VISVESVARAYA TECHNOLOGICAL UNIVERSITY
"JNANA SANGAMA", BELAGAVI-590018

MINIPROJECT (BCA586)

REPORT ON

"SignEase"

Submitted in partial fulfilment of the requirements for the award of the degree of

Bachelor of Engineering

In

Computer Science & Engineering (Artificial Intelligence)

By

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1DT22CA011

Under the guidance of

Prof. Priyanka V

Asst. Prof, Dept. Of CSE(AI)

Affiliated to VTU , Approved by AICTE ,Accredited by NAAC with A+ Grade ,
6 Programs Accredited by NBA (CSE, ISE, ECE, EEE, MECH, CV)

Department of Computer Science & Engineering (Artificial Intelligence)

DAYANAND SAGAR ACADEMY OF TECHNOLOGY AND MANAGEMENT

#Opp Art of Living , Kanakapura Main Road, Bengaluru-560082

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CERTIFICATE

This is to certify that Mini Project work entitled **"SignEase"** is carried out by **Bellapukonda Pooja** bearing USN **"1DT22CA011"** bonafide student of **DAYANAND SAGAR ACADEMY OF TECHNOLOGY AND MANAGEMENT**, in the partial fulfilment for the award of the **Bachelor of Engineering** in Computer Science & Engineering (Artificial Intelligence) of the **Visvesvaraya Technological University, Belagavi**, during the year 2023-24. It is certified that all corrections/suggestions indicated for Internal Assessment have been incorporated in the report deposited in the departmental library. The mini-project report has been approved as it satisfies the academic requirements in respect of Mini Project work prescribed for the said degree for the Fifth semester.

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ACKNOWLEDGEMENT

I take this opportunity to thank everyone involved in the successful implementation of this mini project. I would like to thank the college for providing me an opportunity to work on the mini project.

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Bellapukonda Pooja

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ABSTRACT

SignEase is an innovative platform designed to empower specially-abled individuals and their families by providing an accessible and efficient way to learn sign language. This web-based tool offers a structured four-week curriculum covering basic gestures, alphabets, and conversational skills. A key feature, SignGPT, leverages AI technology to convert textual inputs into sign language animations, enhancing interactivity and learning. The project aims to bridge the communication gap for the hearing and speech-impaired community, making sign language learning engaging and accessible. The platform's user-friendly design includes interactive videos, daily practice modules, and assessment features to track progress. By utilizing modern web development technologies, SignEase serves as a powerful tool to foster inclusivity and understanding in society.

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INTRODUCTION

Effective communication is a cornerstone of human interaction. However, for the deaf and hard-of-hearing community, expressing themselves and understanding others often presents significant challenges due to the lack of universal accessibility to sign language learning resources. This project, titled "SignEase," aims to address these barriers through an innovative platform that simplifies the learning of sign language in an interactive and structured manner.

1.1 Problem Statement

The primary issue lies in the limited accessibility and availability of resources for learning sign language. Existing tools often lack interactivity, real-time feedback, or a structured curriculum, making the learning process daunting for many users. Furthermore, the absence of a tool that can dynamically translate text into sign language gestures further hinders inclusivity for individuals aiming to bridge the communication gap with the deaf community.

1.2 Need to Solve the Problem

The inability to communicate effectively with the deaf and hard-of-hearing population creates a divide that impacts social inclusion, education, and professional opportunities. Addressing this challenge is crucial to fostering inclusivity and breaking down communication barriers. A user-friendly platform that integrates structured learning, real-time feedback, and text-to-sign translation capabilities can make a significant difference in bridging this gap, enabling more individuals to connect meaningfully with the deaf community.

1.3 Purpose of Project

This project proposes the development of "SignEase," a comprehensive web-based platform designed to teach American Sign Language (ASL) in just four weeks. The platform will feature:

- A well-structured curriculum divided into weekly and daily lessons, incorporating instructional videos and assessments.
- An AI-powered tool, "SignGPT," to dynamically convert user-entered text into animated sign language gestures.
- Interactive modules leveraging machine learning and computer vision for real-time gesture recognition and practice feedback.
- A responsive and visually appealing interface to ensure an engaging user experience.
- Analytics and progress tracking to personalize the learning journey and enhance user outcomes.

By combining state-of-the-art technologies like artificial intelligence, web development frameworks, and video integration, SignEase seeks to provide an accessible, engaging, and effective learning solution that empowers users to master sign language efficiently.

CHAPTER : 02

PREVIOUS STUDIES IN THE SAME PROBLEM AREA

1. “Computer Vision and AI” – Authors GabrielSerrano, Daehan Kwak[1]

Features : Real-time Gesture Detection Deep Learning Integration Robustness to Environmental Variations Multi-modal Input Handling

Challenges : Gesture Variability Environmental Conditions Real-time Processing Dynamic Gesture Complexity Data Limitations.

2. “Deep Learning Approaches” – Authors Tangfei Tao, Yizhe Zhao[2]

Features : Traditional and Deep Learning Approaches. Comprehensive Gesture Recognition. Multi-modal Data Utilization. Dataset Standardization and Benchmarking. Accuracy Improvement through Advanced Models.

Challenges : Inconsistencies in Gesture Datasets. Handling Dynamic Gesture Sequences. Scalability to Different Sign Languages. Real-time Processing Limitations. Balancing Accuracy with Computational Efficiency

3. “Convolutional Neural Networks” – Authors Saurav Kumar, Pratiyush Kumar[3]

Features : Use of Convolutional Neural Networks (CNNs).Real-time Hand Gesture and Sign Recognition. High Accuracy in Gesture Classification. Scalability for Diverse Sign Languages. Robustness to Variations in Background and Lighting.

Challenges : Handling Variations in Hand Shape and Motion. Computational Demands of Deep Learning Models. Need for Large, Annotated Gesture Datasets. Real-time Accuracy vs. Processing Speed Trade-off. Generalization Across Different Users and Environments.

CHAPTER 3

REQUIREMENT SPECIFICATION

3.1 HARDWARE REQUIREMENTS

Processor : Intel Core i5 or equivalent
Memory : Minimum 8GB RAM

3.2 SOFTWARE REQUIREMENTS

Programming Language : python 3.9
IDE: visual studio code
Operating System: Windows 11
Web Browser: Google chrome

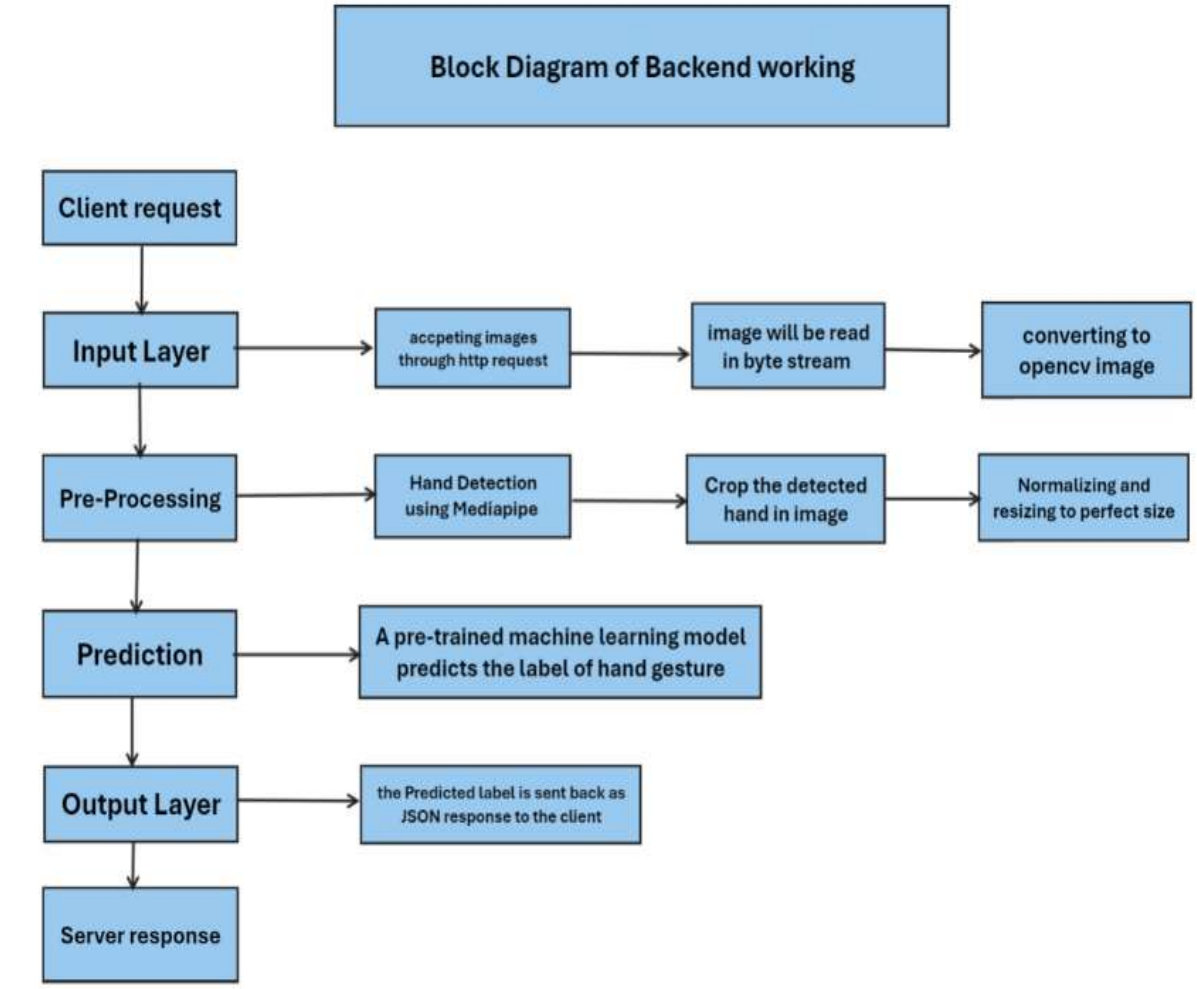
3.3 TECHNOLOGY

Machine leaning model: Data processing model and trained model
Chatbot: AI-powered, trained to handle queries related to the course
Backend: Node.js with MySQL for dynamic data management.

CHAPTER 4

METHODOLOGY

4.1 Flowchart of the work



4.2 Explanation of methodology

The backend for SignEase is designed to seamlessly process user requests and provide robust functionality. The backend starts with the Input Layer, where it accepts HTTP requests for various functions like user login, signup, and content navigation. For gesture recognition, images are submitted as byte streams and converted to the OpenCV format. The Pre-Processing Layer detects hand gestures using MediaPipe, crops the detected hand region, and normalizes the image for further processing.

Next, the Prediction Layer leverages a pre-trained machine learning model to classify hand gestures and generate corresponding labels. The Output Layer sends the results back as a JSON response, which is used by the frontend to provide real-time feedback. Additionally, the backend manages the database with MySQL, securely storing user credentials, progress, assessment results, and course content. Python scripts ensure smooth integration of functionalities, such as managing the SignGPT feature and dynamically serving course material.

The frontend of SignEase is designed to be intuitive and user-friendly, ensuring a seamless learning experience. Upon visiting the website, users are greeted with the Main Page, which introduces the platform, displays the motto, outlines the course curriculum, and showcases user feedback and frequently asked questions (FAQs). This page serves as the gateway to the platform and helps users familiarize themselves with the system.

Users can then navigate to the Login/Signup Page to create a new account or log in to an existing one. Once authenticated, they are directed to a central Dashboard, which provides access to multiple options, including Week 1, Week 2, Week 3, Week 4, SignGPT, and the option to return to the main page.

Selecting a specific week opens the corresponding Weekly Page, where users can access content organized into Days 1 to 6. Each day includes Instructional Videos and a short Assessment designed to reinforce learning. These resources are tailored to progressively build the user's understanding and skills. After completing all six days of content, users face a comprehensive Week-End Assessment to evaluate their overall progress for that week.

This frontend workflow ensures that users can navigate effortlessly through the platform, access structured learning content, and track their progress. The integration of SignGPT allows users to explore advanced functionalities, making the platform highly interactive and engaging.

CHAPTER 5

RESULTS

5.1 Outcomes from the methodology

Although the project is currently in the development phase and yet to be implemented, the proposed methodology is expected to yield significant results. By combining Natural Language Processing (NLP), AI-powered gesture recognition, and real-time feedback mechanisms, the platform is designed to offer an innovative and interactive solution for sign language learning.

Expected outcomes include:

1. **Interactive Learning:** Users will experience an engaging, step-by-step learning journey with instructional videos, daily tasks, and assessments.
2. **Efficient Gesture Recognition:** The integration of Mediapipe and pre-trained ML models ensures accurate detection and classification of hand gestures.
3. **Personalized Feedback:** Immediate and constructive feedback for users practicing gestures will aid skill improvement.
4. **User Progress Tracking:** A dashboard that monitors and displays user progress, providing insights and recommendations to enhance learning outcomes.
5. **Ease of Access:** SignGPT's ability to convert text into animated sign gestures will simplify communication and enhance understanding for learners.

5.2 Comparison with other ML models if using machine learning

When using machine learning for gesture recognition, the performance of the implemented model can be benchmarked against other standard ML models like Support Vector Machines (SVM), Decision Trees, and Convolutional Neural Networks (CNNs).

Expected comparisons include:

1. **Accuracy:** Models like CNNs tend to outperform traditional ML algorithms in image-based tasks due to their ability to learn hierarchical features directly from data.
2. **Real-Time Performance:** By using Mediapipe and TensorFlow, the proposed system is anticipated to achieve faster real-time gesture recognition compared to older approaches like SVM, which may struggle with scalability.
3. **User Experience:** Unlike other systems, this project prioritizes an end-to-end user experience that combines learning modules, feedback, and progress tracking in a single platform.

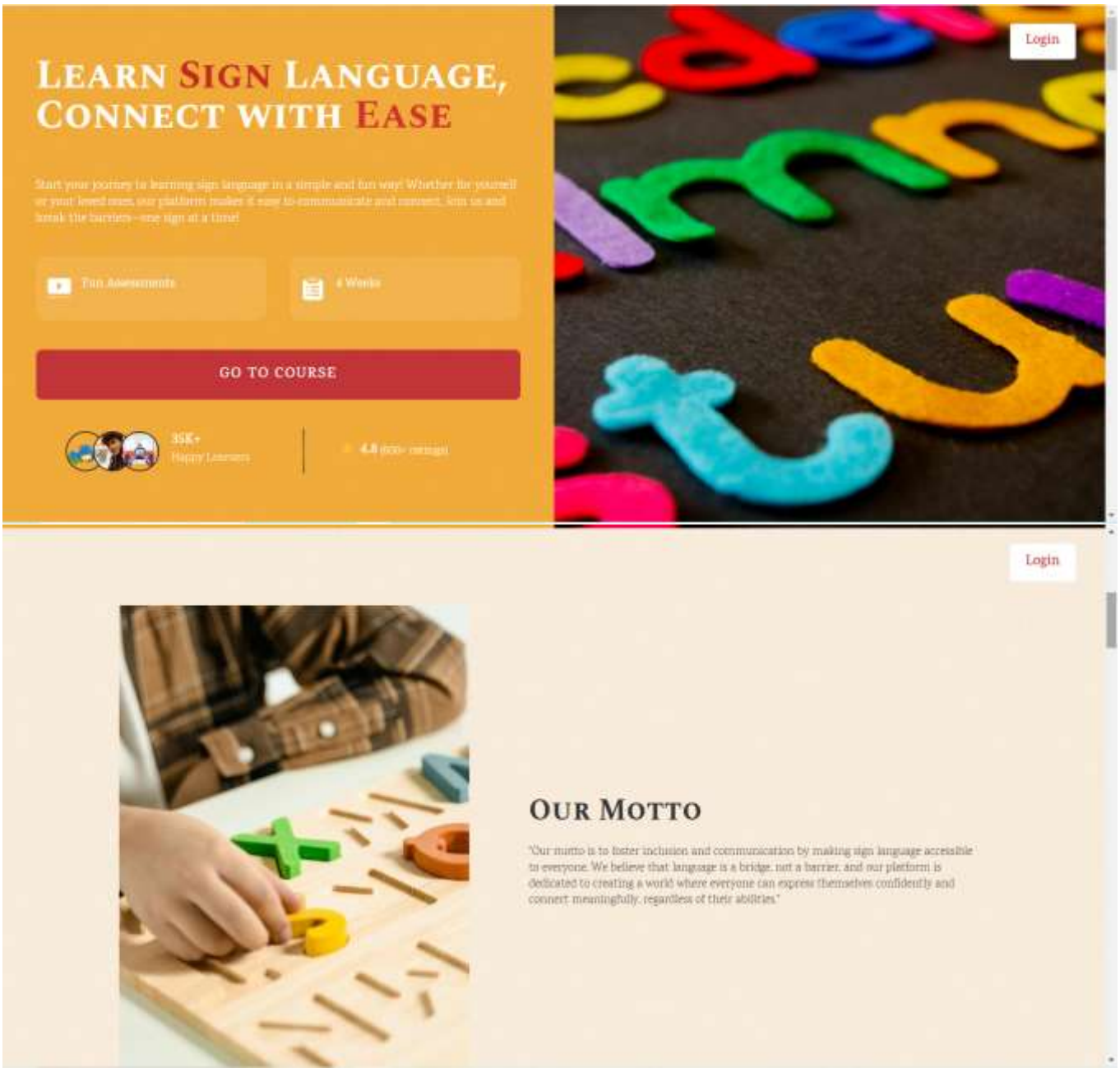
Future implementation and testing will validate these outcomes and comparisons, ensuring the system meets its intended goals effectively.

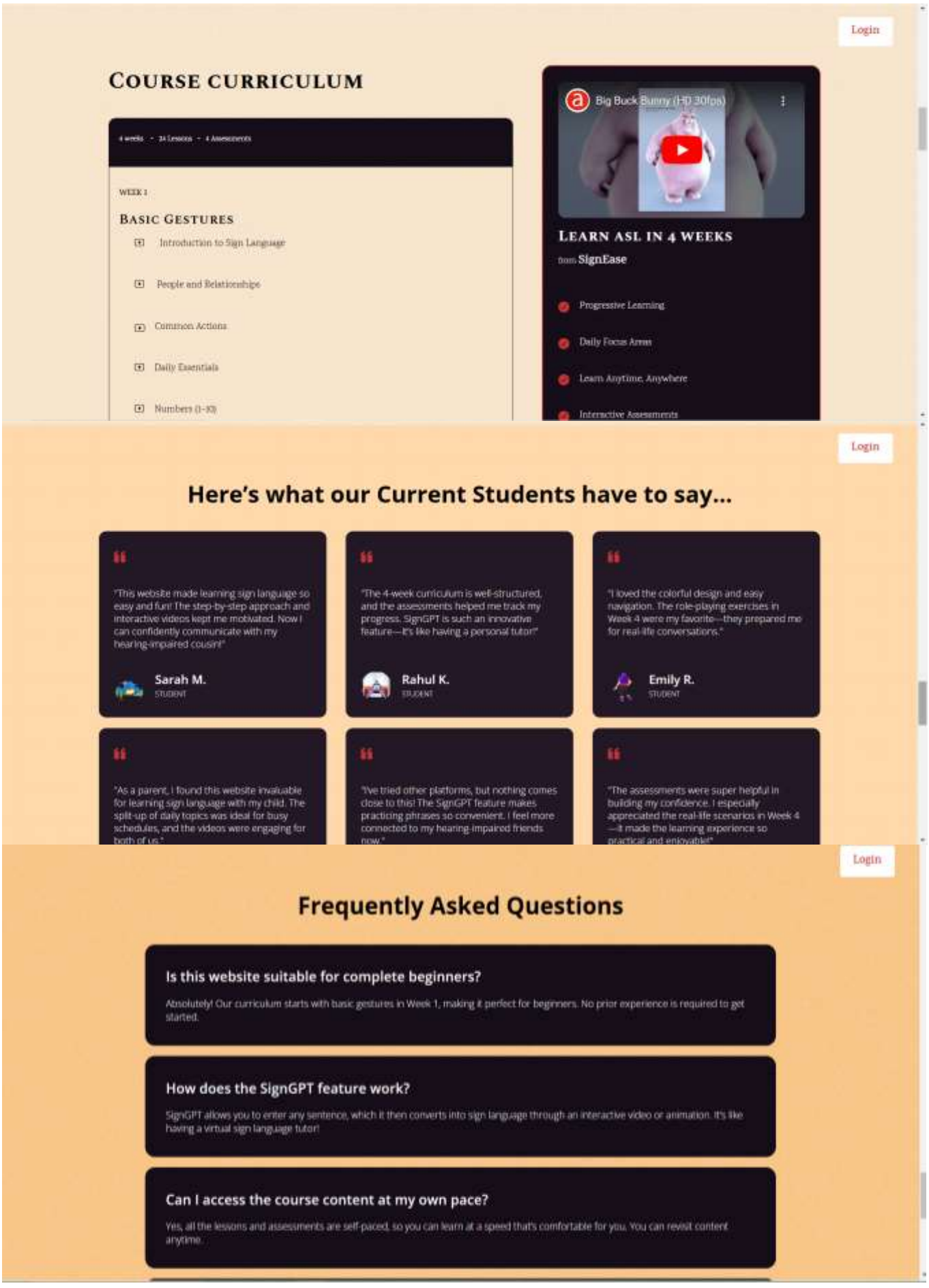
CHAPTER 6

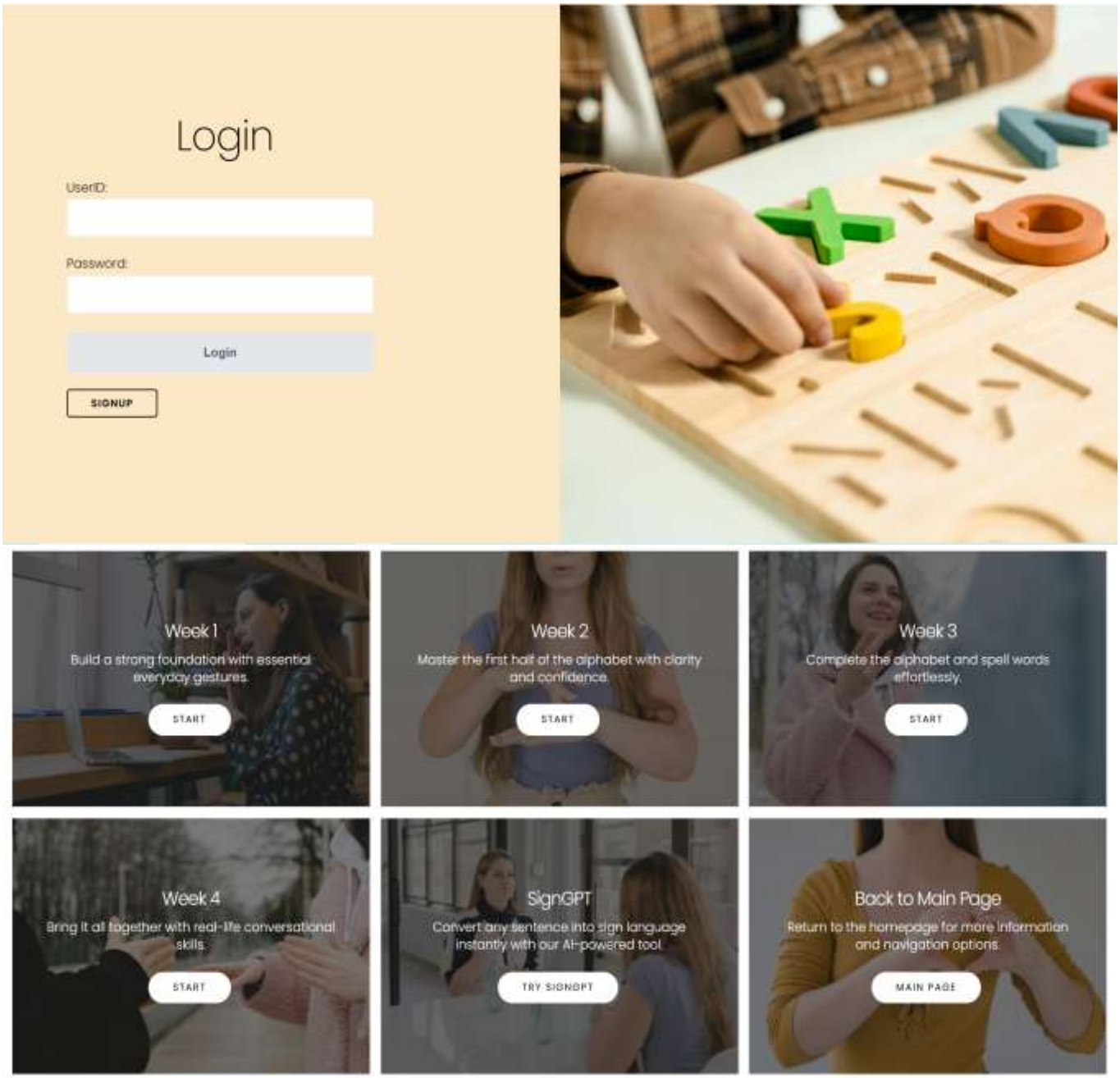
IMPLEMENTATION OUTCOMES

This chapter focuses on the implementation process of the SignEase platform, highlighting key outcomes from the integration of machine learning models, dataset handling, and user interface development. The implementation ensures a seamless connection between AI-powered features, such as SignGPT and gesture recognition, and user-centric functionality, resulting in an accessible and interactive learning system.

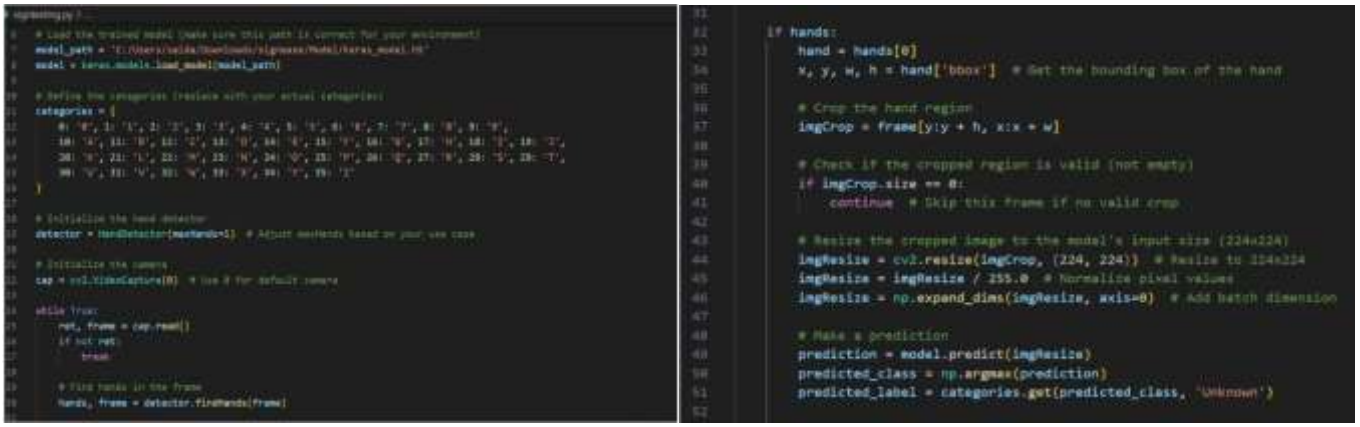
6.1 Front-end




Login
COURSE CURRICULUM
4 weeks • 24 Lessons • 4 Assessments
WEEK 1
BASIC GESTURES
Introduction to Sign Language
People and Relationships
Common Actions
Daily Essentials
Numbers (1-10)
Big Buck Bunny (HD 30fps)
LEARN ASL IN 4 WEEKS
from SignEase
Progressive Learning
Daily Focus Areas
Learn Anytime, Anywhere
Interactive Assessments
Login
Here's what our Current Students have to say...
"This website made learning sign language so easy and fun! The step-by-step approach and interactive videos kept me motivated. Now I can confidently communicate with my hearing-impaired cousin!"
Sarah M.
STUDENT
"The 4-week curriculum is well-structured, and the assessments helped me track my progress. SignGPT is such an innovative feature—it's like having a personal tutor!"
Rahul K.
STUDENT
"I loved the colorful design and easy navigation. The role-playing exercises in Week 4 were my favorite—they prepared me for real-life conversations."
Emily R.
STUDENT
"As a parent, I found this website invaluable for learning sign language with my child. The split-up of daily topics was ideal for busy schedules, and the videos were engaging for both of us."
"I've tried other platforms, but nothing comes close to this! The SignGPT feature makes practicing phrases so convenient. I feel more connected to my hearing-impaired friends now."
"The assessments were super helpful in building my confidence. I especially appreciated the real-life scenarios in Week 4—it made the learning experience so practical and enjoyable!"
Login
Frequently Asked Questions
Is this website suitable for complete beginners?
Absolutely! Our curriculum starts with basic gestures in Week 1, making it perfect for beginners. No prior experience is required to get started.
How does the SignGPT feature work?
SignGPT allows you to enter any sentence, which it then converts into sign language through an interactive video or animation. It's like having a virtual sign language tutor!
Can I access the course content at my own pace?
Yes, all the lessons and assessments are self-paced, so you can learn at a speed that's comfortable for you. You can revisit content anytime.



6.2 Back-end



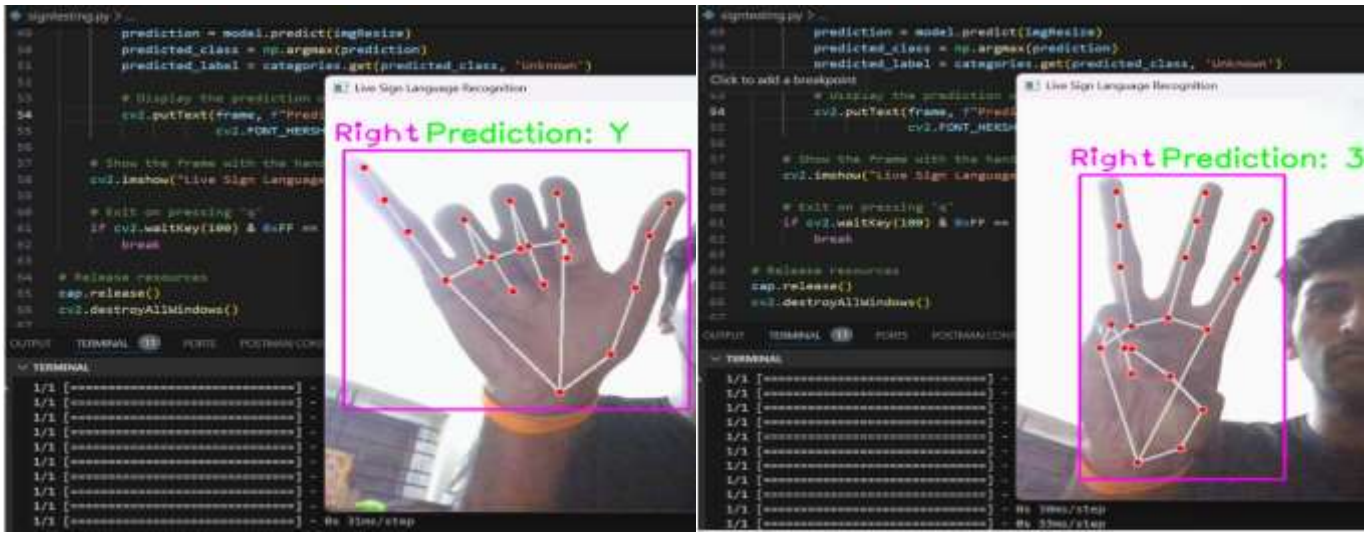
```
    if hands:
        hand = hands[0]
        x, y, w, h = hand['bbox']  # Get the bounding box of the hand

        # Crop the hand region
        imgCrop = frame[y:y + h, x:x + w]

        # Check if the cropped region is valid (not empty)
        if imgCrop.size == 0:
            continue  # Skip this frame if no valid crop

        # Resize the cropped image to the model's input size (224x224)
        imgResize = cv2.resize(imgCrop, (224, 224))  # Resize to 224x224
        imgResize = imgResize / 255.0  # Normalize pixel values
        imgResize = np.expand_dims(imgResize, axis=0)  # Add batch dimension

        # Make a prediction
        prediction = model.predict(imgResize)
        predicted_class = np.argmax(prediction)
        predicted_label = categories.get(predicted_class, 'Unknown')
```


Right Prediction: Y
Right Prediction: 3

CHAPTER : 07

CONCLUSION

The development of the SignEase platform addressed the problem statement by providing an innovative, interactive, and accessible solution for learning sign language. The following conclusions were reached:

1. **Enhanced Accessibility:** The platform bridges the communication gap for individuals aiming to learn sign language by offering a structured, user-friendly, and efficient learning environment.
2. **Seamless Integration of Technology:** By utilizing AI-powered tools like SignGPT, gesture recognition with machine learning models, and real-time feedback, the platform demonstrates how advanced technologies can be harnessed for educational purposes.
3. **Improved Learning Outcomes:** The weekly structure, daily tasks, and assessments ensure consistent progress, while personalized feedback enhances user engagement and learning effectiveness.
4. **Scalable and Inclusive Design:** The modular approach of the platform allows for future scalability, making it adaptable for multiple sign languages and broader accessibility.
5. **User-Centric Design:** The focus on intuitive navigation and responsive design ensures that users, regardless of their technical proficiency, can effectively use the platform to meet their learning goals.

The implementation of SignEase showcases how innovative technological solutions can address critical challenges in education, fostering inclusivity and empowerment for individuals learning sign language.

CHAPTER :08

FUTURE SCOPE AND ENHANCEMENT

The SignEase platform has the potential for significant growth and expansion in the future, with several opportunities for improvement and enhancement:

1. **Support for Multiple Sign Languages:** Expand the platform to include support for different sign languages worldwide, such as British Sign Language (BSL), Indian Sign Language (ISL), and others, to cater to a global audience.
2. **Gamification:** Incorporate gamification elements like badges, leaderboards, and rewards to enhance user engagement and motivation throughout the learning journey.
3. **Voice-to-Sign Translation:** Add functionality to convert spoken language into sign language animations in real-time, making the platform even more versatile.
4. **Advanced AI for Gesture Recognition:** Improve the accuracy of gesture recognition by integrating more advanced machine learning models or deep learning techniques, ensuring precise feedback during practice.
5. **Offline Mode:** Develop an offline version of the platform to enable users in areas with limited internet connectivity to access learning materials and practice modules.
6. **Community Features:** Introduce community-driven features, such as forums, peer-to-peer practice sessions, and live sessions with experts, to foster interaction and collaborative learning.
7. **Accessibility Enhancements:** Further improve accessibility for individuals with additional disabilities, such as visual or hearing impairments, by integrating tools like screen readers or haptic feedback devices.
8. **Mobile Application:** Create a mobile application for the platform, making it more accessible and convenient for users to learn on-the-go.
9. **Integration with AR/VR:** Explore the use of augmented reality (AR) and virtual reality (VR) to provide an immersive learning experience, allowing users to interact with a virtual environment for practicing gestures.
10. **Expanded Curriculum:** Add advanced sign language courses and specialized modules, such as conversational skills, technical vocabulary, and professional scenarios, to cater to different user needs.

These future enhancements will further solidify SignEase as a comprehensive, inclusive, and globally accessible platform for learning sign language.

CHAPTER : 09

REFERENCES

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2. Tangfei Tao; Yizhe Zhao; Tianyu Liu; Jieli Zhu; “Sign Language Recognition: A Comprehensive Review of Traditional and Deep Learning Approaches, Datasets, and Challenges”; IEEE Access (Volume: 12)

3. Saurav Kumar; Pratiyush Kumar; Priyesh Mishra; Pragya Tewari;“A Robust Sign Language and Hand Gesture Recognition System Using Convolutional Neural Networks”; 2023 5th International Conference on Advances in Computing, Communication Control and Networking (ICAC3N)