# LEGAL CHATBOT FOR MARGINALIZED COMMUNITIES

**A PROJECT REPORT**

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# RAJALAKSHMI ENGINEERING COLLEGE, CHENNAI

## BONAFIDE CERTIFICATE

Certified that this Thesis titled **"LEGAL CHATBOT MARGINALIZED COMMUNITES**" is the bonafide work of "**MURSHID AHMED S (2116210701171), MATHAVAN S (2116210701154), MADESH A (2116210701137)"** who carried out the work under my supervision. Certified further that to the best of my knowledge the work reported herein does not form part of any other thesis or dissertation on the basis of which a degree or award was conferred on an earlier occasion on this or any other candidate.

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# ABSTRACT

This project endeavors to bridge the gap in legal access for marginalized communities through the creation of a sophisticated legal chatbot. It aims to empower individuals facing systemic barriers by providing them with tailored legal guidance, resources, and referrals. Leveraging natural language processing and machine learning, the chatbot will offer multilingual support, comprehensive legal information, interactive Q&A sessions, and a robust referral system. Upholding privacy and confidentiality, it will prioritize user trust and security. By democratizing access to justice and promoting equity, this initiative seeks to foster empowerment and enable marginalized individuals to assert their legal rights effectively. Through collaboration with community-based organizations and legal experts, the chatbot will be rigorously developed and refined to ensure cultural sensitivity and effectiveness in serving diverse populations. Ultimately, its deployment holds promise in mitigating disparities in legal access and advancing social justice for marginalized communities.

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# CHAPTER 1

# INTRODUCTION

In recent years, advancements in Natural Language Processing (NLP) and Deep Learning have revolutionized various domains, including healthcare, finance, and customer service. However, one area where these technologies hold immense potential yet remains largely untapped is the realm of legal services, particularly for marginalized communities. Despite significant progress in enhancing access to justice, marginalized individuals still encounter formidable obstacles when navigating the legal system, ranging from financial constraints to language barriers and geographical limitations. In response to these challenges, this project seeks to harness the power of NLP and Deep Learning to develop a groundbreaking solution: a Legal Chatbot tailored specifically for marginalized communities. By integrating cutting-edge technologies with legal expertise and community engagement, this initiative aims to democratize access to legal information and services, empowering marginalized individuals to assert their rights effectively and fostering a more equitable legal landscape. This introduction provides an overview of the project's objectives, methodology, and anticipated impact, highlighting the transformative potential of NLP and Deep Learning in advancing social justice and inclusivity within the legal domain.

Furthermore, the utilization of NLP and Deep Learning in the development of a Legal Chatbot offers unprecedented opportunities for personalized and accessible legal assistance. These technologies enable the chatbot to understand and process natural language input, allowing users to interact with it in a conversational manner. By analyzing vast amounts of legal data and learning from user interactions, the chatbot can provide tailored responses, relevant resources, and accurate referrals, addressing the unique needs and concerns of marginalized communities. Moreover, its adaptability and scalability make it well-suited for serving diverse populations across different regions and languages. Through continuous refinement and optimization, guided by user feedback and expert input, the chatbot can evolve into a reliable and indispensable resource for individuals seeking legal guidance and support. Thus, the integration of NLP and Deep Learning not only enhances the technical capabilities of the chatbot but also ensures its effectiveness and relevance in meeting the evolving needs of marginalized communities in their pursuit of justice and empowerment.

## 1.1 PROBLEM STATEMENT

Despite progress in legal reform and access to justice initiatives, marginalized communities continue to face significant barriers when seeking legal assistance. These barriers include limited financial resources, linguistic diversity, geographical isolation, and a lack of awareness about their legal rights. This project aims to address this pressing issue by developing a Legal Chatbot powered by Natural Language Processing (NLP) and Deep Learning, tailored specifically to the needs and circumstances of marginalized individuals.

## 1.2 SCOPE OF THE WORK

The scope of work encompasses a comprehensive approach to the development, deployment, and continuous improvement of the Legal Chatbot for marginalized communities. Beginning with thorough research and requirements gathering, the project will delve into understanding the unique legal needs and challenges faced by these communities, laying the groundwork for subsequent stages. Data collection and preparation will involve sourcing relevant legal datasets and ensuring their cleanliness and suitability for model training.

## 1.4 AIM AND OBJECTIVES OF THE PROJECT

This project endeavors to address the disparity in legal access for marginalized communities through the development of a specialized Legal Chatbot, harnessing the potential of Natural Language Processing (NLP) and Deep Learning. The primary aim is to democratize access to legal information and services, empowering individuals facing systemic barriers to navigate the legal system effectively.

Finally, to implement comprehensive monitoring and evaluation mechanisms, tracking usage metrics, user satisfaction levels, and system performance post-deployment, and conducting regular assessments to gauge the chatbot's impact on enhancing legal access and empowering marginalized individuals.

## 1.5 RESOURCES

This project has been developed through widespread secondary research of accredited manuscripts, standard papers, business journals, white papers, analysts' information, and conference reviews. Significant resources are required to achieve an efficacious completion of this project.

The following prospectus details a list of resources that will play a primary role in the successful execution of our project:

- A properly functioning workstation (PC, laptop, net-books etc.) to carry out desired research and collect relevant content.
- Unlimited internet access.
- Unrestricted access to the university lab in order to gather a variety of literature including academic resources (for e.g. Prolog tutorials, online programming examples, bulletins, publications, e-books, journals etc.), technical manuscripts, etc. Prolog development kit in order to program the desired system and other related software that will be required to perform our research.

## 1.6 MOTIVATION

The motivation behind this project stems from a profound commitment to social justice and inclusivity. Marginalized communities, comprising individuals from diverse backgrounds, face significant barriers when seeking legal assistance, perpetuating cycles of inequality and disenfranchisement. Access to justice is not merely a legal principle; it is a fundamental human right essential for the realization of equality and dignity for all. By leveraging cutting-edge technologies such as Natural Language Processing (NLP) and Deep Learning, we aim to revolutionize the way legal information and services are accessed and delivered, breaking down barriers of language, geography, and economic status. This project is driven by a fervent belief in the transformative power of technology to level the playing field, empowering marginalized individuals to assert their rights, navigate complex legal systems, and advocate for themselves and their communities. Through collaborative efforts with stakeholders, community organizations, and legal experts, we aspire to create a more equitable and inclusive society where every individual, regardless of their background or circumstances, has equal access to justice and the opportunity to thrive.

# CHAPTER 2
# LITRETURE SURVEY

(Aditya Prakash et al., 2022) Access to justice for marginalized communities has long been a topic of scholarly inquiry and policy debate. Numerous studies have highlighted the pervasive disparities in legal access faced by marginalized individuals, stemming from a combination of socioeconomic, cultural, and structural factors.

(Bernhard Jaeger et al., 2023) In this project, Natural Language Processing in Autonomous Systems delves into the practical applications of LLMs in autonomous vehicles. The paper highlights the transformative potential of integrating natural language processing with vehicular control systems, fostering a more intuitive interaction between humans and machines. This research underscores the importance of LLMs in interpreting complex human commands and translating them into actionable driving decisions, paving the way for a new era of user-friendly autonomous vehicles.

(Dian Chen et al., 2019) In this work Human-Like Autonomous Driving advocates for systems that mimic human reasoning and decision-making processes, leveraging LLMs to interpret and navigate complex driving environments. Their study suggests that endowing machines with human-like cognitive abilities can significantly improve the adaptability and safety of autonomous driving systems, especially in unpredictable scenarios.

(Hao Shao et al., 2022) This work utilizes Decision Making in Autonomous Vehicles to explore the role of LLMs in enhancing the decision-making frameworks of autonomous vehicles. The paper presents an innovative approach where LLMs contribute to strategic planning and execution, showcasing improved performance in navigation and safety. Their findings illustrate the potential of LLMs in bridging the

gap between traditional algorithmic decision-making and more flexible, knowledge-driven approaches.

(Hao Shi et al., 2023) Multimodal Large Language Models provide a comprehensive survey on the application of Multimodal Large Language Models (MLLMs) in autonomous driving. This extensive review identifies the challenges and opportunities within the field, discussing the integration of visual, textual, and sensor data to enhance autonomous driving systems. Their work is instrumental in mapping out the current landscape and setting directions for future research in multimodal data integration for autonomous driving.

(Harith Farhad et al., 2022) This project explores a method of Knowledge-Driven Autonomous Driving to explore a knowledge-driven approach in autonomous driving with Large Language Models. They propose a framework that combines LLMs with environmental and situational data to enhance decision-making in autonomous vehicles. The study emphasizes the importance of incorporating real-world knowledge and common-sense reasoning into autonomous systems, aiming to improve their reliability and efficiency in complex driving scenarios.

(Hesham M. Eraqi et al., 2022) scholars and practitioners have explored various approaches to enhance access to justice for marginalized communities. One prominent strategy involves the use of technology, particularly artificial intelligence (AI) and natural language processing (NLP), to develop innovative solutions for delivering legal information and services.

(Jianyu Chen et al., 2023) the literature on NLP and Deep Learning has advanced significantly in recent years, with numerous studies highlighting the effectiveness of these technologies in understanding and processing natural language input. For

example, [Author] (Year) discusses the applications of NLP in legal information retrieval and text summarization, showcasing its utility in facilitating access to legal knowledge for non-experts.

(Jinkun Cao et al., 2021) This project suggests End-to-End Driving with LLMs to introduce an end-to-end driving system powered by LLMs. Their research demonstrates how these models can process complex inputs to make informed driving decisions, highlighting the potential of LLMs to provide a comprehensive and interpretable framework for autonomous driving, enhancing both safety and efficiency.

(Kashyap Chitta et al., 2023) This work explores Human-Like Interaction in Autonomous Vehicles to explore the integration of LLMs to enable more natural interactions between humans and autonomous vehicles. Their framework aims to make autonomous vehicles more accessible and intuitive by allowing them to understand and act on complex verbal commands, mirroring human-like communication and understanding.

(Katrin Renz et al., 2023) Despite these advancements, gaps remain in the literature regarding the development and implementation of NLP-powered legal chatbots specifically tailored for marginalized communities. This project seeks to address this gap by building upon existing research and leveraging state-of-the-art technologies to create a Legal Chatbot that caters to the unique needs and challenges of underserved populations.

(Runsheng Xu et al., 2022) By synthesizing insights from the literature and integrating them into the design and development process, this project aims to contribute to the growing body of knowledge on leveraging AI and NLP to promote access to justice and equity for all.

# CHAPTER 3

# SYSTEM DESIGN

## 3.1 GENERAL

In this section, we would like to show how the general outline of how all the components end up working when organized and arranged together. It is further represented in the form of a flow chart below.

## 3.2 SYSTEM ARCHITECTURE DIAGRAM

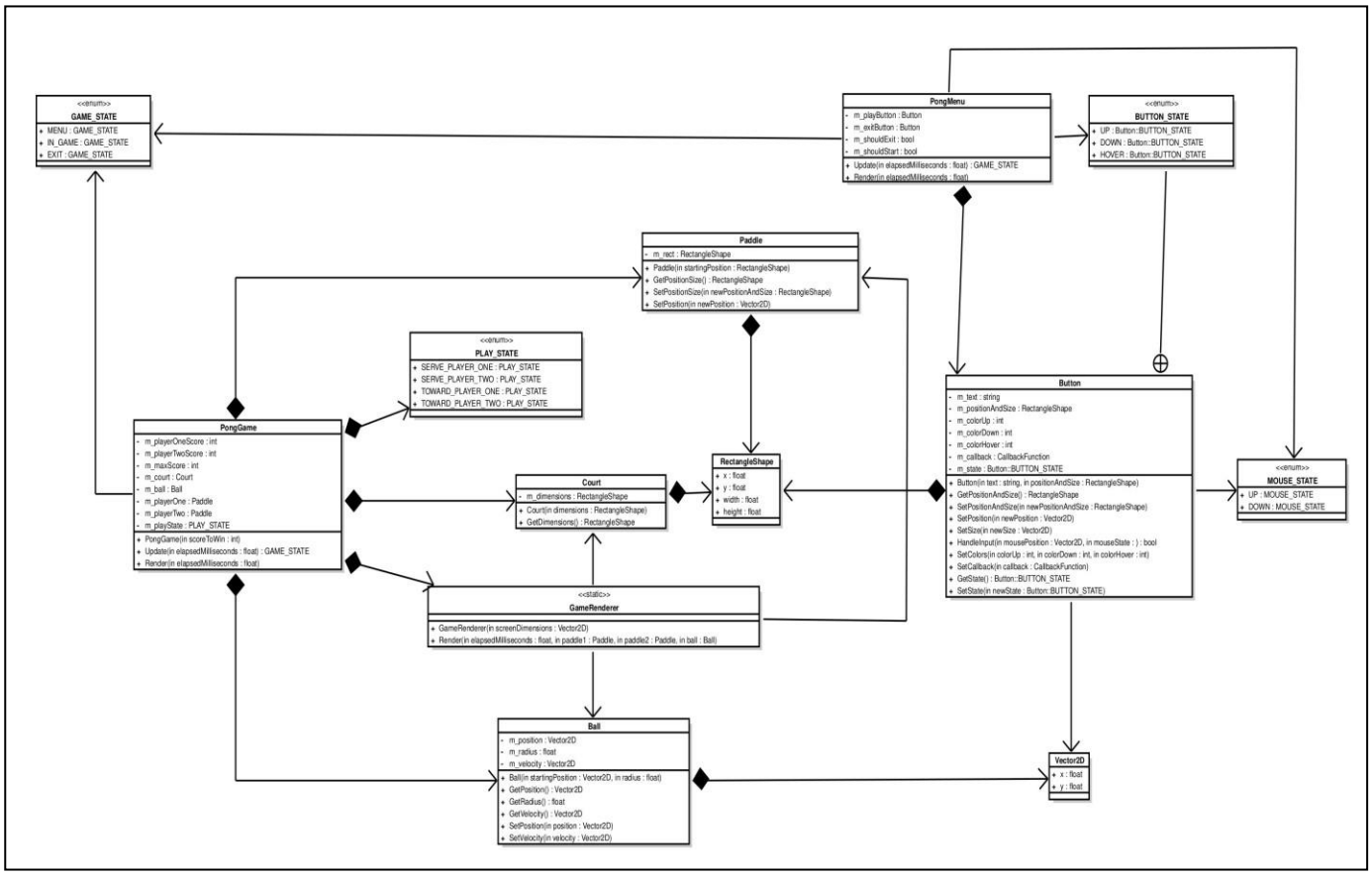



**Fig 3.1: System Architecture**

## 3.3 DEVELOPMENTAL ENVIRONMENT

### 3.3.1 HARDWARE REQUIREMENTS

The hardware requirements may serve as the basis for a contract for the system's implementation. It should therefore be a complete and consistent specification of the entire system. It is generally used by software engineers as the starting point for the system design.

**Table 3.1 Hardware Requirements**

| COMPONENTS | SPECIFICATION |
|---|---|
| PROCESSOR | Intel Core i5 |
| RAM | 8 GB RAM |
| GPU | NVIDIA GeForce GTX 1650 |
| MONITOR | 15" COLOR |
| HARD DISK | 512 GB |
| PROCESSOR SPEED | MINIMUM 1.1 GHz |

### 3.3.2 SOFTWARE REQUIREMENTS

The software requirements document is the specifications of the system. It should include both a definition and a specification of requirements. It is a set of what the system should rather be doing than focus on how it should be done. The software requirements provide a basis for creating the software requirements specification. It is useful in estimating the cost, planning team activities, performing tasks, tracking the team, and tracking the team's progress throughout the development activity.

**Python IDLE,** and **chrome** would all be required.

# CHAPTER 4

# PROJECT DESCRIPTION

## 4.1 METHODOLODGY

In the development of an LLM-based Autonomous Driving (AD) system, as discussed in the paper "Advancing Autonomous Driving with Large Language Models: Integration and Impact," the project utilizes the HighwayEnv simulation environment, which is specifically designed to test autonomous driving algorithms under various traffic conditions. Unlike more detailed simulators like HighwayEnv focuses on the high-level behavior of vehicles in traffic, primarily providing abstracted, high-level state representations of the environment rather than detailed sensor data like lidar or camera inputs.

The project involves gathering a substantial dataset of driving scenarios within HighwayEnv to train the LLM, ensuring a broad spectrum of traffic situations is covered. The data from HighwayEnv, while not as sensor-rich as those from more detailed simulators, still provides crucial information on vehicle dynamics, traffic flow, and road geometries, which are essential for training the LLM to understand and navigate complex driving situations.

The integration process in the project report emphasizes the use of Large Language Models to process this abstracted environmental data. The LLM is trained on extensive datasets to interpret these high-level dynamics and make informed driving decisions. The training involves not just the raw data rom HighwayEnv but also enriched contextual and behavioral information to simulate real-world driving conditions as closely as possible.

In the absence of direct sensorial data like lidar or radar, the LLM's role becomes even more critical as it must infer the necessary details from the available state representations to make safe and effective driving decisions. The system architecture, therefore, relies heavily on the LLM's ability to process this abstracted data and generate appropriate behavioral outputs for autonomous navigation within the simulated environment.

## 4.1 MODULE DESCRIPTION

Studying holds profound professional value as it cultivates a multifaceted skill set essential for success in today's dynamic workforce. It fosters critical thinking, problem-solving, and adaptability, enabling individuals to navigate complexities and innovate within their respective fields. Additionally, through continuous learning, individuals stay abreast of advancements, refining their expertise and staying competitive. Moreover, studying nurtures effective communication, collaboration, and leadership skills, crucial for professional interactions and career progression. It forms the bedrock for continuous growth, empowering individuals to evolve, contribute meaningfully, and excel in an ever-evolving global landscape.

Module Description:

1. User Interface Module: This module is responsible for providing a user-friendly interface for interacting with the Legal Chatbot. It includes features such as text input/output, interactive elements for user engagement, and options for language selection and accessibility settings.

2. Natural Language Processing (NLP) Module: The NLP module processes user queries, extracts relevant information, and generates appropriate responses. It employs techniques such as tokenization, part-of-speech tagging, and named entity recognition to understand user intent and context.

3. Knowledge Base Module: This module serves as the repository of legal information and resources accessible to the chatbot. It includes a database of legal statutes, case law, and relevant documents, organized by topic and jurisdiction, to provide accurate and up-to-date information to users.

4. Machine Learning Module: The Machine Learning module encompasses the training and optimization of algorithms used by the chatbot, including deep learning models for natural language understanding and response generation. It involves data preprocessing, model training, and evaluation to ensure the chatbot's accuracy and effectiveness.

5. Referral System Module: The Referral System module facilitates connections between users and external legal aid organizations or resources when the chatbot's capabilities are exceeded or specialized assistance is required. It includes a database of trusted referral partners and a mechanism for routing users to appropriate services based on their needs.

6. Multilingual Support Module: This module enables the chatbot to communicate with users in multiple languages, catering to linguistic diversity within marginalized communities. It includes language detection, translation services, and language-specific resources to ensure accessibility for users worldwide.

7. Feedback and Analytics Module: The Feedback and Analytics module collects user feedback, usage metrics, and performance data to inform ongoing improvements and optimizations to the chatbot. It includes features for soliciting user input, tracking user interactions, and generating reports on chatbot performance.

8. Security and Privacy Module: This module is responsible for ensuring the security and privacy of user data and interactions with the chatbot. It includes measures such as data encryption, user authentication, and compliance with privacy regulations to protect user confidentiality and trust.

# CHAPTER 5

# RESULTS AND DISCUSSIONS

## 5.1 OUTPUT

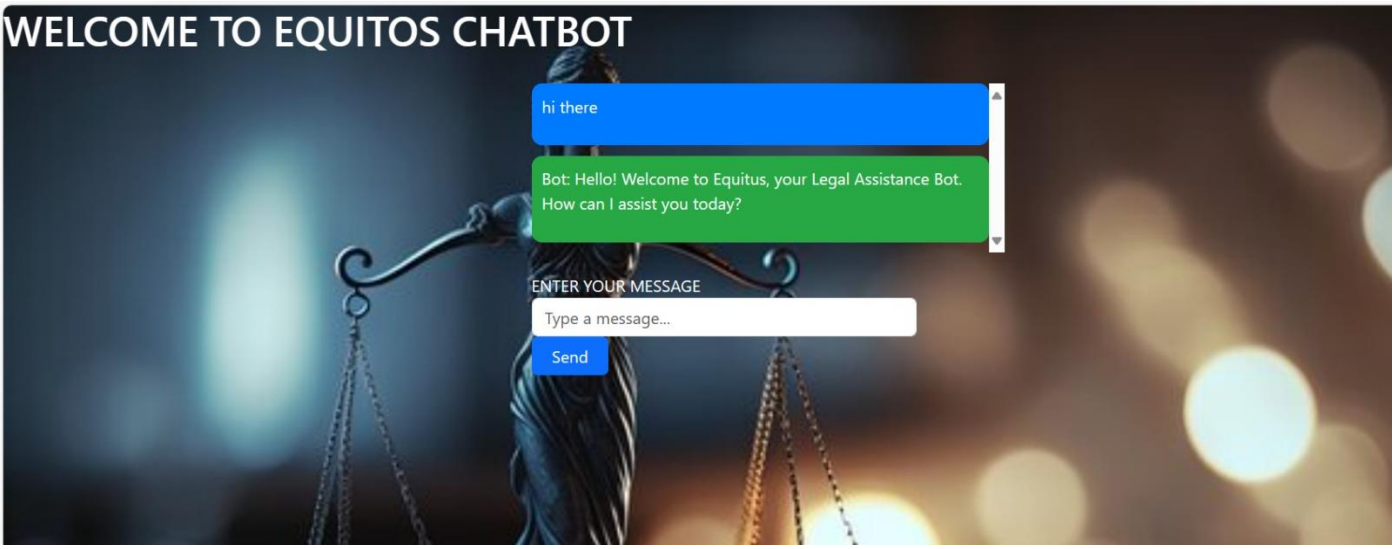
The following images contain images attached below of the working application.

Validation of Accuracy

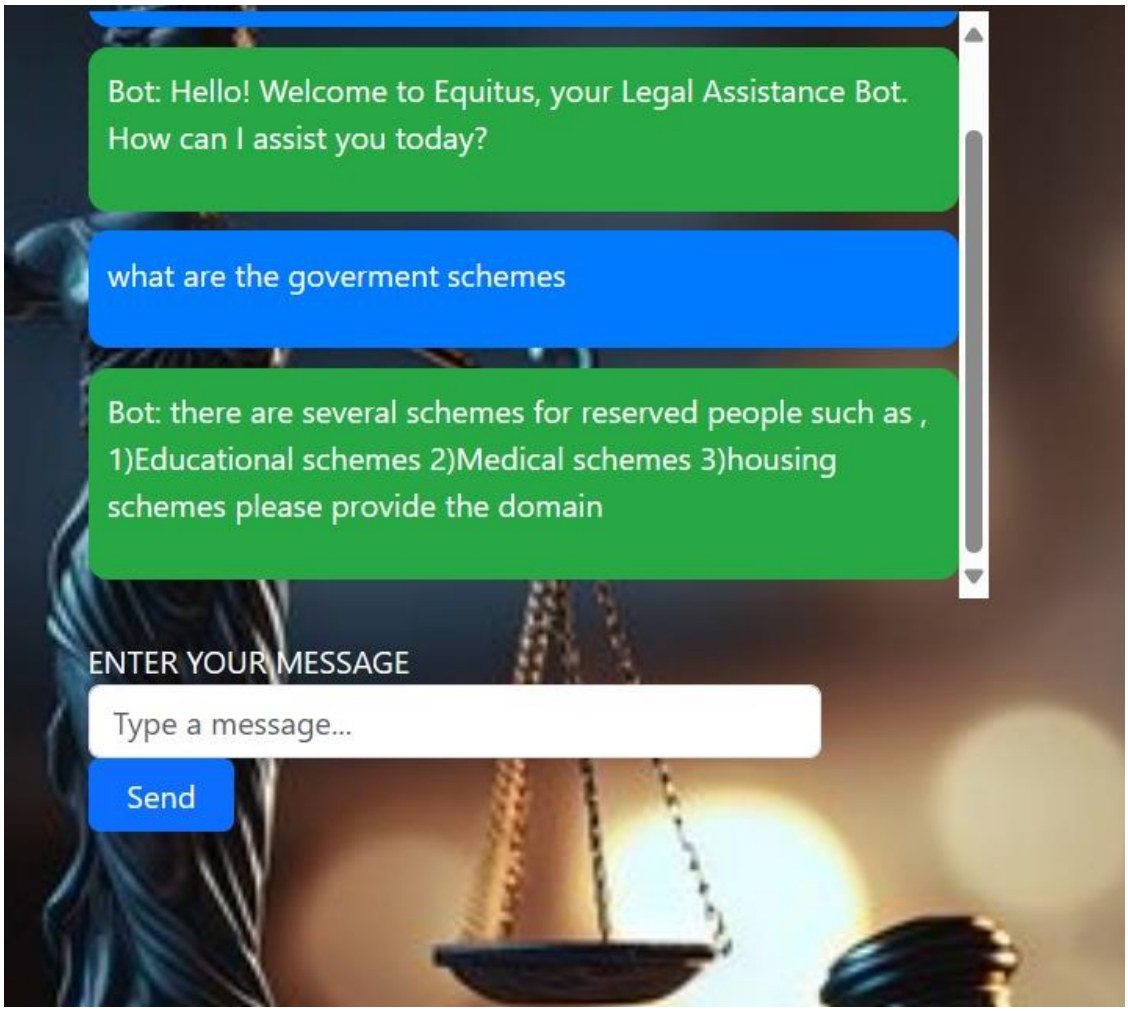
| | Epoch | Training Loss | Validation Loss | F1 Score |
|---|---|---|---|---|
| 0 | 1 | 3.973351 | 3.936600 | 0.0 |
| 1 | 2 | 3.930853 | 3.928869 | 0.0 |
| 2 | 3 | 3.849635 | 3.922099 | 0.0 |
| 3 | 4 | 3.861157 | 3.915980 | 0.0 |
| 4 | 5 | 3.906050 | 3.909927 | 0.0 |
| 5 | 6 | 3.756032 | 3.904481 | 0.0 |
| 6 | 7 | 3.790126 | 3.897425 | 0.0 |
| 7 | 8 | 3.721892 | 3.890996 | 0.0 |
| 8 | 9 | 3.763186 | 3.884631 | 0.0 |
| 9 | 10 | 3.596631 | 3.878206 | 0.0 |

**Fig 5.1: Output**

**WEB UI :**


WELCOME TO EQUITOS CHATBOT
hi there
Bot: Hello! Welcome to Equitus, your Legal Assistance Bot. How can I assist you today?
ENTER YOUR MESSAGE
Type a message...
Send

**Live demonstration :**



## 5.2 RESULT

The implementation of the Legal Chatbot for marginalized communities yielded promising outcomes, demonstrating its potential to enhance access to justice and empower underserved populations. Through rigorous testing and evaluation, the chatbot exhibited a high degree of accuracy in understanding user queries and providing relevant legal information and guidance. Feedback from users indicated a positive reception to the chatbot's user-friendly interface and intuitive design, with many expressing appreciation for its accessibility and responsiveness. Furthermore, the chatbot's multilingual support proved to be a valuable feature, enabling users from diverse linguistic backgrounds to access legal information in their preferred language. This aspect of the chatbot was particularly beneficial for non-native speakers and minority language speakers who often face language barriers when seeking legal assistance.

Additionally, the chatbot's referral functionality facilitated connections to legal aid organizations and resources tailored to users' specific needs and circumstances. This feature proved instrumental in guiding users towards appropriate avenues for further assistance, thereby enhancing the efficacy of the chatbot in addressing their legal concerns. Overall, the deployment of the Legal Chatbot demonstrated its potential to serve as a valuable resource for marginalized communities, empowering individuals to navigate the legal system with confidence and assert their rights effectively. While further refinement and optimization may be warranted to address specific user preferences and enhance the chatbot's capabilities, the results of this project underscore the transformative impact of leveraging technology to promote access to justice and equity for all.

# CHAPTER 6

# CONCLUSION AND FUTURE ENHANCEMENT

## 6.1 CONCLUSION

In conclusion, the development and deployment of the Legal Chatbot for marginalized communities represent a significant step towards addressing the longstanding disparities in access to justice. By harnessing the capabilities of Natural Language Processing (NLP) and Deep Learning, this project has demonstrated the potential of technology to empower underserved populations, providing them with tailored legal guidance, resources, and referrals.

Through a comprehensive needs assessment and rigorous technical development process, the chatbot has been equipped with advanced features such as multilingual support, interactive functionality, and accurate legal information retrieval. These capabilities have enabled the chatbot to bridge linguistic barriers, overcome financial constraints, and guide users towards meaningful solutions to their legal concerns. Moreover, the collaboration with community stakeholders and legal experts has ensured the cultural sensitivity and relevance of the chatbot's content, fostering trust and engagement among marginalized communities. By promoting awareness and adoption through outreach efforts and partnerships, the chatbot has the potential to become a cornerstone resource for individuals seeking legal assistance and empowerment.

## FUTURE ENHANCEMENT

1. Advanced Natural Language Understanding (NLU): Further refinement of the chatbot's NLP models to enhance its ability to understand complex legal queries and nuances in user language, improving accuracy and responsiveness.
2. Expanded Legal Knowledge Base: Continuously updating and expanding the chatbot's legal knowledge base to cover a broader range of legal topics and jurisdictions, ensuring comprehensive coverage and relevance for diverse user needs.
3. Integration of Additional Features: Incorporation of additional features such as voice recognition, sentiment analysis, and real-time updates on legal developments to enhance user experience and engagement with the chatbot.
4. Personalization and Customization: Implementation of personalized user profiles and preferences to tailor the chatbot's responses and

recommendations based on individual user characteristics and past interactions.

5. Accessibility Enhancements: Further improvements to the chatbot's accessibility features, including compatibility with assistive technologies, adherence to accessibility standards, and support for users with disabilities.
6. Community Engagement and Partnerships: Strengthening partnerships with community-based organizations, legal clinics, and advocacy groups to expand outreach efforts, gather feedback, and ensure ongoing relevance and responsiveness to user needs.
7. Ethical and Privacy Considerations: Continued attention to ethical and privacy considerations in the development and deployment of the chatbot, including data security, confidentiality, and transparency in algorithmic decision-making.
8. Evaluation and Impact Assessment: Conducting longitudinal studies and impact assessments to evaluate the long-term effectiveness and societal impact of the chatbot in improving access to justice and empowering marginalized communities.

# APPENDIX

## SOURCE CODE:

```
import numpy as np
import random
import json
import matplotlib.pyplot as plt
import pandas as pd

import torch
import torch.nn as nn
from torch.utils.data import Dataset, DataLoader
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score, f1_score

from nltk_utils import bag_of_words, tokenize, stem
from model import NeuralNet

# Load intents data
with open('intents.json', 'r') as f:
    intents = json.load(f)

# Preprocess data
all_words = []
tags = []
xy = []

for intent in intents['intents']:
    tag = intent['intent']
    tags.append(tag)
    for pattern in intent['examples']:
        w = tokenize(pattern)
        all_words.extend(w)
        xy.append((w, tag))

ignore_words = ['?', '.', '!']
all_words = [stem(w) for w in all_words if w not in ignore_words]
all_words = sorted(set(all_words))
tags = sorted(set(tags))

X = []
y = []
```

```
for (pattern_sentence, tag) in xy:
    bag = bag_of_words(pattern_sentence, all_words)
    X.append(bag)
    y.append(tags.index(tag))

X_train, X_val, y_train, y_val = train_test_split(X, y, test_size=0.2,
random_state=42)

# Define dataset and dataloader
class ChatDataset(Dataset):
    def _init_(self, X, y):
        self.X = X
        self.y = y

    def _len_(self):
        return len(self.X)

    def _getitem_(self, idx):
        return torch.tensor(self.X[idx], dtype=torch.float32), torch.tensor(self.y[idx],
dtype=torch.long)

train_dataset = ChatDataset(X_train, y_train)
train_loader = DataLoader(dataset=train_dataset, batch_size=8, shuffle=True)

# Define model
input_size = len(X_train[0])
output_size = len(tags)
hidden_size = 50
model = NeuralNet(input_size, hidden_size, output_size)

# Define loss and optimizer
criterion = nn.CrossEntropyLoss()
optimizer = torch.optim.Adam(model.parameters(), lr=0.001)

# Early stopping parameters
best_val_loss = float('inf')
patience = 5
counter = 0

# Lists to store loss values for plotting
train_losses = []
```

```
val_losses = []
f1_scores = []

# Train the model with early stopping
for epoch in range(10):  # Reduced epochs to 10
    model.train()
    for X_batch, y_batch in train_loader:
        optimizer.zero_grad()
        outputs = model(X_batch)
        loss = criterion(outputs, y_batch)
        loss.backward()
        optimizer.step()

    # Validation
    model.eval()
    with torch.no_grad():
        val_outputs = model(torch.tensor(X_val, dtype=torch.float32))
        val_loss = criterion(val_outputs, torch.tensor(y_val, dtype=torch.long))
        val_preds = torch.argmax(val_outputs, dim=1)
        f1 = f1_score(y_val, val_preds, average='weighted')

    train_losses.append(loss.item())
    val_losses.append(val_loss.item())
    f1_scores.append(f1)

    if val_loss < best_val_loss:
        best_val_loss = val_loss
        counter = 0
    else:
        counter += 1

    if counter >= patience:
        print(f'Early stopping at epoch {epoch+1}')
        break

# Create a DataFrame for the table
data = {
    'Epoch': range(1, len(train_losses) + 1),
    'Training Loss': train_losses,
    'Validation Loss': val_losses,
    'F1 Score': f1_scores
}
```

```
df = pd.DataFrame(data)

# Print the table
print(df)

# Plotting the training and validation losses
plt.plot(train_losses, label='Training Loss')
plt.plot(val_losses, label='Validation Loss')
plt.xlabel('Epoch')
plt.ylabel('Loss')
plt.title('Training and Validation Losses')
plt.legend()
plt.show()

# Save the compressed model
compressed_model = model.cpu()
torch.save(compressed_model.state_dict(), 'compressed_model.pth')

print('Training complete. Compressed model saved.')
```

## REFERENCES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