4. Brief Description of the Project:

The current Assistive Technology is largely imperative for the deaf and the dumb, whose disability significantly inhibits their oral connectivity and conscious well-being in society, hence forming a bio-mechanical component to complement the deficient natural organs. The current project is viable among all the possible scenarios owing to the concise size of products and services produced during the study. Lip sync is a challenging task subject to various dialects and pronunciations available and the respective speakong styles should also be considered. Hence, during the proposed phase, with proper privacy permissions and all confidentiality assurances, user groups of 90-100 are considered, surveyed, and tested for the efficacy of the developed product. The proposal also involves field studies, pilot studies for feasibility tests, and deployment tests, functional tests for performance in terminal phases, and industrial presentations in the end for commercialization.

5. Brief details of literature survey and existing patents in the proposed intervention (give in bullet points and as brief as possible):

- Real Time Hand Gesture Recognition & its Applications in Assistive Technologies for Disabled: This paper presents a system that can recognize hand gestures in real time and use them to control various applications such as a wheelchair, a robotic arm, a smart home, and a virtual keyboard.

- A Universal Assistive Technology with Multimodal Input and Multimedia Output Interfaces: This paper describes a system that can provide multimodal communication between people with different disabilities and abilities.

- Assistive Sign Language Converter for Deaf and Dumb: This paper proposes a device that can convert sign language into voice and text for deaf and dumb people.

- Assistive Technology For Deaf And Dumb: This paper presents a device that can produce a voice over for what the dumb person wants to speak and simultaneously move the dumb person's lips using bio compatible material

- Speech Recognition and Synthesis Tool: Assistive Technology for Physically Disabled Persons: This paper introduces a tool that can recognize and synthesize speech for physically disabled persons.

- Digital cities of the future: Extending @home assistive technologies for the elderly and the disabled: reviews the current state of the art of assistive technologies and proposes a framework for extending them to support smart home, smart health, and smart mobility scenarios.

- Wav2Lip model uses a deep neural network that takes as input an audio waveform and a face image, and outputs a sequence of lip images that match the audio.

6. Existing state of art in the proposed field/intervention/subject:

Assistive technologies help people with disabilities to perform various tasks and activities. There are many types of assistive technologies, such as hearing aids, cochlear implants, speech recognition, speech synthesis, sign language recognition, sign language synthesis, gesture recognition, gesture synthesis, etc. In this section, we will review some of the existing systems that use these technologies to assist people with different kinds of disabilities.

One of the existing systems help is a real-time hand gesture recognition system that can translate hand gestures into speech or text. The system can also perform actions based on the gestures, such as controlling a wheelchair or a smart home device. The system uses a camera to capture the hand gestures and a computer to process them using a gesture recognition algorithm. The system can recognize 26 gestures that correspond to the English alphabet and some common words. The system can also generate speech or text output using a speech synthesis or a text display module. The system can be used by people who have speech or hearing impairments, or people who want to communicate with them.

Another existing system is a universal assistive technology framework that can support various types of input and output modalities, such as speech, text, gestures, sounds, etc. The framework consists of four layers: the input layer, the processing layer, the output layer, and the user interface layer. The input layer can capture different kinds of inputs from the user, such as voice commands, keyboard inputs, mouse clicks, etc. The processing layer can perform different kinds of tasks based on the inputs, such as translation, conversion, search, etc. The output layer can generate different kinds of outputs for the user, such as speech responses, text messages, images, videos, etc. The user interface layer can provide different kinds of interfaces for the user, such as graphical user interfaces (GUIs), voice user interfaces (VUIs), haptic user interfaces (HUIs), etc. The framework can be used to develop various applications based on the user's needs and preferences, such as a sign language translator, a speech synthesizer, and a multimodal browser.

There also exists a system which is an assistive sign language converter that can convert sign language into speech or text using a glove with sensors and a microcontroller. The system can also convert speech or text into sign language using an animated avatar on a screen. The system uses a glove with flex sensors and an accelerometer to capture the hand movements

and orientations of the user. The system also uses a microcontroller to process the sensor data and send it to a computer or a smartphone via Bluetooth. The system can recognize 26 signs that correspond to the English alphabet and some common words. The system can also generate speech or text output using a speech synthesis or a text display module. The system can also generate sign language output using an animated avatar that mimics the hand movements and orientations of the user. The system can be used by people who have speech or hearing impairments, or people who want to communicate with them.

Digital city platforms can provide assistive technologies for the elderly and the disabled. A digital city is a virtual representation of a real city that can offer various services and information to its citizens. A digital city can enhance the quality of life and social inclusion of the elderly and the disabled by offering them personalized and context-aware assistive technologies that can support their daily activities, health care, education, entertainment, etc. For example, a digital city can provide a sign language translator that can translate spoken words into sign language using an animated avatar on a screen. A digital city can also provide a speech synthesizer that can generate natural-sounding speech from text using a voice cloning technique. A digital city can also provide a multimodal browser that can access different kinds of web content using different kinds of input and output modalities.

Another prevalent system is a hand assistive technology for speech and hearing impaired users that can convert hand gestures into speech and text using a glove with sensors and a microcontroller. The system can also convert speech and text into hand gestures using an animated hand on a screen. The system uses a glove with flex sensors and an accelerometer to capture the hand movements and orientations of the user. The system also uses a microcontroller to process the sensor data and send it to a smartphone via Bluetooth. The system can recognize 26 gestures that correspond to the English alphabet and some common words. The system can also generate speech or text output using a speech synthesis or a text display module. The system can also generate hand gesture output using an animated hand that mimics the hand movements and orientations of the user. The system can be used by people who have speech or hearing impairments, or people who want to communicate with them.

Wav2Lip model is a generative adversarial network (GAN) that can accurately lip-sync videos to any target speech. It is trained on the LRS2 dataset, which includes countless recordings of people speaking in English, and is used to train the Wav2Lip model.

7. Importance of the proposed project in the context of current status (in terms of end user’s utility as well how significant is the proposed intervention/product when compared to already existing products):

The proposed project is important in the context of current status for several reasons. First, it aims to provide a comprehensive and integrated solution for both deaf and dumb people, while most of the existing systems focus on either one of the groups. For example, the papers by Kakkoth and Gharge, Karpov and Ronzhin, and Boppana et al. only address the needs of deaf people, while the paper by Babu et al. only targets the dumb people. The paper by Sharma and Wasson covers both groups, but it does not provide lip synchronization for the dumb people, which is a novel feature of your project. Second, your project uses bio-compatible material to gently move the dumb person's lips, which is a more natural and realistic way of producing speech than using a voice module or a speaker. This can enhance the communication experience and the social acceptance of the dumb people. Third, your project can recognize real-time speech around the deaf person and convert it into text, which is a more convenient and accessible way of receiving information than using hand gestures or sign language. This can improve the situational awareness and the safety of the deaf people. Fourth, your project can potentially benefit a large number of people who suffer from hearing or speech disorders. According to the World Health Organization, there are about 466 million people in the world who have hearing loss, and about 70 million people who use sign language as their first language. Your project can help them overcome the barriers and challenges they face in their daily lives and enable them to communicate more effectively and confidently with others. Therefore, your project is significant and valuable in terms of end user's utility and innovation.

8. Objectives (should be crisp and clear – not more than 3-4, and should not contain the activities involved in the project):

1. To enhance speech-receptive skills of the hearing-deficient.
2. To improve the quality of living and effective social immersion through technology.
3. To ensure cost-effective hearing AT for the deaf and the dumb
4. Reduce compensatory dependence of the disabled on non-biological/mechanical devices and tools

9. Science &Technology component/Innovativeness/Novelty of the project:

The novelty and Science & Technology relevance is theoretically determined and numerically implemented by the following attributes:

- Existing systems, exclusively designed and built for the deaf and the dumb involves no facial and tactile components pertinent to the facial features.
- No lively component was introduced in the previous AT systems owing to infeasibility and difficulties in building such systems.
- The metrics involved during the proposed system design reflect the intricate interdependencies between digital devices and the biological structures. It denotes the need for comfort and safety of the fellow user.
- Scientific calibre and the innovative aspect is exclusively determined by the BLE Device used in the product, fed with relevant intelligent software.

- The fabrication and the material used is entirely bio-compatible, a unique revolutionary aspect of biotechnology critical to the future works.
- The current technology is transformative to induce liveliness to mechanical inventions and innovations, adjacent to the biological parts.

10. Methodology {give step by step process to achieve the proposed objectives (including field trials and scaling)}:

- **Planning Phase(completed):** The methods proposed are assessed and decided based on their feasibility, practicality, and suitability for the pre-determined conditions where the application of these methods vary flexibly with even unpredictable unforeseen situations.
- **Manpower Allocation:**
    - **Aim:** To suit the diversity of the use cases involved, independent investigations are mandated to fulfill all the necessary criteria and constraints, for which separate manpower allocations form a basic requisite.
- **Literature Survey and Analysis of the Existing Technologies:**
    - **Aim:** There is a particular need for the consideration of all the constraints, criteria, and cases since the proposal is highly subjective and dependent.
- **Early Survey and Life Quality Analysis:**
    - **Aim:** Accomplishment of Objective 2
- **System Design and Plan Blueprinting:** Based on the findings from the early survey, the following will be conducted
    - Analysis of
        - possible Lip-teeth-nose-gum-jaw structural constraint
        - Hygienic factors
        - Possible allergies
        - Materials compatible with the skin

      associated with the current system.
    - Consultations with
        - Dentists
        - Dermatologists
        - Orthopaedic
        - Oral Care Doctors/Specialists
        - Biomedical Scientists
    - Collection of all the above STRUCTURAL features and constraints from hospitals of various regions, where the following are the categories:
        - Spatial constraints
        - Mensurations of the space viable for the device
        - Materials compatible with the skin
    - Analysis of possible Lip-teeth-nose-gum-jaw structural constraints on our device
    - Drafting of the blueprint for the system development

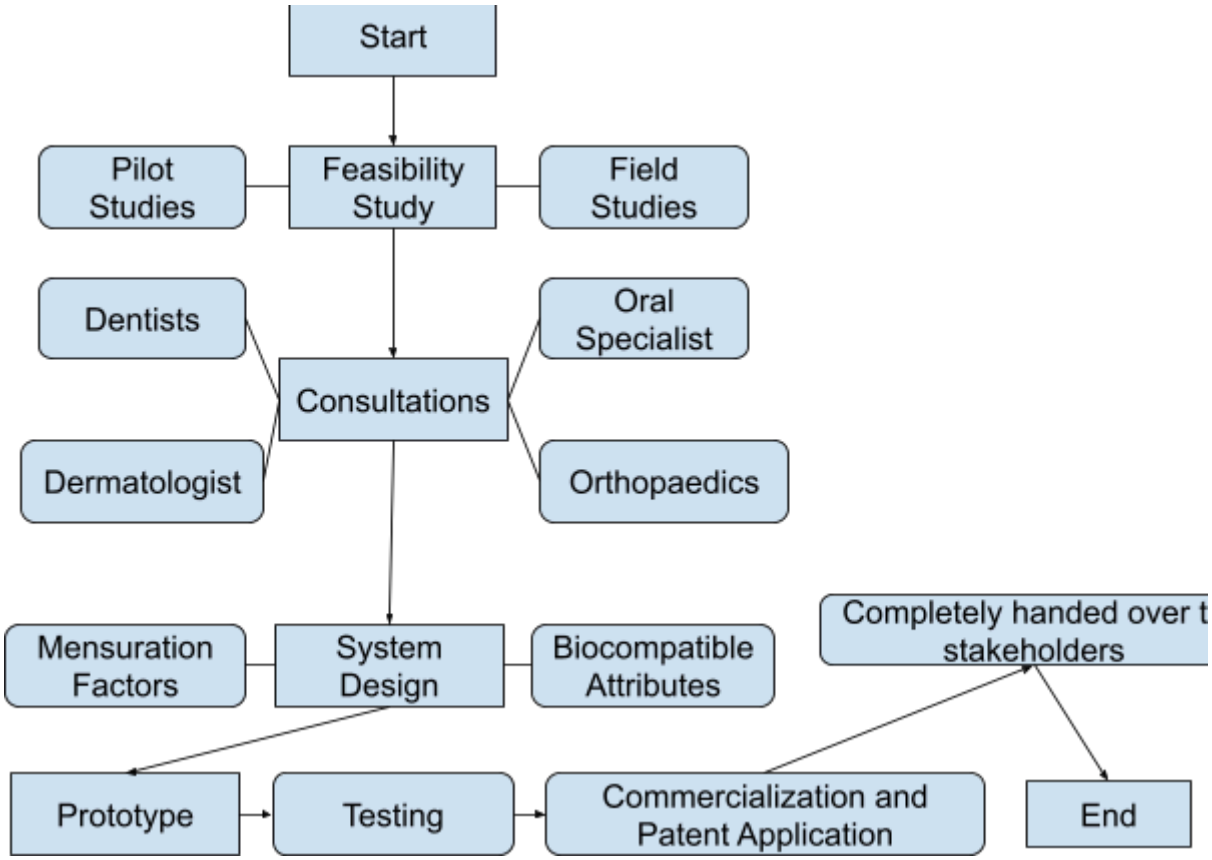
- **Product Making and Initial Deployment**
    - **Equipment collection and Operation initiation:**
        - Internal audit among the organization members
        - External audit with funding agencies, partners, and collaborators
        - Ultimate aim is to ensure cheapest possible equipment use in the project
    - **Making of the product**
        - 47 members work on making the product, divided into distinct segments/subteams based on the planned blueprint
            - Computer vision model integrated for automated detection, which is helpful for the deaf
            - An IoT framework to gently move the mouth according to the movements predicted by the model, especially for the dumb.[Prototype will be developed]
        - 3 Members, including the supervisors inspect the project from time to time
    - **Making of a facial model for initial testing**
    - Operating the device on the model
    - **Testing on individuals:**
        - 30 individuals of varying facial features
        - 10 tests on each individual at different time intervals
    - Evaluation Reports drafted
- **Commercialization**
    - Patent Generation
    - Call for Biddings and Proposals to extend beyond the TRL 7
    - An international symposium inviting industry-academic bodies to come to discuss collaborations
    - Minimum of 3 MoUs expected to be initiated
    - Based on the mutual agreements of all the partners, the product will be commercialized initially as a prototype
    - Success Reports Generated
    - Rest of the commercialization efforts will be handled by the respective institutions.

11. Work Plan:

Sl. No.	*Component/Work Elements or Milestones/Targets*	*Expected Start (Month/Year)*	*Expected Completion (Month/Year)*
1	Manpower Allocation and Initial Survey	January 3, 2024	January 7, 2024
	Review	1 Week Duration	
2	Early Survey and Initial Reports	January, 2024	June, 2024

	Review	1 Week Duration	
3	System Design and Consultations	July, 2024	July, 2025
	Review	1 Week Duration	
4	System Prototyping and Testing	August, 2024	August, 2025
	Review	1 Week Duration	
5	Commercialization	September, 2025	December, 2025

12. Artistic impression/diagrammatic representation of the proposed prototype/ product and flow chart in case of process/protocol:



13. Expected S&T Deliverables (3-4 significant deliverables each year):

Year	*Deliverables (which can be monitored or assessed)*
First	System Design of the proposed device
Second	Equipment Selection and System Prototype
Third	Commercial Product

14. Suggested plan of action for utilization of the outcome expected from the project (give details of field trails, scaling, commercialisation, dissemination, deployment etc):

- Product Prototype is widely disseminated for its usage guidelines, benefits, and applications over Social Media, Mass Media platforms like TV, Phones, etc.
- Awareness campaigns are also organized in Government and Corporate schools or other educational institutions in and around Medak to rationalize the academic pursuits towards the wide persuasion of the obtained outcomes.
- Deployment of the product prototypes will take place across varied ranges of designated deployment points where the devices are tested on test individuals with all privacy concerns followed.
- The project is tested based on its obtained and projected outcomes for scaling extension beyond TRL 6, through the call for proposals initiated by our institute.
- Commercialization to stakeholders is based on non-contact with contact basis where all the rights are sold to the concerned stakeholders but our organization will consistently follow up with the customers' preferences and comfort throughout the commercialization endeavors.
- A patent will be submitted in the name of invesigators and the staff of the project to protect intellectual property.

15. Short Bio-data of PI & Co-PI (With Educational Qualifications):

i. Principal Investigator	
Name	Dr. Lanke Pallavi
Date of Birth	09/05/1987
Highest Qualification	PhD
Designation	Associate Professor
Department	Computer Science and Engineering
Institute/University	B V Raju Insitute of Technology
Expertise in the proposed area of work. Whether had done any in projects in the proposed area of work	
E-Mail & Mobile Number	pallavi.lanke@bvrit.ac.in 99852 76876
ii. Co-Investigator	
Name	Dr. Ch Madhu Babu
Sex and Date of Birth	Male 15/06/1974
Highest Qualification	PhD
Designation	Head of the Department
Department	Computer Science and Engineering
Institute/University	B V Raju Institute of Technology
Expertise in the proposed area of	

work. Whether had done any in projects in the proposed area of work	
E-Mail & Mobile Number	hod.cse@bvrit.ac.in 98488 54358
iii. Co-Investigator	
Name	Sai Sathwik Kosuru
Sex and Date of Birth	Male 03/03/2003
Highest Qualification	Undergraduation
Designation	Undergraduate student
Department	Computer Science and Engineering
Institute/University	B V Raju Institute of Technology
Expertise in the proposed area of work. Whether had done any in projects in the proposed area of work	• Awareness of Deep Learning applicability in Assistive Technologies • Through with the literature pertaining to recent technological developments in Asistive Technology • Worked through the student-faculty cooperation to bring about this proposal.
E-Mail & Mobile Number	21211a05r6@bvrit.ac.in 9848565880
iv. Co-Investigator	
Name	Kaushik Varma Datla
Sex and Date of Birth	Male 22/08/2003
Highest Qualification	Intermediate 12th
Designation	Undergraduate Student
Department	Computer Science and Engineering
Institute/University	B V Raju Institute of Technology
Expertise in the proposed area of work. Whether had done any in projects in the proposed area of work	• Proposed a novel method for multilingual lip-synchronization. • Experience in various Deep learning methodologies.
E-Mail & Mobile Number	21211a05c7@bvrit.ac.in 88568 44331