SIGNLINGO

A Mini-Project Report Submitted
For
Partial Fulfilment of the Requirements of the
Degree of Bachelor of Engineering

In

COMPUTER ENGINEERING

(Semester V)
By

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2023-2024

This work is dedicated to my family.

I am very thankful for their motivation and support.

CERTIFICATE

This is to certify that the mini-project entitled **"SignLingo"** is a bonafide work of "Lisa James Gonsalves **(9607)** Crystal Elaine Fernandes **(9539)** Saahil Fernandes **(9540)** and Eden Evelyn Charles **(9593)"** submitted to University of Mumbai in partial fulfillment of the requirement for the award of the degree of **Bachelor of Engineering** in **Computer Engineering** (Semester- V).

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Approval Sheet

Mini Project Report Approval for T.E. (Semester-V)

This mini-project report entitled SignLingo submitted by Lisa James Gonsalves (9607) Crystal Elaine Fernandes (9539) Saahil Fernandes (9540) and Eden Evelyn Charles (9593) is approved for the degree of Bachelor of Engineering in **Computer Engineering** (Semester-V).

Examiner 1.———————————

Examiner 2. ———————————

Date:

Place: Mumbai

Declaration

We declare that this written submission represents our ideas in our own words and where others' ideas or words have been included, we have adequately cited and referenced the original sources. We also declare that we have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in our submission. We understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.

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Abstract

This innovative project aims to overcome communication barriers faced by the deaf community by leveraging their faster signing speed compared to texting. Inspired by Google Assistant, the project introduces a twist where input is provided in sign language and assistance is delivered in the form of text. It addresses the communication challenges faced by the deaf community, taking into consideration their faster signing speed compared to texting. Recognizing the absence of fully formed sentence datasets, the project adopts a unique approach where individual letters are utilized to form words, with the blank symbol indicating spaces between words. This methodology allows for greater flexibility in dataset training. Moreover, the limited availability of standard datasets for all countries, sub-continents, and languages is acknowledged, emphasizing the need for a large vocabulary database to cater to diverse linguistic contexts.

By harnessing sophisticated computer vision techniques, powerful machine learning algorithms, and advanced natural language processing (NLP) methods, the system enables smooth and effortless communication between ASL users and a chatbot interface. By bridging the gap between ASL and spoken language, this project aims to revolutionize communication dynamics and enhance inclusivity in various domains.

Keywords:

American Sign Language (ASL), Chatbot, Hospital System, Machine Learning,

Acknowledgments

We have great pleasure in presenting the report on “SignLingo”. I take this opportunity to express my sincere thanks to the guide Ms. Merly Thomas, C.R.C.E, Bandra (W), Mumbai, for providing the technical guidelines, and the suggestions regarding the line of this work. We enjoyed discussing the work progress with her during our visits to the department.

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Chapter 1

INTRODUCTION

Hospital management systems typically rely on speech-based communication for booking services, posing challenges for those with auditory impairments. This project introduces an innovative approach to address this issue. The core objective is to empower auditory-impaired individuals with seamless access to hospital booking services. Inspired by Google Assistant, the project adopts a unique approach, enabling sign language input and providing text output. A dedicated website is under development to facilitate sign language translation and offer text-based interactions with AI for booking hospital services. The ultimate goal is to provide auditory-impaired individuals with equal access to hospital booking services, thereby improving their overall healthcare experience.

Chapter 2

OBJECTIVES OF THE PROJECT

1. **ASL Recognition System:** Create a sophisticated ASL recognition system that uses machine learning to accurately interpret sign language gestures, enhancing accessibility for users with hearing impairments.
2. **Interactive Chatbot Interface:** Integrate this system with an intuitive chatbot interface, empowered by real-time natural language processing, to enable seamless and engaging conversations with users.
3. **Symptom Identification and Doctor Connection:** Train the chatbot to identify user-entered symptoms and connect them with the most suitable doctor in the hospital, streamlining the healthcare process for auditory-impaired individuals.
4. **Cross-Platform Accessibility:** Develop the application to be compatible with various devices and platforms, ensuring that users can access it conveniently from their preferred technology, improving overall accessibility.
5. **Emergency Assistance:** The chatbot will also have information in the database regarding critical information, evacuation instructions, video links to CPR tutorials, etc to make people aware and equipped with such information.

Chapter 3

SCOPE OF THE PROJECT

1. The primary objective of this project is to create a sophisticated gesture classification system within a hospital management system, enabling real-time recognition and interpretation of American Sign Language (ASL) gestures. This system will foster inclusive communication between ASL users and a chatbot, thereby addressing the communication gap in healthcare settings and promoting accessibility to those with auditory impairments.
2. The chatbot will also have information in the database regarding critical information, evacuation instructions, video links to CPR tutorials, etc to make people aware and equipped with such information.
3. (add tech stuff)
4. The success of this project will be gauged by the system's accuracy in recognizing ASL gestures, improved communication, enhanced inclusivity, and the seamless integration of additional hospital management functionalities as part of future expansion.

Chapter 4

REVIEW OF LITERATURE

RESEARCH ON ASL RECOGNITION

Title of Paper	Year & Journal	Dataset used	Architecture	Validation	Issues
American Sign Language Recognition using Deep Learning and Computer Vision	May 2020, Journal of Advanced Research in Dynamical and Control Systems	60,000 training images 10,000 testing images 24 classes of ASL letters and numbers	Segmentation of images from video input Conversion to grayscale, scaling, and gesture recognition using CNN	Validation accuracy of >93%.	Model lacks accuracy with noisy background images. Performance is affected when people wear ornaments like rings in the gesture images.
A Review Paper on Sign Language Recognition for The Deaf and Dumb	October 2021, International Journal of Engineering Research & Technology (IJERT)	Custom dataset created using OpenCV Around 800 training images 200 testing images per ASL symbol. Utilized a region of interest (ROI) defined by a blue square in webcam frames Converted RGB input images to grayscale, applied Gaussian blur, adaptive thresholding, and resizing to 128x128.	The system uses a vision-based approach and employs two layers of algorithms. Algorithm Layer 1: preprocesses frames, applies Gaussian blur and thresholding, and uses a CNN model for prediction. Algorithm Layer 2: classifies symbols with similar results.	Accuracy of 92.0%	-
Sign Language Recognition with Advanced Computer Vision		"Sign Language MNIST" Pixel information for around 1,000 images of each of 24 ASL Letters, excluding J and Z	Convolutional Neural Network (CNN) with 24 features Detecting landmarks of the hand using Mediapipe, fingers and palms, and creating a bounding box around the hand.	95% **training accuracy**	-
Interpretation of sign language into English using NLP techniques	August 2017 Journal of Information and Optimization Sciences 38(6):895-910	-(not mentioned)	System Model: A. Sign language conversion into text B. Forming meaningful sentence of text using NLP techniques. DCT coefficients for image processing, 2-DHMMs training model.	With Nearly 90% of accuracy.	-(not discussed)

CNN based feature extraction and classification for sign language	2021 Multimedia Tools and Applications	-	Modified pre-trained AlexNet and modified pre-trained VGG16 models for feature extraction. Multiclass support vector machine (SVM) as the classifier.	Accuracy of 99.82%	-

TABLE 1.1:RESEARCH ON ASL RECOGNINTION

RESEARCH ON CHATBOT

Title of Paper	**Year & Journal**	**Dataset used**	**Architecture/Content**	**Validation**	**Issues**
Chatbot for Hospital Management System	International Journal of Research in Engineering, Science, and Management Volume 5, Issue 8, August 2022	A JSON dataset is sent as input to the model, which contains tags and responses that match a particular pattern.	Used deep neural network techniques like LSTM to classify user queries and generate perfect responses.	The best accuracy of 94.85 was obtained	-
AI Based Chatbot for Hospital Management System	S. R. Dammavalam, N. Chandana, T. R. Rao, A. Lahari and B. Aparna, "AI Based Chatbot for Hospital Management System," 2022 3rd International Conference on Computing, Analytics, and Networks (ICAN), Rajpura, Punjab, India, 2022				
Smart Hospital Chatbot-Virtual Doctor Consultation and Appointment	Vijay Ingawale, Dinesh Bartakke, Shrikant Virkar, Sagar Chavan, Prof. Manisha Navale5	Dataset for healthcare systems were chosen as they met the required criteria	Natural language processing (NLP) d to find an input pattern in a string of characters and SVM	model provides 82% accuracy and it can be further improved using	-

				various preprocessing techniques	
Disease Prediction and Doctor Recommendation System using Machine Learning Approaches	July 2021 International Journal for Research in Applied Science & Engineering Technology (IJRASET) Volume 9 Issue VII July 2021	The dataset is used from various verified sources for different disease predictions.	Four different kinds of models present in our project to predict these diseases are Random Forest Classifier Logistic Regression Gaussian Naïve Bayes and KNN.	The algorithm taken for pro prediction is Random Forest Classifier and Naïve Bayes because of its highest accuracy i.e. 90.2%.	In the future, we can also improve the model by implementing Deep Learning Algorithms by taking large and huge datasets directly from the Hospitals.
HealthCare Chatbot	May 2022 International Research Journal of Engineering and Technology (IRJET)	Datasets for various illnesses are obtained from Kaggle. Various other datasets such as datasets for Diabetes, Pneumonia, Cancer, Dengue, Cold, and so on are also incorporated with the model.	Various machine learning techniques like decision trees, logistic regression, NLP, and neural networks are used, donuts	The accuracy reached for the chatbot model is about 95.52%.	-

TABLE 1.2:RESEARCH ON CHATBOT

BACKGROUND STUDY

Title of Paper	**Year & Journal**	**Content**	**Conclusion**
Emergency Medical Services Communication Barriers and the Deaf American Sign Language User	June 2021 (Research Gate)	Descriptive statistics characterized the study sample and they quantified responses from the baseline survey and both post-intervention surveys. 148 EMS practitioners responded to the baseline survey.	Nearly all participants felt the educational training was beneficial and clinically relevant; three months later, all participants found it to still be helpful. Additionally, the communication tool may apply to other populations that use English as a second language.
SmartCall: A Real-time, Sign Language Medical Emergency Communicator	5th Information Technology for Education and Development (ITED), Abuja, Nigeria, 2022	proposes a low-cost embedded device that allows individuals with a speech impairment to communicate during medical emergencies using CNN. A pilot test on two volunteers	-

		resulted in an offline accuracy of 91.2% and an average online accuracy of 92 %	
Deaf Sign-Language Using Patients' Experiences in Health Emergencies in Wales: Perspectives for Improving Interactions	October 2020 (Research Gate)	Emergency services need to respond quickly and reliably in health emergencies; however, they often do not serve Deaf communities adequately. Access to health care and experiences with the health care system differ widely for Communities around the world.	This level of training may not be feasible, but we need to be aware that it is the healthcare system that creates the barriers, not the Deaf patients. It is therefore up to the healthcare services and professionals to begin breaking the cycle and create more positive experiences.

TABLE 1.3: BACKGROUND STUDY

Chapter 5
PROPOSED SYSTEM

5.1 DRAWBACKS OF EXISTING SYSTEM

- Limited Accessibility: Many websites, applications, and digital services are not designed with the needs of deaf or hearing-impaired users in mind. This lack of accessibility prevents them from fully engaging with these platforms.
- Communication Barriers: Video content that lacks proper captions or sign language interpretation creates significant communication barriers for deaf users. They often struggle to access essential information or understand online content.
- Inaccessible Emergency Alerts: Many emergency notification systems are not equipped to relay important information to the deaf community, leaving them vulnerable during crises.
- Assistive Technology Costs: Some essential assistive technologies, like cochlear implants or hearing aids, can be prohibitively expensive, limiting access for those with financial constraints.

5.2 PROBLEM STATEMENT

There is a critical need to address the communication and healthcare accessibility gap for the deaf and hearing-impaired population. Current healthcare systems lack the necessary accommodations to provide equitable access to medical services for this underserved community, resulting in disparities in healthcare outcomes and the overall quality of care. The project aims to create an inclusive healthcare ecosystem tailored to the unique needs of the deaf and hearing-impaired, enabling them to communicate effectively with healthcare providers, access essential healthcare information, book medical appointments seamlessly, and receive timely emergency healthcare support.

Chapter 6

SYSTEM DESIGN

6.1 BLOCK DIAGRAM

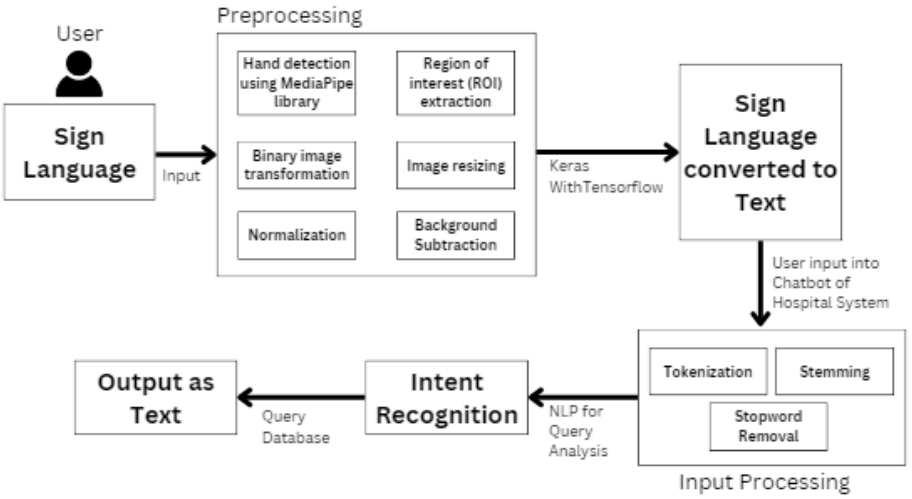


FIG 1. Block Diagram

6.2 MODULE DESCRIPTION

As depicted in the above block diagram, the project will go through the following steps; Initially the user will be given web window where he will be able to give an input (in ASL)with the help of a web cam on the device. Once the input is taken it will be pre processed. during pre processing the hand gesture will be detected using media pipe. to make this detection easier the image will go through other processing like resizing, normalisation, binary image transformation, etc. once the sign is detected it will interpreted with the help of the —--model and converted to text. This text will now be sent to the chatbot as input. this input will now be processed using features like tokenization, stemming, etc. As per input a query will be ran and the chatbot with help of the database will reply to the user.

6.2.1 ALGORITHMS

6.2.1.1 THEORETICAL ANALYSIS

Algorithms (Major)		
Keras with TensorFlow **Description:** Keras, when coupled with TensorFlow, is a deep learning framework		**Natural Language Processing (NLP)** **Description:** The field of AI is dedicated to enabling computers to understand and interact

capable of building and training neural networks. It's highly flexible and suitable for tasks like ASL sign recognition, where deep neural networks can capture intricate patterns. **Justification:** Deep learning has shown exceptional performance in tasks involving image and pattern recognition. In the context of ASL sign recognition, Keras with TensorFlow offers the flexibility to design and train deep neural networks, making it a state-of-the-art choice for image-based classification tasks.		with human language. It is crucial for chatbots, sentiment analysis, language translation, search engines, personalized content, and medical diagnosis. NLP enhances human-computer communication and aids in extracting valuable insights from vast amounts of text data. **Justification:** NLP in booking systems enhances user experience by allowing users to interact naturally. It automates and streamlines the booking process, reduces the need for manual input, and can handle various user preferences, making it a valuable tool for the service industry.

TABLE 2: THEORETICAL ANALYSIS

6.2.1.2 ALGORITHMS USED

Regression:

Theoretical Framework:

Logistic Regression is a statistical model based on the logistic function and maximum likelihood estimation. It's used for binary and multi-class classification.

Strengths:

- Simplicity and interpretability.
- Computational efficiency for large datasets.
- Provides probability estimates.

Limitations:

- Assumes a linear relationship between features and the target variable.
- May not capture complex non-linear patterns.

Random Forest:

Theoretical Framework:

Random Forest is an ensemble method that combines multiple Decision Trees. It's grounded in concepts like bagging and features randomness.

Strengths:

- Reduces overfitting and improves accuracy.
- Handles high-dimensional data effectively.

Limitations:

- Less interpretable compared to single Decision Trees.
- Increased computational complexity due to ensemble nature.

SVM (Support Vector Machine):

Theoretical Framework:

SVMs aim to maximize the margin between different classes by finding the hyperplane that best separates the data.

Strengths:

- Effective for high-dimensional data.
- Can handle non-linear data through kernel tricks.

Limitations:

- Sensitive to the choice of kernel function and parameters.
- Computationally intensive for large datasets.

Keras with TensorFlow for ASL Detection:

Theoretical Framework:

ASL detection with Keras and TensorFlow is based on computer vision and deep learning principles. Convolutional Neural Networks (CNNs) are the foundation.

Strengths:

- Well-suited for image-based tasks like ASL detection.
- Offers a flexible and user-friendly framework.
- Achieves high accuracy in complex recognition tasks.

Limitations:

- Requires significant computational resources and large datasets.
- May need fine-tuning for optimal performance.
- Can struggle with variations in hand signs.

NLP (Natural Language Processing) for Booking:

Theoretical Framework:

NLP for booking systems is rooted in language understanding, semantic analysis, and intent recognition. It leverages linguistic and computational models for user-friendly interactions.

Strengths:

- Enables user-friendly and conversational interactions.
- Extracts essential information from user queries.
- Recognizes user intent for efficient service routing.

Limitations:

- May not always accurately interpret user intent.
- Effectiveness depends on the quality of the language model.
- Handling multilingual support and dialects can be challenging.

6.2.2 DATABASE(S)

Metadata for Firebase Realtime Database:

- Database Type: Firebase Realtime Database (a NoSQL database)
- Real-Time Synchronization: Firebase Realtime Database provides real-time data synchronization, making it ideal for applications that require instant updates.
- Entities: Users, Appointments, Doctors, Appointment Slots
- Relationships: Users have appointments, Appointments are associated with Doctors and Appointment Slots, Doctors have availability slots.

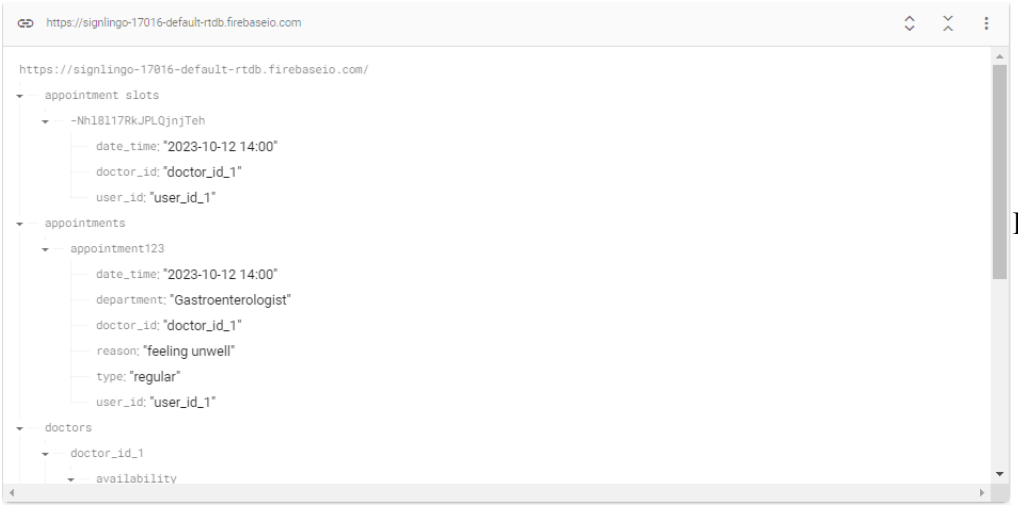
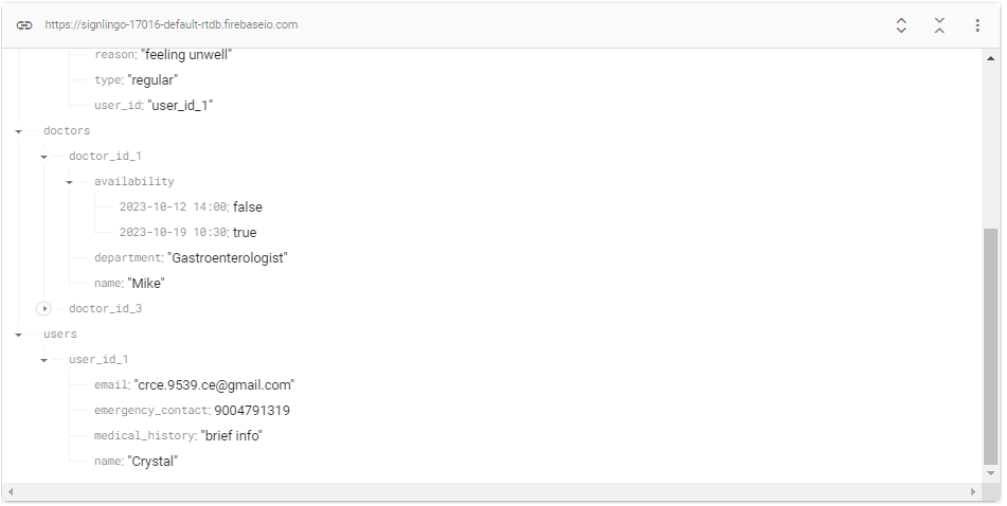


FIG 2. Database 1

FIG 3. Database 2



Metadata for Firebase Firestore Database:

- Authentication and Security: Firebase Authentication for user authentication and access control.
- Data Structure: Organized as collections and documents within each collection.

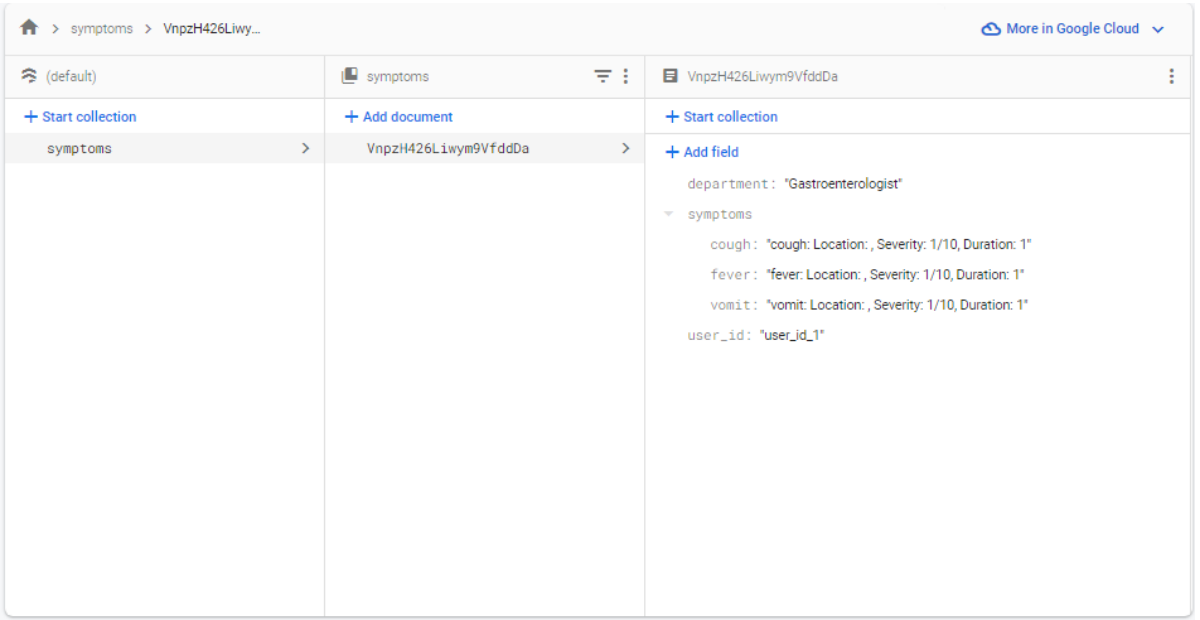


FIG 4 Database 3

Metadata for Firebase Authentication:

- User ID: A unique identifier for the user in the authentication system
- User Email: The user's email address used for authentication
- Profile Photo: A reference to the user's profile photo or avatar(optional)

6.2.3 UML DIAGRAM(S)

6.2.3.1 Data Flow Diagram

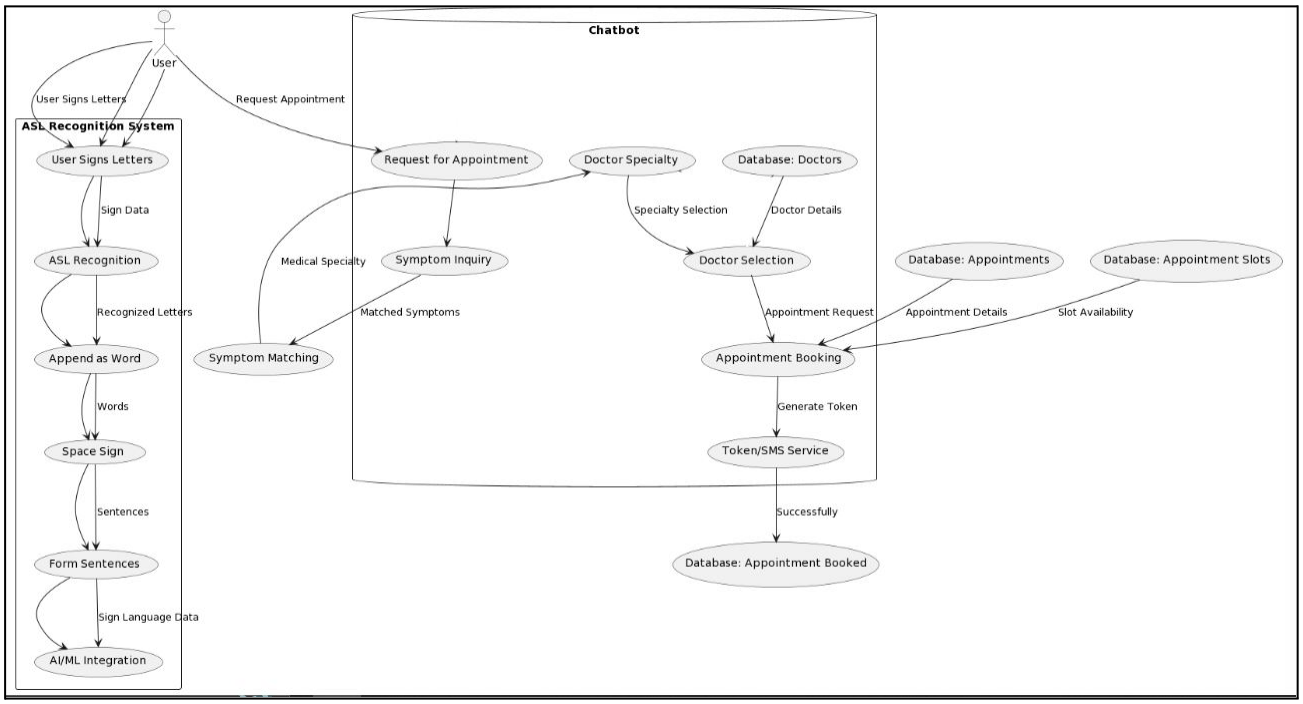


FIG 5 Data Flow Diagram

6.2.3.2 Activity Diagram

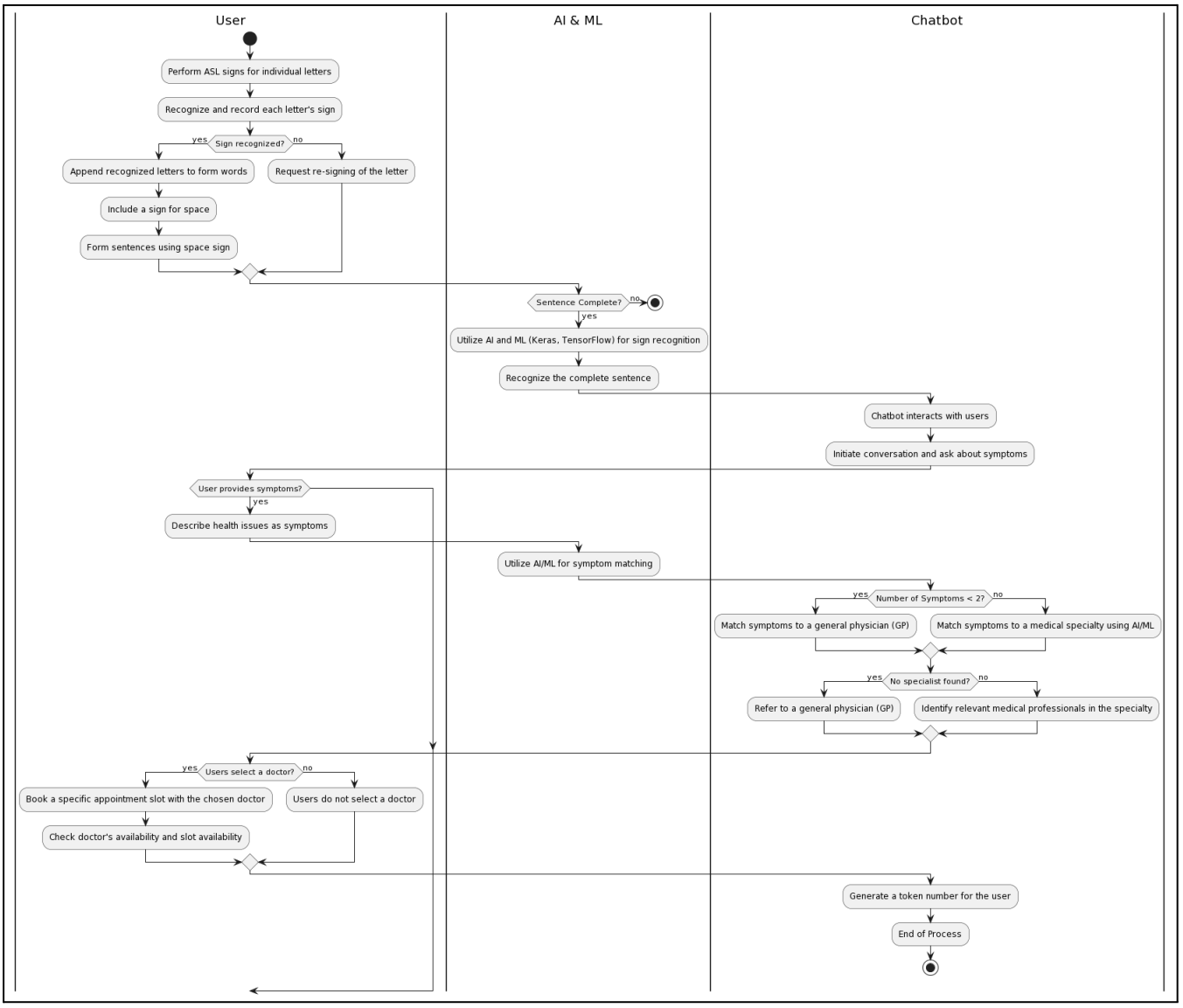


FIG 6 Activity Diagram

6.2.3.3 Use Case

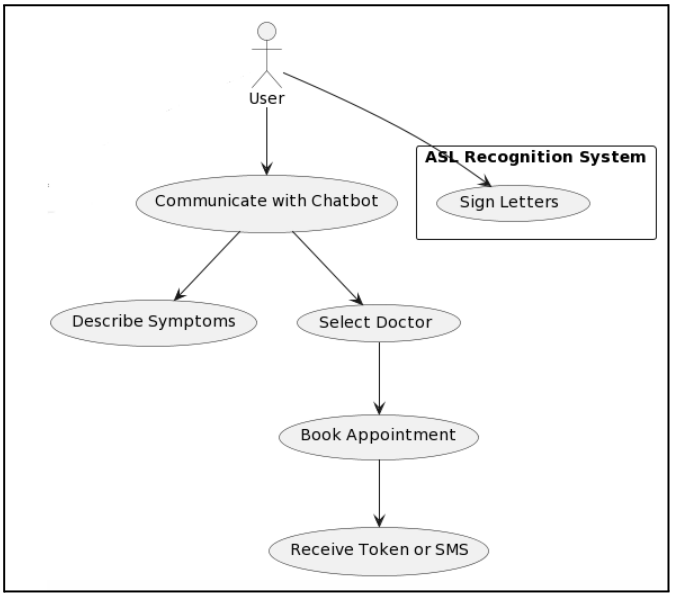


FIG 7. Use Case

6.2.4 DATABASE DESIGN

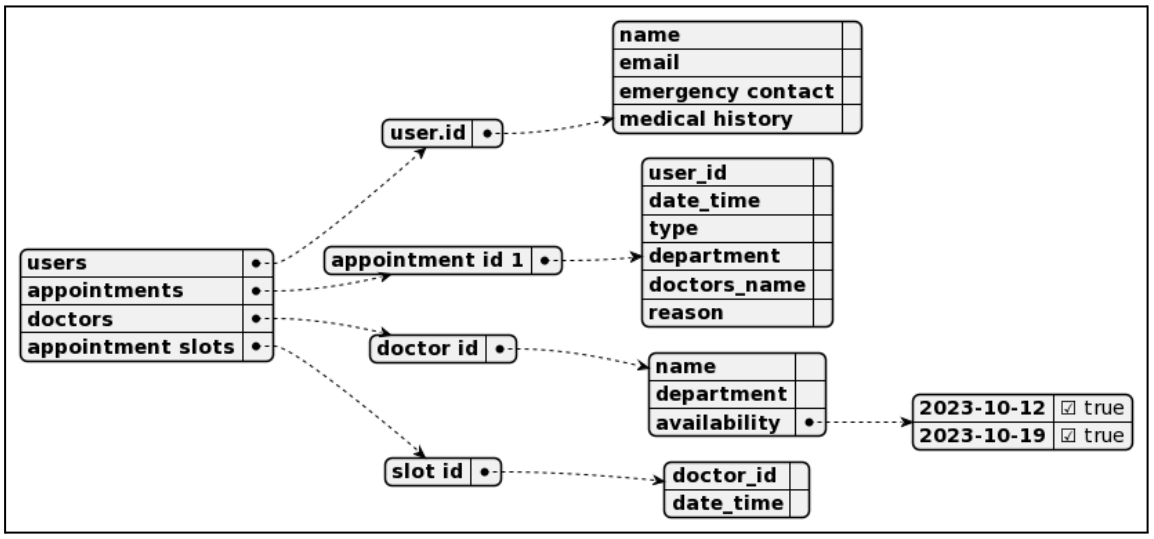
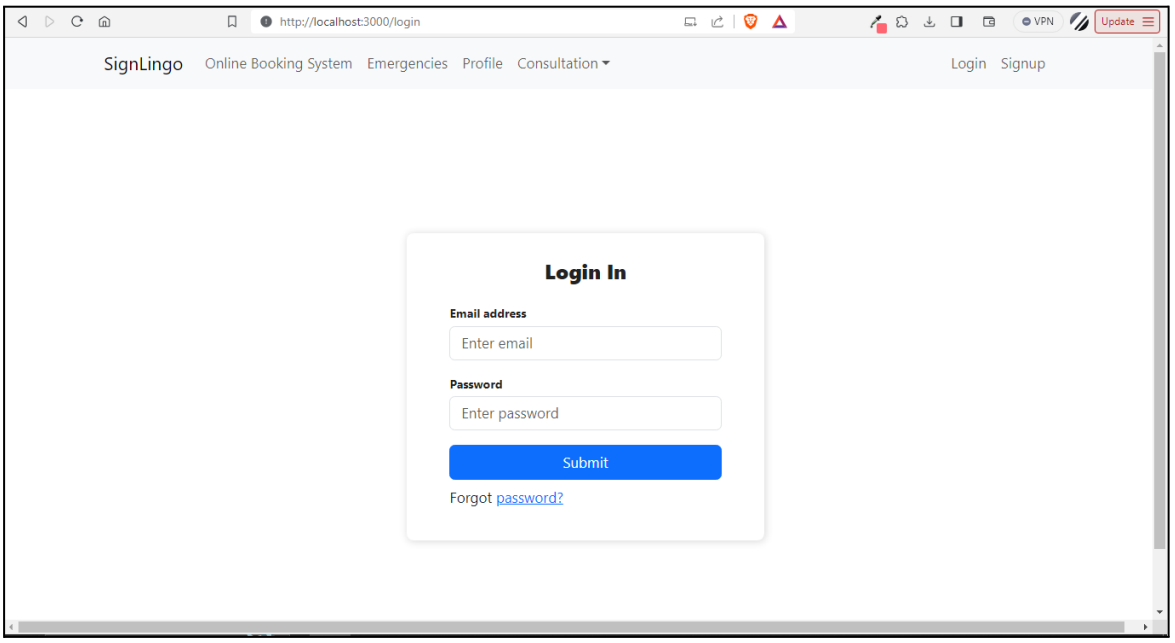
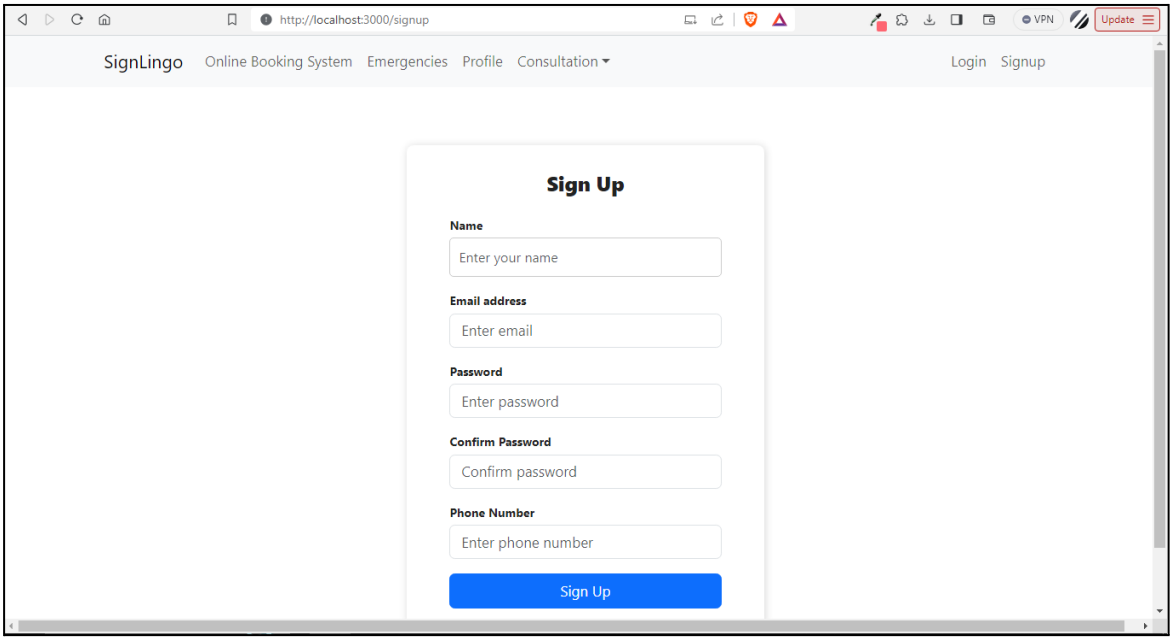
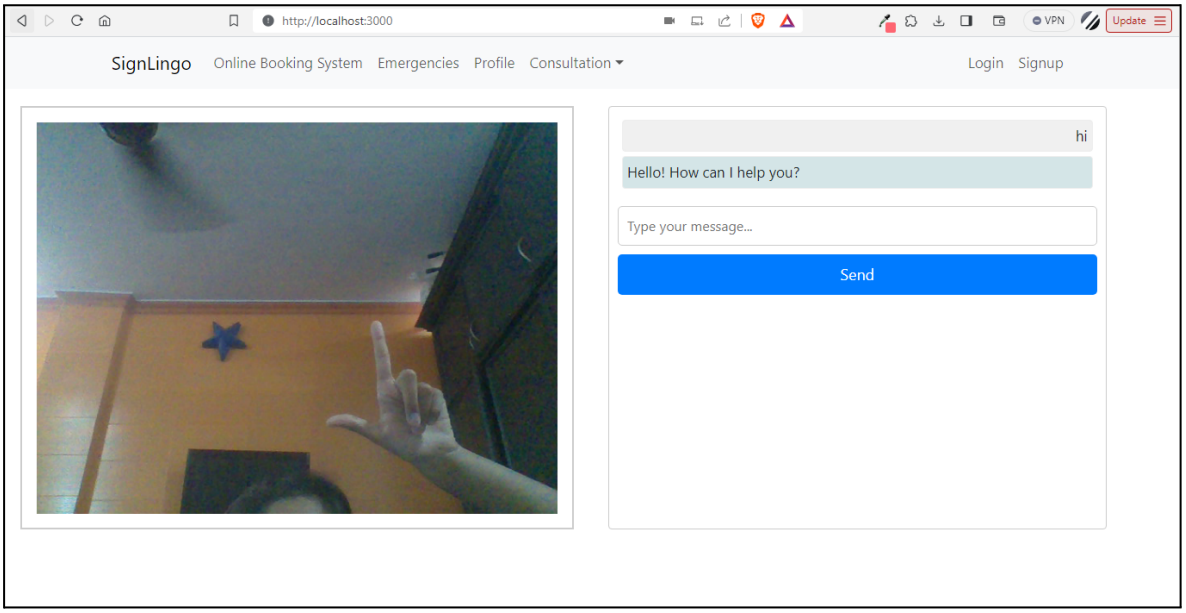


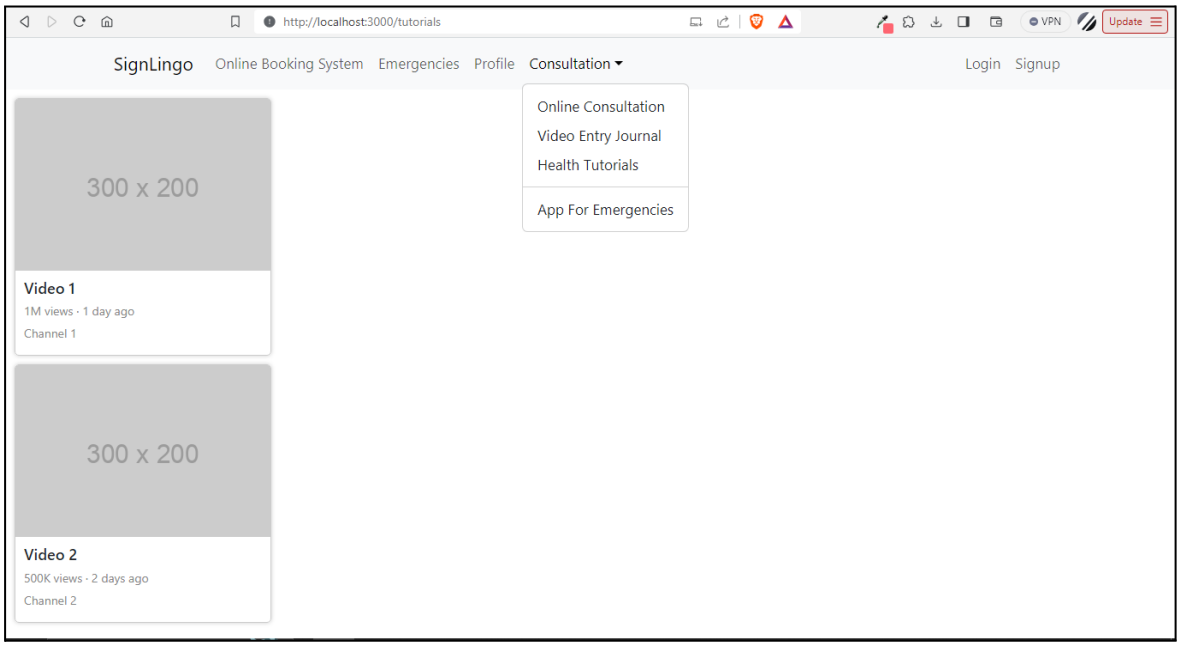
FIG 8 DATABASE DESIGN

6.2.5 UI DESIGN






http://localhost:3000
SignLingo
Online Booking System
Emergencies
Profile
Consultation
Login
Signup
hi
Hello! How can I help you?
Type your message...
Send


http://localhost:3000/tutorials
SignLingo
Online Booking System
Emergencies
Profile
Consultation
Login
Signup
Online Consultation
Video Entry Journal
Health Tutorials
App For Emergencies
300 x 200
Video 1
1M views · 1 day ago
Channel 1
300 x 200
Video 2
500K views · 2 days ago
Channel 2

6.2.6 SOFTWARE AND HARDWARE USED

Software and Hardware Required	Version/Configuration	Reasoning
Laptop with webcam	• Processor - Intel Core i5 • Memory - RAM 8 GB • Storage - 64GB SSD • Webcam - 2-10 MP	The configurations mentioned helped in the smooth flow in the creation of the project
VSCode Jupyter Notebook Python Libraries	v1.83 v7	

Chapter 7

IMPLEMENTATION

ASL Detection and Recognition

Module 1: MediaPipe for Hand Detection

- Employed MediaPipe for hand detection in video frames, providing a robust foundation for our ASL recognition system.

Module 2: Landmark Points Extraction and Preprocessing

- Implemented an efficient ROI extraction mechanism to pinpoint the hand's location within each frame.
- Transformed the ROI into binary images, enhancing feature extraction for subsequent processing.

Module 3: Keras with TensorFlow for ASL Recognition

- Developed and trained a Neural Network model using Keras and TensorFlow, which now recognizes ASL signs.

Chatbot for Appointment Booking

Module 4: Fuzzy Matching for Symptom Matching

- Implemented fuzzy matching using fuzzywuzzy.
- Symptom matching of the dataset and user input.

```python
from fuzzywuzzy import fuzz
from collections import Counter

def match_symptom(user_input, known_symptoms):
    best_match = None
    best_score = 0

    for symptom in known_symptoms:
        score = fuzz.ratio(user_input, symptom)
        if score > best_score:
            best_match = symptom
            best_score = score

    return best_match
```

Module 5: Doctor Speciality Prediction with Scikit-Learn

- We used logistic regression or random forest for doctor speciality prediction.
- Code snippets showing model training.

```python
from sklearn.model_selection import train_test_split
from sklearn.metrics import accuracy_score
from sklearn.linear_model import LogisticRegression
from sklearn.tree import DecisionTreeClassifier
from sklearn.ensemble import RandomForestClassifier
from sklearn.svm import SVC
from sklearn.naive_bayes import GaussianNB
from sklearn.neighbors import KNeighborsClassifier

algorithms = {
    'Logistic Regression': LogisticRegression(),
    'Decision Tree': DecisionTreeClassifier(),
    'Random Forest': RandomForestClassifier(),
    'SVM': SVC(probability=True),
    'NaiveBayes': GaussianNB(),
    'K-Nearest Neighbors': KNeighborsClassifier()
}

X = merged_disease_doctor_df.drop(columns=["Specialty", "Disease"])
y = merged_disease_doctor_df["Specialty"]

X_train, X_test, y_train, y_test = train_test_split(X, y, test_size=0.2, random_state=42)

results = {}

for algo, model in algorithms.items():
    model.fit(X_train, y_train)
    y_pred = model.predict(X_test)

    accuracy = accuracy_score(y_test, y_pred)
    results[algo] = accuracy

# Print the results
for algo, accuracy in results.items():
    print(f"{algo} Accuracy: {accuracy}")

```

Module 6: Chatbot Development and NLP Integration

- We developed the chatbot process, including natural language processing integration.
- Code segment for chatbot logic.

```python
def ask_questions(symptom):
    location = ""
    severity = input(f"On a scale of 1 to 10, how severe is your {symptom}? ")
    duration = input(f"How many days or weeks have you experienced {symptom}? ")
    symptom_info = f"{symptom}: Location: {location}, Severity: {severity}/10, Duration: {duration}"

    return symptom_info

user_input = input("Please describe your symptoms: ")
user_symptoms = user_input.split()
num_symptoms = len(user_symptoms)

symptom_info = {}
for symptom in user_symptoms:
    symptom_info[symptom] = ask_questions(symptom)

user_id = "user_id_1"

if num_symptoms < 2:
    print("You have provided fewer than two symptoms. We recommend seeing a general physician.")

    doctors_ref = db.reference("doctors")
    general_physicians = [doctor for doctor in doctors_ref.get().values() if doctor.get("department") == "General Physician"

    if general_physicians:
        print("General Physicians available:")
        for i, gp in enumerate(general_physicians, start=1):
            print(f"{i}. {gp['name']}")

        user_choice = input("Select a general physician by entering their name: ").lower()

        selected_gp = next((gp for gp in general_physicians if gp['name'].lower() == user_choice.lower()), None)

        if selected_gp:
            gp_id = next((key for key, gp in doctors_ref.get().items() if gp['name'] == selected_gp['name']), None)

            if gp_id:
                slots_ref = db.reference(f"doctors/{gp_id}/availability")
                available_slots = [slot for slot, is_available in slots_ref.get().items() if is_available]

                if not available_slots:
                    print("No available slots for this doctor. Please try again later.")
                else:
                    print("Available slots:")
```

Deployment and Maintenance

Module 7: Deployment Tools and Processes

Tools and Technologies:

- Django Backend: Our deployment strategy is centered around Django, a robust web framework. Django provides the foundation for our backend services.
- React Frontend: We leverage React, a powerful JavaScript library, to build an interactive and dynamic user interface. React serves as the frontend component, ensuring a seamless user experience.

Deployment Approach:

- RESTful API Development: With Django, we construct a RESTful API that powers the backend. This API facilitates communication with our React frontend, enabling the exchange of data.
- API Endpoints: We create well-defined API endpoints that serve as gateways for data transmission between the backend and the frontend. Each endpoint corresponds to a specific functionality.

User Interaction:

- React Integration: React seamlessly integrates with our Django backend through these API endpoints. It provides an intuitive and responsive user interface, making interactions enjoyable for users.

Chapter 8

RESULTS

This project has been partially successful on its path to make the hospital management system effiient to use for the deaf community utilizing American Sign Language (ASL) to text technology. By introducing a unique approach that takes advantage of the faster signing speed of ASL users, we have made significant strides in enhancing accessibility and inclusivity for individuals with hearing impairments.

The system is developed to be highly compatible with various devices and platforms. This ensures that users can conveniently access our system from their preferred device. We have developed a system to successfully recognize ASL and interpret it to text. The chatbot developed, helps to book an appointment by asking questions. It also matches the user to a doctor based on the symptoms described.

As the individual components are developed, we aim to integrate these system and develop a fully functional website.

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APPENDIX-II

<<Plagiarism Report>>