A Mini Project Synopsis on

SignConnect:

A seamless connection, from voice to sign

T.E. - D.S Engineering

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CERTIFICATE

This is to certify that the Mini Project report on SignConnect: A seamless connection, from Voice to Sign has been submitted by Vedant Parulekar (21107034), Umesh Pawar (21107014), Dalbirsingh Matharu (21107005), Tanaya Patil (21107017) who are Bonafide students of A. P. Shah Institute of Technology, Thane, Mumbai, as a partial fulfillment of the requirement for the degree in **CSE(DATA SCIENCE)**, during the academic year **2023-2024** in a satisfactory manner as per the curriculum laid down by the University of Mumbai.

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Chapter 1

Introduction

It is said that Sign language is the mother language of deaf people. This includes the combination of hand movements, arms or body, and facial expressions. There are 135 types of sign languages all over the world. Some of them are American Sign Language (ASL), Indian Sign Language (ISL), British Sign Language (BSL), Australian Sign Language (Auslan) and many more. We are using Indian Sign Language in this project. This system allows the deaf community to enjoy all sorts of things that normal people do from daily interaction to accessing information Sign language is communication language used by deaf people using their face, hands, or eyes while using the vocal tract. The sign language recognizer tool is used for recognizing the sign language of deaf and dumb people. Gesture recognition is an important topic due to the fact that segmenting a foreground object from a cluttered background is a challenging problem. There is a difference when a human looking at an image and a computer looking at an image. For Humans, it is easier to find out what is in an image but not for a computer. It is because of this, that computer vision problems remain a challenge. Sign language is a language that consists of signs made with hands and other movements, facial expressions, and postures of the body, it is primarily used by people who are deaf or hard of hearing people so that they can easily express their thoughts or communicate with other people. Sign language is very important as far the deaf people are concerned for their emotional, social, and linguistic growth. The first language for deaf people is sign language which proceeded bilingually with the education of national sign language as well as national written or spoken language. There are different communities of deaf people all around the world therefore the sign language for these communities will be different. The different sign languages used by different communities are America uses American Sign Language, Britain sign language is used by Britain, similarly, India uses Indian sign language, etc. For expressing thoughts and communicating with each other. IJARSCT ISSN (Online) 2581-9429 International Journal of Advanced Research in Science, Communication and Technology (IJARSCT) Volume 2, Issue 3, April 2022 Copyright to IJARSCT DOI: 10.48175/IJARSCT-3308 539 www.ijarsct.co.in Impact Factor: 6.252 According to 2011 census of India, there are 63 million people which sums up to 6.3% of the total population, who are suffering from hearing problems. Out of these people, 76-89% of the Indian hearing-challenged people have no knowledge of language either signed, spoken, or written. The reason behind this low literacy rate is either the lack of sign

language interpreters, unavailability of Indian Sign Language tools, or lack of research on Indian sign language. Sign language is a natural way of communication for challenged people with speaking and hearing disabilities. There have been various mediums available to translate or to recognize sign language and convert it to text, but text-to-sign language conversion systems have been rarely developed, this is due to the scarcity of any sign language corpus. This is done by eliminating stop words from the reordered sentence. Stemming is applied to convert the words to their root form as Indian sign language does not support inflections of the word. All words of the sentence are then checked against the words in the dictionary containing videos representing each of the words. If the words are not found in the dictionary, their corresponding synonym is used to replace them. The proposed system is innovative as the existing systems are limited to the direct conversion of words into Indian sign languages whereas our system is capable of doing the translation.

1.1 Purpose

The purpose of a "Speech to Sign" system is to break down communication barriers between individuals who are deaf or hard of hearing and those who do not know sign language. By seamlessly translating spoken language into sign language, this technology aims to empower individuals with hearing disabilities to engage in effective and meaningful communication in various aspects of their lives, from education and healthcare to social interactions and employment. Additionally, it serves as an educational tool, helping users, both deaf and hearing, to learn and understand sign language, fostering inclusivity, and bridging the gap between diverse linguistic and communication needs. Ultimately, the purpose of such a system is to promote accessibility, equity, and equal opportunities for all individuals, regardless of their hearing abilities, fostering a more inclusive and connected society.

1.2 Objectives

Creating an ASR system with a 90% accuracy rate for the target spoken language(s) necessitates extensive data collection and deep learning techniques. This technology aims to transcribe spoken language into text, benefiting various applications.

Developing a system for Indian Sign Language animations or text-based representations requires advanced computer vision and machine learning algorithms capable of recognizing and interpreting sign language gestures. It bridges communication gaps for the hearing-impaired population.

Designing a user-friendly interface is crucial. This interface should cater to speakers and individuals with hearing disabilities, providing an intuitive, accessible experience. Features such as voice and gesture recognition should be seamlessly integrated, and customization options considered for individual needs.

Inclusivity is at the core of this project, with accessibility features like text-to-speech, speech-to-text, and compatibility with screen readers ensuring a broad user base.

Continuous learning and adaptation are essential to maintain the ASR system's accuracy. Regular updates and feedback integration are vital for sign language recognition as well.

Cultural and linguistic sensitivity is pivotal, considering the nuances of Indian Sign Language, fostering acceptance, and effectiveness.

Integration with various devices, applications, and services promotes widespread adoption. Security measures, including data encryption and privacy controls, must be robust.

Scalability and localization efforts expand the system's reach to other sign languages, promoting global inclusivity.

User training and support are crucial to ensure users can confidently utilize this technology for effective communication. This multi-faceted approach blends advanced technology with cultural understanding, fostering inclusivity and communication enhancement.

1.3 Scope

Designing a user-friendly platform that is accessible to both speakers and individuals with hearing disabilities is a transformative endeavour. This platform, when integrated into the medical industry, has the potential to revolutionize patient care. Medical professionals can utilize it for seamless and accurate communication with deaf or hard-of-hearing patients during appointments. This not only enhances the patient's healthcare experience but also ensures crucial medical information is exchanged effectively, reducing the risk of miscommunication.

In the business industry, this technology becomes a valuable asset. Businesses can implement it in customer service operations, such as hotlines and chat services, to cater to deaf or hard-of-hearing customers. This ensures that all customers, regardless of their hearing abilities, receive the support and service they need, contributing to customer satisfaction and loyalty.

The cross-industry application of this platform underscores its versatility and societal impact. It fosters improved communication, understanding, and accessibility, breaking down barriers in both medical and business contexts. Ultimately, it champions inclusivity and equal opportunities, making a significant contribution to a more equitable and accessible world for all.

Chapter 2

Problem Definition

The problem addressed by a "Speech to Sign" system is the pervasive and often profound communication barrier experienced by individuals who are deaf or hard of hearing when interacting with the wider world. This barrier stems from the fundamental mismatch between the auditory nature of spoken language and the visual-gestural nature of sign language. As a result, these individuals encounter challenges in accessing information, services, education, employment, and even basic social interactions.

Traditional solutions, such as sign language interpreters, while essential, are not always available, leading to delays, inefficiencies, and disparities in communication access. Furthermore, the broader population's limited knowledge of sign language exacerbates this problem, resulting in persistent isolation and unequal access to opportunities.

The problem is complex, encompassing the need for immediate, accurate translation of spoken language into sign language to facilitate real-time communication. It also includes the imperative to address the larger societal issue of promoting sign language education and awareness among both deaf and hearing individuals. In essence, the "Speech to Sign" system seeks to alleviate this multifaceted communication challenge, fostering a more inclusive and equitable society by enabling effective cross-language communication and encouraging broader sign language literacy.

Chapter 3

Proposed System

The proposed "Speech to Sign" system aims to provide an innovative and comprehensive solution for bridging the communication gap between individuals who are deaf or hard of hearing and those who do not know sign language. This system will leverage cutting-edge technology and educational resources to create a user-friendly and accessible platform.

3.1 Features and Functionalities

Here are the key features and functionalities of a "Speech to Sign" system:

Automatic Speech Recognition (ASR): ASR technology is at the core of this system, responsible for converting spoken language into written text. This foundational component enables the entire translation process by transcribing spoken words accurately, bridging the communication gap between speakers and non-speakers of sign language.

Natural Language Processing (NLP): NLP takes the transcribed text a step further by extracting the meaning, context, and sentiment. This vital step enhances the translation accuracy by understanding the nuances of spoken language, considering factors like tone, idioms, and cultural context, thus making the sign language generation more precise and relevant.

Sign Language Generation: This component is tasked with creating real-time sign language animations or images that correspond to the transcribed speech. It's a crucial element for effective communication, ensuring that the system can convey the meaning of spoken words in a visual form understandable to the deaf or hard of hearing.

Real-time Translation: Facilitating immediate and seamless translation is the ultimate goal of the system. This feature enables natural, dynamic conversations between speakers of spoken language and users of sign language, ensuring real-time communication and inclusivity.

User-Friendly Interface: A user-friendly interface is essential for both inputting spoken language and viewing sign language output. It should be intuitive and easy to navigate, providing a positive user experience for both speakers and individuals with hearing disabilities.

Customization Options: Recognizing that sign language can vary regionally and that individuals may have personal preferences, the system offers customization options. Users can tailor the sign language output to match their specific needs, thereby promoting more personalized and accurate communication.

Accessibility Features: Ensuring inclusivity is a top priority. The system includes accessibility features like voice commands, screen readers, and other adaptive technologies to accommodate users with disabilities. This extends the platform's reach, making it usable by the widest range of individuals.

Chapter 4

Project Outcomes

The outcomes of a "Speech to Sign" project can have a significant impact on various stakeholders and contribute to enhancing accessibility and inclusivity. Here are some key project outcomes:

The user's ability to input spoken language via a microphone or typed text offers a flexible and convenient means of communication. They can simply speak into a microphone or type their message, ensuring that the system accommodates different preferences and accessibility needs.

Receiving real-time sign language translations, either as visual representations of signs or animations, is the crux of this technology. This feature allows the user to immediately comprehend and respond to spoken language, creating a seamless and inclusive communication experience. It bridges the gap between the hearing and the deaf or hard of hearing, fostering greater understanding.

The system's versatility extends to various aspects of life, enabling users to engage in daily communication with hearing individuals who do not know sign language. This has profound implications for both personal and professional settings. In personal interactions, it means users can effortlessly converse with family, friends, and colleagues without relying on intermediaries or written notes.

In professional settings, this technology promotes workplace inclusivity. Deaf or hard-of-hearing individuals can communicate with hearing colleagues and clients more effectively, participating fully in meetings, presentations, and discussions. This fosters equal opportunities in the workplace, contributing to diversity and inclusion.

The reverse feature, where users can understand what someone is trying to communicate via sign language through sign-to-text translation, adds another layer of accessibility. This feature is particularly valuable in instances where the user may encounter individuals who prefer or solely use sign language as their means of communication. By providing this functionality, the system becomes a bridge between different communication modes, ensuring everyone can participate in conversations regardless of their preferred method of expression.

Chapter 5

Software Requirements

Software requirements for the "Speech to Sign" system:

- Operating System (OS):
  The system should be compatible with common OS platforms such as Windows, macOS, and Linux to ensure widespread accessibility.

- Development Environment:
  Choose a suitable integrated development environment (IDE) for software development. Common choices include Visual Studio Code, PyCharm, or Eclipse.

- Programming Languages:
  Utilize programming languages for various components:
  Python for ASR and NLP components.
  HTML, CSS, and JavaScript for the user interface (web-based application).

- Speech Recognition Libraries:
  Depending on your chosen ASR technology, you may need libraries or APIs. For instance: Google Cloud Speech-to-Text API for Google ASR.

- Natural Language Processing Libraries:
  Implement NLP using libraries like NLTK (Natural Language Toolkit), spaCy, or transformers (e.g., Hugging Face's Transformers) for advanced text analysis.

- Web Framework:
  If developing a web-based application, select a suitable web framework like Django, Flask, or Ruby on Rails.

- Sign Language Animation Tools:
  Choose software for creating sign language animations or images, such as Adobe Animate, Synfig Studio, or similar animation tools.

- Version Control:
  Implement version control using Git and host the repository on platforms like GitHub, GitLab, or Bitbucket for collaborative development.

- Web Development Tools:
  Use web development tools like HTML/CSS preprocessors (e.g., SASS/SCSS), JavaScript frameworks (e.g., React, Angular, or Vue.js), and web development extensions for browsers (e.g., React DevTools).

- User Interface (UI) Design Tools:
  Use design software like Adobe XD, Sketch, Figma, or similar tools for UI/UX design.

- Text Editors (for Documentation):
  Utilize text editors such as Microsoft Word, Google Docs, or Markdown editors for documentation and user guides.

- Testing and Quality Assurance Tools:
  Employ testing frameworks (e.g., PyTest for Python) and continuous integration tools (e.g., Jenkins, Travis CI) to ensure software quality.

- Containerization and Deployment Tools:
  Use containerization tools like Docker and deployment platforms like AWS, Heroku, or Google Cloud Platform for hosting and scaling the system.

- Documentation and Knowledge Management:
  Use documentation tools like Confluence, DokuWiki, or Markdown-based documentation systems for documenting the project's progress and knowledge sharing.

- Analytics and User Behavior Tracking:
  Implement analytics tools like Google Analytics or Matomo for tracking user behavior and system usage.

- Backup and Data Recovery Tools:

Develop and implement backup and data recovery strategies using tools appropriate for the chosen database system and hosting environment.

Software requirements for the "Sign to Text" system:

- Operating System (OS):
  Ensure compatibility with common OS platforms such as Windows, macOS, and Linux for widespread accessibility.

- Development Environment:
  Choose an appropriate integrated development environment (IDE) for software development, such as Visual Studio Code, PyCharm, or Eclipse.

- Programming Languages:
  Select programming languages for various project components:
  Python for computer vision and machine learning.
  HTML, CSS, and JavaScript for the user interface.

- Computer Vision Libraries:
  Implement computer vision using libraries like OpenCV for sign language gesture recognition.

- Machine Learning Frameworks:
  Utilize machine learning frameworks such as TensorFlow or PyTorch for building and training sign language recognition models.

- Web Framework:
  If developing a web-based application, select a suitable web framework like Django, Flask, or Ruby on Rails.

- Version Control:
  Implement version control using Git and host the repository on platforms like GitHub, GitLab, or Bitbucket for collaborative development.

- Web Development Tools:
  Use web development tools such as HTML/CSS preprocessors (e.g., SASS/SCSS), JavaScript frameworks (e.g., React, Angular, or Vue.js), and web development extensions for browsers (e.g., React DevTools).

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- Testing and Quality Assurance Tools:
  Employ testing frameworks (e.g., PyTest for Python) and continuous integration tools (e.g., Jenkins, Travis CI) to ensure software quality.

- Security Tools:
  Implement security tools like SSL certificates (for web-based applications), firewall configurations, and intrusion detection systems to protect user data.

- Collaboration and Communication Tools:
  Utilize communication and collaboration tools such as Slack, Microsoft Teams, or email for team coordination and communication.

- Project Management Tools:
  Employ project management tools like Jira, Trello, or Asana for task tracking, sprint planning, and project coordination.

Chapter 6

Project Design

Speech to Sign:

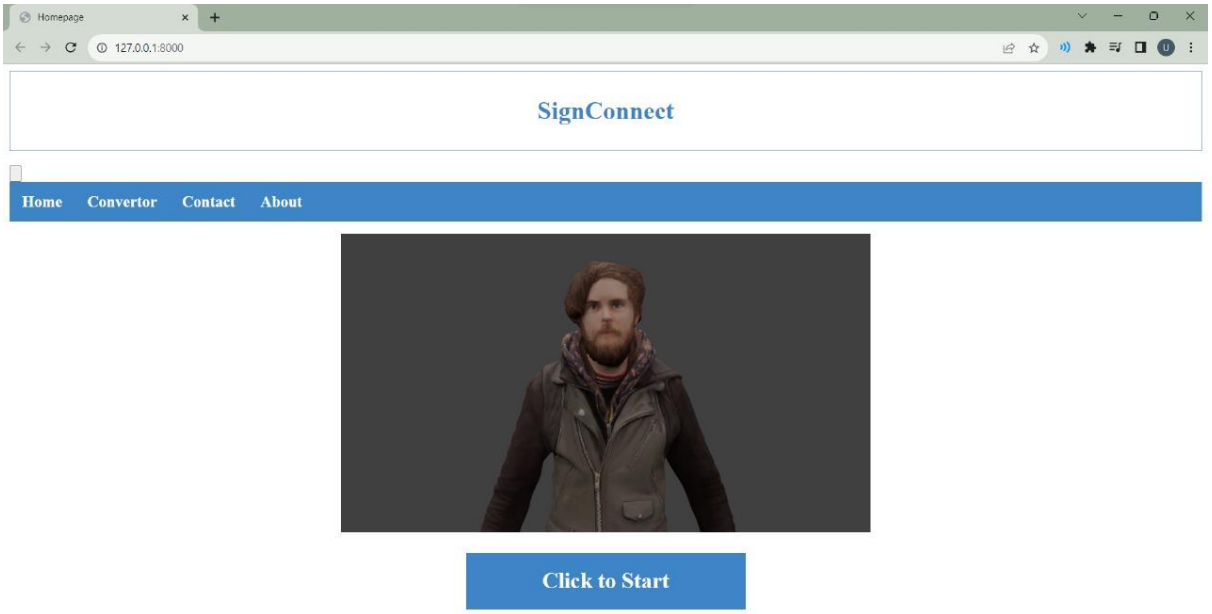

Figure 1
The Home Page

Figure 2
Contact Page

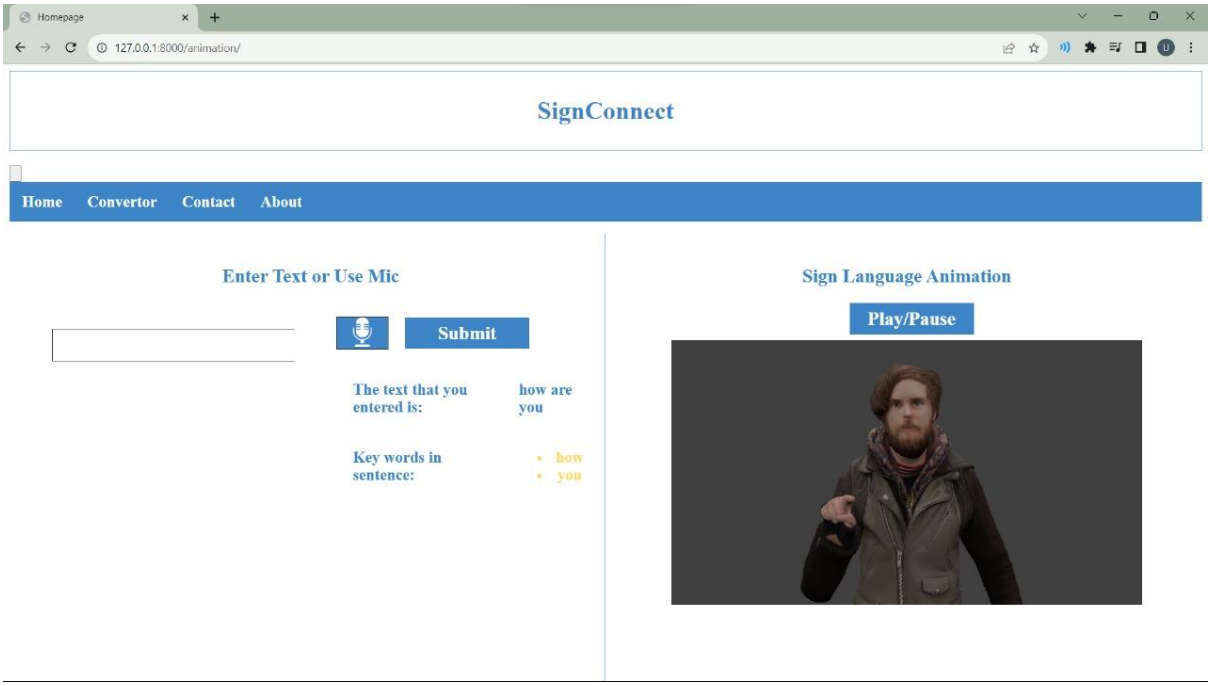

Figure 3
The conversion page from text/audio to sign

Sign to text:

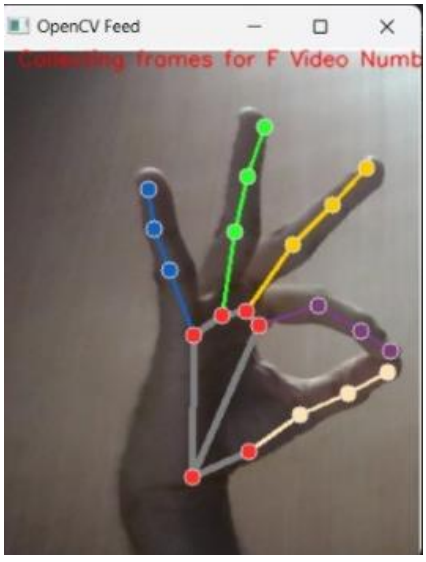

Figure 4

Analysing decision points

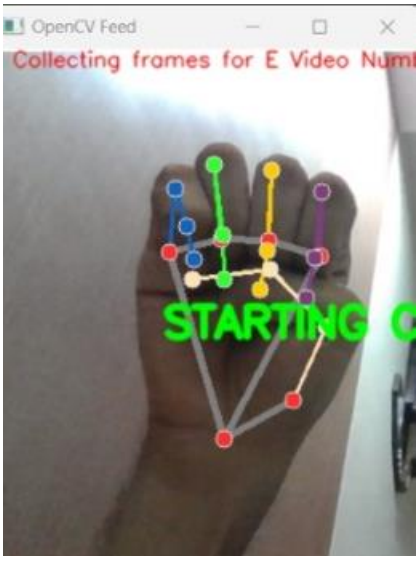

Figure 5

Analysing decision points

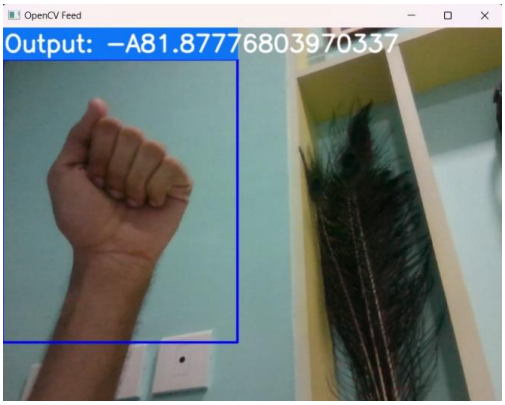

Figure 6
Recognizing alphabets

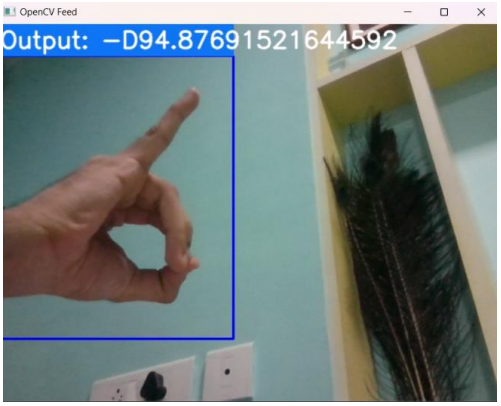

Figure 7
Recognizing alphabets

Chapter 7

Project Scheduling

Sr. No	Group Member	Time duration	Work to be done
1	Vedant Parulekar	**August-November**	Implementing the machine learning algorithm required for the project.
2	Umesh Pawar	**August-November**	Implementing the machine learning algorithm required for the project.
3	Dalbirsingh Matharu	**August-November**	Implementing the GUI of the project.
4	Tanaya Patil	**August-November**	Implementing the GUI of the project.

GANTT CHART

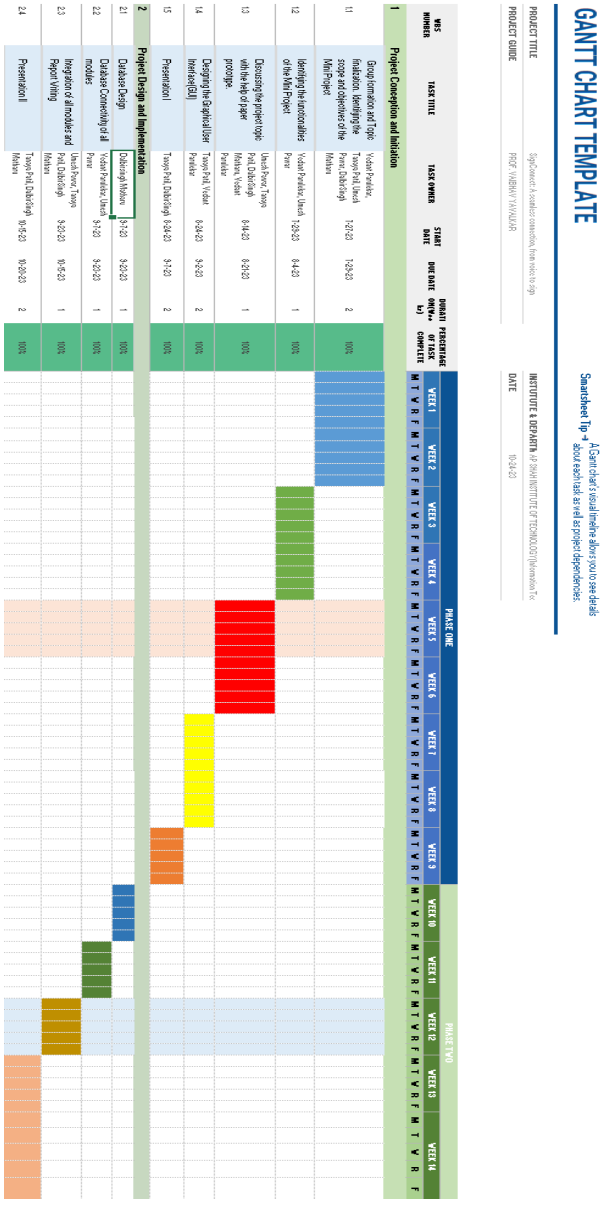

Figure 8
Gantt Chart

Here in the above figure 8, the rows of the chart contain the task titles such as the project conception and initialization as well as the project design and implementation which in subdivision contains the group formation, topic finalizing, prototype, GUI designing, backend implementation etc. The columns contain the duration of the task completed, the percentage of work completed, the number of weeks required to complete a particular task, the specific dates, and the team members who contributed towards the completion of tasks The detailed explanation of the Gantt chart is explained below: The project conception and initiation task were executed by the July month end around 29/07/23. The task of initiation included many more sub-tasks such as group formation and topic finalization which was performed during the 1 week of project initialization. The group formed included 4 members Vedant Parulekar, Umesh Pawar, Dalbirsingh Matharu, and Tanaya Patil, and the finalized topic was SignConnect: A seamless connection from voice to sign. Further, the upcoming week led to the task of identifying the scope and objectives of the mini-projects. This was during the time interval of 29/07/23 to 04/08/23. The next sub-task was to identify the functionalities of the project which was done by the two members Vedant Parulekar, and Umesh Pawar in a span of one week from 29/07/23 to 14/08/23. The discussion of the project topic with the help of a paper prototype was completed with equal contribution from all the group members within one week from 14/08/23 to 21/08/23. The next main task of Graphical User Interface (GUI) designing was completed by Tanaya Patil, and Vedant Parulekar within 2 weeks from 24/08/23 to 02/09/23. The next week from 24/08/23 to 07/09/23 the members worked on the preparation of Presentation I. The next major task was database design and implementation. It took all 5 weeks to complete the final implementation. The database Design and connectivity of all modules were done by Dalbirsingh Matharu during the course time of 2 weeks from 07/09/23 to 23/09/23. The integration of all modules and report writing was completed by all the group members from 23/09/23 to 15/10/23. The preparation of final presentation II work was equally shared by all the group members in the time of 2 weeks from 15/10/23 to 20/10/23.

Chapter 8

Conclusion

The "Speech to Sign" and "Sign to Text" projects represent a profound commitment to inclusivity, accessibility, and breaking down the communication barriers that have long separated individuals with hearing disabilities from the broader world. These projects harness the power of technology, combining Automatic Speech Recognition (ASR), Natural Language Processing (NLP), computer vision, and machine learning to create comprehensive solutions for both spoken-to-sign and sign-to-spoken language translation.

The "Speech to Sign" project pioneers a system that not only translates spoken language into sign language but also offers a rich educational experience, enabling users to learn and understand sign language effectively. On the other hand, the "Sign to Speech" project empowers sign language users by providing them with a means to express themselves in spoken language, thus promoting mutual understanding.

In combination, these projects are transformative. They foster inclusivity, empower individuals with hearing disabilities to communicate fluently and naturally and promote sign language literacy among the broader population. Moreover, they advocate for a more inclusive society, one where communication barriers dissolve, and individuals of all hearing abilities can connect, learn, and thrive together. These projects are more than technological endeavours; they are powerful tools for change and progress, bringing us closer to a world where communication is truly universal and boundless.

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