
RSET
RAJAGIRI SCHOOL OF
ENGINEERING & TECHNOLOGY
(AUTONOMOUS)

*Mini Project Report On*

# IPC Insight (An application for predicting Indian Penal Code sections applicable to crime narratives)

*Submitted in partial fulfillment of the requirements for the award of the degree of*

## Bachelor of Technology

*in*

***Computer Science & Engineering***

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# CERTIFICATE

*This is to certify that the mini project report entitled* ***"IPC Insight"*** *is a bonafide record of the work done by* ***Rahul Varghese (U2103169), Ranjit Shine (U2103170), Reuben Simon George (U2103173), Rohan Thundil Rajeev (U2103182)*** *submitted to the APJ Abdul Kalam Technological University in partial fulfillment of the requirements for the award of the degree of Bachelor of Technology (B. Tech.) in Computer Science and Engineering during the academic year 2023-2024.*

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# Abstract

The Indian Penal Code (IPC) enscompasses a vast array of legal provisions governing criminal offenses in India. Understanding and navigating through the IPC sections relevant to a specific crime narrative is crucial for legal practitioners and law enforcement agencies.

IPC Insight is a novel application designed to analyze crime narratives and identify the relevant sections of the Indian Penal Code (IPC) applicable to each narrative. Leveraging advanced natural language processing (NLP) techniques and vector database technology, IPC Insight provides users with an intuitive platform to input crime narratives and receive real-time insights into the corresponding legal implications.

The system preprocesses the narratives, converts them into numerical vector representations, and indexes them in the vector database for efficient retrieval. By comparing the vector representations of crime narratives with those of IPC sections, IPC Insight accurately identifies the sections most closely related to each narrative.

IPC Insight empowers legal practitioners, law enforcement agencies, and the general public to navigate the complexities of the legal landscape with confidence and clarity, facilitating informed decision-making and promoting justice and compliance.

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# List of Abbreviations

- IPC- Indian Penal Code
- NLP- Natural Language Processing
- DB- Database

# Chapter 1

# Introduction

## 1.1 Background

The Indian Penal Code (IPC) is a comprehensive legal framework that governs criminal offenses in India. Understanding and interpreting the IPC sections relevant to specific crime incidents are essential tasks for legal practitioners, law enforcement agencies, and individuals seeking legal guidance. However, manually analyzing crime narratives to identify the applicable IPC sections can be time-consuming and prone to errors.

To address this challenge, IPC Insight leverages advancements in natural language processing (NLP) and database technology to automate the process of analyzing crime narratives and identifying relevant IPC sections. By preprocessing crime narratives, converting them into numerical vector representations, and indexing them in a vector database, IPC Insight streamlines the analysis process and provides users with real-time insights into the legal implications of crime incidents.

With IPC Insight, users can input crime narratives into the system and receive instant feedback on the IPC sections applicable to each narrative. This empowers users to make informed decisions, comply with legal regulations, and promote justice in their respective domains. IPC Insight serves as a valuable tool for legal professionals, law enforcement agencies, and individuals alike, offering a seamless and efficient solution for navigating the complexities of the Indian legal landscape.

## 1.2 Problem Definition

Manual analysis of crime narratives for IPC section identification is time-consuming and error-prone. We need a solution for quick and accurate interpretation of crime descriptions within the IPC framework.

## 1.3 Scope and Motivation

The scope of the IPC Insight project encompasses the development of a comprehensive and reliable application for analyzing crime narratives and identifying the relevant sections of the Indian Penal Code (IPC). This includes:

1. Designing and implementing an intuitive user interface for inputting crime narratives.
2. Preprocessing crime narratives using natural language processing (NLP) techniques.
3. Storing and indexing crime narratives and IPC sections in a vector database for efficient retrieval.
4. Developing algorithms to compare crime narratives with IPC sections and identify relevant matches.
5. Providing users with real-time insights into the legal implications of crime incidents based on the identified IPC sections.
6. Ensuring the reliability, accuracy, and security of the IPC Insight application.

The motivation behind the IPC Insight project stems from the need to address the challenges associated with manual analysis of crime narratives within the Indian legal system. These challenges include:

1. Time-consuming and labor-intensive nature of manual analysis.
2. Lack of consistency and accuracy in interpreting legal implications.
3. Inefficiency in identifying relevant IPC sections for crime incidents.
4. Limited accessibility to legal expertise for individuals and organizations.

## 1.4 Objectives

- To Develop an application trained on the Indian Penal Code (IPC) to analyze crime narratives and provide legal guidance.

- To design an intuitive user interface for inputting crime incident details and displaying the relevant IPC section and Punishment
- To provide explanations or justifications for the predicted IPC sections and punishments to enhance user understanding and trust

### 1.5 Challenges

1. **Natural Language Understanding:** Developing accurate natural language processing (NLP) models to effectively understand and interpret crime narratives, which may vary in complexity and language style.
2. **Data Quality and Consistency:** Ensuring the availability of high-quality and consistent crime narrative datasets for training and validation, as variations in data quality can impact the performance of the system.
3. **Legal Complexity:** Addressing the intricate nature of legal language and the Indian Penal Code (IPC), which contains numerous sections and sub-sections that may overlap or have nuanced interpretations.

### 1.6 Assumptions

Stability of Legal Framework: Assuming that the legal framework, including the IPC, remains stable during the development and deployment of the system, with minimal changes or updates.

### 1.7 Societal / Industrial Relevance

The IPC Insight project holds significant societal and industrial relevance in several ways:

**1. Legal Practitioners and Law Enforcement Agencies:** IPC Insight provides a valuable tool for legal practitioners and law enforcement agencies to efficiently analyze crime narratives and interpret legal implications within the Indian Penal Code (IPC). By automating the process of identifying relevant IPC sections and associated punishments, IPC Insight streamlines legal analysis and decision-making, saving time and resources for legal professionals.

**2. Legal Education and Training:** IPC Insight can serve as an educational tool for law students, legal interns, and aspiring legal professionals to learn about the application of the IPC in real-world scenarios. By providing insights into the legal implications of crime incidents, IPC Insight enhances legal education and training, enabling students to develop practical skills in legal analysis and interpretation.

**3. Research and Innovation:** IPC Insight stimulates research and innovation in the fields of natural language processing (NLP), machine learning, and legal informatics. Researchers and practitioners can explore novel approaches and methodologies for analyzing crime narratives and interpreting legal statutes, leading to advancements in legal technology and data-driven decision-making.

## 1.8 Organization of the Report

The report is structured as follows:

**Chapter 1 - Introduction**: Provides background,definition of the problem, objectives, challenges and relevance of the project.

**Chapter 2 - Software Requirements Specification:** Describes the project's overall description, including system features and nonfunctional requirements.

**Chapter 3 - System Architecture and Design:** Presents the project's architecture, user interfaces, implementation strategies and the work schedule

**Chapter 4 - Result and Discussions:** Presents the testing procedures, snapshots of the UI, quantitative results, and discuss the findings.

**Chapter 5 - Conclusion:** Presents the concluding remarks, including a summary of findings and future scope for the project.

## 1.9 Summary

The first chapter of the IPC Insight project report introduces the need for automating the analysis of crime narratives to identify relevant sections of the Indian Penal Code (IPC), a task traditionally plagued by time-consuming and error-prone manual processes. IPC Insight leverages advancements in natural language processing (NLP) and vector database technology to provide real-time legal insights. The project aims to develop a user-friendly interface, preprocess crime narratives using NLP, and store data in a vector

database for efficient retrieval. The motivation is to overcome the inefficiencies of manual analysis, ensuring accuracy and accessibility to legal expertise. The objectives include developing a reliable application for legal guidance, enhancing user understanding, and ensuring system reliability. The project is relevant for legal practitioners, law enforcement, education, and research, offering significant improvements in legal analysis and decision-making.

# Chapter 2

# Software Requirements Specification

## 2.1 Introduction

### 2.1.1 Purpose

The purpose of this document is to provide a comprehensive overview of the requirements for the development of IPC Insight, a machine learning model trained on the Indian Penal Code (IPC) for analysing crime narratives and providing applicable sections and punishments.

### 2.1.2 Product Scope

The scope of IPC Insight includes the development, training, and deployment of a machine learning model that takes crime narratives as input and outputs the relevant IPC sections and punishments. Users can input textual descriptions of criminal incidents or events into the system through an intuitive user interface. Crime narratives undergo preprocessing to standardise formatting, remove noise, and enhance text quality, ensuring consistency and accuracy in analysis. Leveraging state-of-the-art NLP techniques, IPC Insight comprehends the semantics and context embedded within crime narratives. IPC Insight employs advanced feature extraction mechanisms to distil essential information and complexities from crime narratives. Supervised learning algorithms are applied to categorise offences accurately and predict associated IPC sections and punishments. The system identifies and extracts relevant sections of the Indian Penal Code mentioned within crime narratives. IPC Insight predicts applicable punishments or legal consequences associated with identified IPC sections.The primary goal of the IPC Insight project is to assist legal professionals, law enforcement agencies, and other stakeholders in ensuring compliance with the Indian Penal Code (IPC).

## 2.2 Overall Description

### 2.2.1 Product Perspective

IPC Insight is an innovative AI-driven tool designed to simplify the analysis of crime narratives by identifying relevant sections of the Indian Penal Code. Whether you input text or audio, IPC Insight quickly provides accurate legal interpretations, helping legal professionals, law enforcement, and the general public understand the legal implications of crime incidents.

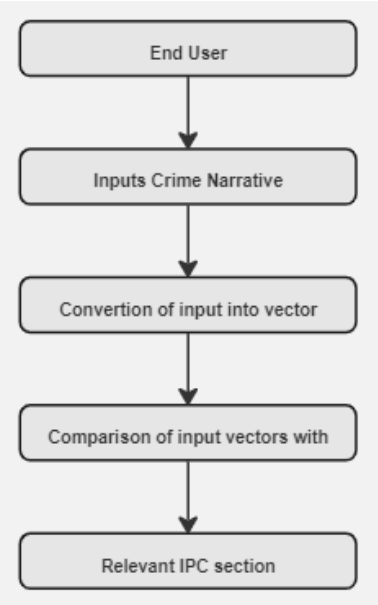


Figure 2.1: Flowchart

### 2.2.2 Product Functions

- Accept crime narratives as input.
- Preprocess input text to remove noise and irrelevant information.
- Identify and extract relevant IPC sections mentioned in the input narrative.
- Determine applicable punishments based on the identified IPC sections.
- Display the result containing the identified IPC sections and associated punishments.

### 2.2.3 Operating Environment

IPC Insight will operate within a Python environment, utilising essential libraries and frameworks for machine learning and natural language processing.

#### Hardware Platform

- The model will operate on standard computing hardware commonly used by consumers, including desktop computers, laptops, tablets, and mobile devices.
- The hardware platform should have sufficient processing power, memory, and storage to support web browsing and data processing activities.

#### Operating System and Version

The software is designed to be platform-independent and compatible with multiple operating systems. These include:

- Windows (Versions 7, 8, 10  11)
- macOS (Versions 10.12 (Sierra) and above)
- Linux (Various distributions such as Ubuntu, Fedora, and CentOS)

### 2.2.4 Design and Implementation Constraints

The Design and implementation constraints for the IPC Insight project encompassess various factors that may limit the system's development, deployment, or operation.

**Dataset Availability and Quality:** Limited availability of labelled crime narrative dataset for training the machine learning model. Insufficient data may affect the model's performance and generalisation ability.

**Legal and Regulatory Compliance:** Adherence to legal and regulatory frameworks governing the use of legal data and machine learning algorithms. Compliance requirements may impose restrictions on data collection, processing, and storage practices.

**Computational Resources:** Availability of computational resources, such as processing power and memory, for training and deploying the machine learning model. Inadequate resources may lead to longer training times, slower inference speeds, or scalability issues.

**Model Interpretability:** Ensuring the interpretability of the machine learning model's predictions and decision-making processes. Lack of interpretability may hinder user trust and acceptance of the model's recommendations, particularly in legal contexts.

### 2.2.5 Assumptions And Dependencies

Assumptions and dependencies play a crucial role in the successful development and deployment of a project like IPC Insight. Here are some assumptions and dependencies for the project:

#### Availability of Labelled Data

Sufficient labelled crime narrative data for training the machine learning model is available or can be collected. Insufficient data may affect the model's performance and generalisation ability.

#### Stability of Legal Framework

The legal framework, including the Indian Penal Code (IPC), remains stable and does not undergo significant revisions during the project timeline. Changes in legal regulations or interpretations may affect the relevance and accuracy of the model's predictions.

#### Domain Expertise

Access to domain expertise in both natural language processing (NLP) and legal domains is available to guide model development and evaluation. Lack of expertise may affect the accuracy and relevance of the model's predictions and recommendations.

#### Access to Computational Resources

Availability of computational resources, such as processing power and memory, for training and deploying the machine learning model. Inadequate resources may lead to longer training times, slower inference speeds, or scalability issues.

## 2.3 External Interface Requirements

### 2.3.1 User Interfaces

IPC Insight shall provide a user-friendly graphical interface for inputting crime narratives and viewing the generated output. Input text field for crime narratives, buttons for submitting queries and displaying results. Intuitive design, clear labelling, error messages for invalid inputs, and responsiveness across devices.

### 2.3.2 Hardware Interfaces

The hardware interface requirements for IPC Insight specify the hardware components and configurations necessary to deploy and operate the system effectively. Here are the hardware interface requirements:

**Server Infrastructure**

IPC Insight requires a server infrastructure to host the system components, including

- Central Processing Unit (CPU): A multicore processor capable of handling concurrent requests and computations efficiently.
- Random Access Memory (RAM): Adequate RAM to support model inference, data processing, and caching operations.
- Storage: Sufficient storage capacity for storing application code, datasets, model checkpoints, and log files.
- Network Interface: High-speed network interface for data transfer between the server and client device

**Client Devices**

- IPC Insight should be accessible from various client devices, including desktop computers, laptops, tablets, and smartphones.
- Client devices should have compatible web browsers installed to access the web-based interface of IPC Insight.

### 2.3.3 Software Interfaces

#### User Interface

The User Interface of IPC Insight will interact with users to input crime narratives, view analysis results, and provide feedback. It will include forms, buttons, and displays for interacting with the system. - Crime narratives: Input by users to be processed by the system. - Analysis results: Displayed to users for review and validation.

#### Web Server

IPC Insight will be deployed as a web application running on a web server. It will handle incoming requests from users' web browsers and serve the appropriate responses.

#### Natural Language Processing (NLP) Libraries

IPC Insight will utilise NLP libraries such as NLTK and Transformers for text preprocessing, feature extraction, and analysis of crime narratives.

#### Machine Learning Libraries

IPC Insight will use machine learning libraries such as scikit-learn, TensorFlow, or PyTorch for training and deploying ML models for IPC section classification and punishment prediction.

### 2.3.4 Communication Interfaces

- Web Browser Interface: IPC Insight will be accessed through web browsers, allowing users to interact with the system's graphical user interface (GUI).
- Communication Protocol: The system shall utilise HTTP (Hypertext Transfer Protocol) and HTTPS (HTTP Secure) for communication between the web server and users' web browsers.
- Communication Security: HTTPS to encrypt data transmitted between the client and server, ensuring data confidentiality and integrity.

## 2.4 System Features

The IPC section identification system feature in IPC Insight is responsible for accurately identifying and extracting relevant sections of the Indian Penal Code (IPC) mentioned within crime narratives. This feature plays a crucial role in the analysis process, as it forms the foundation for further legal guidance and prediction of associated punishments. Here's an elaboration on this system feature:

### 2.4.1 Crime Incident Input Feature

#### Description and Priority

This feature provides a user interface for inputting narrative descriptions of crime incidents. Users can type or paste in the details of the crime they want to analyse. It is a high priority feature that is essential for users to interact with the system and obtain predictions for the relevant IPC sections and punishments.

#### Stimulus/Response Sequences

1. User navigates to the input interface.
2. User types or pastes in the narrative description of the crime incident.
3. System acknowledges receipt of the input and prepares to process it.

#### Functional Requirements

REQ 1: The system shall provide a text input field that supports various formats, including plain text and formatted text, for users to enter narrative descriptions of crime incidents.

REQ 2: The system should handle special characters, punctuation, and other non-alphanumeric characters in the input text appropriately.

REQ 3: If the input is invalid (e.g., empty), the system should display an error message and prompt the user to provide valid input.

REQ 4: The system should provide a submit button or similar mechanism for users to confirm their input and initiate the analysis process.

REQ 5: The system should respond promptly to user input and provide feedback to indicate that the input has been successfully received and is being processed.

### 2.4.2 Prediction of IPC Sections and Punishments

#### Description and Priority

The system shall accurately predict the relevant section of the Indian Penal Code (IPC) and its associated punishment based on the narrative crime incident inputted by the user. This feature is of high priority as it constitutes the core functionality of the system.

#### Stimulus/Response Sequences

1. System acknowledges receipt of the input and prepares to process it.
2. System predicts the relevant IPC section and its associated punishment.
3. System displays prediction

#### Functional Requirements

REQ 1: The system shall process and analyse user-inputted narrative descriptions of crime incidents using a trained machine learning model.

REQ 2: The system shall display the predicted IPC section and its associated punishment to the user.

REQ 3: The system shall handle invalid inputs by providing appropriate error messages.

## 2.5 Other Nonfunctional Requirements

### 2.5.1 Performance Requirements

The system should process crime narratives and generate outputs within a reasonable amount of time frame. The throughput should scale linearly with the increase in computational resources.

### 2.5.2 Safety Requirements

Ensure that all user data, including crime narratives and analysis results, are securely stored and transmitted. Implement encryption techniques (such as HTTPS) to protect data in transit. Use secure authentication mechanisms to control access to sensitive data and features.

### 2.5.3 Security Requirements

The system should comply with data privacy regulations and protect sensitive information contained in crime narratives. Access to the system should be based on user Login in order to prevent external or unauthorised access.

### 2.5.4 Software Quality Attributes

**Accuracy*:*** The system should accurately identify and extract relevant IPC sections and punishments from crime narratives. The model's predictions should align closely with legal standards and regulations.

**Reliability:** The system should operate reliably under normal conditions and handle unexpected inputs or errors gracefully.It should have mechanisms for error detection, handling, and recovery to ensure uninterrupted service.

**Scalability:** The system should be able to accommodate increases in the number of users or the volume of data without significant degradation in performance. It should support horizontal and vertical scalability to meet growing demands.

**Usability:** The system should be user-friendly, with intuitive interfaces for inputting crime narratives and viewing generated reports.It should provide informative feedback and guidance to users, minimising the need for extensive training or technical expertise.

**Portability:** The system should be deployable across different platforms and environments, including cloud-based services, on-premises servers, and mobile devices. It should minimise dependencies on specific hardware or software configurations.

## 2.6 Summary

This chapter outlines the tool's overall description, functionality, and requirements. IPC Insight simplifies analyzing crime narratives by identifying relevant IPC sections and determining punishments. It accepts text or audio inputs, preprocesses them, and provides legal interpretations. The tool operates in a Python environment, compatible with various systems and hardware. Key constraints include data availability, legal compliance, and computational resources. Assumptions include a stable legal framework and access to domain expertise. External interfaces include user-friendly input methods and server infrastructure. Core features involve inputting crime incidents, predicting IPC sections, and displaying results. Nonfunctional requirements emphasize performance, safety, security, accuracy, reliability, scalability, usability, and portability, ensuring a robust application.

# Chapter 3

# System Architecture and Design

## 3.1 System Overview

The project is designed to automate the process of identifying relevant sections of the Indian Penal Code (IPC) based on narrative crime incidents. The system comprises of the below components to achieve its objectives

**1. User Interface:** Provides an intuitive platform for users to input crime narratives and interact with the system. Allows users to submit textual descriptions of crime incidents through a user-friendly interface. The interface is developed using HTML, CSS, and JavaScript to ensure a smooth and responsive user experience.

**2. Natural Language Processing (NLP) Module:** Preprocesses the crime narratives to extract key features and convert them into numerical representations. Utilizes advanced NLP techniques, such as tokenization, stemming, lemmatization, and vectorization. These techniques help in analyzing the semantic content of the crime narratives and identifying relevant keywords and phrases. The preprocessing steps ensure that the text data is clean and ready for further analysis.

**3. Speech-to-Text Module**: Converts spoken crime narratives into text, enabling users to input narratives via speech.Utilizes the *speech_recognition* library from Python to process and transcribe speech input into text accurately. This module enhances accessibility and ease of use for users who may prefer or require voice input over typing. The speech recognition process involves capturing audio input, processing it to remove noise, and accurately transcribing the spoken words into a textual format that can be further analyzed by the NLP module.

**4. Vector Database:** Stores and indexes the vector representations of crime narratives and IPC sections for efficient retrieval and similarity search. Employs Chroma

DB to provide a scalable and optimized storage solution for handling large volumes of textual data. The vector database ensures that the data is organized and can be accessed quickly, facilitating real-time analysis and comparison. The vectors are indexed to allow for rapid similarity searches, which are crucial for identifying the most relevant IPC sections corresponding to each crime narrative.

**5. IPC Section Identification Engine:** The IPC section identification engine is responsible for matching crime narratives with relevant IPC sections stored in the vector database. It utilizes advanced similarity scoring techniques, such as cosine similarity and vector space models, to quantify the similarity between crime narratives and IPC section descriptions. By analyzing vector representations, the engine identifies the IPC sections closely related to each narrative, ensuring accurate classification and prediction.

**6. Output Module:** The output module presents the results of the analysis to users in a comprehensible and actionable format. It displays the identified IPC sections along with relevant details, such as section numbers, titles, and corresponding punishments. Additionally, the module provides explanations or justifications for the predicted IPC sections, offering insights into the decision-making process of the system

## 3.2 Architectural Design

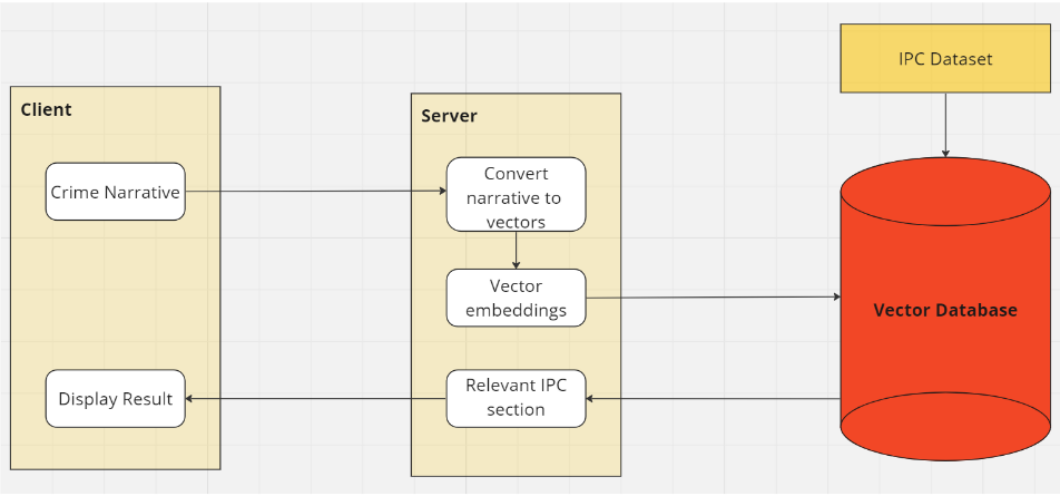


Figure 3.1: Architectural Diagram

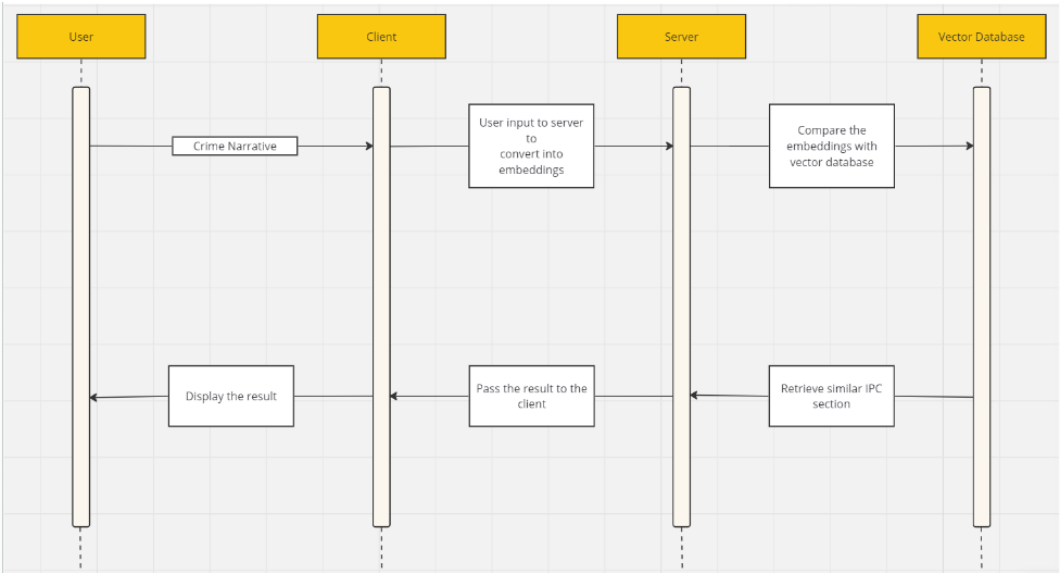


Figure 3.2: Sequence Diagram

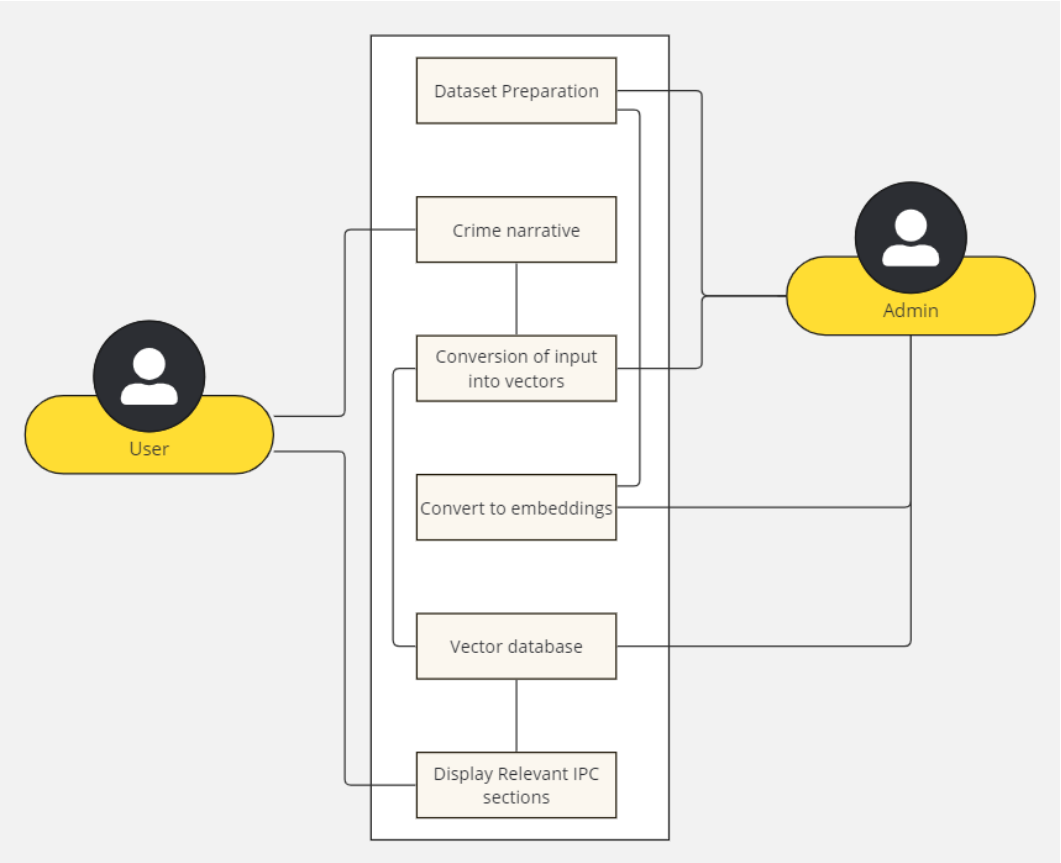


Figure 3.3: Use-Case Diagram

## 3.3 Dataset identified

| Section | Root | Keyword | Description | Punishment | Bailable/Non-Bailable |
|---|---|---|---|---|---|
| IPC_109 | Abetment | Abetment | It addresses situations where a person abets the commission of an offense, and the act abetted is committed as a direct consequence of the abetment. | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment. | Bailable/Non-Bailable |
| IPC_110 | Abetment | Abetment | It pertains to situations where a public servant abets the commission of an offense. | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment. | Bailable/Non-Bailable |
| IPC_111 | Abetment | Abetment | It deals with situations where a person abets the commission of an offense punishable with death or life imprisonment. | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment. | Bailable/Non-Bailable |
| IPC_112 | Abetment | Abetment | It deals with situations where a person abets the commission of an offense punishable with imprisonment. | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment. | Bailable/Non-Bailable |
| IPC_113 | Abetment | Abetment | It addresses situations where a person abets the commission of an offense for which no specific punishment is provided in the Indian Penal Code. | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment. | Bailable/Non-Bailable |
| IPC_114 | Abetment | Abetment | It deals with situations where a person abets the commission of an offense and is present at the scene when the offense is committed. | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment. | Bailable/Non-Bailable |
| IPC_115 | Abetment | Abetment | It deals with situations where a person abets the commission of an offense punishable with death or imprisonment for life, but the offense is not actually committed. | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment. | Non-Bailable |
| IPC_116 | Abetment | Abetment | It addresses situations where a person abets the commission of an offense punishable with imprisonment, but the offense is not actually committed. | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment. | Bailable/Non-Bailable |
| IPC_117 | Abetment | Abetment | It addresses situations where a person abets the commission of an offense by the public or by more than ten persons. | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment. | Bailable/Non-Bailable |
| IPC_118 | Concealment | Concealment | It addresses situations where a person conceals their intention or plan to commit an offense punishable with imprisonment. | It is the same as if the offense had been committed. | Non-Bailable |

Figure 3.4: A snapshot of the dataset

The dataset comprises of the Indian Penal Code (IPC) section number, offense description, corresponding punishment and a column to show whether it is a bailable or a non-bailable offense. Through preprocessing, each crime narrative is converted into numerical vector embeddings using advanced NLP techniques, capturing its semantic meaning. Covering various criminal activities, the dataset aids in accurate categorization, with diverse IPC sections and associated punishments. This resource facilitates training and evaluation of our system, enabling accurate analysis of crime narratives by comparing vector embeddings, providing actionable insights into the legal framework.

### 3.4 Proposed Methodology/Algorithm

Step 1: **User Sign-In**

- Read the User ID and Password from the user. Query the database to check if the user exists and if the provided password matches.
- If user exists and password is correct: Allow user to enter the dashboard
- If user doesn't exist or password is incorrect: Prompt user to register by providing name, username, and password. Add user information to the database.

Step 2: **User Input Crime Narrative**

- Read input Crime Narrative as Text or Audio
- If input is text: Proceed to Step 3.
- If input is audio: Transcribe audio to text using speech recognition library in python. Proceed to Step 3.

Step 3: **Fetch Applicable IPC Section**

- Send the crime narrative to the backend server.
- Backend server processes the narrative to determine the applicable IPC section.

Step 4: **Output**

- Receive the predicted IPC section(s) from the backend.
- Display the applicable IPC section(s) to the user.

## 3.5 User Interface Design

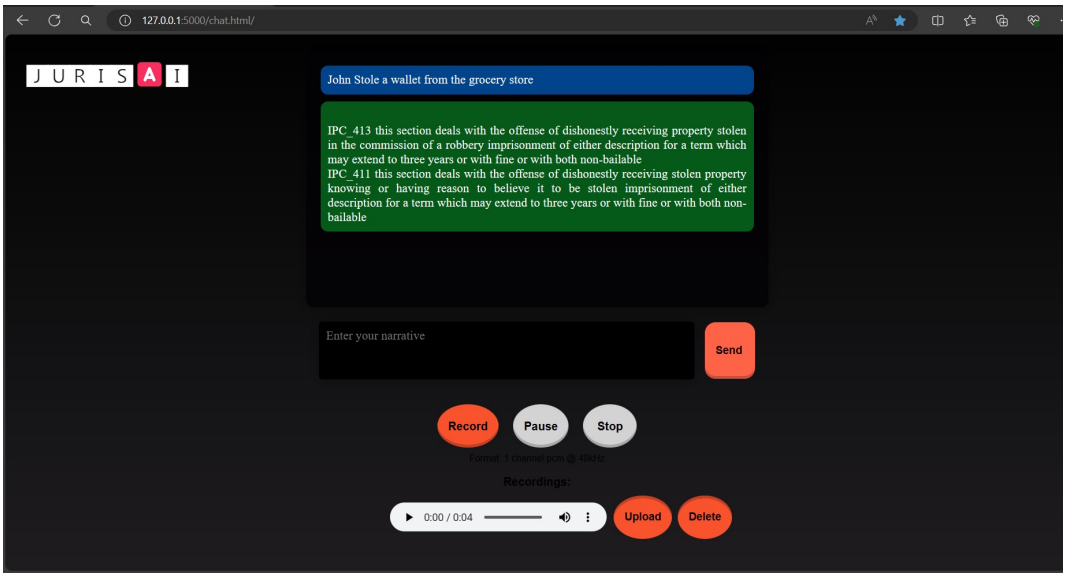


Figure 3.5: Chatbox

## 3.6 Database Design

In this database design section, we've outlined the structure of two databases: MongoDB for storing sign-in information and ChromaDB for storing vector embeddings.

In MongoDB we used a collection called *ipc insight*. This collection stores user data including usernames, email addresses, and passwords for authentication purposes. Additionally, it can include other relevant information such as user profiles, preferences, and settings.

ChromaDB is employed to store vector embeddings associated with each sections of the Indian Penal Code. It serves as a specialized database optimized for efficient storage and retrieval of high-dimensional vector data.

### 3.7 Description of Implementation Strategies

**1. NLTK for Data Preprocessing:** Utilize NLTK (Natural Language Toolkit) for preprocessing crime narratives before embedding them into vector representations. Apply tokenization, stemming, and part-of-speech tagging to extract essential features from the textual data and prepare it for embedding.

**2. Sentence Transformers (all-mpnet-base-v2) for Embeddings:** Use Sentence Transformers, specifically the all-mpnet-base-v2 model, to generate embeddings for crime narratives and IPC sections. Embed crime narratives and IPC sections into high-dimensional vector representations, capturing semantic similarities and relationships between them.

**3. ChromaDB as Vector Database:** Implement ChromaDB as the vector database to store and index the embeddings of crime narratives and IPC sections. Leverage ChromaDB's efficient retrieval and similarity search capabilities to quickly identify relevant IPC sections based on the embeddings of crime narratives.

**4. Front-end Development with HTML and CSS:** Develop the front-end interface of IPC Insight using HTML and CSS to create a user-friendly platform for interacting with the system. Design HTML templates to enable users to input crime narratives, submit queries, and visualize the predicted IPC sections and associated punishments.

**5. Integration using Flask:** Integrate Flask, a micro web framework for Python, to handle HTTP requests and responses and manage the back-end logic of IPC Insight. Utilize Flask to serve the IPC Insight application, route requests to the appropriate functions for processing, and render dynamic HTML content to users.

## 3.8 Module Division

The system mainly consists of a client module, a server module and a vector database.

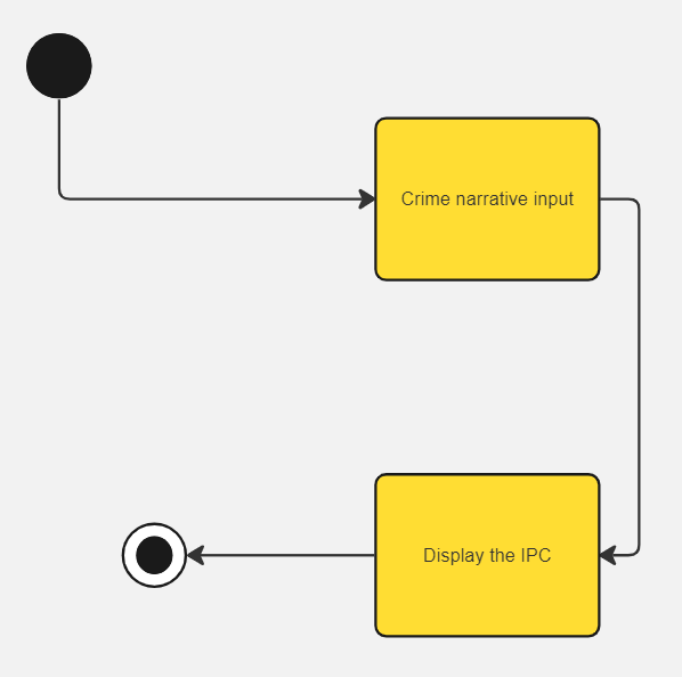


Figure 3.6: Client Side

The Client Module is responsible for receiving the user's crime narrative input from the front end and send it to the server module for processing. After Processing the input at the backend, the relevant IPC sections are displayed back to the client side or the user.

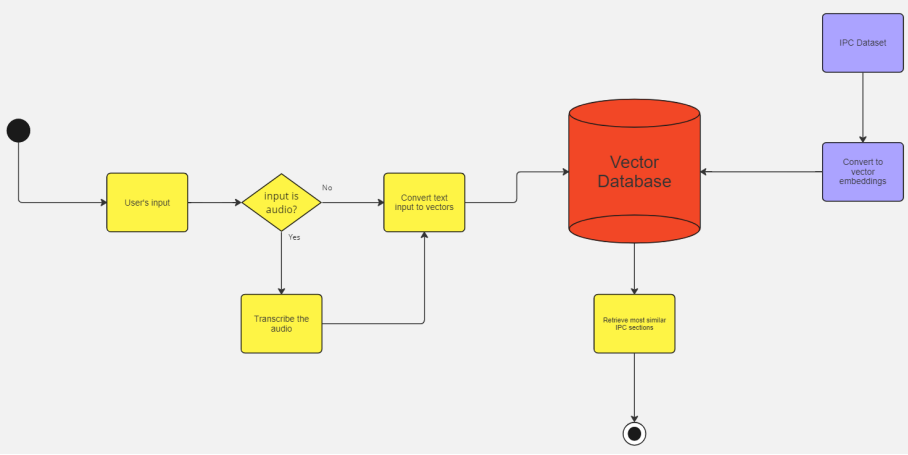


Figure 3.7: Server Side

The Server module acts as the Processing unit for this system. The Server Module receives the input crime narratives. It will check whether the input is in an audio format or a text format. If it is in an audio format, then it will transcribe the audio and then convert this input narrative to a vector embedding using an embedding model. This embedding is then compared with the embeddings of the IPC dataset in the Vector Database and the relevant IPC section is predicted.

## 3.9 Work Schedule - Gantt Chart


Figure 3.8: Gantt Chart

## 3.10 Summary

In this chapter, we delved into the intricate architecture of the IPC Insight system. This system is designed to seamlessly handle large volumes of textual data, primarily crime narratives, and efficiently predict the relevant sections of the Indian Penal Code (IPC) associated with each narrative. Key components include a Vector Database for storing the vector embeddings, an IPC Section Identification system for matching the narratives with IPC sections, and an Output Module for presenting results.

In this chapter, we presented visual aids such as the architectural diagram, use case diagram, sequence diagram, and module-wise diagram. These images provide a clear illustration of how the IPC Insight system operates, depicting the flow of data and interactions between different components. We discussed the dataset's importance and methodology for user interaction, providing an overview of the system's operational flow.

# Chapter 4

# Results and Discussions

## 4.1 Overview

The IPC Insight application successfully classifies crime narratives into the appropriate IPC sections with a high degree of accuracy. Using vector embeddings and Chroma DB, the application matches the input crime narratives with the descriptions of IPC sections effectively. The front-end interface, developed with HTML, CSS, and JavaScript, allows users to input narratives and receive results seamlessly. User sign-in data, securely stored in the MongoDB cloud database, ensures a personalized experience. The application demonstrated resilience in handling real-world crime narratives, highlighting its practical applicability for legal professionals and law enforcement agencies. Further improvements and updates could enhance its applicability and accuracy even more.

## 4.2 Testing

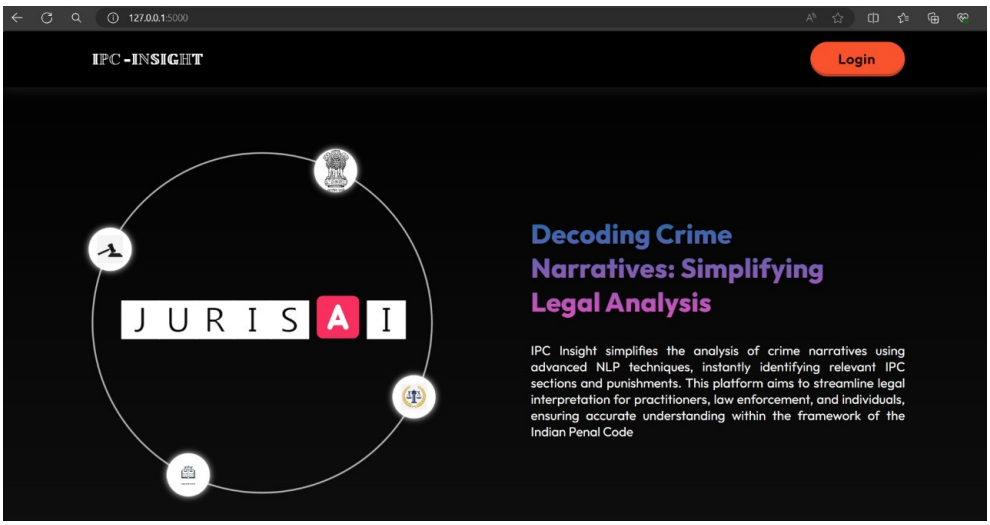


Figure 4.1: Home Page

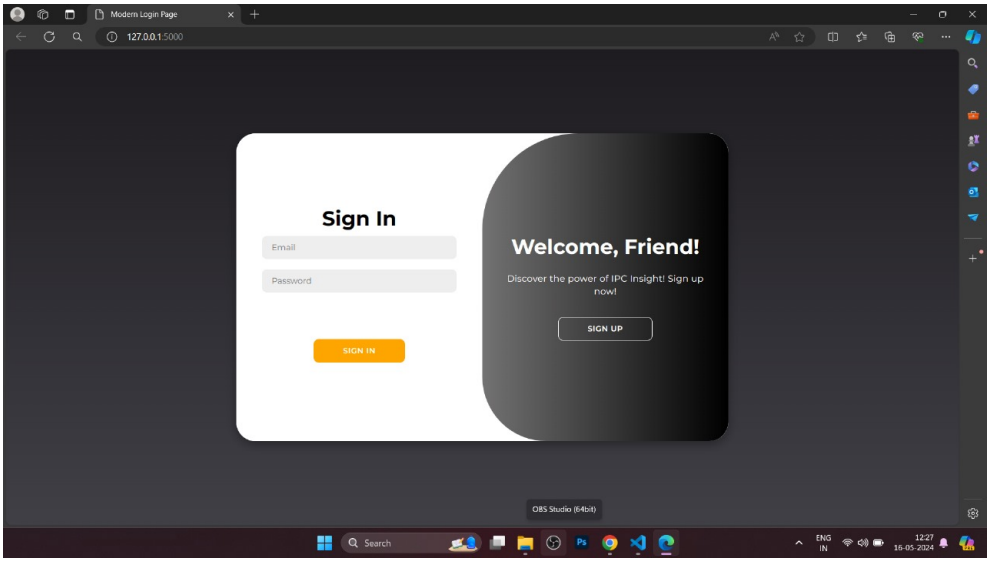


Figure 4.2: Sign in Page

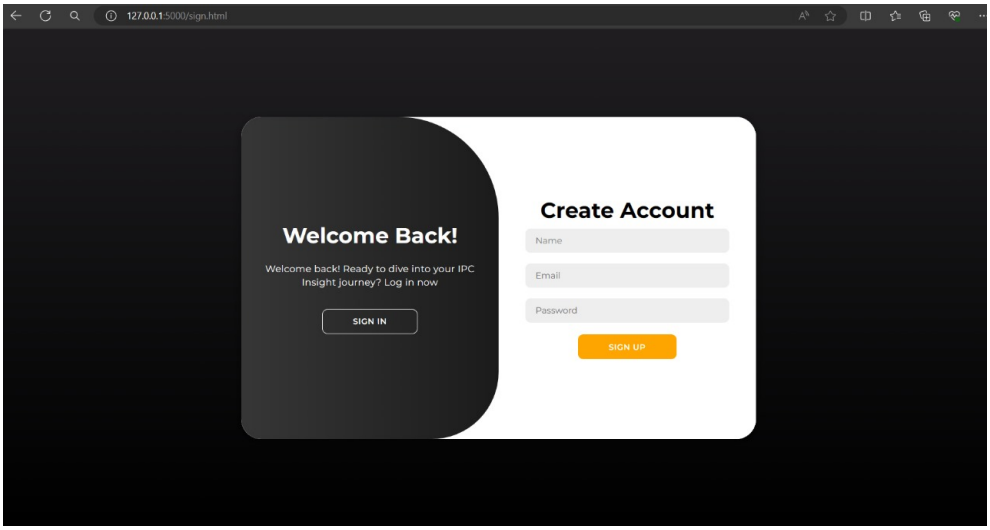


Figure 4.3: Sign up Page


Figure 4.4: Menu Page

JURIS AI

| Section | Description | Punishment | Bailable/Non-Bailable |
|---|---|---|---|
| IPC 109 | It addresses situations where a person abets the commission of an offense and the act abetted is committed as a direct consequence of the abetment | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment | Bailable/Non-Bailable |
| IPC 110 | It pertains to situations where a public servant abets the commission of an offense | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment | Bailable/Non-Bailable |
| IPC 111 | It deals with situations where a person abets the commission of an offense punishable with death or life imprisonment | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment | Bailable/Non-Bailable |
| IPC 112 | It deals with situations where a person abets the commission of an offense punishable with imprisonment | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment | Bailable/Non-Bailable |
| IPC 113 | It addresses situations where a person abets the commission of an offense for which no specific punishment is provided in the Indian Penal Code | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment | Bailable/Non-Bailable |
| IPC 114 | It deals with situations where a person abets the commission of an offense and is present at the scene when the offense is committed | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment | Bailable/Non-Bailable |
| IPC 115 | It deals with situations where a person abets the commission of an offense punishable with death or imprisonment for life but the offense is not actually committed | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment | Non-Bailable |
| IPC 116 | It addresses situations where a person abets the commission of an offense punishable with imprisonment but the offense is not actually committed | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment | Bailable/Non-Bailable |
| IPC 117 | It addresses situations where a person abets the commission of an offense by the public or by more than ten persons | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment | Bailable/Non-Bailable |
| IPC 118 | It addresses situations where a person conceals their intention or plan to commit an offense punishable with imprisonment | It is the same as if the offense had been committed | Non-Bailable |

Figure 4.5: IPC Directory

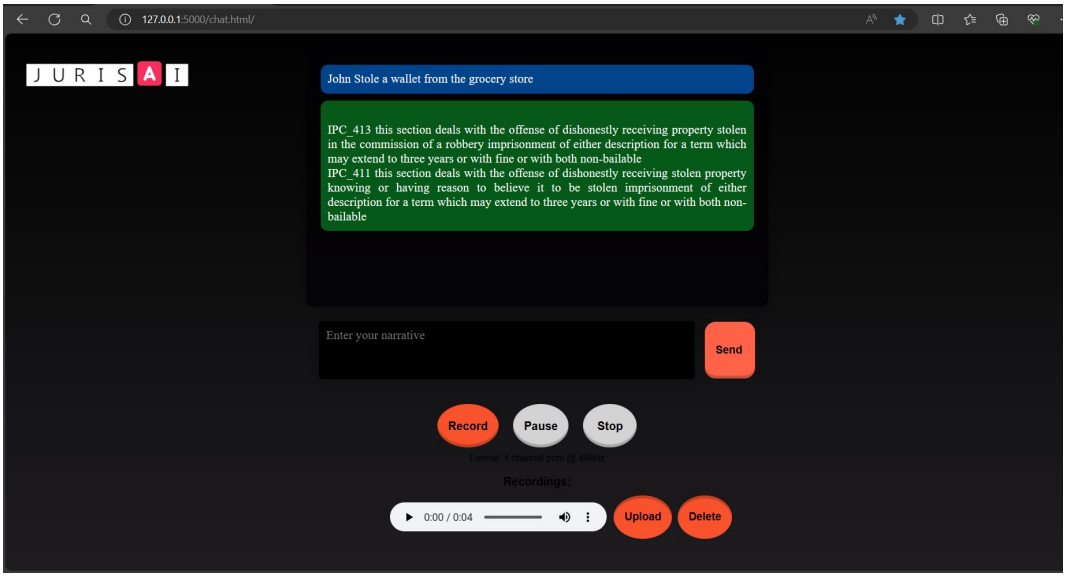


Figure 4.6: Chatbox

## 4.3 Quantitative Results

The quantitative analysis of our project focuses on evaluating the performance of the application in terms of accuracy. This metric provide a comprehensive understanding of the model's effectiveness in classifying crime narratives according to IPC sections.

1. **Accuracy**: It is the ratio of correctly predicted instances to the total instances.

$$Accuracy = \frac{CorrectlypredictedInstances}{TotalInstances} \tag{4.1}$$

The accuracy of the IPC Insight application was evaluated using a test set of 54 samples, out of which 50 were correctly classified, resulting in an accuracy rate of approximately 92.59%. The Accuracy was calculated by dividing the correctly predicted instance (50) by the total number of instance (54) and multiplying the value by 100.

## 4.4 Discussion

The IPC Insight application demonstrated a high degree of accuracy in classifying crime narratives according to the relevant IPC sections. Specifically, the model was tested with 54 samples, out of which 50 were correctly classified, resulting in an accuracy rate of approximately 92.59%. This high accuracy indicates the model's effectiveness in understanding and correctly interpreting various crime narratives.

**Reasons Behind the Results:**

- **Vector Embeddings**: The use of vector embeddings for representing IPC sections and crime narratives ensured that the semantic meaning of the text was captured effectively, facilitating accurate matching.
- **Chroma DB**: Leveraging Chroma DB Vector database for storing and retrieving embeddings allowed efficient and precise matching of narratives to IPC sections.
- **Data Quality:** The quality and comprehensiveness of the training data played a crucial role in the model's performance. Well-annotated and diverse training samples contributed to the model's ability to generalize well to new, unseen data.

## 4.5 Summary

The IPC Insight application accurately categorizes crime narratives into the right IPC sections. It uses vector embeddings and Chroma DB to match narratives with IPC descriptions effectively. The user-friendly front-end interface, built with HTML, CSS, and JavaScript, allows seamless interaction. User data is securely stored in MongoDB. Testing showed a high accuracy rate of approximately 92.59% with 54 samples, where 50 were correctly classified. The success is attributed to vector embeddings, Chroma DB, and high-quality dataset. This highlights the application's practical usefulness for legal professionals and law enforcement agencies, with potential for further improvements.

# Chapter 5

# Conclusion

## 5.1 Conclusion

The primary goal of this project is to assist legal professionals, law enforcement agencies, and other stakeholders in ensuring compliance with the Indian Penal Code (IPC). IPC Insight represents a significant step forward in legal analysis and crime narrative interpretation, leveraging advanced natural language processing (NLP) techniques and vector embedding technology.

The results of this project are highly encouraging, with the application achieving an impressive accuracy rate of 92.59% by correctly classifying 50 out of 54 test samples. This high level of accuracy underscores the application's capability to effectively interpret and classify complex crime narratives according to the relevant IPC sections.

Several factors contributed to these positive outcomes:

- **Advanced NLP Techniques:** Utilizing vector embeddings to represent both IPC sections and crime narratives allowed the model to capture semantic meanings accurately, facilitating precise matching and classification.
- **Efficient Data Management:** Chroma DB's role in storing and retrieving embeddings ensured quick and accurate classification, making the system both efficient and scalable.
- **Quality of Training Data:** High-quality, well-annotated training data enabled the model to generalize well across diverse crime narratives, enhancing its applicability in real-world scenarios.

## 5.2 Future Scope

Implementing **Optical Character Recognition (OCR)** functionality would allow your system to extract text from images or scanned documents, which could be useful for analyzing crime-related documents or evidence that are not in digital format.

A **PDF generation** feature will empower IPC Insight to dynamically generate PDF documents. This capability will streamline the process of creating reports, case files, and legal documents related to crime analysis.

Expanding IPC Insight to include the **Criminal Procedure Code (CRPC)** and the **Civil Procedure Code (CPC)** will provide a comprehensive platform for legal analysis and research.

## 5.3 Summary

The IPC Insight project aims to assist legal professionals and law enforcement agencies in complying with the Indian Penal Code (IPC) by accurately classifying crime narratives. Leveraging advanced NLP techniques and vector embedding technology, the application achieved an impressive accuracy rate of 92.59%. Future enhancements such as OCR integration, PDF generation, and expansion to include additional legal codes further enhance IPC Insight's capabilities, making it a valuable tool in legal analysis and crime interpretation.

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# Appendix A: Presentation

# IPC INSIGHT

Guide: Ms. Jisha Mary Jose

RAHUL VARGHESE
RANJIT SHINE
REUBEN SIMON GEORGE
ROHAN THUNDIL RAJEEV



## CONTENTS

## INTRODUCTION

- It is an application which is engineered to analyze crime narratives.
- Provides relevant sections of the Indian Penal Code (IPC) and associated punishments
- Utilize natural language processing (NLP) and supervised learning algorithms.



## PROBLEM DEFINITION

- Manual analysis of crime narratives for IPC section identification is time-consuming and error-prone. We need a solution for quick and accurate interpretation of crime descriptions within the IPC framework.

## OBJECTIVES

- To Develop an application trained on the Indian Penal Code (IPC) to analyze crime narratives and provide legal guidance.
- To design an intuitive user interface for inputting crime incident details and displaying the relevant IPC section and Punishment
- To provide explanations or justifications for the predicted IPC sections and punishments to enhance user understanding and trust



## SCOPE AND RELEVANCE

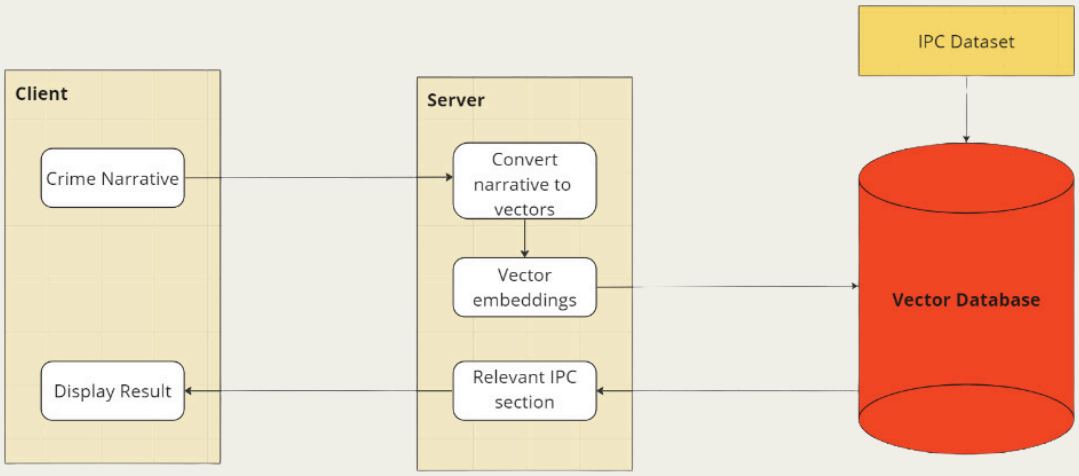
- **Scope:** The scope of this IPC Insight project encompasses the development of a comprehensive and a reliable tool for legal practitioners, law enforcement agencies, and the general public.
- **Relevance:** It streamlines legal analysis and crime investigation by automating the identification of relevant IPC sections from crime narratives, saving time and resources for legal professionals and law enforcement.

## SYSTEM DESIGN

- The system mainly consists of a client module, a server module and a vector database
- The architecture of the system is as follows



## ARCHITECTURE DIAGRAM

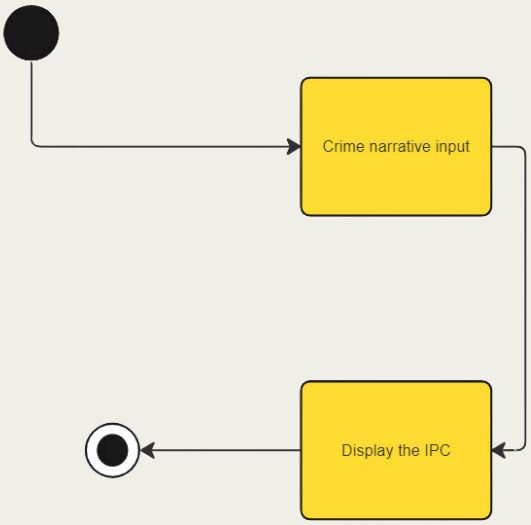


## VECTOR EMBEDDINGS

| Word | Vector embedding |
|---|---|
| `cat` | `[1.5, -0.4, 7.2, 19.6, 20.2]` |
| `dog` | `[1.7, -0.3, 6.9, 19.1, 21.1]` |
| `apple` | `[-5.2, 3.1, 0.2, 8.1, 3.5]` |
| `strawberry` | `[-4.9, 3.6, 0.9, 7.8, 3.6]` |
| `building` | `[60.1, -60.3, 10, -12.3, 9.2]` |
| `car` | `[81.6, -72.1, 16, -20.2, 102]` |
| **Query:** `fruit` | `[-5.1, 2.9, 0.8, 7.9, 3.1]` |



## CLIENT MODULE

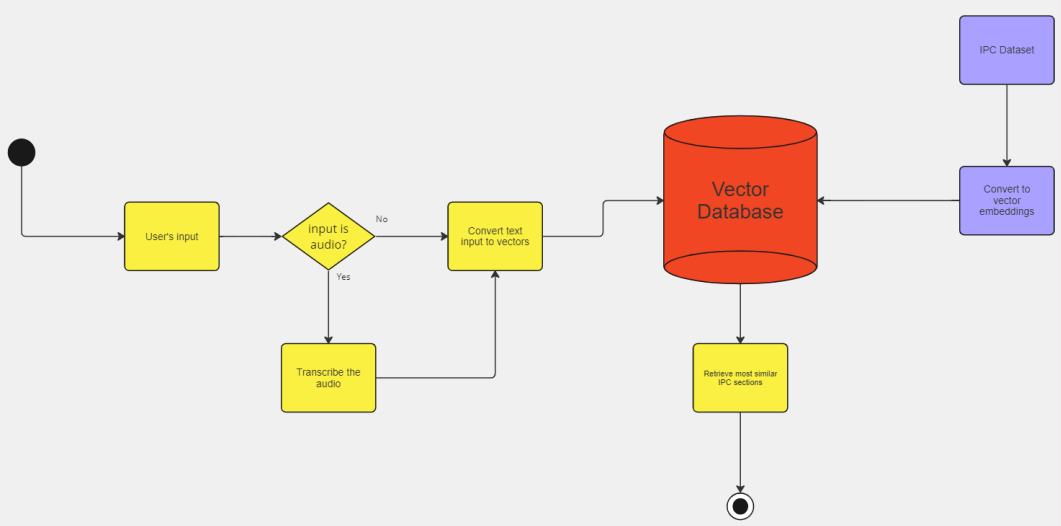


## CLIENT MODULE

- The Client Module is responsible for receiving the user's crime narrative input from the front end and send it to the server module for processing
- After Processing the input at the backend, the relevant IPC sections are displayed back to the client side or the user



## SERVER MODULE

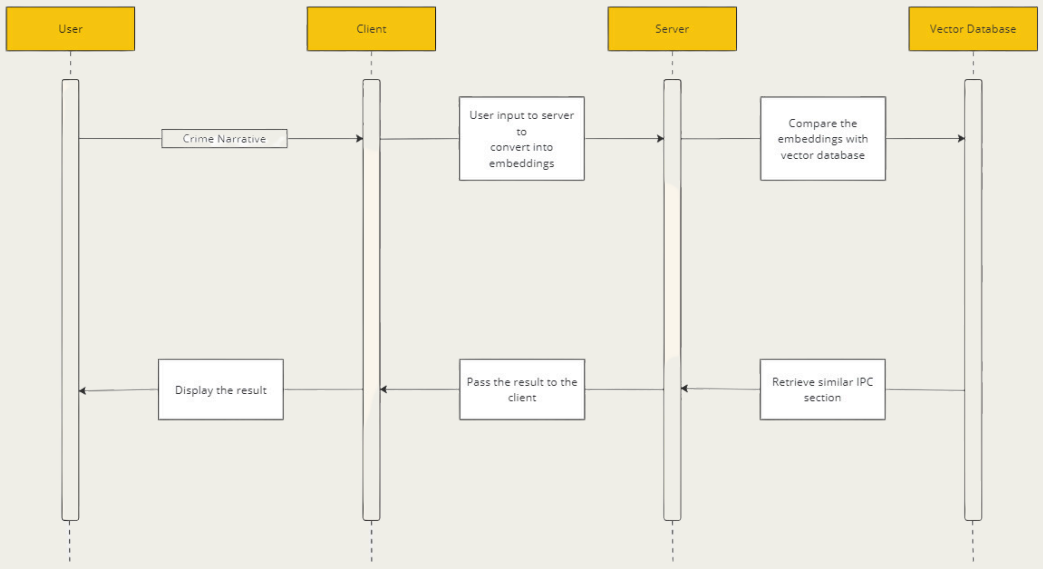


## SERVER MODULE

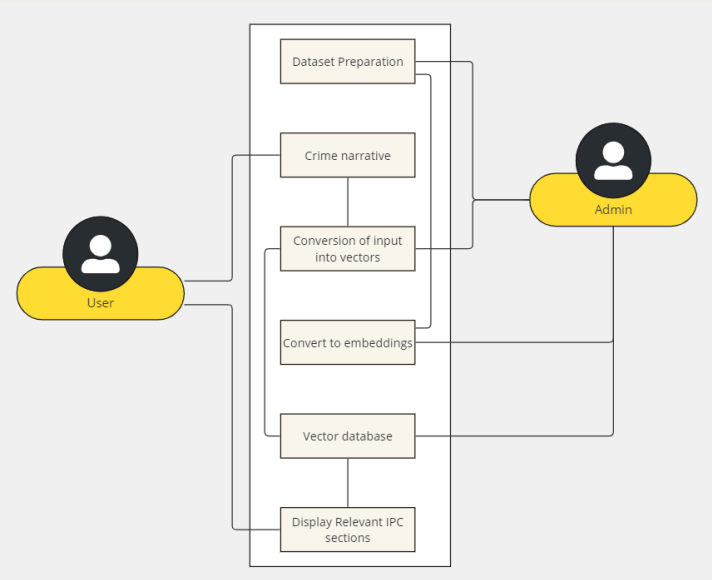
- The Server module acts as the Processing unit for this system.
- The Server Module receives the input crime narratives. It will then convert this input narrative to a vector embedding using an embedding model.
- This embedding is then compared with the embeddings of the IPC dataset in the Vector Database and the relevant IPC section is predicted.



## SEQUENCE DIAGRAM



# USE CASE DIAGRAM

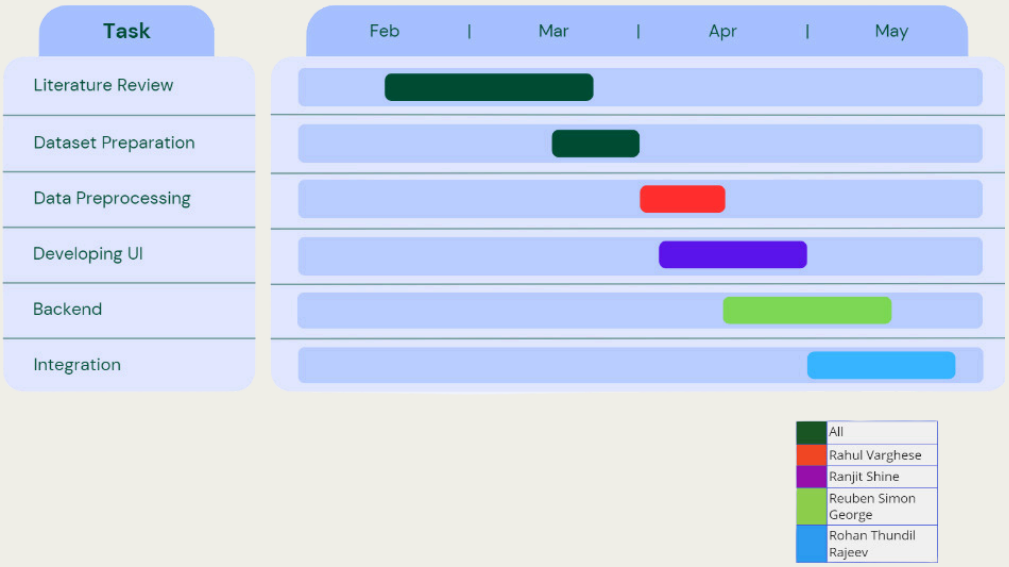





# DATASET

| Section | Root | Keyword | Description | Punishment | Bailable/Non-Bailable |
|---|---|---|---|---|---|
| IPC_109 | Abetment | Abetment | It addresses situations where a person abets the commission of an offense, and the act abetted is committed as a direct consequence of the abetment. | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment. | Bailable/Non-Bailable |
| IPC_110 | Abetment | Abetment | It pertains to situations where a public servant abets the commission of an offense. | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment. | Bailable/Non-Bailable |
| IPC_111 | Abetment | Abetment | It deals with situations where a person abets the commission of an offense punishable with death or life imprisonment. | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment. | Bailable/Non-Bailable |
| IPC_112 | Abetment | Abetment | It deals with situations where a person abets the commission of an offense punishable with imprisonment. | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment. | Bailable/Non-Bailable |
| IPC_113 | Abetment | Abetment | It addresses situations where a person abets the commission of an offense for which no specific punishment is provided in the Indian Penal Code. | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment. | Bailable/Non-Bailable |
| IPC_114 | Abetment | Abetment | It deals with situations where a person abets the commission of an offense and is present at the scene when the offense is committed. | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment. | Bailable/Non-Bailable |
| IPC_115 | Abetment | Abetment | It deals with situations where a person abets the commission of an offense punishable with death or imprisonment for life, but the offense is not actually committed. | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment. | Non-Bailable |
| IPC_116 | Abetment | Abetment | It addresses situations where a person abets the commission of an offense punishable with imprisonment, but the offense is not actually committed. | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment. | Bailable/Non-Bailable |
| IPC_117 | Abetment | Abetment | It addresses situations where a person abets the commission of an offense by the public or by more than ten persons. | It is the same as if the act abetted had been committed in consequence and no express provision is made for its punishment. | Bailable/Non-Bailable |
| IPC_118 | Concealment | Concealment | It addresses situations where a person conceals their intention or plan to commit an offense punishable with imprisonment. | It is the same as if the offense had been committed. | Non-Bailable |

## WORK DIVISION






## SOFTWARE/HARDWARE REQUIREMENTS

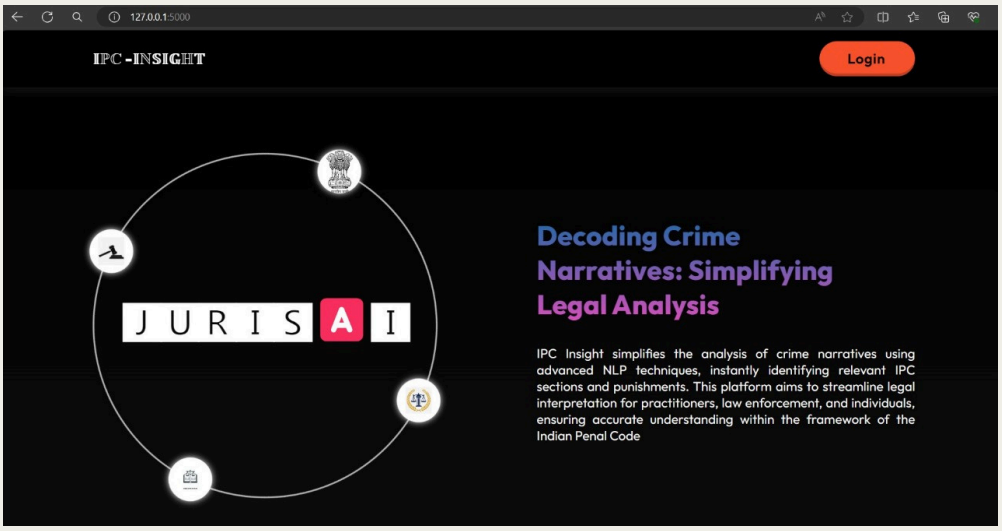
### Software

- Programming Language: Python
- NLTK (Natural Language Toolkit) For text preprocessing, tokenization, and other NLP tasks.
- Hugging Face Sentence Transformer for all-mpnet-base-v2 (converting input text to vector embeddings)
- Chroma DB Vector Database

### Hardware

- CPU and Memory:
  - A multi-core CPU (e.g., Intel Core i5 or higher) to handle data preprocessing and training tasks efficiently.
  - Sufficient RAM (at least 8 GB)
- GPU:
  - NVIDIA GPUs , such as GeForce GTX or RTX series.

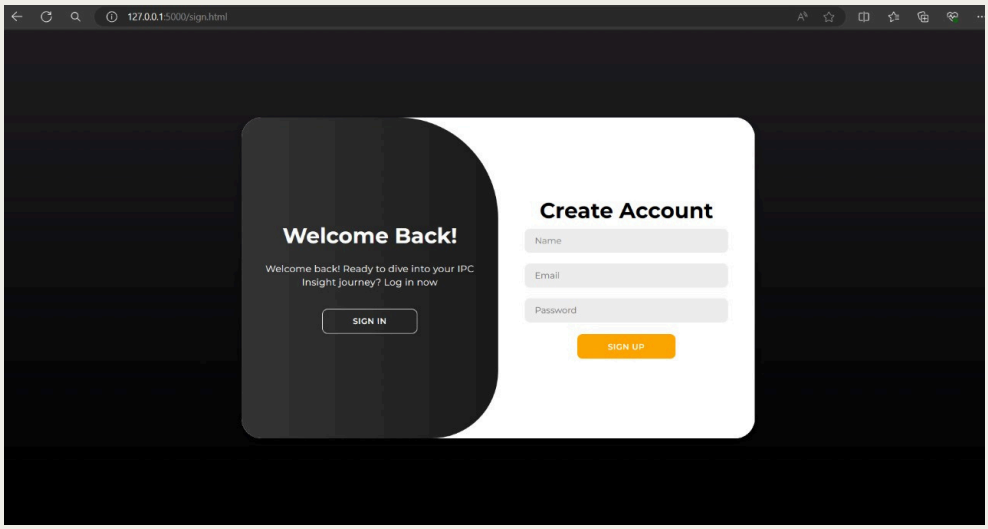
# RESULTS




**Home Page**

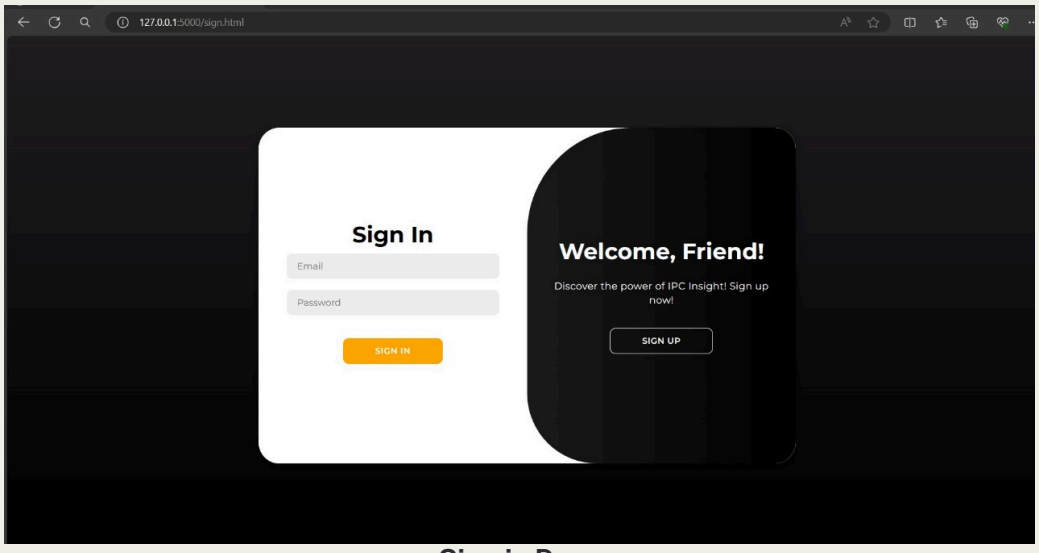


# RESULTS




**Sign-Up Page**

# RESULTS



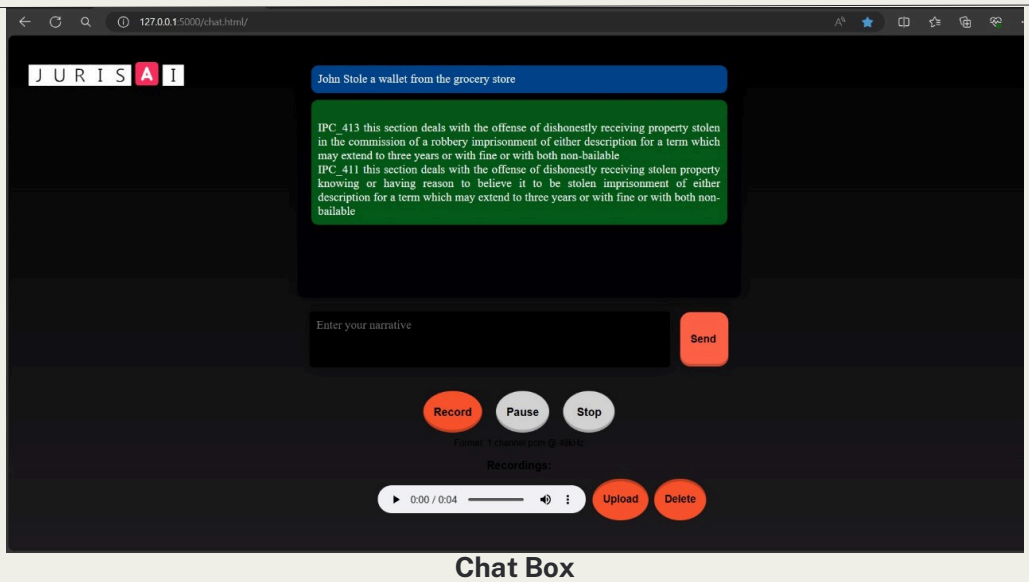

**Sign in Page**



# RESULTS


**Menu Page**

## RESULTS




**Chat Box**



## CONCLUSION

- The primary goal of this project is to assist legal professionals, law enforcement agencies, and other stakeholders in ensuring compliance with the Indian Penal Code (IPC).
- In conclusion, IPC Insight represents a significant step forward in legal analysis and crime narrative interpretation.

## FUTURE ENHANCEMENTS

- Implementing Optical Character Recognition (OCR) technology.
- A PDF generation feature will empower IPC Insight to dynamically generate PDF documents.
- Expanding IPC Insight to include the Criminal Procedure Code (CRPC) and the Civil Procedure Code (CPC) will provide a comprehensive platform for legal analysis and research.



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- https://docs.trychroma.com/

# Thank you!

# Appendix B: Vision, Mission, Programme Outcomes and Course Outcomes

**DEPARTMENT OF COMPUTER SCIENCE & ENGINEERING**
**RAJAGIRI SCHOOL OF ENGINEERING & TECHNOLOGY (AUTONOMOUS)**
**RAJAGIRI VALLEY, KAKKANAD, KOCHI, 682039**
**(Affiliated to APJ Abdul Kalam Technological University)**

# Vision, Mission, Programme Outcomes and Course Outcomes

### Institute Vision

To evolve into a premier technological institution, moulding eminent professionals with creative minds, innovative ideas and sound practical skill, and to shape a future where technology works for the enrichment of mankind.

### Institute Mission

To impart state-of-the-art knowledge to individuals in various technological disciplines and to inculcate in them a high degree of social consciousness and human values, thereby enabling them to face the challenges of life with courage and conviction.

### Department Vision

To become a centre of excellence in Computer Science and Engineering, moulding professionals catering to the research and professional needs of national and international organizations.

### Department Mission

To inspire and nurture students, with up-to-date knowledge in Computer Science and Engineering, ethics, team spirit, leadership abilities, innovation and creativity to come out with solutions meeting societal needs.

**Programme Outcomes (PO)**

Engineering Graduates will be able to:

**1. Engineering Knowledge**: Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**2. Problem analysis**: Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**3. Design/development of solutions**: Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

**4. Conduct investigations of complex problems**: Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

**5. Modern Tool Usage**: Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

**6. The engineer and society**: Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

**7. Environment and sustainability**: Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.

**8. Ethics**: Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**9. Individual and Team work**: Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings.

**10. Communication**: Communicate effectively with the engineering community and with society at large. Be able to comprehend and write effective reports documentation. Make effective presentations, and give and receive clear instructions.

**11. Project management and finance**: Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments.

**12. Life-long learning**: Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change.

**Programme Specific Outcomes (PSO)**

A graduate of the Computer Science and Engineering Program will demonstrate:

**PSO1: Computer Science Specific Skills**

The ability to identify, analyze and design solutions for complex engineering problems in multidisciplinary areas by understanding the core principles and concepts of computer science and thereby engage in national grand challenges.

**PSO2: Programming and Software Development Skills**

The ability to acquire programming efficiency by designing algorithms and applying standard practices in software project development to deliver quality software products meeting the demands of the industry.

**PSO3: Professional Skills**

The ability to apply the fundamentals of computer science in competitive research and to develop innovative products to meet the societal needs thereby evolving as an eminent researcher and entrepreneur.

**Course Outcomes**

After the completion of the course the student will be able to:

**CO1:**

Identify technically and economically feasible problems (Cognitive Knowledge Level: Apply)

**CO2:**
Identify and survey the relevant literature for getting exposed to related solutions and get familiarized with software development processes (Cognitive Knowledge Level: Apply)

**CO3:**
Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions of minimal complexity by using modern tools & advanced programming techniques (Cognitive Knowledge Level: Apply)

**CO4:**
Prepare technical report and deliver presentation (Cognitive Knowledge Level: Apply)

**CO5:**
Apply engineering and management principles to achieve the goal of the project (Cognitive Knowledge Level: Apply)

# Appendix C: CO-PO-PSO Mapping

## COURSE OUTCOMES:

After completion of the course the student will be able to

| SL. NO | DESCRIPTION | Blooms' Taxonomy Level |
|---|---|---|
| CO1 | Identify technically and economically feasible problems (Cognitive Knowledge Level: Apply) | Level 3: Apply |
| CO2 | Identify and survey the relevant literature for getting exposed to related solutions and get familiarized with software development processes (Cognitive Knowledge Level: Apply) | Level 3: Apply |
| CO3 | Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions of minimal complexity by using modern tools & advanced programming techniques (Cognitive Knowledge Level: Apply) | Level 3: Apply |
| CO4 | Prepare technical report and deliver presentation (Cognitive Knowledge Level: Apply) | Level 3: Apply |
| CO5 | Apply engineering and management principles to achieve the goal of the project (Cognitive Knowledge Level: Apply) | Level 3: Apply |

## CO-PO AND CO-PSO MAPPING

| | PO 1 | PO 2 | PO 3 | PO 4 | PO 5 | PO 6 | PO 7 | PO 8 | PO 9 | PO 10 | PO 11 | PO 12 | PSO 1 | PSO 2 | PSO3 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 3 | 3 | 3 | 3 | | 2 | 2 | 3 | 2 | 2 | 2 | 3 | 2 | 2 | 2 |
| CO2 | 3 | 3 | 3 | 3 | 3 | 2 | | 3 | 2 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO3 | 3 | 3 | 3 | 3 | 3 | 2 | 2 | 3 | 2 | 2 | 2 | 3 | | | 2 |
| CO4 | 2 | 3 | 2 | 2 | 2 | | | 3 | 3 | 3 | 2 | 3 | 2 | 2 | 2 |
| CO5 | 3 | 3 | 3 | 2 | 2 | 2 | 2 | 3 | 2 | | 2 | 3 | 2 | 2 | 2 |

3/2/1: high/medium/low

## JUSTIFICATIONS FOR CO-PO MAPPING

| MAPPING | LOW/ MEDIUM/ HIGH | JUSTIFICATION |
|---|---|---|
| 101003/CS622T.1-PO1 | **HIGH** | Identify technically and economically feasible problems by applying the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| 101003/CS622T.1-PO2 | **HIGH** | Identify technically and economically feasible problems by analysing complex engineering problems reaching substantiated conclusions using first principles of mathematics. |
| 101003/CS622T.1-PO3 | **HIGH** | Design solutions for complex engineering problems by identifying technically and economically feasible problems. |
| 101003/CS622T.1-PO4 | **HIGH** | Identify technically and economically feasible problems by analysis and interpretation of data. |
| 101003/CS622T.1-PO6 | **MEDIUM** | Responsibilities relevant to the professional engineering practice by identifying the problem. |
| 101003/CS622T.1-PO7 | **MEDIUM** | Identify technically and economically feasible problems by understanding the impact of the professional engineering solutions. |
| 101003/CS622T.1-PO8 | **HIGH** | Apply ethical principles and commit to professional ethics to identify technically and economically feasible problems. |
| 101003/CS622T.1-PO9 | **MEDIUM** | Identify technically and economically feasible problems by working as a team. |
| 101003/CS622T.1-PO10 | **MEDIUM** | Communicate effectively with the engineering community by identifying technically and economically feasible problems. |
| 101003/CS622T.1-P011 | **MEDIUM** | Demonstrate knowledge and understanding of engineering and management principles by selecting the technically and economically feasible problems. |
| 101003/CS622T.1-PO12 | **HIGH** | Identify technically and economically feasible problems for long term learning. |
| 101003/CS622T.1-PSO1 | **MEDIUM** | Ability to identify, analyze and design solutions to identify technically and economically feasible problems. |
| 101003/CS622T.1-PSO2 | **MEDIUM** | By designing algorithms and applying standard practices in software project development and Identifying technically and economically feasible problems. |
| 101003/CS622T.1-PSO3 | **MEDIUM** | Fundamentals of computer science in competitive research can be applied to Identify technically and economically feasible problems. |
| 101003/CS622T.2-PO1 | **HIGH** | Identify and survey the relevant by applying the knowledge of mathematics, science, engineering fundamentals. |

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| 101003/CS622T.2-PO2 | **HIGH** | Identify, formulate, review research literature, and analyze complex engineering problems get familiarized with software development processes. |
| 101003/CS622T.2-PO3 | **HIGH** | Design solutions for complex engineering problems and design based on the relevant literature. |
| 101003/CS622T.2-PO4 | **HIGH** | Use research-based knowledge including design of experiments based on relevant literature. |
| 101003/CS622T.2-PO5 | **HIGH** | Identify and survey the relevant literature for getting exposed to related solutions and get familiarized with software development processes by using modern tools. |
| 101003/CS622T.2-PO6 | **MEDIUM** | Create, select, and apply appropriate techniques, resources, by identifying and surveying the relevant literature. |
| 101003/CS622T.2-PO8 | **HIGH** | Apply ethical principles and commit to professional ethics based on the relevant literature. |
| 101003/CS622T.2-PO9 | **MEDIUM** | Identify and survey the relevant literature as a team. |
| 101003/CS622T.2-PO10 | **HIGH** | Identify and survey the relevant literature for a good communication to the engineering fraternity. |
| 101003/CS622T.2-PO11 | **MEDIUM** | Identify and survey the relevant literature to demonstrate knowledge and understanding of engineering and management principles. |
| 101003/CS622T.2-PO12 | **HIGH** | Identify and survey the relevant literature for independent and lifelong learning. |
| 101003/CS622T.2-PSO1 | **MEDIUM** | Design solutions for complex engineering problems by Identifying and survey the relevant literature. |
| 101003/CS622T.2-PSO2 | **MEDIUM** | Identify and survey the relevant literature for acquiring programming efficiency by designing algorithms and applying standard practices. |
| 101003/CS622T.2-PSO3 | **MEDIUM** | Identify and survey the relevant literature to apply the fundamentals of computer science in competitive research. |
| 101003/CS622T.3-PO1 | **HIGH** | Perform requirement analysis, identify design methodologies by using modern tools & advanced programming techniques and by applying the knowledge of mathematics, science, engineering fundamentals. |
| 101003/CS622T.3-PO2 | **HIGH** | Identify, formulate, review research literature for requirement analysis, identify design methodologies and develop adaptable & reusable solutions. |

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| 101003/CS622T.3-PO3 | **HIGH** | Design solutions for complex engineering problems and perform requirement analysis, identify design methodologies. |
| 101003/CS622T.3-PO4 | **HIGH** | Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. |
| 101003/CS622T.3-PO5 | **HIGH** | Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools. |
| 101003/CS622T.3-PO6 | **MEDIUM** | Perform requirement analysis, identify design methodologies and assess societal, health, safety, legal, and cultural issues. |
| 101003/CS622T.3-PO7 | **MEDIUM** | Understand the impact of the professional engineering solutions in societal and environmental contexts and Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions. |
| 101003/CS622T.3-PO8 | **HIGH** | Perform requirement analysis, identify design methodologies and develop adaptable & reusable solutions by applying ethical principles and commit to professional ethics. |
| 101003/CS622T.3-PO9 | **MEDIUM** | Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings. |
| 101003/CS622T.3-PO10 | **MEDIUM** | Communicate effectively with the engineering community and with society at large to perform requirement analysis, identify design methodologies. |
| 101003/CS622T.3-PO11 | **MEDIUM** | Demonstrate knowledge and understanding of engineering requirement analysis by identifying design methodologies. |
| 101003/CS622T.3-PO12 | **HIGH** | Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change by analysis, identify design methodologies and develop adaptable & reusable solutions. |
| 101003/CS622T.3-PSO3 | **MEDIUM** | The ability to apply the fundamentals of computer science in competitive research and prior to that perform requirement analysis, identify design methodologies. |
| 101003/CS622T.4-PO1 | **MEDIUM** | Prepare technical report and deliver presentation by applying the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| 101003/CS622T.4-PO2 | **HIGH** | Identify, formulate, review research literature, and analyze complex engineering problems by preparing technical report and deliver presentation. |

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| 101003/CS622T.4-PO3 | **MEDIUM** | Prepare Design solutions for complex engineering problems and create technical report and deliver presentation. |
| 101003/CS622T.4-PO4 | **MEDIUM** | Use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions and prepare technical report and deliver presentation. |
| 101003/CS622T.4-PO5 | **MEDIUM** | Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools and Prepare technical report and deliver presentation. |
| 101003/CS622T.4-PO8 | **HIGH** | Prepare technical report and deliver presentation by applying ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice. |
| 101003/CS622T.4-PO9 | **HIGH** | Prepare technical report and deliver presentation effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings. |
| 101003/CS622T.4-PO10 | **HIGH** | Communicate effectively with the engineering community and with society at large by prepare technical report and deliver presentation. |
| 101003/CS622T.4-PO11 | **MEDIUM** | Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work by prepare technical report and deliver presentation. |
| 101003/CS622T.4-PO12 | **HIGH** | Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change by prepare technical report and deliver presentation. |
| 101003/CS622T.4-PSO1 | **MEDIUM** | Prepare a technical report and deliver presentation to identify, analyze and design solutions for complex engineering problems in multidisciplinary areas. |
| 101003/CS622T.4-PSO2 | **MEDIUM** | To acquire programming efficiency by designing algorithms and applying standard practices in software project development and to prepare technical report and deliver presentation. |
| 101003/CS622T.4-PSO3 | **MEDIUM** | To apply the fundamentals of computer science in competitive research and to develop innovative products to meet the societal needs by preparing technical report and deliver presentation. |
| 101003/CS622T.5-PO1 | **HIGH** | Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems. |
| 101003/CS622T.5-PO2 | **HIGH** | Identify, formulate, review research literature, and analyze complex engineering problems by applying engineering and management principles to achieve the goal of the project. |

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| 101003/CS622T.5-PO3 | **HIGH** | Apply engineering and management principles to achieve the goal of the project and to design solutions for complex engineering problems and design system components or processes that meet the specified needs. |
| 101003/CS622T.5-PO4 | **MEDIUM** | Apply engineering and management principles to achieve the goal of the project and use research-based knowledge including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions. |
| 101003/CS622T.5-PO5 | **MEDIUM** | Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools and to apply engineering and management principles to achieve the goal of the project. |
| 101003/CS622T.5-PO6 | **MEDIUM** | Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities by applying engineering and management principles to achieve the goal of the project. |
| 101003/CS622T.5-PO7 | **MEDIUM** | Understand the impact of the professional engineering solutions in societal and environmental contexts, and apply engineering and management principles to achieve the goal of the project. |
| 101003/CS622T.5-PO8 | **HIGH** | Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice and to use the engineering and management principles to achieve the goal of the project. |
| 101003/CS622T.5-PO9 | **MEDIUM** | Function effectively as an individual, and as a member or leader in teams, and in multidisciplinary settings and to apply engineering and management principles to achieve the goal of the project. |
| 101003/CS622T.5-PO11 | **MEDIUM** | Demonstrate knowledge and understanding of engineering and management principles and apply these to one's own work, as a member and leader in a team. Manage projects in multidisciplinary environments and to apply engineering and management principles to achieve the goal of the project. |
| 101003/CS622T.5-PO12 | **HIGH** | Recognize the need for, and have the preparation and ability to engage in independent and lifelong learning in the broadest context of technological change and to apply engineering and management principles to achieve the goal of the project. |
| 101003/CS622T.5-PSO1 | **MEDIUM** | The ability to identify, analyze and design solutions for complex engineering problems in multidisciplinary areas. Apply engineering and management principles to achieve the goal of the project. |

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| 101003/CS622T.5-PSO2 | **MEDIUM** | The ability to acquire programming efficiency by designing algorithms and applying standard practices in software project development to deliver quality software products meeting the demands of the industry and to apply engineering and management principles to achieve the goal of the project. |
| 101003/CS622T.5-PSO3 | **MEDIUM** | The ability to apply the fundamentals of computer science in competitive research and to develop innovative products to meet the societal needs thereby evolving as an eminent researcher and entrepreneur and apply engineering and management principles to achieve the goal of the project. |