer, bone cancer, etc. The segmentation, detection, and extraction of infected tumour area from magnetic resonance (MR) images are a primary concern of this project.

**Project 6: Lane detection for ADAS**

Advanced driver assistant systems (ADAS) have been implemented in many vehicles to help increase both the safety of drivers and pedestrian. The related technology is also used to develop self-driving cars.

**Project 7: Face Emotion recognition**

Emotions often mediate and facilitate interactions among human beings. Thus, understanding emotion often brings context to seemingly bizarre and/or complex social communication. Emotion can be recognized through a variety of means such as voice intonation, body language, and more complex methods such electroencephalography. However, the easier, more practical method is to examine facial expressions. There are seven types of human emotions shown to be universally recognizable across different cultures: anger, disgust, fear, happiness, sadness, surprise, contempt. Interestingly, even for complex expressions where a mixture of emotions could be used as descriptors, cross-cultural agreement is still observed. Therefore, a utility that detects emotion from facial expressions would be widely applicable.

**Project 8: Intelligent Traffic Light Control using Image Processing**

Day by day the traffic issue has become a major problem in India due to the rising number of motor vehicles. For this reason, one has to utilize the traffic signals which can do the real-time checking of compactness of traffic. This project employs an arrangement of image processing for controlling the traffic in an easy way by capturing images of traffic at crossroads. A step-by-step procedure for changing the duration of the traffic light depends on the traffic density of crossroads at a traffic signal.

**Project 9: Identification of Human Act by Image Processing**

This project is used to identify the human act by image processing in real-time, and the main intention is to communicate the identified gestures using the camera system. This system starts on recognizing the human act given in the database as it transmits the activate signs to the camera arrangement for recording & storing the video stream in the system. The process of pattern matching is utilized to now actions from the recorded video outline straight. The image from the video is intern evaluates by the database and finally, the output will get.

**Project 10: Real time Drowsy Driver Detection**

Driver fatigue is a significant factor in a large number of vehicle accidents. The aim of this project is to develop a prototype drowsiness detection system. The focus will be placed on designing a system that will accurately monitor the eye movements of a driver in real-time. By monitoring the eye movements, it is believed that the symptoms of driver fatigue can be detected early enough to avoid a car accident.

**Project 11: Currency Identification System**

The identification of different countries’ currency is very difficult. The main intention of this project is to help citizens to resolve this problem. However, currency identification systems are based on image analysis and are completely not enough.

The process of this project makes automatic as well as strong, and this system uses as an example of the Chinese renminbi (RMB) and Sweden SEK to demonstrate the techniques.

**Project 12: Automatic Vehicle Parking System**

Nowadays, there are many cities worldwide facing a lot of problems with vehicle parking due to less availability of parking places, high land prices, etc. To overcome this issue here is a solution namely an automatic car parking system. The proposed system is used in public places like hotels, offices, theatres, homes, hospitals, stadiums, airports, etc. There are several advantages by using this system such as it occupies less space, takes less time for taking as well as delivering the car, safety, and security for the vehicle from thefts.

1. **RUBRICS (Only for Lab components)**

|  |  |
| --- | --- |
| **Marks Distribution (Total Marks 70)** | |
| **Continuous Evaluation (30Marks)** | **Project Evaluations with Industry Mentor (40 Marks)** |
| Each experiment shall be evaluated for 10 marks and at the end of the semester proportional marks shall be awarded out of total 20. And at the end of semester one final viva will be conducted on all topics of subject taught in lab and theory for 10 marks. | The project shall be evaluated for 30 marks. It will include the marks for defining clear problem statement, project objective, implementation and output achieved using various Image processing techniques. And at the end of the semester viva will be conducted related to the project review for 10 Marks. |
| Following is the breakup of 20 marks for each  **5 Marks**: Observation & conduct of experiment. Teacher may ask questions about experiment.  **10 Marks:** For report writing  **5 Marks:** For the 15 minutes quiz to be conducted in every lab. |

**Annexure 1**

**Introduction to Image Processing**

**(CSL316)**

Lab Practical Report



Faculty name: Neha Gahlan Student name: Dhruv Chawla

Roll No.: 22CSU298

Semester: 7th

Group: AI - 4

Department of Computer Science and Engineering

The NorthCap University, Gurugram- 122001, India

Session 2020-21

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| --- | --- | --- | --- | --- | --- | --- |
| **Sr. No.** | **Title of the Experiment** | **Page No.** | **Date of Experiment** | **Date of Submission** | **Marks** | **Signature** |
| **1.** | Introduction to digital Image processing using PIL and cv2 libraries in python |  |  |  |  |  |
| **2.** | Mathematical and Image Transformation on Image Processing |  |  |  |  |  |
| **3.** | Implementation of negative transformation, log transformation, power law transformation |  |  |  |  |  |
| **4.** | To obtain histogram equalization image, contrast stretching |  |  |  |  |  |
| **5.** | Implementation of piecewise linear transformation: gray level slicing, Thresholding and Bit plane slicing |  |  |  |  |  |
| **6.** | Implementation of correlation and convolution filters for Image processing |  |  |  |  |  |
| **7.** | Implementation of smoothing filters: averaging filter, Median Filter, Mean Filter, Min-Max Filter in spatial domain |  |  |  |  |  |
| **8.** | Implementation of Sharpening filter in spatial domain: Gaussian Filter (First Order Filter), Laplace Filter (Second Order Filter) |  |  |  |  |  |
| **9.** | Implementation of Image Smoothening in Frequency Domain |  |  |  |  |  |
| **10.** | Implementation of Image Sharpening in Frequency Domain |  |  |  |  |  |
| **11.** | Edge detection in images using canny algorithm |  |  |  |  |  |
| **12.** | To perform morphological operations on images |  |  |  |  |  |
| **13.** | Perform Image segmentation on Image processing |  |  |  |  |  |
| **14.** | To perform practical to detect objects such as pedestrian, cars, traffic signs, in an image. |  |  |  |  |  |
| **15.** | To perform the practical for face detection using OpenCv |  |  |  |  |  |
| **16.** | To explore GAN and implement the GAN for one of Image Processing Application |  |  |  |  |  |

**EXPERIMENT NO. 1**

|  |
| --- |
| **Student Name and Roll Number: Dhruv Chawla 22CSU298** |
| **Semester /Section: 7th /B** |
| **Link to Code:** |
| **Date: 04-08-25** |
| **Faculty Signature:** |
| **Marks:** |

|  |
| --- |
| **Objective:**   * To read the image and plot, convert it into array and visualize it on console * To explore the python libraries and functions which are mainly used to read digital Image and used apply operations on digital Image |
| **Outcome: Students will able to use the python libraries which are available for image processing.** |
| **Problem Statement:** Introduction to digital Image processing using PIL and cv2 libraries in python |
| **Background Study:** Python Imaging Library is a free and open-source additional library for the Python programming language that adds support for opening, manipulating, and saving many different image file formats.  OpenCV is the huge open-source library for the computer vision, machine learning, and image processing and now it plays a major role in real-time operation which is very important in today's systems. By using it, one can process images and videos to identify objects, faces, or even handwriting of a human. |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:**   1. What are the features PIL?   Ans. Supports opening, manipulating, and saving many image formats (JPEG, PNG, GIF, BMP, etc.).  Provides basic operations like cropping, resizing, rotating, filtering, and drawing.  Lightweight and simple for basic image editing tasks.   1. What are the features OpenCV?   Ans. Advanced image processing (edge detection, filtering, transformations).  Computer vision features (face detection, object tracking, motion analysis).  Supports real-time operations with camera input and video processing.  Highly optimized and widely used in AI/ML projects.   1. What is difference between PIL and OpenCv?   Ans. **PIL** is mainly for basic image editing and format conversion, while **OpenCV** is designed for advanced image processing, computer vision, and machine learning tasks.  PIL works with images as simple objects, whereas OpenCV offers faster performance and handles both images and video streams.   1. Which library is better for doing image processing**?**   Ans. If you just need simple image editing, PIL is lightweight and easy. For real-time, complex image processing and computer vision, OpenCV is far more powerful and widely used. |

**EXPERIMENT NO. 2**

|  |
| --- |
| **Student Name and Roll Number: Dhruv Chawla 22CSU298** |
| **Semester /Section: 7th /B** |
| **Link to Code:** |
| **Date: 18-08-25** |
| **Faculty Signature:** |
| **Marks:** |

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| --- |
| **Objective:**   * To understand mathematical operations on image and visualize the output of image after applying operations. * To understand the point operation can be performed on Image |
| **Outcome:**  **Student will able to implement the mathematical operations and transformation performed on image suing various in-built method of PIL and cv2.** |
| **Problem Statement:** Mathematical and Image Transformation on Image Processing |
| **Background Study:**  Image arithmetic applies one of the standard arithmetic operations or a logical operator to two or more images. The operators are applied in a pixel-by-pixel way, i.e. the value of a pixel in the output image depends only on the values of the corresponding pixels in the input images. |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:**   1. **What are different types of arithmetic operation can be done on image?** 2. **What are different types of arithmetic operation can be done on image?** 3. **What are the applications of arithmetic operations on image?** 4. **What is difference between constant multiplication and multiplication of two image?** 5. **What is use of constant multiplication in image?** 6. **Which operation we can remove the unwanted region from image?** 7. **What is the use of not operation?** |

**EXPERIMENT NO. 3**

|  |
| --- |
| **Student Name and Roll Number:** |
| **Semester /Section:** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
| **Marks:** |

|  |
| --- |
| **Objective:**   * To understand the transformation to maintaining the good contrast image for low contrast image * To understand the concept of histogram equalization * To understand the concept of contrast stretching |
| **Outcome:**  **Student will able to maintain the optimum contrast for low contrast image** |
| **Problem Statement:** To obtain histogram equalization image, contrast stretching |
| **Background Study:** **Histogram equalization is a method in image processing of contrast adjustment using the image's histogram.** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |

**EXPERIMENT NO. 4**

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| **Student Name and Roll Number:** |
| **Semester /Section:** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
| **Marks:** |

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| **Objective:** |
| **Outcome:** |
| **Problem Statement:** |
| **Background Study:** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |

**EXPERIMENT NO. 5**

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| **Student Name and Roll Number:** |
| **Semester /Section:** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
| **Marks:** |

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| **Objective:** |
| **Outcome:** |
| **Problem Statement:** |
| **Background Study:** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |

**EXPERIMENT NO. 6**

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| **Student Name and Roll Number:** |
| **Semester /Section:** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
| **Marks:** |

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| **Objective:** |
| **Outcome:** |
| **Problem Statement:** |
| **Background Study:** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |

**EXPERIMENT NO. 7**

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| **Student Name and Roll Number:** |
| **Semester /Section:** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
| **Marks:** |

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| **Objective:** |
| **Outcome:** |
| **Problem Statement:** |
| **Background Study:** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |

**EXPERIMENT NO. 8**

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| **Student Name and Roll Number:** |
| **Semester /Section:** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
| **Marks:** |

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| **Objective:** |
| **Outcome:** |
| **Problem Statement:** |
| **Background Study:** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |

**EXPERIMENT NO. 9**

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| **Student Name and Roll Number:** |
| **Semester /Section:** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
| **Marks:** |

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| **Objective:** |
| **Outcome:** |
| **Problem Statement:** |
| **Background Study:** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |

**EXPERIMENT NO. 10**

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| **Student Name and Roll Number:** |
| **Semester /Section:** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
| **Marks:** |

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| **Objective:** |
| **Outcome:** |
| **Problem Statement:** |
| **Background Study:** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |

**EXPERIMENT NO. 11**

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| **Student Name and Roll Number:** |
| **Semester /Section:** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
| **Marks:** |

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| **Objective:** |
| **Outcome:** |
| **Problem Statement:** |
| **Background Study:** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |

**EXPERIMENT NO. 12**

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| **Student Name and Roll Number:** |
| **Semester /Section:** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
| **Marks:** |

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| **Objective:** |
| **Outcome:** |
| **Problem Statement:** |
| **Background Study:** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |

**EXPERIMENT NO. 13**

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| **Student Name and Roll Number:** |
| **Semester /Section:** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
| **Marks:** |

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| **Objective:** |
| **Outcome:** |
| **Problem Statement:** |
| **Background Study:** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |

**EXPERIMENT NO. 14**

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| **Student Name and Roll Number:** |
| **Semester /Section:** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
| **Marks:** |

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| **Objective:** |
| **Outcome:** |
| **Problem Statement:** |
| **Background Study:** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |

**EXPERIMENT NO. 15**

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| **Student Name and Roll Number:** |
| **Semester /Section:** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
| **Marks:** |

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| **Objective:** |
| **Outcome:** |
| **Problem Statement:** |
| **Background Study:** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |

**EXPERIMENT NO. 16**

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| **Student Name and Roll Number:** |
| **Semester /Section:** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
| **Marks:** |

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| **Objective:** |
| **Outcome:** |
| **Problem Statement:** |
| **Background Study:** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |

**Annexure 2**

**<SUBJECT NAME>**

**(CODE)**

Project Report



Faculty name Student name

Roll No.:

Semester:

Group:

Department of Computer Science and Engineering

The NorthCap University, Gurugram- 122001, India

Session 2020-21

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| **4.** | **Design**  **4.1 Data/Input Output Description:**  **4.2 Algorithmic Approach / Algorithm / DFD / ER diagram/Program Steps** |  |
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