SECURE EXAMINATION WITH EYEBALL TRACKING

Submitted in partial fulfillment of the
requirements for the award of
Bachelor of Engineering degree in Computer Science and Engineering

By

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DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

SCHOOL OF COMPUTING

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INSTITUTE OF SCIENCE AND TECHNOLOGY
(DEEMED TO BE UNIVERSITY)
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BONAFIDE CERTIFICATE

This is to certify that this Project Report is the bonafide work of **Gade Bala Rohith Reddy(3911306)** who carried out Project Phase 2 entitled **"Secure Examination with Eyeball tracking"** under my supervision from January 2023 to April 2023.

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DECLARATION

I, **Gade Bala Rohith Reddy (Reg.No- 3911306),** hereby declare that the Project Report entitled **"Secure Examination with eyeball tracking"** done by me under the guidance of **Ms.YOGITHA M M.E., Ph.D.** is submitted in partial fulfillment of the requirements for the award of Bachelor of Engineering degree in **Computer Science and Engineering**.

DATE: 20.04.2023
PLACE: Chennai

SIGNATURE OF THE CANDIDATE

ACKNOWLEDGEMENT

I am pleased to acknowledge my sincere thanks to the **Board of Management** of **SATHYABAMA** for their kind encouragement in doing this project and for completing it successfully. I am grateful to them.

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ABSTRACT

With the advent of COVID-19, remote learning has blossomed. Schools and universities may have been shut down but they switched to applications like Microsoft Teams to finish their academic years. However, there has been no solution to examinations. Some have changed it to an assignment form where students can just copy and paste from the internet, while some have just canceled them outright. If the way we are living is to be the new norm there needs to be some solution. Online examinations is allowing students to give exams from home where they will be monitored by a proctor for the whole duration of the exam. So let's create an AI in python that can monitor the students using the webcam and laptop microphone itself and enable the teachers to monitor multiple students simultaneously. In this project, we describe a strategy for avoiding the physical presence of a proctor during the test by developing a multi-modal system. We captured video using a webcam along with active window capture. The face of the test taker is identified and analyzed to forecast his emotions. To identify his head pose, his feature points are identified. Furthermore, aspects including a phone, a book, or the presence of another person are detected. This combination of models creates an intelligent rule-based inference system that is capable of determining if any malpractice took place during the examination. During this project, we use the YOLOv3 object identification algorithm which is a better option when it comes to object detection. The core purpose of examinations is to encourage more focused learning and to test the student's ability. The result of examinations can go a long way in opening up opportunities for candidates.

LIST OF FIGURES

CHAPTER 1

INTRODUCTION

The use of an online examination system has also accelerated the advancement of accessible technology. But often one of the prominent arguments is that there is a possibility of compromise on security and fairness in the online exam platform. Artificial Intelligence has been making attempts every day to minimize the restrictions of online examinations by giving several remote proctoring solutions. These solutions are divided into three categories, live online proctoring, recorded proctoring, and AI Proctoring.

Cutting-edge technologies are providing learning systems with new ways to securely and effectively assess students' academic honesty. Remote proctoring no longer restricts students to a physical location or a precise exam time due to the rapid technological revolution leading to the shifts in demands for advanced online proctoring solutions. Therefore, learning systems and students are embracing AI-powered virtual platforms, and they are now normal practice.

According to the forecast by IDC Worldwide Semi-annual Artificial Intelligence Tracker shows worldwide revenues surpassing $300 billion in 2024 with a five-year compound annual growth rate (CAGR) of 17.1%. Furthermore, due to the COVID-19 lockdown, the way examinations are now conducted and supervised has been transformed. AI-enabled monitoring tools ensure enhanced proctoring security and a holistic experience for both educators and students. Detect identity impersonation and fraud. Reduce examination stress for students. No need to travel, students can complete their exams from the comfort of home. Discover content theft and collusion. Identify potential cheating behaviors using facial markers and iris tracking. Detect suspicious activities such as students using a second screen.

AI-powered online proctoring is an effective alternative to traditional proctoring and creates a cheat-deterring environment where exam integrity and security are ensured by integrating machine learning technologies. Artificial intelligence solutions are the most suitable for addressing identity and privacy concerns and organizing online surveillance efficiently and securely.

Facial recognition: API facial recognition is used to validate the exam participant's identity and validate any misconduct by matching the student's face against their student identification photo

Audio: This feature allows the invigilation software to record all sound throughout the recording including talking and background noise. Irregular or loud audio is recorded as potential cheating as students should be taking their exam in a quiet room and not with other people in the room.

Eye movement detection: If the candidate is involved in cheating activities trying to move his eyes to other objects, the system detects misconduct.

Object/face detection: ML-driven algorithms allow scanning an exam tester’s environment to monitor for objects that are not permitted during an exam. For example, the IRIS software can detect if any other faces are present in the testing environment.

The software would assist the human proctor in keeping track of student activities. In this way, whenever a student is suspected, they would be brought to the forefront of the human proctor's screen, and their suspicious activity flagged for later review. This way, a single human proctor can focus their attention on students most likely to cheat. It also provides an extra layer to the monitoring system. This way, false positives can also be reduced, and the workforce required to monitor the exam also reduces. The system's selection depends on the preferences of the university and the resources of the majority of the student body. Technologies used in this project are OpenCV, Dlib, TensorFlow, NLTK, and Pyttsx3.

CHAPTER 2

LITERATURE SURVEY

[1] Nigam, A., Pasricha, R., Singh, T., & Churi, P. (2021). A systematic review on AI-based proctoring systems: Past, present, and future. *Education and Information Technologies*, *26*(5), 6421-6445.4 primary research questions which were focusing on the existing architecture of AIPS, Parameters to be considered for AIPS, trends, and Issues in AIPS, and the Future of AIPS. Our 360-degree analysis of OPS and AIPS reveals that security issues associated with AIPS are multiplying and are a cause of legitimate concern.

[2] Lee, K., & Fanguy, M. (2022). Online exam proctoring technologies: Educational innovation or deterioration *British Journal of Educational Technology*, *53*(3), 475-490.Foucault's theory of disciplinary governmentality. This study analyses three datasets. The first dataset includes institutional documents related to online examinations and proctoring (eg, university bulletins, staff notices, and student guides). The second dataset was collected by conducting semi-structured interviews with fourteen faculty members recruited using a purposive convenience sampling approach (Creswell, **2014**).

[3] Motwani, S., Nagpal, C., Motwani, M., Nagdev, N., & Yeole, A. (2021). AI-Based Proctoring System for Online Tests. Available at SSRN 3866446. Local Binary Pattern Histogram Algorithm the Local Binary Pattern Histogram (LBPH) algorithm is a simple solution to the problem of face recognition, which can identify both the front and side. However, the LBPH algorithm recognition rate under conditions of diversification of illumination, the variability of expression, and the deflection of attitude is decreased. Local Binary Pattern (LBP) is a straightforward yet effective surface administrator which names the pixels of a picture by thresholding the neighborhood of every pixel and thinks about the outcome as a binary number.

[4] Tweissi, A., Al Etaiwi, W., & Al Eisawi, D. (2022). The Accuracy of AI-Based Automatic Proctoring in Online Exams. Electronic Journal of e-Learning, 20(4), 419-435. The experiment on 244 online exam sessions was done using Manual Testing methodology, which is a software testing technique used for verification of software to spot and resolve any possible errors or flaws (Anwarand Kar,2019). Previous experiments used multiple features such as a deep learning neural network called Long Short-Term Memory (LSTM) to compare the proposed software performance with respect to human judgment(Nigam et al, 2021).

LSTMs are artificial recurrent neural networks (RRN), which is an architecture usually used in several applications, including but not limited to time series prediction, natural language processing, sentiment analysis, image and video captioning text recognition, and sound detection (Van Houdt, Mosquera, and Nápoles,2020).

[5] Sridhar, A., & Rajshekhar, J. S. (2022). AI-Integrated Proctoring System for Online Exams. Journal of Artificial Intelligence, 4(2), 139-148. The algorithm is mainly used for the recognition of the face, nose, eyebrows, and mouth. It will select in 3 forms such as edge feature, line feature, and four-rectangle feature. The Haar Feature Selection is divided into 2 parts, the right part, and the left part. The right part is the brighter part of the human face and the left part is the darker part of the human face. The pixel would be taken and some of the pixels will be identified.

[6] Kasinathan, V., Yan, C. E., Mustapha, A., Hameed, V. A., Ching, T. H., & Thiruchelvam, V. (2022). ProctorEx: An Automated Online Exam Proctoring System. Mathematical Statistician and Engineering Applications, 71(3s2), 876-889. Face Detection this system receives webcam video and performs face detection. The first processing performed by the backend server is face detection. A thorough comparison was done by the researcher on various face detection algorithms before deciding to implement OpenCV Deep Neural Network (DNN) as it had good accuracy with fast execution time. For face detection, ProctorEx uses a pre-trained face detection model, the Caffe model. To use the model, the prototxt file which defines the model architecture, and the Caffe model file which contains the weights for DNN layers are required.

[7] Prathish, S., & Bijlani, K. (2016, August). An intelligent system for online exam monitoring. In 2016 International Conference on Information Science (ICIS) (pp. 138-143). IEEE..By joining consistent personality checks and programmed recognition of misbehavior or dubious exercises by an understudy, this framework gives a versatile, on-the-web, totally computerized, a human communication-free delegating framework that can be gotten to by test takers and directors to a really productive answer for the customary issue of online test administering. The screen's webcam has an inherent receiver to catch any solid in the room. This framework additionally catches the screen captures from an understudy's machine aimlessly, an ideal opportunity to guarantee respectability. Validation of the personality of the test takers is a significant and possibly costly issue in internet testing. In this framework, confirmation is cultivated utilizing the webcam and straightforward, solid acknowledgment methods.

[8] by N.L Clarke and P. Dowland, the paper presents a feasible model to facilitate remote and electronic proctoring during examinations of students. The strategy involves utilizing translucent recognition to give a non-disruptive and persistent authentication of student's identity all through the period of test taking. A model is created and an appraisal of the technology of the created platform showcases the success of this method.

[9] by Vahid Kazemi and Josephine Sullivan, the theory tends to the issue of Face Arrangement for a solitary picture. It shows how an outfit of relapse trees can be utilized to gauge the face's milestone positions or landmarks from an inadequate subset of pixel powers, accomplishing execution with excellent forecasts. They present an overall structure dependent on inclination boosting for learning a gathering of relapse trees that advances the number of square losses and normally handles missing or incompletely named information. They show how utilizing fitting priors misusing the design of picture information assists with effective component choice. Distinctive regularization systems and its significance to battle overfitting are likewise researched. Moreover, they examine the dependence of accurate predictions on the quantity of available training data.

[10] published by Asep Hadian S. G and Yoanes Bandung, a unique approach is followed wherein user verification is at high importance on a continuous scale. A large dataset of user images is used to train the CNNs to identify the user in low light and general scenarios. They have achieved this by using filters that detect features that must pass non-linear mapping such that the CNN can learn the values. This system is trained during times of lecture for a MOOC or Classroom setup instead of a first-time approach just during exams, which provides leverage to higher accuracy and larger dataset, which in turn eliminates false positives while training the model. The system accuracy rate is measured in the final evaluation stage using false acceptance rate (FAR) and false rejection (FRR) in the verificationprocess.

2.1 INFERENCES FROM LITERATURE SURVEY

- From the above-mentioned literature works, it is clear that there has been effective research on the secure exam with ai proctoring and many models have been proposed.
- Ai-based proctoring needs more features for a safe examination with more attributes such as face moment, eyeball tracking, multiple face detection, voice detection, Tab switching, etc.
- Many have proposed the same project using CNN but the accuracy was not up to the mark.
- Many have proposed the model based on pre-trained data sets.
- It is evident that the above-mentioned systems have their own pros and cons.
- While some of the recent works involve hybrid technologies and provide better accuracies, they are still far from what is needed.
- With higher accuracy, comes the need for low computational costs, high processing speed, and most of all, the convenience of use.

2.2 OPEN PROBLEMS IN THE EXISTING SYSTEM

- There exists a wide variety of algorithms that are capable of solving the shortest path problem.

The Following algorithms are available:

  - Eigenfaces
  - Scale Invariant Feature Transform (SIFT)
  - Fisher faces
  - Local Binary Patterns Histograms (LBPH)

- There are various deep learning-based facial recognition algorithms available.

  - Deep Face
  - Deep ID series of systems,
  - FaceNet
  - VGGFace

- This project does not eliminate the need for a proctor as he is required to perform certain operations. There are certain ways to cheat as well through this system like a person sitting behind the laptop communicating with the test-taker by writing.

- To completely stop cheating we would need external hardware like a spectacle camera to cover the whole field of view of the test-taker and apply computer vision on its feed.
- But that would eliminate the goal to make an AI that anyone can use without using anything extra other than a standard laptop and using this a proctor can also multiple students at once.

CHAPTER 3
REQUIREMENT ANALYSIS

3.1 FEASIBILITY STUDIES/RISK ANALYSIS OF THE PROJECT

FEASIBILITY STUDY

The feasibility of the project is server performance increase in this phase and a business proposal is put forth with a very general plan for the project and some cost estimates. During system analysis, the feasibility study of the proposed system is to be carried out. For feasibility analysis, some understanding of the major requirements for the system is essential.

Three key considerations involved in the feasibility analysis are

- Economical feasibility
- Technical feasibility
- Operational feasibility

ECONOMICAL FEASIBILITY

This study is carried out to check the economic impact that the system will have on the organization. The amount of funds that the company can pour into the research and development of the system is limited. The expenditures must be justified. Thus the developed system is well within the budget and this was achieved because most of the technologies used are freely available. Only the customized products had to be purchased.

TECHNICAL FEASIBILITY

This study is carried out to check the technical feasibility, that is, the technical requirements of the system. Any system developed must not have a high demand on the available technical resources. This will lead to high demands being placed on the client. The developed system must have modest requirements, as only minimal or null changes are required for implementing this system.

OPERATIONAL FEASIBILITY

The aspect of the study is to check the level of acceptance of the system by the user. This includes the process of training the user to use the system efficiently. The user must not feel threatened by the system, instead must accept it as a necessity. The level of acceptance by the users solely depends on the methods that are employed to educate the user about the system and to make him familiar with it. His level of confidence must be raised so that he is also able to make some constructive criticism, which is welcomed, as he is the final.

3.2 SOFTWARE REQUIREMENTS SPECIFICATION DOCUMENT

Hardware Requirements:

4GB RAM or above
A processor of frequency 1.5GHz or above

Language Used:

Python

Software Requirements:

PyCharm
Vscode
Jupyter Notebook
Python IDLE

Package Requirements:

OpenCV
Dlib
TensorFlow
NLTK
Pyttsx3

CHAPTER 4

DESCRIPTION OF THE PROPOSED SYSTEM

4.1 SELECTED METHODOLOGY OR PROCESS MODEL

The AI will have four vision-based capabilities which are combined using multithreading so that they can work together:

1. Gaze tracking
2. Mouth open or close
3. Person Counting
4. Mobile phone detection

Apart from this, the speech from the microphone will be recorded, converted to text, and will also be compared to the text of the question paper to report the number of common words spoken by the test-taker.

- We shall aim to track the eyeballs of the test-taker and report if he is looking to the left, right, or up which he might do to have a glance at a notebook or signal to someone. This can be done using Dlib's facial keypoint detector and OpenCV for further image processing. I have already written an article on how to do real-time eye-tracking which explains in detail the methods used that will be used later on.

- This is very similar to eye detection. Dlib's facial key points are again used for this task and the test-taker is required to sit straight (as he would in the test) and the distance between the lips key points (5 outer pairs and 3 inner pairs) is noted for 100 frames and averaged. If the user opens his/her mouth the distances between the points increase and if the increase in distance is more than a certain value for at least three outer pairs and two inner pairs then infringement is reported.

- The pre-trained weights of YOLOv3 were trained on the COCO dataset to detect people and mobile phones in the webcam feed. If the count is not equal an alarm can

be raised. The index of mobile phones in the COCO dataset is 67 so we need to check if any class index is equal to that then we can report a mobile phone as well.

- Finally combining all four key features using multi-threading, s eye-tracking, and mouth detection are based on dlib we can create a single thread for them and another thread can be used for the YOLOv3 tasks: people counting and mobile detection.

4.2 ARCHITECTURE / OVERALL DESIGN OF THE PROPOSED SYSTEM

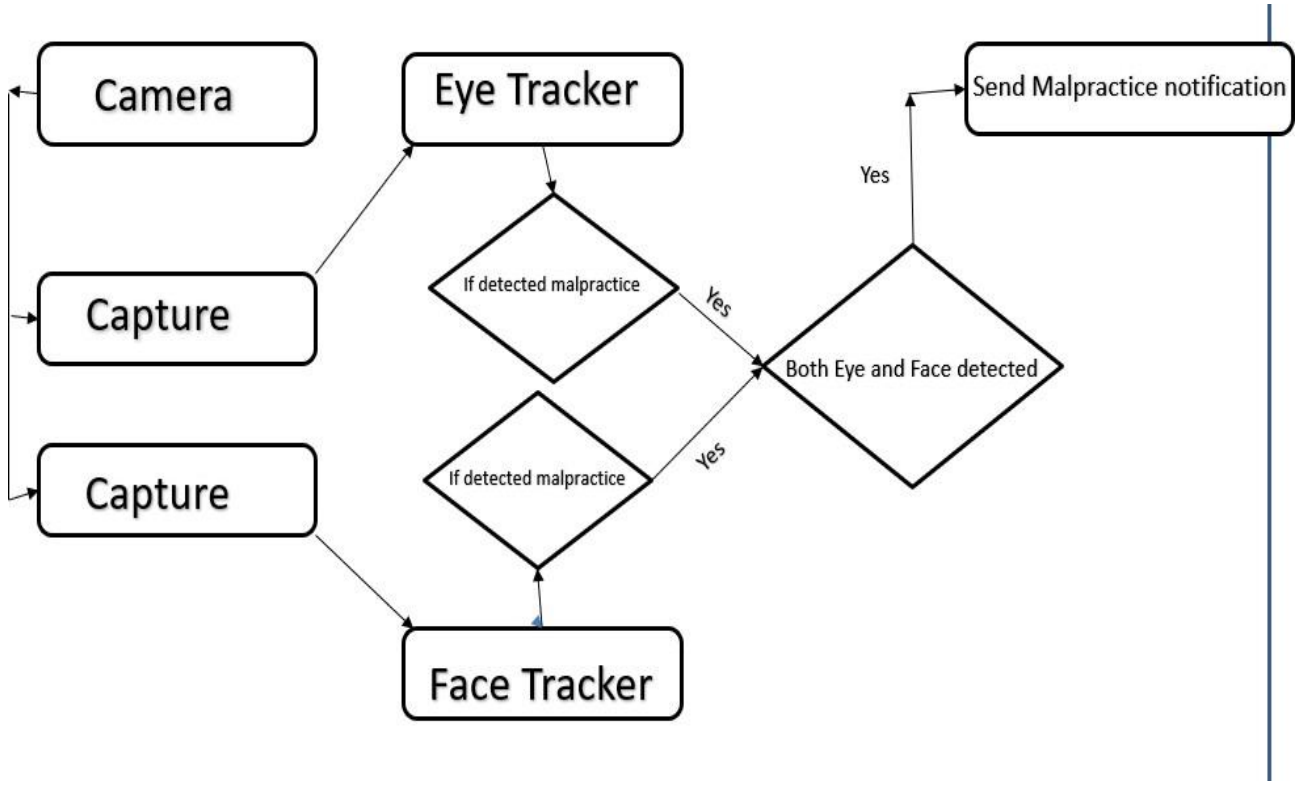

Fig 4.2: System Architecture for secure examination

- The block diagram of the proposed system has been shown in the above figures. The camera captures the image of the person inside the frame and detects each feature from the face using the facial landmark technique in the system.
- The next step in the process would be as it starts to find the position and condition of each feature to analyze, it should detect whether the person is cheating or not.
- If any of the features especially the eye and the head pose/state of the person are detected to be abnormal then automatically the system starts to produce the malpractice notification.
- This is where we will get the final judgment that a person is

cheating in an examination.

4.3 DESCRIPTION OF SOFTWARE FOR IMPLEMENTATION AND TESTING PLAN OF THE PROPOSED MODEL/SYSTEM

- Anaconda is an open-source package manager for Python and R. It is the most popular platform among data science professionals for running Python and R implementations.
- There are over 300 libraries in data science, so having a robust distribution system for them is a must for any professional in this field. Anaconda simplifies package deployment and management.
- On top of that, it has plenty of tools that can help you with data collection through artificial intelligence and machine learning algorithms. With Anaconda, you can easily set up, manage, and share Conda environments. Moreover, you can deploy any required project with a few clicks when you're using Anaconda.
- There are many advantages to using Anaconda and the following are the most prominent ones among them: Anaconda is free and open-source. This means you can use it without spending any money.
- In the data science sector, Anaconda is an industry staple. It is open-source too, which has made it widely popular. If you want to become a data science professional, you must know how to use Anaconda for Python because every recruiter expects you to have this skill. It is a must-have for data science.
- It has more than 1500 Python and R data science packages, so you don't face any compatibility issues while collaborating with others. For example, suppose your colleague sends you a project which requires packages called A and B but you only have package A.
- Without package B, you wouldn't be able to run the project. Anaconda mitigates the chances of such errors. You can easily collaborate on projects without worrying about compatibility issues.
- It gives you a seamless environment that simplifies deploying projects. You can deploy any project with just a few clicks and commands while managing the rest. Anaconda has a thriving community of data scientists and machine learning professionals who use it regularly.
- If you encounter an issue, chances are, the community has already answered the same. On the other hand, you can also ask people in the community about the issues you face there, it's a very helpful community ready to help new learners. With Anaconda, you can easily create and train machine learning and deep learning

models as it works well with popular tools including TensorFlow, Scikit-Learn, and Theano.

- You can create visualizations by using Bokeh, Holoviews, Matplotlib, and Datashader while using Anaconda.

How to Use Anaconda for Python

Now that we have discussed all the basics in our Python Anaconda, let's discuss some fundamental commands you can use to start using this package manager.

Listing All Environments

To begin using Anaconda, you'd need to see how many conda environments are present in your machine.

- conda env list

It will list all the available Conda environments in your machine.

Creating a New Environment

You can create a new Conda environment by going to the required directory and using this command:

- conda create -n <your_environment_name>

You can replace <your_environment_name> with the name of your environment. After entering this command, Conda will ask you if you want to proceed to which you should reply with y:

Proceed ([y])/n)?

On the other hand, if you want to create an environment with a particular version of Python, you should use the following command:

- conda create -n <your_environment_name> python=3.6

Similarly, if you want to create an environment with a particular package, you can use the following command:

- conda create -n <your_environment_name>pack_name

Here, you can replace pack_name with the name of the package you want to use.

If you have a .yml file, you can use the following command to create a new Conda environment based on that file:

- conda env create -n <your_environment_name> -f <file_name>.yml

We have also discussed how you can export an existing Conda environment to a .yml file later in this article.

Activating an Environment

You can activate a Conda environment by using the following command:

- conda activate <environment_name>

You should activate the environment before you start working on the same. Also, replace the term <environment_name> with the environment name you want to activate. On the other hand, if you want to deactivate an environment use the following command:
conda deactivate

Installing Packages in an Environment

Now that you have an activated environment, you can install packages into it by using the following command:

- conda install <pack_name>

Replace the term <pack_name> with the name of the package you want to install in your Conda environment while using this command.

Updating Packages in an Environment

If you want to update the packages present in a particular Conda environment, you should use the following command:
conda update
The above command will update all the packages present in the environment. However, if you want to update a package to a certain version, you will need to use the following command:

- conda install <package_name>=<version>

Exporting an Environment Configuration

Suppose you want to share your project with someone else (colleague, friend, etc.). While you can share the directory on Github, it would have many Python packages, making the transfer process very challenging. Instead of that, you can create an environment configuration .yml file and share it with that person. Now, they can create an environment like yours by using the .yml file.
For exporting the environment to the .yml file, you'll first have to activate the same and run the following command:

- conda env export ><file_name>.yml

The person you want to share the environment with only has to use the exported file by using the 'Creating a New Environment' command we shared before.

Removing a Package from an Environment

If you want to uninstall a package from a specific Conda environment, use the following

command:

- conda remove -n <env_name><package_name>

On the other hand, if you want to uninstall a package from an activated environment, you'd have to use the following command:

- conda remove <package_name>

Deleting an Environment

Sometimes, you don't need to add a new environment but remove one. In such cases, you must know how to delete a Conda environment, which you can do so by using the following command:

- conda env remove –name <env_name>

The above command would delete the Conda environment right away.

4.4 PROJECT MANAGEMENT PLAN

- Finding motivation
- Started to search for the relevant papers
- Finding or learning the required algorithms
- Design the architecture of the system
- Coding
- Validating the proposed system

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