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| **Introduction to Image Processing** | | |
| Lab Manual | | |
| **Department of Computer Science and Engineering**  **The NorthCap University, Gurugram** | | |
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**Introduction to Image Processing Lab Manual**

**CSL 316**

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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**

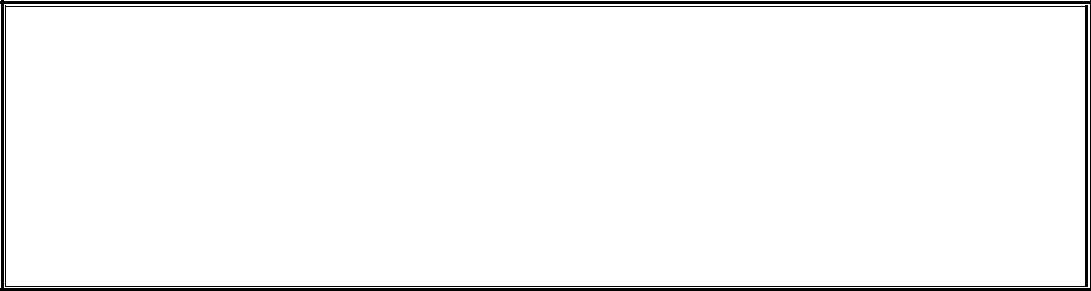
**The NorthCap University Gurugram**

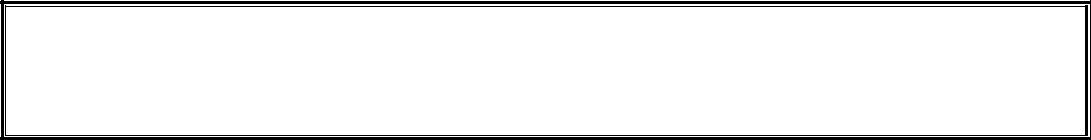
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Copying or facilitating copying of lab work comes under cheating and is considered as use of unfair means. Students indulging in copying or facilitating copying shall be awarded zero marks for that particular experiment. Frequent cases of copying may 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/**](about:blank) 2. [**https://www.coursera.org/learn/computer-vision-basics**](about:blank) 3. [**https://www.classcentral.com/course/computer-vision-object-detection-19259**](about:blank) 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](about:blank) 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](about:blank) 3. [https://www.pdfdrive.com/practical-machine-learning-and-image-processing-for-facial-recognition-object-detection-and-pattern-recognition-using-python-e188718832.html](about:blank)   **Reference Websites: (nptel, swayam, coursera, edx, udemy, lms, official documentation weblink)**   * [https://www.edx.org/course/computer-vision-image-analysis-1/](about:blank) * [http://www.cse.iitm.ac.in/~vplab/computer\_vision.html](about:blank) * [**www.lms.ncuindia.edu/lms**](about:blank)   **Interview/Placement related Commonly asked Questions:**   * [**https://engineeringinterviewquestions.com/digital-image-processing-viva-questions-and-answers-ece/**](about:blank) * [**https://www.exams99.com/interview-questions/digital-image-processing-interview-questions-and-answers**](about:blank) * [**https://www.sanfoundry.com/digital-image-processing-multiple-choice-questions-answers/**](about:blank) | | | | | | | | | |

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 and Image Transformation on 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 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 |
|  | Edge detection in images using canny algorithm | Python 3.0 | 2 hrs | CO3 |
|  | To perform morphological operations on images | Python 3.0 | 2 hrs | CO3 |
|  | Perform Image segmentation on Image processing | Python 3.0 | 2 hrs | CO3 |
|  | To perform practical to detect objects such as pedestrian, cars, traffic signs, in an image. | Python 3.0 | 2 hrs | CO4 |
|  | To perform the practical for face detection using OpenCv | Python 3.0 | 2 hrs | CO4 |
|  | To explore GAN and implement the GAN for one of Image Processing Application | 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: 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 : Mrs. Meghna Sharma Student name: Karan choudhary

Roll No.: 18csu103

Semester: 6th

Group: B-1

Department of Computer Science and Engineering

The NorthCap University, Gurugram- 122001, India

Session 2020-21

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| --- | --- | --- | --- | --- | --- | --- |
| **S.No** | **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: Karan choudhary(18csu103)** |
| **Semester /Section: 6th / DS-B-1** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
| **Marks:** |

|  |
| --- |
| **Objective:**  Exploring digital Image processing using PIL and cv2 libraries in python |
| **Outcome:**  Familiar with digital Image processing using PIL and cv2 libraries in python. |
| **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. It is available for Windows, Mac OS X and Linux. The latest version of PIL is 1.1.  **OpenCV** - Python makes use of NumPy, which is a highly optimized library for numerical operations with a MATLAB-style syntax. All the OpenCV array structures are converted to and from NumPy arrays. This also makes it easier to integrate with other libraries that use NumPy such as SciPy and Matplotlib. |
| **Code(Solution):** |
|  |

**EXPERIMENT NO. 2**

|  |
| --- |
| **Student Name and Roll Number: Karan choudhary(18csu103)** |
| **Semester /Section: 6th/ DS-B-1** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
| **Marks:** |

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| **Objective:**  Exploring Mathematical and Image Transformation on Image Processing |
| **Outcome:**  Familiar withMathematical and Image Transformation on Image Processing |
| **Problem Statement:**  Mathematical and Image Transformation on Image Processing |
| **Background Study:**  An **Image transformation** can be applied to an **image** to convert it from one domain to another. Viewing an **image** in domains such as frequency or Hough space enables the identification of features that may not be as easily detected in the spatial domain.    Function applied inside this digital system that **process** an **image** and convert it into output can be called as **transformation** function. As it shows **transformation** or relation, that how an image1 is converted to image2. |
| **Code(Solution):**    **Output:**  **C:\Users\Nikhil Garg\Downloads\DECA\MUX\pyhton\1.JPGC:\Users\Nikhil Garg\Downloads\DECA\MUX\pyhton\2.JPG**  **C:\Users\Nikhil Garg\Downloads\DECA\MUX\pyhton\3.JPGC:\Users\Nikhil Garg\Downloads\DECA\MUX\pyhton\4.JPG**  **C:\Users\Nikhil Garg\Downloads\DECA\MUX\pyhton\5.JPG**  **C:\Users\Nikhil Garg\Downloads\DECA\MUX\pyhton\6.JPG** |
|  |

**EXPERIMENT NO. 3**

|  |
| --- |
| **Student Name and Roll Number: Karan choudhary(18csu103)** |
| **Semester /Section: 6th/ DS-B-1** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
| **Marks:** |

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| **Objective:**  Exploring negative transformation, log transformation, power law transformation |
| **Outcome:**  Familiar with negative transformation, log transformation, power law transformation |
| **Problem Statement:**  Implementation of negative transformation, log transformation, power law transformation |
| **Background Study:**  **Negative Transformation**:- The second linear transformation is negative transformation, which is invert of identity transformation.  **Log Transformation**:- The log transformation is, arguably, the most popular among the different types of transformations used to transform skewed data to approximately conform to normality.  **Power law**:- a power law is a functional relationship between two quantities, where a relative change in one quantity results in a proportional relative change in the other quantity, independent of the initial size of those quantities: one quantity varies as a power of another. |
| **Code(Solution):**    **Negative Transformation:**    **Log Transformation:**    **Power Law Transformation:**     |  | | --- | |  | |

**EXPERIMENT NO. 4**

|  |
| --- |
| **Student Name and Roll Number: Karan choudhary(18csu103)** |
| **Semester /Section: 6th/ DS-B-1** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
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| **Objective:**  Exploring histogram equalization image, contrast stretching |
| **Outcome:**  Familiar with histogram equalization image, contrast stretching |
| **Problem Statement:**  To obtain histogram equalization image, contrast stretching |
| **Background Study:**  **Histogram Equalization** - This method usually increases the global contrast of many images, especially when the usable data of the image is represented by close contrast values. Through this adjustment, the intensities can be better distributed on the histogram. This allows for areas of lower local contrast to gain a higher contrast. Histogram equalization accomplishes this by effectively spreading out the most frequent intensity values. The method is useful in images with backgrounds and foregrounds that are both bright or both dark.  **Contrast Stretching** - is a simple image enhancement technique that attempts to improve the contrast in an image by `stretching' the range of intensity values it contains to span a desired range of values, e.g. the the full range of pixel values that the image type concerned allows. |
| **Code(Solution):**  A)HISTOGRAM EQUALIZATION        B)CONTRAST STRETCHING            OPEN CV – |

**EXPERIMENT NO. 5**

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| **Student Name and Roll Number: Karan choudhary(18csu103)** |
| **Semester /Section: 6th / DS-B-1** |
| **Link to Code:** |
| **Date:** |
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| **Objective:**  Exploring piecewise linear transformation: gray level slicing, Thresholding and Bit plane slicing |
| **Outcome:**  Familiar with piecewise linear transformation: gray level slicing, Thresholding and Bit plane slicing |
| **Problem Statement:**  Implementation of piecewise linear transformation: gray level slicing, Thresholding and Bit plane slicing |
| **Background Study:**  **Gray-level Slicing**  Sometimes we need to highlight a specific range of gray levels in a image. Possible application areas are finding masses of water in satellite imagery, enhancement of flaws in x-ray images, etc.  There are two basic approaches towards gray-level slicing.  **Binary Thresholding:** all Gray levels in the range of interest are displayed using a high value and the rest using a low value.  **Gradual Thresholding:** desired range of gray levels are brightened but the background and the gray-level tonalities are preserved.  **Threshold Slicing**  So, we would consider a thresholding function that will search the image pixel by pixel. If the intensity of a pixel is greater than or equal to 150, it will be assigned a value of 255 and if its intensity falls below 150, a zero will be assigned in its place.  **Bit Plane Slicing**   1. Sometimes it is desirable to highlight the contribution made by specific bits to the total image appearance. 2. The image can be imagined to be composed of Eight 1-bit planes -- Plane 0 for the LSB plane and Plane 7 for the MSB. 3. The higher order bits contain visually significant data, the lower order plane contain more subtle details.   This can be accomplished by doing a **Bitwise AND** operation. For example, say the intensity of a pixel is 246 in decimal. In binary this would be (11110110)2(11110110)2. So in order to find the value of the 6th bit, one has to simply do this (11110110)2⊙(01000000)2(11110110)2⊙(01000000)2. The result will simply produce the value of the 6th bit. In other words, 246⊙64246⊙64 will give you the value of the 6th bit. |
| **Code(Solution):**  **Gray-level Slicing**      **Threshold Slicing**      **Bit Plane Slicing** |
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**EXPERIMENT NO. 6**

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| **Student Name and Roll Number: Karan choudhary(18csu103)** |
| **Semester /Section: 6th/ DS-B-1** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
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| **Objective:**  Exploring correlation and convolution filters for Image processing |
| **Outcome:**  Familiar with correlation and convolution filters for Image processing |
| **Problem Statement:**  Implementation of correlation and convolution filters for Image processing |
| **Background Study:**  **Correlation Filters** – Correlation Filters are a class of classifiers, which are specifically optimized to produce sharp peaks in the correlation output, primarily to achieve accurate localization of targets in scenes.  **Convolution Filters -** A convolution filter passes over all the pixels of the image in such a manner that, at a given time, we take 'dot product' of the convolution filter and the image pixels to get one final value output. |
| |  | | --- | | **Code(Solution):**  **a) Convolution Filters:**    **B) Correlation Filters:** | |
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**EXPERIMENT NO. 7**

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| **Student Name and Roll Number: Karan choudhary(18csu103)** |
| **Semester /Section: 6th / DS-B-1** |
| **Link to Code:** |
| **Date:** |
| **Faculty Signature:** |
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| **Objective:**  Exploring smoothing filters: averaging filter, Median Filter, Mean Filter, Min-Max Filter in spatial domain |
| **Outcome:**  Familiar with smoothing filters: averaging filter, Median Filter, Mean Filter, Min-Max Filter in spatial domain |
| **Problem Statement:**  Implementation of smoothing filters: averaging filter, Median Filter, Mean Filter, Min-Max Filter in spatial domain |
| **Background Study:**  **Spatial Filtering -** technique is used directly on pixels of an image. Mask is usually considered to be added in size so that it has a specific centre pixel. This mask is moved on the image such that the centre of the mask traverses all image pixels.  **Mean Filter -** Linear spatial filter is simply the average of the pixels contained in the neighbourhood of the filter mask. The idea is replacing the value of every pixel in an image by the average of the grey levels in the neighbourhood define by the filter mask.  **Averaging filter -** It is used in reduction of the detail in image. All coefficients are equal.  **Median filter -** Each pixel in the image is considered. First neighbouring pixels are sorted and original values of the pixel is replaced by the median of the list.  **Minimum filter -** 0th percentile filter is the minimum filter. The value of the center is replaced by the smallest value in the window.  **Maximum filter -** 100th percentile filter is the maximum filter. The value of the center is replaced by the largest value in the window**.** |
| **Code(Solution):** |
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**EXPERIMENT NO. 8**

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| **Student Name and Roll Number: Karan choudhary(18csu103)** |
| **Semester /Section: 6 / DS-B-1** |
| **Link to Code:** |
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| **Objective:**  Exploring Sharpening filter in spatial domain: Gaussian Filter (First Order Filter), Laplace Filter (Second Order Filter) |
| **Outcome:**  Familiar with Sharpening filter in spatial domain: Gaussian Filter (First Order Filter), Laplace Filter (Second Order Filter) |
| **Problem Statement:**  Implementation of Sharpening filter in spatial domain: Gaussian Filter (First Order Filter), Laplace Filter (Second Order Filter) |
| **Background Study:**  **Sharpening filter in spatial domain -** It is also known as derivative filter. The purpose of the sharpening spatial filter is just the opposite of the smoothing spatial filter. Its main focus in on the removal of blurring and highlight the edges. It is based on the first and second order derivative.  **Gaussian Filter (First Order Filter) –** have the properties of having no overshoot to a step function input while minimizing the rise and fall time. This behavior is closely connected to the fact that the Gaussian filter has the minimum possible group delay. It is considered the ideal time domain filter, just as the sinc is the ideal frequency domain filter.  **Laplace Filter (Second Order Filter) -** The Laplacian of an image highlights regions of rapid intensity change and is an example of a second order or a second derivative method of enhancement . It is particularly good at finding the fine details of an image. Any feature with a sharp discontinuity will be enhanced by a Laplacian operator. The Laplacian is a well-known linear differential operator approximating the second derivative. |
| **Code(Solution):** |
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**EXPERIMENT NO. 9**

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| **Student Name and Roll Number: Karan choudhary(18csu103)** |
| **Semester /Section: 6th/ DS-B-1** |
| **Link to Code:** |
| **Date:** |
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| **Objective:**  Exploring Image Smoothening in Frequency Domain |
| **Outcome:**  Got familiar with Image Smoothening in Frequency Domain |
| **Problem Statement:**  Implementation of Image Smoothening in Frequency Domain |
| **Background Study:**  **Image Smoothing (Low-pass Frequency Domain Filters)**  A low-pass filter that attenuates (suppresses) high frequencies while passing the low frequencies which results in creating a blurred (smoothed) image. It leaves the low frequencies of the Fourier transform relatively unchanged and ignores the high frequency noise components. Three main low-pass filters are: |
| **Code(Solution):** |
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**EXPERIMENT NO. 10**

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| **Student Name and Roll Number: Karan choudhary(18csu103)** |
| **Semester /Section: 6th / DS-B-1** |
| **Link to Code:** |
| **Date:** |
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| **Objective:**  Exploring Image Sharpening in Frequency Domain |
| **Outcome:**  Got Familiar with Image Sharpening in Frequency Domain |
| **Problem Statement:**  Implementation of Image Sharpening in Frequency Domain |
| **Background Study:**  **Image Sharpening (High-pass Frequency Domain Filters)**  Sharpening of an image in the frequency domain can be achieved by high pass filtering process which attenuates (suppress) low frequency components without disturbing high frequency information in the Fourier transform of the image.  The high-pass filter Hhp is often represented by its relationship  to the low-pass filter (Hlp) as:  Hhp (u, v) =1- Hlp (u, v)i.  Ideal High-Pass Filter (IHPF)  The ideal high pass filter simply cuts off all the low frequencies  lower than the specified cut-off frequency. |
| **Code(Solution):** |
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**EXPERIMENT NO. 11**

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| **Student Name and Roll Number: Karan choudhary(18csu103)** |
| **Semester /Section: 6 / DS-B-II** |
| **Link to Code:** |
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| **Objective:** |
| **Outcome:** |
| **Problem Statement:** |
| **Background Study:** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |
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**EXPERIMENT NO. 12**

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| **Student Name and Roll Number: Karan choudhary(18csu103)** |
| **Semester /Section: 6 / DS-B-II** |
| **Link to Code:** |
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| **Objective:** |
| **Outcome:** |
| **Problem Statement:** |
| **Background Study:** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |
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**EXPERIMENT NO. 13**

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| **Student Name and Roll Number: Kashish Bhagat(18csu106)** |
| **Semester /Section: 6 / DS-B-II** |
| **Link to Code:** |
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| **Faculty Signature:** |
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| **Objective:** |
| **Outcome:** |
| **Problem Statement:** |
| **Background Study:** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |
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**EXPERIMENT NO. 14**

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| **Student Name and Roll Number: Kashish Bhagat(18csu106)** |
| **Semester /Section: 6 / DS-B-II** |
| **Link to Code:** |
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| **Objective:** |
| **Outcome:** |
| **Problem Statement:** |
| **Background Study:** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |
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**EXPERIMENT NO. 15**

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| **Student Name and Roll Number: Kashish Bhagat(18csu106)** |
| **Semester /Section: 6 / DS-B-II** |
| **Link to Code:** |
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| **Objective:** |
| **Outcome:** |
| **Problem Statement:** |
| **Background Study:** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |
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**EXPERIMENT NO. 16**

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| **Student Name and Roll Number: Kashish Bhagat(18csu106)** |
| **Semester /Section: 6 / DS-B-II** |
| **Link to Code:** |
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| **Faculty Signature:** |
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| **Objective:** |
| **Outcome:** |
| **Problem Statement:** |
| **Background Study:** |
| **Code(Solution):** |
| **Sample Outputs:** |
| **Question Bank:** |
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**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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