RAMAIAH
Institute of Technology

Project Report on

SMART GLASSES FOR PEOPLE WITH HEARING AID

Submitted to

Ramaiah Institute of Technology, Bangalore
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In fulfilment of the requirement for the award of degree of

BACHELOR OF ENGINEERING
IN
ELECTRONICS & TELECOMMUNICATION ENGINEERING

For the Academic Year 2023-2024
Submitted by

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Department of Electronics & Telecommunication Engineering

CERTIFICATE

Certified the project work entitled " Smart Glasses for people with Hearing Aid" carried out by Harsh Vardhan Singh (1MS20ET023), Tarunay Shrivastava (1MS20ET053) ,Utkarsh Soni (1MS20ET054), Sahana N G (1MS20ET042), bonafide student of Ramaiah Institute of Technology, Bangalore, in fulfilment for the award of Bachelor of Engineering in Electronics & Telecommunication Engineering of the Visvesvaraya Technological University, Belgaum during the year 2023-2024. It is certified that all corrections/suggestions indicated for internal assessment have been incorporated in the report deposited in the department library. The project report has been approved as it satisfies the academic requirements in respect of project work prescribed for the said degree.

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DECLARATION

We hereby declare that the project entitled “Smart Glasses for people with Hearing Aid” has been carried out independently by us, under the guidance of Dr. Kusuma S.M. Assistant Professor, Electronics & Telecommunication Engineering, Ramaiah Institute of Technology, Bangalore. This report has been submitted in partial fulfilment for the award of degree, Bachelor of Engineering in Electronics & Telecommunication Engineering of Ramaiah Institute of Technology (Autonomous Institute, affiliated to VTU, Belgaum) during the year 2023-2024.

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ABSTRACT

This project introduces innovative smart glasses designed specifically for individuals with hearing impairments. The primary goal of these smart glasses is to enhance communication accessibility through real-time translation and transcription capabilities. The device leverages a Raspberry Pi to process audio inputs captured via an advanced microphone system. These inputs are then translated and transcribed in real-time, displaying the text directly onto the smart glasses lenses.

The smart glasses are capable of translating multiple languages, tailored to the user's preferences, thus facilitating broader communication in diverse settings. Furthermore, the integration of Artificial Intelligence technologies, such as OpenAI's ChatGPT, enhances user interaction by enabling voice commands for Internet searches and other digital tasks, directly displaying the results on the lenses.

The proposed methodology encompasses a comprehensive analysis of user requirements, hardware compatibility, and software integration. The design phase involves the meticulous selection of compatible hardware components and the development of user-friendly software interfaces optimized for the Organic Light Emitting Diode (OLED) screens of the glasses. Testing phases ensure the accuracy of transcription and translation, system reliability, and user interface efficacy.

The project aims not only to provide a technical solution but also to foster greater inclusion and independence for the deaf and hard-of-hearing community, making everyday interactions smoother and more engaging. Through this endeavour, significant advancements in assistive technologies are anticipated, paving the way for more innovative solutions in the realm of wearable technology.

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Project Outcome mapping

Project work –ETP (2020-2024)

Course outcomes

CO1	Review the literature and identify a suitable problem by analyzing the requirements based on current trends and societal needs in the domain of interest and arrive at the specifications
CO2	Identify the clear objectives & methodology for implementing the project by visualizing the Hardware and Software
CO3	Design and Implementation of identified Problem using appropriate modern tools and Techniques in the area of telecommunication/ multidisciplinary areas
CO4	Validate the achieved results and demonstrate good project defense, presentation skills, leadership and punctuality as a team/individual
CO5	Ability to write the thesis following ethical values and publish the work in quality conferences/journals supporting lifelong learning abilities

Mapping of Course outcome to Program outcome

ETP : Project work																
CO	**Statement**	**Program Outcomes (POs)**												**PSOs**		
		1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**1**	**2**	**3**
ETP.1	Review the literature and identify a suitable problem by analyzing the requirements based on current trends and societal needs in the domain of interest and arrive at the specifications	3	3		3		2	2		3			2	3	2	1
ETP.2	Identify the clear objectives & methodology for implementing the project by visualizing the Hardware and Software	3	3	3	3		2	2		3		3	2	3	2	2
ETP.3	Design and Implementation of identified Problem using appropriate modern tools and Techniques in the area of telecommunication/ multidisciplinary areas	3	3	3	3	3	2	2		3		3	2	3	2	2
ETP.4	Validate the achieved results and demonstrate good project defense, presentation skills, leadership and punctuality as a team/individual	3	3						3	3	3	3	1	2	-	3
ETP.5	Ability to write the thesis following ethical values and publish the working quality conferences/journals supporting lifelong learning abilities								3	3	3		3	-	-	3
Course Articulation		3	3	3	3	3	2	2	3	3	3	3	2	2.75	2	2.2

Justification:

1. CO1 mapped to (POs 1, 2, 4,6,7,9,12) (PSO 1,2,3)

The project "Smart Glasses for People with Hearing Aid" involved an extensive literature review to identify communication challenges faced by individuals with hearing impairments. Existing solutions, such as hearing aids and cochlear implants, were evaluated for their limitations in real-time communication and interaction. This review highlighted the need for innovative assistive technologies that provide immediate visual feedback of auditory information. By analyzing current trends and societal needs, the project identified the gap in real-time transcription and translation capabilities, thus setting the foundation for developing smart glasses that enhance accessibility and interaction for the deaf and hard-of-hearing community. This aligns with the program outcomes related to problem analysis, ethical practices, and lifelong learning.

2. CO2 mapped to (POs 1, 2, 3,4,6,7,9,11,12) (PSO 1,2,3)

The project defined clear objectives to develop smart glasses that offer real-time audio transcription, multilingual translation, and AI-based interaction. The methodology involved selecting suitable hardware components, such as Raspberry Pi, OLED display, and a high-quality microphone, and integrating software for speech recognition, translation, and AI interaction. The approach ensured a comprehensive visualization of both hardware and software requirements, emphasizing user-friendly design and efficient functionality. This phase also considered societal impacts and ethical standards, ensuring the project adhered to program outcomes related to design and development, problem analysis, and effective communication.

3. CO3 mapped to (POs 1, 2,3,4,5,6,7,9,11,12) (PSO 1,2,3)

The project defined clear objectives to develop smart glasses that offer real-time audio transcription, multilingual translation, and AI-based interaction. The methodology involved selecting suitable hardware components, such as Raspberry Pi, OLED display, and a high-quality microphone, and integrating software for speech recognition, translation, and AI interaction. The approach ensured a comprehensive visualization of both hardware and software requirements, The smart glasses were designed and implemented using modern tools and techniques, incorporating both hardware and software components. The hardware setup included connecting Raspberry Pi with an OLED display and a microphone, while the software involved integrating speech recognition, translation modules, and OpenAI’s API for enhanced user interaction. The project emphasized using advanced technologies to create a seamless and efficient user experience, addressing real-world challenges faced by individuals with hearing impairments. This stage demonstrated the application of engineering principles, problem-solving, and the use of modern engineering tools, aligning with program outcomes related to design, investigation, and the consideration of societal impacts.emphasizing user-friendly design and efficient functionality. This phase also considered societal impacts and ethical standards, ensuring the project adhered to program outcomes related to design and development, problem analysis, and effective communication.

4. CO4 mapped to (POs1, 2, 3,8,9,10,11,12) (PSO 1,3)

The project validation involved rigorous testing to ensure the smart glasses met the objectives of real-time transcription, accurate translation, and effective AI-based interaction. The results were presented through detailed documentation and presentations, showcasing the team’s ability to defend their project, demonstrate leadership, and adhere to punctuality. The validation process highlighted the importance of teamwork, ethical practices, and effective communication in achieving project goals. This phase aligned with program outcomes related to project management, ethical practices, and the ability to work effectively as a team or individual, ensuring the project’s success and practical applicability.

5. CO5 mapped to (POs 8,9,11,12) (PSO 3)

The final phase involved writing a comprehensive thesis that adhered to ethical standards and aimed for publication in quality conferences and journals. The thesis documented the research, design, implementation, and results of the smart glasses project, emphasizing the contributions to the field of assistive technology. The writing process ensured clarity, thoroughness, and adherence to academic standards, supporting lifelong learning and professional development. This phase aligned with program outcomes related to ethical practices, effective communication, project management, and the ability to contribute to the field through high-quality publications, reinforcing the project's impact and relevance.

CHAPTER 1
INTRODUCTION

This chapter provides the need for Smart Glasses, Motivation for the project, Objectives, Applications, Limitations of the proposed project and Organisation of the report.

1.1 Need for Smart Glasses:

Individuals with hearing impairments face significant obstacles in social interactions, educational environments, and professional settings due to communication barriers. Traditional assistive technologies like hearing aids and cochlear implants, while beneficial, often fall short in providing real-time communication solutions and are limited in environmental adaptability. Smart glasses equipped with real-time transcription and translation capabilities bridge these gaps by offering immediate visual feedback of auditory information. This technological advancement enhances communication accessibility and interaction, empowering the deaf and hard of hearing community by providing them with tools to better navigate and participate in everyday conversations and activities.

1.2 Motivation behind the Project:

The motivation behind the development of smart glasses stems from a commitment to leverage cutting-edge technology to address real-world challenges faced by individuals with hearing impairments. The project is driven by the potential to transform daily communication for these individuals, thereby reducing the isolation they often experience. By developing smart glasses capable of translating and transcribing spoken language in real time, this initiative aims to significantly improve the quality of life for the hearing-impaired, enabling them to engage more fully in all aspects of life, from personal interactions to professional opportunities.

1.3 Introduction to Smart Glasses:

Smart glasses represent a convergence of several cutting-edge technologies aimed at enhancing the quality of life for users with specific needs, such as those with hearing impairments. These devices utilize high-precision microphones and advanced processing units to ensure accurate audio capture and quick processing speeds. The integration of speech recognition technology is pivotal, allowing the device to convert spoken words into text almost instantaneously. This real-time transcription is crucial for users who rely on visual input to communicate effectively. Furthermore, the technology embedded in smart glasses supports various languages, which broadens their applicability across different linguistic and cultural backgrounds, ensuring inclusivity.

Figure 1.1: Expected Design of a smart Glass

The potential of smart glasses extends beyond mere transcription. These devices are also equipped with augmented reality (AR) technology that allows them to overlay digital information onto the physical world. For instance, during conversations, not only can the speech be transcribed, but facial expressions and non-verbal cues can also be annotated with descriptions to enhance understanding. This feature is particularly useful in social settings where non-verbal communication is significant. Moreover, AR can be used for navigation assistance within both familiar and unfamiliar environments, displaying directions and alerts that help users navigate spaces safely and more independently. Figure 1.1 shows how smart glasses can look when designed properly.

Despite their advanced capabilities, the design and development of smart glasses also focus on user comfort and ease of use. The glasses are typically lightweight and styled to resemble standard eyewear, minimizing the stigma often associated with assistive devices. User interface (UI) considerations are key, with gestures and voice commands frequently incorporated to allow users to interact with the device without needing to use their hands. This aspect is especially beneficial for individuals who might also have mobility impairments. Additionally, ongoing advancements in battery technology and energy-efficient processors are addressing one of the primary limitations of wearable tech—ensuring that the glasses can be used throughout the day without frequent recharging. This commitment to user-centered design underscores the goal of smart glasses to not only provide functional support but also enhance the daily living experience of individuals with hearing impairments.

1.4 Applications:

- **Public Services Accessibility:** In public spaces like libraries, government buildings, and transit hubs, smart glasses can greatly improve accessibility. In order to reduce confusion and increase accessibility to public services, real-time transcription services enable those with hearing impairments to obtain instantaneous text-based outputs of spoken announcements or instructions. When there is an emergency and prompt, precise communication is critical, this app is invaluable.

- **Artistic and Leisure pursuits:** Smart glasses have the potential to revolutionize the way people with hearing loss interact with cultural spaces like theaters, museums, and concert halls. These gadgets let viewers interact with cultural content to the fullest by providing real-time captioning and translations of live performances or guided tours. It is also possible to modify the technology so that it can describe plays or musical compositions, enhancing the auditory experience and enabling users to recognize subtleties that would not otherwise be possible.

- **Service to Customers and Retail:** Smart glasses can make interactions between employees and consumers who have hearing loss easier in retail settings. The glasses aid in precise communication, lowering the possibility of misunderstandings and raising the caliber of service by transcribing client requests and questions. Real-time language translation is another feature of these devices that is very helpful in tourist-heavy locations or international corporate settings where people frequently speak different languages.

The main benefit of smart glasses in all of these applications is their capacity to close the gap between the visual and auditory domains, removing obstacles that people with hearing loss often encounter. The adaptability of smart glasses underscores its potential as a game-changing instrument in numerous facets of daily existence, offering not only practical advantages but also cultivating an increased level of self-reliance and interaction with the outside world.

1.5 Limitations:

- **Technological Integration and Compatibility:** Integrating and being compatible with other current technologies and systems presents another difficulty for smart glasses. Compatibility problems may occur since these devices frequently require connections with different hardware and software in order to operate at their best. For example, it can be difficult to make sure that smart glasses work well with various smartphone manufacturers or digital systems in public infrastructures. Furthermore, frequent modifications to the glasses themselves may be required due to software updates and other technological advancements, which could present difficulties with maintenance and user adaptation.

- **Cost and Accessibility:** The production of smart glasses generally necessitates sophisticated technology, which drives up prices and prevents a wider range of people from purchasing them. This financial barrier may make it impossible for those who stand to gain the most from the technology to obtain it. To guarantee that these helpful gadgets are available to all societal segments, especially those with little financial resources, efforts must be taken to lower production costs, enhance subsidies, or establish financial assistance programs.

- **User adaptation and Training:** Even with smart glasses' advanced sophistication, user adaptation is still a major challenge. It can be intimidating for potential users to have to learn how to use such sophisticated equipment, particularly for elderly people or people who are not used to digital technology. Ensuring user-friendliness and offering thorough training are essential for widespread adoption. Furthermore, prolonged use of digital displays and augmented reality may cause cognitive overload or discomfort in certain users, emphasizing the necessity for these gadgets to be designed with ease of use and minimal obtrusion in mind.

These restrictions show how much more research and development in the field of smart eyewear is required to overcome these obstacles. Through advancements in technology, increased affordability, and user-friendliness, smart glasses hold the potential to significantly improve the lives of those who suffer from hearing loss.

1.6 Organization of the report:

This report is divided into 9 chapters which are as follows:

- Chapter 1 provides an overview of the novel smart glasses project and opens the door to the rest of the report. This chapter gives the reader an overview of the revolutionary potential of smart glasses as well as the urgent need for cutting-edge assistive technology for people with hearing impairments. It highlights the point where technology and accessibility converge, outlining the main inspirations for the project.

- Chapter 2 provides technological foundations of smart glasses that are covered in detail in this chapter. It looks at past advancements in assistive technology, especially those that support visual and aural communication. The chapter also discusses wearable technology, augmented reality, and speech recognition developments, all of which have an immediate impact on the functionality and design of smart glasses. Readers obtain a thorough overview of the history and present status of these technologies, which bolsters the reasoning behind the project's orientation.

- Chapter 3 summarizes research on the efficacy of earlier applications of related technologies and points out areas in need of improvement for the current project. It explores many viewpoints on technology, offers critical assessments of sources, and lays the groundwork for the advances brought forth by the smart glasses project. This evaluation of the literature not only demonstrates the project's value, but also its significance to the discipline.

- Chapter 4 discusses the problem statement, objectives and brief methodology of the smart glasses.

- Chapter 5 provides the information about the block diagram and the detailed explanation of each block with hardware and software components utilized.

- Chapter 6 discusses the flowchart, the implementation of the project and software design of the smart glasses utilized for the project.

- Chapter 7 discusses the execution and the outcomes of the proposed project.

- Chapter 8 provides Conclusion and future scope of the project.

- Chapter 9 provides the details of the referenced papers.

CHAPTER 2
BACKGROUND THEORY

This chapter outlines the theoretical underpinnings and previous work that inform and inspire the design and functionality of our smart glasses project. This section delves into the historical and theoretical foundations of the technologies used in this project. It includes a discussion of background work related to assistive technologies for hearing impairments, wearable technology, speech recognition, and augmented reality.

2.1 Discussion of background work related to the project:

2.1 Assistive Technologies for Hearing Impairments

The development of assistive technologies for individuals with hearing impairments has a rich history marked by significant milestones. The earliest hearing aids were mechanical devices that used acoustic principles to amplify sound. Over time, electronic hearing aids were developed, offering more precise amplification and customization based on individual hearing profiles. However, these traditional hearing aids primarily focus on amplifying sound and often fall short in environments with significant background noise or in situations where understanding spoken language is critical, such as in multilingual settings.

Recent advancements have sought to overcome these limitations by incorporating modern technologies such as digital signal processing, wireless connectivity, and integrated software solutions. Innovations like cochlear implants and bone-anchored hearing systems have further expanded the capabilities of assistive devices. Despite these advancements, there remains a critical need for solutions that provide real-time transcription and translation services to enhance communication accessibility. Our smart glasses project addresses this need by leveraging cutting-edge technologies to deliver an inclusive communication experience for individuals with hearing impairments.

2.2 Wearable Technology

Wearable technology represents a transformative approach to integrating digital functionalities into everyday life. Early examples of wearable technology include basic fitness trackers and heart rate monitors. These devices have evolved into sophisticated gadgets like smartwatches, which offer a wide range of features including health monitoring, notifications, and even cellular connectivity. Smart glasses are an extension of this evolution, designed to provide augmented reality (AR) experiences by overlaying digital information onto the physical world.

The concept of AR has been explored extensively in various domains. For example, AR applications in navigation provide turn-by-turn directions directly in the user's field of view, enhancing situational awareness and safety. In education, AR has been used to create interactive learning experiences, bringing abstract concepts to life. Our project builds on these foundations by using AR to display real-time transcriptions and translations on the lenses of the smart glasses. This approach ensures that the user can access critical information without diverting their attention from their surroundings, thereby facilitating seamless and effective communication.

2.3 Speech Recognition

Speech recognition technology has undergone remarkable advancements, transitioning from rudimentary systems with limited vocabulary to sophisticated engines capable of understanding natural language with high accuracy. Early speech recognition systems required extensive training and were constrained by limited processing power and memory. Modern systems, however, leverage powerful algorithms and vast datasets to achieve impressive performance in diverse environments.

The SpeechRecognition library in Python exemplifies these advancements. It offers a straightforward interface for developers to convert spoken language into text, enabling applications in various fields such as virtual assistants, transcription services, and voice-controlled devices. In our project, the SpeechRecognition library is utilized to provide real-time transcription of conversations. This functionality is crucial for individuals with hearing impairments, as it allows them to read spoken words and engage in conversations more effectively. The ability to transcribe speech in real-time addresses a significant gap in traditional hearing aids and enhances the overall communication experience.

2.4 Translation Technology

Translation technology has revolutionized global communication by breaking down language barriers. Early translation tools were basic and often inaccurate, relying on rudimentary algorithms and limited language databases. Today's translation technologies, such as Google's Googletrans library, use advanced machine learning models to provide near-instantaneous and highly accurate translations across numerous languages.

Our smart glasses project leverages the Googletrans library to offer real-time translation services. This feature is particularly beneficial in multilingual environments, where understanding and participating in conversations across different languages is essential. By displaying translated text directly on the lenses, users can follow and engage in conversations regardless of the language spoken. This capability not only promotes inclusivity but also empowers users to navigate diverse social and professional settings with confidence.

2.5 Integration of AI for Enhanced Interaction

Artificial Intelligence (AI) has become a cornerstone of modern technological innovation, providing advanced capabilities for data processing, decision-making, and user interaction. The integration of AI into consumer devices has transformed the way we interact with technology, offering personalized and context-aware experiences.

In our smart glasses project, we integrate OpenAI's API to enable an "Ask AI" feature. This feature allows users to interact with the glasses through voice commands, asking questions or retrieving information in real-time. The AI component enhances the functionality of the glasses, making them not only a tool for communication but also an intelligent assistant. Whether it's providing information about nearby places, answering queries, or offering recommendations, the AI feature enriches the user experience by making the device more responsive and versatile.

2.6 Hardware and Software Integration

The hardware backbone of our smart glasses project is the Raspberry Pi, a versatile and affordable microcomputer renowned for its flexibility and power. The Raspberry Pi serves as the central processing unit, running the software that handles transcription, translation, and AI interactions. Its compact size and robust capabilities make it an ideal choice for wearable applications.

The software stack includes the SpeechRecognition library for converting speech to text, the Googletrans library for translation, and OpenAI's API for the AI interaction feature. Together, these components create a seamless system that processes spoken language, translates it as needed, and displays the information on an OLED screen embedded in the glasses. The use of an OLED screen ensures that the displayed text is clear and easily readable, even in varying lighting conditions.

The integration of hardware and software in our project exemplifies the synergy between physical components and digital functionalities. This combination enables the smart glasses to provide real-time, context-aware assistance, enhancing the user's ability to communicate and interact with their environment.

CHAPTER 3
LITERATURE REVIEW

This chapter deals with various literature review papers that delves into the recent studies and advancements to provide a foundational understanding and justify the approach taken in this project.

3.1 Review of Literature:

Jan Gugenheimera, Katrin Plaumanna, Florian Schaubb, Patrizia Di Campli San Vitoa, Saskia Ducka, Melanie Rabusa, Enrico Rukzioa [1], The Impact of Assistive Technology on Communication Quality Between Deaf and Hearing Individuals (2017)

The document is a comprehensive literature review focusing on the impact of assistive technologies (ATs) on the communication quality between deaf and hearing individuals. It critically examines the role of real-time translation technologies through methodologies like focus groups and Wizard of Oz studies, highlighting that while these technologies can enhance interactions, they often interrupt communication flow and emphasize the communication deficiencies of deaf individuals. This, in turn, reinforces their subordinate societal status. The review utilizes Co-Cultural Theory to analyze these dynamics and suggests a paradigm shift in AT design philosophy—from aiding deaf individuals to 'hear' to enabling hearing individuals to 'sign.' This approach aims to foster more inclusive and balanced communication dynamics between the deaf and hearing communities.

Md Mehedi Hassan, MD Ashik Mahmud, Abrar Shahrivar. Naauibuddin Sarkar. Soniov Chandra [2], Smart Spectacles for The Deaf with Voice to Text and Sign Language Integration (2023)

The paper "Smart Spectacles for The Deaf with Voice to Text and Sign Language Integration" explores a novel technological solution aimed at aiding individuals with hearing impairments. It discusses an advanced eyewear device that can convert spoken language into both written text and sign language. The authors, Md Mehedi Hassan, MD Ashik Mahmud, Abrar Shahrivar, Naauibuddin Sarkar, and Soniov Chandra, focus on the system's design and practical implementation. Their research evaluates the effectiveness of the device through a detailed examination of current literature and real-world needs, aiming to enhance communication for the deaf community. This study not only assesses technical feasibility but also considers user acceptance and potential barriers to widespread adoption.

E Waisberg, J Ong, M Masalkhi, N Zaman, P Sarker [3], Meta Smart Glasses–Large Language Models and the Future for Assistive Glasses for Individuals with Vision Impairments (2024)

It explores the integration of large language models (LLMs) into smart glasses to enhance assistive technologies for visually impaired individuals. The study emphasizes how these advanced models can significantly improve the functionality of smart glasses by enabling more intuitive and responsive interactions. By leveraging LLMs, the smart glasses can process and understand complex commands and queries in real-time, providing users with a more seamless and interactive experience. The research discusses potential applications, such as real-time descriptive audio of surroundings and interactive assistance, which could also be beneficial for other disabilities, including hearing impairments. This technology aims to improve the independence and quality of life for individuals with vision impairments by enhancing their perception and navigation of their environment.

C Zhang, K Sato, B Wu [4], A Design of Smart Glasses-Based Gesture Recognition and Translation System for Sign Languages (2023)

It presents an innovative system designed to improve communication accessibility for the hearing impaired. This study focuses on developing smart glasses equipped with gesture recognition technology that can accurately interpret sign language and translate it into spoken and written text in real-time. The paper elaborates on the technical aspects of the system, including the algorithms used for gesture recognition and the integration of translation software within the smart glasses framework. By providing a seamless translation of sign language, the system aims to bridge the communication gap between individuals with hearing impairments and those who do not understand sign language, enhancing social interactions and inclusivity. This technology represents a significant step forward in assistive devices, offering real-time communication support for the hearing impaired.

I. Sinha and O. Caverly [5], EyeHear: Smart Glasses for the Hearing Impaired (2020)

The paper discusses the development of "EyeHear," a type of smart glasses designed to assist people who are hearing impaired. These smart glasses leverage advanced computer interface technology to facilitate communication and interaction in the workplace for those with hearing challenges. The study emphasizes the use of data glasses, integrating them as a tool to bridge communication gaps faced by hearing-impaired individuals in professional settings. The paper likely explores the technical specifications, user interface design, and the potential impacts of these glasses on improving daily activities and job performance for users.

L Boppana [6], IoT Based Wearable Glasses for Visually Impaired Users (2023)

It delves into the development of smart glasses that utilize Internet of Things (IoT) technology to aid visually impaired individuals. These glasses are designed to provide real-time environmental data through sensors and cameras, helping users navigate their surroundings more safely and independently. The core technology integrates various IoT components to analyze and relay visual information to the wearer through audio feedback, which describes the environment, identifies obstacles, and suggests safe paths. The paper discusses the technical framework, including the use of cloud computing for data processing and machine learning algorithms for object recognition and spatial navigation. This research highlights the potential of IoT in enhancing assistive devices, aiming to significantly improve mobility and quality of life for visually impaired users, demonstrating a pivotal shift towards more integrated and supportive assistive technologies.

M Freudenthaler, M Posch, F Scheele [7], SMART GLASSES TO SUPPORT PEOPLE WITH DISABILITIES–AN EXPLORATIVE STUDY (2023)

It investigates the potential of smart glasses as assistive technologies to enhance the lives of people with various disabilities. This explorative study evaluates the usability, accessibility, and impact of smart glasses, focusing on how they can improve social inclusion and independence. The research encompasses qualitative interviews and participatory observations with disabled users, examining their experiences and the practical benefits of using smart glasses in everyday activities. The findings suggest that smart glasses can significantly contribute to increased autonomy and engagement in social and professional environments. The study advocates for further development and customization of smart glasses to meet diverse needs and challenges faced by disabled individuals, emphasizing the importance of integrating user feedback in the design process to ensure that the technology is both functional and empowering.

J Yuvanesh, S Sherine, and I Kala [8], Implantable and Wearable Devices for IoT Applications–A Prototype of Integrated Multi-Feature Smart Shoes and Glass for the Safe Navigation of Blind People (2023)

The authors explore the development of a sophisticated IoT-based system designed to assist visually impaired individuals with navigation. This system integrates smart shoes and glasses equipped with various sensors that detect obstacles and provide real-time feedback to the user. The smart shoes and glasses work together to map the environment and communicate data through haptic feedback and audio cues, enabling safer and more independent mobility for blind individuals. The research highlights the prototype's functionality in enhancing spatial awareness and offering directional guidance, demonstrating significant potential in improving the quality of life for people with visual impairments through technology. This study exemplifies innovative integration of IoT devices in assistive technology, paving the way for future advancements in wearable navigational aids.

S Ananth, G Naren Balaji, P Prasad [9], Design and Implementation of Smart Guided Glass for Visually Impaired People (2023)

The authors present an innovative approach to aiding visually impaired individuals through the use of smart glasses. These glasses are equipped with advanced sensors and technology that enable real-time environmental feedback, assisting users in navigating their surroundings safely and effectively. The smart glasses utilize GPS, ultrasonic sensors, and cameras to detect obstacles and provide audio cues to the wearer, thus enhancing their spatial awareness and mobility. This paper details the technical specifications, design process, and implementation challenges of the smart glasses. It emphasizes the potential of such technologies to significantly improve the quality of life for visually impaired persons by providing them with greater independence and security in daily activities. The research also explores future enhancements, including more seamless integration with other smart devices and improved accuracy in obstacle detection.

K Srividya, AK Anand, M Jayasree [10], Smart Glasses for Disabled People (2023)

It explores the development and potential of smart glasses designed to aid individuals with various disabilities, including hearing impairments. The study emphasizes the importance of incorporating multiple functionalities into smart glasses to enhance the daily living experiences of disabled individuals. The smart glasses discussed are equipped with features such as real-time text-to-speech conversion, environmental recognition, and navigation aids, which are facilitated through advanced sensors and integrated software. The paper highlights the collaborative efforts required between technology developers, healthcare professionals, and disabled communities to ensure that the devices meet the specific needs of users. The authors argue for the potential of these technologies to significantly improve the autonomy and quality of life for disabled individuals by providing them with greater independence and connectivity to their surroundings.

3.2 Summary of Literature Review

The papers highlighted above delve into the development and impact of assistive technologies, particularly smart glasses, on the lives of individuals with various disabilities, including hearing and visual impairments. These studies showcase a range of innovative solutions that aim to enhance communication, mobility, and daily living for disabled populations. For instance, technologies such as real-time translation and transcription integrated with ChatGPT, sign language recognition, and environmental sensing through IoT applications are explored to facilitate better navigation and interaction within the environment. Each study emphasizes the need for technology to be user-centric, suggesting that assistive devices should not only compensate for disabilities but also empower users by enhancing their abilities to interact more effectively and independently.

Moreover, the research collectively advocates for a shift in the design philosophy of assistive technologies—from merely aiding the disabled to actively facilitating a more inclusive interaction with the world around them. The integration of advanced computational models and sensory technologies in devices like smart glasses opens new avenues for improving the quality of life for people with disabilities, promoting greater social inclusion, independence, and participation in community and professional settings. This body of work underscores the critical role of interdisciplinary collaboration in the successful design and implementation of technologically advanced assistive devices, highlighting ongoing innovations and future potentials in the field.

CHAPTER 4
PROBLEM STATEMENT

In this chapter the aim of the project, problem statement, objectives of the proposed model and methodology are explained.

4.1 PROBLEM STATEMENT:

The project aims to develop a user-friendly smart lens interface that offers real-time audio transcription, multilingual translation, and seamless integration with an AI model like ChatGPT for on-demand information retrieval. This addresses the need for enhanced accessibility and communication support for individuals with hearing impairments or language barriers.

4.2 OBJECTIVES:

- Create a user-friendly smart lens interface that shows real time transcription of the audio that the device hears.
- Creating a solution where all these real time transcriptions can be translated into different languages as per the person's requirements.
- Integration of an Artificial Intelligence using OpenAI API to access GPT 3.5.

4.3 METHODOLOGY:

- The idea of smart glasses was inspired by going through multiple research papers based on helping deaf people through smart glasses which have sign language detection but there was no idea which included real time transcription, translation and openai integration to help people with a more easier way of interaction.

- The project began with the selection of suitable hardware components, starting with the integration of a Raspberry Pi with an OLED display.

- A high-quality microphone was added to the system to capture audio inputs effectively. This microphone was essential for real-time audio transcription.

- To ensure the smart glasses had internet connectivity, a WiFi module was incorporated, enabling the device to access online translation services and other APIs.

- A stable and portable power supply was designed to support the continuous operation of the Raspberry Pi, OLED, and microphone.

- For the software interface, Python was chosen as the primary programming language due to its versatility and extensive libraries. Python code was developed to manage the connection and functionality of the OLED display.

- The next step was to add the core functionalities of the smart glasses: real-time audio transcription, language translation, and integration with OpenAI's models.

- The audio captured by the microphone was processed using speech recognition libraries in Python. This transcribed the spoken words into text in real time.

- The transcribed text was then passed through a translation module, utilizing cloud-based services to convert the text into the user's preferred language.

- To enhance user interaction, OpenAI's API was integrated, allowing the smart glasses to process voice commands and provide responses directly on the OLED screen.

- The final step involved testing and fine-tuning the system to ensure seamless integration and functionality. The goal was to display the transcribed and translated text on the OLED screen in real time, facilitating communication for individuals with hearing impairments.

- Throughout the development process, iterative testing and user feedback were crucial in refining both the hardware setup and software algorithms to achieve a user-friendly and efficient smart glasses system.

CHAPTER 5

SYSTEM DESIGN OF SMART GLASSES

This chapter provides a detailed overview of the system architecture for the smart glasses designed for people with hearing impairments. The design incorporates both hardware and software components to achieve real-time transcription and translation of spoken language.

5.1 Block Diagram of Smart Glasses Connection

The Figure 5.1 shows the block diagram which presents an overview of the main components of the smart glasses system.

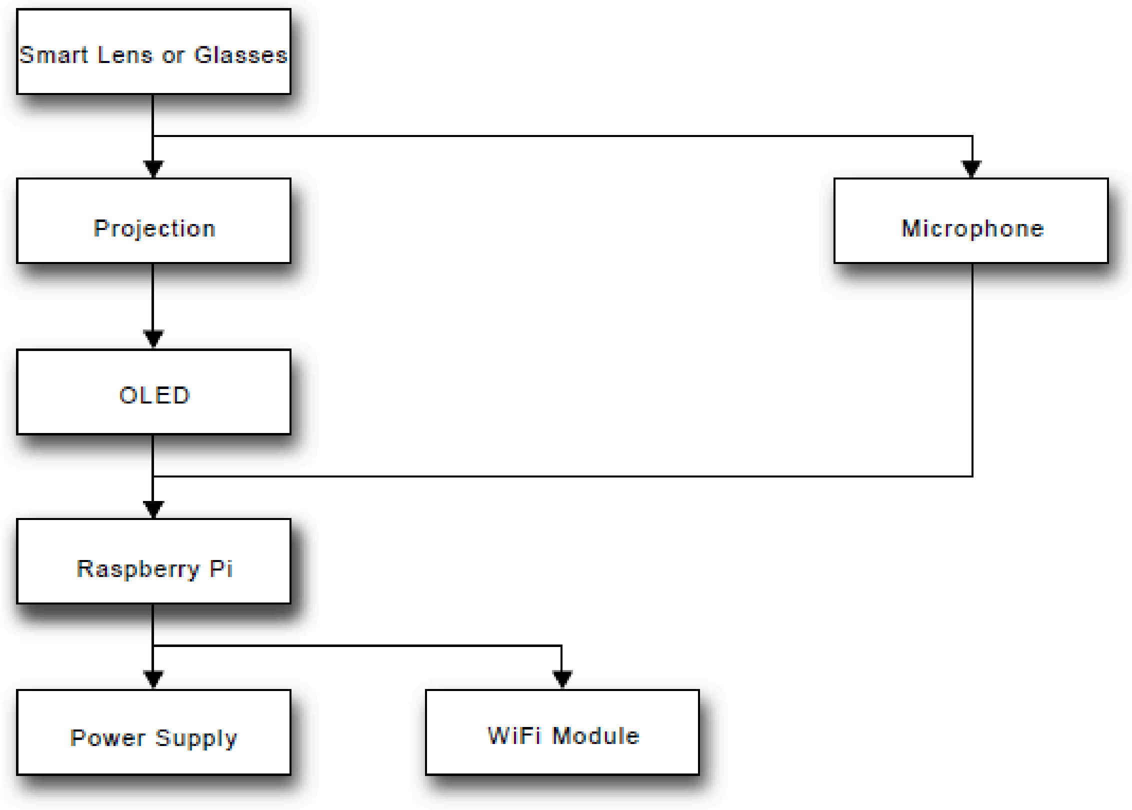


Figure 5.1: Block Diagram of Smart Glasses Connection

5.2 Description of Block Diagram

The block diagram represents a smart wearable system consisting of several interconnected components. At the core, smart lenses or glasses provide the user with augmented visual capabilities, utilizing a projection system to display information onto an OLED screen. A Raspberry Pi serves as the central processing unit, controlling the system and running applications. The Raspberry Pi is powered by a dedicated power supply and equipped with a WiFi module for internet connectivity and communication with other devices. Additionally, a microphone captures audio input for voice commands and other audio processing tasks. This system integrates visual augmentation with internet connectivity and voice interaction, offering an enhanced and interactive user experience.

5.3 Explanation of Individual Blocks:

- **Smart Lens or Glasses:**
  These are wearable devices, either as glasses or contact lenses, that incorporate technology to provide augmented reality experiences. They can display information directly in the user's field of view.
- **Projection:**
  This component handles projecting images or information from the smart lenses or glasses onto a display surface. It typically involves miniature projectors integrated within the eyewear, allowing users to see augmented visuals overlaid on their real-world view.
- **OLED:**
  The Organic Light Emitting Diode (OLED) display is used to show the projected images or information. OLED screens are chosen for their high contrast, thin profile, and energy efficiency, providing clear and vibrant displays.
- **Raspberry Pi:**
  A compact, versatile computer that acts as the brain of the system. It processes data, runs software applications, and manages communication between different components. It can handle tasks such as processing visual data, running augmented reality applications, and managing user interactions.
- **Power Supply:**
  This block provides the necessary electrical power to the Raspberry Pi and other components. It ensures the entire system operates smoothly by delivering a stable power source.

- **WiFi Module:**
  This component enables the system to connect to wireless networks. It allows the Raspberry Pi to access the internet, communicate with other devices, and facilitate online functionalities such as data synchronization, cloud computing, and remote control.
- **Microphone:**
  The microphone captures audio input, which can be used for voice commands, communication, or other audio-related functions. It allows the user to interact with the system through speech, enabling hands-free operation and voice-controlled features.

Each of these components plays a crucial role in creating a cohesive and functional smart wearable device that enhances the user's experience by combining augmented reality, internet connectivity, and voice interaction.

5.4 Hardware and Software Requirements

Hardware Components:

- Raspberry Pi:
  The Raspberry Pi is a central element in the architecture of smart glasses, serving as the brain behind the operation. This small yet powerful computer handles all the data processing tasks required to convert audio signals into text. Its compact size and efficiency make it ideal for embedding in wearable technologies where space and power consumption are at a premium. With its GPIO (General Purpose Input/Output) pins, the Raspberry Pi can also connect and control various peripheral devices essential for the smart glasses, such as microphones and displays, making it a versatile choice for developing advanced assistive devices.

- Microphone:
  A high-quality microphone is crucial for the functionality of smart glasses, particularly for ensuring that speech recognition is accurate and effective under various environmental conditions. The microphone used must be capable of isolating speech from background noise and handling different accents and speech patterns. Advances in microphone technology, such as directional microphones and noise cancellation features, enhance the device's ability to capture clear audio, which is vital for real-time transcription accuracy and the overall user experience.

- OLED Display:

  The OLED (Organic Light Emitting Diode) display plays a key role in presenting information visually to the user. Its high contrast ratio and ability to display deep blacks make it suitable for readability in various lighting conditions, which is essential for outdoor and indoor use. OLED displays consume less power compared to traditional LCDs, which is beneficial for battery conservation in wearable devices. Additionally, the thinness and flexibility of OLED screens offer more options for ergonomic and comfortable designs in smart glasses.

- Power Supply:

  For smart glasses, the power supply must not only be durable but also lightweight and capable of maintaining a charge over extended periods of use. This often means using advanced battery technologies such as lithium-ion or lithium-polymer, which provide a good balance between weight and capacity. Energy efficiency in the design is critical, as it ensures that the device can operate throughout the day on a single charge, which is crucial for users who rely on the device for communication and interaction throughout their daily activities.

- WiFi Connectivity:

  WiFi connectivity in smart glasses extends their functionality significantly by enabling them to access a wide range of online services and cloud-based applications. WiFi also allows for software updates and synchronization with other devices, enhancing the glasses' capabilities and ensuring they remain functional with the latest advancements in technology and security. This connectivity must be consistently reliable and secure to protect users' data and ensure seamless operation of the device in diverse environments.

- Raspberry Pi 4 Pin Diagram:

  The Raspberry Pi 4 features a 40-pin GPIO header, including multiple 3.3V and 5V power pins to interface with external devices like sensors and motors. These pins are crucial for expanding the capabilities of the Raspberry Pi in various projects.

  Figure 5.2 shows the pin details of Raspberry pi 4 .

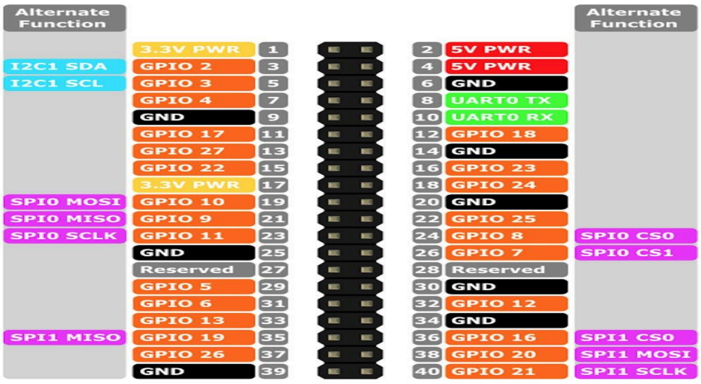
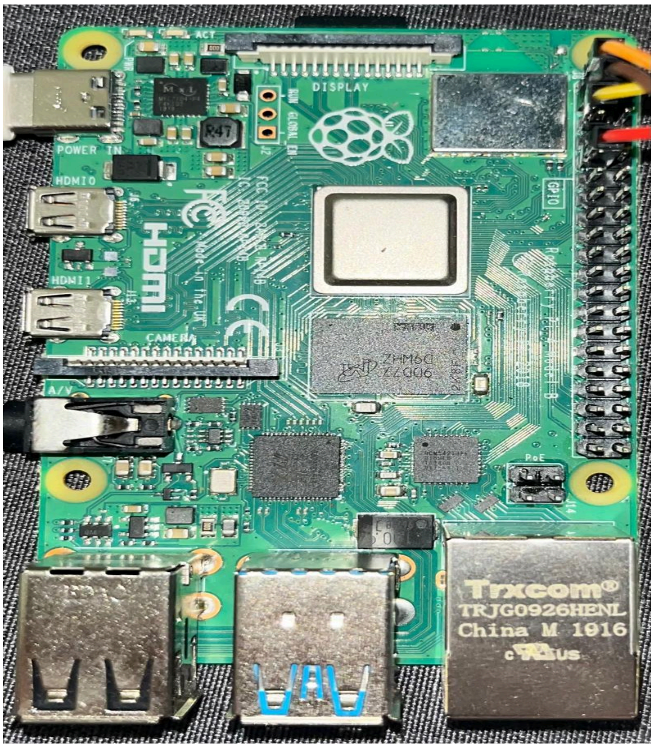


Figure 5.2: Raspberry Pi pin diagram



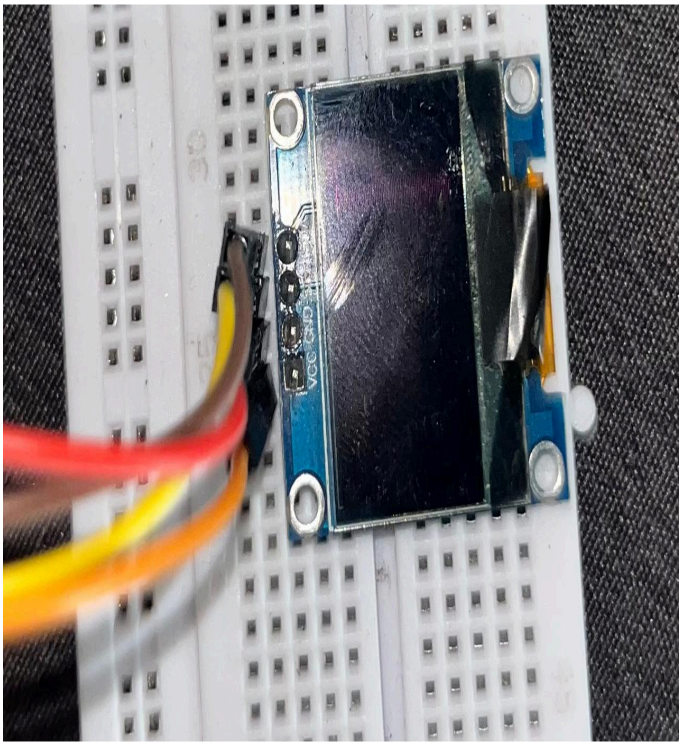


Figure 5.3: Raspberry Pi 4 Connection

Figure 5.4: OLED Connection

Here, Figure 5.3 and Figure 5.4 depicts Raspberry Pi and OLED connected to each other through wires.

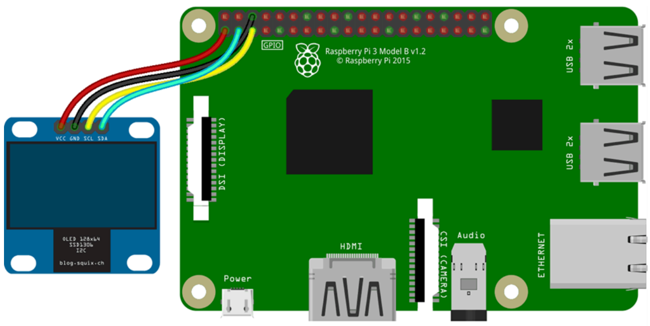


Figure 5.5: Raspberry Pi connected to OLED

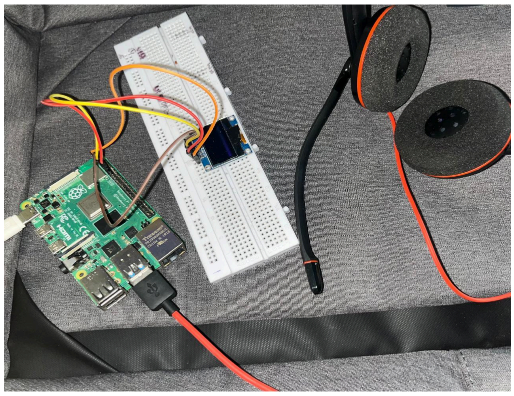


Figure 5.6: Prototype Connection

The figure 5.5 depicts the OLED & Raspberry Pi connection where,

VCC(OLED) - Pin 1(Raspberry Pi), GND(OLED) - Pin 6 (Raspberry Pi)

SCL(OLED) - Pin 5(Raspberry Pi), SDA(OLED) - Pin 3(Raspberry Pi)

The figure 5.6 shows the hardware connection done for making the smart glasses which includes an OLED, Microphone and a Raspberry Pi connected together.

Software Components:

- Speech Recognition Software:

The speech recognition software is a crucial component of smart glasses, enabling the device to interpret spoken words and convert them into written text. Advanced algorithms within this software can detect nuances in speech, including accents and dialects, which enhances its effectiveness across diverse user groups. Services like Google's Speech-to-Text provide robust models trained on vast datasets, which contribute to higher accuracy in real-time speech recognition. This software is continually updated to include improvements in language processing, ensuring that it stays effective even in challenging environments where background noise or multiple speakers may be present.

- Translation Software:

Translation software in smart glasses allows for the immediate conversion of transcribed text from one language to another, making these devices incredibly valuable in multicultural and multilingual contexts. Utilizing APIs like Google Translate, this software supports numerous languages and dialects, providing broad coverage that can cater to a global user base. The translation process is optimized for speed and accuracy, ensuring that the translations are not only quick but also contextually appropriate, which is essential for effective communication. These capabilities are particularly beneficial in educational, travel, and international business settings, where understanding multiple languages is crucial.

- OLED Interface Software:

The OLED interface software manages the presentation of information on the glasses' display. It controls how text, icons, and animations appear, ensuring that they are legible and aesthetically pleasing. The software is designed to make efficient use of the OLED's capabilities, such as its high contrast ratios and fast response times, to provide a user experience that is comfortable for the eyes over extended periods. Customization features such as adjustable brightness and text size help accommodate users' individual preferences and needs, enhancing usability and satisfaction.

- Raspberry Pi OS:

The Raspberry Pi OS, formerly known as Raspbian, is a lightweight operating system based on Debian Linux, optimized for the Raspberry Pi hardware. It provides a stable and efficient platform for running all the necessary applications and services on the smart glasses. The OS includes a range of pre-installed software and utilities that are essential for developing and maintaining the system, such as device drivers and libraries for interfacing with various hardware components like the OLED display and microphone. Its user-friendly interface and extensive community support make it an ideal choice for developers, allowing them to quickly address issues and implement new features as the project evolves. Additionally, the OS's lightweight nature ensures that system resources are conserved, allowing for faster processing and longer battery life.

This comprehensive system design ensures that the smart glasses are not only functional but also user-friendly and efficient in assisting individuals with hearing impairments in their daily communications. The figure 5.7 shows the integration of the functions that are used in running the project which includes OpenAI integration, speech recognition and a translation function.

```python
def ask_openai(prompt):
    try:
        response = openai.ChatCompletion.create(
            model="gpt-3.5-turbo",
            messages=[{"role": "system", "content": "You are a helpful assistant."},
                      {"role": "user", "content": prompt}]
        )
        return response.choices[0].message['content'].strip()
    except Exception as e:
        print(f"An error occurred: {str(e)}")
        return None

def recognize_speech_from_mic(phrase_time_limit=5):
    recognizer = sr.Recognizer()
    with sr.Microphone(device_index=3) as source:
        recognizer.adjust_for_ambient_noise(source, duration=1)
        print("Listening...")
        audio = recognizer.listen(source, phrase_time_limit=5)
        try:
            speech_text = recognizer.recognize_google(audio)
            scroll_text(oled, speech_text, font_default)
            print("You said:", speech_text)
            return speech_text
        except sr.UnknownValueError:
            print("Could not understand audio")
            return None
        except sr.RequestError as e:
            print(f"Could not request results from Google Speech Recognition service; {e}")
            return None

def translate_text(text, dest_language, oled, font):
    translator = Translator()
    try:
        if dest_language not in LANGUAGES:
            print("Invalid language code. Please say a valid language code.")
            return
        translation = translator.translate(text, dest=dest_language)
        print(f"Original Text: {text}")
        print(f"Translated Text [{LANGUAGES.get(dest_language, 'Unknown')}]: {translation.text}")
        scroll_text(oled, translation.text, font)
    except Exception as e:
        print(f"An error occurred during translation: {str(e)}")

# Language dictionary
Lang = {'english': 'en', 'french': 'fr', 'german': 'de','malyalam':'ml', 'hindi': 'hi', 'kannada': 'kn', 'malayalam': 'ml', 'marathi': 'mr', 'spanish': 'es', 'tamil': 'ta',

state = "default"
lang_code = None
```

Figure 5.7: Software Integration

CHAPTER 6

IMPLEMENTATION OF PROJECT

The implementation of the smart glasses project involves several critical stages, from the initial design to final deployment, ensuring the device meets both functional and user experience requirements effectively.

6.1 Flow Chart

The flowchart presented in Figure 6.1 outlines the design and implementation process for a software application that interacts with smart glasses. It is structured to handle audio inputs from a user, process these inputs through various functions like speech recognition and command execution, and provide real-time text output on the device. Here's a detailed step-by-step explanation based on the flowchart:

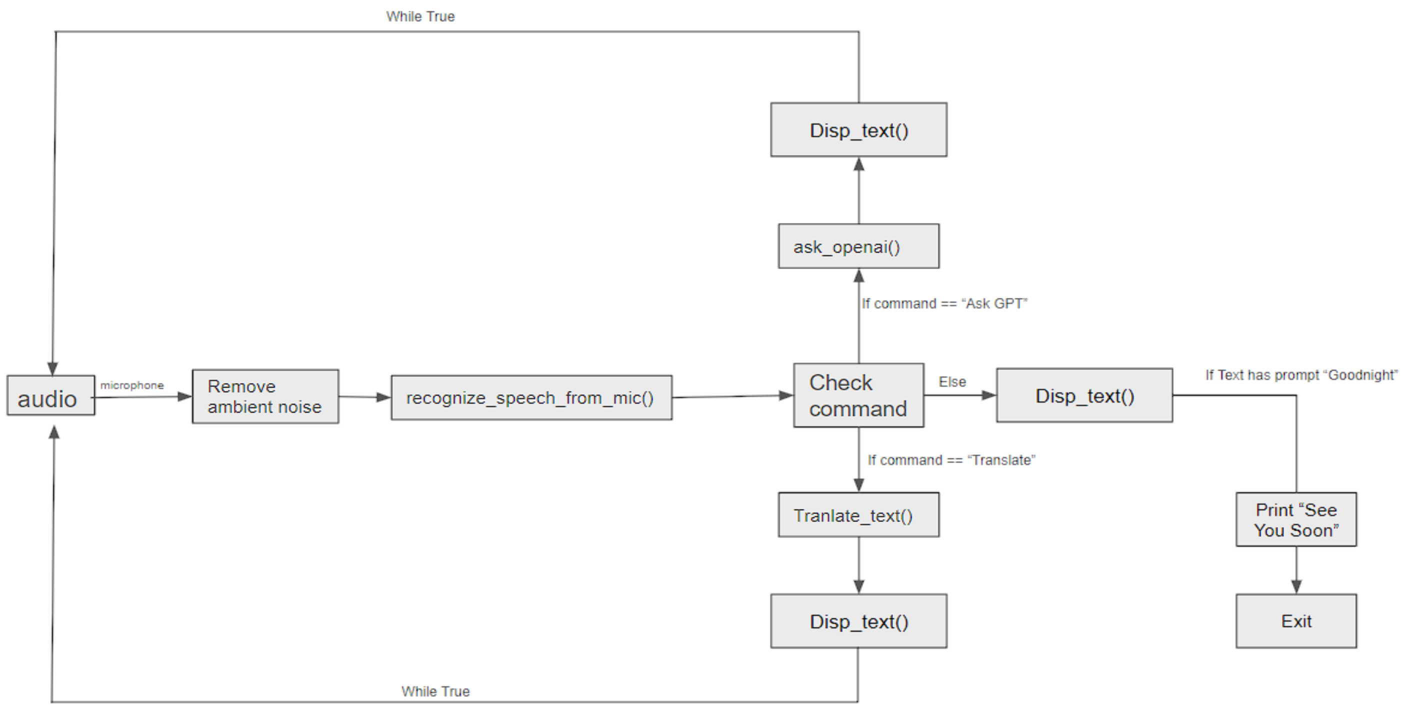


Figure 6.1: Flowchart of the Design and Implementation of the Project

- **Audio Input:**

  The process begins with audio input captured through a microphone integrated into the smart glasses. This input serves as the primary data source for speech recognition and further processing.

- **Remove Ambient Noise:**
  The first step in processing the audio input is to filter out ambient noise. This is crucial for improving the accuracy of speech recognition by ensuring that the system focuses solely on the user's voice, reducing errors caused by background sounds.

- **Recognize Speech from Microphone:**
  Once the audio is cleared of ambient noise, it is passed to the `recognize_speech_from_mic()` function. This function utilizes speech recognition software (possibly Google Speech-to-Text or a similar service) to convert spoken language into text. The sophistication of the speech recognition algorithm allows it to handle various dialects and speech nuances effectively.

- **Check Command:**
  After transcription, the text is analyzed to determine if it contains specific commands that the software can execute. These commands could be predefined triggers such as "Translate" or "Ask GPT" which direct the flow of operations within the software.

- **Command Execution:**
  Depending on the command detected in the previous step, the flowchart branches into different paths:

  Ask OpenAI (`ask_openai()`): If the command is "Ask GPT," the text is sent to an OpenAI model, likely utilizing an API to fetch a response based on the input query. This allows the user to interact dynamically with AI for information retrieval or other tasks.

  Translate Text (`Translate_text()`): If the command is "Translate," the software uses translation software (like Google Translate API) to convert the transcribed text into another specified language. This feature is especially useful in multilingual settings or for users learning a new language.

- **Display Text (`Disp_text()`):**
  After processing, whether it is a translation, a response from OpenAI, or standard speech-to-text transcription, the resultant text is displayed on the OLED screen of the smart glasses. The

`Disp_text()` function ensures that the text is clear and readable, making effective use of the OLED display's capabilities for sharpness and efficiency.

- **Loop or Exit:**
  The process is designed to loop continuously, allowing for real-time interaction and updates. However, if a specific exit command or prompt (e.g., "Goodnight") is detected, the system will execute the "Print 'See You Soon'" command followed by an "Exit." This ends the session and turns off the device or exits the application, depending on how the function is implemented.

This flowchart effectively demonstrates a responsive, real-time interactive system designed for accessibility and user engagement, leveraging advanced technologies like speech recognition, AI, and translation to assist users with hearing impairments or those needing real-time language translation.

6.2 Explanation of the Software Design and Implementation

Software Design:

- **Modules and Libraries:**

  openai: Used for interacting with the OpenAI API to get responses from models like GPT-3.5-turbo.
  speech_recognition (sr): Used for converting speech to text using Google's speech recognition service.
  gtts: Used for text-to-speech conversion.
  IPython.display: Used to handle audio output within a Jupyter notebook environment.
  googletrans: Used for translating text between different languages.
  adafruit_ssd1306: Used for interfacing with the SSD1306 OLED display.
  PIL (Pillow): Used for image handling and drawing text on images.
  time, textwrap: Standard libraries for time-related functions and wrapping text, respectively.
  The Figure 6.2 shows the Modules and Libraries that are used in the code for the software to run properly.

```python
import openai
import speech_recognition as sr
from gtts import gTTS
from IPython.display import Audio, display
import os
from googletrans import Translator, LANGUAGES
import board
import busio
import digitalio
import adafruit_ssd1306
from PIL import Image, ImageDraw, ImageFont
import time
import textwrap
```

Figure 6.2: Modules and Libraries

- **Hardware Setup:**

  I2C Bus and OLED Display: The script sets up the I2C bus and initializes the SSD1306 OLED display. This is done using the busio and adafruit_ssd1306 libraries.

```python
# Setups
openai.api_key = "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"
i2c = busio.I2C(board.SCL, board.SDA)
oled = adafruit_ssd1306.SSD1306_I2C(128, 64, i2c)
font_path_hin = "/home/final/TTF/NotoSansDevanagari-VariableFont_wdth,wght.ttf"
font_path_kan = "/home/final/TTF/NotoSansKannada-VariableFont_wdth,wght.ttf"
font_path_tam = "/home/final/TTF/NotoSansTamil-VariableFont_wdth,wght.ttf"
font_path_tel = "/home/final/TTF/NotoSansTelugu-VariableFont_wdth,wght.ttf"
font_path_mal = "/home/final/TTF/NotoSansMalayalam-VariableFont_wdth,wght.ttf"
font_path_urd = "/home/final/TTF/NotoNastaliqUrdu-VariableFont_wght.ttf"
font_path_mar = "/home/final/TTF/NotoSans-VariableFont_wdth,wght.ttf"
font_default = ImageFont.truetype(font_path_kan, 16)

def get_font(lang_code):
    if lang_code == 'hi':
        return ImageFont.truetype(font_path_hin, 16)
    elif lang_code == 'kn':
        return ImageFont.truetype(font_path_kan, 16)
    elif lang_code == 'ml':
        return ImageFont.truetype(font_path_mal, 16)
    elif lang_code == 'ta':
        return ImageFont.truetype(font_path_tam, 16)
    elif lang_code == 'te':
        return ImageFont.truetype(font_path_tel, 16)
    elif lang_code == 'ur':
        return ImageFont.truetype(font_path_urd, 16)
    elif lang_code == 'mr':
        return ImageFont.truetype(font_path_mar, 16)
    else:
        return font_default
```

Figure 6.3: Hardware Setup

- **Fonts:**

  Multiple font paths are defined for different languages. The get_font function returns the appropriate font based on the language code.

- **Functions:**

  get_font(lang_code): Returns the appropriate font for a given language code.

  display_startup_message(oled, text, font): Displays a startup message on the OLED display.

  scroll_text(oled, text, font): Scrolls text on the OLED display if the text height exceeds the display height.

  ask_openai(prompt): Sends a prompt to the OpenAI API and returns the response.

  recognize_speech_from_mic(phrase_time_limit): Captures audio from the microphone and converts it to text using Google Speech Recognition.

  translate_text(text, dest_language, oled, font): Translates text to a specified language and displays it on the OLED screen. The Figure 6.3 and 6.4 shows the code written for font inclusion and OLED configuration)

```python
def display_startup_message(oled, text, font):
    oled.fill(0)
    image = Image.new("1", (oled.width, oled.height))
    draw = ImageDraw.Draw(image)
    draw.text((0, 0), text, font=font, fill=255)
    oled.image(image)
    oled.show()
    time.sleep(2)

def scroll_text(oled, text, font):

    lines = textwrap.wrap(text, width=oled.width // font.getsize('X')[0])
    image = Image.new("1", (oled.width, oled.height))
    draw = ImageDraw.Draw(image)
    text_height = len(lines) * font.getsize('X')[1]

    if text_height <= oled.height:
        draw.rectangle((0, 0, oled.width, oled.height), outline=0, fill=0)
        for i, line in enumerate(lines):
            draw.text((0, i * font.getsize('X')[1]), line, font=font, fill=255)
        oled.image(image)
        oled.show()
        time.sleep(1)
        return

    draw.rectangle((0, 0, oled.width, oled.height), outline=0, fill=0)
    for i, line in enumerate(lines):
        draw.text((0, i * font.getsize('X')[1]), line, font=font, fill=255)
    oled.image(image)
    oled.show()
    time.sleep(1)

    y = 0
    while y < text_height - oled.height:

        draw.rectangle((0, 0, oled.width, oled.height), outline=0, fill=0)

        for i, line in enumerate(lines):
            draw.text((0, i * font.getsize('X')[1] - y), line, font=font, fill=255)

        oled.image(image)
        oled.show()

        y += 3.5
        time.sleep(0.05)

    time.sleep(2)

    oled.fill(0)
    oled.show()
```

Figure 6.4: OLED Configuration Functions

- **State Management:**

  The script uses a state machine to handle different modes (default, translate, ask gpt). The current state determines how user commands are processed.

  default state: The initial state where the system waits for a command.

  translate state: Activated when the user wants to translate text. It asks for a language and then translates subsequent commands.

  ask gpt state: Activated when the user wants to ask something to GPT. It sends the command to OpenAI and displays the response. Figure 6.5 shows the default mode where the speech is being recognized from the mic. The figure 6.6 shows the code for translation mode and figure 6.7 shows the code for OpenAI integration mode.

```python
# Startup message
display_startup_message(oled, "Welcome! ", font_default)

while True:
    command = recognize_speech_from_mic(3)
    if command is None:
        continue
    command = command.lower()

    if state == "default":
        if 'translate' in command or 'translate this to ' in command:
            state = "translate"
            scroll_text(oled, "which language",font_default)
            abc = recognize_speec (variable) abc: Any
            if abc and abc.lower(
                lang_code = Lang[abc.lower()]
                scroll_text(oled,"trasnslate mode:on", font_default)
            else:
                print("Could not understand language.")
        elif 'ask gpt' in command:
            state = "ask gpt"
        else:
            print(f"Echo: {command}")
```

Figure 6.5: State Management: Default

```python
elif state == "translate":
    if 'exit translate' in command:
        state = "default"
        print("Exiting translation mode...")
    elif 'change language' in command:
        #new_lang_code = input("Enter new language code: ")
        scroll_text(oled, "which language",font_default)
        abc = recognize_speech_from_mic(3)
        if abc and abc.lower() in Lang:
            new_lang_code = Lang[abc.lower()]
            scroll_text(oled,"trasnslate mode:on", font_default)
        if new_lang_code:
            lang_code = new_lang_code
            print(f"Language changed to {lang_code}")
        else:
            print("No valid language code entered. Please try again.")
    elif lang_code:
        font = get_font(lang_code)
        translate_text(command, lang_code, oled, font)
    else:
        print("No valid language code specified. Please try again.")
```

Figure 6.6: State Management: Translation

```python
elif state == "ask gpt":
    if 'exit gpt' in command:
        state = "default"
        print("Exiting GPT mode...")
    else:
        response_text = ask_openai(command)
        if response_text:
            font = get_font(lang_code) if lang_code else font_default
            scroll_text(oled, response_text, font)
            print("Response:", response_text)

if 'good night' in command or 'bye' in command:
    scroll_text(oled, "See you soon :)", font_default)
    break
```

Figure 6.7: State Management: OpenAI

- **User Interaction:**

  The script continuously listens for commands using speech recognition.

  Depending on the state and command, it either translates the text, queries OpenAI, or changes settings (like the translation language).

  The software design is modular and extensible, leveraging various libraries to handle specific tasks such as speech recognition, translation, and display control. The state machine approach allows for flexible handling of different user commands, enhancing the interactivity and usability of the system. The implementation focuses on real-time user interaction and seamless integration of various functionalities to create a cohesive user experience.

CHAPTER 7

RESULTS AND DISCUSSION

This chapter gives the proper study of the results and outcomes that are obtained from the project and concludes that all the objectives were achieved.

7.1 Real-Time Audio Transcription

Development of a smart lens interface that provides real-time audio transcription has been done. The integration of a microphone with the smart glasses allows the system to capture audio input effectively. The audio data is processed by the Raspberry Pi, which runs a speech-to-text algorithm. The transcribed text is then displayed on the OLED screen embedded in the smart glasses. This feature ensures that users can see a live transcription of conversations or environmental sounds, making it particularly useful for individuals with hearing impairments or in noisy environments. Figure 7.1 shows how the speech is being recognized through a microphone and displayed on the OLED.

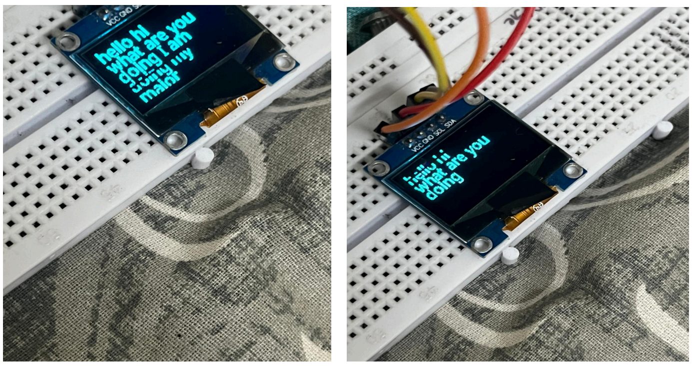


Figure 7.1: Real-Time Transcription

7.2 Language Translation of Transcriptions

The next objective was to translate the real-time transcriptions into different languages as per the user's requirements. So, implementation of a language translation module that interfaces with the real-time transcription system has been done. Utilizing cloud-based translation services via the WiFi module, the transcribed text can be instantly translated into the desired language. The translated text is then displayed on the OLED screen, providing a seamless multilingual experience. This feature is beneficial for users in multilingual settings, facilitating better communication and understanding. Figure 7.2 and 7.3 shows how the recognized speech is being converted into Hindi and Kannada.

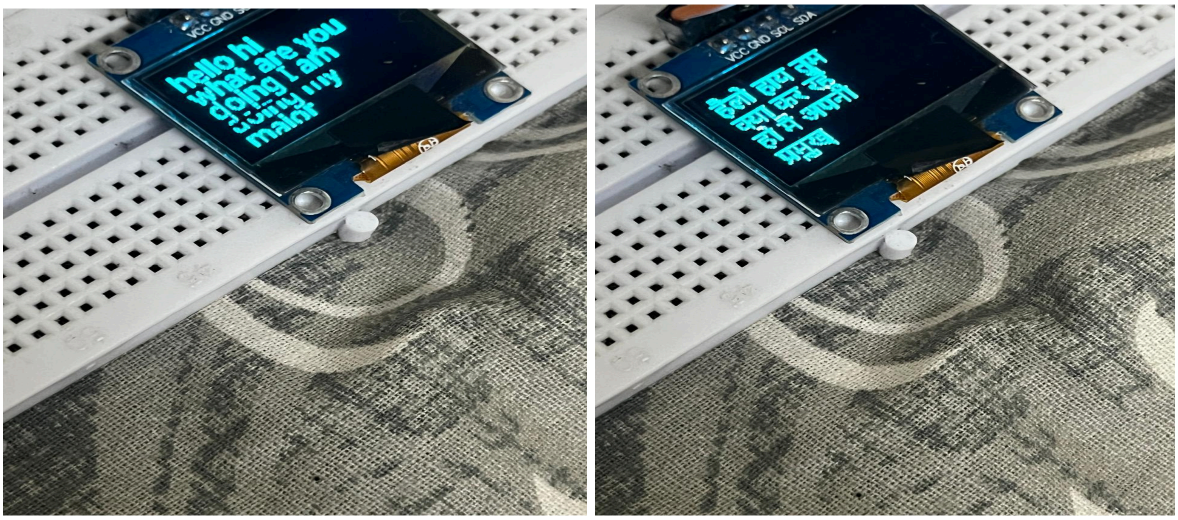


Figure 7.2: Real-Time Translation (Hindi)

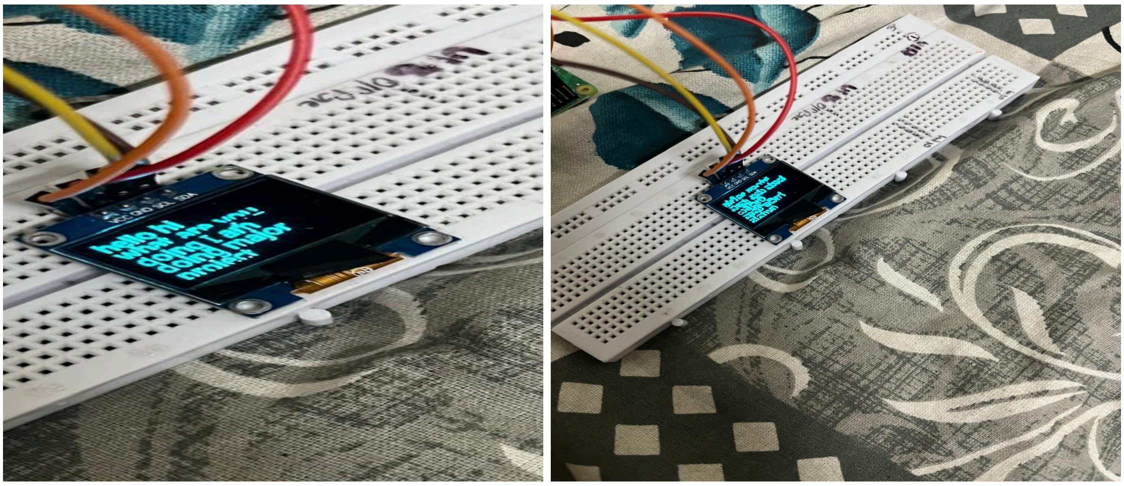


Figure 7.3: Real-Time Translation (Kannada)

7.3 Integration of OpenAI Model for Enhanced Interaction

To enhance the functionality of the smart glasses, Integration of an OpenAI API has been done. This integration allows users to interact with the AI by simply speaking commands. The microphone captures the voice command, which is processed by the Raspberry Pi and then sent to the OpenAI model via the WiFi module. The AI processes the request, and the response is displayed on the OLED screen. For instance, if a user wants to search for information, they can directly ask the AI, and the results will be shown in their field of view. This hands-free interaction significantly enhances the usability and convenience of the smart glasses. The below figure 7.4 shows how the activation of the GPT mode then figure 7.5 shows how the prompt is given and the figure 7.6 shows how the GPT gives response. The figure 7.7 shows that the good night prompt is given and figure 7.8 shows the GPT response to it and then figure 7.9 shows that “see you soon” is displayed that means the exit of program.

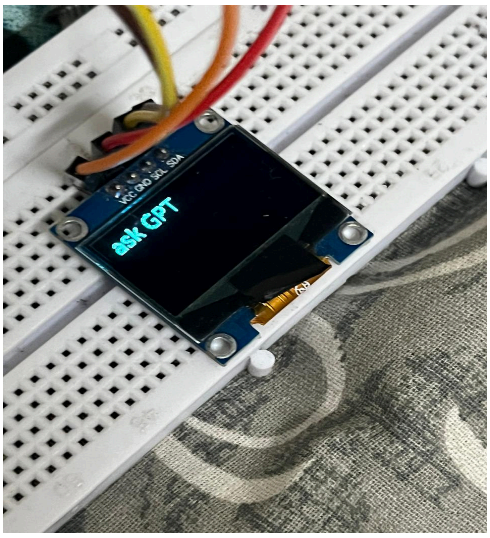


Figure 7.4: Activation of GPT

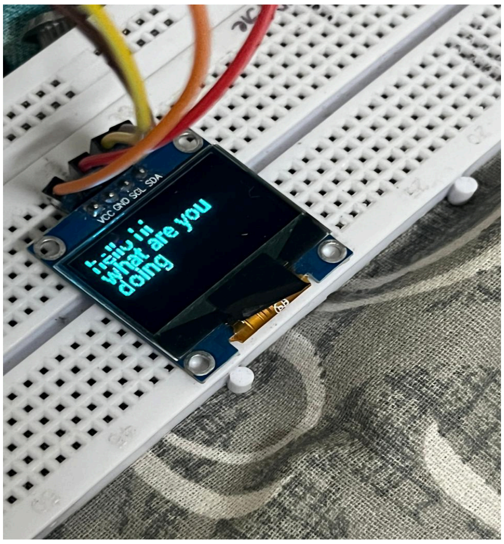


Figure 7.5: Prompt is given

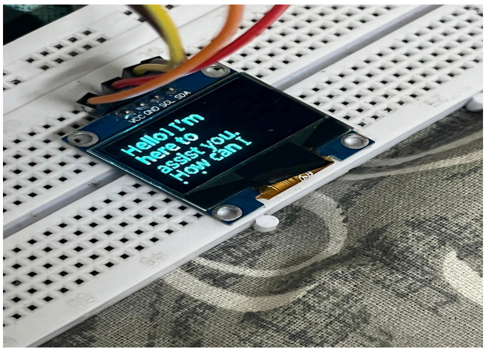


Figure 7.6: GPT Response

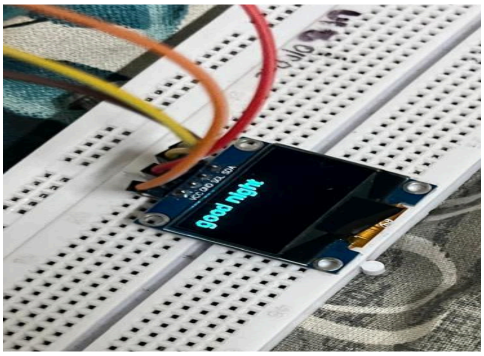
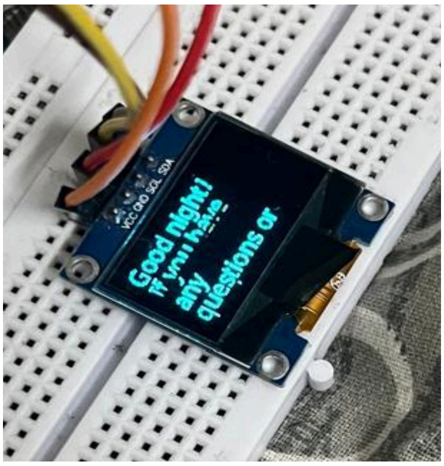


Figure 7.7: Good Night prompt given



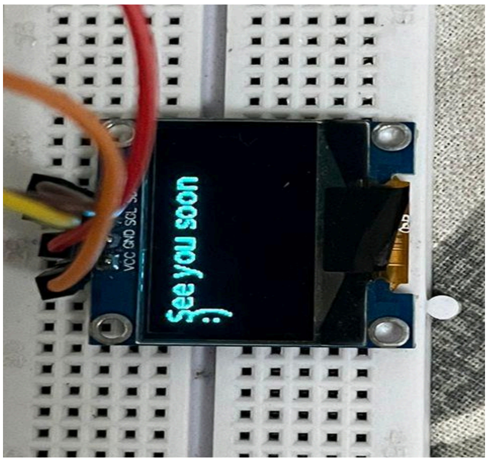


Figure 7.8: GPT Response Figure 7.9: Greetings (Glasses are off)

The implementation of these features demonstrates that the project's objectives have been met successfully. The smart lens interface not only transcribes audio in real-time but also translates it into multiple languages, catering to diverse user needs. The integration of an OpenAI model adds an intelligent layer to the system, enabling users to access information and perform searches without needing a separate device.

The use of a Raspberry Pi as the central processing unit proved to be efficient and effective for handling the various tasks, including audio processing, transcription, translation, and communication with the OpenAI model. The OLED display provided clear and readable text, enhancing the overall user experience.

Overall, the smart glasses system offers a robust and user-friendly solution that meets the project's objectives. The successful integration of real-time transcription, multilingual translation, and AI interaction positions this project as a significant advancement in wearable technology, providing practical benefits for users in everyday scenarios. Future enhancements could include improving battery life, optimizing the size and weight of the components, and expanding the range of supported languages and AI functionalities.

CHAPTER 8
CONCLUSION AND FUTURE SCOPE

This chapter summarizes the project's outcomes and explores potential avenues for future enhancements and applications of the smart glasses technology.

8.1 Conclusion of the Project

Conclusion

In conclusion, this project has successfully achieved its primary objectives by developing a smart lens interface that offers real-time audio transcription, multilingual translation, and AI-based interaction. The smart glasses system captures audio, transcribes it instantly, and displays the text on an OLED screen, enhancing accessibility for users, particularly in noisy environments or for those with hearing impairments. Additionally, the integration of a language translation module allows the transcribed text to be translated into different languages, catering to users in multilingual settings. The incorporation of an OpenAI model, such as ChatGPT, enables users to interact with the AI through voice commands, making information retrieval and other tasks more convenient and hands-free.

The system's effectiveness is driven by the efficient use of a Raspberry Pi as the central processing unit, managing audio processing, transcription, translation, and communication with the AI model. The user-friendly interface and clear display provided by the OLED screen contribute to a seamless user experience. This project not only demonstrates the feasibility of combining these advanced technologies into a wearable device but also highlights the potential for significant practical benefits in everyday use.

8.2 Future Scope

While the current implementation successfully meets the project objectives, there are several areas for future improvement and expansion:

- **Enhanced Battery Life:** Optimizing power consumption and integrating more efficient power management solutions to extend the battery life of the smart glasses, ensuring longer usage times without frequent recharging.

- **Miniaturization and Weight Reduction:** Further miniaturizing the components and reducing the overall weight of the smart glasses to enhance user comfort and wearability, making them more practical for extended use.

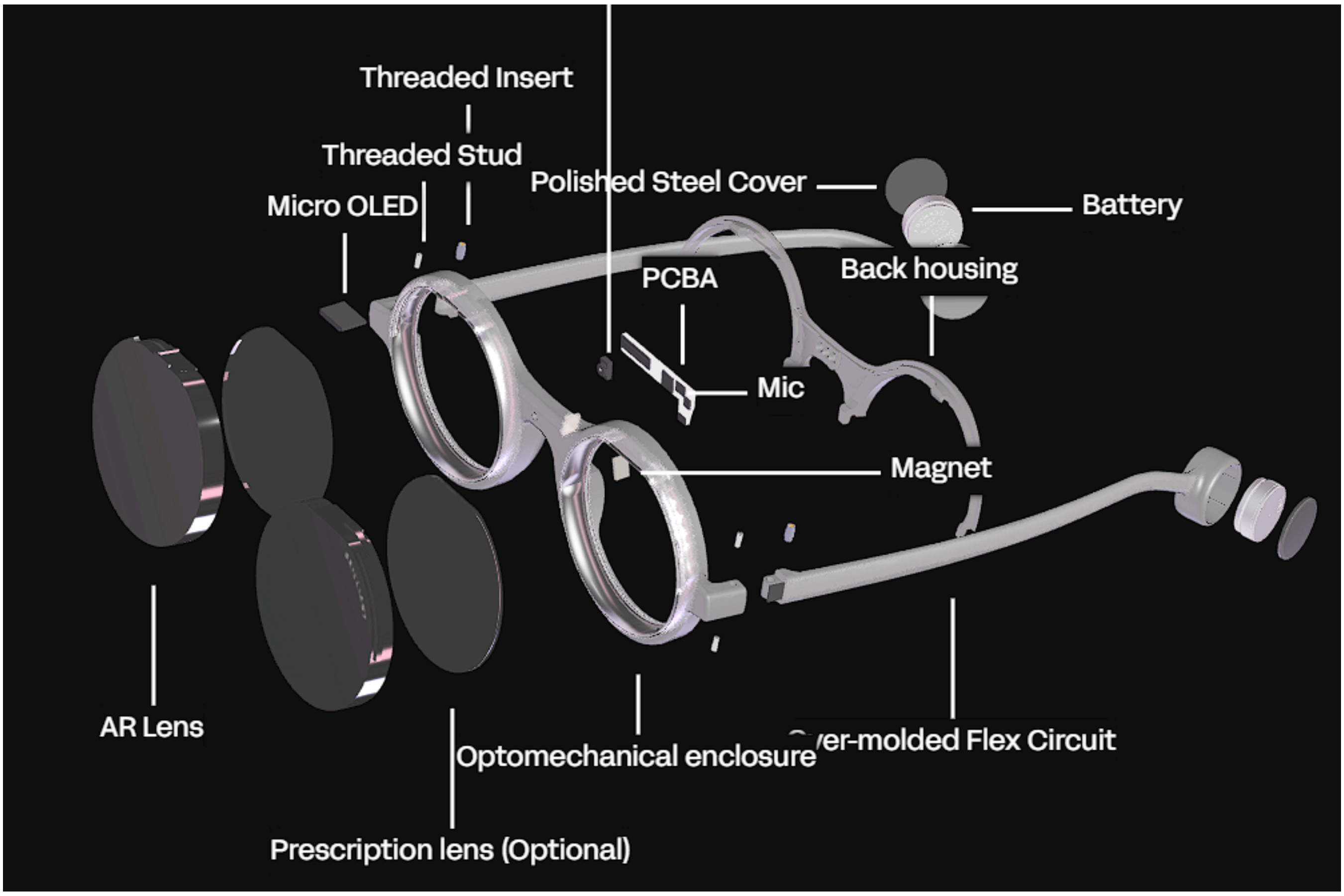


Figure 8.1: Prototype Idea of Smart Glasses

Figure 8.1 illustrates the exploded view of a smart glasses design, detailing components such as the AR Lens, Micro OLED display, PCBA (Printed Circuit Board Assembly), microphone, battery, and various structural elements like the back housing, over-molded flex circuit, and magnetic attachments.

- **Improved Audio Processing:**
  Enhancing the audio processing capabilities to improve accuracy in diverse and noisy environments. This could involve integrating more advanced noise-cancellation algorithms and higher-quality microphones.

- **Expanded Language Support:**
  Increasing the range of supported languages for translation to cater to a broader audience, including regional dialects and less commonly spoken languages.

- **Advanced AI Integration:**
  Expanding the functionalities of the integrated AI model to include more complex tasks, such as contextual understanding, personalized recommendations, and advanced search capabilities.

- **Augmented Reality (AR) Enhancements:**
  Incorporating augmented reality features to overlay additional contextual information, navigation aids, and interactive elements directly onto the user's field of view.

- **Security and Privacy:**
  Implementing robust security measures to protect user data and ensure privacy, especially when dealing with sensitive information processed by the AI model and during WiFi communications.

- **User Interface Customization:**
  Allowing users to customize the display settings, such as text size, color, and layout, to suit individual preferences and enhance readability.

- **Integration with Other Devices:**
  Exploring integration with other smart devices and systems, such as smartphones, smart home devices, and health monitoring systems, to create a more interconnected and versatile user experience.

By addressing these areas, the smart glasses system can be further refined and expanded, providing even greater value to users and positioning itself as a leading solution in the wearable technology market.

CHAPTER 9
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IEEE Format Paper:

SMART GLASSES FOR PEOPLE WITH HEARING AID

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Abstract – This project presents cutting-edge smart glasses made especially for those who have hearing loss. These smart glasses are primarily intended to improve accessibility to communication by utilising real-time transcription and translation services. The apparatus utilises a Raspberry Pi to handle audio inputs obtained through a sophisticated microphone setup. The text is then instantly shown on the lenses of the smart glasses after being translated and transcribed in real-time from these inputs. According to the user's preferences, the smart glasses may translate between several languages, enabling more extensive communication in a variety of scenarios. In addition, voice commands for online searches and other digital chores are made possible by the integration of AI technologies, like OpenAI's ChatGPT, which improves user interaction by showing the results immediately on the lenses. Our process includes a thorough examination of hardware compatibility, software integration, and user needs. During the design process, the development of software interfaces that are easy to use and specifically tailored for the OLED panels of the glasses is done, along with the careful selection of relevant hardware components. Testing stages verify system dependability, user interface effectiveness, and transcription and translation accuracy. In addition to offering a technological solution, the initiative seeks to increase the deaf and hard-of-hearing community's independence and inclusion by facilitating more seamless and interesting daily contacts. We hope that this project will result in notable progress in assistive technologies, opening the door for more creative wearable technology solutions.

Keywords – Smart Glasses, Hearing Impairments, Translation, Transcription, OpenAI.

I. Introduction

Communication is essential in today's connected world, but those with hearing loss frequently encounter major obstacles. There is still a significant communication barrier between the hearing and the hearing-impaired in real-time, dynamic contexts, even with advances in technology and the development of assistive equipment. By creating smart glasses, a ground-breaking technical innovation that will revolutionise how persons with hearing impairments interact with their environment, this project seeks to close this gap. The idea of smart glasses is not new; these gadgets employ digital data to improve the user's vision. This initiative, however, adopts a novel strategy by customising the technology for people who have hearing loss. This is accomplished by instantly translating spoken words into text that is shown on the glasses through real-time transcription. The potential to greatly enhance the quality of life for those with hearing problems is what motivates this creative use. These smart glasses make it possible for users to participate more actively in social interactions, professional meetings, classroom discussions, and casual conversations by providing real-time communication. This is achieved without the customary obstacles that frequently prevent people with hearing loss from fully participating in society. The integration of cutting-edge digital technology, such as complex speech recognition software and dynamic text translation capabilities, forms the basis of this project.Said words are recorded by the system using a premium microphone that is built within the glasses. After that, this audio is analysed by robust, small-sized computer gear that is built into the frame and uses sophisticated algorithms to translate voice to text. Real-time translation of the transcribed text into the user's preferred language facilitates inclusive and accessible communication.In addition, the project makes use of state-of-the-art AI technology to improve user interaction, such as integration with services like OpenAI's ChatGPT. This enables users to speak commands to the gadget to search the internet and do other digital chores; the device then displays the findings immediately on the lenses of the glasses.

The smart glasses have undergone extensive testing, and user input has been crucial to their improvement. According to preliminary testing, consumers value being able to alter the text's display parameters, like font size and colour, to suit their own tastes, which improves readability and comfort.In addition to offering a technical solution, this project promotes the deaf and hard-of-hearing community's increased freedom and inclusion, resulting in more seamless and interesting daily interactions. The endeavour aims to revolutionise accessibility for those with hearing impairments by paving the road for additional innovative solutions in wearable technology. It is hoped that this will lead to breakthroughs in assistive technologies.

A. *Problem Statement*

The goal of the research is to develop a smart lens interface that is easy to use and accessible for people who have language or hearing challenges. Real-time audio transcription will be provided by this cutting-edge interface, allowing users to view spoken words as text. It will also have the ability to translate between languages in many languages, facilitating smooth communication. By integrating with an AI model such as ChatGPT, users will be able to retrieve information on demand and receive timely responses and pertinent data. By integrating these features, the smart lens seeks to dramatically enhance its users' quality of life by promoting greater comprehension and communication in a range of social and professional settings. When verbal communication is difficult or in noisy circumstances, real-time audio transcription will be especially helpful. By bridging linguistic gaps, the multilingual translation function will increase accessibility and inclusivity in talks. Users will have a strong tool for getting prompt assistance and reply thanks to the integration with ChatGPT, which will further improve their capacity to handle everyday chores and interactions with ease. This project demonstrates a dedication to using cutting-edge technology to provide more support and diversity.

II. Literature Survey

Research in augmented reality, speech recognition, assistive technologies for the deaf, and human-computer interaction has contributed to the usefulness of smart glasses as assistive technology for those with hearing impairments. In order to provide a basic understanding and validate the method used in this research, this literature review examines recent studies and breakthroughs, emphasising the integration of different technologies to promote accessibility and communication.

The [1], This extensive overview of the research focuses on how assistive technologies (ATs) affect the quality of communication between hearing and deaf people. Through techniques like focus groups and Wizard of Oz studies, it critically examines the role of real-time translation technologies, highlighting how, although these technologies can improve interactions, they frequently disrupt communication flow and highlight the communication deficiencies of deaf people, reinforcing their subordinate societal status. The review proposes a paradigm shift in the design philosophy of AT by analysing these dynamics using Co-Cultural Theory helping the deaf to "hear" to empowering the hearing to "sign." The goal of this strategy is to promote more equitable and inclusive communication between the hearing and the deaf communities.

In [2], This essay investigates a cutting-edge technology remedy meant to help those who have hearing loss. It talks about a cutting-edge eyewear gadget that can translate spoken words into written and sign language. The writers concentrate on the system's design and practical application, assessing the gadget's efficacy by a thorough analysis of recent research and practical requirements. The technical viability, user acceptability, and possible obstacles to broad adoption are evaluated in this study.

In [3], The aim of this research is to investigate how assistive technologies for people with visual impairments can be improved by incorporating large language models (LLMs) into smart glasses. The smart glasses can analyse and comprehend complicated commands and inquiries in real-time by utilising LLMs, giving consumers a more dynamic and seamless experience. Potential uses that could help people with hearing loss are discussed in the paper, including interactive help and real-time audio descriptions of the environment.

The [4]. This research describes a novel approach intended to increase hearing-impaired people's accessibility to communication. Its main goal is to create smart glasses with gesture-detection capabilities that can instantly translate written and spoken text into sign language with accuracy. The technology attempts to close the communication gap between people who do not understand sign language and those who have hearing difficulties by offering a smooth translation of sign language.

[5]. The creation of "EyeHear," smart eyewear intended to help those with hearing loss, is the topic of this essay. These glasses make use of cutting-edge computer interface technology to help people with hearing impairments communicate and interact at work. The study places a strong emphasis on the features, usability, and possible benefits of these glasses for enhancing daily tasks and work performance

[6], This research looks on the creation of smart spectacles that help visually challenged people by utilising the Internet of Things (IoT) technologies. Through the use of sensors and cameras, these glasses offer users with real-time environmental data, enabling them to more safely and freely navigate their surroundings. The main technology combines a number of Internet of Things components to interpret visual data and provide the wearer with aural feedback.

In [7], The purpose of this exploratory project is to determine whether smart glasses can improve the lives of individuals with a range of disabilities as assistive technology. It assesses the impact, usefulness, and accessibility of smart glasses with an emphasis on how they can increase independence and social inclusion. The study examines the experiences and usefulness of impaired users using qualitative interviews and participatory observations.

The emphasis of [8] is on a study that investigates the creation of an Internet of Things-based navigation aid for people with visual impairments. The technology combines smart glasses and shoes with a variety of sensors that can identify impediments and give the user immediate input via haptic feedback and aural prompts. G Naren Balaji, P Prasad, S Ananth, "Design and Implementation of Smart Guided Glass for Visually Impaired People" (2023).

The paper [9] The development and potential of smart glasses—which are intended to help people with a range of disabilities—are examined in this study. The mentioned smart glasses come with functions including environmental identification, real-time text-to-speech conversion, and navigation assistance. The study emphasises the cooperative efforts necessary to guarantee that the gadgets satisfy the unique requirements of users, greatly enhancing the independence and standard of living for people with disabilities.

III. Proposed System Design

A. Introduction

Individuals with hearing impairments often face significant challenges in navigating social interactions, educational environments, and professional settings due to communication barriers. Traditional assistive technologies, such as hearing aids and cochlear implants, have limitations in real-time communication and environmental interaction. Smart glasses, equipped with real-time transcription and translation capabilities, address these gaps by providing immediate visual feedback of auditory information, thereby enhancing communication accessibility and interaction for the deaf and hard-of-hearing community. By converting spoken language into readable text displayed on the glasses, users can better understand and participate in conversations, lectures, and meetings. The multilingual translation feature further extends this accessibility to diverse linguistic contexts, allowing users to interact seamlessly across different languages. This innovative approach not only improves the quality of life for individuals with hearing impairments but also fosters more inclusive and effective communication in various settings. Smart glasses represent a significant advancement in assistive technology, offering a practical solution to overcome the limitations of traditional devices and support greater independence and participation for the deaf and hard-of-hearing community.

B. Block Diagram

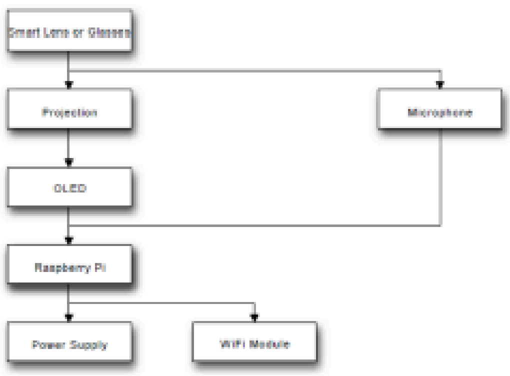

Fig 1. Block Diagram of Smart Glasses Connection

The block diagram illustrates a smart wearable system made up of multiple interdependent parts. Fundamentally, smart glasses or lenses give the user enhanced vision by projecting data onto an OLED screen using a projection device. The Raspberry Pi acts as the system's central processing unit, managing apps and overseeing operations. In order to connect to the internet and communicate with other devices, the Raspberry Pi has a WiFi module and is powered by a separate power source. A microphone also records sound input for use in voice commands and other audio processing applications. This system offers a more engaging and improved user experience by combining voice interaction, visual augmentation, and internet access.

C. Explanation of Individual Blocks

I. Smart Lenses: These are wearable gadgets that use technology to create augmented reality experiences. They can be spectacles or contact lenses. They have the ability to provide data right in the user's field of vision.

II. Projection: This part manages the projection of data or pictures from the smart glasses or lenses onto a surface for display. Usually, tiny projectors built inside the eyeglasses let users see augmented images superimposed on top of their actual field of vision.

III. OLED: The projected images or data are displayed using an Organic Light Emitting Diode (OLED) display. OLED panels are preferred for their vivid and clear displays due to their high contrast, thin profile, and energy economy.

IV. Raspberry Pi: serves as the system's brain. It is a small, multipurpose computer. It controls inter-component communication, executes software programmes, and processes data. It is capable of handling activities including managing user interactions, analysing visual data, and operating augmented reality applications.

V. Power Supply: This block gives the Raspberry Pi and other components the electrical power they require. It provides a steady power supply, ensuring the system functions as a whole.

VI. WiFi Module: With the help of this part, the system may establish wireless network connections. It enables the Raspberry Pi to interact with other devices, connect to the internet, and provide online features including cloud computing, remote control, and data synchronisation.

VII. Microphone: The microphone records sound input for use in voice commands, speech recognition, and other audio-related applications. It enables voice control and hands-free operation by allowing the user to communicate verbally with the machine.

D. Explanation of Hardware and Software:

I. Hardware Components

1. Raspberry Pi: a small, capable computer with enough computing capability to process data in real time.
2. Microphone: For precise speech recording, a high-quality microphone is required.
3. OLED Display: Because of its efficiency and crispness, OLED displays are used in wearable technology.
4. Power Source: The gadget may be used for longer periods of time without needing to be recharged thanks to a strong and lightweight battery.
5. WiFi connectivity: is necessary to provide basic services like cloud-based processing and API calls for translation.

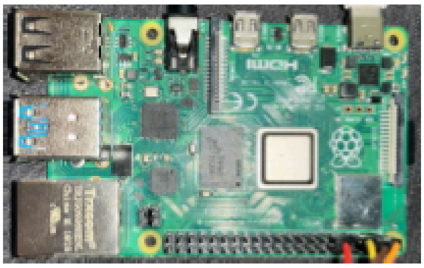

Fig 2. Raspberry Pi 4 Connection

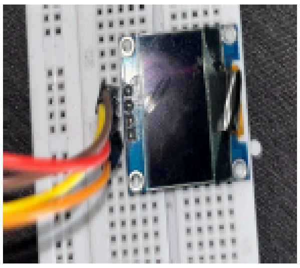

Fig 3. OLED Connection

Fig 4. Microphone

II. Software Components:

1. Speech recognition software: Transforms spoken words into text using sophisticated algorithms. You might use Google Speech-to-Text or a comparable service.

2. Software for translation: Translates the recorded text into the target language. APIs such as Google Translate could handle this.

3. OLED Interface Software: Controls the information presented on the OLED panel, making it readable and lucid.

4. OS for Raspberry Pi: Raspbian, a slimmed-down variant of Linux, is one option for effectively controlling software programmes.

This thorough system design guarantees that the smart glasses are effective and user-friendly in helping people with hearing impairments communicate on a daily basis, in addition to being functional.

Fig 5. Software Integration

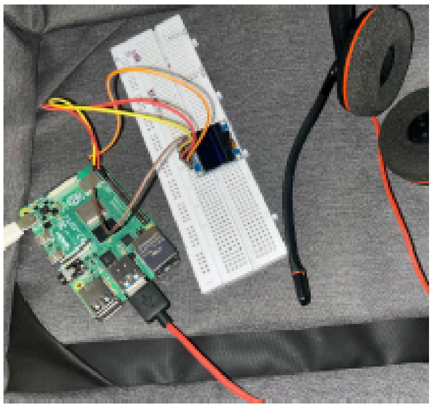

Fig 6. Prototype Connection

IV. Results and Discussion

A. *Real-Time Audio Transcription*

We have effectively created an interface for smart lenses that offers audio transcription in real-time. The smart glasses' integrated microphone enables the system to efficiently record audio input. The Raspberry Pi processes the audio input using a speech-to-text method. Next, the text transcription is shown on the smart glasses' OLED screen. This function is especially helpful for people with hearing problems or in noisy surroundings because it guarantees that users can see a live transcription of conversations or ambient sounds.

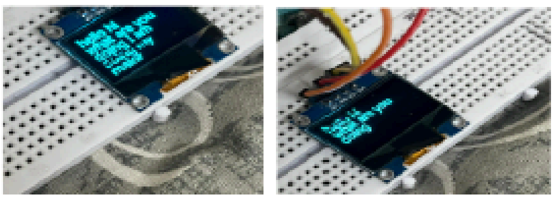

Fig 7. Real-Time Transcription

B. *Language Translation of Transcriptions*

Translating the real-time transcriptions into several languages in accordance with user needs was the next goal. We put in place a language translation module that communicates with the transcribing system in real-time. The transcribed text can be translated into the required language instantaneously by using cloud-based translation services using the WiFi module. After that, the translated text appears on the OLED screen, resulting in a fluid bilingual experience. Users in multilingual environments will benefit from this functionality, which makes communication and comprehension easier.

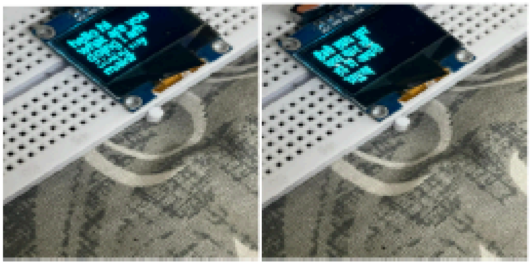

Fig 8. Real-Time Translation(Hindi)

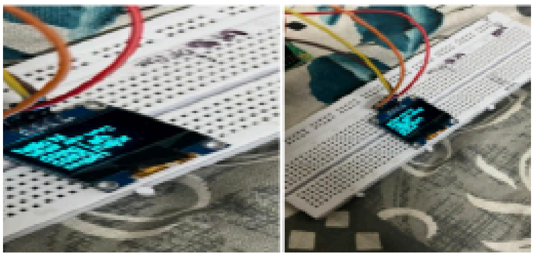

Fig 9. Real-Time Translation(Kannada)

C. *Integration of OpenAI Model for Enhanced Interaction*

We included an OpenAI model, such as ChatGPT, into the system to improve the smart glasses' functioning. With this integration, users can communicate with the AI by only uttering commands to it. The voice instruction is picked up by the microphone, analysed by the Raspberry Pi, and then transmitted via the WiFi module to the OpenAI model. The request is processed by the AI, and the result is shown on the OLED panel. For example, users can ask the AI directly to search for information, and the results will appear in their field of view. The hands-free interaction greatly improves the smart glasses' usability and convenience.

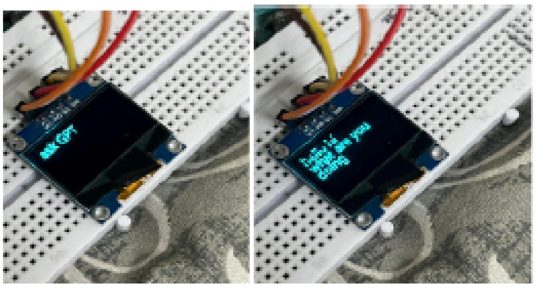

Fig 10. Activation of GPT(Prompt is given)

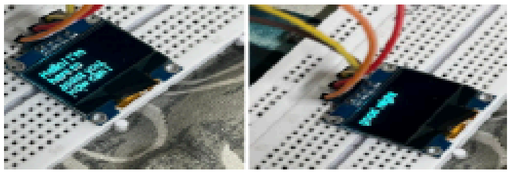

Fig 11.GPT Response(Good Night Prompt given)

D. *Discussion*

The effective completion of the project's goals is evidenced by the installation of these features. In order to meet the varied needs of its users, the smart lens interface not only translates audio into several languages but also transcribes it in real-time. By integrating an OpenAI model, users may access information and do searches without requiring an additional device, introducing an intelligent layer to the system. For managing several duties, such as audio processing, transcription, translation, and communication with the OpenAI model, the Raspberry Pi was used as the central processing unit. This proved to be an efficient and successful solution. The user experience was improved overall by the OLED display's ability to produce legible text. All things considered, the smart glasses system provides a reliable and easy-to-use solution that satisfies the project's goals. This project represents a huge development in wearable technology, offering real-time transcription, multilingual translation, and AI interaction that works well together to benefit users in everyday circumstances. Future improvements can include extending the supported language range, enhancing AI functionalities, and optimising the size and weight of the components.

V. Conclusion

In conclusion, by creating a smart lens interface that provides real-time audio transcription, multilingual translation, and AI-based interaction, this project has effectively met its main goals. The technology in the smart glasses system records audio, quickly transcribes it, and shows the text on an OLED screen. This improves accessibility for users, especially for people who are hard of hearing or are in noisy surroundings. Furthermore, the incorporation of a language translation module facilitates the translation of the transcribed text into many languages, thereby accommodating users in multilingual environments. The integration of an OpenAI model, like ChatGPT, allows users to communicate with the AI via voice commands, improving the convenience and hands-free nature of tasks like information retrieval. The Raspberry Pi, which serves as the system's central processing unit and effectively handles audio processing, transcription, translation, and AI model communication, is the key to its efficacy. A seamless usage experience is enhanced by the OLED screen's brilliant display and user-friendly interface. This experiment not only shows that integrating these cutting-edge technologies into a wearable gadget is feasible, but it also emphasizes how beneficial it could be for daily use. The smart lens interface is a testament to the advances in assistive technology, offering the potential to enhance the quality of life for those with language barriers and hearing impairments through its creative combination of real-time transcription, multilingual translation, and AI integration. This research opens the door for future communication options that are more inclusive and accessible by tackling these issues with a single, integrated device.

VI. References

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APPENDIX:

```
import openai
import speech_recognition as sr
from gtts import gTTS
from IPython.display import Audio, display
import os
from googletrans import Translator, LANGUAGES
import board
import busio
import digitalio
import adafruit_ssd1306
from PIL import Image, ImageDraw, ImageFont
import time
import textwrap

# Setups
openai.api_key = "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"
i2c = busio.I2C(board.SCL, board.SDA)
oled = adafruit_ssd1306.SSD1306_I2C(128, 64, i2c)
font_path_hin = "/home/final/TTF/NotoSansDevanagari-VariableFont_wdth,wght.ttf"
font_path_kan = "/home/final/TTF/NotoSansKannada-VariableFont_wdth,wght.ttf"
font_path_tam = "/home/final/TTF/NotoSansTamil-VariableFont_wdth,wght.ttf"
font_path_tel = "/home/final/TTF/NotoSansTelugu-VariableFont_wdth,wght.ttf"
font_path_mal = "/home/final/TTF/NotoSansMalayalam-VariableFont_wdth,wght.ttf"
font_path_urd = "/home/final/TTF/NotoNastaliqUrdu-VariableFont_wght.ttf"
font_path_mar = "/home/final/TTF/NotoSans-VariableFont_wdth,wght.ttf"
font_default = ImageFont.truetype(font_path_kan, 16)

def get_font(lang_code):
    if lang_code == 'hi':
        return ImageFont.truetype(font_path_hin, 16)
    elif lang_code == 'kn':
```

```
        return ImageFont.truetype(font_path_kan, 16)
    elif lang_code == 'ml':
        return ImageFont.truetype(font_path_mal, 16)
    elif lang_code == 'ta':
        return ImageFont.truetype(font_path_tam, 16)
    elif lang_code == 'te':
        return ImageFont.truetype(font_path_tel, 16)
    elif lang_code == 'ur':
        return ImageFont.truetype(font_path_urd, 16)
    elif lang_code == 'mr':
        return ImageFont.truetype(font_path_mar, 16)
    else:
        return font_default

def display_startup_message(oled, text, font):
    oled.fill(0)
    image = Image.new("1", (oled.width, oled.height))
    draw = ImageDraw.Draw(image)
    draw.text((0, 0), text, font=font, fill=255)
    oled.image(image)
    oled.show()
    time.sleep(2)

def scroll_text(oled, text, font):

    lines = textwrap.wrap(text, width=oled.width // font.getsize('X')[0])
    image = Image.new("1", (oled.width, oled.height))
    draw = ImageDraw.Draw(image)
    text_height = len(lines) * font.getsize('X')[1]

    if text_height <= oled.height:
        draw.rectangle((0, 0, oled.width, oled.height), outline=0, fill=0)
        for i, line in enumerate(lines):
```

```
        draw.text((0, i * font.getsize('X')[1]), line, font=font, fill=255)
    oled.image(image)
    oled.show()
    time.sleep(1)
    return

draw.rectangle((0, 0, oled.width, oled.height), outline=0, fill=0)
for i, line in enumerate(lines):
    draw.text((0, i * font.getsize('X')[1]), line, font=font, fill=255)
oled.image(image)
oled.show()
time.sleep(1)

y = 0
while y < text_height - oled.height:

    draw.rectangle((0, 0, oled.width, oled.height), outline=0, fill=0)

    for i, line in enumerate(lines):
        draw.text((0, i * font.getsize('X')[1] - y), line, font=font, fill=255)

    oled.image(image)
    oled.show()

    y += 3.5
    time.sleep(0.05)

time.sleep(2)

oled.fill(0)
oled.show()
```

```
def ask_openai(prompt):
    try:
        response = openai.ChatCompletion.create(
            model="gpt-3.5-turbo",
            messages=[{"role": "system", "content": "You are a helpful assistant."},
                      {"role": "user", "content": prompt}]
        )
        return response.choices[0].message['content'].strip()
    except Exception as e:
        print(f"An error occurred: {str(e)}")
        return None

def recognize_speech_from_mic(phrase_time_limit=5):
    recognizer = sr.Recognizer()
    with sr.Microphone(device_index=3) as source:
        recognizer.adjust_for_ambient_noise(source, duration=1)
        print("Listening...")
        audio = recognizer.listen(source, phrase_time_limit=5)
        try:
            speech_text = recognizer.recognize_google(audio)
            scroll_text(oled, speech_text, font_default)
            print("You said:", speech_text)
            return speech_text
        except sr.UnknownValueError:
            print("Could not understand audio")
            return None
        except sr.RequestError as e:
            print(f"Could not request results from Google Speech Recognition service; {e}")
            return None

def translate_text(text, dest_language, oled, font):
    translator = Translator()
    try:
```

```
        if dest_language not in LANGUAGES:
            print("Invalid language code. Please say a valid language code.")
            return
        translation = translator.translate(text, dest=dest_language)
        print(f"Original Text: {text}")
        print(f"Translated Text [{LANGUAGES.get(dest_language, 'Unknown')}]: {translation.text}")
        scroll_text(oled, translation.text, font)
    except Exception as e:
        print(f"An error occurred during translation: {str(e)}")

# Language dictionary
Lang = {'english': 'en', 'french': 'fr', 'german': 'de','malyalam':'ml', 'hindi': 'hi', 'kannada': 'kn', 'malayalam':
'ml', 'marathi': 'mr', 'spanish': 'es', 'tamil': 'ta', 'telugu': 'te', 'urdu': 'ur'}

state = "default"
lang_code = None

# Startup message
display_startup_message(oled, "Welcome! ", font_default)

while True:
    command = recognize_speech_from_mic(3)
    if command is None:
        continue
    command = command.lower()

    if state == "default":
        if 'translate' in command or 'translate this to ' in command:
            state = "translate"
            scroll_text(oled, "which language",font_default)
            abc = recognize_speech_from_mic(3)
            if abc and abc.lower() in Lang:
                lang_code = Lang[abc.lower()]
```

```
            scroll_text(oled,"trasnslate mode:on", font_default)
        else:
            print("Could not understand language.")
    elif 'ask gpt' in command:
        state = "ask gpt"
    else:
        print(f"Echo: {command}")

elif state == "translate":
    if 'exit translate' in command:
        state = "default"
        print("Exiting translation mode...")
    elif 'change language' in command:
        #new_lang_code = input("Enter new language code: ")
        scroll_text(oled, "which language",font_default)
        abc = recognize_speech_from_mic(3)
        if abc and abc.lower() in Lang:
            new_lang_code = Lang[abc.lower()]
            scroll_text(oled,"trasnslate mode:on", font_default)
        if new_lang_code:
            lang_code = new_lang_code
            print(f"Language changed to {lang_code}")
        else:
            print("No valid language code entered. Please try again.")
    elif lang_code:
        font = get_font(lang_code)
        translate_text(command, lang_code, oled, font)
    else:
        print("No valid language code specified. Please try again.")


elif state == "ask gpt":
    if 'exit gpt' in command:
```

```
        state = "default"
        print("Exiting GPT mode...")
    else:
        response_text = ask_openai(command)
        if response_text:
            font = get_font(lang_code) if lang_code else font_default
            scroll_text(oled, response_text, font)
            print("Response:", response_text)

if 'good night' in command or 'bye' in command:
    scroll_text(oled, "See you soon :)", font_default)
    break
```